Zootaxa 3701 (3): 349–364
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3701.3.5
http://zoobank.org/urn:lsid:zoobank.org:pub:E25E2CF6-70F8-4198-B5C6-0ADE9DEB9121

A new species of *Leptodactylus* Fitzinger (Anura, Leptodactylidae, Leptodactylinae) from montane rock fields of the Chapada Diamantina, northeastern Brazil

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Abstract

In this paper, we describe a new species of the *Leptodactylus fuscus* group on the basis of adult morphology and advertisement call, occurring restricted to montane rock fields of the Chapada Diamantina, northern portion of the Espinhaço Range, central State of Bahia, northeastern Brazil. In addition, we re-describe the advertisement call of *L. camaquara* from its type locality. *Leptodactylus oreomantis* **sp. nov.** represents the first species of the genus occurring restricted to montane rock fields of the Chapada Diamantina, northeastern Brazil, whereas the other three species of the *L. fuscus* group assumed to be restricted to montane field environments (*L. camaquara*, *L. cunicularius*, and *L. tapiti*) occur in association with mountain ranges of southeastern or central Brazil.

Key words: Bioacoustics, Espinhaço Range, *Leptodactylus oreomantis* **sp. nov.**, *Leptodactylus fuscus* species group, Montane rock fields, Serra do Cipó, taxonomy

Introduction

The genus *Leptodactylus* Fitzinger (*sensu* Pyron & Wiens 2011) currently comprises 75 species distributed from southern United States (Texas), West Indies, to Argentina and Uruguay (Frost 2013). The *Leptodactylus fuscus* (Schneider) species group was first defined in Heyer (1969), and reviewed in Heyer (1978). Ponssa (2008) redefined this phenetic group as a monophyletic grouping through a phylogenetic approach based mainly on adult morphology and osteology. The *L. fuscus* group is currently composed of 27 species with the most widespread distribution in the genus, with representative taxa from southern USA (*L. fragilis* Brocchi) to central Argentina and/or southern Uruguay (*L. latinasus* Jimenez de la Espada).

At least three species of the *L. fuscus* group are assumed to be restricted to moderate and/or high altitude regions of montane rock fields (approximately 800–1400 m a.s.l.): i) *L. camaquara* Sazima and Bokermann, 1978, ii) *L. cunicularius* Sazima and Bokermann, 1978, both described from the Serra do Cipó, southern portion of the Espinhaço Range, southeastern Brazil (Leite *et al.* 2008); and iii) *L. tapiti* Sazima and Bokermann, 1978, described from the Chapada dos Veadeiros, northern State of Goiás, central Brazil. Herein we recognize a new species of the *L. fuscus* group on the basis of adult morphology and advertisement call, restricted to montane rock fields of the Chapada Diamantina, northern Espinhaço Range, central State of Bahia, northeastern Brazil. Besides, we re-describe the advertisement call of *L. camaquara* from its type locality.

Accepted by M. Vences: 9 Jul. 2013; published: 20 Aug. 2013

Material and methods

Specimens and vocalizations of the new species were obtained in the Municipalities of Ibiocoara, Mucugê, Piatã, and Rio de Contas, State of Bahia, northeastern Brazil. Specimens and vocalizations of *L. camaquara* were obtained at the Parque Nacional da Serra do Cipó, Municipality of Santana do Riacho, State of Minas Gerais (19°23′S; 43°36′W, approximately 1105 m a.s.l.).

Type specimens and additional examined specimens (Appendix 1) are housed in the following Brazilian zoological collections: Museu de Zoologia da Universidade de São Paulo (MZUSP), São Paulo, State of São Paulo; Museu de Zoologia da Universidade Estadual de Campinas (ZUEC), Campinas, State of São Paulo; Célio F. B. Haddad Collection (CFBH), Rio Claro, State of São Paulo; Museu Nacional do Rio de Janeiro (MNRJ), Rio de Janeiro, State of Rio de Janeiro; Collection of the Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, State of Minas Gerais; and Collection of frogs of the Museu de Biodiversidade do Cerrado at the Universidade Federal de Uberlândia (AAG-UFU), Uberlândia, State of Minas Gerais.

Eleven morphological measurements were taken by TRC from adult specimens with calipers to the nearest 0.1 mm. Nine measurements follow Duellman (1970): snout-vent length (SVL), head length (HL), head width (HW), eye diameter (ED), tympanum diameter (TD), eye-nostril distance (END) (= snout length), internarial distance (IND), shank length (SL) (= tibia length), and foot length (FL). Two measurements follow Heyer *et al.* (1990): thigh length (TL) and hand length (HAL). Head shape standard terminology follows Heyer *et al.* (1990).

Advertisement calls of the new species were recorded with a Marantz PMD 660 digital recorder; calls of *L. camaquara* were recorded with a Microtrack II digital recorder, both set at a sampling rate of 44.1 kHz and a resolution of 16 bits, coupled to Sennheiser K6/ME66 directional microphones. Bioacoustic variables were analyzed on a personal computer with Windows XP Professional operating system using the software Raven Pro 1.5, 64-bit version (Bioacoustics Research Program 2012). Temporal variables were measured directly in audiospectrograms; dominant frequency was obtained in the software (Peak Frequency measurement function). Sound figures were obtained with Seewave 1.6.4 (Sueur *et al.* 2008), package of R 2.15.1, 64 bit version (R Development Core Team 2012). Raven Pro and Seewave settings were Hanning (Hann) window, 85% overlap, and 256 or 512 points resolution (FFT). Sound files and recording information, including temperatures, are listed in Appendix 2. Call terminology follows Duellman and Trueb (1994). Given that the advertisement call of the new species is released in note groups (trill-like call pattern), we proposed to assess quantitative data of the duration of first notes as consisting of the arithmetic mean of the first three notes of a trill; median notes as the arithmetic mean of the three median notes; and the end notes as the arithmetic mean of the last three notes of a given trill. The same was performed to assess quantitative data of internote intervals among first, median, and end notes. Total mean values of bioacoustic variables and their associated standard deviations were obtained from individual mean values, since we do not have uniform samples among the recorded individuals, whereas the range of values encompasses the minimum and maximum values of the whole sample analyzed. Voucher specimens: *Leptodactylus* **sp. nov.**: UFMG 4355–4356, 4461; *L. camaquara*: AAG-UFU 0046; *L. plaumanni*: AAG-UFU 1795.

Species account

***Leptodactylus oreomantis* sp. nov.**
Figures 1–4

Holotype. UFMG 3825, adult male, collected at the Vale do Queiroz, Serra das Almas (13°31'23"S; 41°57'28"W, approximately 1575 m a.s.l.), Municipality of Rio de Contas, State of Bahia, northeastern Brazil, on 14 January 2010, by F. S. F. Leite, M. R. Lindemann, and R. B. Mourão.

Paratypes. Eleven adult males: UFMG 4444 (13°31'11"S; 41°56'59"W, 1540 m a.s.l.), UFMG 4461 (13°30'42"S; 41°56'58"W, 1461 m a.s.l.), on 10 January 2010, at the type locality, by F. S. F. Leite, M. R. Lindemann, and R. B. Mourão; UFMG 4355–4356 (12°45'58"S; 41°29'48"W, 1310 m a.s.l.), on 21 January 2010, Vale do Paty, Parque Nacional da Chapada Diamantina, Municipality of Mucugê, State of Bahia; UFMG 4361–4363 (13°21'38"S; 41°16'34"W, 1295 m a.s.l.), on 29 January 2010, Municipality of Ibicoara, State of Bahia; all collected by F. S. F. Leite, M. R. Lindemann, and R. B. Mourão; UFMG 7888–7891 (13°08'12"S; 41°51'32"W,

1341 m a.s.l.), on 15 January 2010, Serra da Tromba, Nascente do Rio de Contas, Municipality of Piatã, by T. L. Pezzuti, L. O. Drummond, B. Imai, L. Rodrigues. Six adult females: UFMG 4443, 4445 (13°31'11"S; 41°56'59"W, 1540 m a.s.l.), on 10 January 2010, at the type locality, by F. S. F. Leite, M. R. Lindemann, and R. B. Mourão; UFMG 4260–4261 (12°46'38"S; 41°29'04"W, 1294 m a.s.l.), on 20 January 2010, UFMG 4294 (12°48'28"S; 41°27'55"W, 1300 m a.s.l.), on 21 January 2010, Parque Nacional da Chapada Diamantina, Municipality of Mucugê; UFMG 4332 (13°21'38"S; 41°16'34"W, 1295 m a.s.l.), Municipality of Ibicoara. Undetermined sex: UFMG 7948–7950 (13°13'01"S; 41°15'52"W, 1213 m a.s.l.), Serra do Sincorá, Parque Nacional da Chapada Diamantina, Toca do Vaqueiro, Municipality of Mucugê, on 19 January 2010, by T. L. Pezzuti, L. O. Drummond, B. Imai, L. Rodrigues.

Diagnosis. *Leptodactylus oreomantis* **sp. nov.** is assigned to *Leptodactylus* (*sensu* Heyer 1969) by possessing a distinct tympanum, toes without webs, vomerine teeth present, and cutaneous folds on the tarsus; and assigned to the *L. fuscus* group by the following set of characters: 1) small body size; 2) toes lacking fringing or webbing; 3) adult males lacking thumb spines. The new species is diagnosed from the other 27 species of the *L. fuscus* group by the following combination of characters: 1) small-sized *Leptodactylus* (adult male SVL < 35 mm); 2) slender body in dorsal view; 3) presence of six well-defined continuous dorsolateral folds; 4) absence of longitudinal light stripes on skin folds along the superior surfaces of thighs and/or shanks; 5) advertisement call composed of series of non-pulsed notes forming trills.

Comparisons with other species. *Leptodactylus oreomantis* **sp. nov.** (adult male SVL 28.1–33.8 mm) is promptly diagnosed from all moderate-sized (adult male SVL > 35 mm < 90 mm; *sensu* Heyer & Thompson 2000) species of the *L. fuscus* group: *L. bufonius*, *L. cunicularius*, *L. cupreus*, *L. didymus L. elenae*, *L. fuscus*, *L. jolyi*, *L. labrosus*, *L. longirostris*, *L. mystaceus*, *L. mystacinus*, *L. notoaktites*, *L. poecilochilus*, *L. sertanejo*, *L. spixi*, *L. troglodytes*, and *L. ventrimaculatus* (combined adult male SVL 36–65 mm) by its smaller body size (see Tables 1, 4). *Leptodactylus oreomantis* **sp. nov.** can additionally be diagnosed from the following moderate-sized species (*L. albilabris*, *L. bufonius*, *L. caatingae*, *L. cupreus*, *L. elenae*, *L. fragilis*, *L. labrosus*, *L. latinasus*, *L. longirostris*, *L. mystaceus*, *L. mystacinus*, *L. notoaktites L. poecilochilus*, *L. troglodytes*, and *L. ventrimaculatus*) by the presence of six well-defined dorsolateral folds, whereas all species abovementioned have only one or two pairs of well-defined, ill-defined or no dorsolateral folds (see Table 4); from *L. jolyi* and *L. sertanejo* by the absence of light longitudinal stripes on skin folds along the superior surfaces of thighs and/or shanks (see figs. 2A–B, 2E–F).

TABLE 1. Morphological measurements (mm) of *Leptodactylus oreomantis* **sp. nov.** type series (including the holotype) from the Chapada Diamantina, State of Bahia, Brazil. Mean±SD (minimum–maximum).

Morphological measurements (mm)	Males (N=12)	Females (N=6)
Snout-vent length	31.2±1.3 (28.1–33.8)	36.1±1.8 (33.2–38.3)
Head length	12.6±0.7 (11.5–14.2)	14.1±0.6 (13.3–14.9)
Head width	10.0±0.6 (9.3–11.5)	11.5±0.8 (10.4–12.8)
Eye diameter	2.8±0.2 (2.5–3.0)	3.3±0.4 (2.7–4.0)
Tympanum diameter	1.9±0.1 (1.7–2.1)	2.2±0.2 (2.0–2.4)
Eye-nostril distance	3.0±0.2 (2.7–3.3)	3.6±0.4 (3.0–4.0)
Internarial distance	2.6±0.1 (2.3–2.7)	3.1±0.2 (2.9–3.4)
Hand length	7.7±0.5 (6.9–8.4)	9.0±0.6 (8.2–10.0)
Thigh length	15.8±0.7 (14.6–16.9)	19.0±1.0 (17.9–20.4)
Shank length	18.3±1.1 (16.6–20.4)	21.8±1.1 (20.2–23.0)
Foot length	19.4±0.9 (18.1–20.9)	22.9±1.2 (21.3–24.8)

Among the small-sized species of the group, *Leptodactylus oreomantis* **sp. nov.** is diagnosed from *L. albilabris*, *L. caatingae*, *L. fragilis*, and *L. latinasus*, by the presence of six well-defined dorsolateral folds, whereas all species abovementioned have only one pair of well-defined, ill-defined or no dorsolateral folds (see Table 4). The new species is diagnosed from *L. gracilis* and *L. plaumanni* by the absence of light longitudinal stripes on skin folds along the superior surfaces of thighs and/or shanks, by having a pointed snout in dorsal view, and by possessing a very slender body shape in dorsal view (see figs. 2A–B), whereas both aforementioned species have

longitudinal stripes on skin folds along the superior surfaces of thighs and/or shanks, sub-elliptical snouts in dorsal view, and comparatively more robust body shape in dorsal view (see figs. 2C–D); from *L. marambaiae*, by the absence of dark longitudinal stripes on dorsum, and by the absence of a light stripe along the outer surface of shanks (see figs. 3A, D); from *L. camaquara*, by the presence of a light longitudinal stripe on the posterior surface of thighs (posterior surface of thighs with light spots on a dark-colored background in *L. camaquara*; see figs. 3A, E). *Leptodactylus oreomantis* **sp. nov.** can additionally be diagnosed from *L. marambaiae* and *L. camaquara* by having a pointed snout in dorsal view and by possessing a very slender body shape in dorsal view, whereas both aforementioned species have a sub-elliptical snout in dorsal view and slightly (*L. marambaiae*) or remarkably (*L. camaquara*) robust body shape in dorsal view (see figs. 3A, D–E). The new species is morphologically more closely related to *L. furnarius* and *L. tapiti*, all three species sharing the presence of a light vertebral pin-stripe, six well-defined sinuous and continuous dorsolateral folds, posterior surface of thighs striped, and pointed snout in dorsal view (figs. 3A–C). *Leptodactylus oreomantis* **sp. nov.** is diagnosed from *L. tapiti* by possessing a discrete post-commissural gland (well-developed in *L. tapiti*), and by possessing a comparatively more slender body shape in dorsal view (see figs. 3A, C). *Leptodactylus oreomantis* **sp. nov.** (adult male SVL 28.1–33.8 mm; mean 31.2, SD = 1.3, N = 12) can be diagnosed from *L. furnarius* [adult male SVL 35.0–37.5 mm, mean 35.9 (Sazima & Bokermann 1978); adult male SVL 31.0–39.0 mm, mean 36.5 (Heyer & Heyer 2004)] by its smaller body size (figs. 3A–B).

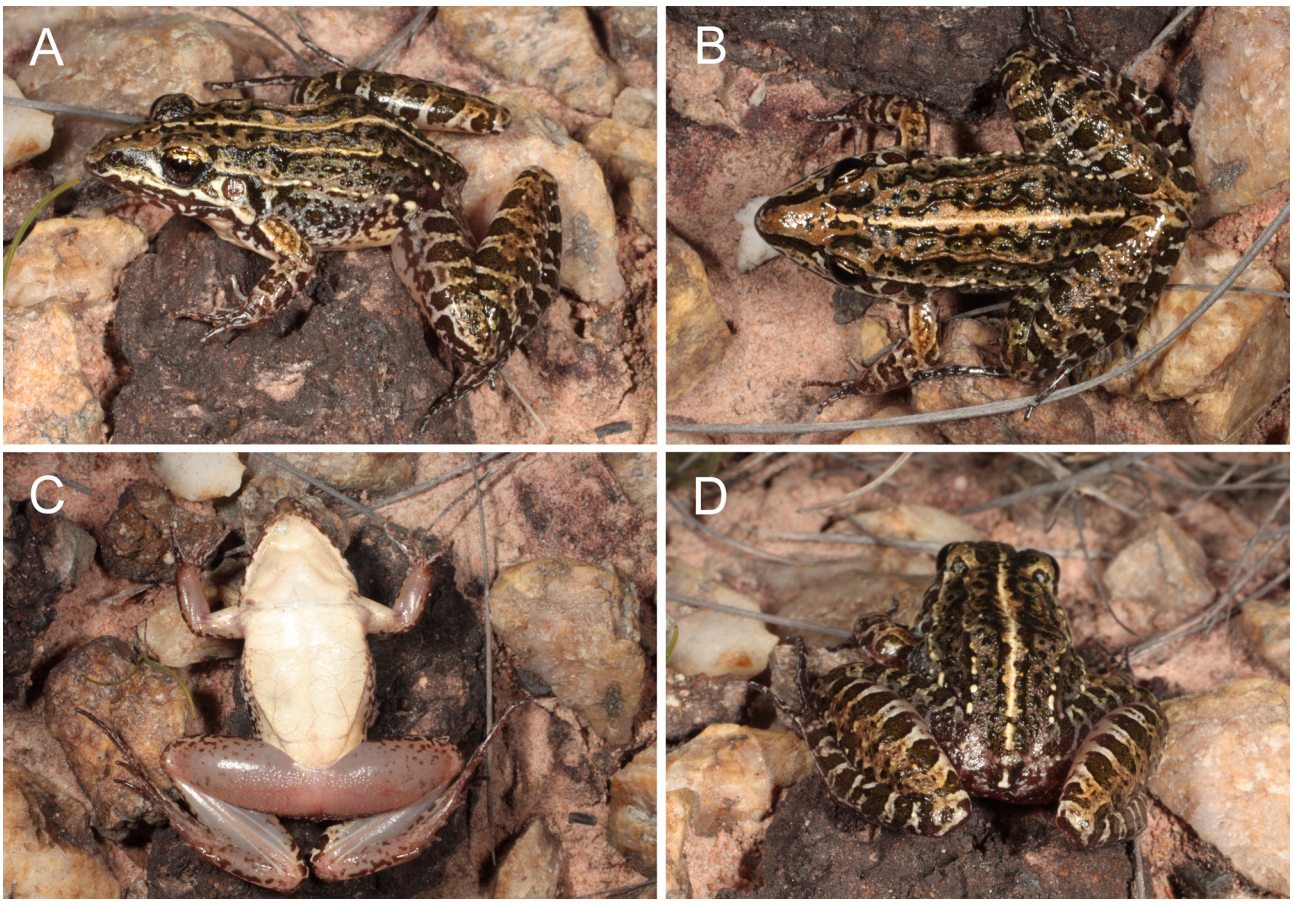

FIGURE 1. Lateral (A), dorsal (B), ventral (C), and posterior (D) views of a live adult male paratype of *Leptodactylus oreomantis* **sp. nov.** (UFMG 4444) from the Vale do Queiroz, Serra das Almas, Municipality of Rio de Contas, State of Bahia, northeastern Brazil.

The advertisement call pattern sets *Leptodactylus oreomantis* **sp. nov.** apart from almost all species of the *L. fuscus* group (see Table 4). For comparative bioacoustic data of the *L. fuscus* species group, see Heyer (1978), Bilate *et al.* (2006), Caramaschi *et al.* (2008), Giaretta and Costa (2007), Carvalho and Ron (2011), and Brandão *et al.* (2013). The advertisement call of *Leptodactylus oreomantis* **sp. nov.** consists of a long series of non-pulsed notes forming trills. The same advertisement call pattern is already known for *L. cunicularius* and *L. plaumanni*

(Sazima & Bokermann 1978; Kwet *et al.* 2001; Heyer *et al.* 2008; see fig. 6, Tables 3–4). Nonetheless, the new species can easily be diagnosed from *L. cunicularius* by having a pointed snout in dorsal view, a very slender body shape in dorsal view, continuous longitudinal dorsolateral folds (fig. 3A), and smaller body size (see Table 4), whereas *L. cunicularius* has a sub-elliptical snout in dorsal view, a remarkably robust body shape in dorsal view, interrupted longitudinal dorsolateral folds (see fig. 3F), and a remarkably larger body size (see Table 4); from *L. plaumanni*, by lacking light longitudinal stripes on skin folds along the superior surfaces of thighs and/or shanks [Heyer 1978 (reported as *L. geminus* Barrio, currently a synonym of *L. plaumanni*); Kwet *et al.* 2001], whereas *L. plaumanni* possesses evident light stripes on skin folds along superior surfaces of thighs and/or shanks (figs. 2A–C). The advertisement call of *L. ventrimaculatus* is still undescribed, but its call structure is more similar to that of *L. labrosus* instead (S. R. Ron pers. comm.).

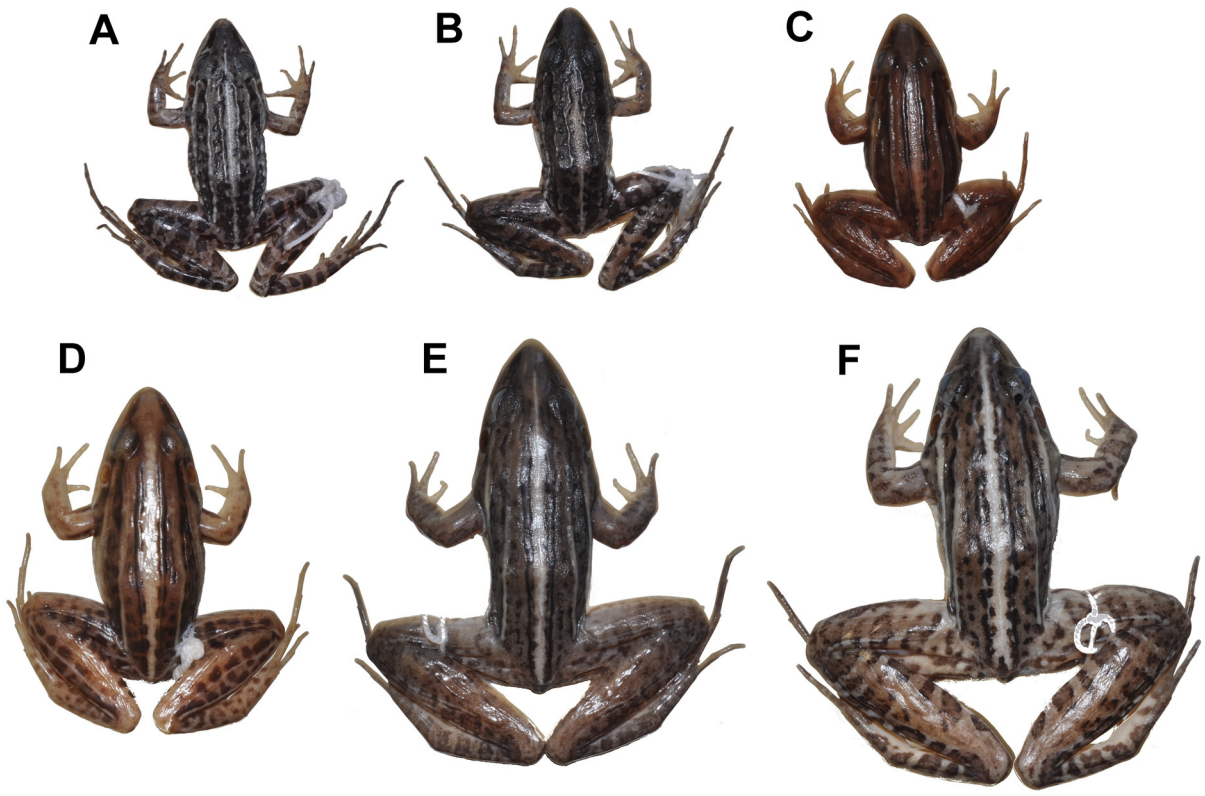

FIGURE 2. Comparative adult male specimens of the new species and four comparative species: (A) holotype (UFMG 3825; SVL 31.1 mm) and (B) paratype (UFMG 4363; SVL 30.8 mm) of *Leptodactylus oreomantis* **sp. nov.**; (C) voucher specimen (see fig. 6C) of *Leptodactylus plaumanni* (AAG-UFU 1795; SVL 30.9 mm) from Canela, Rio Grande do Sul; (D) voucher specimen of *Leptodactylus gracilis* (AAG-UFU 1796; SVL 38.7) from Santo Amaro da Imperatriz, Santa Catarina; (E) topotype specimen of *Leptodactylus jolyi* (AAG-UFU 4092; SVL 46.8) from Rio Grande da Serra, São Paulo; (F) topotype specimen of *Leptodactylus sertanejo* (AAG-UFU 4946; SVL 48.5 mm) from Uberlândia, Minas Gerais.

Assuming a close morphological relatedness among the new species, *L. furnarius*, and *L. tapiti*, we further diagnose *L. oreomantis* **sp. nov.** from *L. laurae* (Heyer 1978), currently placed as a junior synonym of *L. furnarius* in Heyer (1983), an earlier available name prior to our description. The new species is diagnosed from *L. laurae* (mean adult male SVL 36.1 mm, SD = 2.3; holotype 40.4 mm) by its smaller body size (adult male SVL 28.1–33.8 mm; mean 31.2, SD = 1.3, N = 12). Furthermore, advertisement call pattern of *L. laurae* [T.R. Carvalho unpubl. data; recordings from the Municipality of Chiador, ca. 40 km to its type locality (Municipality of Juiz de Fora)] and *L. furnarius* (Sazima & Bokermann 1978) are identical (peep-like calls) in comparison to the trill-like call pattern of the new species.

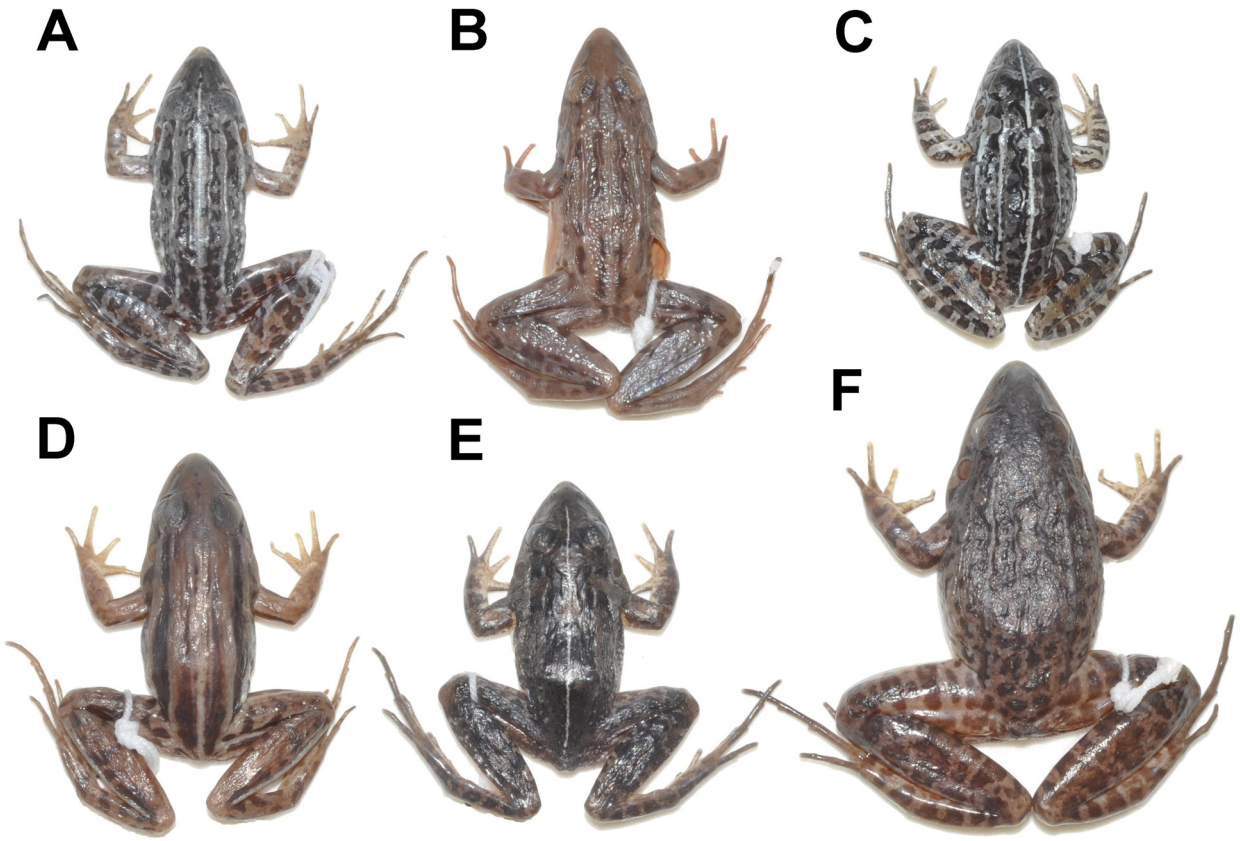

FIGURE 3. Comparative adult male specimens of the new species and five comparative species: (A) holotype of *Leptodactylus oreomantis* **sp. nov.** (UFMG 3825; SVL 31.1 mm); (B) non-topotype specimen of *L. furnarius* from Campinas (approximately 100 km in a straight line to its type locality), State of São Paulo (AAG-UFU 1619; SVL 32.8 mm); (C) topotype (Alto Paraíso de Goiás) of *L. tapiti* (AAG-UFU 0871; SVL 29.5 mm); (D) topotype (Restinga de Marambaia) of *L. marambaiae* (AAG-UFU 4193; SVL 32.6 mm); (E) topotype (Santana do Riacho) of *L. camaquara* (AAG-UFU 0046; SVL 30.8 mm); (F) topotype (Santana do Riacho) of *L. cunicularius* (AAG-UFU 3165; SVL 41.8 mm).

Description of holotype. UFMG 3825 (figs. 2A, 3A, 4). Adult male. Snout pointed in dorsal view (fig. 4A), acuminate in lateral view (fig. 4B) (*sensu* Heyer *et al.* 1990). Well-developed fleshy ridge on snout tip. Nostrils closer to the snout tip than to the eyes; canthus rostralis barely discernible; loreal region very slightly concave; upper eyelids smooth; supratympanic fold from the posterior eye corners to the base of arms; vocal sac subgular, expanded laterally, vocal slits present; vomerine teeth in two straight rows just behind choanae, almost connecting to each other. Relative finger lengths II $\simeq$ IV < I < III; finger tips rounded, not expanded, and with no webbing or fringing; inner metacarpal tubercle elongated; outer metacarpal tubercle ovoid, approximately double of inner dimension (fig. 4D). No thumb asperities or prepollex. Two undulating dorsal continuous dermal folds from interorbital region to groin; two dorsal and continuous dermal folds from the eyes to groin; two lateral dermal folds from the eyes to groin, interrupted in its last third. Discrete commissural glands just posterior to the jaw angle. Dorsal surfaces of body and limbs smooth, a few discrete granules scattered on the body. Dorsal surfaces of arms and legs with transverse stripes. Belly smooth. Posterior surface of thighs with a longitudinal stripe. Relative toe lengths I < II < V < III < IV; toe tips rounded, not expanded, and with no webbing, ridged laterally. Inner and outer metatarsal tubercles discrete, ovoid (fig. 4C). Tarsal folds absent. Heel, outer tarsi and sole of feet with scant minute tubercles.

Measurements of holotype. Morphometric characters (mm) and ratios (%) in relation to SVL (31.1 mm): HL 12.1 (38.9), HW 9.4 (30.2), ED 2.7 (8.7), TD 1.8 (5.8), END 3.0 (9.6), IND 2.6 (8.3), HAL 7.3 (23.5), TL 15.7 (50.5), SL 17.5 (56.3), FL 19.1 (61.4).

Color of holotype in preservative (figs. 2A, 3A). Dorsum with black anastomotic blotches on a brownish gray background. Limbs with black transverse stripes on a brownish gray background. Posterior surface of thighs with a light longitudinal stripe on a dark brown background. Cream stripes from inner metacarpal tubercle

extending to two thirds length of tarsi. Cream vertebral pin-stripe with light stripes on the four external dorsolateral folds. Belly and throat cream, immaculate. Cream stripe from the snout tip to the base of arms. Outer tarsi and sole of feet scattered with white dots.

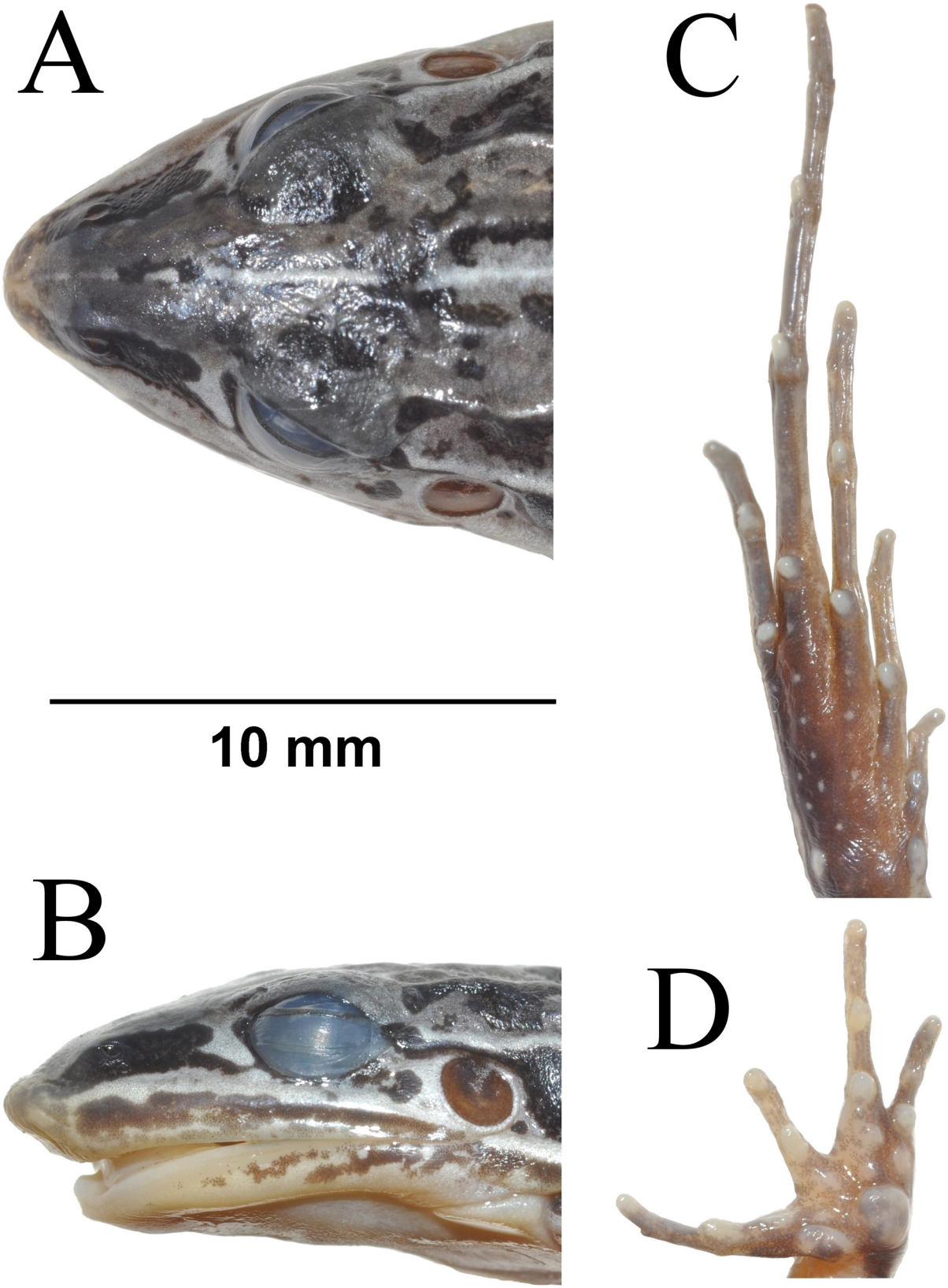

FIGURE 4. *Leptodactylus oreomantis* **sp. nov.**, holotype (UFMG 3825), adult male. Dorsal (A) and lateral (B) views of head, and ventral views of foot (C) and hand (D). Scale bar = 10 mm.

Variation. Specimens UFMG 4294, 4355–4356, 7888–7891 have dorsal surfaces of body and limbs darkened in preservative so that the blotches are not visible. Specimens UFMG 4261, 4332, 4355–4356, 4362, 4368, 7888–7889, 7891, 7949–7950 have ventral surfaces of body (throat and belly) and limbs (thighs) with scattered black spots. Specimens UFMG 4136, 4261, 4294, 4356, 4362–4363, 4444, 7888–7891, 7949 have interrupted or no light stripes on dorsolateral folds. Female specimens have a more robust body. Specimens UFMG 4260–4261, 4294, 4332, 4363, 4443, 4445, 7890–7891, 7948–7950 have no well-developed shovel-like fleshy ridge on snout tip.

Color in life (fig. 1). In life, coloration is similar to that of specimens in preservative, but with vivid colors. Iris golden to silver with black vermiculation.

Geographic distribution. *Leptodactylus oreomantis* **sp. nov.** is known from the Serra das Almas (Municipality of Rio de Contas), Serra da Tromba (Municipality of Piatã), and Serra do Sincorá (Municipalities of Mucugê and Ibicoara). These mountain ranges belong to the Chapada Diamantina, northernmost Espinhaço Range, State of Bahia, northeastern Brazil.

Natural history. *Leptodactylus oreomantis* **sp. nov.** occurs in high altitude (altitudes ranging from 1213 to 1575 m a.s.l.) rock fields, called *campos rupestres*, a typical phytophysiognomy of the Espinhaço Range (fig. 5A). For a characterization of the *campos rupestres* flora, see Giulietti *et al.* (1987), Stannard (1995), and Vasconcelos (2011). For a characterization of the Espinhaço Range anuran fauna, see Heyer (1999), and Leite *et al.* (2008). Males call on meadows from the ground, mainly close to swallow temporary pools, and associated with small temporary streamlets without gallery forests (fig. 5B). The species is mainly active during the night, but in rainy or misty days males can also be heard during daylight. This species can easily be found (at least heard) during the beginning of the rainy season in the study region (December-January).

FIGURE 5. (A) General view of the montane rock fields (*campos rupestres*) at the type locality, Vale do Queiroz, Serra das Almas, Municipality of Rio de Contas, State of Bahia, northeastern Brazil (note the Pico das Almas summit in the background, reaching 1958 m a.s.l.); (B) Reproductive habitat of *Leptodactylus oreomantis* **sp. nov.**

Etymology. The epithet *oreomantis* stands for 'mountain frog', from Greek (*oreos* = mountain; *mantis* = anuran/frog). A literal translation for *Mantis* would be 'prophet', but this term was also employed to refer to amphibians, since they represented the 'weather prophets' to ancient Greek civilization. This name is used as a noun in apposition.

Conservation. The extent of occurrence measured by a minimum convex polygon (EO, *sensu* IUCN 2001) of *Leptodactylus oreomantis* **sp. nov.** has 3537 km^2. Within its EO, there are two Federal or State protected areas, the Parque Nacional da Chapada Diamantina (about 1519 km^2), which is strictly protected (equivalent to IUCN category II, IUCN 1994), and the Área de Relevante Interesse Ecológico Nascente do Rio de Contas (about 48 km^2), which is a sustainable use reserve (equivalent to IUCN category V), although the species is known based on observational occurrences only for the former. The species EO also contains very small reserves where it occurs

(Parque Municipal Serra das Almas, Municipality of Rio de Contas at the type locality) or could potentially occur (Parque Municipal Sempre-Viva, Municipality of Mucugê, Parque Municipal do Espalhado, Municipality of Ibicoara, and Reserva Particular do Patrimônio Natural Itamarandiba, Municipality of Abaíra).

The species type locality (Serra das Almas) is broadly known by its singular floristic diversity (Stannard 1995), including several microendemics and ancient plant lineages (Ribeiro *et al.* 2012). This montane region is also the type locality of the hylid *Bokermannohyla flavopicta* (Leite *et al.* 2012). However, despite its small protected area, the Serra das Almas currently has limited, if there is any, management and supervision. Therefore, disorderly land use and occupation, fire (from criminals and from agriculture or native pasture management for cattle breeding), and unregulated tourism are constant threats to *Leptodactylus oreomantis* **sp. nov.** habitat. In assigning Serra das Almas as the type locality of an additional species, we expect to increase scientific and conservation concern to this region so as to arouse a more committed stance of the Brazilian government concerning the conservation and management of this unique biodiversity heritage. The creation of new and larger reserves is an imperative to hopefully meet a reserve system capable to ensure biodiversity representation.

Advertisement call. Four males recorded (N = 79 advertisement calls). Advertisement call (Table 2; fig. 6) consists of series of 16–98 notes/call (mean 52.1; SD = 1.8) with duration varying from 0.74–5.09 seconds (mean 2.62; SD = 0.18) at a rate of 7–13 calls/minute (mean 9.1; SD = 2.0), and intercall interval from 1.22–9.71 seconds (mean 3.17; SD = 1.05), forming a trill-like pattern. Each call has an ascendant amplitude modulation at its beginning (first notes), and is composed of non-pulsed notes with up to 3 harmonics possessing a very slight or no ascendant frequency modulation, emitted at a rate of 353–644 notes/minute (mean 438.8; SD = 97.6). Duration of first notes varies from 13–22 ms (mean 16.6; SD = 2.7) with internote interval from 25–41 ms (mean 32.5; SD = 4.0), duration of median notes varies from 19–24 ms (mean 21.3; SD = 1.8) with internote interval from 26–37 ms (mean 31.4; SD = 2.2), duration of end notes varies from 17–24 ms (mean 20.3; SD = 1.7) with internote interval from 28–50 ms (mean 38.2; SD = 5.3). Dominant frequency peaks from 2.76–3.10 kHz (mean 2.97 kHz; SD = 0.03) and corresponds to the fundamental harmonic. The second and third harmonics are increasingly weaker in sound energy, peaking at approximately 6 kHz and 9 kHz, respectively.

TABLE 2. Advertisement call variables of *Leptodactylus oreomantis* **sp. nov.** from the Chapada Diamantina (Municipalities of Piatã and Rio de Contas), State of Bahia; and *Leptodactylus camaquara* from the Parque Nacional da Serra do Cipó (Municipality of Santana do Riacho), State of Minas Gerais. Mean±SD (minimum–maximum). N = number of recorded specimens (number of analyzed calls).

Bioacoustic variables	*Leptodactylus oreomantis* **sp. nov.** N=4 (79)	*Leptodactylus camaquara* N=8 (119)
Call duration (s)	2.62±0.18 (0.74–5.09)	0.20±0.02 (0.16–0.27)
Intercall interval (s)	3.17±1.05 (1.22–9.71)	0.34±0.04 (0.23–0.78)
Notes/call	52.1±1.8 (16–98)	----------
Duration of first notes (ms)	16.6±2.7 (13–22)	----------
First internote intervals (ms)	32.5±4.0 (25–41)	----------
Duration of median notes (ms)	21.3±1.8 (19–24)	----------
Median internote intervals (ms)	31.4±2.2 (26–37)	----------
Duration of end notes (ms)	20.3±1.7 (17–24)	----------
End internote intervals (ms)	38.2±5.3 (28–50)	----------
Calls/minute	9.1±2.0 (7–13)	----------
Calls/second	----------	2.2±0.4 (1–3)
Notes/minute	438.8±97.6 (353–644)	100.0±9.3 (94–120)
Dominant frequency (kHz)	2.97±0.03 (2.76–3.10)	2.43±0.02 (2.25–2.44)

***Leptodactylus camaquara* advertisement call.** Eight males recorded (N = 119 advertisement calls). Advertisement call (Table 2; fig. 7) consists of a non-pulsed signal with up to 3 harmonics possessing a slight ascendant frequency modulation, emitted at a rate of 94–120 calls/minute (mean 100.0; SD = 9.3), and at a rate of 1–3 calls/seconds (mean 2.2; SD = 0.4). Call duration varies from 0.16–0.27 seconds (mean 0.20; SD = 0.02) with

intercall interval from 0.23–0.78 seconds (mean 0.34; SD = 0.04). Dominant frequency peaks from 2.25–2.44 kHz (mean 2.43 kHz; SD = 0.02) and corresponds to the fundamental harmonic. The second and third harmonics are increasingly weaker in sound energy, peaking at approximately 5.0 kHz and 7.5 kHz, respectively.

Additional remarks. The Espinhaço Range stands out for harboring a great diversity of the *L. fuscus* group (Heyer 1978), where 10 species have been already recorded (*L. caatingae*, *L. camaquara*, *L. cunicularius*, *L. furnarius*, *L. fuscus*, *L.* cf. *jolyi*, *L. mystacinus*, *L. troglodytes*, *L. mystaceus*, and *Leptodactylus oreomantis* **sp. nov.**; F. S. F. Leite pers. comm.) within this mountain range, although only *L. camaquara* and *Leptodactylus oreomantis* **sp. nov.** are in fact endemic to the Espinhaço Range. In the region of the Serra do Cipó, southern portion of the Espinhaço Range, State of Minas Gerais, seven species are sympatric (*L. camaquara*, *L. cunicularius*, *L. furnarius*, *L. fuscus*, *L.* cf. *jolyi*, *L. mystacinus*, and *L. mystaceus*) (Leite pers. comm.).

Since the compilation of the Espinhaço Range anuran endemics by Leite *et al.* (2012), who listed 33 taxa, three new species have been described: *Corythomantis galeata* (Pombal *et al.* 2012), *Proceratophrys redacta* (Teixeira *et al.* 2012), and *Leptodactylus oreomantis* **sp. nov.** (present study). These authors did not include *Bokermannohyla sagarana* (Leite *et al.* 2011) in their checklist. Therefore, 37 anuran species should be considered endemic to the Espinhaço Range until the present time.

Leptodactylus oreomantis **sp. nov.** represents the first species of the genus occurring restricted to montane rock fields (*campos rupestres*) of the Chapada Diamantina, northeastern Brazil. The other three species of the *L. fuscus* group assumed to be restricted or at least associated with montane field environments (*L. camaquara*, *L. cunicularius*, and *L. tapiti*) occur associated with mountain ranges of southeastern or central Brazil. *Leptodactylus oreomantis* **sp. nov.** is the third species of the *L. fuscus* group with a trill-like advertisement call pattern, in which the advertisement call consists of well-defined note series. Interestingly, all three species of the *L. fuscus* group possessing the same trill-like advertisement call pattern are easily set apart from each other based solely on a general morphological approach: i) *L. cunicularius* is morphologically relatively similar to *L. fuscus*, which possesses a long whistle advertisement call pattern (Heyer & Reid 2003); ii) *L. plaumanni* is most morphologically similar or even identical to *L. gracilis* (see Kwet *et al.* 2001), which possesses a short whistle advertisement call pattern (Kwet *et al.* 2001); iii) *Leptodactylus oreomantis* **sp. nov.** is morphologically more closely related to *L. furnarius* and *L. tapiti*, both possessing a peep-like advertisement call pattern (Heyer & Heyer 2004; Brandão *et al.* 2013). Based on the currently available phylogenetic hypothesis of the *L. fuscus* species group (Ponssa 2008), in which *L. plaumanni* and *L. cunicularius* were recovered in different clades, it is possible to assume that the trill-like call pattern should possibly have appeared at least two times independently, since we have not tested the phylogenetic position of *Leptodactylus oreomantis* **sp. nov.** yet.

The advertisement call characteristics of *Leptodactylus oreomantis* **sp. nov.** are very similar to those of *L. cunicularius* and *L. plaumanni* (see Kwet *et al.* 2001; Heyer *et al.* 2008; fig. 6). However, the advertisement call of *L. cunicularius* has a higher advertisement call rate (calls/minute), and a lower peak of sound energy in comparison with *L. oreomantis* **sp. nov.** (see Table 3). The obvious differences in emission rate among all three species could be attributed either to physical factors, as the temperature, or social context, for instance, the differential density of conspecific calling males at the time these species were recorded. In any case, addressing how temperature affected these recordings would depend on a larger sample of recorded individuals, as well as a wider range of temperatures so that we could apply proper statistical approaches. It worth stressing, despite some slight differences in quantitative bioacoustic variables, that these three taxa are not diagnosed from each other based solely on bioacoustic information available until the present moment. On the other hand, an unequivocal diagnosis under a morphological/morphometric approach of these species based on the combination of body size (small or moderate-sized species), body shape in dorsal view (slender or robust), and the presence/absence of longitudinal stripes on skin folds along dorsal surfaces of thighs and/or shanks promptly supports their distinctiveness as independent lineages (see figs. 2A–C, and 3A, F), and represents a reliable line of evidence for the identification of both live and preserved specimens. Besides, there is no geographic distribution overlap among these three species, considering that *Leptodactylus oreomantis* **sp. nov.** is restricted to montane rock fields of the Chapada Diamantina in northeastern Brazil, *L. cunicularius* is restricted to montane rock fields of southeastern Brazil (Heyer *et al.* 2008), and *L. plaumanni* occurs in southern Brazil and Argentina (Lima 2007).

TABLE 3. Comparative bioacoustic parameters (range of values) of the three species of the *Leptodactylus fuscus* group with trill-like advertisement call pattern (*Leptodactylus oreomantis* **sp. nov.**, *L. cunicularius*, and *L. plaumanni,* and their respective sources).

Bioacoustic variables*	*Leptodactylus oreomantis* **sp. nov.** (Present study)	*Leptodactylus cunicularius* (Heyer *et al.* 2008)	*Leptodactylus plaumanni* (Kwet *et al.* 2001)*
Call duration (s)	0.74–5.09	0.91–3.09	1.10–3.10
Notes/call	16–98	6–51	17–54
Calls/minute	7–13	15–19	----------
Dominant frequency (kHz)	2.76–3.10	2.36–2.67	1.90–3.48

* Bioacoustic data on *L. geminus* (*L. plaumanni* junior synonym) were also included in the range of values.

TABLE 4. Summary of adult male size (value range), character states of dorsolateral folds, and advertisement call pattern for the species of the *Leptodactylus fuscus* group. Species with a trill-like advertisement call pattern are in bold type. 'Non-pulsed' calls encompasses the remaining non-pulsed call patterns (e.g. short/long whistles and peep-like calls). Body size decimal numbers were rounded.

Species	SVL (mm)	Dorsolateral folds	Call pattern	Source
L. albilabris	30–43	One pair	Non-pulsed	Heyer (1978)
L. bufonius	52	No well-defined folds	Non-pulsed	Heyer (1978)
L. caatingae	32–37	Ill-defined or no folds	Pulsed call	Heyer & Juncá (2003)
L. camaquara	29–32	Six well-defined folds	Non-pulsed	Sazima & Bokermann (1978); Present study
L. cunicularius	36–43	Six well-defined folds	Trill	Sazima & Bokermann (1978); Heyer *et al.* (2008)
L. cupreus	49–57	One pair	Non-pulsed	Caramaschi *et al.* (2008); Cassini *et al.* (2013)
L. didymus	46–52	One pair	Non-pulsed	Heyer *et al.* (1996)
L. elenae	38–46	One or two pairs	Non-pulsed	Heyer & Heyer (2002)
L. fragilis	26–43	Ill-defined folds	Pulsed call	Heyer *et al.* (2006)
L. furnarius	31–39	Six well-defined folds	Non-pulsed	Heyer & Heyer (2004)
L. fuscus	43	Six well-defined folds	Non-pulsed	Heyer (1978); Heyer & Reid (2003)
L. gracilis	30–48*	Six well-defined folds	Non-pulsed	Heyer (1978); Kwet *et al.* (2001)
L. jolyi	45	Six well-defined folds	Non-pulsed	Sazima & Bokermann (1978)
L. labrosus	55	One or two pairs	Pulsed call	Heyer (1978); Carvalho & Ron (2011)
L. latinasus	28–38	Ill-defined or no folds	Non-pulsed	Heyer (1978)
L. longirostris	38	One or two pairs	Non-pulsed	Heyer (1978); Crombie & Heyer (1983)
L. marambaiae	33–38	Six well-defined folds	Non-pulsed	Izecksohn (1976)
L. mystaceus	43	One pair	Pulsed call	Heyer (1978); Heyer *et al.* (1996)
L. mystacinus	44–65	One or two pairs	Non-pulsed	Heyer *et al.* (2003)
L. notoaktites	47	One pair	Non-pulsed	Heyer (1978); Heyer *et al.* (1996)
***L. oreomantis* sp. nov.**	28–34	Six well-defined folds	Trill	Present study
L. plaumanni	30–42*	Six well-defined folds	Trill	Heyer (1978); Kwet *et al.* (2001)
L. poecilochilus	45	One or two pairs	Non-pulsed	Straughan & Heyer (1976); Heyer (1978)
L. sertanejo	48–54	Six well-defined folds	Non-pulsed	Giaretta & Costa (2007)
L. spixi	43	One pair	Non-pulsed	Heyer (1983); Bilate *et al.* (2006)
L. tapiti	30	Six well-defined folds	Non-pulsed	Sazima & Bokermann (1978); Brandão *et al.* (2013)
L troglodytes	49	No well-defined folds	Non-pulsed	Heyer (1978)
L. ventrimaculatus	50	One pair	Pulsed call	Heyer (1978); Santiago R. Ron pers. comm.

* Given the wide range of SVL values, we assume that both male and female specimens are included. Gender was not mentioned (see Table 3 in Kwet *et al.* 2001).

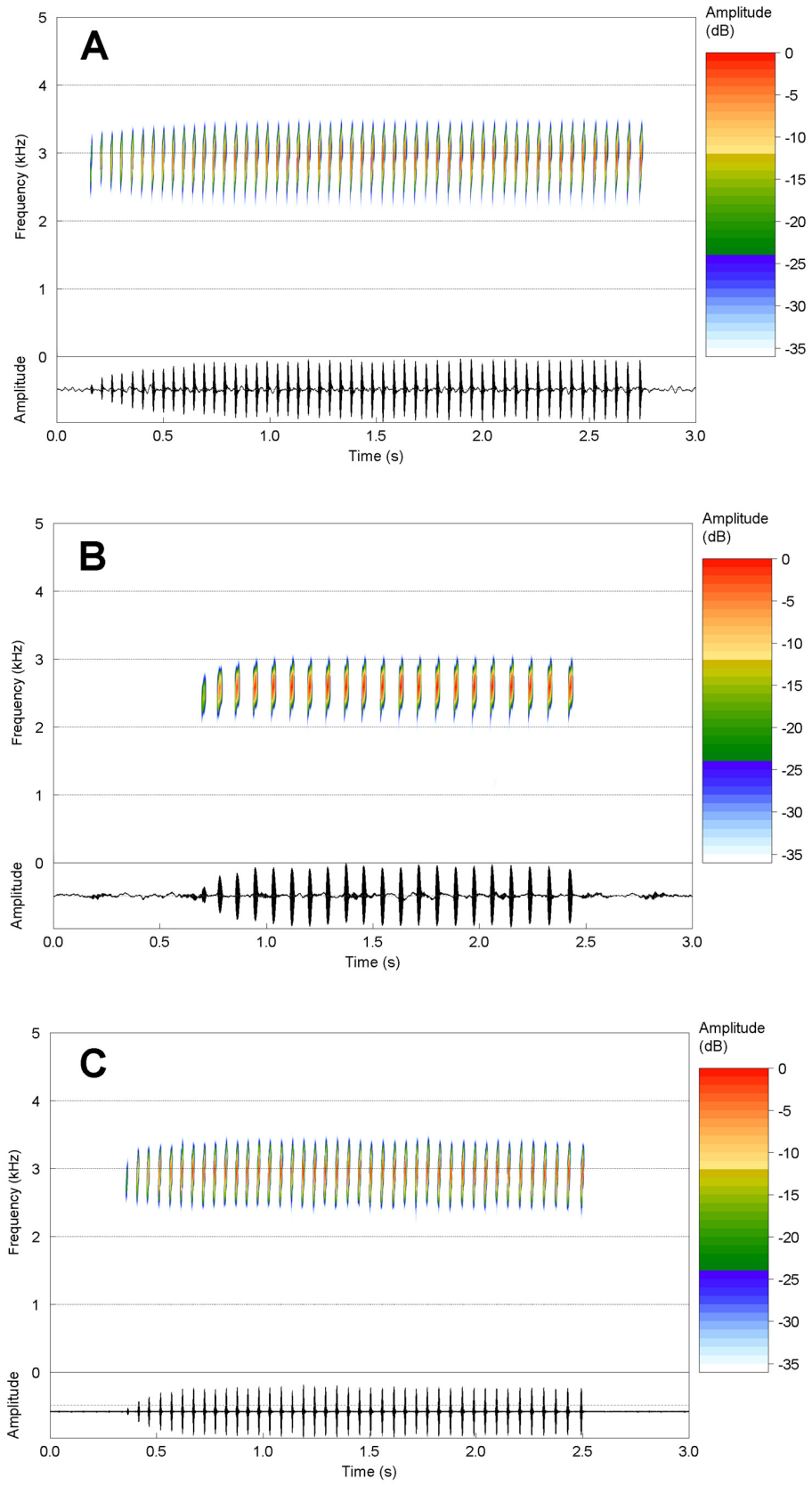

FIGURE 6. Audiospectrograms (above) and corresponding oscillograms (below) of (A) a 52-note advertisement call of *Leptodactylus oreomantis* **sp. nov.** from the Serra das Almas, Municipality of Rio de Contas, State of Bahia; (B) a 21-note advertisement call of *L. cunicularius* from the Municipality of Santana do Riacho, State of Minas Gerais; and (C) a 41-note advertisement call of *L. plaumanni* from the Municipality of Canela, State of Rio Grande do Sul. Figures generated at 256 points resolution (FFT).

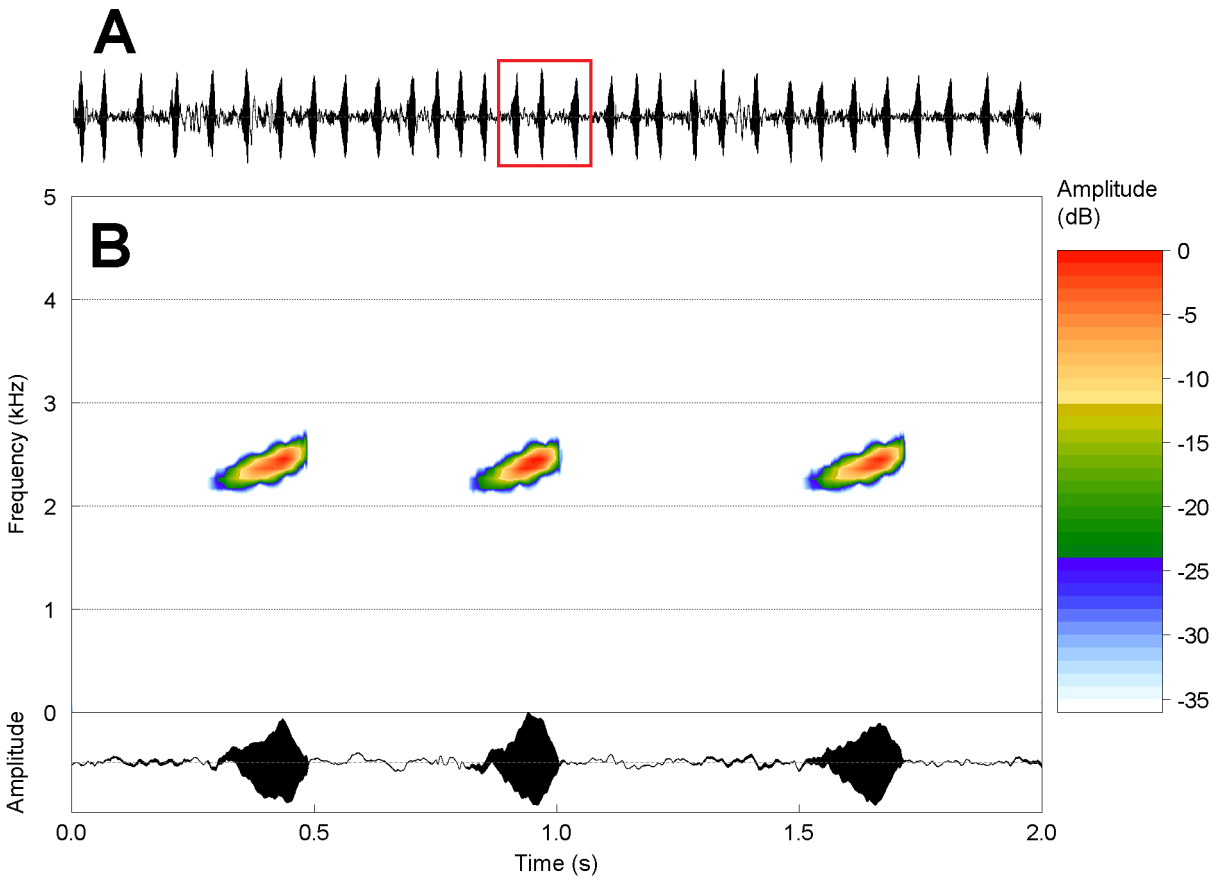

FIGURE 7. (A) Oscillogram (20 seconds) of a section of 31 advertisement calls of *Leptodactylus camaquara* from the Municipality of Santana do Riacho, State of Minas Gerais; (B) Audiospectrogram (above) and corresponding oscillogram (below) detailing three advertisement calls (15th–17th calls delimited by a red rectangle outline) of the section of 31 advertisement calls of *L. camaquara*. Figures generated at 512 points resolution (FFT).

The advertisement call of *L. camaquara* was described in its original description (Sazima & Bokermann 1978). The bioacoustic data presented in the original description concerning the call structure demonstrated a slight ascendant frequency modulation, as well as the quantitative variables of call duration, intercall interval, dominant frequency (fundamental harmonic), and the presence of three harmonics are in compliance with our data.

Acknowledgments

We are very grateful to W.R. Heyer, an anonymous reviewer, and M. Vences, whose comments and suggestions greatly improved the manuscript. We also thank B.F.V. Teixeira, L.O. Drummond, M.R. Lindemann, R.B. Mourão, P.P.D. Pinheiro, B. Imai, and L. Rodrigues for assistance in the field; R. Lee, A. Baptista, and S. Dias for guiding us to the high altitude study sites; H.C. Costa for helping with the etymology. We are indebted to A.A. Giaretta for providing sound files and specimens under his care, as well as for taking and editing some of the figures. CNPq provided F.S.F.L. with a fellowship, FAPESP conceded a research grant to T.R.C. This work was supported by Programa Biota Minas/FAPEMIG and FAPEMIG/Vale. Collection permits: ICMBio/SISBIO 29954–2 and 21185–1.

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APPENDIX 1. Additional examined specimens.

Leptodactylus albilabris—PORTO RICO (MZUSP 80255, 101832); *Leptodactylus bufonius*—ARGENTINA: FORMOSA: Matacos (MNRJ 39965); PARAGUAY: PRESIDENTE HAYES: Pozo Colorado (MNRJ 69308–69311; MZUSP 83353–83354); *Leptodactylus caatingae*—BRAZIL: BAHIA: Curaçá (MZUSP 81093–81095); PARAÍBA: São João do Cariri (MNRJ 38307–38308, 40825–40827); *Leptodactylus camaquara*—BRAZIL: MINAS GERAIS: Jaboticatubas (Paratypes: ZUEC 1367–1368, 1438, 1670, 2086, 2528, 2571, 2845, 3361; Topotypes: ZUEC 3954); Santa Bárbara (MNRJ 72750–72751); Santana do Riacho (Paratypes: ZUEC 2271, 2478; Topotypes: AAG-UFU 0046–0047; MNRJ 38735); *Leptodactylus cunicularius*—BRAZIL: MINAS GERAIS: Jaboticatubas (Holotype: MZUSP 73685; Paratypes: CFBH 6238–6240; MNRJ 60133; MZUSP 74179–74182, 74270–74271, 74223–74225, 74228; ZUEC 1438, 1621, 3338; Topotypes: CFBH 782, 24370; MZUSP 74183–74184, 74273–74274, 86578; UFMG 2913; ZUEC 5891, 8213); Santana do Riacho (AAG-UFU 1155–1156, 3165); *Leptodactylus cupreus*—BRAZIL: MINAS GERAIS: Ervália (Holotype: MNRJ 47752; Paratypes: MNRJ 47753–47754, 50436–50438); *Leptodactylus elenae*—ARGENTINA: CHACO (MNRJ 39961–39963); BRAZIL: MATO GROSSO: Cuiabá (AAG-UFU 2119–2121); *Leptodactylus fragilis*—PANAMA (MZUSP 143063–143064); *Leptodactylus furnarius*—BRAZIL: DISTRITO FEDERAL: Brasília (AAG-UFU 2668, 3041–3042); MATO GROSSO: Alto Araguaia (AAG-UFU 1725); GOIÁS: Caldas Novas (AAG-UFU 3110, 4333–4336); MINAS GERAIS: Araguari (AAG-UFU 3169); Presidente Olegário (MNRJ 32579); Santana do Riacho (MNRJ 71930); São Roque de Minas (AAG-UFU 0063–0065); Uberlândia (AAG-UFU 0020, 2161, 2167, 2197); SÃO PAULO: Campinas (AAG-UFU 1619); Santo André, Paranapiacaba (Holotype: MZUSP 73678; Paratypes: MZUSP 74226–74227, 74230–74231, 74297–74300); *Leptodactylus fuscus*—BRAZIL: MATO GROSSO: Cuiabá (AAG-UFU 2122); MINAS GERAIS: Perdizes (AAG-UFU 2848–2854); Uberlândia (AAG-UFU 2162–2163, 2168, 2196, 2250–2251, 3077–3089); SÃO PAULO: Guararapes (AAG-UFU 2013–2015); Itatiba (AAG-UFU 2182–2183); *Leptodactylus gracilis*—BRAZIL: RIO GRANDE DO SUL: Bagé (MNRJ 82565); SANTA CATARINA: Itapema (AAG-UFU 3129); Florianópolis, Praia do Campeche (Holotype: MZUSP 56589; Paratypes: MZUSP 56590–56591); Palhoça (MNRJ 74313–74316); URUGUAY: COLONIA (MZUSP 22926); *Leptodactylus jolyi*—BRAZIL: SÃO PAULO: RIO GRANDE DA SERRA (AAG-UFU 4092–4093, 4146); *Leptodactylus labrosus*—ECUADOR: PICHINCHA (MZUSP 56374–56375); *Leptodactylus latinasus*—BRAZIL: RIO GRANDE DE SUL: Bagé (MNRJ 82570–82572); URUGUAY: ARTIGAS (MZUSP 56611–56612); MALDONADO (MZUSP 52760–52763); *Leptodactylus longirostris*—BRAZIL: AMAZONAS: Itacoatiara (MNRJ 56678); PARÁ (MZUSP 54128–54135); Porto Trombetas (MNRJ 48137, 48139, 48142); *Leptodactylus marambaiae*—BRAZIL: RIO DE JANEIRO: Restinga de Marambaia (AAG-UFU 4193; MNRJ 19950, 20088, 30932, 40745); *Leptodactylus mystaceus*—BRAZIL: ACRE: Rio Branco (AAG-UFU 4197); AMAZONAS: Itacoatiara (MNRJ 56708–56714; MZUSP 57355, 60129); PARÁ: Altamira (ZUEC 5772, 7194, 7197, 7218, 7228, 7250, 7326, 7399, 14928, 14973, 15012); RONDÔNIA: Cacoal (AAG-UFU 2560); *Leptodactylus mystacinus*—BRAZIL: BAHIA: Piatã (AAG-UFU 1686); MINAS GERAIS: Uberlândia (AAG-UFU 3064–3076); RIO GRANDE DO SUL: Santa Maria (MNRJ 18762); *Leptodactylus notoaktites*—BRAZIL: SÃO PAULO: Iporanga (Holotype: MZUSP 25428); Ribeirão Branco (MNRJ 19347–19355); *Leptodactylus plaumanni*—BRAZIL: SANTA CATARINA: Rancho Queimado (MNRJ 72228, 72475–72477); *Leptodactylus poecilochilus*—COSTA RICA (MZUSP 101585; ZUEC 18743); *Leptodactylus sertanejo*—BRAZIL: GOIÁS: Alto Paraíso de Goiás (AAG-UFU 0764–0765, 1342–1345, 3124); MINAS GERAIS: São Roque de Minas (AAG-UFU 0059, 0067–0075); Uberlândia (Paratypes: AAG-UFU 3107–3108; Topotypes: AAG-UFU 4654–4657, 4946); *Leptodactylus spixi*—BRAZIL: BAHIA: Ilhéus (MNRJ 1724, 9300–9302); MINAS GERAIS: Marliéria (MZUSP 150080–150081); RIO DE JANEIRO: Teresópolis (MZUSP 101297); *Leptodactylus tapiti*—BRAZIL: GOIÁS: Alto Paraíso de Goiás (Holotype: MZUSP 73680; Paratypes: MZUSP 74308–74313, 74087–74099; Topotypes: AAG-UFU 0868–0871); *Leptodactylus troglodytes*—BRAZIL: BAHIA: Jaborandi (MNRJ 62306–62323); MINAS GERAIS: Janaúba (AAG-UFU 1075–1076); PERNAMBUCO: Igarassu (MNRJ 57873); *Leptodactylus ventrimaculatus*—ECUADOR: PICHINCHA (MZUSP 77040–77042, 57687).

APPENDIX 2. Sound files.

Leptodactylus oreomantis—Leptod_oreomPicodasAlmasBA2aFSFLm660; 20:30; 12 January 2010; Rio de Contas, Bahia, Brazil; air 20.0°C.

Leptodactylus camaquara—Leptod_camaqCipoMG4cTRC_AAGmt; 18:24, 20 November 2010; Parque Nacional da Serra do Cipó, Minas Gerais, Brazil; air 18.0°C.

Leptodactylus cunicularius—Leptod_cuniculCipoMG5AAGb; 18:45, 04 December 2005; Santana do Riacho, Minas Gerais, Brazil; air 17.9°C. Sound file ceded by Ariovaldo A. Giaretta.

Leptodactylus plaumanni—Leptod_plaumAAG17; 19:40, 31 December 1997; Canela, Rio Grande do Sul, Brazil; air 20.0°C. Analogue recording. Sound file ceded by Ariovaldo A. Giaretta.