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A new "Bat-Voiced" species of *Dendropsophus* Fitzinger, 1843 (Anura, Hylidae) from the Amazon Basin, Brazil

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Abstract

We describe *Dendropsophus ozzyi* **sp. nov.**, a new species of treefrog, tentatively included in the *Dendropsophus microcephalus* Group and most notably diagnosed by the presence of pointed fingers and an advertisement call with a very high dominant frequency. The new species is known from three localities in the Brazilian Amazon forest, two on western State of Pará and one (the type locality) in eastern State of Amazonas (03°56'50"S and 58°26'36"W, 45 m a.s.l.).

Key words: Advertisement call, Amazonia, Dendropsophini, *Dendropsophus microcephalus* Group, taxonomy

Introduction

Treefrogs of the genus *Dendropsophus* Fitzinger 1843 form a speciose clade within the subfamily Hylinae (see Faivovich *et al.* 2005), with nearly 100 valid nominal species (Frost 2014). The genus is widespread through Central and South America, occurring in open and forested areas from southern Mexico to central Argentina and Uruguay. The species-level taxonomy within several groups of this genus is rather complicated (e.g., Duellman 1982; Moravec *et al.* 2008) and in many instances renders diagnoses and descriptions of new species a daunting task. However, while some species are quite similar or even nearly indistinguishable from several others (see Jungfer *et al.* 2010), some recently described species can be conspicuously distinct and easily diagnosable (e.g., *D. frosti* Motta *et al.* 2012 and *D. manonegra* Rivera-Correa and Orrico 2013). Therefore, albeit molecular tools have been a great advance in discovering and understanding the biodiversity as a whole (e.g., Bickford *et al.* 2007), in

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Dendropsophus, morphology and acoustic analyses still play their role as discovery operations in taxonomy, and play it well.

Amazonia harbors a great diversity of frogs (Bass *et al.* 2010), including many species of *Dendropsophus* (e.g., Duellman 1978). Several sites may host many syntopic species—Iquitos, in Peru, harbors 16 *Dendropsophus* species (Rodriguez & Duellman 1994)—and there are many areas lacking proper collection effort (Ávila-Pires *et al.* 2010; Peloso 2010). However, even well sampled localities (e.g., Leticia, in Colombia) still present us with new, remarkably distinct species (see Motta *et al.* 2012). Herein, we describe one of such distinct species, found in three localities of the Brazilian Amazonia.

Material and methods

We collected specimens from Floresta Nacional de Pau-Rosa, municipality of Maués, State of Amazonas, Brazil, and from the municipality of Juruti, State of Pará, Brazil (Figs. 1–2). Additional specimens examined for comparisons are listed in Appendix I. All examined material is deposited in the following collections: Celio F. B. Haddad Amphibian Collection, Departamento de Zoologia, Universidade Estadual Paulista, Campus de Rio Claro, State of São Paulo, Brazil (CFBH); Universidad Nacional de Colombia, Instituto de Ciencias Naturales, Museo de Historia Natural, Bogotá, Colombia (ICN); Instituto Nacional de Pesquisas da Amazônia, Manaus, State of Amazonas, Brazil (INPA-H); Jorge Jim Private Collection, Departamento de Zoologia, Universidade Estadual Paulista, Campus Botucatu, State of São Paulo, Brazil (JJ) [now at MNRJ]; Museu de Ciências Naturais, Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, State of Minas Gerais, Brazil (MCNAM); Museu Nacional, Rio de Janeiro, State of Rio de Janeiro, Brazil (MNRJ); Coleção Herpetologica Oswaldo Rodrigues da Cunha, Museu Paraense Emílio Goeldi, Belém, State of Pará, Brazil (MPEG); Museu de Zoologia da Universidade de São Paulo, São Paulo, State of São Paulo, Brazil (MZUSP); Museu de Zoologia, Universidade Federal da Bahia, Salvador, State of Bahia, Brazil (UFBA); Universidade Federal do Mato Grosso, Cuiabá, State of Mato Grosso, Brazil (UFMT); National Museum of Natural History, Division of Amphibians and Reptiles, Washington, D.C., USA (USNM); Museu de História Natural, Universidade Estadual de Campinas, Campinas, State of São Paulo, Brazil (ZUEC). Additionally, TG states for Taran Grant field numbers.

Individuals from Maués and Juruti were euthanized in a 0.25% chloretone solution or with Benzotop (benzocaine 20%) respectively. Specimens were fixed in a 10% formaldehyde solution and stored in 70% ethanol within one to five days of fixation.

Advertisement calls of specimens from Maués were recorded with a Marantz PMD620 digital recorder using the internal, built-in, microphone, with 24 bits resolution, 44 kHz sampling frequency. We used the software Raven, version 1.5 (The Cornell Lab of Ornithology, available from http://www.birds.cornell.edu/raven.) for bioacoustic analyses. Recordings were labeled "Pedro Luiz Peloso Digital Recordings" (PLPDR) and deposited at Coleção Sonora UNESP-Rio Claro, Universidade Estadual Paulista, Campus Rio Claro, São Paulo, Brazil. Spectral analyses were performed based on Fast Fourier transformations with a resolution of 256 points. Parameters measured were: note duration (milliseconds, ms; measured from the audiospectrogram, with doubtful limits checked on the waveform); interval between notes (ms); and dominant frequency of the note (Hertz, Hz; Max Frequency in Raven 1.5). Advertisement call terminology follows Duellman & Trueb (1986); the exception is the determination of calls by phases (monophasic, biphasic/diphasic, etc) that account for the amount of distinct notes in the call (see Duellman, 1970, and Littlejohn & Harrison 1985).

For measurements, we used digital calipers under a stereomicroscope (to the nearest 0.1 mm). Morphological terminology follows Duellman (1970). Webbing formulas follow Savage and Heyer (1967; 1997), although finger notation (numbered II–V) follows the proposal of Fabrezi (1992). Abbreviations used throughout the text are: SVL (snout-vent length), HL (head length), HW (head width), ED (eye diameter), TD (tympanum diameter), IOD (interorbital distance), END (eye-nostril distance), ELW (eyelid width), THL (thigh length), TL (tibia length), and FL (foot length). Measurements are those of Duellman (1970) and Heyer *et al.* (1990).

Sex and maturity were determined by examination of secondary sexual characters (i.e., presence of vocal slits, expansion of the vocal sac, and presence of nuptial pads in males). Illustrations were made with a drawing tube attached to a stereomicroscope. Color and pattern descriptions of live specimens are based on photographs taken in the field and on field notes.

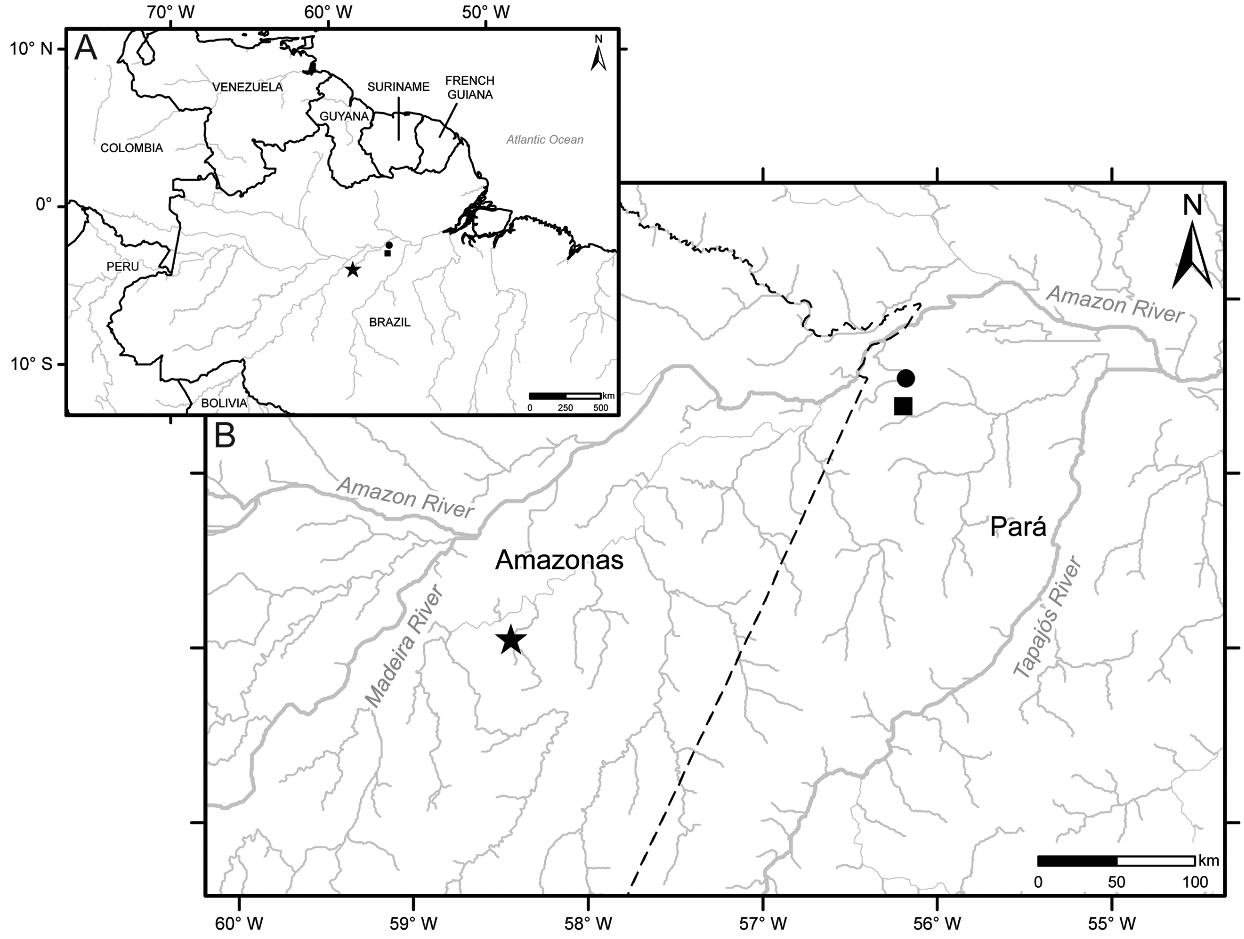

FIGURE 1. Distribution of *Dendropsophus ozzyi* **sp. nov.** (A) Amazon region (B) a close-up of the Rio Madeira–Rio Tapajós interfluve evidencing known occurrence of the new species in the States of Amazonas and Pará. Star (type locality) = Comunidade Bragança, Rio Paraconi, Floresta Nacional de Pau-Rosa (FNPR), Maués, Amazonas, Brazil. Circle = Igarapé Prudente, Juruti, State of Pará, Brazil. Square = Igarapé Mutum, Juruti, State of Pará, Brazil.

Description of the new taxon

Dendropsophus ozzyi, new species

(Figs. 3–6)

Holotype: MPEG 27811, an adult male, collected on vegetation of pond within the forest, at Comunidade Bragança, Rio Paraconi, Floresta Nacional de Pau-Rosa (FNPR), Maués, State of Amazonas, Brazil (03°56’50”S and 58°26’36”W, 45 meters above sea level [m a.s.l.]) on 25 February 2009, by M.J. Sturaro and P.L.V. Peloso (Figs 3–4).

Paratopotypes: MPEG 27809–27814, five adult males, collected on 20 February to 03 March 2009, other data same as holotype.

Paratypes: INPA-H 32742–32748, seven adult males on 23 June 2010, and 21 March 2011; CFBH 35760 and 35761, two adult males, on 23 June 2010, all collected by M. Gordo; MPEG 22400–22404, four adult males and one adult female, on 07 March 2008, collected by S. Neckel-Oliveira and H. F. Silva-Filho; all from Igarapé Prudente (02°27'13.03"S; 56°10'54.14"W), Juruti, State of Pará, Brazil. CFBH 35762–35763, two adults males, on 19 march 2011; CFBH 35764, an adult male, on 7 May 2013; MZUSP 154084–154088, five adult males, on 19 March 2011; MNRJ 86921–86925, five adult males, on 07 May 2013, all collected by M. Gordo; MPEG 22352–22355, three adult males and one adult female, on 08 March 2008, collected by S. Neckel-Oliveira and H. F. Silva-Filho; all from Igarapé Mutum (02°36'46.09"S; 56°11'38.53"W), Juruti, State of Pará, Brazil.

FIGURE 2. Three sites at Igarapé Mutum, Juruti Municipality, State of Pará, Brazil, where *Dendropsophus ozzyi* **sp. nov.** was collected. Photographs taken on 15 December 2013.

Generic placement: We assign the new species to the genus *Dendropsophus* on the basis of its overall morphological similarity with other species of the genus (Figs. 3–6). Overall morphology (particularly the combination of size, dorsum color, and flash colors) and advertisement calls of *D. ozzyi* are similar to those of species assigned to the *D. microcephalus* Group. Within this group, the new species is most similar to *D. shiwiarum* Ortega-Andrade and Ron 2013 because both species are unique in having pointed discs (Ortega-Andrade & Ron 2013). *Dendropsophus shiwiarum* is assigned to the *D. microcephalus* Group largely due to its resemblance to *D. riveroi* (Ortega-Andrade & Ron 2013); the later was, however, originally assigned to the *D. minimus* Group and only recently shown to be part of the *D. microcephalus* Group (Fouquet *et al.* 2011). For the above reasons, we tentatively assign *D. ozzyi* to the *D. microcephalus* Group.

We could not evaluate the putative morphological synapomorphies of the genus suggested by Faivovich *et al.* (2005) and we do not know the number of chromosomes for the species described here; a diploid number of 2N = 30 seems to be a synapomorphy for the genus (Suarez *et al.* 2013). We were also unable to check the proposed larval synapomorphies for the *D. microcephalus* Group (Duellman & Trueb, 1983; Faivovich *et al.* 2005), as no tadpoles have been collected. Thus, we remark that a formal test of the relationships of *D. ozzyi* is still lacking.

Diagnosis. *Dendropsophus ozzyi* is diagnosable by the following combination of character states: (1) a medium sized member of the *Dendropsophus microcephalus* Group, (SVL 18.5–21.5 mm in adult males, N = 37); (2) head wider than body; (3) snout truncate in dorsal and lateral views; (4) nostrils protuberant; (5) large prominent eyes (EL/HW 0.3–0.5, N = 37); (6) nictitating membrane bearing brownish pigmentation on its border; (7) small tympanum (TD/ED 0.3–0.5, N = 37); (8) axillary membrane present; (9) glandular nuptial pads on finger II; (10) hands webbing formula II 2^{-} – 2^{-} III 2^{-} – 2^{-} IV 2^{+} – 2^{+} V; (11) feet webbing formula I 2 – 2^{+} II 1^{+} – 3^{-} III 1^{+}– 2^{+} IV 2^{+} – 1^{+} V; (12) fingers and toes bearing pointed discs; (13) no inner tarsal fold; (14) calcar tubercle absent, heel with small, inconspicuous tubercles; (15) a dorsal sheath covering 1/3 of the cloacal opening; (16) in life, dorsal surfaces plain light brown with randomly distributed dark smudges; palmar, plantar and ventral surfaces of the axillary membrane, thigh, and shank vivid orange, belly creamy white with clear white spots and a rectangular bright white area, gular region orangish cream with brown flecks, vocal sac transparent; (17) advertisement call composed of a single, not pulsed, tonal, and highly pitched (dominant frequency around 9 kHz) note.

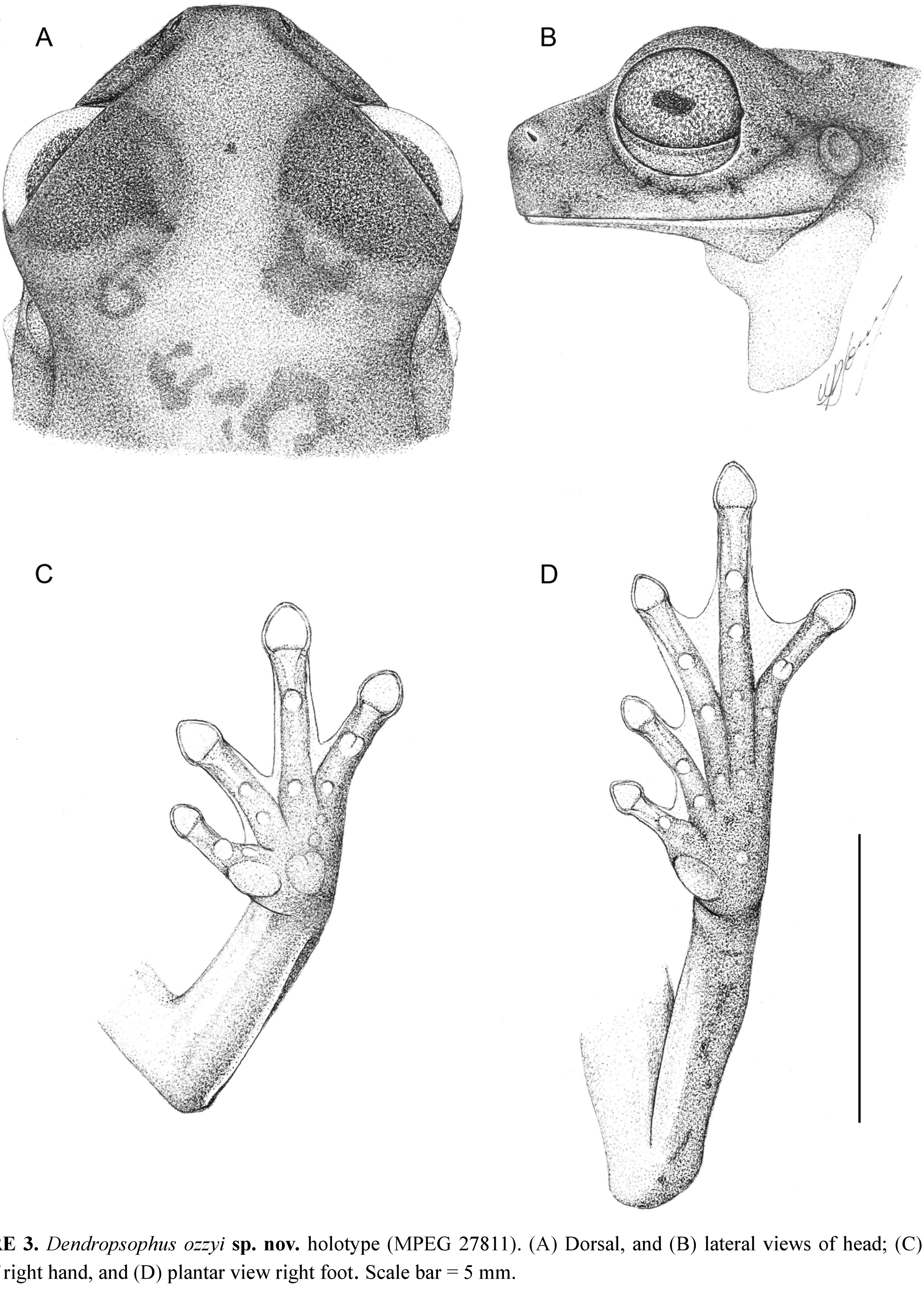

FIGURE 3. *Dendropsophus ozzyi* **sp. nov.** holotype (MPEG 27811). (A) Dorsal, and (B) lateral views of head; (C) palmar view of right hand, and (D) plantar view right foot. Scale bar = 5 mm.

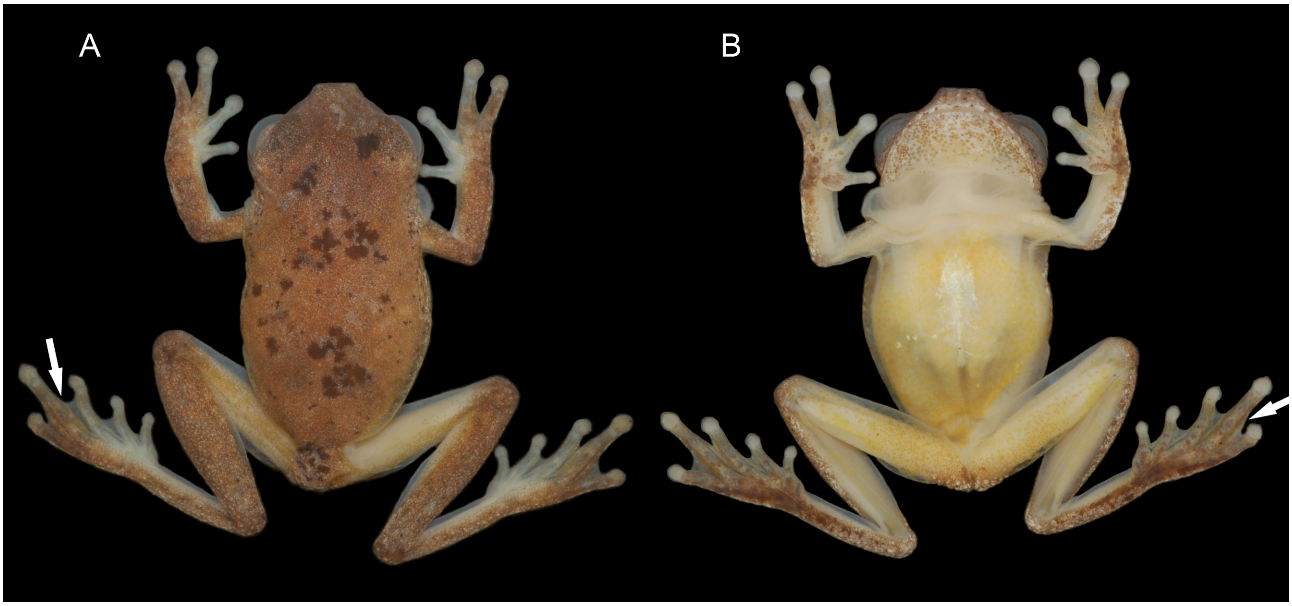

FIGURE 4. *Dendropsophus ozzyi* **sp. nov.** holotype (MPEG 27811). (A) Dorsal and (B) ventral views of the body. SVL = 19.6 mm. Arrowheads point to the glandular patch of Toe IV.

Comparison with other species. *Dendropsophus ozzyi* differs from all other species of *Dendropsophus*, except *D. shiwiarum*—also in the *D. microcephalus* Group—by having pointed discs on fingers and toes. In the following paragraphs we first diagnose our new species from *D. shiwiarum* and then provided additional diagnostic characters that differentiate *D. ozzyi* from all other species of the genus arranged by species groups.

Dendropsophus ozzyi differs from *D. shiwiarum* by (character states of the later in parenthesis; all retrieved from Ortega-Andrade and Ron 2013) by the absence of dark brown interorbital, canthal, and post-orbital stripes extending to mid-flank (present); absence of suborbital bars or spots (present); shanks not presenting bars (present); gular region (and not the vocal sac) orangish cream with brown flecks (bright yellow, unflecked); by the absence of a distinct supratympanic fold (present). These species also differ by their color in life, while *D. ozzyi* presents vivid orange flash colors, *D. shiwiarum* presents "fleshy white" (sic) flash colors. "Fleshy" can be interpreted as a variety of colors, including orange. From pictures in Ortega-Andrade & Ron (2013) we understand that the color in *D. shiwiarum* is better described as pinkish-white.

Morphometrically, *Dendropsophus shiwiarum* and *D. ozzyi* are distinguishable by their eye-to-nostril distance (EN = 1.2–1.8 in *D. shiwiarum* and EN = 2.31–2.37 mm in *D. ozzyi*). Advertisement calls of the two species differ by the longer duration of *D. ozzyi* (248 ms *vs*. 52.83 ± 31.87 ms of *D. shiwiarum* [original description does not present range]) and especially by the higher dominant frequency of *D. ozzyi* (9130.1–10136.7 Hz *vs*. 3983.6–5254.1 Hz of *D. shiwiarum*).

From other species of the *Dendropsophus microcephalus* Group, *D. ozzyi* is distinguished from species of the *D. rubicundulus* Clade *sensu* Faivovich *et al.* (2005) (traits of the later in parentheses) by the stouter body (body slender), light brown dorsum in live and preserved specimens (dorsum dark green in life and violet in preserved specimens) with unaligned spots (stripes or aligned spots). From species of the *D. decipiens* Clade *sensu* Faivovich *et al.* (2005) by the absence of dorsal patterns (all species framed, except *D. berthalutzae* that presents an '><' or an 'X') (Pugliese *et al.* 2000).

The simple (monophasic) advertisement call also distinguishes *D. ozzyi* from most *Dendropsophus* species (see below). The high dominant frequency distinguishes *D. ozzyi* from all other congeners (Table 2), except from *D. minusculus* (9020–9360 Hz see Duellman & Pyles 1983) although call duration of *D. ozzyi* is much longer [165–386 ms vs. 10–46 ms (Duellman & Pyles 1983; Lescure & Marty 2000 respectively)].

Dendropsophus ozzyi is distinguished from species of the *D. columbianus* Group by the smaller SVL [combined SVL = 21.1 mm in *D. columbianus*, to 33.5 mm in *D. bogerti* (data of both species from Cochran & Goin 1970)], except that the maximum SVL of *D. ozzyi* is 0.5 mm longer than the minimum SVL of *D. columbianus*. Apart from that, members of the *D. columbianus* Group have flecked or marbled bellies, and dorsum with dark spots (Duellman 1989; Rivera-Correa & Gutiérrez-Cárdenas 2012). Additionally, advertisement calls of species of the *D. columbianus* Group are diphasic (see Duellman & Trueb 1983) while *D. ozzyi* has a simple call.

Dendropsophus ozzyi is also smaller than species of the *D. garagoensis* Group [combined SVL ranges from 21.3 mm in *D. virolinensis* (see Kaplan & Ruiz-Carranza 1997) to 31.5 mm in *D. praestans* (see Duellman & Trueb 1983) specimens], except that the maximum SVL of *D. ozzyi* is 0.2 mm larger then the minimum SVL of *D. virolinensis* (21.3 mm). Species of the *D. garagoensis* Group also present different dorsal patterns, with paramedial white lines and dark blotches in the flanks (both traits absent in *D. ozzyi*) (Kaplan 1991; 1997; Kaplan & Ruiz-Carranza 1997). To date, advertisement calls of the *D. garagoensis* Group are unknown.

From species of the *D. labialis, D. marmoratus* and *D. parviceps* Groups, the new species differs by the homogeneous light brown dorsum whereas (green in life fading to gray in preserved specimens in the *D. labialis* Group and lichenous, both in life and in preserved specimens, in the *D. marmoratus* and *D. parviceps* Groups). From the *D. labialis* and *D. marmoratus* Groups by the smaller SVL [combined SVL ranging from 27.5 mm in *D. melanargyreus* (VGDO unpub. data) to 61 mm in *D. labialis*, (from Guarnizo *et al.* 2012)]. Species of the *D. marmoratus* and *D. parviceps* Groups have black flash colors [species of the *D. parviceps* Group with or without bright yellow spots (see Duellman & Crump 1974)], and species of the *D. labialis* Group have blue colors (e.g., Guarnizo *et al.* 2012), while *D. ozzyi* has orange flash colors. Additionally, many species of the *D. marmoratus* and *D. parviceps* Groups have suborbital bars (e.g., Duellman & Crump 1974; Lutz & Bokermann 1963). These character states also distinguish *D. ozzyi* from *D. yaracuyanus,* a species without formal assignment to a species group (Mijares-Urrutia & Rivero 2000) but quite similar to species of the *D. parviceps* Group. Additionally, calls of species of the *D. parviceps* Group are complex (e.g., Amezquita & Hodl 2004; Duellman & Crump 1974; Marquez *et al.* 1993) while *D. ozzyi* has a simple call. Calls of the *D. labialis* (Guarnizo *et al.* 2012) and *D. marmoratus* Group (Orrico *et al.* 2009) are longer and have much lower dominant frequencies.

Dendropsophus ozzyi is smaller than species of the *D. leucophyllatus* Group [combined SVL ranging from 23 mm in *D. bifurcus* (see Kaplan & Ruiz-Carranza 1997) to 40 mm in *D. anceps* specimens (see Duellman & Trueb 1983)]. Exceptions are *D. rossalleni* [19–22.3 mm (De la Riva & Duellman 1997)] and smaller individuals of *D. elegans* [20 mm (Lutz, 1973)] as *D. ozzyi* reaches a maximum SVL of 21.5 mm. Additionally, *D. ozzyi* does not have any interorbital bar or blotch of different color of the dorsum ground color, as observed in all species of the *D. leucophyllatus* Group. Furthermore, species of the *D. leucophyllatus* Group have pectoral glandular patches—a likely synapomorphy for the group (see comments in Rivera-Correa & Orrico 2013)—which are absent in *D. ozzyi* Additionally, species of the *D. leucophyllatus* Group present diphasic calls (e.g., Conte *et al.* 2010; Jungfer *et al.* 2010; Marquez *et al.* 1993) while *D. ozzyi* presents a monophasic call.

Dendropsophus ozzyi is distinct from species of the *D. minutus* Group by possessing a small cloacal sheath partially covering the cloaca (long cloacal sheath covering entirely the cloaca in *D. minutus* Group) and by the absence of white supracloacal and tarsal lines (present in species of the *D. minutus* Group). These traits also distinguish *D. ozzyi* from *D. stingi* and *D. amicorum* that present such structure and are quite similar to species of the *D. minutus* Group although not assigned to any species group in the original description (see Kaplan 1994; Mijares-Urrutia 1998). These same traits also distinguish *D. ozzyi* from *D. aperomeus*, a species of the *D. minimus* Group (Duellman 1982).

The *Dendropsophus minimus* Group has been consistently recovered as paraphyletic but to date it is still recognized because *D. minimus* has never been included in a phylogenetic analysis (Fouquet *et al.* 2011); therefore, the status of the group name remains unclear (Frost 2014). We group the comparisons of *D. ozzyi* with the remaining species still associated with this possibly paraphyletic arrangement for convenience only, however, not formally recognizing it. *Dendropsophus minimus* presents a concealed tympanum (clearly visible in *D. ozzyi*) a clear tarsal fold (absent in *D. ozzyi*), a rostral white line (absent in *D. ozzyi*) and a different dorsal pattern (Ahl 1933). *Dendropsophus miyatai* presents a concealed tympanum (visible in *D. ozzyi*), a bright red over bright yellow, dorsal pattern in life (light brown in *D. ozzyi*), and absence of fimbriae on hind limbs (present in *D. ozzyi*) (Vigle & Goberdhan-Vigle 1990). Additionally, calls of the *D. minutus* Group are complex, diphasic or even triphasic (e.g., Cardoso & Haddad 1984; Duellman 1978; Heyer *et al.* 1990; Kohler & Lotters 2001b; Marquez *et al.* 1993; Morais *et al.* 2012) while *D. ozzyi* has a simple, monophasic, call.

The following comparisons pertain to species of the genus not assigned to a group (Faivovich *et al.* 2005). *Dendropsophus ozzyi* differs from *D. haraldschultzi* by presenting a light brown smooth dorsum while *D. haraldschultzi* has a grayish cream dorsum with thin longitudinal stripes composed of small dots and with a series of glands, more densely distributed over the head (Bokermann 1962). From *D. battersbyi*, *D. ozzyi* can be distinguished mainly by the smaller SVL—males of *D. ozzyi* range between 19.45–21.53 mm *vs*. 33 mm of the male holotype of *D. battersbyi*, and by different overall coloration; while *D. battersbyi* is gray and minutely dotted with reddish brown on all the upper and lower surfaces except the forelimbs and belly, *D. ozzyi* is light brown. *Dendropsophus battersbyi* presents a dark canthal and supratympanic streak, loreal region whitish with dark dots, limbs crossbarred and a pair of callous, white spots on the buttocks—features absent in *D. ozzyi* (see Rivero 1961). *Dendropsophus tintinnabulum* presents a concealed tympanum (visible in *D. ozzyi*) and a white line dividing the dorsum from the flanks in preservative (VGDO observation on the syntypes). In life, *D. tintinnabulum* presents a grayish green dorsum and the venter is bluish green (Melin 1941); *D. ozzyi* has a light brown dorsum and the venter is orange and white.

Description of holotype: Adult male, SVL 19.4 mm; head wider than long (HW/HL 1.18), widest below eyes; snout truncate in both dorsal and lateral views, eye-nostril distance longer than eye diameter (END/ED 1.17); canthus rostralis indistinct, straight; loreal region slightly concave; lips thin; internarial area slightly depressed; nostrils protuberant, directed dorsolaterally; interorbital area flat; IOD/ED 1.48, IOD/HW 0.49; eyes large and protuberant (ED/HL 0.40, ED/HW 0.33); ELW 1.38 mm. Pupil horizontally elliptical; nictitating membrane transparent, its border slightly pigmented in the same pattern of the eyelid. Supratympanic fold barely visible, semi-circular in outline, less visible on the posterior portion; tympanum small (TD/HL 0.17), distinct, nearly round, separated from eye by a distance of 1.3 tympanum diameter; choanae small, oval, not concealed by palatal shelf of maxillary arch; vomerine odontophores very small, the right bearing two small, unaligned teeth while the left bears three; tongue cordiform, notched behind, posterior 1/3 not adhered to floor of mouth; vocal slits long, extending from midlateral base of tongue to almost the angle of jaws; vocal sac developed, single, and subgular, extending over the forearm (Figs. 3–4).

Arm slender, not hypertrophied; axillary membrane reaching half arm, delimited by the *m. pectoralis portio axillaris* (seen by transparency). Lateral border of arm with fimbria composed of small tubercles, not all clearly individualized. Fingers short, bearing discs; finger discs are slightly pointed, albeit disc of Finger II is slightly less, close to round; relative length of fingers II < III < V < IV; subarticular tubercles less wide than the digits, round on all fingers, bifid on penultimate articulation of Finger IV, most prominent on fingers II, III and IV; supernumerary tubercles present; inner metacarpal tubercle flat, elliptic; outer metacarpal tubercle bifid, nearly not visible; glandular nuptial pad covering the area corresponding to the prepollex in mesial view; webbing basal between fingers II and III; webbing formula II 2^-–2^- III 2^-–2^- IV 2^+–2^+ V (Fig. 3C).

Hind limb long and slender (TL/SVL 0.53); no tarsal fold, but outer margins of tarsus and feet with fimbriae similar to the one found in arm; calcar tubercle absent, heel with small, inconspicuous tubercles; toes bearing pointed discs, smaller than those on fingers; feet slightly dehydrated, right one more than the left; relative lengths of toes I < II < III < V < IV; subarticular tubercles, round, bifid on penultimate articulation of Toe V, shallow; small supernumerary tubercles present on toes III and IV; inner metatarsal tubercle flat, elliptical; outer metatarsal tubercle indistinct, nearly not visible; webbing formula I 2–2^+ II 1^+–3^- III 1^+–2^+ IV 2^+–1^+ V. Toe IV bears a gland, visible at both dorsal and ventral views at the level of subarticular tubercles II and III; dorsally, a glandular patch is visible on Toe III (Fig. 4).

Skin on dorsum, head, dorsal surfaces of forearms and thighs, flanks and groin smooth, finely shagreen on head, shank and tarsus; skin on belly and ventral surfaces of thighs granular. Cloacal opening directed posteriorly, above the thighs, covered by a small cloacal sheath dorsally; cloacal tubercles absent. Pectoral region, belly, ventral surfaces of forearm and thigh with many minute acini filled with dark yellow secretion. Pectoral acini not arranged as a glandular patch; loosely distributed over the area (Fig. 4)

Coloration in preservative: All dorsal surfaces yellowish brown, except thighs, fingers II, III, IV and toes I, II, III, IV that are cream. Dorsal ground color is darker at the head, fading posteriorly. Dorsum bears 13 brown smudges of irregular shape. Canthus rostralis, eyelid and the anterior third of the flanks have brown and white markings. Iris black with many minute silver spots of variable diameters. Ventral areas creamy white, except for the submandibular area that bears various brown flecks, palmar and plantar surfaces have a pattern resembling the dorsal pattern. The belly also presents a bright white rectangular area, roughly covering the area of the sternum. Dissections of paratype CFBH 35764 demonstrated that it is a layer of iridophores at the perimysium of the abdominal muscles.

FIGURE 5. *Dendropsophus ozzyi* **sp nov.** Live male specimens: (A) MZUSP 154086, SVL = 19.8; (B) MZUSP 154086 (day coloration), SVL = 19.8; (C) MZUSP 154084, SVL = 19.3; (D) CFBH 35763, SVL = 18.8; (E) MNRJ 86923, SVL = 20.5; (F) MPEG 27810, SVL = 19.8 mm. (A)–(E) from Igarapé Mutum, Juruti, State of Pará, Brazil; (F) from Comunidade Bragança, Rio Paraconi, Floresta Nacional de Pau-Rosa (FNPR), Maués, State of Amazonas, Brazil (paratopotype).

Coloration in life (based on paratype MPEG 27810): Dorsal surfaces of head and body brown. Flanks, arms, hands (excluding fingers II to IV and finger disc of Finger V), tibia, and the external region of feet (including toes IV and V) light brown. Thighs, fingers II to IV and finger disc of Finger V, and internal region of feet (including toes I to III and toe discs of toes IV and V) vivid orange. Palmar, plantar and ventral surfaces of the axillary membrane, thigh and shank vivid orange. Ventrolateral areas of tarsus and feet dark brown. Belly creamy white with clear white spots and a rectangular bright white area (as described above). Gular region orangish cream with brown flecks. Iris copper with dark reticulations. Lateral areas of the head and flanks light brown, nearly white, composing a diffuse stripe starting at the loreal region and extending posteriorly to the groin through the trunk.

FIGURE 6. Dorsal (a) and ventral (b) color patterns of 21 preserved paratypes of *Dendropsophus ozzyi* **sp. nov.** from Juruti, Pará, Brazil. Scale bar = 20.0 mm. (1) INPA-H 32746; (2) INPA-H 32747; (3) INPA-H 32743; (4) MZUSP 154084; (5) MZUSP 154085; (6) MZUSP 154086; (7) MZUSP 154087; (8) MZUSP 154088; (9) INPA-H 32744; (10) INPA-H 32745; (11) INPA-H 32742; (12) INPA-H 32748; (13) CFBH 35760; (14) MNRJ 86921; (15) MNRJ 86925; (16) CFBH 35763; (17) CFBH 35764; (18) CFBH 357602; (19) MNRJ 86922; (20) MNRJ 86923; (21) MNRJ 86924. For additional information see Table 1 and text.

Variation. Measurements are shown in Table 1. External morphology of the type series is generally concordant with the holotype; including color (Fig. 5–6). The number and conspicuousness of ventral acini varies from nearly none (MPEG 27809) to many (MPEG 27810, 27812 and MZUSP 154087 as also do the number of clear white flecks (while MPEG 27809 has none, MPEG 27810 has many) and the iridophore area of the abdominal perimysium. Dorsal coloration varies slightly, from lighter (MPEG 27814) to darker (MPEG 27809; CFBH 35764) shades of brown. The number, shape, and position of dorsal smudges also vary from absent (MPEG 27814; MZUSP 154086) to more then 20 (MPEG 27812). Left thigh muscles of MPEG 27809, MZUSP 154084–154088, and the left foot of MPEG 27810 were removed in the field as tissue samples for molecular analyses.

Advertisement call. Most of the recordings have more than one individual calling, and in many cases it is impossible to distinguish which one is emitting the note. Nonetheless, we have measured the note duration and spectral parameters for all the notes in the best recording (PLDR 035; *N* = 11 notes from up to three distinct calling males), and only the first three notes and the intervals between them in the second recording (PLDR 036; certainly emitted by the same individual). One of the individuals in recording PLDR 036 was collected (MPEG 27814, field number FPR 205) but the calls emitted by this male are unsuitable for bioacoustical analyses (saturated recording). Nonetheless, the call can be unambiguously identified as belonging to the same species as the ones for which analyses were performed.

Analyses of recordings reveal that the advertisement call of *Dendropsophus ozzyi* consists of an unusually high-pitched single note, emitted at relatively long intervals (Fig. 7). Amplitude modulation within the note shows higher energy at the beginning of the note, with energy decreasing abruptly and then continuing with small energy for the remaining of the note duration. Note duration is 165–386 ms (mean 248 ms; N = 14), interval between notes is 1965–5183 ms (*N* = 2), and the dominant frequency is 9130.1–10136.7 Hz (mean 9560.7 Hz; *N* = 14). Notes are not clearly multi-pulsed, except for a single note with four pulses.

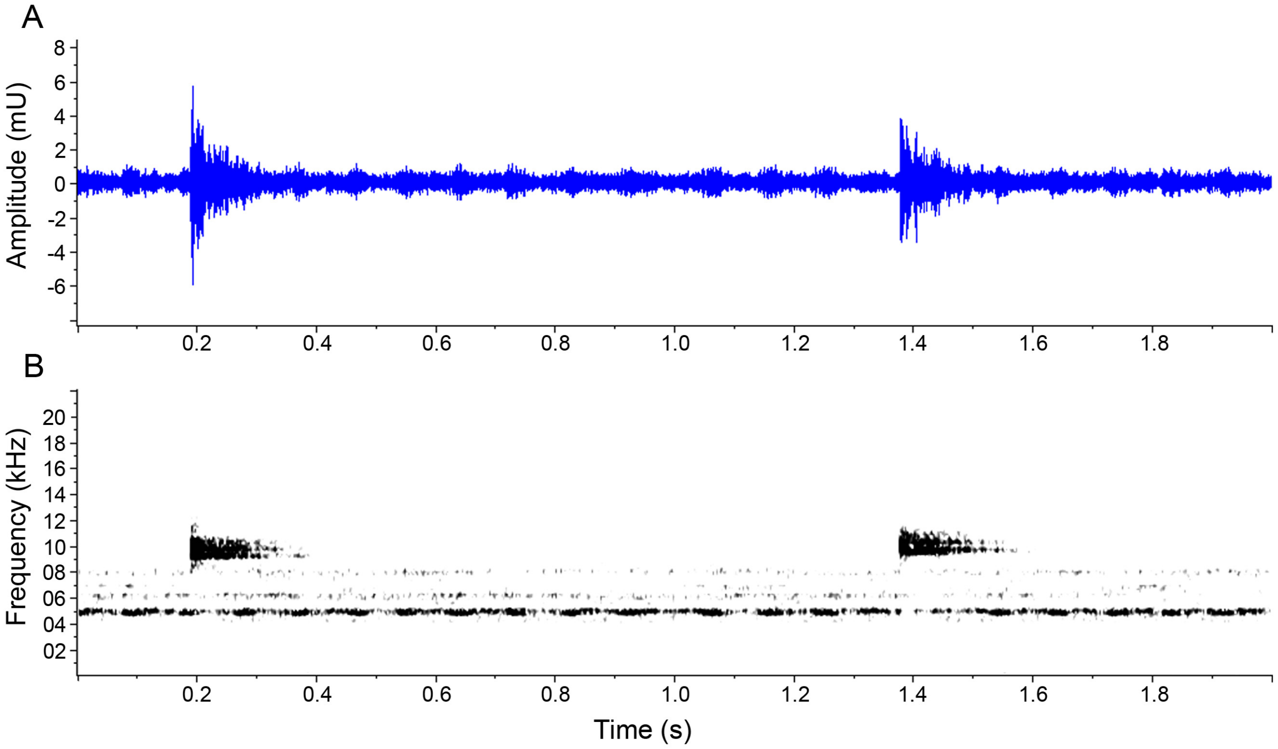

FIGURE 7. Waveform (A) and audiospectrogram (B) of advertisement calls (recording PLDR 036) of two individuals of Dendropsophus ozzyi sp. nov. from the type-locality. The first call is from paratype MPEG 27814, the second from an unvouchered specimen.

Natural history. *Dendropsophus ozzyi* was found mainly on bushes close to water bodies, such as ponds and swamps, inside Terra Firme forest. The most commonly used type of vegetation were shrubs and small trees < 5cm DBH (diameter at breast height), where individuals were observed on the leaves and branches in heights that varied from ground level (0 m) to 3.5 m, with prevalence between 1.0 and 1.5 m. No difference was observed in height of perch between sexes. Most individuals were observed 0.5 m away from water bodies. In addition, no individuals were observed farther than 5.0 m away from water bodies. Calling males were observed in the wettest months, from November to June. Time of observation varied overnight, from 18:00 to 23:00 and was more frequent

TABLE 1. Measurements of *Dendropsophus ozzyi* **sp. nov.** type-series. For abbreviations, see text.

Catalog Number	Field Number	Status	SVL	HL	HW	ED	ELW	END	IOD	TD	THL	TL	FL
MPEG 27809	FPR 105	Paratopotype	19.80	5.80	6.20	2.50	1.40	2.90	3.60	0.90	9.70	10.40	13.80
MPEG 27810	FPR 140	Paratopotype	20.00	6.50	7.20	2.60	1.40	2.50	3.60	1.40	10.80	11.10	14.10
MPEG 27811	FPR 141	Holotype	19.50	5.80	6.90	2.30	1.50	2.70	3.40	1.00	9.10	10.30	13.40
MPEG 27812	FPR 142	Paratopotype	18.50	5.70	6.50	2.30	1.50	2.90	3.60	1.10	9.60	10.10	13.30
MPEG 27813	FPR 143	Paratopotype	21.50	5.70	7.10	2.90	1.50	2.90	3.60	1.40	9.70	9.70	13.50
MPEG 27814	FPR 205	Paratopotype	19.80	6.10	6.80	2.30	1.50	2.30	3.30	0.80	10.20	9.80	13.50
INPA-H 32742	J123	Paratype	18.30	6.60	6.90	3.00	1.90	2.05	2.50	1.10	10.20	10.50	13.20
MZUSP 154088	J117	Paratype	20.10	7.40	8.00	2.90	1.90	2.00	2.60	1.00	10.20	10.80	13.00
MNRJ 86925	J264	Paratype	18.10	6.80	6.50	2.90	1.50	1.90	2.50	0.95	10.20	10.20	13.20
INPA-H 32744	J121	Paratype	19.00	6.60	7.00	2.80	2.10	2.10	2.50	0.75	10.00	10.40	13.40
CFBH 35764	J205	Paratype	19.40	7.10	7.30	2.90	1.70	1.90	2.50	0.85	10.25	10.50	13.50
CFBH 35762	J129	Paratype	18.60	7.20	7.30	2.85	2.40	2.00	2.10	0.90	10.40	10.90	13.90
MNRJ 86921	J206	Paratype	20.40	7.40	7.40	3.10	1.90	1.85	2.20	1.00	10.50	10.45	13.90
CFBH 35760	J125	Paratype	18.30	7.40	7.30	3.00	1.85	1.80	2.50	0.80	10.30	10.25	13.50
MNRJ 86923	J208	Paratype	20.50	7.10	7.30	3.00	1.90	1.90	2.60	1.00	10.85	10.90	14.10
MNRJ 86922	J207	Paratype	19.20	7.00	7.10	2.65	1.60	1.90	2.20	1.20	9.70	10.40	14.10
MZUSP 154087	J116	Paratype	20.65	7.10	7.60	3.00	2.30	1.85	2.80	1.05	11.00	10.80	14.15
CFBH 35761	J126	Paratype	20.90	7.40	7.20	2.90	2.30	1.90	2.55	0.95	11.70	11.50	13.70
INPA-H 32746	J18	Paratype	19.90	6.90	7.60	2.90	2.20	2.00	2.70	0.90	11.30	11.30	14.65
MNRJ 86924	J263	Paratype	19.50	7.50	7.10	3.00	1.60	1.90	2.30	1.05	10.00	10.45	13.80
MZUSP 154086	J115	Paratype	19.80	6.80	7.70	2.85	1.90	1.80	2.40	0.90	9.90	10.40	13.35
MZUSP 154085	J114	Paratype	19.40	7.10	7.40	2.70	1.70	2.10	2.20	0.95	10.65	10.60	12.70
INPA-H 32747	J19	Paratype	19.20	6.70	6.95	3.05	2.30	1.90	2.50	0.90	10.00	10.20	13.70
INPA-H 32748	J124	Paratype	18.00	6.45	6.85	2.65	1.80	1.75	2.30	0.90	10.15	10.00	12.90
INPA-H 32743	J20	Paratype	19.90	7.20	7.50	2.90	2.10	1.90	2.85	0.90	10.40	10.40	14.35
MZUSP 154084	J113	Paratype	19.30	7.00	7.25	2.90	1.85	2.05	2.60	0.95	10.85	11.05	13.00
INPA-H 32745	J122	Paratype	17.90	6.80	6.85	2.50	1.75	1.85	2.25	1.00	10.40	10.15	13.60
MPEG 22352	JUR246	Paratype	19.70	5.80	6.20	2.50	1.39	2.90	3.50	0.80	9.80	10.50	13.60
MPEG 22353	JUR247	Paratype	19.60	5.80	6.10	2.60	1.41	2.50	3.50	0.90	9.60	10.30	13.40
MPEG 22354	JUR248	Paratype	21.30	6.60	7.10	2.80	1.50	2.90	3.60	1.40	10.40	11.10	14.10
MPEG 22355	JUR249	Paratype	18.60	5.70	6.50	2.30	1.42	2.30	3.30	0.90	9.60	10.10	13.30
MPEG 22400	JUR221	Paratype	19.80	5.70	6.20	2.40	1.43	2.30	3.70	1.10	9.70	9.70	13.50
MPEG 22401	JUR222	Paratype	21.40	6.70	7.20	2.90	1.51	2.90	3.40	1.40	10.50	11.20	14.30
MPEG 22402	JUR223	Paratype	19.90	5.70	6.20	2.50	1.42	2.40	3.30	1.10	9.60	9.90	13.10
MPEG 22403	JUR224	Paratype	18.70	5.60	6.10	2.30	1.47	2.30	3.50	0.80	9.50	9.70	13.20
MPEG 22404	JUR225	Paratype	18.60	5.60	6.10	2.40	1.45	2.50	3.30	1.20	9.50	9.80	13.20
CFBH 35762	J130	Paratype	18.75	7.20	7.45	2.95	2.20	2.00	2.45	0.95	10.70	10.90	13.80

TABLE 2. Advertisement call emission type and dominant frequency for species assigned to the *Dendropsophus microcephalus* Group.

			Dominant Frequency (kHz)			
Species	**clade**	**Call type**	*Minimum*	*Maximum*	*Average*	**Reference**
D. berthalutzae	*decipiens*	monophasic	3.7	4.7	3.8	Forti *et al.* (2012); Moura *et al.* (2012)
*D. bipunctatus**		monophasic	4.8	5.6	?	Abrunhosa *et al.* (2001)
D. branneri		monophasic	5.9	6.6	6.3	Nunes *et al.* (2007)
D. coffeus		diphasic	5.7	6	5.8	Köhler *et al.* (2005)
D. cruzi		monophasic	5.2	7	6.3	Bastos *et al.* (2003)
D. decipiens	*decipiens*	monophasic	4.7	5.2	5	Abrunhosa *et al.* (2001)
D. elianeae	*rubicundulus*	monophasic	2.9	4	3.3	Martins (2004)
D. gryllatus		diphasic	3.6	4.9	3.8	Duellman (1973)
D. haddadi	*decipiens*	monophasic	4.3	4.9	4.5	Ruas *et al.* (2012)
D. jimi	*rubicundulus*	diphasic	3.6	4.6	4	Martins & Jim (2004)
D. joannae		diphasic	6.6	7	6.9	Köhler & Lötters (2001a)
D. juliani		monophasic	3.4	4.1	3.7	Moravec *et al.* (2006)
*D. leali***		monophasic	6.1	6.7	6.4	Köhler & Lötters (2001a) and references therein
*D. meridianus****		monophasic	?	?	8	Pombal Jr. & Bastos (1998)
D. microcephalus		diphasic	5.1	6.2	5.7	Duellman (1968)
*D. minusculus*****		monophasic	9	9.3	9.2	Duellman & Pyles (1983)
D. nanus		diphasic	2.6	5.5	3.9	Martins & Jim (2003)
D. oliveirai	*decipiens*	monophasic	5.7	6.7	6.1	Santana *et al.* (2011)
***D. ozzyi* sp. nov.**		**monophasic**	**9.1**	**10.1**	**9.6**	**Present study**
D. phlebodes		diphasic	3.2	4	3.6	Duellman (1968)
D. reicheli		monophasic	6.2	6.6	6.3	Moravec *et al.* (2008)
*D. rhodopeplus***		diphasic	3.12	3.9	3.51	Duellman (1972, 1978); Marquez (1993)
D. riveroi		monophasic	4.3	5.3	4.8	Marquez *et al.* (1993)
D. robertmertensi		diphasic	5.1	5.8	5.4	Duellman (1968)
D. rubicundulus	*rubicundulus*	monophasic	?	?	4.4	Cardoso & Vielliard (1985)
D. sanborni		diphasic	3.8	5.9	5.1	Martins & Jim (2003)
D. sartori		diphasic	2.9	3.6	3.2	Duellman (1968)
D. shiwiarum		monophasic	4	5.2	4.4	Ortega-Andrade & Ron (2013)
D. tritaeniatus	*rubicundulus*	monophasic	3.9	4.5	4.2	Teixeira *et al.* (2013)
D. werneri		diphasic	6.3	7.4	6.7	Lingnau & Bastos (2003); Lingnau *et al.* (2004)

**= Abrunhosa et al. (2001) report different values in their text and table. We reproduce the largest range reported.*

= Marquez (1993) reports dominant frequencies around 120 Hz, a curiously low value. Authors also report additional emphasized frequencies of higher values that are a more robust test to our hypothesis that* D. ozzyi ***sp. nov. *has an unusually high dominant frequency. See Orrico* et al. *(2009) for a discussion on dominant frequency artifacts.*

****= Bastos & Pombal (2003) do not report which frequency is dominant, just that there are emphasized harmonics around 3 and 8 kHz. Their figure 11 depicts a call with dominant frequency around 7 kHz.*

***** Lescure & Marty (2000) and Tárano (2010) report different values (~5 kHz and 3.8 kHz respectively).*

between 19:00 and 21:00. Amplectant pairs and tadpoles were not observed. All collection sites are between the Tapajós and Madeira Rivers, and we expect more populations of D. ozzyi to be found within this area.

Etymology. The specific epithet is used as a noun in the genitive case and honors John Michael "Ozzy" Osbourne, a famous British rock singer, former vocalist of the rock band Black Sabbath, for its contribution to modern music and culture. Ozzy is commonly associated with bats because of the famous episode in which, on stage while he was performing a gig, he bit off a bat's head thrown by a fan. He later stated that he thought it was a plastic toy.

When calling, this new *Dendropsophus* species can be vaguely associated with the high pitch sounds emitted by some bat species that are hearable to the human ear. When we heard this species in the field we immediately pictured a calling bat. Because of this "bat association" we take the opportunity to name this species after one of the biggest music legends of all time.

Discussion

The advertisement call of *Dendropsophus ozzyi* is remarkable not only within *Dendropsophus* but also among anurans. Its extraordinary high dominant frequency (around 9 kHz) is similar to the one found in *Odorrana tormota* Wu, 1977 (5–10 kHz; see Feng *et al.* 2002) and *Huia cavitympanum* (Boulenger, 1893) (11–12 kHz; see Arch *et al.* 2008), the only anuran species known to communicate using ultrasound, i.e., frequencies above 20 kHz (Feng *et al.* 2006; Narins *et al.* 2004; Suthers *et al.* 2006). Although the dominant frequencies of the advertisement calls of these species are not ultrasonic, they are able to perceive and respond to ultrasonic information (Arch *et al.* 2008; Feng *et al.* 2006; Narins *et al.* 2004; Suthers *et al.* 2006). Another species, *Odorrana livida* Blyth, 1856 is also able to detect ultrasonic frequencies (Feng *et al.* 2006) but there is no evidence of ultrasonic communication to date. Unfortunately, we have not recorded *D. ozzyi* calls with the appropriate equipment for recording ultrasound. The evidence at hand suggests that *D. ozzyi* is a good candidate to also communicate using ultrasound and this possibility deserves further research. *Dendropsophus minusculus* (Rivero, 1971), another species of the *D. microcephalus* Group, is also candidate to communicate or detect ultrasounds given the similarity in dominant frequency (up to 9.3 kHz, Table 2) with the "ultrasonic" species mentioned above.

Interestingly, the ultrasound sensitivity of *Odorrana tormota* is partially related to an unusual external ear morphology with very thin tympanic membranes that are recessed in the skull at the end of the ear canals—shortening their distances to the inner ear, and resulting in reduced ossicular mass (Narins & Feng 2007). It is worth noticing that the external tympanum of *Huia cavitympanum* is also recessed (Boulenger 1893). The external tympanic morphology of *Dendropsophus ozzyi* is not unusual for *Dendropsophus* (and many other hylids). *Dendropsophus ozzyi* is significantly smaller than *O. tormota*; perhaps a recessed tympanum is unnecessary for its size. However, if ultrasonic communication in *D. ozzyi* is confirmed through behavioral tests (see Narins *et al.* 2004), histological sections and physiological tests (see Feng *et al.* 2006) should be performed to investigate possible pathways for ultrasonic detection.

Odorrana tormota and *Huia cavitympanum*, which are neither sympatric nor closely related, are found in similar habitats—rushing streams—suggesting that environmental adaptation played an important role on the development of ultrasonic communication in both species (Arch *et al*. 2008). *Dendropsophus ozzyi* was collected in lentic or low-flow waters, quite differently from *O. tormota* and *H. cavitympanum* habitats.

The unusual high dominant frequency of *Dendropsophus ozzyi* is even higher than that of several syntopic insect calls. Insect species syntopic with *D. ozzyi* present dominant frequencies ranging 5.0–8.5 kHz (see Fig. 7), values quite similar to those found in other *Dendropsophus* species (see Table 2). Some anuran species are known to modify the dominant frequencies of their advertisement calls in response to masking interferences (see Gerhardt 1999; Gerhardt & Huber 2002). Thus, the high dominant frequencies in *D. ozzyi* could be an evolutionary response to avoid this particular background noise. However, we have only found a single record in the literature of this relation between anurans and insects: *Oophaga pumilio* (Schmidt, 1857) responds to acoustic interference of cicadas (Paez *et al.* 1993).

Duellman & Fouquette (1968) recognized that calls of species related to *Dendropsophus microcephalus* would consist of primary and secondary notes, i.e. diphasic calls. Other *Dendropsophus* species, not necessarily related to *D. microcephalus*, were also reported to present diphasic calls—e.g., *D. anceps* (Lutz, 1929) assigned to the *D.*

leucophyllatus Group (see Rivera-Correa & Orrico 2013) present diphasic calls (Gomes & Martins 2006). Nevertheless, it seems clear that mono/diphasic calls present heritable, variable information given that other species of *Dendropsophus* (e.g., species from the *D. marmoratus* Group) present monophasic calls (see Orrico *et al.* 2009), as does *Xenohyla* [VGDO pers. obs. and Izecksohn & Carvalho-e-Silva (2001)], the sister taxon of *Dendropsophus* (see Faivovich *et al.* 2005). Therefore, the appearance of diphasic calls is a possible synapomorphy of internal clades of *Dendropsophus*, especially within the *D. microcephalus* Group (as well of possible secondary losses as inferred in Table 2).

The Floresta Nacional de Pau-Rosa (FNPR) is a governmental protected area of about 947,520 hectares located on the southwest portion of the state of Amazonas. Composed entirely of lowland forests, the forest coverage of the locality is—in general—very well preserved. Even with a low and concentrated effort for sampling herpetological species in the area (14 days), focused on just a few sampling sites, two of us (PLVP and MJS) found around 40 species of amphibians in the locality. Most impressive though, is the number of unnamed taxa among those species. With the present description of *Dendropsophus ozyyi* this is the fourth new species described and named from material collected therein (or nearby in Juruti municipality—see *Allobates grillisimilis* Simões *et al.* 2013, *Scinax sateremawe* Sturaro and Peloso 2014, and *Trachycephalus helioi* Nunes *et al.* 2013) and at least two other hylid frog species from that area remain to be named. This only comes to reinforce the notion of our lack of basic knowledge regarding Amazonian biodiversity and the urgent need for additional species inventories, exploratory fieldwork, and revisionary taxonomic work (Peloso 2010).

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APPENDIX I. additional material examined for comparisons.

Dendropsophus acreanus. **BRAZIL**: **Acre**: Cruzeiro do Sul: "Sede do Campus Avançado" (ZUEC 4570–74), "Vila Militar" e "Campus Avançado" (ZUEC 4653), 7° B.E.C. (ZUEC 4665), Vila Militar (ZUEC 4609-11, ZUEC 4692-93, ZUEC 8510–11). Feijó (paratype: MZUSP 74235); Tarauacá (holotype: MZUSP 74198; paratypes: MNRJ 3971, MZUSP 73719).

Dendropsophus anataliasiasi. **BRAZIL**: **Goiás**: São João da Aliaça (MNRJ 27772–5).

Dendropsophus anceps. **BRAZIL**: **Espírito Santo**: Linhares: Floresta Nacional de Goytacazes (CFBH 25156, CFBH 22999, CFBH 23000, CFBH 23066, CFBH 26549). Linhares: Povoação (CFBH 5795–804).

Dendropsophus araguaya. **BRAZIL**: **Mato Grosso**: Alto Araguaya: (paratypes: MNRJ 17240–1).

Dendropsophus berthalutzae. **BRAZIL**: **Rio de Janeiro**: Duque de Caxias: Parque Natural Municipal de Duque de Caxias (MNRJ 54699–714).

Dendropsophus bifurcus. **ECUADOR**: **Morona**: Santiago: Sevilla Don Bosco (MZUSP 55637). **Napo**: Loreto (MZUSP 116720–4), Santa Cecilia (MZUSP 116703–6, MZUSP 116695–6).

Dendropsophus bipunctatus. **BRAZIL**: **Bahia**: Aurelino Leal: Fazenda Pedras Pretas (CFBH 18721–2, CFBH 18734–5). **Espírito Santo**: Linhares: "Fazenda São Bento, Povoação" (CFBH 23081–2).

Dendropsophus bogerti. **COLOMBIA**: **Antioquia**: Yarumal: Santa Rosa (ICN 14275), "Finca Media Luna, Cto El Cedro" (ICN 38278–9).

Dendropsophus branneri. **BRAZIL**: **Bahia**: Maracás: "Fazendas Cana Brava e Santo Onofre" (CFBH 18801–5, CFBH 19312, CFBH 19314–15, CFBH 19319–26, CFBH 19530). **Pernambuco**: Bonito: "Açude do Prata" (CFBH 20825, CFBH 20829, CFBH 20833).

Dendropsophus cachimbo. **BRAZIL**: **Pará**: Redenção (MZUSP 70875–6).

Dendropsophus carnifex. **ECUADOR**: **Imbabura**: Apuela (USNM 234925, USNM 234930, USNM 234932, USNM 234934, USNM 234939, USNM 234942, USNM 234944–6, USNM 234948).

Dendropsophus columbianus. **COLOMBIA**: **Valle del Cauca**: La Cumbre: "Vereda Chicoral, corregimiento Bitaco, cabeceras rio Bitaco, Quebrada Aguas Lindas" (ICN 33334–41).

Dendropsophus cruzi. **BRAZIL**: **Goiás**: Silvânia (paratypes: CFBH 2939–44).

Dendropsophus decipiens. **BRAZIL**: **Rio de Janeiro**: Duque de Caxias: Parque Natural Municipal de Duque de Caxias (MNRJ 50837, MNRJ 54719–35). Seropédica: FLONA Mario Xavier (CFBH 25710–14).

Dendropsophus dutrai. **BRAZIL**: **Bahia**: Ilhéus: Universidade Estadual de Santa Cruz (MNRJ 52406). **Sergipe**: Estância:

Areia Branca (alotype: MZUSP 38024, holotype: MZUSP 38025). Indiaroba: "Fazenda Sabão, Povoado do Retiro" (MNRJ 46746). São Cristóvão: Gasoduto Catu–Camópolis (MNRJ 38910).

Dendropsophus ebraccatus. **HONDURAS**: **Gracias a Dios**: Kaska Tingni (USNM 559102, USNM 559105, USNM 559107, USNM 550109–13, USNM 550115–16).

Dendropsophus elegans. **BRAZIL**: **Bahia**: Gandu: Estrada para Piraí do Norte (CFBH 27974). **Espírito Santo**: Linhares: CRFVRD (CFBH 22663–7), Reserva Natural da Cia. Vale do Rio Doce (CFBH 11083). **Minas Gerais**: Novo Cruzeiro (MCNAM 3944). **Paraná**: Guaratuba: Serra do Araraquara (Fazenda Creminácio) (CFBH 23220). **Rio de Janeiro**: Macaé (MNRJ 53166). Rio de Janeiro: Pedra de Guaratiba (MNRJ 42960–2). **São Paulo**: Ribeirão Grande: Fazenda Intermontes (CFBH 24541–2).

Dendropsophus elianeae. **BRAZIL**: **São Paulo**: Rio Claro: "Sítio Zezé, Itapé" (CFBH 21149–54, CFBH 21189–95).

Dendropsophus garagoensis. **COLOMBIA**: **Boyacá**: Miraflores: "Finca el Vergel, 38 km (by road) NE Garagoa on road to Miraflores, Vereda el Tunjito" (holotype: ICN 17781, paratypes: ICN 17794, ICN 17800, ICN 17803, ICN 17806, ICN 17814, ICN 17815).

Dendropsophus cf. *garagoensis* (*bogerti*?). **COLOMBIA**: **Antioquia**: Sonsón: "Rio Verde de los montes, Vereda La Soledad" (ICN 39730–3).

Dendropsophus gaucheri. **BRAZIL**: **Pará**: Campos do Ariramba: Igarapé Jaramacaru (MZUSP 54051–56).

Dendropsophus giesleri. **BRAZIL**: **Minas Gerais**: Ouro Preto: Lagoa do *Physalaemus maximus* (MNRJ 41730–2). **Rio de Janeiro**: Rio das Ostras: REBIO União (MNRJ 37343–4).

Dendropsophus gryllatus. **ECUADOR**: **Los Rios**: Quevedo: Estación Ecológica Rio Palenque (paratypes: MZUSP 73742–3).

Dendropsophus haddadi. **BRAZIL**: **Bahia**: Ilhéus (CFBH 25798–802**)**. **Espírito Santo**: Conceição da Barra (CFBH 1538), Mata do Queixada (CFBH 1630–1, CFBH 1634–5, CFBH 1637).

Dendropsophus haraldschultzi. **BRAZIL**: **Amazonas**: Santa Rita do Weil (holotype: MZUSP 74192). **ECUADOR**: **Amazonas**: Letícia: "km 13,8 Letícia–Tarapacá" (ICN 46644–6, ICN 46650, ICN 46656, ICN 46658, ICN 46660, ICN 46666–7, ICN 50843).

Dendropsophus jimi. **BRAZIL**: **Minas Gerais**: Unaí (MCNAM 10679, MCNAM 10681–90). **São Paulo**: Botucatu (CFBH 25705–9).

Dendropsophus koechlini. **PERU**: **Madre de Dios**: (ZUEC 14839–40).

Dendropsophus labialis. **COLOMBIA**: **Boyacá**: Bongui (ICN 33224). Cómbita: "Páramo de Sote, Finca La Concepción" (ICN 33610, ICN 33612, ICN 33618, ICN 33620, ICN 33631, ICN 33628, ICN 33631). **Cundinamarca**: Bogotá (USNM 95874–83), Ciudad Universitária (ICN 53811).

Dendropsophus leali. **BRAZIL**: **Amazonas**: Reservas INPA–WWF (MZUSP 77068, MZUSP 77070–1). **Rondônia**: **Forte Príncipe da Beira** (alotype: MZUSP 74211, holotype: MZUSP 74210).

Dendropsophus leucophyllatus. **BRAZIL**: **Amapá**: Serra do Navio (MCNAM 2088). **Maranhão**: Estreito: Fazenda Ouro Verde (CFBH 18038). **Pará**: Acarí (CFBH 20322). **Estreito**: Fazenda Ituaneiras (CFBH 9135).

Dendropsophus marmoratus. **BRAZIL**: **Amazonas**: Limoeiro (MZUSP 50743–75). **ECUADOR**: **Napo**: Loreto (MZUSP 106636–39).

Dendropsophus melanargyreus. **BRAZIL**: **Mato Grosso**: Aparecida do Tabuado (MNRJ 17784, MNRJ 17785). Aripuanã (MZUSP 80611–22). Chapada dos Guimarães (UFMT 1406–7, UFMT 2943–7).

Dendropsophus meridensis. **VENEZUELA**: **Merida**: La Carbonera: Bosque San Eusébio (ICN 32424, ICN 32426–7). **BRAZIL**: **Rio de Janeiro**: Rio de Janeiro: Brejinho do horto do MNRJ da quinta da Boa Vista (CFBH 22236–45, CFBH 23642–9).

Dendropsophus microps. **BRAZIL**: **São Paulo**: Ribeirão Grande: Fazenda Intermontes (CFBH 24548–9).

Dendropsophus minutus. **BRAZIL**: **São Paulo**: Rio Claro: "Sítio Zezé, Itapé" (CFBH 21155, CFBH 21171–86).

Dendropsophus miyatai. **COLOMBIA**: **Amazonas**: Letícia: Corrego de Tarapacá (ICN 35746–55).

Dendropsophus nahdereri. **BRAZIL**: **Santa Catarina**: São Bento do Sul: "Serra Alta": Estrada Saraiva (topotypes: MNRJ 4406–10; lectotype: MNRJ 3295; paralectotypes: MNRJ 3509, MNRJ 3294, MNRJ 3296; paratype: WCAB 512), Estrada Rio Vermelho a Rio Natal (topotypes: CFBH 3564–5), Rio vermelho (paratypes: MZUSP 74217, MZUSP 112938).

Dendropsophus nanus. **BRAZIL**: **Mato Grosso**: Pindaíba: Fazenda Brasil (MZUSP 91336–61). **São Paulo**: Pirassununga: CEPTAS – Cachoeira de Emas (CFBH 21340–5, CFBH 21346–52).

Dendropsophus novaisi. **BRAZIL**: **Bahia**: Maracás: Fazenda Santo Onofre (paratypes: MNRJ 4049, MZUSP 74335–43; topotypes: UFBA 2437–49, UFBA 2486–507, UFBA 2831, UFBA 2925).

Dendropsophus oliveirai. **BRAZIL**: Bahia: Maracás: "Fazendas Santo Onofre e Cana Brava" (topotypes: CFBH 19316–18, CFBH 19327–34, CFBH 19336,CFBH 19339),

Dendropsophus padreluna. **COLOMBIA**: **Cundinamarca**: Abán: "Granja Padre Luna, Vereda Las Marias" (ICN 22012, ICN 22021, ICN 22027–8, ICN 22030, ICN 22032, ICN 22035–6, ICN 22043, ICN 22051, ICN 22053, ICN 22061, ICN 22063, ICN 22235, ICN 22254, holotype: ICN 22065).

Dendropsophus parviceps. **BRAZIL**: **Acre**: Cruzeiro do Sul: Mata da Infraero (TG 2887), Rio Jurua- Tejo (ZUEC 11209).

Dendropsophus pauiniensis. **BRAZIL**: **Amazonas**: Boca do Pauíni (holotype: MZUSP 49892).

Dendropsophus phlebodes. **COSTA RICA**: **Alajuela Province**: 2 mi. NE Muelle de Arenal cut over vegetation banana plantation (MNRJ 3639, MNRJ 14635).

Dendropsophus praestans. **COLOMBIA**: **Huila**: San Agostín: "Finca Yaguará, Vereda Aranca" (ICN 53818). San José de

Isnos (ICN 7558–61).

Dendropsophus pseudomeridianus. **BRAZIL**: **Rio de Janeiro**: Seropédica: Brejo no gramado em frente à entrada principal da Rural (UFFRJ) (CFBH 22226–29, CFBH 22231–35).

Dendropsophus rhodopeplus. **BRAZIL**: **Acre**: Cruzeiro do Sul (TG 2860)

Dendropsophus riveroi. **BRAZIL**: **Rondônia**: Ji–Paraná: Nova Brasília (USNM 292375, USNM 304061–3, USNM 304067–74, USNM 304081–5).

Dendropsophus rossaleni. **BRAZIL**: **Pará**: Oriximiná: "Lago Acumã, Porto de Trombetas" (MCNAM 8671–2).

Dendropsophus ruschii. **BRAZIL**: **Espírito Santo**: Pedra Azul: Parque e Nascente do Rio Juai (MNRJ 31548–50). **Minas Gerais**: Pedra Dourada (MNRJ 47849–57).

Dendropsophus salli. **BRAZIL**: **Acre**: Tarauacá (MZUSP 116707–19). **Rondônia**: Porto Velho (MZUSP 117916–17, MZUSP 116697–702).

Dendropsophus sanborni. **BRAZIL**: **São Paulo**: Rio Claro: "Sítio Zezé, Itapé" (CFBH 21203, CFBH 21196–202, CFBH 21204–5).

Dendropsophus sarayacuensis. **BRAZIL**: **Acre**: Tarauacá (MNRJ 3652). **Mato Grosso**: Aripuanã (MZUSP 80632–4). **ECUADOR**: **Napo**: Santa Cecilia (MZUSP 55604–7).

Dendropsophus schubarti. **BRAZIL**: **Rondônia**: Ji–Paraná (MZUSP 92583, paratypes: MZUSP 73651–2). Nova Brasília (MZUSP 60488–91).

Dendropsophus seniculus. **BRAZIL**: **Espírito Santo**: Aracruz: "Barra do Riacho, Eucaliptal alagado perto da fábrica de celulose" (CFBH 4027). Linhares: "Fazenda 3 ilhas, Povoaçao" (CFBH 5990–1), "Fazenda Pirajá, Povoação" (CFBH 5988–9), Povoação (CFBH 4084), Reserva da Vale (MNRJ 22838–60), Reserva Florestal Barra Seca (MNRJ 1997a–c). **Rio de Janeiro**: Angra dos Reis (CFBH 5761), Mambucaba e Palmital (CFBH 22649–57). Duque de Caxias: Barro Branco (MNRJ 3085a–m). Rio de Janeiro: Jacarepaguá (Estrada do Cafundó) (MNRJ 2121a–g, MNRJ 1415, MNRJ 7756–63).

Dendropsophus soaresi. **BRAZIL**: **Piauí**: Picos (paratypes: JJ 5741–48).

Dendropsophus stingi. **COLOMBIA**: **Boyacá**: Miraflores: "Finca el Vergel, 38 km (by road) NE Garagoa on road to Miraflores, Vereda el Tunjito" (holotype: ICN 15844).

Dendropsophus timbeba. **BRAZIL**: **Acre**: Cruzeiro do Sul (ZUEC 10641, ZUEC 11033–8, ZUEC 11053, paratypes: ZUEC 5476, ZUEC 5723). Xapuri: caminho para Vila Boa Vista (holotype: MZUSP 60560).

Dendropsophus triangulum. **BRAZIL**: **Acre**: Cruzeiro do Sul: Vila do BEC (CFBH 4611, CFBH 4628, CFBH 4632, CFBH 4661, CFBH 4667), Vila militar (CFBH 52). **COLOMBIA** (ICN 53091).

Dendropsophus virolinensis. **COLOMBIA**: **Santander**: Charalá: "El Reloj, El encino" (ICN 39002, ICN 39011, ICN 39017), "Insp. De Policia de Virolin, Cañaverales, Km 70 Duitama–Charalá" (ICN 12517–19, ICN 12526, ICN 12532, ICN 12544–5, ICN 12548–9, ICN 12553, ICN 12556, ICN 12558–9).

Dendropsophus walfordi. **BRAZIL**: **Rondônia**: Costa Marques: Forte Príncipe da Beira (holotype: MZUSP 73652).

Dendropsophus xapuriensis. **BRAZIL**: **Acre**: Xapuri: Caminho para Vila Boa Vista (paratype: CFBH 6261, holotype: MZUSP 60558).