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Vocal repertoire of *Sphaenorhynchus palustris* (Anura, Hylidae), with notes on *S. botocudo*

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The genus *Sphaenorhynchus* TSCHUDI, 1838 currently contains 14 species of tree frogs distributed in the Amazon and Orinoco basins of South America, in the Guianas, eastern Brazil and on Trinidad (FROST, 2013). The only possible exception is *Sphaenorhynchus platycephalus* (WERNER, 1894) whose type locality and exact distribution are unknown (CARAMASCHI et al. 2009). Herein we contribute to the knowledge on *Sphaenorhynchus* taxonomy by describing the vocal repertoire of *S. palustris* BOKERMANN, 1966. In addition, we report the presence of a distinctive longitudinal white spot below the eye in some specimens of this species, which was considered a putative autapomorphy of another species, *S. botocudo*, described by CARAMASCHI et al. (2009). *Sphaenorhynchus palustris* was described from Soretama, Linhares, state of Espírito Santo, Brazil (BOKERMANN, 1966) and is known to occur to the northeastern of Bahia (JUNCA & PIMENTA, 2004) while *S. botocudo* is known only from its type locality, Fazenda Gemada, Mucurici, also in the state of Espírito Santo.

In order to confirm species identification, we compared our specimens to the material in the herpetological collection of Museu Nacional (MNRJ; appendix). Calls of *Sphaenorhynchus palustris* were recorded on 30 December 2011 between 19:00 and 21:30 h (25°C air temperature) in a flooded open area with emergent grass, in the centre of an artificial pasture that is used for raising cattle, at the Fazenda das Palmeiras (39°50'17" W and 18°05'8" S, 77 m above sea level), municipality of Mucuri, state of Bahia, Brazil. Sounds were recorded in wav format, with a Sony ICD P620 digital recorder with an Audio-Technica Pro 24 stereo condenser microphone positioned at ca. 30 cm from two calling males (both perched on emergent vegetation). The recordings were then analysed using Sound Ruler (V. 0.9.6.0) at a sampling frequency of 44.1 kHz and 16-bit resolution. The oscillogram and spectrogram were produced using the following

parameters: FFT width = 256, Overlap = 0.9, and Hanning window function. Description and terminology of acoustic properties follow DUELLMAN & TRUEB (1994).

In total, 32 calls of two males were analysed. Voucher specimens were euthanised in 10% lidocaine, fixed in 10% formalin and preserved in 70% alcohol and are now in the herpetological collection of Museu de Zoologia João Moojen, Universidade Federal de Viçosa (MZUFV 11730, 11737, 11738 and 11740), municipality of Viçosa, state of Minas Gerais, Brazil. One recorded male (Fig. 1A; MZUFV 11730; snout–vent length 29.7 mm) was calling perched on a blade of grass about five centimetres above the water surface, with two other calling males being positioned approximately two metres away. The other recorded male was calling also from a blade of grass, about 1.5 m above the water, apparently without any other males calling in its closer vicinity.

Two types of calls can be recognized among vocalizations emitted by the recorded males: calls here referred to as type I, were more frequently emitted and could be heard from males calling apparently alone, are therefore classified as the advertisement call; type II calls were rarely emitted, always by interacting males and thus probably related to a territorial/aggressive function.

Calls of *Sphaenorhynchus palustris*

Calls of type I (Fig. 1B) are homogeneous with regard to note structure and consist of 1–4 multipulsed notes (1.9 ± 0.7 ; $n = 28$ calls), with a duration of 14.7–508.5 ms (165.8 ± 127.1 ; $n = 28$ calls), intervals between notes of 126.7–169.5 ms (148.6 ± 12.1 ; $n = 26$ intervals), note durations of 10.7–35.8 ms (17.0 ± 5.1 ; $n = 54$ notes), and a dominant frequency of 2760.3–3618.2 kHz (3096.5 ± 246.9 ; $n = 54$ notes).

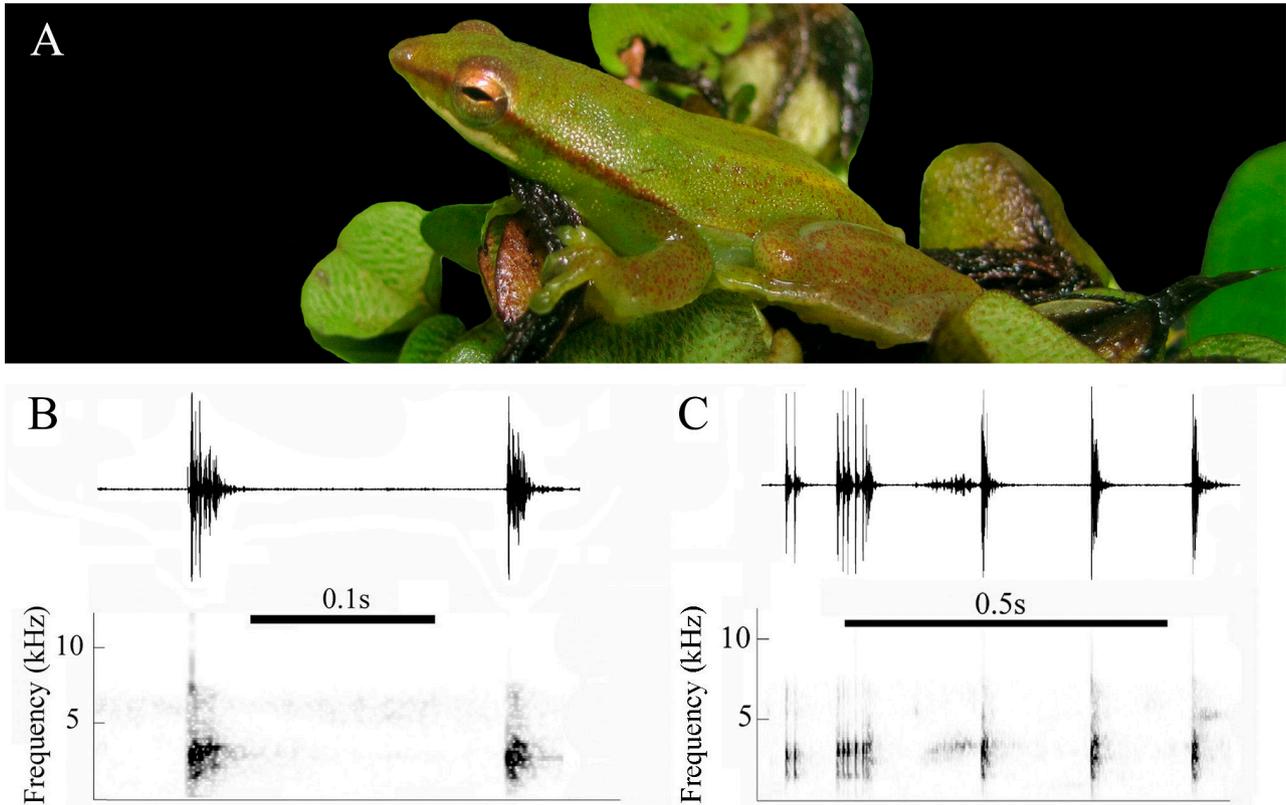


Figure 1. (A) recorded male of *Sphaenorhynchus palustris* in life (MZUFV 11730; SVL 29.6 mm); (B) oscillogram and spectrogram of call type I of *S. palustris*; (C) oscillogram and spectrogram of call type II of *S. palustris*.

Calls of type II (Fig. 1C) consist of 4–6 multipulsed notes (5 ± 0.8 ; $n = 4$ calls), with a duration of 468.3–831.9 ms (634.9 ± 150.9 ; $n = 4$ calls), and intervals between notes of 48.5–166.7 ms (122.2 ± 41.1 ; $n = 16$ intervals). Type II calls contain two different types of notes: the first and second notes have durations of 15.7–57.5 ms (46.0 ± 15.0 ; $n = 8$ notes), 2–8 pulses/note (5.5 ± 2.0 ; $n = 8$ notes), 0.08–0.14 pulses/ms (0.12 ± 0.02 ; $n = 8$ notes), and dominant frequencies of 2760.3–3440.2 Hz (3017.2 ± 202.4 ; $n = 8$ notes) whereas the third to sixth notes have durations of 10.2–18.9 ms (14.2 ± 2.5 ; $n = 12$ notes) and dominant frequencies of 2761.1–3446.1 kHz (3091.5 ± 225.0 ; $n = 12$ notes). All notes of type I calls and the third to sixth notes type II calls are similar and have pulses merged, which makes it difficult to quantify the number of pulses per note. The first and second notes of type II calls are longer, with clearly defined and spaced pulses.

From the ten species of *Sphaenorhynchus* occurring in eastern Brazil, advertisement calls have been described for seven: *S. caramaschii* TOLEDO, GARCIA, LINGNAU & HADDAD, 2007; *S. mirim* CARAMASCHI, ALMEIDA & GASPARINI, 2009; *S. orophilus* (LUTZ & LUTZ, 1938); *S. palustris* BOKERMANN, 1966; *S. pauloalvini* BOKERMANN, 1973; *S. prasinus* BOKERMANN, 1973; and *S. surdus* (COCHRAN, 1953). We compared our call data of *S. palustris* (call type I) to the call descriptions by BOKERMANN (1973), HEYER et al. (1990),

NUNES et al. (2007), TOLEDO et al. (2007) and LACERDA et al. (2011). The advertisement call of *S. palustris* can be distinguished from those of *S. caramaschii* and *S. surdus* by its shorter duration and higher dominant frequency (call duration of 1.5–1.99 s and dominant frequency of 2.24–2.37 kHz in *S. surdus*; call duration of 5.23–10.2 s and dominant frequency of 2.49–2.76 kHz in *S. caramaschii*); from calls of *S. mirim* by its shorter note duration, lower dominant frequency and higher number of notes per call (call/note duration of 0.034–0.101 s, dominant frequency of 3.085–3.398 kHz and only one note/call in *S. mirim*); from calls of *S. orophilus* by its shorter duration and a lower number of notes per call (call duration of 0.3–1.8 s and 2–12 notes/call in *S. orophilus*); from calls of *S. pauloalvini* by its lower number of notes per call and shorter note duration (6–8 notes/call and note duration of ca. 0.05 s in *S. pauloalvini*); from *S. prasinus* by its lower number of notes per call and higher dominant frequency (5 notes/call and dominant frequency of 1.3–1.5 kHz in *S. prasinus*). Although the vocalization of *S. palustris* can thus be easily distinguished from those already described for the genus, it is worth mentioning that some characters used for comparisons, such as call duration or number of notes per call may depend on the social context in which a male emits a call. The description of the advertisement call of *Sphaenorhynchus palustris* from the municipality of Porto Seguro,

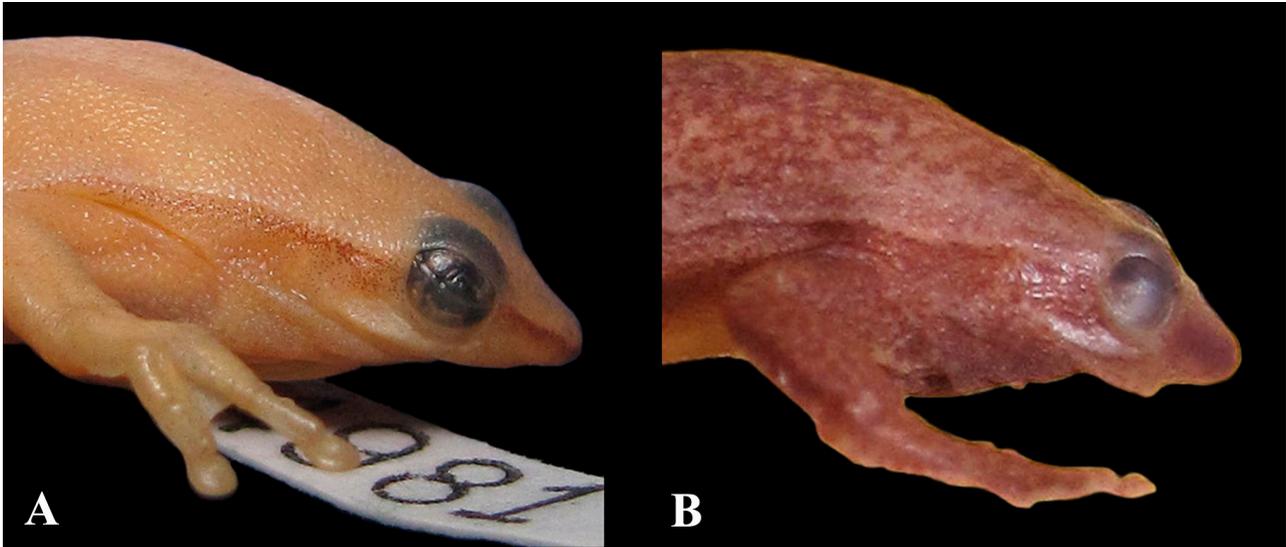


Figure 2. (A) adult male of *S. palustris*, demonstrating the presence of a longitudinal white spot under the eye (MNRJ 54981; SVL 30.5 mm); and (B) adult male of *S. bromelicola* (MNRJ 69655; SVL 25.9 mm) likewise showing the presence of a longitudinal white spot under the eye.

state of Bahia, provided by NUNES et al. (2007) is similar to the call type we present herein. However, we also recorded calls with four notes (1–3 notes/call in NUNES et al. 2007). Besides, although the latter authors presented data on the vocalization emitted by males calling in chorus, they did not record the vocalization here referred to as call type II.

The habitat where males were recorded is flooded, open, artificial grassland, densely covered with emergent and floating vegetation similar to the habitats observed for other species of this genus (comp. CARAMASCHI et al. 2009, LACERDA et al. 2010, 2011). Like other species of its genus, *S. palustris* appears to be capable of readily colonizing degraded areas (see CARAMASCHI et al. 2009).

Comments on *Sphaenorhynchus botocudo*

According to CARAMASCHI et al. (2009), *Sphaenorhynchus botocudo* is distinguished from all other species of its genus by the presence of a distinctive longitudinal white spot below the eye. The present study invalidates the proposal of such autapomorphy, as we also observed such a spot in the vouchers of the present study (Fig. 1A), other preserved specimens of *S. palustris* (Fig. 2A) and *S. bromelicola* BOKERMANN, 1966 (Fig. 2B) in museum collections. Nevertheless, *S. botocudo* also differs from all other congeners by a combination of traits (see CARAMASCHI et al. 2009), thus it still can be considered a valid species. LACERDA et al. (2010) provided a record of *S. botocudo* from the municipality of Mucuri based on two collected specimens with the distinct longitudinal white spot under the eye. Due to the present invalidation of the diagnostic value of this character, we regard this record as pertaining to the referred population as *S. palustris*.

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Appendix

Sphaenorhynchus botocudo – BRAZIL, state of Espírito Santo: Mucurici, Fazenda Gemada (MNRJ 50625, holotype; MNRJ 50626–50640, paratypes).

Sphaenorhynchus bromelicola – BRAZIL, state of Bahia: Maracás: Fazenda Santo Onofre (MNRJ 4029, 5860, paratype): Maracás: Fazenda Cana Brava (MNRJ 4289–93, 69648–55).

Sphaenorhynchus palustris – BRAZIL, state of Espírito Santo: Conceição da Barra (MNRJ 30049, 30059, 54979, 54981, 54983): state of Bahia: Estação Veracel (MNRJ 42649–57).