



A new species of *Sphaenorhynchus* (Anura; Hylidae) from Brazil

LUÍS FELIPE TOLEDO^{1,2,5}, PAULO C. A. GARCIA³, RODRIGO LINGNAU⁴ & CÉLIO F. B. HADDAD¹

¹Departamento de Zoologia, Instituto de Biociências, Universidade Estadual Paulista, Caixa Postal 199, CEP 13506-970, Rio Claro, São Paulo, Brasil. E-mail: toledolf2@yahoo.com

²Current adress: Universidade Federal do Paraná, Pós Graduação em Ecologia e Conservação, Setor de Ciências Biológicas, Centro Politécnico, Av. Cel. Francisco H. dos Santos, 210, Jardim da Américas, Curitiba, PR, CEP 81531-970

³Museu de Zoologia, Universidade de São Paulo, Avenida Nazaré, 481, Ipiranga, CEP 04263-000, São Paulo, São Paulo, Brasil. E-mail: pcagarcia@gmail.com

⁴Centro Integrado de Análise e Monitoramento Ambiental, Universidade Estadual de Mato Grosso do Sul, Rodovia Dourados Itahum Km 12, Cidade Universitária, 79804-970, Dourados, Mato Grosso do Sul, Brasil; and Programa de Pós-Graduação em Zoologia, Faculdade de Biociências, Pontifícia Universidade Católica do Rio Grande do Sul, Av. Ipiranga 6681, 90619-900, Porto Alegre, Rio Grande do Sul, Brasil

⁵Corresponding author: toledolf2@yahoo.com

Abstract

A new species of *Sphaenorhynchus*, probably closely related to *S. surdus*, is described from the states of São Paulo, Paraná, and Santa Catarina in the southeast and south of Brazil. This species, *Sphaenorhynchus caramaschii* **sp. nov.**, is an intermediate species in size within the genus and is characterized by the absence of external tympanum, by the snout from truncate to slightly mucronate in dorsal view and protruding in lateral view, by the presence of a dark line from the snout to the eye, and mainly by differences in the advertisement call (a long call with several notes). It is found in open areas, calling during the wet season of the year, generally, in the deepest area of permanent ponds. Illustrations of the adults, descriptions of the advertisement calls, and a map of geographic distribution of the species are provided. Also, we provide data on the distribution and natural history of *S. surdus* and describe its advertisement call.

Key words: Amphibia, *Sphaenorhynchus caramaschii* **sp. nov.**, *Sphaenorhynchus surdus*, species description, Atlantic Forest

Introduction

Sphaenorhynchus Tschudi, 1838 is a sister genus of *Dendropsophus* and *Xenohyla* (Faivovich *et al.* 2005). Synapomorphies for *Sphaenorhynchus* have been proposed by Duellman and Wiens (1992) and by the present moment there are 11 recognized species in the genus (Frost 2007).

Among the 11 species of *Sphaenorhynchus*, seven [*S. bromelicola* Bokermann, 1966, *S. orophilus* (Lutz & Lutz, 1938), *S. palustris* Bokermann, 1966, *S. pauloalvini* Bokermann, 1973, *S. planicola* (Lutz & Lutz, 1938), *S. prasinus* Bokermann, 1973, and *S. surdus* (Cochran, 1953)] are known from the Atlantic Forest of Brazil, three [*S. carneus* (Cope, 1868), *S. dorisae* (Goin, 1957), and *S. lacteus* (Daudin, 1800)] are from the Amazon basin, and the distribution of *S. platycephalus* (Werner, 1894) remains unknown (Frost 2007). *Sphaenorhynchus surdus* is the only species known to occur below the Tropic of Capricorn. The remaining species are known from the northeast of the state of São Paulo to the Amazon basin (Heyer *et al.* 1990; Frost 2007). After the description of *S. surdus* in 1953 by Doris Cochran, all *Sphaenorhynchus* collected from the south of the state of São Paulo to the state of Rio Grande do Sul were identified as *S. surdus* (e.g., Bertoluci & Rodrigues 2002; Garcia & Vinciprova 2003; Conte & Machado 2005; Pombal & Haddad 2005). However,

they consist, at least, of two species: *S. surdus* and a new species here described. We here describe the advertisement calls, provide illustrations, natural history data, and a map of geographic distribution of both species.

Materials and methods

Animals were collected during several expeditions and by different researchers. Male vocalizations were recorded with a Marantz cassette tape recorder (PMD222), equipped with an external directional microphone (Audiotecnica AT835b or Sony ECM-MS907) positioned ca. 50 cm from the calling male. We used chrome cassette tapes at 4.75 cm/s. We analyzed the calls using Raven 1.2 software (16 bits of resolution, 44 kHz of frequency sampling, FFT and frame length of 256 samples). The terminology for the vocal analysis follows that presented in Toledo and Haddad (2005).

Museum abbreviations of specimens used in the description are CFBH (Célio F. B. Haddad anuran collection, Departamento de Zoologia, UNESP, Rio Claro, SP, Brazil), MCP (Museu de Ciências e Tecnologia da PUCRS, Porto Alegre, RS, Brazil), MHNCI (Museu de História Natural Capão da Imbuia, Curitiba, PR, Brazil), MZUSP (Museu de Zoologia da USP, São Paulo, SP, Brazil), UMMZ (University of Michigan Museum of Zoology), and ZUEC (Museu de História Natural da UNICAMP, Campinas, SP, Brazil). Abbreviations used in the measurements of adults are SVL (snout-vent length), HL (head length), HW (head width), ED (eye diameter), IOD (interorbital distance), END (eye to nostril distance), IND (internarial distance), THL (thigh length), TBL (tibia length), and FL (foot length). All measurements are presented in millimeters. The measurements of the adults follow Cei (1980), Heyer *et al.* (1990), and Duellman (2001). Description of snout shape in dorsal view follows Heyer *et al.* (1990) and in lateral view follows Cei (1980) and Duellman (2001). For morphometric measurements we used a digital calliper of 0.01 mm of precision and an ocular micrometer in a Zeiss stereomicroscope. Line drawings of the adults were made in a Zeiss stereomicroscope SV11 with a drawing tube.

Sphaenorhynchus surdus (Cochran, 1953)

Hyla aurantiaca surda Cochran, 1953—*Name-bearing type*: holotype by original designation, UMMZ 106736, adult male according to original description, SVL 28 mm. – Type locality: "Curitiba, Paraná", Brazil. – *Paratypes* according to original description – UMMZ 104115, adult male collected with the holotype; UMMZ 104116 A – C, adult males collected in another site in the municipality of Curitiba, state of Paraná, Brazil. *Herpetologica*, 8: 112.

Other chresonyms:

Hyla aurantiaca: BOULENGER, 1888

Sphoerohyla surda: GOIN, 1957

Sphaenorhynchus surda: GORHAM, 1974

Sphaenorhynchus surdus: BOKERMANN, 1966:45

Holotype. MZUM 106736. Adult male. SVL 28 mm, collected at the municipality of Curitiba (approximately 25°25' S; 49°16' O), state of Paraná, Brazil (Figure 1).

Diagnosis [as presented in Cochran (1953)] – No external tympanum; interorbital diameter twice the width of the upper eyelid; a dark dorsolateral line from snout almost to groin.

Description of Holotype. Provided by Cochran (1953).

Advertisement call. Adult males of *S. surdus* call from the floating vegetation, generally in the deepest portion of temporary or permanent ponds (Figure 2). The advertisement call was described in words by Cochran (1953) as "hitting resonant rocks together quickly 4 or 5 times". The advertisement call of *S. surdus*, recorded all over its distribution (municipalities of São Bento do Sul, Lebon Régis, Ponte Serrada, Urubici, Lages, and Lontras, all in the state of Santa Catarina, and municipality of São José dos Ausentes, state of Rio Grande do Sul), but in the type locality, has from 18 to 22 notes, ranging from 1.34 ± 0.13 kHz (range: 0.98 –

1.54; n = 27 notes; 1 male) to 3.41 ± 0.17 kHz (range: 3.17 – 3.85; n = 27 notes; 1 male). The mean dominant frequency is 2.29 ± 0.03 kHz (range: 2.24 – 2.37; n = 27 notes; 1 male). The duration of the call is about 1.7 seconds, but it depends on the number of notes in the calls. The mean duration of an individual note is 0.02 ± 0.004 s (0.01 – 0.03; n = 27 notes; 1 male). The first two notes differ from the remaining by having a much more pulsed structure. There is a short interval between the notes (mean: 0.07 ± 0.007 s; range: 0.05 – 0.08; n = 27 notes; 1 male) (Table 1; Figure 3).

TABLE 1. Acoustical characteristics of the advertisement calls of *Sphaenorhynchus caramaschii* sp. nov. and *S. surdus*. Values presented as mean \pm standard deviation (range) when n > 2. The specific n value is indicated when it is different from that indicated in the first column.

Species / Notes type (N)	Locality	Duration of the call (s)	Frequency (kHz)			Notes / call or Pulses / note	Duration of the note (ms)	Interval between notes (ms)
			Minimum	Maximum	Dominant			
<i>S. surdus</i> / notes type I (1 male / 4 calls / 27 notes)	Lebon Régis, SC	1.55–1.99	1.34 \pm 0.13 (0.98–1.54)	3.41 \pm 0.17 (3.17–3.85)	2.29 \pm 0.03 (2.24–2.37)	18–22	21.70 \pm 4.43 (13.0–32.0)	68.29 \pm 6.93 (52.0–86.0)
<i>S. surdus</i> / notes type II (1 male / 2 calls / 4 notes)	Lebon Régis, SC	–	1.12 \pm 0.05 (1.05–1.15)	3.69 \pm 0.17 (3.47–3.84)	2.40 \pm 0.02 (2.37–2.41)	8.75 \pm 3.86 (5–14)	60.25 \pm 14.57 (44.0–74.0)	71.0 \pm 10.39 (58.0–82.0)
<i>S. caramaschii</i> (1 male / 3 calls / 30 notes)	Piraquara, PR	8.50 \pm 2.83 (5.23– 10.20)	0.94 \pm 0.45 (0.11–1.57)	4.24 \pm 0.40 (3.68–5.43)	2.62 \pm 0.09 (2.49–2.76)	35.0 \pm 11.36 (22– 43)	0.54 \pm 0.01 (0.37–0.68)	220.9 \pm 44.3 (183–373)

Tadpole. Unknown.

Natural history. Males breed in the hot and rainy season of the year and call from the floating vegetation, generally in permanent ponds. The reproductive mode is probably number 1 (*sensu* Haddad & Prado 2005): eggs and exotrophic tadpoles in lentic water.

Geographic distribution. Besides the type locality, the species has also been collected in the municipalities of São Bento do Sul, Lebon Régis, Ponte Serrada, Urubici (based on advertisement call recordings), Lages, and Lontras, all in the state of Santa Catarina, and municipality of São José dos Ausentes, state of Rio Grande do Sul (Figure 8).

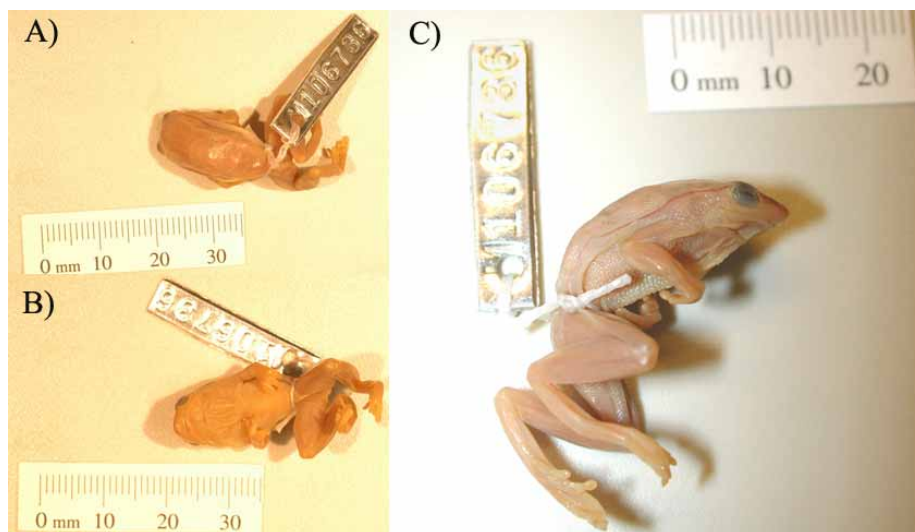


FIGURE 1. Holotype of *Sphaenorhynchus surdus* (UMMZ 106736) in dorsal (A), ventral (B), and lateral (C) views.



FIGURE 2. Adult male *Sphaenorhynchus surdus* calling in a permanent pond in the municipality of Lebon Régis, state of Santa Catarina, South Brazil.

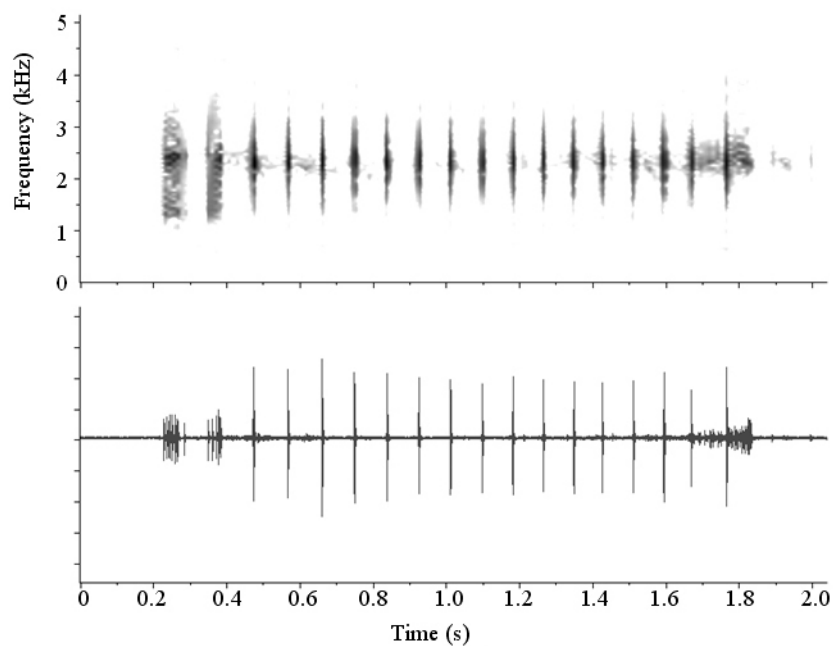


FIGURE 3. Spectrogram (above) and waveform (below) of the advertisement call of *Sphaenorhynchus surdus* recorded at the municipality of Lebon Régis, state of Santa Catarina, Brazil.

***Sphaenorhynchus caramaschii* sp. nov.**

Sphaenorhynchus surdus: BERTOLUCI AND RODRIGUES, 2002; POMBAL JR. AND HADDAD, 2005

Holotype. CFBH 2222, an adult male collected in a permanent pond at the Fazenda São Luís (24°21'30" S, 48°44'35" W; 910 m. altitude), municipality of Ribeirão Branco, state of São Paulo, southeastern Brazil, by Célio F. B. Haddad and José P. Pombal Jr. on 27 November 1993 (Figure 4).

Paratopotypes. CFBH 2219-21; 2223 adult males collected with the holotype. All the remaining paratypes were collected in the same locality of the holotype (Fazenda São Luís, Ribeirão Branco, São Paulo), but in different dates. CFBH 194 adult male collected on 11 October 1985 by A. J. Cardoso, M. Gordo, M. Martins, J. P. Pombal Jr., and C. F. B. Haddad; CFBH 267 adult male collected on 26 January 1989 by C. F. B. Haddad and J. P. Pombal Jr.; CFBH 370 adult male collected on 27 December 1987 by C. F. B. Haddad, M. Gordo, and J. P. Pombal Jr.; CFBH 1777 adult male collected on 7 December 1992 by C. F. B. Haddad and J. P. Pombal Jr.; CFBH 2210 adult male collected on 8 October 1993 by R. P. Bastos, O. C. Oliveira, and J. P. Pombal Jr.; CFBH 2285-94 adult males and a female (CFBH 2287) collected on 8 February 1993 by R. P. Bastos, O. C. Oliveira, and J. P. Pombal Jr.; CFBH 2313 adult male collected on 15 January 1994 by R. P. Bastos and C. F. B. Haddad; CFBH 6875-78; 6933-37 adult males and one female (CFBH 6933) collected on 14 January 2004 by C. F. B. Haddad, C. P. A. Prado, and L. O. M. Giasson; CFBH 9583; 11285 adult males collected on 14 January 2005 by C. F. B. Haddad, J. Alexandrino, M. Guimarães, and M. Gridi-Papp. In total there are 31 paratypes, of which 29 are males and two are females.



FIGURE 4. Dorsal view of the holotype of *Sphaenorhynchus caramaschii* sp. nov. (CFBH 2222).

Diagnosis. *Sphaenorhynchus caramaschii* is an intermediate size species for the genus (Figure 5) and is characterized by the following combination of characters: (1) absence of external tympanum; (2) snout from truncate to slightly mucronate in dorsal view and protruding in lateral view; (3) presence of a dark line from the snout to the eye; and (4) a long advertisement call, generally with more than 5 seconds of duration and more than 20 notes per call.

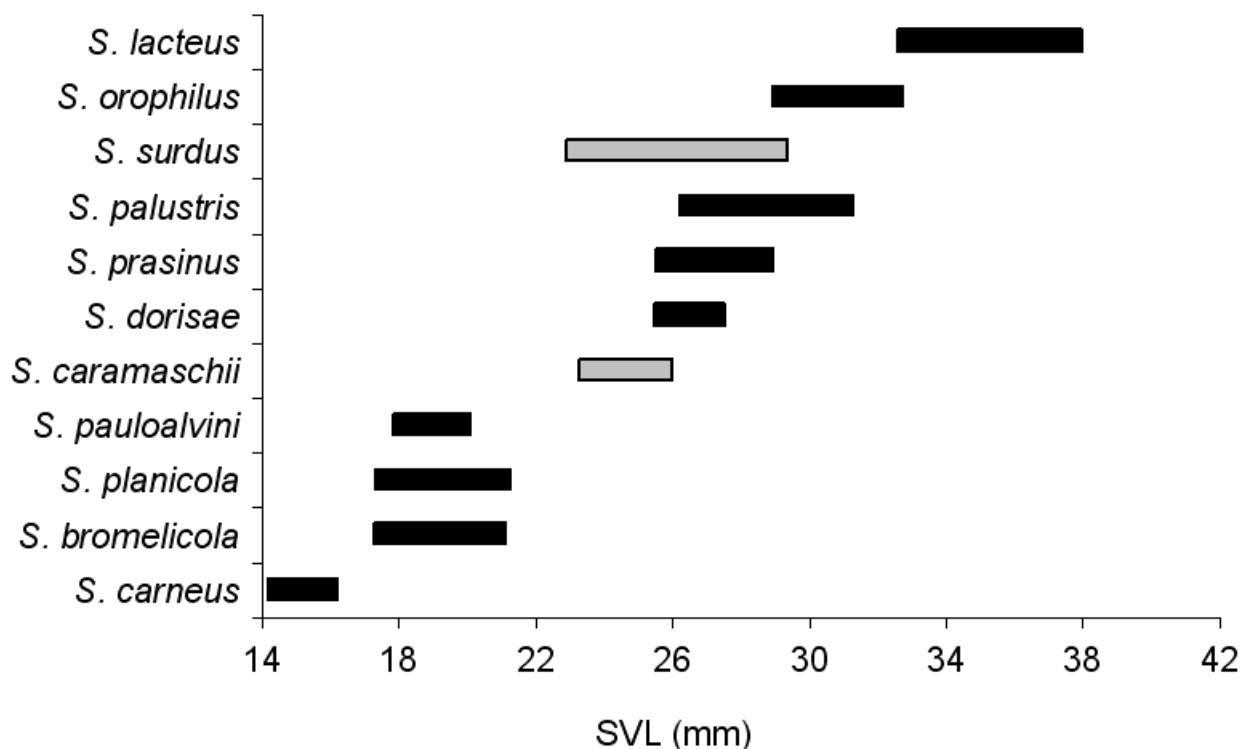


FIGURE 5. Range of snout-vent-length (SVL) of the species of *Sphaenorhynchus*. In gray are the species treated in the present study.

Comparison with other species. *Sphaenorhynchus caramaschii* is distinguished from *S. planicola* and *S. dorisae* by presenting a dark line from the snout to the eyes (absent in these former species). From *S. carneus* it is distinguished by having vomerian teeth and a SVL greater than 20 mm. From *S. lacteus* and *S. pauloalvini* it is distinguished by having a concealed tympanum. From *S. prasinus* it is distinguished by having a dorsolateral white line. From *S. bromelicola* it is distinguished by having vocal sac well developed, with longitudinal folds in the pectoral region; in *S. bromelicola* the vocal sac is small without longitudinal folds in the pectoral region. From *S. palustris* and *S. orophilus* it is distinguished by lacking dark nuptial asperities in males and by having the tympanum invisible from skin transparency. Finally, from *S. surdus* it is distinguished by having the snout generally truncate, sometimes slightly mucronate (mucronate in *S. surdus*) and, mainly, by having a long advertisement call, generally with more than 5 seconds of duration (usually below 2 seconds in *S. surdus*), and by having larger interval between notes, greater than 0.1 seconds (below 0.09 seconds in *S. surdus*) (see also Table 1).

Description of Holotype. Body elliptic and slender. Head triangular, longer than broad. Snout slightly mucronate in dorsal view and protruding in lateral view (Figure 6). Mouth opening ventral. Internarial distance narrow, shorter than the eye to nostril distance. *Canthus rostralis* rounded. Choanae rounded. Interorbital distance larger than eye diameter. Tympanum indistinct and concealed, but perceptible beneath skin. Vocal sac single, externally expanded, and large with evident transversal folds. There is one large vocal slit on each side of the tongue. Vomerine teeth in two distinct, short transverse, series, with three teeth each, lying between and just posterior to choanae. Tongue narrow, longer than wide. Thigh slightly longer than tibia; foot shorter than thigh and tibia. Finger length I<IV<II<III. Toe length I<II<V<III<IV. Finger and toes tips with rounded adhesive disks (Figure 6). Thumb with keratinized nuptial pad. Finger webbing reduced and toe webbing moderately developed. Finger and toe subarticular tubercles rounded and single. There are several rounded supernumerary tubercles in the hand between the first subarticular tubercle and the elliptical internal metacarpal tubercle and the heart-shaped external metacarpal tubercle. In the feet there are 13 supernumerary tubercles mostly between the rounded external metacarpal tubercle and the oval internal metacarpal tubercle. Inner metatarsal tubercle large and ovoid. Ventral skin granular and dorsal skin slightly granular, almost smooth. Cloacal region granular and cloacal flap absent. Measurements of the holotype are presented in table 2.

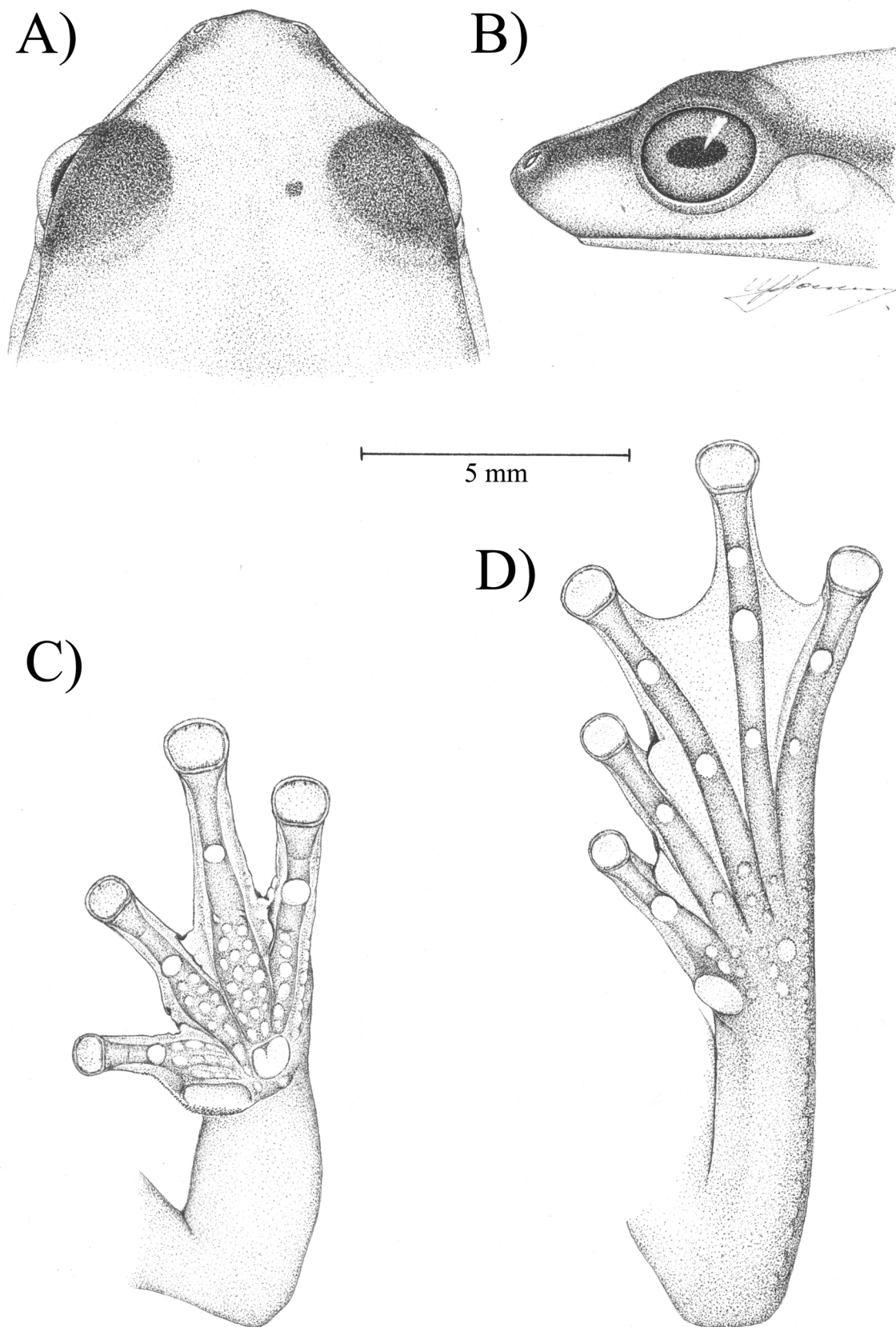


FIGURE 6. Holotype of *Sphaenorhynchus caramaschii* sp. nov. (CFBH 2222; adult male) in dorsal (A) and lateral (B) views of head; and ventral views of hand (C) and foot (D).

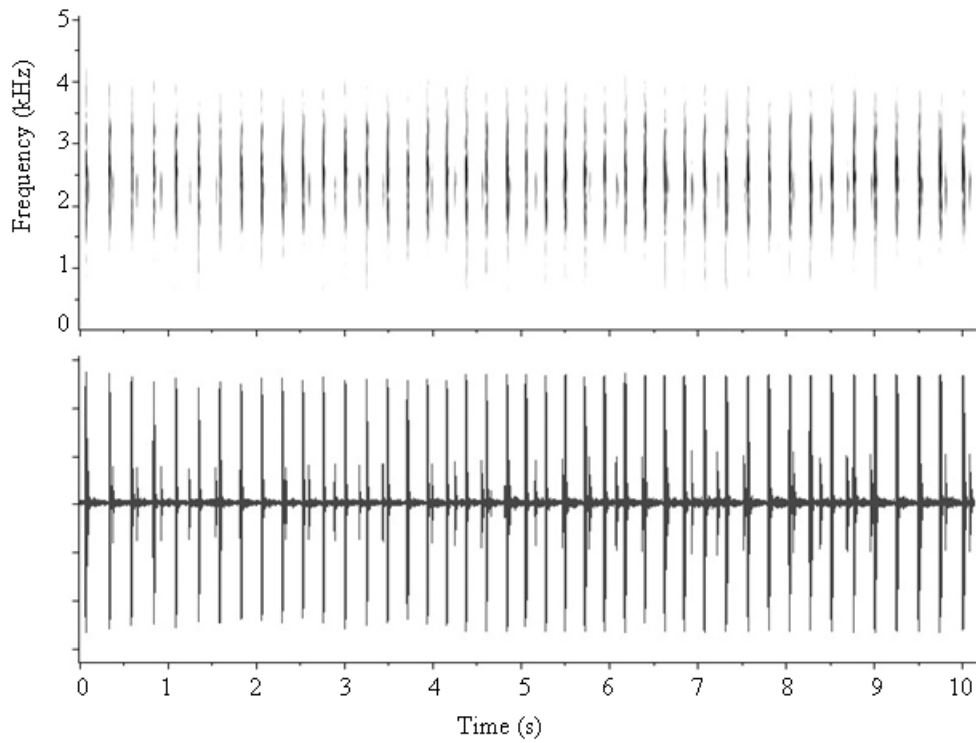


FIGURE 7. Spectrogram (above) and waveform (below) of the advertisement call of *Sphaenorhynchus caramaschii* **sp. nov.** recorded at the municipality of Piraquara, state of Paraná, Brazil.

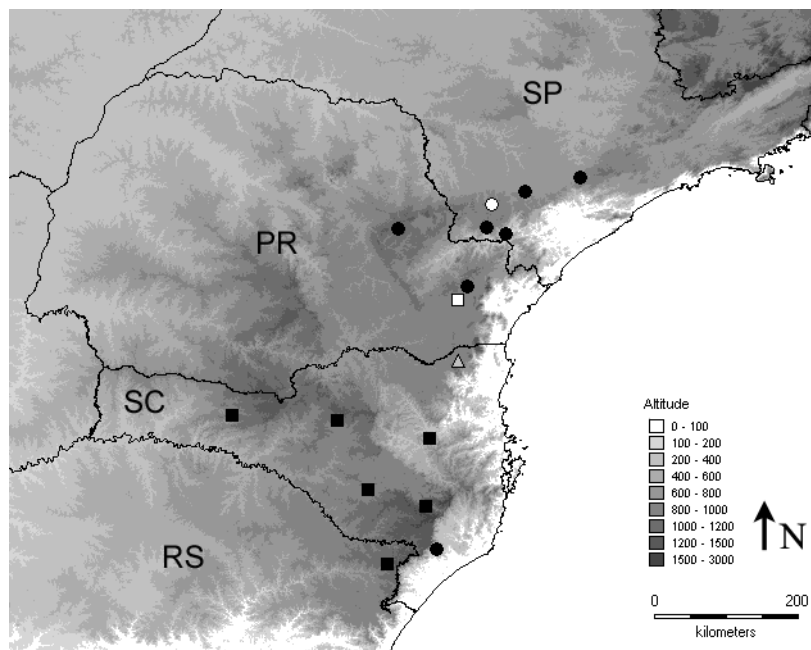


FIGURE 8. Geographic distribution of *Sphaenorhynchus surdus* (squares) and *Sphaenorhynchus caramaschii* **sp. nov.** (circles). The open symbols indicate the type localities of the two species. The gray triangle indicates the sympatric occurrence of both species. The abbreviations refer to the Brazilian states of São Paulo (SP), Paraná (PR), Santa Catarina (SC), and Rio Grande do Sul (RS).

TABLE 2. External morphometry of *Sphaenorhynchus surdus* (holotype and other males) and *S. caramaschii* **sp. nov.** (holotype and paratypes). Values presented in mm as mean \pm standard deviation (range). “NM” means “not measured” because of the individual was damaged. Holotype of *S. surdus* based on data in Cochran (1953).

Measurement	<i>S. surdus</i>		<i>S. caramaschii</i>		
	Holotype	Males (n = 17)	Holotype	Males (n = 11)	Females (n = 2)
Snout-vent-length	28	25.78 \pm 2.29 (22.85 – 29.32)	24.33	24.67 \pm 0.98 (23.25 – 25.94)	26.45 – 28.89
Head length	7.5	7.59 \pm 0.74 (6.17 – 9.14)	8.01	7.48 \pm 0.35 (6.91 – 8.10)	8.18 – 8.51
Head width	7.5	7.75 \pm 0.53 (6.80 – 8.41)	7.55	7.54 \pm 0.38 (6.66 – 7.95)	8.20 – 8.55
Eye diameter	Not provided	2.13 \pm 0.21 (1.74 – 2.67)	2.06	2.13 \pm 0.16 (1.93 – 2.52)	2.20 – 2.38
Interorbital distance	Twice the width of upper eyelid	3.53 \pm 0.36 (2.97 – 4.19)	3.59	3.52 \pm 0.33 (3.05 – 4.15)	4.11 – 4.38
Eye-nostril distance	Not provided	2.37 \pm 0.18 (2.10 – 2.68)	2.54	2.46 \pm 0.19 (2.23 – 2.83)	2.84 – 2.88
Internostril distance	Not provided	1.77 \pm 0.23 (1.40 – 2.19)	1.88	1.72 \pm 0.15 (1.52 – 1.98)	1.72 – 2.17
Thigh length	12	12.43 \pm 0.99 (10.97 – 14.11)	12.02	12.02 \pm 0.58 (11.33 – 13.35)	NM – 13.12
Tibia length	13.5	12.53 \pm 0.86 (11.07 – 13.86)	11.71	12.51 \pm 0.56 (11.52 – 13.33)	NM – 13.00
Foot length	11.5	11.37 \pm 0.91 (10.17 – 12.85)	10.85	11.64 \pm 0.87 (10.34 – 13.36)	NM – 12.53

Color in life. Dorsum and limbs are bright green with brownish dots. Venter smooth green, but lighter than dorsum. Presence of a white dorsolateral line from the snout to the groin; under this line there is a dark line from the snout to the flanks. Dark line from the eye to the snout present. Cloacal region with white spots.

Color in preservative (70% ethanol). Dorsum and limbs of whitish beige with brownish dots. Ventral region whitish yellow. Limbs in ventral view darker than belly. The dark line from the eyes to the snout is present. Cloacal region with white spots. Nuptial pad brown.

Variation. Females larger than males and lacking nuptial pad that is present in males. There is little variation in external morphology within the sexes (see also Table 2). Differently from the holotype, some paratypes have the head broader than long, or as broad as long, and the thigh shorter than the tibia, or as long as the tibia. The snout shape varies from truncate to slightly mucronate. In most individuals the dark line from the snout extends to the flanks, in some individuals ends in the edge of the eyes. Dorsal pigmentation varies considerably among individuals, since from totally uniform green to strongly brownish spotted dorsum.

Advertisement call. The advertisement call of the *S. caramaschii* described here was recorded in the municipality of Piraquara, state of Paraná. It has 22 to 43 notes, frequency ranging from 0.94 \pm 0.45 kHz (range: 0.11 – 1.57; n = 30 notes; 1 male) to 4.24 \pm 0.40 kHz (range: 3.70 – 5.43; n = 30 notes; 1 male). Mean dominant frequency is 2.62 \pm 0.09 kHz (range: 2.50 – 2.76; n = 30 notes; 1 male). The mean duration of the call is 8.49 \pm 2.83 seconds (range: 5.23 – 10.21; n = 5 calls; 1 male), but it depends on the number of notes in the call. The mean duration of an individual note is 0.06 \pm 0.01 s (range: 0.04 – 0.07; n = 30 notes; 1 male). The notes are pulsed and the mean interval between them is 0.22 \pm 0.04 s (range: 0.18 – 0.37; n = 30 notes; 1 male) (Table 1; Figure 7). Two adjacent males may call in antiphony.

Tadpole. Unknown.

Natural history. Males breed in the hot and rainy season of the year (September-March) and call from the floating vegetation in temporary or permanent ponds. The reproductive mode is number 1 (*sensu* Haddad and Prado, 2005): eggs and exotrophic tadpoles in lentic water. The eggs are attached individually to submerged vegetation.

Geographic distribution. Besides the type locality, the species occurs also in the municipalities of Pilar do Sul, Iporanga, Apiaí, and Ribeirão Grande, all in the state of São Paulo, in the municipality of Piraí do Sul and Piraquara, state of Paraná, and in the municipality of Treviso and São Bento do Sul (based on recordings), state of Santa Catarina (Figure 8).

Etymology. The specific name honours Dr. Ulisses Caramaschi, who first recognized this species as new and for his large contribution to the knowledge of Brazilian anurans.

Discussion. *Sphaenorhynchus caramaschii* is known to occur in the highlands of the states of São Paulo, Paraná, and Santa Catarina. In Santa Catarina it also occurs in a lowland locality (about 150m a.s.l.). In the municipality of São Bento do Sul (state of Santa Catarina) it is sympatric with *S. surdus* and may be sympatric with this species in the neighborhood of the municipality of Curitiba (state of Paraná) as well, due to the proximity between the municipalities of Piraquara (where we found *S. caramaschii*) and Curitiba (the type locality of *S. surdus*). The municipality of Piraquara was part of the municipality of Curitiba until 1984 and, therefore, there is a chance that the type series of *S. surdus* was collected in Piraquara, confirming the sympatry of these two species in the state of Paraná. However, the two species have so far not been observed occurring in the same pond. The status of the populations of the municipalities of Dom Pedro de Alcântara and Torres, both in the state of Rio Grande do Sul and considered as *S. surdus* (Garcia & Vinciprova, 2003), needs to be reevaluated. Both species seem to be abundant, occurring in pristine and degraded areas (such as fish farms: P. C. A. Garcia, pers. obs.). Although, we still lack some information on the geographic distribution, and other natural history traits, of both species (*S. caramaschii* and *S. surdus*), based on our current knowledge we are able to indicate these species as Least Concern, according to the IUCN criteria. Genetic studies involving both species are being prepared and significant differences among these two species are recognized (J. Faivovich, pers. com.).

Acknowledgements

Miguel Vences and Jiří Moravec made valuable comments on early versions of the manuscript. Ronald Heyer, Magno Segalla, and Axel Kwet provided recordings of advertisement calls of some localities; Greg Schneider provided information and pictures of the holotype of *Sphaenorhynchus surdus*. Glaucia M. F. Pontes, Júlio C. Moura-Leite, and Ivan Sazima allowed the access to museum specimens from the Museu de Ciências e Tecnologia, PUCRS, Museu de História Natural Capão da Imbuia, and from the Museu de História Natural, UNICAMP, respectively; Jaime R. Somera made the line drawings; FAPESP (BIOTA proc. no. 01/13341-3 and procs. JP 05/56228-3 and 06/57853-1) and CNPq for grants and CAPES for scholarships. RL thanks CNPq for doctoral fellowship and Sincol Reflorestadora for logistic support in Lebon Régis. IBAMA(RAN) provided collecting permits.

References

- Bertoluci, J. & Rodrigues, M.T. (2002) Seasonal patterns of breeding activity of Atlantic rainforest anurans at Boracéia, southeastern Brazil. *Amphibia-Reptilia*, 23, 161–167.
- Bokermann, W.C.A. (1966) *Lista anotada das localidades tipo de anfíbios brasileiros*. Serviço de Documentação, São Paulo. 183p.

- Boulenger, G.A. (1888) A list of batrachians from the province Santa Catharina, Brazil. *Annals and Magazine of Natural History*, I 6, 415-417.
- Cei, J. M. (1980) Amphibians of Argentina. *Monitore Zoologico Italiano* (N.S.) Monografia, 2, 1-609.
- Cochran, D.M. (1953) Three new Brazilian frogs. *Herpetologica*, 8, 111-115.
- Conte, C.E. & Machado, R. A. (2005) Riqueza de espécies e distribuição espacial e temporal em comunidade de anuros (Amphibia, Anura) em uma localidade de Tijucas do Sul, Paraná, Brasil. *Revista Brasileira de Zoologia*, 22, 940-948.
- Duellman, W.E. (2001) *Hylid Frogs of Middle America*. Volume 1. Society for the Study of Amphibians and Reptiles, 694 pp.
- Duellman, W.E. & Wiens, J.J. (1992) The status of the hylid frog genus *Ololygon* and the recognition of *Scinax* Wagler, 1830. *University of Kansas, Museum of Natural History Occasional Papers*, 151, 1-23.
- Faivovich, J., Haddad, C.F.B., Garcia, P.C.A., Frost, D.R., Campbell, J.A. & Wheller, W.C. (2005) Systematic review of the frog family Hylidae, with special reference to Hyliinae: phylogenetic analysis and taxonomic revision. *Bulletin of the American Museum of Natural History*, 294, 1-240.
- Frost, D.R. (2007) *Amphibian Species of the World: an online reference*. American Museum of Natural History, New York, USA, Available from: <http://research.amnh.org/herpetology/amphibia/index.php>. (July 4, 2007).
- Garcia, P.C. A. & Vinciprova, G. (2003) Anfíbios. In: Fontana, C. S., Bencke, G. A. & dos Reis, R. E. (Orgs.), *Livro Vermelho da Fauna Ameaçada de Extinção no Rio Grande do Sul*. Porto Alegre: Edipucrs, pp. 147-164.
- Goin, C.J. (1957) Status of the frog genus *Sphoerohyla* with a synopsis of the species. *Caldasia*, 8, 11-31.
- Gorham, S.W. (1974) Checklist of World Amphibians up to January 1, 1970. Saint John, Lingley Printing Co. Ltd., 173p.
- Haddad, C.F.B. & Prado, C.P.A. (2005) Reproductive modes in frogs and their unexpected diversity in the Atlantic Forest of Brazil. *BioScience*, 55, 207-217.
- Heyer, R.W., Rand, A.S., Cruz, C.A.G., Peixoto, O.L. & Nelson, C.E. (1990) Frogs of Boracéia. *Arquivos de Zoologia*, 31, 231-410.
- Pombal, J.P.Jr. (1997) Distribuição espacial e temporal de anuros (Amphibia) em uma poça permanente na Serra de Paranapiacaba, sudeste do Brasil. *Revista Brasileira de Biologia*, 57, 583-594.
- Pombal, J.P.Jr. & Haddad, C.F.B. (2005) Estratégias e modos reprodutivos de anuros (Amphibia) em uma poça permanente na Serra de Paranapiacaba, Sudeste do Brasil. *Papéis Avulsos de Zoologia*, 45, 201-213.
- Lutz, A. & Lutz, B. (1938) On *Hyla aurantiaca* Daudin and *Sphaenorhynchus* Tschudi and on two allied Hylidae from south-eastern Brazil. *Annais da Academia Brasileira de Ciencias*, 10, 175-194.
- Toledo, L.F. & Haddad, C.F.B. (2005) Acoustic repertoire and calling site of *Scinax fuscomarginatus* (Anura, Hylidae). *Journal of Herpetology*, 39, 455-464.

Appendix 1. Specimens examined

Sphaenorhynchus bromelicola: BAHIA: Maracás: MZUSP 99475; 99477; 99479-80; 99483. *Sphaenorhynchus caramaschii*: SÃO PAULO: Iporanga: CFBH 6320-23; Ribeirão Branco: CFBH 194; 267; 370; 1777; 2210; 2219-23; 2285-94; 2313; 6875-78; 6933-37; Ribeirão Grande: CFBH 15581-84; PARANÁ: Piraí do Sul: CFBH: 8223; Piraquara: MCP 8325; SANTA CATARINA: Treviso: CFBH 9854; 10325. *Sphaenorhynchus carneus*: AMAZONAS: Manaus: CFBH 4984-87. *Sphaenorhynchus dorisae*: AMAZONAS: Lago Janauarí: MZUSP 53720-23. *Sphaenorhynchus lacteus*: AMAZONAS: Manaus: CFBH 4993-94; COLOMBIA: Chaquetá los Alicangaros: MZUSP 99416; 99418; 99421; 99425. *Sphaenorhynchus orophilus*: RIO DE JANEIRO: Terezópolis: MZUSP 53463-65. *Sphaenorhynchus palustris*: ESPÍRITO SANTO: Conceição da Barra: CFBH 2375-77; BAHIA: Porto Seguro: CFBH 3702-03. *Sphaenorhynchus pauloalvini*: ESPÍRITO SANTO: Linhares: MZUSP 53319-21. *Sphaenorhynchus planicola*: ESPÍRITO SANTO: Aracruz: CFBH 5365; 5562; Conceição da Barra: CFBH 4155; 9693-94; Linhares: CFBH 1575; Serra: CFBH 1440. *Sphaenorhynchus prasinus*: ESPÍRITO SANTO: São Mateus: CFBH 1524; 1636-39. *Sphaenorhynchus surdus*: PARANÁ: Curitiba: MZUM 106736; SANTA CATARINA: Lages: CFBH 8546; ZUEC 11256-57; Lontras: CFBH 13909-13; MCP 1300; 1303-04; São Bento do Sul: CFBH 11052-53; Lebon Régis: CFBH 15750-15751; Ponte Serrada: CFBH 15752; RIO GRANDE DO SUL: São José dos Ausentes: MCP 4618; 4622.