



THE TADPOLE, ADVERTISEMENT CALL, AND GEOGRAPHIC DISTRIBUTION OF *PHYSALAEMUS MAXIMUS* FEIO, POMBAL & CARAMASCHI, 1999 (AMPHIBIA, ANURA, LEIUPERIDAE)¹

(With 2 figures)

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ABSTRACT: Herein we describe the tadpole and the advertisement call of *Physalaemus maximus*, based on specimens from the Municipality of Ouro Preto, State of Minas Gerais, Brazil. Our data are compared with the information available on the *P. olfersii* species group. Updated data on geographic distribution are also presented.

Key words: Anura. Leiuperidae. *Physalaemus maximus*. Tadpole. Advertisement call.

RESUMO: O girino, canto de anúncio e distribuição geográfica de *Physalaemus maximus* Feio, Pombal & Caramaschi, 1999 (Amphibia, Anura, Leiuperidae).

Descreve-se o girino e o canto de anúncio de *Physalaemus maximus*, baseado em espécimes provenientes do Município de Ouro Preto, Estado de Minas Gerais, Brasil. Os dados são comparados com as informações disponíveis para o grupo de *P. olfersii*. Dados atualizados sobre distribuição geográfica também são apresentados.

Palavras chave: Anura. Leiuperidae. *Physalaemus maximus*. Girino. Vocalização.

INTRODUCTION

The neotropical genus *Physalaemus* Fitzinger, 1826 is currently composed by 39 species occurring from northern to southern South America, east to the Andes (NASCIMENTO *et al.* 2005). *Physalaemus maximus* Feio, Pombal & Caramaschi, 1999 was originally allocated to the *P. signifer* species group (Girard, 1853), according to LYNCH (1970). However, those authors suggested the possibility that *P. aguirrei* Bokermann, 1966, *P. maximus*, *P. olfersii* (Lichtenstein & Martens, 1856), and *P. soaresi* Izecksohn, 1965 would possibly form a separate species group. NASCIMENTO *et al.* (2005) revised the systematics of the genus *Physalaemus* and defined seven species groups, allocating those four species in the *P. olfersii* species group. The species of this group occur in the Atlantic Forest Domain (*sensu* AB'SÁBER, 1977) from the State of Bahia southwards to the State

of Santa Catarina, Brazil. Within the *P. olfersii* species group, the tadpoles of *P. maximus* and *P. olfersii*, and the advertisement call of *P. maximus* are still unknown. Herein, we describe the tadpole, the advertisement call, and present new information on the geographic distribution of *P. maximus*.

MATERIAL AND METHODS

Adults and a foam nest of *P. maximus* were collected in a swamp at the margins of Estrada Real (20°29'S, 43°35'W, 1248m), close to the locality of Santa Rita de Ouro Preto, Municipality of Ouro Preto, State of Minas Gerais, Brazil, on 29/IX/2005. One foam nest was collected and maintained in our laboratory. Nineteen tadpoles between stages 35-38 were fixed and preserved in 5% formalin and deposited in the Amphibian Collection of the Museu Nacional - Rio de Janeiro (MNRJ 46717).

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Tadpoles were staged according to GOSNER (1960). Measurements and terminology follow ALTIG & McDIARMID (1999). Measurements were taken using a caliper (0.2mm) and an ocular grid millimeters in stereomicroscope.

Advertisement calls were recorded on the same date and locality where the foam nest was collected, using a Coby CX-R50 portable cassette recorder. Sonogramas were analyzed with the softwares Avisoft-Sonograph Light 1, version 2.7 and Cool Edit Pro, version 2.0. Vocalizations were digitized and edited at a sampling frequency of 11 kHz, FFT with 256 points, filter Hamming and 16-bit resolution. Air temperature was recorded with a digital thermometer to the nearest 0.5°C. Description and terminology of acoustic properties of advertisement calls follows DUELLMAN & TRUEB (1986). Comparison between acoustic parameters of calls of the *P. olfersii* species group was performed using data from HEYER *et al.* (1990), PIMENTA & CRUZ (2004) and WEBER *et al.* (2005).

RESULTS

Description of the tadpole – Stages 35-38. Mean total length 26.1mm (range=23.6-27.9mm; n=19) (Tab.1). Body oval in dorsal and ventral views, elliptical in lateral views (Figs.1A-C). Body length about 41% of total length; body height about 56% of body length and 72% of body width. Snout rounded in dorsal view, nearly rounded in lateral view. Eyes dorsolateral; eye diameter about 13% of body length. Distance between eyes about 44% of body width. Nostril-snout distance about 14% of body length. Nostrils elliptical, large, nearly round, oriented dorsally, closer to the tip of snout than to the eyes. Nostril diameter about 28% of nostril-snout distance. Spiracle tubular-shaped, sinistral, of medium length, posterodorsally oriented, closer to the eyes than to the anal tube. Anal tube wide, well developed, dextral, with its anterior half attached to the ventral fin. Tail length about 58% of total length. Tail height less than body height. Dorsal fin originating with the caudal musculature, slightly arched and wider than dorsal fin, ending in a rounded tip. Oral disc anteroventral approximately 30% of body width. Labial tooth row formula 2(2)/3(1) (Fig.1D). One row of marginal papillae in the upper lip with a large dorsal gap. Lower lip with one row of marginal papillae, alternately

projected anteriorly and posteriorly, emulating two rows. Jaw sheaths black, completely serrated; upper jaw sheath arch-shaped and lower sheath “V”-shaped.

Color – In life, body translucent with many brown and black spots on dorsum and golden dots scattered all over the body; brown spots on dorsal surface of tail; lateral surfaces with scattered brown dots; legs white, immaculate; iris black with yellow and golden points. In preservative, the color pattern is the same as in life, but faded. The color of the iris is also faded, remaining grey.

Advertisement call – The advertisement call consisted of a single note with a fundamental frequency and six harmonics between 0.69 and 1.81kHz, with weak descendent frequency modulation (Fig.2A-B). The mean duration of the advertisement call was 2.01s (SD=0.26; range=1.09-2.31; n=42 calls of one male), and the mean intercall interval (as defined by PIMENTA & CRUZ, 2004) was 2.39s (SD=1.04; range=1.19-6.23; n=42 calls of one male). Fundamental frequency was about 0.69 and 0.82kHz. The dominant frequency presented two values: in 50% of the calls it was 0.732kHz and in the remaining 50% it was 0.775kHz, always corresponding to the first harmonic; the sixth harmonic ranged from 1.59 to 1.81kHz.

TABLE 1. Range, mean, and standard deviation (SD) of measurements (mm) of *Physalaemus maximus* tadpoles.

	RANGE	MEAN	SD
Total length	23.6 – 27.8	26.1	1.0
Body length	10.0 – 11.6	10.8	0.5
Body width	6.6 – 8.6	7.8	0.5
Body height	5.0 – 7.9	6.0	0.7
Tail length	13.6 – 16.7	15.3	0.8
Tail height	3.6 – 6.4	4.9	0.5
Internostril distance	1.2 – 1.6	1.4	0.1
Interorbital distance	3.0 – 3.8	3.4	0.3
Eye diameter	1.2 – 2.1	1.4	0.2
Nostril diameter	0.4 – 0.5	0.4	0.0
Eye-nostril distance	1.5 – 2.00	1.7	0.1
Nostril-snout distance	1.1 – 1.9	1.5	0.2
Oral disc width	2.1 – 2.7	2.3	0.2

(n=19, stages 35-38).

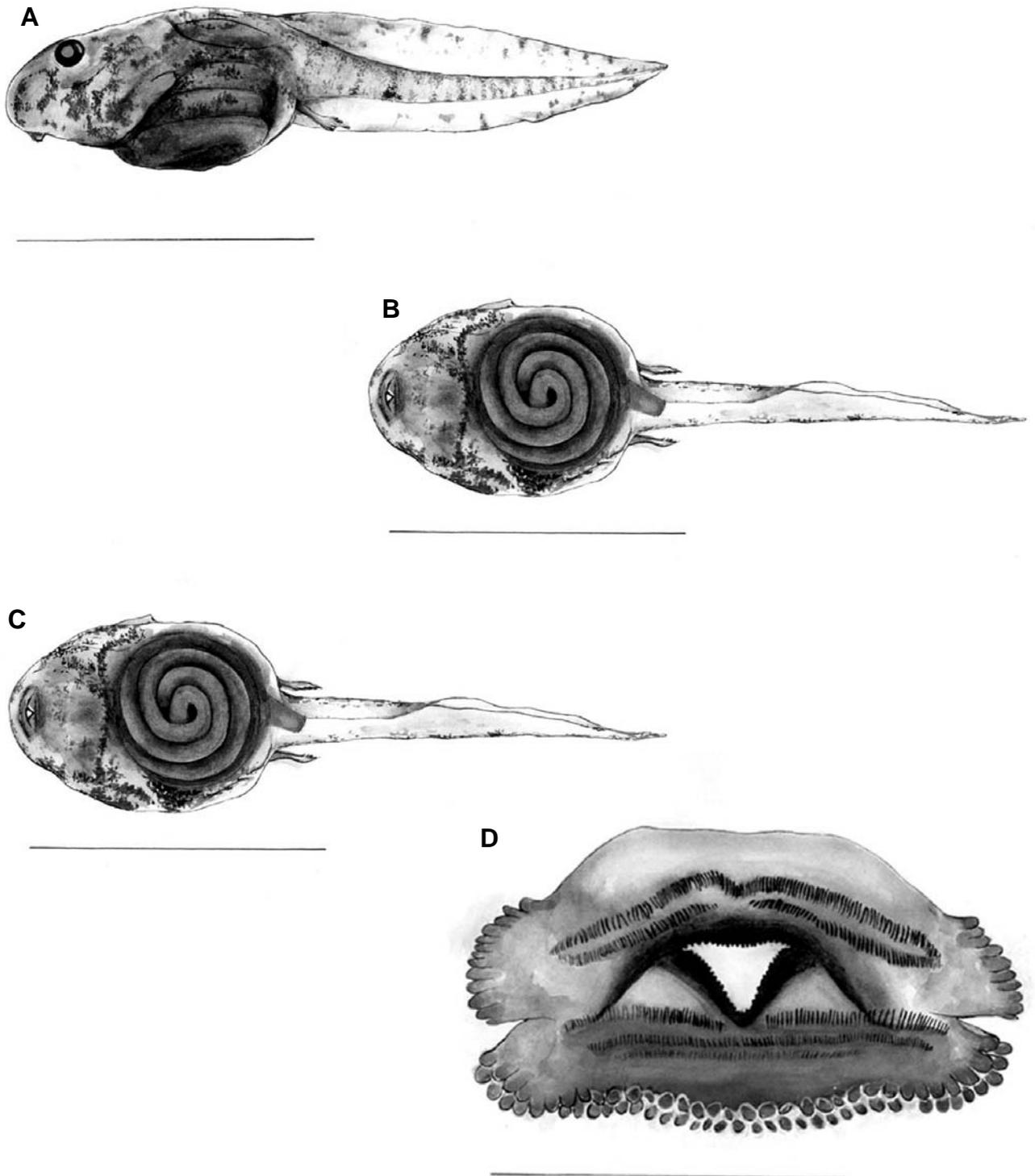


Fig. 1- Tadpole of *Physalaemus maximus*, stage 37: (A) lateral view; (B) dorsal view; (C) ventral view (scale bars = 10mm); (D) oral disc, scale bar = 1mm.

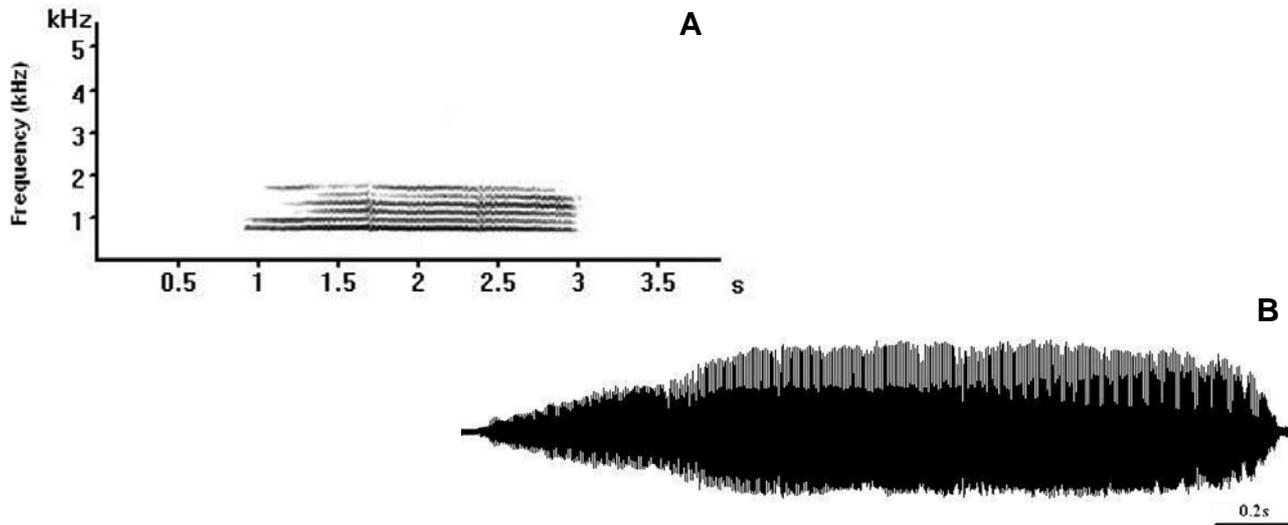


Fig.2- (A) Audiospectrogram, and (B) waveform of the advertisement call of *Physalaemus maximus* recorded at Ouro Preto, Minas Gerais, Brazil on 22 April 2002, 06:51 PM. Air temperature = 26°C. Collected specimen (LZV.520A). Scale bar = 0.5s.

DISCUSSION

The tadpole of *P. maximus* presents the same morphological general pattern of the tadpoles of the *P. olfersii* species group, differing in some important details. Tadpoles of *P. maximus* are larger and more robust than tadpoles of *P. aguirrei* and *P. soaresi* (combined total length for these species 16.6-25.4mm; PIMENTA & CRUZ, 2004; WEBER *et al.*, 2005). The tadpoles of *P. maximus* have a smaller tail in relation to total length than tadpoles of *P. soaresi*. *Physalaemus maximus* has the highest tail in relation to body height in comparison with the other tadpoles of the *P. olfersii* species group. The tadpole of *P. maximus* also presents golden dots scattered all over the body, absent in *P. aguirrei* and *P. soaresi*. All tadpoles of the *P. olfersii* species group present the same labial tooth row formula. The tadpole of *P. maximus* differs from *P. soaresi* by the presence of one row of marginal papillae alternately projected anteriorly and posteriorly on the lower lip, emulating two rows; the same pattern as described for *P. aguirrei* (PIMENTA & CRUZ, 2004).

The advertisement call distinguishes *P. maximus* from other species of the *P. olfersii* species group mainly by differences in dominant frequency and call duration. *Physalaemus maximus* differs from other members of the group in having the lowest fundamental frequency; *P. maximus* differs

from *P. aguirrei* by a longer call duration and from *P. olfersii* in the smaller call duration. The comparison of advertisement call data for members of the *P. olfersii* species group is shown in table 2.

According to NASCIMENTO *et al.* (2005), *P. aguirrei*, *P. maximus*, *P. olfersii*, and *P. soaresi* form a monophyletic group of species. Larval characters have been used to resolve taxonomic problems and phylogenetic relationships among genera and species groups (*e.g.* Cruz, 1982). The resemblances found among the characters of the tadpoles of *P. aguirrei*, *P. maximus*, *P. olfersii*, and *P. soaresi* corroborate the hypothesis that the *P. olfersii* species group constitutes a distinct group worth recognition.

Geographic distribution – *Physalaemus maximus* was first known from Serra do Brigadeiro, Municipality of Araçuaia, State of Minas Gerais (FEIO *et al.*, 1999), and it was considered a restrict endemic species known only from this locality. In recent surveys of the herpetofauna on the region of Ouro Preto, BAÊTA *et al.* (2005) collected the first material of *P. maximus* outside the type-locality, extending its geographic distribution 120km to the southwest. The updated geographical distribution of this species is the type-locality, Serra do Brigadeiro, and the region of Ouro Preto, both in the State of Minas Gerais, Brazil. Serra do Brigadeiro is situated in extreme northern of

Mantiqueira mountain ranges, while the region of Ouro Preto is situated in southern Espinhaço mountain ranges, both being high altitude rocky complexes and showing high diversity and endemics species. Many recent works have enlarged the geographical distribution of Brazilian

anuran species that were previously considered as narrow endemics (e.g. PIMENTA & SILVANO 2001, 2002; SILVANO & PIMENTA, 2002) and new species are still being described frequently, due to the existence of several Brazilian areas whose herpetofauna remains poorly known.

TABLE 2. Comparison between acoustic parameters of calls of the *Physalaemus olfersii* species group.

	CALL DURATION (s)	DOMINANT FREQUENCY (kHz)	CALL STRUCTURE (s)	FREQUENCY MODULATION	FUNDAMENTAL FREQUENCY (kHz)	NUMBER OF HARMONICS	FREQUENCY AMPLITUDE (kHz)	REFERENCE
agui	0.21-0.25	3.1	H	D	0.43-1.03	7	0.43-4.73	PIMENTA & CRUZ (2004)
max	1.09-2.31	0.732 or 0.775	H	N	0.69-0.83	6	0.61-1.81	Present study
olfer	3.5-4.0	1.7-2.0	Var	WFD	?	9	1.00-2.00	HEYER <i>et al.</i> (1990)
soar	1.34-2.40	3.3	H	A	?	5	?	WEBER <i>et al.</i> (2005)

Data from HEYER *et al.* (1990), PIMENTA & CRUZ (2004) and WEBER *et al.* (2005). (agui) *P. aguirrei*; (max) *P. maximus*; (olfer) *P. olfersii*; (soar) *P. soaresi*; (H) harmonic structure, (Var) structure variable, (A) ascendent frequency modulation, (D) descendent frequency modulation, (N) no frequency modulation, (WFD) weak descendent frequency modulation.

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