

## Correspondence

**First account of distress calls in leiuperid frogs  
with a description of the advertisement call of topotypic  
*Physalaemus maximus***

DIEGO JOSÉ SANTANA<sup>1</sup> & MÁRIO RIBEIRO MOURA<sup>2</sup>

<sup>1</sup> Universidade Federal da Paraíba, Centro de Ciências Exatas e da Natureza, Departamento de Sistemática e Ecologia, CEP 58051-900. João Pessoa, PB, Brazil

<sup>2</sup> Museu de Zoologia João Moojen, Universidade Federal de Viçosa. Av. Peter Henry Rolfs s/n. CEP 36570-000. Viçosa, MG, Brazil

Corresponding author: DIEGO JOSÉ SANTANA, e-mail: santana\_herpeto@yahoo.com.br

Manuscript received: 8 June 2011

*Physalaemus maximus* FEIO, POMBAL & CARAMASCHI, 1999 (Fig. 1) is a leiuperid frog endemic to the Brazilian Atlantic Forest. It belongs to the *Physalaemus olfersii* species group (NASCIMENTO et al. 2005) and is distinguished mainly by its larger size (see FEIO et al. 1999, CASSINI et al. 2010). *Physalaemus maximus* is restricted to the montane forest of southeastern Brazil and known only from two localities: the Serra do Brigadeiro Mountains, municipality of Araponga, and the Serra do Ouro Branco Mountains, between the boundaries of the municipalities of Ouro Preto and Ouro Branco (BAËTA et al. 2005), both in the State of Minas Gerais, Brazil.

Anuran advertisement calls are species-specific (GERHARDT & DAVIS 1988) and their acoustic analysis can significantly contribute to resolving taxonomic issues (e.g., DUELLMAN & TRUEB 1986). In the behavioural repertoire of frogs and toads, calls are used in different contexts, and the same species may present different signals (e.g., WELLS 1977). A distress call is characterized by loud, explosive sounds emitted in response to disturbance or potential predators (DUELLMAN & TRUEB 1986). BAËTA et al. (2007) described the advertisement call of *P. maximus* from a locality ca. 120 km distant from the type locality, but other vocalizations of this species have remained unknown. Herein, we describe the advertisement and the distress calls of *P. maximus* from its type locality.

Individuals of *Physalaemus maximus* were calling on 4 December 2009, from after sunset until about 22:00 hrs, in a permanent pond inside a forested area in the Serra do Brigadeiro State Park (PESB) (20°43'19"S; 42°28'43"W, datum SAD1969, 1,320 m elevation), municipality of Araponga, State of Minas Gerais, Brazil. Advertisement calls of a topotypic male were recorded on site, calling from the grass at the margin of a permanent pond, with the recorder being positioned about 50 cm from the individual. On the following day in the laboratory, we elicited by handling several distress calls from a male collected the day before

and recorded these using a Panasonic RR-US450® digital recorder. The recordings were then analysed with AVISOFT-SASLab Light for Windows (v. 3.74) and SoundRuler (V. 0.9.4.1). Audiospectrograms were produced with the following parameters: FFT = 256, frame = 100, overlap = 75 and flat top filter. A sound spectrogram, oscillogram and power spectrum were generated in SoundRuler (V. 0.9.4.1). Description and terminology of the calls' acoustic properties follows DUELLMAN & TRUEB (1986). A voucher specimen is deposited at the herpetological collection of the Museu de Zoologia João Moojen, Universidade Federal de Viçosa, Viçosa, State of Minas Gerais (MZUFV 10200).

Males of *P. maximus* are reproductively active at the beginning of the rainy season between October and December. The advertisement call is emitted sporadically, apparently more frequently in high-density choruses. Playbacks of the advertisement call were frequently responded to by nearby males. The advertisement call (Fig. 2) of the topotypic specimen is composed by one single multipulsed note, with a non-harmonic structure and a frequency modulation at the beginning; it has a mean duration of  $2.05 \pm 0.16$  s (range 1.8–2.4 s;  $n = 7$ ); intervals between pulses range between 0.005 and 0.007 s (mean  $0.006 \pm 0.001$  s;  $n = 7$ ); the call shows a mean of  $332 \pm 30$  pulses per note (range 312–398;  $n = 7$ ); pulse rate ranges from 158 to 167 pulses per second ( $161 \pm 3.4$ ;  $n = 7$ ), and the dominant frequency lies at 1.07 kHz. The recorded males of *P. maximus* called in a multi-species chorus with the following other anuran amphibians: *Aplastodiscus leucopygeus*, *Dendropsophus decipiens*, *D. minutus*, *D. elegans*, *Hypsiboas faber*, *Phyllomedusa burmeisteri*, *Physalaemus feioi*, *Rhinella pombali*, *Scinax eurydice* and *S. aff. perereca*.

Several distress calls (Fig. 3) were emitted by one male *P. maximus* (MZUFV 10200) during handling. The call was produced with an open mouth, and consists mainly of two single (rarely one), harmonic, unpulsed notes with a duration of 0.05–0.14 s (mean  $0.09s \pm 0.03$  s;  $n = 19$ ). The domi-



Figure 1. An adult male *Physalaemus maximus* (MZUFV 10200, 46.3 mm snout-vent length) whose call was recorded in the Serra do Brigadeiro State Park, municipality of Araponga, Minas Gerais, Brazil. Photo: M. RIBEIRO MOURA.

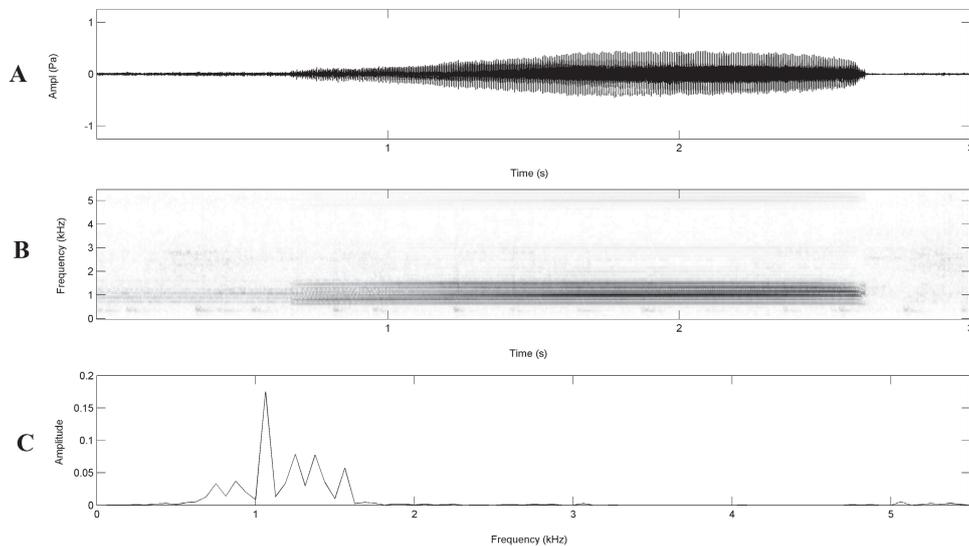


Figure 2. *Physalaemus maximus*: advertisement call (A) oscillogram, (B) audiospectrogram and (C) power spectrum of a single call (air temperature 21°C).

nant frequency (taken at the point of maximum energy in the oscillogram) was 1.06-1.75 kHz (mean  $1.39 \pm 0.16$  kHz;  $n = 19$ ).

The advertisement call parameters of individuals from PESB are similar to those previously described by BAÊTA et al. (2007). However, in contrast to these authors, who found intercall intervals (mean  $2.39 \pm 1.04$ ; range 1.19-6.23), the present study shows that the advertisement call *P. ma-*

*ximus* is emitted sporadically, often stimulated by the presence of conspecific calling males. Moreover, this result is confirmed by the focal males' response to playbacks and call imitations by the researcher. CASSINI et al. (2010) summarized the advertisement calls of the members in the *P. olfersii* species group and stated that the 'harmonics' of BAÊTA et al. (2007) were actually 'side bands' sensu VIELLIARD (1993). Our results (i.e., a multipulsed call with

## Correspondence

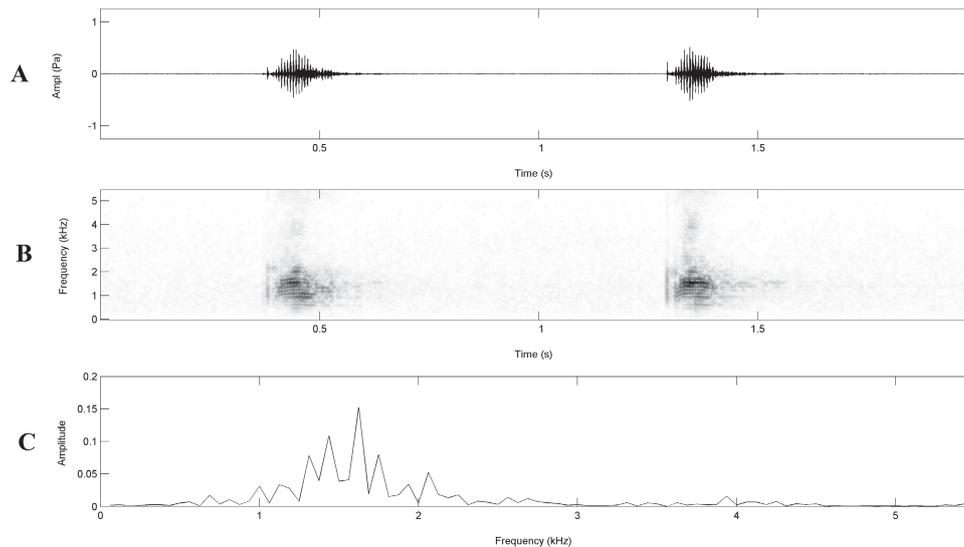


Figure 3. *Physalaemus maximus*: distress call (A) oscillogram and (B) audiospectrogram of two calls (air temperature 21°C).

a mean of 332 pulses per note and a pulse rate of 161) corroborate the findings of CASSINI et al. (2010).

TOLEDO & HADDAD (2009) described distress calls as a plesiomorphic character in anurans, assuming that some groups lost the capability of emitting distress calls. While this is true for the genus *Scinax* (TOLEDO & HADDAD 2009) and several members of the families Leiuperidae (TOLEDO & HADDAD 2009), Myobatrachidae and Limnodynastidae (WILLIAMS et al. 2000), according to our findings, a distress call is present in at least one leiuperid species. Nevertheless, the presence of this kind of call within the Leiuperidae can be related to the fact that *P. maximus* is the largest species in its genus and one of the largest in its family. Anuran body size (i.e., snout-vent length) has been directly related to the success of acoustic defensive strategies, since according to TOLEDO & HADDAD (2009), larger frogs emit more distress calls. Therefore, it is likely that other leiuperid frogs that match *P. maximus* in size, may also produce distress calls (e.g., *Eupemphix nattereri*, *Physalaemus marmoratus* and *Physalaemus centralis*).

### Acknowledgements

We thank SARAH MÂNGIA for her assistance during fieldwork. Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) and Instituto Estadual de Florestas (IEF) issued collection permits (IBAMA 20857-1, IEF 071/09), and the Universidade Federal de Viçosa provided logistic support. We are also grateful to the Fundação de Amparo à Pesquisa do Estado de Minas Gerais (FAPEMIG) for their financial support (CRA-APQ-02370-09) and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for their fellowships granted to MRM and DJS.

### References

BAÊTA, D., P. H. BERNARDO, B. ASSIS, V. A. SÃO-PEDRO, L. O. DRUMMOND & M.R.S. PIRES (2005): *Physalaemus maximus* – Herpetological Review, **36**: 200.

BAÊTA, D., A. C. C. LOURENÇO, T. L. PEZZUTI & M. R. S. PIRES (2007): The tadpole, advertisement call, and geographic distribution of *Physalaemus maximus* Feio, Pombal & Caramaschi, 1999 (Amphibia, Anura, Leiuperidae) – Arquivos do Museu Nacional, **65**: 27–32.

CASSINI, C. S., C. A. G. CRUZ & U. CARAMASCHI (2010): Taxonomic review of *Physalaemus olfersii* (Lichtenstein & Martens, 1856) with revalidation of *Physalaemus lateristriga* (Steindachner, 1864) and description of two new related species (Anura: Leiuperidae) – Zootaxa, **2491**: 1–33.

CRUZ, C. A. G. (1990): Sobre as relações intergenéricas de Phyllo-medusinae da Floresta Atlântica (Amphibia, Anura, Hylidae) – Revista Brasileira de Biologia, **50**: 709–726.

DUELLMANN, W. E. & L. TRUEB (1986): Biology of amphibians. – Baltimore and London: Johns Hopkins University Press.

FEIO, R. N., J. P. POMBAL JR. & U. CARAMASCHI (1999): New *Physalaemus* (Anura: Leptodactylidae) from the Atlantic Forest of Minas Gerais, Brazil – Copeia, **1999**: 141–145.

GERHARDT, H. C. & M. S. DAVIS (1988): Variation in the coding of species identity in the advertisement calls of *Litoria verreauxi* (Anura: Hylidae). – Evolution, **42**: 556–563.

NASCIMENTO, L. B., U. CARAMASCHI & C. A. G. CRUZ (2005): Taxonomic review of the species groups of the genus *Physalaemus* Fitzinger, 1826 with revalidation of the genera *Engystomops* Jiménez-De-La-Espada, 1872 and *Eupemphix* Steindachner, 1863 (Amphibia, Anura, Leptodactylidae). – Arquivos do Museu Nacional, **63**: 297–320.

TOLEDO, L. F. & C. F. B. HADDAD (2009): Defensive vocalizations of Neotropical anurans. – South American Journal of Herpetology, **4**: 25–42.

VIELLIARD, J. (1993): Side-bands artifact and digital sound processing. – Bioacoustics, **5**: 159–162.

WELLS, K. D. (1977): The social behavior of anuran amphibians. – Animal Behavior, **25**: 666–693.