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# Parental distress call: a previously unreported defensive call in female *Leptodactylus latrans* (Anura, Leptodactylidae)

Guilherme Alexandre Sestito[1], Diego José Santana[1,*], Adrian Antonio Garda[2] and David Lucas Röhr[2]

**Abstract.** Although anurans present a variety of parental care behaviours, there are only few records available and parental care in anurans to date is a vastly understudied subject. Few species display parental care behaviours consisting of aggressive behaviour, where one or both parents defend their offspring. Behaviours which involve vocalizations are much more common among anurans, as males frequently emit calls with a reproductive function during breeding season.
In this study, we describe a distress call of *Leptodactylus latrans* emitted in an unusual context. On two occasions we recorded female *L. latrans* jumping towards intruders while attempting to bite and emitting distress calls to protect their tadpoles. This display suggests the existence of a new category of distress call, expressed in a parental care context, which diverges from the functions of anuran distress calls reported up to date. Due to the context in which this behaviour was exhibited, we classify this vocalization as parental distress call.

**Key words.** Parental care, acoustic behaviour, aggressive behaviour, Amphibia

## Introduction

Parental care is known for only a minority of the extant anuran species, in which it appears in various forms (Beck, 1998). In these species, parental care may be maternal, paternal or both (McDiarmid, 1978; Beck, 1998). One form of anuran parental care is the guarding of the offspring in different developmental phases, including egg protection and tadpole transportation (McDiarmid, 1978; Beck, 1998; Prado et al., 2000; Gibson & Buley, 2004).

When eggs and tadpoles are under eminent threat, protection may be assured through direct confrontation of the aggressor (Prado et al., 2002; Gibson & Buley, 2004). Frogs of the genus *Leptodactylus* may exhibit aggressive behaviour (e.g. jumping towards the attacker) when their tadpoles are distressed,. Conversely, outside a parental care defensive context, the emission of defensive vocalization is a common strategy for the clade (Toledo & Haddad, 2009).

Acoustic communication plays a main role in the behavioural ecology of most anuran species, particularly for reproductive functions (Gerhardt, 1994). Males of most species emit an advertisement call which mainly serves to attract mates, but also has a spacing function between individuals in a chorus (Wells, 2007).

Acoustic behaviour is predominant in male anurans, but females of certain species may vocalize during distinct contexts. Females of a handful of species respond to males through reciprocal calls, which aid mate localization (Tobias et al., 1998) and may indicate females' reproductive state (Schaepfer & Figeroa-Sandi, 1998) and quality (Bosch & Marquez, 2001), as well as possibly having a function during female-female competition for scarce males (Krishna & Krishna, 2005). Females may also produce an aggressive territorial call when a conspecific of either sex approaches its retreat sites (Steward & Rand, 1991) and a release call when they are clasped during an unreceptive period (Emerson & Boyd, 1999).

[1] Centro de Ciências Biológicas e da Saúde, Universidade Federal de Mato Grosso do Sul, Cidade Universitária, Campo Grande – MS CEP 79070–900, Brasil
[2] Departamento de Botânica, Ecologia e Zoologia, Universidade Federal do Rio Grande do Norte, Campus Universitário, Natal – RN CEP 59078–900, Brasil
* Corresponding author. E-mail: jose.santana@ufms.br

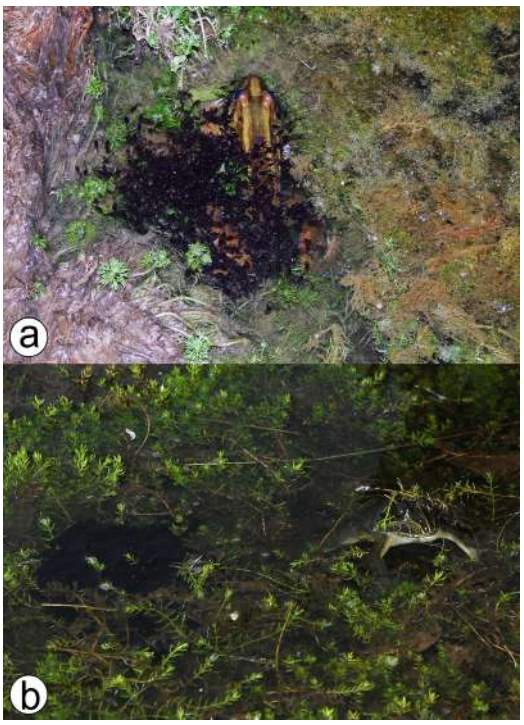


**Figure 1.** Females of *Leptodactylus latrans* exhibiting their parental care behaviour with a tadpole school. (a) Individual from SAG (unvouchered specimen), and (b) individual from BJS.

Vocalizations associated with agonistic behaviours are known for male, female and even juvenile anurans (Martins & Haddad, 1988). Distress calls are generally produced with the mouth widely open when frogs feel threatened, or are grasped by a predator (Hödl & Gollmann, 1986; Toledo & Haddad, 2009).

Understanding the behavioural context under which anurans emit different vocalizations is fundamental for the comprehension of the evolutionary history of this behaviour. Herein, we describe a distress call of *Leptodactylus latrans* which is emitted in an unusual context compared to other Leptodactylids or anurans. We discuss the results considering the functionality and evolution of this vocalization for anurans.

## Material and Methods

We observed two separate events where female *Leptodactylus latrans* emitted distress calls. During a field expedition in November 08, 2009 at Santo Antônio do Glória (SAG) (20º58'30"S , 42º17'16"W), Muriaé Municipality, Minas Gerais State, Brazil, a female *L. latrans* was sighted beside a tadpole school. When approached, she attacked any near object, jumping towards it with her mouth open while screaming. We filmed this behaviour using a Fuji Finepix S5200 ® digital camera. We extracted the audio track from the film using the Online Audio Converter (available at http://online-audio-converter.com), at 44.1 kHz in a .wav format. At another opportunity in November 18, 2011 at Bom Jardim da Serra (BJS) Municipality (28º20'25"S , 49º37'34"W), Santa Catarina State, Brazil, we observed the same behaviour and the distress call emitted by the female in the same context was recorded using a Marantz PMD661 recorder and a Sennheiser ME 66 directional microphone.

We analysed the calls with Raven Pro 1.5 for Windows (Bioacoustics Research Program, 2014) and constructed audio spectrograms in R software using the package "seewave"(Sueur et al., 2008) with the following parameters: FFT window width = 256, Frame = 100, Overlap = 75, and flat top filter. Terminology in call descriptions follows Duellman and Trueb (1986).

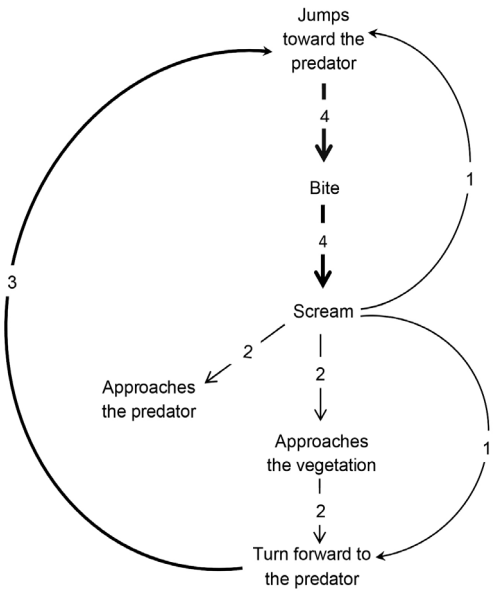


**Figure 2.** Ethogram of the defensive behaviour sequence shown by female Leptodactylus latrans from São João do Glória, municipality of Vieiras, state of Minas Gerais.

## Results

The female *Leptodactylus latrans* observed at SAG (Figure 1) was partially submerged in a pond when we approached it. Its initial behaviour was to jump towards the intruders while attempting to bite and emitting distress calls. After this initial display it moved away, retreating to the aquatic vegetation and staying still.

Whenever we moved near the female and her tadpoles, the female turned towards us and stayed in an alert posture. At any further approximation the aggressive behaviour of jumping, biting and emitting distress calls was resumed. For further details on behavioural sequence and display quantifications see figures 2 and 3. Female *Leptodactylus latrans* from both locations (SAG and BJS) always stayed in our sight, never attempting to escape or hide, while the behaviour of jumping towards the intruders, biting and screaming was the most frequent.

A total of ten distress calls were recorded for the female at BJS. These calls (Fig. 4) had a mean dominant frequency of 2.83 ± 1.52 kHz (range: 0.75 – 4.69) and a call duration of 0.11 ± 0.05 s (range: 0.04 – 0.22). Four distress calls were recorded for the female of SAG. These calls had a mean dominant frequency of 2.70 ± 1.52 kHz (range: 0.387 – 3.49) and a call duration of 0.09 ± 0.03 s (range: 0.06 – 0.13).

The vocalizations of both females consist of a harmonic call in which the energy concentration varies greatly between calls, causing a surprisingly high variation in the dominant frequency, considering different calls from the same individual.

## Discussion

Aggressive behaviour towards potential predators is known for some anuran species, especially those of medium to large body size. Moreover, females and even males of different *Leptodactylus* species are known to protect either their terrestrial nesting burrow or aquatic tadpole schools (Vaz-Ferreira & Gehrau, 1975; Downie et al., 1996; Vaira, 1997; Prado et al., 2000; Gibson & Buley, 2004).

*Leptodactylus latrans* defensive behaviour repertoire is similar to the one exhibited by two species from the same genus (*L. podicipinus* and *L. fallax*), which also react with aggressive behaviour to possible threats to their eggs or tadpoles (Prado et al., 2000; Prado et al., 2002; Gibson & Buley, 2004). However, no distress call has been reported for these species.

One possible function of the distress call is to warn neighbours of the eminent danger (Leary & Razafindratsita, 1998). However, currently the most widely accepted function is that frogs scream when attacked in order to startle the predator and therefore raising the chances for an escape (Hödl & Gollmann, 1986; Wells, 2007). Another possibility is that the distress call may attract a third species which could predate on the frog's predator (Högstedt, 1983; Hödl & Gollmann, 1986). Anuran distress calls are known

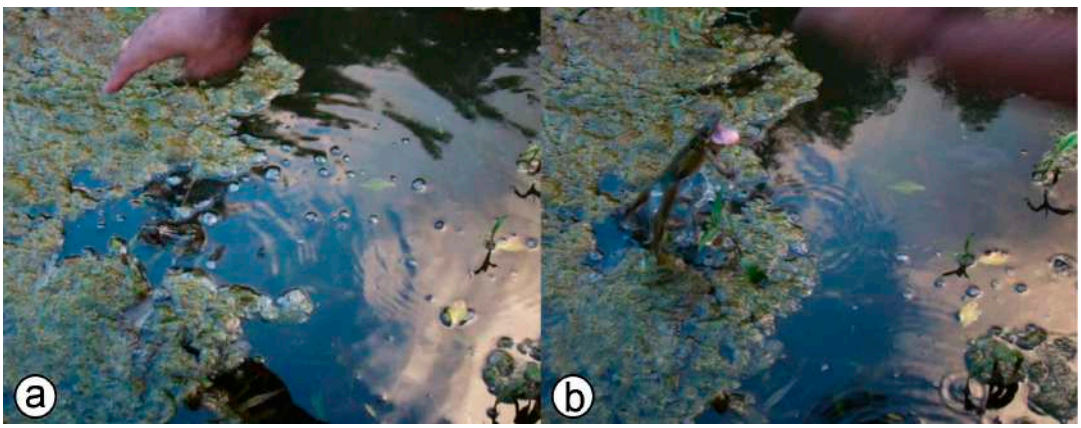


**Figure 3.** Frames from the video of the defensive behaviour sequence shown by the *Leptodactylus latrans* from São João do Glória, municipality of Vieiras, Minas Gerais State, Brazil. (a) The frog is sitting still in the water defending the tadpoles, and (b) the frog is jumping with an open mouth to attack the intruder.

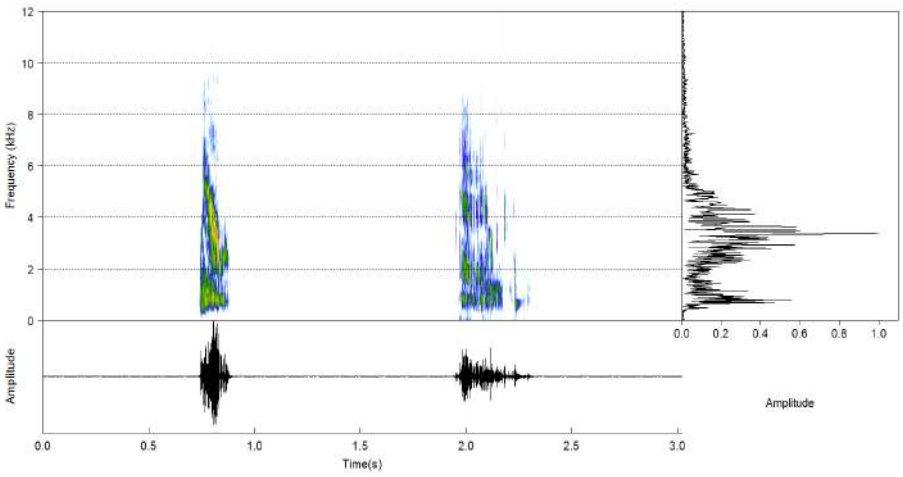


**Figure 4.** Two parental distress calls of female *Leptodactylus latrans,* Bom Jardim da Serra Municipality, Santa Catarina State, Brazil. A) Spectrogram; B) Power spectrum of the second call; C) Oscillogram.

for having a large variability between calls (Hödl & Gollmann, 1986; Toledo & Haddad, 2009), which may reflect a selective pressure to surprise the predator (Hödl & Gollmann, 1986).

Conversely, in many circumstances the individual emits the call repeatedly, supporting the hypothesis of a function of attracting a third species (Högstadt, 1983; Hödl & Gollmann, 1986).

Agonistic vocalizations in birds and crocodilians are believed to have evolved in a parental care context (Staton, 1978; Högstedt, 1983), while for anurans this possibility has never been considered. Furthermore, distress calls emitted by female *L. latrans* might have the function of attracting the predator's attention and therefore of enhancing the probability of the tadpoles to escape (Ferraz, 2011).

This display of *L. latrans* suggests the existence of a new category of distress call, expressed in a parental care context, which diverges from the functions of anuran distress calls reported up to date. Due to the context in which this behaviour was exhibited, we classify this vocalization as parental distress call.

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