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The Distress Calls of *Leptodactylus chaquensis* Cei, 1950 and *Leptodactylus elenae* Heyer, 1978 (Anura: Leptodactylidae)

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The distress calls of *Leptodactylus chaquensis* Cei, 1950 and *Leptodactylus elenae* Heyer, 1978 (Anura: Leptodactylidae)

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Abstract. We describe the distress calls of *Leptodactylus chaquensis* and *Leptodactylus elenae*. They each consist of a single, long, tonal sound with complex harmonic structure and complex frequency modulation. The distress calls of both species are different from their respective advertisement calls. Moreover, there are also clear interspecific differences. Harmonic frequencies in *L. elenae* are higher, there are fewer emphasized harmonics and the call is shorter and repeated at a higher rate (sometimes paired) than the call of *L. chaquensis*. Call duration, call rate, and position of the dominant harmonic change with the strength of the stimulus that the individuals are under; therefore, they are more variable than their respective advertisement calls.

Key words: Anura: Leptodactylidae: *Leptodactylus chaquensis*, *Leptodactylus elenae*; distress call; Bolivia.

Distress calls in frogs are emitted under extremely dangerous circumstances as, for example, an individual being captured by a predator (Hödl & Gollmann 1986). It is still unclear which could be the actual function of this explosive call, although it has been suggested as a defensive mechanism or a warning signal of risk to con-specifics (Leary & Razafindratsita 1998). In those species where distress calls have been analysed, they strongly differ from advertisement calls and can be emitted by females, males, and juveniles (Duellman & Trueb 1986, Hödl & Gollmann 1986). Nevertheless, distress calls have been described from only a few species; this is particularly true in the Neotropical region (Hödl & Gollmann 1986). Among *Leptodactylus*, Duellman & Trueb (1986) described the distress call of *L. pentadactylus* and Hödl & Gollmann (1986) described those of *L. fuscus, L. ocellatus* and *L. pentadactylus*. During fieldwork in Bolivia, the previously unknown distress calls of *Leptodactylus chaquensis* and *L. elenae* were recorded. The aim of this paper is to describe these distress calls and compare them with those previously described for the genus *Leptodactylus*.

Calls were recorded using a Sony WM D6C tape recorder and a Sennheiser Me 80 directional microphone. The calls were recorded on TDK SA60 cassettes and digitized at a sampling frequency of 44.1 KHz and 16 bit resolution with a Delta 66 digitizing board and Peak 3.2 (OSX) software (Fonoteca of Museo Nacional Ciencias Naturales, CSIC, Madrid), and edited with Audacity 1.2.2 (OSX). CoolEdit 2.0 (Syntrillium Software Corp.) was used to obtain quantitative information and to generate audiospectrograms and oscillograms on a PC compatible computer. Frequency information was obtained through Fast Fourier Transformations (FFT) (width, 1024 points). Voucher specimens were fixed in 10% formalin and preserved in 70% ethanol. Specimens are deposited at the Museo Nacional de Ciencias Naturales, Madrid, Spain (MNCN). Digitized calls were deposited in the Fonoteca Zoológica of the Museo Nacional de Ciencias Naturales, Madrid. Air temperature at time of recording was 19 ºC for *L. chaquensis* and 24 ºC for *L. elenae*, both under relatively dry conditions. Terminology of call characteristics follows Márquez et al. (1995).

Distress calls of *Leptodacyltus chaquensis* and *L. elenae* were first noticed while hand-capturing specimens in the field. To record the calls, specimens were held by their

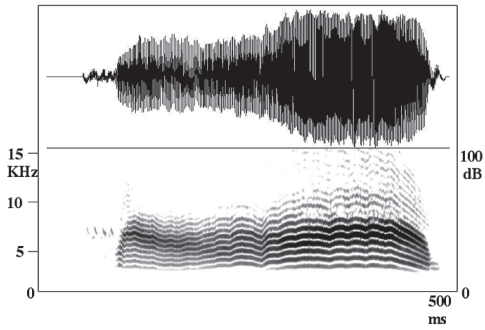

Fig. 1. Oscillogram (top) and audiospectrogram (bottom) of the distress call of a juvenile female (MNCN 42081) of *Leptodactylus chaquensis*, SVL= 27.4 mm.

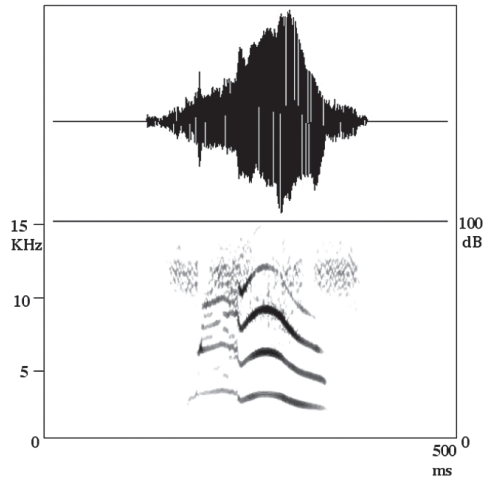

Fig. 2. Oscillogram (top) and audiospectrogram (bottom) of the distress call of an adult female (MNCN 42082) of *Leptodactylus elenae*, SVL=39.6.

hind legs; they began to vocalize when slightly agitated. Fifteen calls were recorded and analyzed for *L. chaquensis*, nine from a subadult female [MNCN 42080, snout-vent length (SVL) 58.3 mm] and six from a juvenile female (MNCN 42081, SVL 27.4 mm); 17 calls were recorded and analyzed for *L. elenae* from a single adult female (MNCN 42082, SVL 39.6 mm). The calls of *Leptodactylus chaquensis* were recorded in Santa Cruz de la Sierra (17º 47' S, 63º 10' W), Bolivia, on 20 April 2003 at 20:30 h by J. M. Padial, R. de Sá and S. Reichle (call references 4921-22). Calls of *Leptodactylus elenae* were recorded at a forest edge situation in a disturbed, open area of Amazonian lowland forest at La Chonta (17º 39' 36" S, 63º 42' 6.6" W), Amboró National Park, Departamento Santa Cruz, Bolivia, on 22 April 2003 at 21:00 h by J. M. Padial and R. de Sá (call reference 4923).

Leptodactylus macrosternum Miranda-Ribero, 1926 and *L. chaquensis* are sibling species, morphologically indistinguishable (De la Riva & Maldonado 1999). Nevertheless, following De la Riva et al. (2000), we assign the Cerrado population that we worked with from southern Bolivia to *L. chaquensis*, because *L. macrosternum* is restricted to Amazonian areas. Individuals were active during the night at the shore of a pond. They emitted the distress call with the mouth open and only when they were captured by hand. The call consisted on a single, long, tonal sound with complex harmonic structure (at least seven emphasized harmonics) and with complex frequency and intensity modulation (Fig. 1). Calls of the two individuals recorded differ considerably in call rate, note duration and repetition rate (Table 1). Most energy of the call is distributed among five to eight harmonics between 1200-7400 Hz with a fundamental frequency between 600 and 800 Hz. The dominant harmonic is usually the sixth although sometimes it could be the seventh or the fifth. In MNCN 42081 the call consisted of more than eight harmonics, with most energy distributed between 1500-7400 Hz; the dominant frequency coincided with the sixth or the seventh harmonic. The call of specimen MNCN 42080 differed in having most energy distributed between the fifth and eight harmonics, between 1200-5700 Hz; the dominant harmonic is the sixth and sometimes the fifth or seventh.

La Chonta site is located less than 30 km from Macuñucú, from where *L. elenae* has

	number of calls analysed	call duration (ms)	calls per min	dominant frequency (Hz)	fundamental frequency (Hz)	SVL (mm)	air temperature (ºC)
L. chaquensis MNCN 42080	9	545 (479-611)	9.49	4100 (2600-5200)	600-800	58.3	19
L. chaquensis MNCN 42081	6	360 (287-427)	36.99	5450 (4800-5800)	600-800	27.4	19
L. elenae MNCN 42082	17	222 (191-248)	23.61	7100 (2300-9600)	2700 (1600-3400)	39.6	24

Tab. 1. Summary of quantitative parameters of the distress calls of *Leptodactylus chaquensis* and *L. elenae*.

already been reported (HEYER & HEYER 2002). The calls of *L. elenae* were emitted with the mouth open, at a higher rate (sometimes in pairs) when the specimen was stressed. It consisted of a single, long, tonal sound with three to five emphasized harmonics, and frequency and intensity modulation (Fig. 2, Table 1). The energy of the call is distributed in the first three harmonics, between 1600-12000 Hz; the dominant frequency is very high and mostly corresponds with the third harmonic, but sometimes also with the fundamental (three times) or second (one time) harmonics.

The distress calls in both species are very different from their respective advertisement calls (MÁRQUEZ et al. 1995, HEYER & HEYER 2002). Moreover, there are also clear interspecific differences. Harmonic frequencies in *L. elenae* are higher, there are fewer emphasized harmonics and the call is shorter and repeated at a higher rate (sometimes paired) than the call of *L. chaquensis*.

The distress call of *Leptodactylus pentadactylus* (DUELLMAN & TRUEB 1986, HÖDL & GOLLMANN 1986) is most similar to that of *L. elenae* than to *L. chaquensis*. It also consists of three to four emphasized harmonics, although the fundamental harmonic has a frequency between 500-2000 Hz and the dominant harmonic is around 3500-4000 Hz (Fig. 4-18 of DUELLMAN & TRUEB 1986, Fig. 4b of HÖDL & GOLLMANN 1986).

Many Bolivian records of *L. chaquensis* were previously assigned to *L. ocellatus* (see distributional revision in DE LA RIVA & MALDONADO 1999) although the advertisement calls of these two sibling species differ considerably (BARRIO 1966). The distress call of *L. ocellatus* has been previously described and illustrated (HÖDL & GOLLMANN 1986). Overall, this call is remarkably similar to the distress call of *L. chaquensis*, but they differ in three characteristics. The fundamental frequency is almost the same in both taxa but the call of *L. ocellatus* is longer (615-960 ms) and it has a lower dominant frequency (0.9-3.2 kHz).

The distress call of *L. fuscus* has also been described (HÖDL & GOLLMANN 1986); it differs from the calls described herein in call duration, although it is similar in dominant frequency to that of *L. chaquensis*. It would be interesting to compare the distress calls of *L. chaquensis* with that of *L. macrosternum* but, unfortunately, no distress calls have been reported for the latter.

The distress calls of *Leptodactylus* species are complex, modulated, and with harmonic structure. They appear to be interspecifically variable and, thus, have taxonomic value; however they are not commonly used for taxonomic or phylogenetic analyses. This is understandable since, in distress calls, call duration, call rate, and position of the dominant harmonic change with the strength of the stimulus that the individuals are under; therefore, they are more variable than advertisement calls (which are subject to selective pressure to warrant mate recognition) and, in most cases, may not provide consistent taxonomic information.

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