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The release call of *Rhinella mirandaribeiroi* (Gallardo, 1965) (Anura: Bufonidae)

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Similarly to advertisement calls, release calls are important in anuran reproduction. These calls are emitted when an individual is amplexed by a male and wants to signalize that it is not a receptive female (Wells, 2007). They are advantageous to individuals because energy is conserved and it minimizes the vulnerability of couples to predation (McClelland and Wilczynski, 1989). *Rhinella mirandaribeiroi* (Gallardo, 1965) is a moderate-sized toad found in the Cerrado biome and one of the 12 species belonging to the *Rhinella granulosa* species group (Narvaes and Rodrigues, 2009). Its advertisement call was described recently (Morais et al., 2012). However, its release call remains unknown. Herein, we describe the release call of *R. mirandaribeiroi* recorded in Central Brazil.

We recorded the release calls of three males of *Rhinella mirandaribeiroi* at a dam in Barro Alto, Goiás, central Brazil (-48.927778; -15.081028; DATUM= WGS-84). The first one was recorded in January 2011, the other two in October 2012. Males emitted release calls while being handled for measuring and weighing. After realizing that, we elicited a series of release calls by pressuring both sides of each animal's abdominal region behind forelimbs. Recordings in 2011 were made with a Marantz PMD 222 recorder coupled to a Sennheiser ME66 microphone and in 2012 with a Tascan DR-40 recorder coupled to a Yoga HT-81 microphone.

We measured the following parameters: call duration (ms), note number, note duration (ms), pulse number, pulse duration (ms), dominant frequency (Hz), maximum frequency (Hz) and minimum frequency (Hz). The description of the call followed Gerhardt (1988) and Wells (2007). We used 44 kHz sampling frequency, 16 bit resolution and saved in mono format. The vocalizations were analyzed with Avisoft-SASLab Lite and Cool Edit 96 software. Frequency information was obtained through Fast Fourier Transformation (FFT) (width, 1024 points). The sonograms and oscillograms were made with overlap 75% and Window Flat Top. Voucher individuals were measured (snout-vent length) and weighted using a digital caliper (to the nearest 0.05 mm) and a digital scale (to the nearest 0.05 g), respectively, and deposited in the "Coleção Zoológica da Universidade Federal de Goiás" (ZUFG 6022, 7041).

The release call has an average duration of 730 ms and is composed of 7 to 53 notes, each one varying from 2 to 4 pulses (Table 1). Males responded to the pressure with a series of release calls (Figure 1) and also produced a series of vibrations, which consisted of sequential abdominal and thoracic muscular contractions. The vibrations were produced in silence or together with the calls, but the calls were always emitted with vibrations. Vibrations seem to be important to initiate dismounting of males (Wells, 2007).

There are descriptions of release calls for five species assigned to the *R. granulosa* species group: *R. azarai*, *R. bergi*, *R. dorbignyi*, *R. fernandezae* (Guerra et al., 2011) and *R. bernardoi* (Sanabria and Quiroga, 2012). The release calls of the group are very irregular and two types of calls are observed: non-pulsed and

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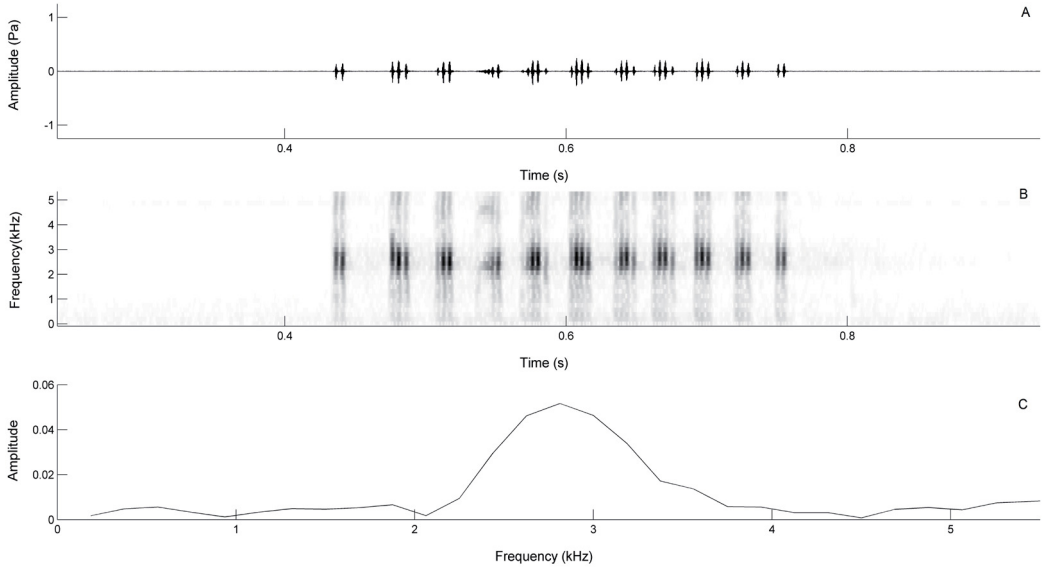

Figure 1. Release call of *Rhinella mirandaribeiroi* from Central Brazil (ZUFG 7041). A) Oscillogram; B) Spectrogram; and C) Amplitude spectrum of the call. (SVL = 57.7 mm; Mass = 12.15 g).

pulsed, which may vary from 2 to 49 pulses (Table 1). Call duration of *R. mirandaribeiroi* is the longest and the one with most notes. Calls of other species are composed by one note (Guerra et al., 2011; Sanabria and Quiroga, 2012). *Rhinella mirandaribeiroi* has one of the highest dominant frequencies of the group; only *R. bergi* presents higher frequency (Table 1). Therefore, the release call of *R. mirandaribeiroi* clearly differs from the other species of the group and can be used as a taxonomic tool.

The temporal structure of release calls of *R. mirandaribeiroi* differs from its advertisement call (Morais et al., 2012), but both calls have similar dominant frequency. Similar frequencies are expected between those calls because they are produced by the same morphological apparatus and are affected by body size (Castellano et al., 2002). While advertisement calls have the potential of inhibit mismatings and diverge in sympatry under selection, release calls are expected to converge to facilitate interspecific communication in heterospecific amplexus (Leary, 2001).

Table 1. Acoustic parameters of the release calls of *Rhinella mirandaribeiroi, R. bernardoi, R.azarai, R. bergi, R. dorbignyi, R. fernandezae*. Data are presented as mean ± SD and (range, n).

	Call	Call duration (ms)	Note/call	Note duration (ms)	Pulse/note
R. mirandaribeiroi (n=3)	Pulsed	730 ± 550 (0.13-2.05, n=15)	15.9 ± 13.7 (6-53, n=15)	12 ± 10 (0.006-0.029, n=60)	2.5 ± 0.7 (1-4, n=60)
R. bernardoi (n=5)*	Pulsed	3.4	1	3.4	7
R. azarai (n=1)	Unpulsed	29 ± 34 (2-260, n=102)	1 (n=102)	29 ± 34 (2-260, n=102)	-
R. azarai (n=13)	Pulsed	38 ± 19 (9-91, n=192)	1 (n=192)	38 ± 19 (9-91, n=192)	4.8 ± 2.4 (2-14)
R. bergi (n=1)	Unpulsed	15 ± 3 (11-23, n=25)	1 (n=25)	15 ± 3 (11-23, n=25)	-
R. dorbignyi (n=3)	Pulsed	471 ± 200 (195-775, n=19)	1 (n=19)	471 ± 200 (195-775, n=19)	23.6 ± 14.7 (7-49)
R. fernandezae (n=1)	Unpulsed	41 ± 17 (13-88, n=21)	1 (n=21)	41 ± 17 (13-88, n=21)	-
R. fernandezae (n=1)	Pulsed	206 ± 65 (155-321, n=7)	1 (n=7)	206 ± 65 (155-321, n=7)	10.7 ± 1.5 (10-14)

* Standard deviations and range values were not included for *R. bernardoi* because those data were not available in the original paper.

Table 1. Continued

	Pulse duration (ms)	Dominant frequency (Hz)	Maximum frequency (Hz)	Minimum frequency (Hz)	References
R. mirandaribeiroi (n=3)	4.5 ± 4.2 0.002-0.039, n=150)	2434.4 ± 126.9 (2192-2596, n=15)	5093.3 ± 856.5 (3300-5800, n=15)	1186.7 ±247.5 (900-1600, n=15)	Present paper
R. bernardoi (n=5)*	0.25	1152	-	-	Sanabria & Quiroga (2012)
R. azarai (n=1)	-	2097 ± 174 (1736-2431, n=102)	-	-	Guerra et al. (2011)
R. azarai (n=13)	8 ± 8 (1-58)	2143 ± 156 (1910-2431, n=192)	-	-	Guerra et al. (2011)
R. bergi (n=1)	-	2712 ± 93 (2587-3061, n=25)	-	-	Guerra et al. (2011)
R. dorbignyi (n=3)	5 ± 5 (1-28)	2109 ± 82 (2005-2252, n=19)	-	-	Guerra et al. (2011)
R. fernandezae (n=1)	-	1557 ± 67 (1466-1703, n=21)	-	-	Guerra et al. (2011)
R. fernandezae (n=1)	11 ± 4 (6-26)	1937 ± 26 (1897-1961, n=7)	-	-	Guerra et al. (2011)

*Standard deviations and range values were not included for *R. bernardoi* because those data were not available in the original paper.

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