

ADVERTISEMENT CALL AND BREEDING ACTIVITY OF *PHYSALAEMUS CUQUI* (LOBO, 1993)

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IN America, most of the research on anuran breeding behaviour has dealt with north temperate or Neotropical species, and very little attention has been paid to the reproductive behaviour of southern South American species. *Physalaemus cuqui*, a leptodactylid frog found throughout much of northwestern Argentina, was originally considered a northern population of *P. albonotatus* (Barrio, 1965; Laurent, 1969) until Lobo (1993) described it as a separate species based on osteological and morphometric differences. Although systematic relationships of the species have been investigated (Lobo, 1993), with the exception of the description of its tadpole (Perotti, 1997) and some additional distributional records (Lobo, 1994), no new information concerned with the breeding behaviour of this species has been published since its original description. The purpose of this paper is to: 1)

describe the advertisement call of the species, and 2) present data on some aspects of breeding behaviour and clutch characteristics. The data were obtained between October 1996 and April 1997 in Parque Nacional Calilegua, located about 100 km north of San Salvador de Jujuy, Argentina (23°35' S 64°50' W). The area is a typical subtropical humid montane forest (Brown & Grau, 1993). The rainfall (about 1200 mm per year) is strongly seasonal, the wet season starting around November and lasting until March. Recordings and observations were made mainly in flat open areas at an altitude of 600 m. Night observations of reproductive activity were obtained for at least 10 days each month by one of us (MV). When amplexus occurred observations were made to the end of the oviposition. After mating pairs separated spontaneously, body sizes (SVL) were measured with dial calipers to the nearest 0.1 mm.

Parameter	Mean ± SD	Range
Note duration (msec)	1580.1 ± 224.8	(1291.3 - 1948.1)
Calls/minute	8.6 ± 1.6	(6 - 11)
Pulses/call	26.7 ± 5.7	(17.0 - 37.4)
Pulses/second	22.9 ± 2.2	(19.5 - 25.6)
Fundamental frequency (Hz)		
Beginning	512.2 ± 25.9	(475.5 - 576.5)
End	422.7 ± 20.6	(446.8 - 381.9)
Dominant frequency (Hz)	1877.6 ± 132.3 [4°]	(1784.0 - 1971.2)
[Harmonic dominant]	2284.3 ± 75.6 [5°]	(2183.0 - 2428.6)
	2591.9 ± 143.9 [6°]	(2261.8 - 2713.0)

Table 1. Summary of numerical parameters of advertisement calls of 10 *Physalaemus cuqui* males recorded at Parque Nacional Calilegua, Argentina.

Location and dimensions of foam nests were recorded and then preserved in 10% formalin. All descriptive statistics are given as $\bar{x} \pm 1$ SD. Recordings of 10 individual advertisement calls were made on 14 February 1997 from 18:00 to 22:00 h, 24° C air temperature and 96% air relative humidity. Voucher specimens have the number FML 06263 (Instituto de Herpetología, Fundación Miguel Lillo, Tucumán, Argentina). A Marantz PMD 430 tape recorder and a Sennheiser ME-66 microphone were used for recordings from a distance of 0.5 to 1.5 m, which were digitized and analyzed at the Smithsonian Tropical Research Institute (Panamá) using Signal/RTS PC-based signal analysis software. Frequency information was obtained through fast Fourier transformation (FFT) (width 256 points). The terminology used for the description of the calls follows Heyer et al. (1990).

Physalaemus cuqui emits a long trilled whine at a rate of 6 to 11 calls per minute. Call duration ranges from 1.2 to 2.1 seconds. Calls are strongly partially pulsed; the pulse rate is 19.5-25.6 per second, with 13 to 36 pulses per call. The fundamental frequency (slightly modulated) is at about 512 Hz at the beginning and falling to about

422 Hz by the end of the call. Seven or eight harmonics are clearly evident in the audiospectrogram of the call (Fig. 1). The fourth, fifth and sixth harmonic are the dominant broadcast frequencies ranging from 1784 to 2713 Hz, with intensity peaks at 1877.6, 2284.7, and 2636.6 Hz respectively. Detailed spectral data are summarized in Table 1.

Males call mainly during the rainy season (November-February). Daily chorus activity extends from 19:30 h to 01:50 h. On three occasions, isolated males were calling at dusk (17:00 h). Males call in small temporary rain-filled or larger more permanent ponds from stationary positions floating close to the muddy shoreline (19.8 ± 18.2 cm). They inflate their lungs fully and then force some of that air through the larynx and then into the vocal sac producing the call and then return the air to the lungs for the next call. Most frogs vocalize in shallow water (4.0 ± 2.3 cm deep). Some however called in an artificial pool filled with 50 cm of rain water indicating that males can float and call from deeper waters. Female SVL (32.8 ± 0.8 mm, $N = 9$) is greater than that of males (31.1 ± 1.6 mm, $N = 26$) ($t_{33} = 3.03$, $P < 0.01$). Size of unmated males (SVL = 30.9 ± 1.68 mm) did not differ from the size of mated

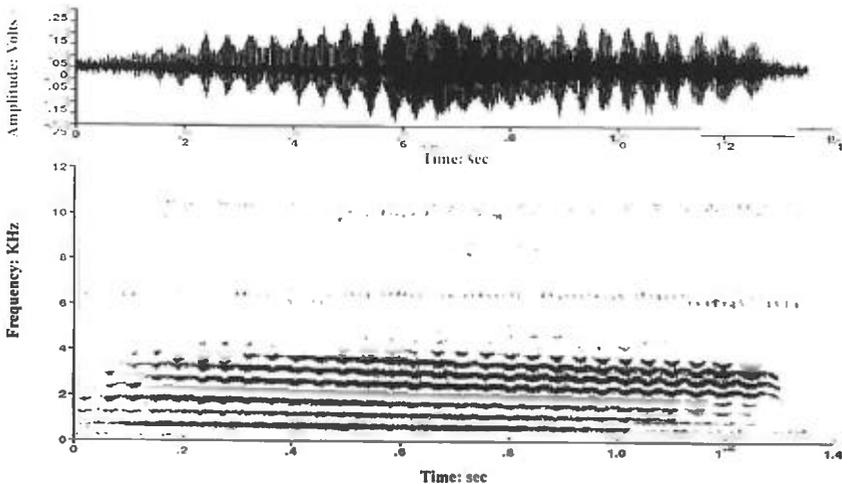


Figure 1. Oscillogram and audiospectrogram of the advertisement call of *Physalaemus cuqui* recorded at Parque Nacional Calilegua, Argentina. FML 06263, Collector number LF 16 (air temperature 24° C).

males (SVL = 31.9 ± 0.94 mm; $t_{25} = 1.62$, $P > 0.10$). The mean body size ratio (female SVL/male SVL) for eight recorded couples was 1.04 ± 0.03 (range: 1.00 - 1.07). A regression of paired male size on female size was not significant ($F_{1,6} = 0.49$, $P > 0.50$). Clutches were deposited every month during the rainy season. However, there was significant variation compared to an expected distribution of equal monthly deposition ($X^2_3 = 7.71$, $P < 0.05$), with more than twice as many clutches deposited in November, December and January (18.6 clutches/month) as in February (7 clutches/month). Mated pairs made foam nests at the water surface by means of a rapid succession of kicks by the male, in a similar way to that reported by Heyer & Rand (1977) for *Physalaemus pustulosus*. Nests are placed short distances from the shoreline (4.0 ± 6.3 cm) in 5.2 ± 3.0 cm of water; some were attached to the surrounding vegetation and some were not. Foam nests are hemispheric (diameter: 71.0 ± 17.4 mm; height 35.1 ± 8.4 mm). Nine nests contained an average of 975 unpigmented eggs (range: 705-1316 eggs) with a diameter of 1.28 ± 0.04 mm each (obtained by random measures of 10 eggs/nest).

Physalaemus cuqui clearly represents a prolonged breeding species (in the sense of Wells, 1977) although shows marked seasonality. Reproductive activity occurs during every month of the rainy season but decreasing clutch frequency through November to February indicates that reproductive activity increases at the early phase of rainy season. The species shows slight sexual dimorphism, with females being larger and heavier than males. Although the sample size was small, we found no evidence of large male advantage or size-assortative mating related to male mating success.

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