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**ADVERTISEMENT CALLS OF TWO
BOLIVIAN TOADS (ANURA:
BUFONIDAE: *BUFO*)**

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Bufo poeppigii is a species of the *Bufo marinus* group occurring on Amazonian slopes of the Andes from Colombia to Bolivia (Frost, 1985). The taxonomic status of this toad has been in state of flux since its description, but it is now clear that it is a valid species (De la Riva, Marquez & Bosch, 1995). On the other hand, populations usually recognized as *Bufo "typhonius"*, occurring from Panama and the Chococoan region of South America to southeastern Brazil, throughout the entire Amazon basin and Guianas, represent a complex of species and its proper name is *Bufo margaritifera* complex (Hoogmoed, 1986, 1989, 1990; Hass, Dunskey, Maxson & Hoogmoed, 1995). Bolivia is one of the regions where the systematics of this complex is obscure. Data on recordings of the advertisement calls may be a useful tool in order to distinguish between the different forms presumably involved. Discussions on the taxonomic status of both *B. poeppigii* and the *B. margaritifera* complex in Bolivia are beyond the scope of this study, except in the context of the differences in the advertisement calls. Thus, the goals of this paper are: (1) to describe for the first time the advertisement call of *B. poeppigii*, and compare it with that of its close relative, *B. marinus*; and (2) to provide data on the advertisement calls of two different populations of the *B. margaritifera* complex from Bolivia, and compare them with recordings obtained by other authors from populations of the same complex elsewhere.

Recordings were obtained in 1990 and 1994. Materials and methods used in recording and analysing data are explained in other papers by us [see for example Marquez, De la Riva & Bosch (1993)]. Voucher specimens were deposited in the Centro de Estudios Tropicales, Sevilla, Spain, and/or in the Museo de Historia Natural "Noel Kempff Mercado", Santa Cruz de la Sierra, Bolivia.

Recordings of *Bufo poeppigii* were obtained at Bulo-Bulo, Province Carrasco, Department of Santa Cruz, Bolivia (17° 16' S; 64° 20' W), where males called at night from ephemeral rain-filled puddles, in a

disturbed area near human settlements. Some specimens were calling from the shore of the puddles, whereas others were in the water with the body partially submerged. Air temperature was 25.4°C at the time of recording. The call (Fig. 1) was loud and emitted at regular intervals (mean call rate, 16.3 calls per min.). The call was a train of 10-45 pulse groups (*sensu* Schneider & Sinsch, 1991) emitted at a regular rate (17.0 pulse groups per second), forming a call with variable duration (631.0-2680.6 ms). Most calls were formed by a long train of pulse groups but some showed an interruption and two shorter pulse trains were emitted in quick succession. Each pulse group was composed of 3-5 pulses emitted at regular intervals (mean pulse rate within pulse group, 131.7 pulses/s). The dominant frequency of the calls was 1033.2 Hz, although power was present in 750-1500 Hz range.

No previous recordings of *B. poeppigii* are available for comparison. A related species, which is sympatric with *B. poeppigii* at Bulo-Bulo, is *B. marinus*. Calls of *B. marinus* were analysed by Schlüter (1981, 1984) in Panguana, Peru. Because *B. poeppigii* could also occur in Panguana, and this is a species of which the taxo-

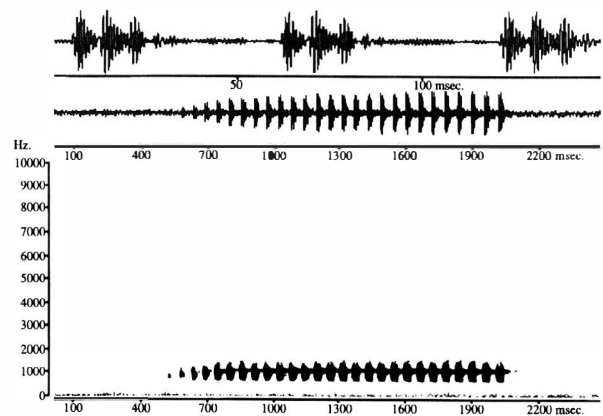


FIG. 1. Audiospectrogram and oscillogram of a 2.5 s section of a characteristic advertisement call of *Bufo poeppigii* recorded at Bulo-Bulo, Bolivia.

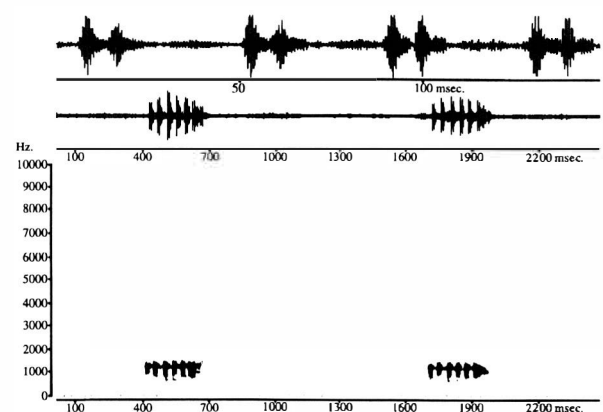


FIG. 2. Audiospectrogram and oscillogram of a 2.5 s section of a characteristic advertisement call of *Bufo margaritifera* recorded at La Bola, Bolivia.

nomic status has been subject of controversy, we have to be cautious when considering the population of toads from Panguana. However, the species in this locality has always been considered to be *B. marinus* by the different authors working in the area (Toft & Duellman, 1979; Schlüter, 1981, 1984; Aichinger, 1987; 1991). In fact, the available data on calls of toads from Panguana seem to indicate that *B. marinus* is the species occurring there (or, at least, the recorded species). Schlüter (1981; 1984) found a range frequency between 300-1000 Hz, and his Fig. 1 (Schlüter, 1981: p.100) shows a call consisting of 20 pulses at an interval of about 1400 ms. These data indicate a lower pitched call than that of *B. poeppigii*. Eastal (1986) shows an audiospectrogram of the call of *B. marinus* from Tinalandia (western Ecuador), with a duration of about 2000 ms, containing more than 20 pulses, and with the highest frequency hardly reaching 1000 Hz. Again, this is a lower frequency call than that of *B. poeppigii*. One of us (DLR) heard *B. marinus* calling at Valle de Sajta, a locality near Bulo-Bulo. The call was structurally similar to that of *B. poeppigii*, but also sounded lower in frequency. This difference may be simply due to the larger size of *B. marinus* in comparison to *B. poeppigii*. As was pointed out by Blair (1964) [see also Martin (1972)], in the genus *Bufo*, unless atypical allometric growth of the larynx is present, the smaller the animal, the higher the dominant frequency. Thus, given that the calls of *B. marinus* and *B. poeppigii* differ mainly in the dominant frequency, this difference might be explained solely by the difference in size between both species.

Recordings of toads of the *B. margaritifera* complex were obtained at La Bola, Department of Santa Cruz (17° 48' S; 62° 50' W), a Chacoan area near the city of Santa Cruz de la Sierra, and at Puerto Almacén, north-western Department of Santa Cruz (15° 46' S; 62° 15' W), an Amazonian locality in wet subtropical forest (Tosi *et al.*, 1975). At La Bola, where air temperature was 23.5°C at the time of recording (a single observation), a few males called at night in ephemeral ponds, whereas in Puerto Almacén, although males sometimes formed choruses and called around ephemeral ponds, most of the observations were made on males calling from stream banks (De la Riva, 1993). Normally, the calling site is right on the shore, although sometimes the individuals were partially submerged. The call (Fig. 2) was loud and emitted at regular intervals (mean call rate, 57.0 calls/min). It consisted of a train of 5-7 pulse groups (*sensu* Schneider & Sinsch, 1991) emitted at regular intervals (26.6 pulse groups/s), forming a call with variable duration (197.3-291.6 ms). Each pulse group was composed of 1-4 pulses emitted at regular intervals (mean pulse rate within pulse group, 102.1 pulses/s). The mean dominant frequency was 1332.3 Hz, and energy was distributed in the 500-1500 Hz range. Calls from La Bola and Puerto Almacén were almost identical, and the toads them-

TABLE 1. Summary of the numerical parameters (mean±SD, range) of the vocalizations of *B. poeppigii* and *B. margaritifera*

	<i>B. poeppigii</i>	<i>B. margaritifera</i>
Individuals analysed	1	3
Calls analysed	19	32
Call duration (ms)	1760.4±598.7 631.0-2680.6	238.2±22.9 197.3-291.6
Dominant freq. (Hz)	1033.2±71.6 907.0-1141.3	1332.3±107.0 1211.5-1544.7
Pulse groups/call	29.9±10.1 10.0-45.0	6.3±0.6 5.0-7.0
Pulses/pulse group	3.3±0.6 3.0-5.0	2.0±0.5 1.0-4.0
Pulse groups/second	17.0±0.6 15.8-17.8	26.6±2.1 22.4-30.1
Pulses/second	131.7±13.2 99.0-146.0	102.1±17.4 52.2-149.2
Pulse duration/period	0.4±0.1 0.3-0.6	0.5±0.1 0.2-0.9
Calls/min.	16.3±8.9 5.6-37.3	57.0±18.6 31.3-95.2

selves looked similar. In Table 1 are the pooled data from both localities. A slightly higher frequency was detected in the Puerto Almacén recordings, which may be due to a smaller size of the calling male. Thus, it seems that Chacoan populations do not differ from Amazonian Bolivian ones. Although members of the *B. margaritifera* complex have been always considered as rainforest species that can enter cloud forest up to 1840 m (Duellman, 1978), in Bolivia they also occur in the temperate Andean valleys to 1400 m (De la Riva, pers. obs.), and extends over the northern Chaco at least to the latitude 19° 27' S (De la Riva, 1990; De la Riva, Castroviejo & Cabot, 1992).

The calls of some populations of toads in the *B. margaritifera* complex have been described and analysed by Duellman (1978) and Schlüter (1981) (as *B. typhonius*), in Santa Cecilia (Ecuador) and Panguana (Peru), respectively. Duellman (1978) found a call of only 3-5 rapid notes (= pulses), lasting 150-200 ms, with a dominant frequency of about 1500 Hz. Thus, these Ecuadorian toads seem to emit a call that is slightly shorter and higher pitched than are the calls of the Bolivian toads. On the other hand, the results presented by Schlüter (1981) show a call with a broader range of frequencies (800-2200 Hz) and a higher number of pulses, as may be observed in his Fig. 4

(Schlüter, 1981: p.103). Although some caution is needed given the small samples considered, the differences observed between these results and ours could be indicative of species-level differences. This would be not unexpected, given the presumably small areas of distribution of some of the species in the complex, and the apparent concentration of species in the Amazonian regions of Ecuador and northern Peru (Hoogmoed, 1990).

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