

## SHORT NOTES

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**FIRST DESCRIPTION OF THE  
ACOUSTIC REPERTOIRE OF *RANA  
ITALICA* (ANURA, RANIDAE)**

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Vocalizations of *Rana italica* from six adult males were obtained from Torrente Gentile, a small brook located in the Torrente San Siro basin, Santa Margherita Ligure (Northern Italy). All signals were propagated from the bottom of shallow pools and were inaudible in air. Two common and one rare call type were documented. All calls were short, low amplitude signals. The most common call is frequency modulated, harmonically rich and the other two are not. None exceed 0.26 s. Our study confirms that males call underwater. This is consistent with the conclusion that it has an underwater mate recognition system.

*Key words:* frog, reproductive behaviour, underwater propagation, vocalizations

The Italian stream frog is widespread within the Italian Peninsula, and prefers small streams within the wet, broad-leaf forests of the Apennines from central Liguria to Calabria (Zuffi, 1997; Picariello *et al.*, 2006). Despite its abundance and distribution, information about the ecology of *R. italica* is scanty (Guarino *et al.*, 1993), and no detailed study of its breeding ecology has been done to date. Both males and females remain near stream pools for most of the year, using rocks on the bottom of deeper pools with permanent water as refuges against predators, as well as for mating and egg laying (Lanza, 1983).

Breeding occurs from February to May and peak breeding activities occur in March (Guarino *et al.*, 1993). Males attract females by emitting weak, frequently repeated calls, which are uttered underwater, and are generally not audible in air unless frogs are calling just below the water surface. This is probably the main reason why no description of the vocal repertoire of this species has been published to date. The purpose of this study is therefore to characterize the vocalizations of *R. italica*.

We recorded male calls at Torrente Gentile, a small brook located in the Torrente San Siro basin, in Santa Margherita Ligure Municipality (Northern Italy, 44°20'N, 9°12'E). Vocal signals of frogs were recorded on 22 March 2003 between 22:00 and 24:00 hrs in two adjacent pools (each one approximately 6 m<sup>2</sup>; elevation 150 m a.s.l.). The first pool was about 80 cm deep, and the second about 1 m. The water temperature was 9.6 C° in both pools, and did not vary during the recording time. Recordings were obtained using an omnidirectional MPC piezo hydrophone (Dolphinear, Arretec, frequency range 7–22,000 Hz) and a Sony TC-D5 cassette recorder. All records were made at 9.5 cm/s tape speed. During recording sessions it was not possible to hear the frogs calling from the border of the pools without the hydrophone, despite the fact that the background noise caused by the flow of water was quite low. We obtained a total of 25 minutes of recordings that included 176 vocalizations from a total of six different males (average = 29 ± 8 SE for individual, range: 11–66). Call sites varied between 30 and 90 cm deep. Calling males were unambiguously identified by their position within the pools (four frogs called from the first pool and two from the second one). The distance between a calling male and the hydrophone was small, varying from 30–50 cm. Vocalizations obtained from each male were analysed using Cool Edit Pro v. 2.0 (Syntrillium). The best resolution was achieved analysing vocalizations in the 0–11 KHz frequency range, using a sampling rate of 22,050 sample/s; band-width 28 Hz; a frequency resolution 10 Hz and time resolution 23 ms. We visually examined and compared spectrograms in order to identify the different call types. For each call we measured the following four variables (when applicable): call duration (ms), time to peak amplitude (ms), dominant frequency (Hz) and fundamental frequency (Hz). Unless otherwise stated, values reported are means ± SE.

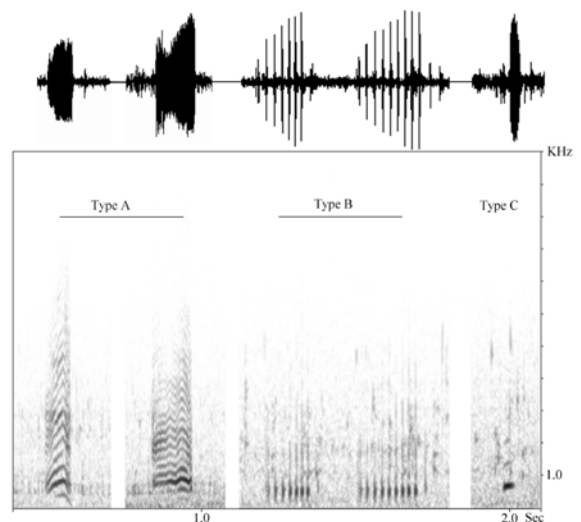


FIG. 1. Sonograms and waveforms of call types of *Rana italica*.

TABLE 1. Summary of spectrographic features of call types of *Rana italica*.

	Call types		
	A	B	C
<b>SAMPLE SIZE</b>			
<i>n</i> of individuals	6	4	6
<i>n</i> of calls	135	28	13
<i>n</i> of calls per individual	22.5±7.3 (9-58)	7±2.4 (2-13)	2.2±0.5 (1-4)
<b>CALL FEATURES</b>			
Duration (ms)	152±8.9 (135-162)	173±10.7 (149-260)	81±4.2 (68-87)
Time of the peak amplitude (ms)	111±8.7 (89-120)	130±10.2 (93-212)	57±5.1 (49-66)
Fundamental frequency (Hz)	297±23.9 (225-368)	–	731±16.1 (646-754)
Dominant Frequency (Hz)	1059±112 (765-1202)	611±18.8 (553-723)	731±16.1 (646-754)

Calls could be unambiguously assigned to three different call types based on the shape of their spectrogram and audibly by observers. All the individuals analysed shared the vocal repertoire described below.

The sonagrams and oscillograms are provided in Fig. 1. The description of the several call types are here provided.

Call type A is a harmonically rich, frequency modulated call that sounded similar to a short scream or a “squack”, with a mean duration of 152±8.9 ms (range 135-162, *n*=6) and a mean fundamental frequency is 297±23.9 Hz (range 225-368, *n*=6). Peak amplitude was variable but typically increased gradually to a maximum after an average of 111±8.7 ms (range 89-120, *n*=6). Dominant frequency averaged 1059±112 Hz but varied widely (range 765-1202, *n*=6); corresponding generally to the fourth harmonic (Fig. 1, Table 1).

Call type B was of lower intensity, and resulted in a “grongron” like utterance somewhat similar to the call of *Rana dalmatina* (Nöllert & Nöllert, 1992). Call type B was quite different from type A, it was a pulsed sound lacking frequency modulation and composed of 5 to 15 pulses (average 7.9±0.4, *n*=4). Pulses were regularly spaced and most of the energy was concentrated at the lower frequencies. Dominant frequency averaged 611±18.8 Hz and varied from 553-723, (*n*=4). Call duration varied substantially, averaging 173±10.7 ms (range 149-260, *n*=4). The amplitude of the pulses increased gradually and a maximum was reached after 130±10.2 ms on average but varied two-fold (range 93-212 ms, *n*=4).

Call type C is a short, high-pitched note that sounded like an “uh”. Average duration was 81±4.2 ms that varied much less than the other call types (68-87, *n*=6). Fundamental frequency corresponded to the dominant frequency, averaging 731±16.1 Hz (range 646-754, *n*=6). Amplitude increased to a maximum value after 58±5.1 ms (range 49-66, *n*=6). This call type showed only slight harmonic structure.

Call type A was the most frequently recorded (135 calls); by contrast, call type C was rarely recorded. Among 176 calls, type C was documented only 13 times. We decided not to capture or otherwise disturb the calling males during or after recording sessions. In addition, any external light caused the abrupt cessation of all singing, and therefore we were unable to observe any behaviour that could be associated with a given call type. However, based on other related European ranid frog species (*R. graeca*, Asimakopoulos *et al.*, 1990; Asimakopoulos, 1994; *R. latastei*, Farronato *et al.*, 2000), and the time within the breeding season, we provisionally consider call type A to represent a male advertisement call. Call type B may represent some form of territorial spacing signal, or an agonistic element. Call type C may represent a release call. Further recordings under controlled conditions that permit simultaneous recordings and visual observations should provide further information on call function.

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