

## Advertisement Call and Breeding Period of the Frog, *Kaloula pulchra* (Microhylidae)

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The Western Ghats region of India has been identified as one of the 18 biodiversity hot spots of the world (WCMC 1988), and harbors 205 species of amphibians (Daniels 1992). *Kaloula pulchra* is a medium-sized burrowing frog (mean male SVL = 67.3 mm, N = 10) distributed in parts of Western Ghats. Although *K. pulchra* is a common microhylid of this region, we have limited knowledge about this species from the Western Ghats. In particular, very little is known about its reproductive biology. We investigated the

breeding period and advertisement call of this species.

Both field observations during the breeding season and characterization of the male call parameters were conducted near Dharwad (15°27'N, 75°05'E). From 1989 to 1997, we recorded male calls with directional microphones (AKG, D- 707/190 C, D- 1000 I) and tape recorder (AKAI AJ 490 FS, 4.8 cm/s) at water temperatures of 19-21°C and relative humidities between 90 and 93%. We used a LUTRON SL 4001 SPL meter (fitted with Bruel & Kjaer multi-function acoustic calibrator, 4226) to measure the sound pressure level (re 20 µPa, "fast" root-mean-square [RMS], C weighing) from a distance of 1 m. Calls of 20 males were analyzed by the acoustic analyzer computer program MOSIP® spectro analysis V6 8, 41/89, MEDAV GmbH, at Zoological Institute, University of Bonn, Germany; statistical analysis was carried out with Statgraphics (STSC, Statistical Graphic Corp., Knoxville, Tennessee, USA).

Calling activity began after the first two to three heavy pre-monsoon showers (April/May) during 1990,1991,1992 and 1996. When the pre-monsoon rains failed to occur during 1993, 1994, 1995, and 1997, the calling began with the onset of monsoon rains (June/July) and continued until August. Observations over a period of eight years indicated that the males emit the advertisement call from April to August. During the same period amplected pairs also were observed in the field. Hence, in the absence of reports on the gonadal cycles, we suggest that April to August may be the breeding period of *K. pulchra*. The calls were given while males floated on the water surface. Calling was in chorus, however adjacent calling males alternated their calls (N = 50). Advertisement calls were emitted in series with variable call intervals. Each call occurred in a single pulse group of 28-56 pulses (mean ± SE, 42 ± 1; Fig. 1A) and the number of pulses per second varied between 54 and 114 (mean ± SE, 84.2 ± 6.1). The pulse interval was very short and could not be recorded. The amplitude varied slightly from call to call (Fig. 1B). The call began with a pulse of low amplitude and reached the maximum after the 6<sup>th</sup> to 10<sup>th</sup> pulse (Fig. 1A). Subsequently it decreased gradually. The call duration, call interval, and the call period varied from 318 to 932 ms (mean ± SE, 579 ± 14; N = 20), 207 to 1078 ms (mean ± SE, 541 ± 27; N = 20) and 797 to 1672 ms (mean ± SE, 1140 ± 31; N = 20), respectively. The frequency spectra ranged between 50 and 1760 Hz with two bands (Fig. 1C). The dominant frequencies were between 400-1220 Hz (mean ± SE, 704.8 ± 85.1; N = 10). The sound pressure level measured from a distance of 1 m from the frog varied between 54 and 60 dB.

The advertisement calls of breeding male anurans have two main functions: a) intrasexual competitive interactions for calling stations, which in some species are also oviposition sites, and for active (acoustic) space; and b) intersexual attraction of mates (Littlejohn 1977). Additionally, calling sites and call parameters may reflect mechanisms for reproductive isolation among species. Acoustic communication studies in Western Ghat microhylids are limited to *Microhyla omata* (Hiremath 1991), *M. rubra* (Kanamadi et al. 1994), *Ramanella variegata* (Kanamadi et al. 1993), and *R. montana* (Kadadevaru et al. 1998).

*Kaloulapulchra*, *R. variegata*, *M. omata*, and *M. rubra* are sympatric microhylid species at Dharwad. Calling sites of *M. rubra* are on land in open fields near water bodies (Kanamadi et al. 1994), whereas those of *M. omata* are depressions in muddy areas, and

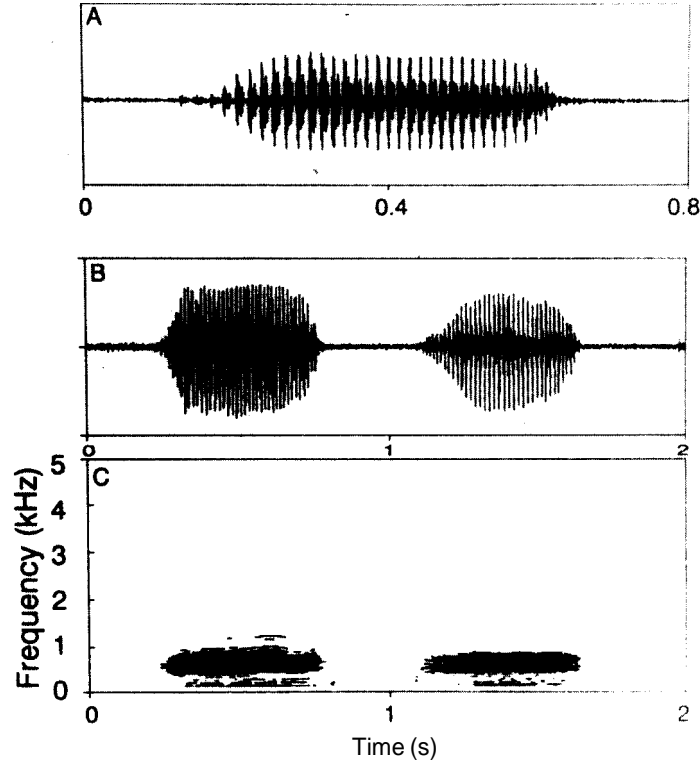


FIG. 1. (A) Oscillogram of a single advertisement call of *Kaloulapulchra* (66 mm SVL) showing amplitude modulation. Oscillogram (B) and sonagram (C) of two advertisement calls of *K. pulchra* (66 mm SVL) showing call interval and frequency spectra respectively. Recorded in Dharwad, India. Water temperature 20°C.

also in spaces under the grass (Hiremath 1991). The advertisement call of *M. rubra* consisted of 66-135 pulses/s (mean ± SE, 108 ± 2.4; N = 39). The call duration varied from 138 to 228 ms (mean ± SE, 168 ± 3.2; N = 39) and the number of pulses ranged between 15 and 21 (mean ± SE, 18.0 ± 2.4; N = 40). In *M. omata*, the advertisement call comprised 33-0 pulses/s (mean ± SE, 30.0 ± 0.3; N = 28). The call duration varied from 13 to 77 s (mean ± SE, 33.2 ± 5.3; N = 14) and the pulse number ranged between 10 and 14 (mean ± SE, 12.8 ± 0.30; N = 28). Males of *K. pulchra* call from the surface of water bodies, similar to those of *R. variegata* (Kanamadi et al. 1993). It is likely that the different calling sites of *M. rubra* and *M. ornata* contribute to spatial separation of these sympatric species from *K. pulchra* and *R. variegata*. The advertisement call of *R. variegata* consisted of 359-385 pulses/s (mean ± SE, 369 ± 4.6; N = 5). The call duration varied from 187 to 234 ms (mean ± SE, 214 ± 3.6; N = 10) and the pulse number ranged between 74 and 137 (mean ± SE, 96 ± 5.6; N = 11). Its frequency spectra ranged between 300 and 4300 Hz with harmonics and a distinct fundamental frequency (Kanamadi et al. 1993). In the present study of *K. pulchra*, the pulse number (28-56) and the frequency range (50-1760 Hz) are much lower. Although males of both species share common calling sites, the species-specific pulse number and the variation in the frequency range may help in attracting conspecific females.

The call duration of *K. pulchra* from Thailand (Heyer 1971) ranged from 560 to 600 ms, consisted of 32-35 pulses/s with 18-21 pulses/call, and the frequency spectra had a dominant band at 250 Hz. Our study of the same species shows differences in the

call duration, pulses/s, pulses/call, and the frequency range. The differences in the call parameters may reflect geographic variation, as described in *Rana ridibunda* (Schneider 1973; Nevo and Schneider 1983; Kuhn and Schneider, 1984; Schneider and Sofianidou 1985), *Bombina orientalis* (Akef and Schneider 1985; Schneider et al. 1986), and *M. omata* (Hiremth 1991).

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