

# REPRDUCTIVE BEHAVIOUR AND MATING CALL STUDIES OF THE ANURANS IN BRAHMAGIRI WILDLIFE SANCTUARY, WESTERN GHATS

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## ABSTRACT

Brahmagiri wildlife sanctuary (11°56'N, 11°68'N: 75° 45'E, 75°67'E) located in southern part of Kodagu district, Western Ghats. The sanctuary spread over an area of 181 sq. km. The terrain undulating with an altitude up to 1527mts. Acoustic signals are of central importance to the biology of animals to ensure reproduction. Vocalization is a striking behavioral feature, particularly during the breeding season of many types of animals. Acoustic studies of anurans were carried out during rainy seasons between June 2018 to October 2018. Acoustic call features of three species were analysed in the present study. These include *Raorchestes glandulosus*, *Raorchestes luteolus* and *Raorchestes tuberochumerus*. Average numbers for each acoustic property were calculated for each anuran species. Analyses of call pattern among the anuran of the Western Ghats are to document species distribution pattern, richness, relative abundance and landscape ecology.

**Keywords:** Acoustic studies, Cryptic species, Mating call, Reproductive behaviour, Wildlife sanctuary.

## INTRODUCTION

Anurans are capable of different types of vocalizations which serve different functions. The courtship call, also known as the mating or breeding call is emitted by males and has two functions. The attraction of conspecific females and the announcement of an occupied territory to other males of the same or different species. There are three types of courtship calls the courtship call produced by males in attempt to attract a conspecific female, a territorial call produced by a resident male in response to an courtship call received above a critical threshold of intensity, and an encounter call evoked during close range agnostic interactions between males (Duellman and Trueb, 1994). The courtship call acts as courtship isolating mechanism (Duellman and Pyles, 1983). Acoustic signals are of central importance to the biology of animals to ensure reproduction. Vocalization is a striking behavioral feature, particularly during the breeding season of many types of animals. Sexually mature males produce mating calls during breeding season and are termed as mating call or advertisement call. Evolutionary

divergence among animal courtship signals are an important component of the speciation process. Acoustic signals also play important roles in sexual selection. Females show acoustically mediated mate preferences that increase offspring fitness (Welch *et al.*, 1998). Among vertebrates, advertisement calls by males are widespread in mammals, birds and amphibians (Schneider and Haxhiu, 1994; Welch *et al.*, 1998; Doutrelant *et al.*, 2000). In anurans, It is well known that the mating call is an important behavioral isolating mechanism and no two species have been found to have the same call (Blair, 1958; Gerhardt, 1994; Ryan and Rand, 1993), The preferential response of females to the mating calls of conspecific males often maintain reproductive isolation among population. Anuran activity patterns are dynamic and are affected by changes in the climatic conditions (Ossen and Wassersug, 2002). Calling activity of frogs is influenced by environmental factors such as photoperiod, light intensity, relative humidity and air temperature. (Gerhardt, 1978) Advertisement calls are given most frequently. Calling activity is intense during May to August and decreases noticeably during September to October. Calling begins after sunset at 18.30 – 19.0 h and continues till late night. The anuran advertisement calls are being used as a diagnostic tool for clarifying the taxonomy (Nunes *et al.*, 2007). Mainly for monitoring the populations of amphibians (Wier and Mossman, 2005; Weir *et al.*, 2005) or for estimating the relative abundance of calling male anurans (Nelson and Graves, 2004). Several reports are available on the role of bioacoustic communication in anurans of Western Ghats (Hiremath and Kanmadi, 1993; Kanmadi *et al.*, 1992; 1993; 1994; 1995; Kadadevaru, *et al.*, 1998; 2002; Kuramoto and Joshy, 2001; Hampson and Bennet, 2002; Savitha and Bosch, 2007). However, there are only few reports on acoustic behaviour of anurans in Kodagu district are available (Kuramoto and Joshy, 2001; Hampson and Bennet, 2002; Savitha and Bosch, 2007; Krishna and Sreepada, 2010; Modak *et al.*, 2016; Krishna, 2018; Krishna *et al.*, 2018). Hence acoustic call structures of three species of frogs that are distributed in the Brahmagiri Wildlife Sanctuary, Western Ghats of Kodagu are discussed in the present study.

## MATERIALS AND METHODS

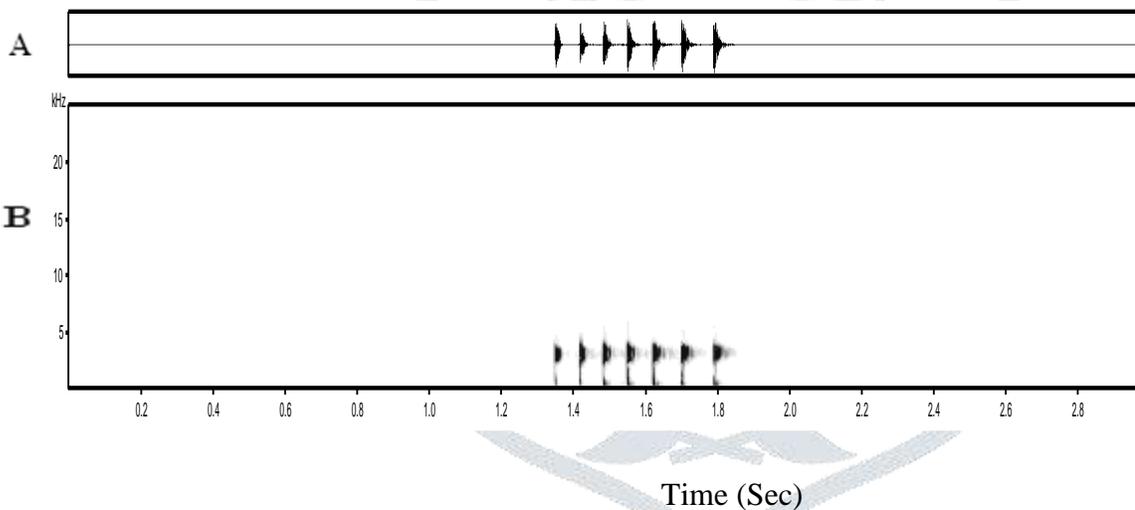
Brahmagiri wildlife sanctuary (11°56'N, 11°68'N: 75° 45'E, 75°67'E) located in southern part of Kodagu district, Western Ghats. The sanctuary spread over an area of 181 sq. km. The terrain undulating with an altitude up to 1527mts. Temperature varies from 10°C during winter to 32°C during summer. Annual rain fall is about 3000mm to 6000mm. The forests are mainly evergreen and semi evergreen in nature. Shola vegetation is dominant at higher altitude, moist deciduous forest are seen in some lower regions of the sanctuary. Acoustic studies of anurans were carried out during rainy seasons between June 2018 to October 2018 Call duration and pulse rate are temperature dependent (Platz, 1989). Air and water temperature were measured at the time of call recording using a digital thermometer and atmospheric humidity was recorded using hygrometer. The call recordings were made with a Sony WMD6C (walkman) TCD5 PRO cassette tape recorders and Sennheiser ME88 microphones. Call classification and call components terminology follows (Duelman and Trueb, 1994); (Cocroft and Ryan, 1995) and (Littlejohn, 2001). Six important call properties were analysed (Call duration, Pulse rate(s), pulse length(s) number of pulses per call, Fundamental and Dominant frequency). Oscillogram

and audiospectrogram of advertisement calls were studied for call analysis using the software Avisoft-SAS Lab Pro®, Version 4.40 (Avisoft Bioacoustics, Germany).

## RESULTS AND DISCUSSION

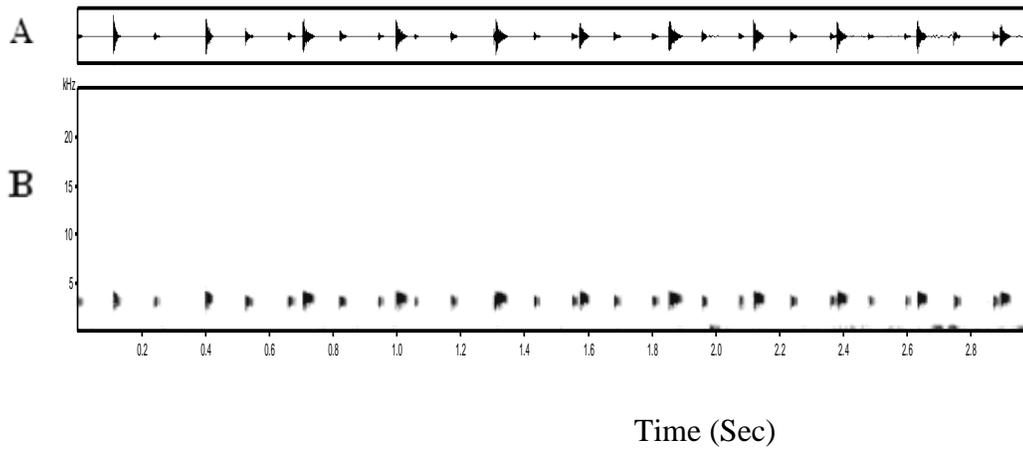
Acoustic call features of three species were analysed in the present study. These include *Raorchestes glandulosus*, *Raorchestes luteolus* and *Raorchestes tuberothumerus*. Average numbers for each acoustic property were calculated for each anuran species and the values are given in (Table 1). Oscillogram and audio spectrogram of advertisement calls of three species of anurans in the Brahmagiri Wildlife Sanctuary, Western Ghats of Kodagu are given in (Figures 1-3).

***Raorchestes glandulosus*** (Jerdon,1853): Advertisement calls of this species was recorded in ever green forest tree at Madikeri on 11<sup>th</sup> August 2009. At air temperature 21.5°C, water temperature 20°C and humidity 83%. Call duration of this frog are 0.45 seconds with 35 pulses per seconds, 0.025 seconds of pulse length, pulses per calls about 5, fundamental frequency 2.06kHz and dominant frequency 3.59kHz. Hampson and Bennet (2002) have analyzed earlier the calls of *Green philautus* and reported that fundamental frequency of 1.94 kHz, dominant frequency of 3.10 kHz and pulse



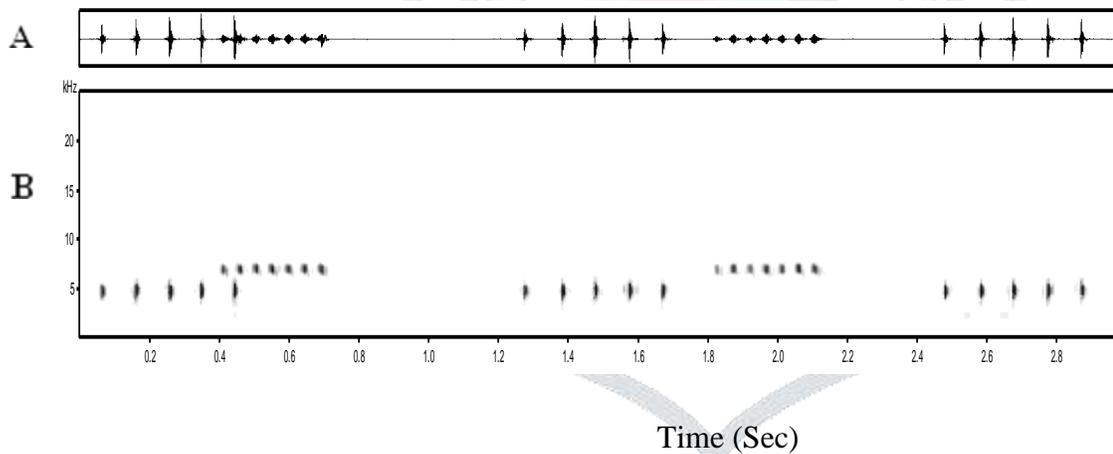
**Fig. 1.** *Raorchestes glandulosus* : **A** . Oscillogram **B** . Audio spectrogram

***Raorchestes luteolus*** (Kuramoto and Joshy, 2003): The advertisement calls of this species were recorded in cardamom plantation at Makkandur on 21<sup>st</sup> June 2009. At an air temperature of 21°C, water temperature 19.5°C and humidity 82%. Call duration of this frog are 0.32 seconds with 56 pulses per seconds, 0.015 seconds of pulse length, each call constitutes 7 pulses, fundamental frequency 2.13kHz and dominant frequency 3.31kHz. Advertisement calls of this species was reported previously by Kuramoto and Joshy (2001) as *Philautus travancoricus* and recorded fundamental frequency was about 2.57kHz and dominant frequency was about 2.83 for this species.



**Fig. 2.** *Raorchestes luteolus* : **A.** Oscillogram **B.** Audio spectrogram

*Raorchestes tuberochumerus* (Kuramoto and Joshy, 2003): The advertisement calls of this species were recorded in coffee plantation at Maragodu on 29<sup>th</sup> August 2009. At an air temperature of 23°C, water temperature 21.5°C and humidity 72%. Call duration of this frog are 0.5 seconds with 5 pulses per seconds, 0.1 seconds of pulse length, each call constitutes 5 pulses, fundamental frequency 3.67kHz and dominant frequency 4.83kHz. Advertisement calls of this species was reported previously by Kuramoto and Joshy (2001) as *Philautus bombayensis* and recorded dominant frequency was about 3.95 kHz for this species and it is coincided with this studies.



**Fig. 3.** *Raorchestes tuberochumerus* : **A.** Oscillogram **B.** Audio spectrogram

**Table: 1.** Bioacoustics properties of three species of frogs in Brahmagiri Wildlife Sanctuary, Western Ghats.

| Species                              | Call      | Pulses                 |           |           | Frequency (kHz) |          |
|--------------------------------------|-----------|------------------------|-----------|-----------|-----------------|----------|
|                                      | length(s) | rate(s <sup>-1</sup> ) | length(s) | No./ call | Fundamental     | Dominant |
| 1. <i>Raorchestes glandulosus</i>    | 0.45      | 35                     | 0.025     | 5         | 2.06            | 3.59     |
| 2. <i>Raorchestes luteolus</i>       | 0.32      | 56                     | 0.015     | 7         | 2.13            | 3.31     |
| 3. <i>Raorchestes tuberochumerus</i> | 0.5       | 5                      | 0.1       | 5         | 3.67            | 4.83     |

## CONCLUSIONS

The anuran advertisement calls are being used as a diagnostic tool for clarifying the taxonomy among closely related cryptic species. Anuran vocalization surveys used as a technique for monitoring the occurrence of populations of amphibians. Studies of acoustic parameters are also important for understanding the evolutionary behaviour of communication in anurans and provide an essential tool in conservation monitoring program. Analyses of call pattern among the anuran of the Western Ghats are to document species distribution pattern, richness, relative abundance and landscape ecology.

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