

ADVERTISEMENT CALL STUDIES OF FROGS IN THE RAJIV GANDHI NATIONAL PARK, NAGARAHOLE, WESTERN GHATS, INDIA

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Abstract

Rajiv Gandhi National Park, Nagarahole is one of the hot spots for wildlife in the Nilgiri Biosphere Reserve (Western Ghats), Karnataka State. The national park covers an area of 643.4 sq. km. with a core zone of 192 sq.km. The terrain undulating with an altitude ranging from 701 to 959 m asl. Monsoon is erratic, but it generally rains from June to September with an annual rainfall of about 1,440 mm and temperature range is 14°C-33° C. Anuran calls at the breeding season is one of the principal means of guidance for individuals of a species to gather at suitable breeding sites. The call of each species is distinctive and is a good guide for field identification. Since the development of sound analysis techniques, the comparison of advertisement calls of different populations has played a major role in the detection of cryptic species worldwide. Acoustic studies of anurans were carried out in the region during rainy seasons between 2013-2014. Acoustic call features of 5 anuran species were analyzed in the present study. These included *Euphlyctis hexadactylus*, *Fejervarya granosa*, *Microhyla ornata*, *Ramanella triangularis* and *Clinotarsus curtipes*.

Keywords: Advertisement calls, wildlife, Biosphere, National Park, cryptic species

Introduction

The most remarkable factor in the life of amphibians is their breeding habit. It is a well-known fact that among land vertebrates only amphibians begin their lives in water as tadpoles. It is during the breeding season coinciding with the monsoons in India that the normally circumspect frogs and toads throw all caution to the winds and the male makes its presence known by its loud call a sound which at night is a continuous roar as thousands of frogs and toads of different species give tongue to advertise their presence in the selected breeding site. The call in the breeding season is one of the principal means of guidance for individuals of a species to gather at suitable breeding sites. The call of each species is distinctive and is a good guide for field identification.

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 a 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). A second type of call, the territorial call, is comprised an acoustic signals and is accompanied by corporal vibration produced by a male or an unreceptive female in response to amplexus. Other types of calls include the reciprocation call which is given by a receptive female, and the distress call which is delivered in response to an enemy or predator for defenses.

Since the development of sound analysis techniques, the comparison of advertisement calls of different populations has played a major role in the detection of cryptic species worldwide. This way many new taxa have been detected by variation in their advertisement calls before their genetics were studied (Schneider, 1974; Paillette *et al.*, 1992; Schneider and Haxhiu, 1994; Matsui, 1997; Myers *et al.*, 1998; Sanchez-Harraiz *et al.*, 2000; Channing *et al.*, 2002). Comparison of morphology and calls of cryptic species have been done by Funk *et al.* (2008). Species specific anuran advertisement call has been used as a diagnostic character for clarifying the taxonomy among closely related species (Heyer *et al.*, 1990; Sullivan and Malmos, 1994; Abrunhosa *et al.*, 2005; Napoli and Cruz, 2005; Silva-Filho and Junca, 2006). However, it is evident from the literature that there are several reports are available on the advertisement call studies of anurans of the 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; Krishna and Sreepada, 2010; Modak *et al.*, 2016). Therefore, the current study of advertisement call structures of five frogs that are distributed in the Rajiv Gandhi national park, Nagarhole Western Ghats were carried out.

Materials and Methods

Study Area

Rajiv Gandhi National Park, Nagarhole (12°15'E, 76°17'N) is one of the hot spots for wildlife in the Nilgiri Biosphere reserve in the Western Ghats in Karnataka State. The national park covers an area of 643.4 sq. km. with a core zone of 192 sq.km. The terrain undulating with an altitude ranging from 701 to 959 m asl. Monsoon is erratic, but it generally rains from June to September with an annual rainfall of about 1,440 mm and temperature range is 14°C-33°C. The water sources in this park include the Lakshmmantirtha river, Sarati Hole, Nagar Hole, Balle Halla, Kabini river, four perennial streams, 47 seasonal streams, four small perennial lakes, 41 artificial tanks, several swamps, Taraka dam and the Kabini reservoir. The predominant vegetation in the Nagarhole National Park is of southern tropical mixed deciduous both moist and dry with small patches of semi evergreen and evergreen type (Lal Ranjit, 1994). Acoustic studies of anurans were

carried out during rainy seasons between 2013-2014 (June-September). 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 component terminology are followed based on 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 audio spectrogram of advertisement calls were studied for call analysis using the software Avisoft-SAS Lab Pro, Version 4.40 (Avisoft Bioacoustics, Germany).

Acoustic call features of 5 anuran species belonging to 3 families in 5 genera were analyzed in the present study. These included *Euphlyctis hexadactylus* and *Fejervarya granosa* in family Dicroglossidae, *Microhyla ornata* and *Ramanella triangularis* in family Microhylidae and *Clinotarsus curtipes* in family Ranidae. 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 5 species of anurans in the Western Ghats of Kodagu are given in Figures 1-5.

Euphlyctis hexadactylus (Lesson 1834): The advertisement calls of this species were recorded in a small stream flowing in the national park on 6th July 2013. At air temperature 21°C, water temperature 19.5°C and humidity 85%, call duration of this frog was about 0.6 seconds with 15 pulses per second was the pulse rate, with fundamental frequency of 1.34 kHz, and dominant frequency of 2.55 kHz. Pulse length was 0.06 seconds and number of pulses per call was 12. Kuramoto and Joshy (2009) have analyzed earlier the calls of *Euphlyctus hexadactylus* and reported that the call duration is about 0.25 and dominant frequency is 2.29 kHz.

Fejervarya granosa (Kuramoto, Joshy, Kurabayashi and Sumida 2007): Advertisement calls of this species were recorded near the perennial slow flowing streams of the national park on 4th September 2013. At air temperature of 21°C, water temperature of 19.5°C and humidity 78%, all duration was 0.4 seconds with 92 pulses per second, 0.013 seconds of pulse length, pulses per calls about 16, fundamental frequency of 1.16 kHz and dominant frequency of 3.65 kHz. Kuramoto *et al.* (2007) have analyzed earlier the calls of *Fejervarya granosa* and reported that the call fundamental frequency of 1.7 kHz and dominant frequency of 3.4 kHz.

Microhyla ornata (Duméril and Bibron 1841): Calls were recorded at the Rajiv Gandhi National Park, Nagarahole near temporary pond on 8th August 2013 at air temperature of 24°C, water temperature of

22.5°C and humidity of 71%. Call duration was 0.50 seconds with 24 pulses per seconds, 0.006 seconds of pulse length, each call constitutes 12 pulses, fundamental frequency of 1.87 kHz and dominant frequency of 3.39 kHz. The call is similar to that was described by Kanamadi *et al.* (1994) for *Microhyla rubra*.

Ramanella triangularis (Günther 1875): Calls were recorded in moist deciduous forest of national park near temporary pond on 3rd July 2013 at air temperature of 20°C, water temperature of 18.5°C and humidity of 91%. Call duration of this frog were 0.22 seconds with 22 pulses per second, 0.055 seconds of pulse length, each call constituted 22 pulses, fundamental frequency of 0.84 kHz and dominant frequency 1.92 kHz. Savitha and Bosch (2007) have analysed earlier the calls of *Ramanella maintained* and reported that the call peak frequency at the beginning of 1.9kHz and peak frequency at the end was 2.3 kHz, and call duration were 0.15 seconds. The advertisement calls of *Ramanella Montana* were also reported previously by Kadadevaru *et al.* (1998) in the Western Ghats. Call duration of this frog was about 0.16 seconds with 34 pulses per second. Fundamental frequency was 0.37 kHz and dominant frequency was about 3.4 kHz respectively.

Clinotarsus curtipes (Jerdon 1853): The advertisement calls of this species were recorded in semi evergreen forest near a pond on 21st July 2014 at air temperature of 21.5°C, water temperature of 20°C and humidity 83%. Call duration was 0.9 seconds with 38 pulses per second, 0.11 seconds of pulse length, each call constitutes 8 pulses, fundamental frequency of 0.63 kHz and dominant frequency of 1.77 kHz. Hampson and Bennet (2002) have analysed earlier the calls of *Rana curtipes* and reported that fundamental frequency of 0.7 kHz, dominant frequency of 1.4 kHz and pulse length was about 0.64 seconds. *R. curtipes* showed a little higher fundamental frequency compared to *C. curtipes*. But this species's dominant frequency was a lower than that of *C. curtipes*.

Conclusion

Anuran vocalization surveys are widely used as a technique for monitoring the occurrence of populations of amphibians. Analyses of call pattern among the anurans of the Western Ghats are used predominantly in the context of taxonomy, systematics and to document species distribution pattern, richness, relative abundance and landscape ecology. The comparison of advertisement calls of different populations has played a major role in the detection of cryptic species worldwide. This way, many new taxa have been detected by variations in their advertisement calls before their genetics were studied. Therefore, acoustic calls can be used to resolve the phylogenetic relationship among species. Studies of acoustic parameters are also important for understanding the evolutionary behavior of communication in anurans and provide an essential tool in conservation monitoring program.

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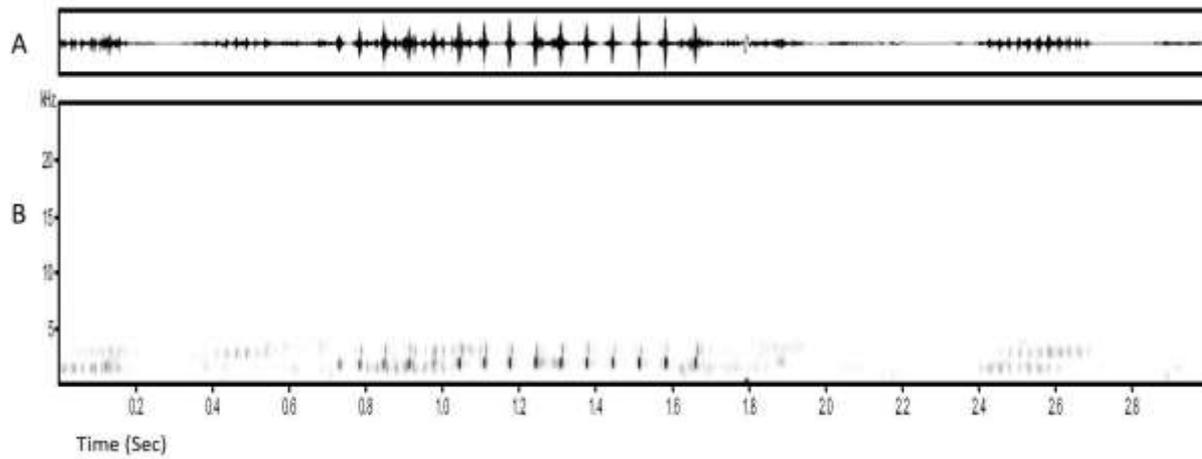


Fig. 1. *Euphlyctis hexadactylus* : A. Oscillogram B. Audio spectrogram

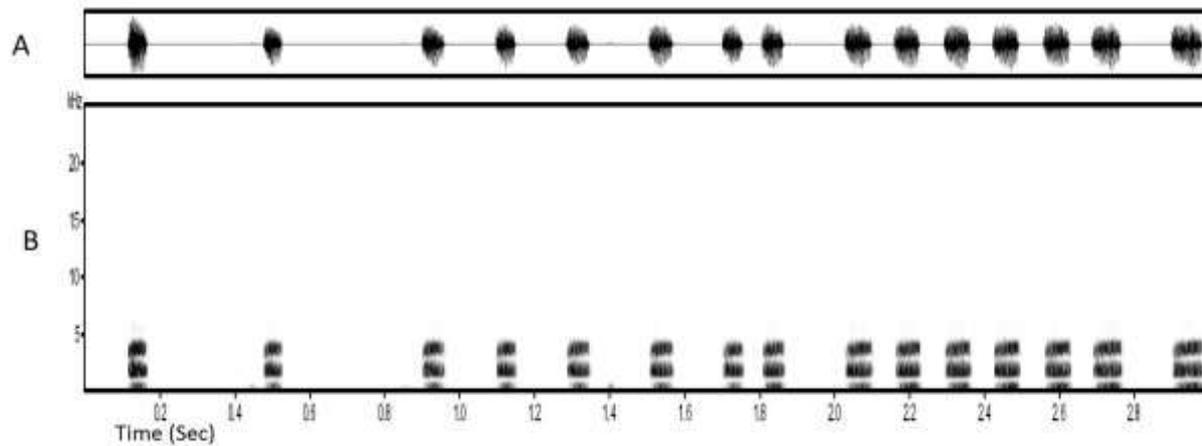


Fig. 2. *Fejervarya granosa* : A. Oscillogram B. Audio spectrogram

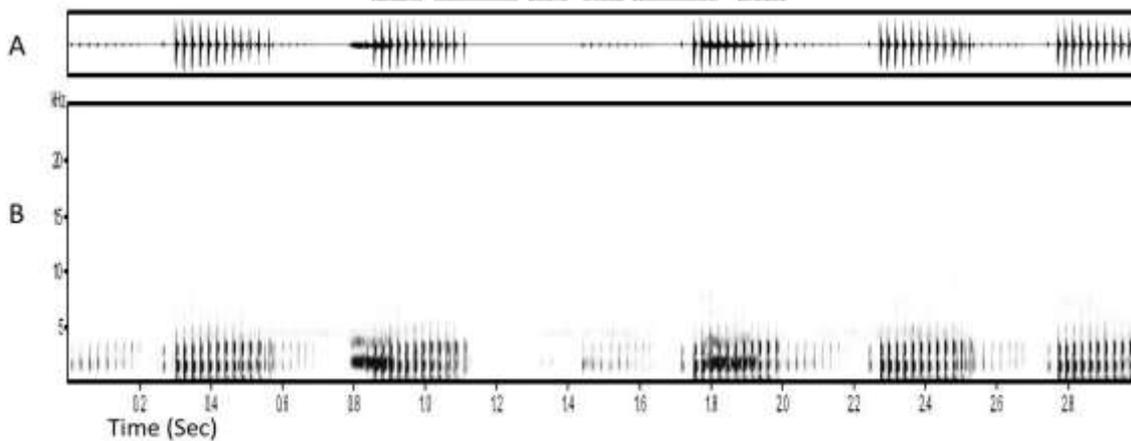


Fig. 3. *Microhyla ornata* : A. Oscillogram B. Audio spectrogram

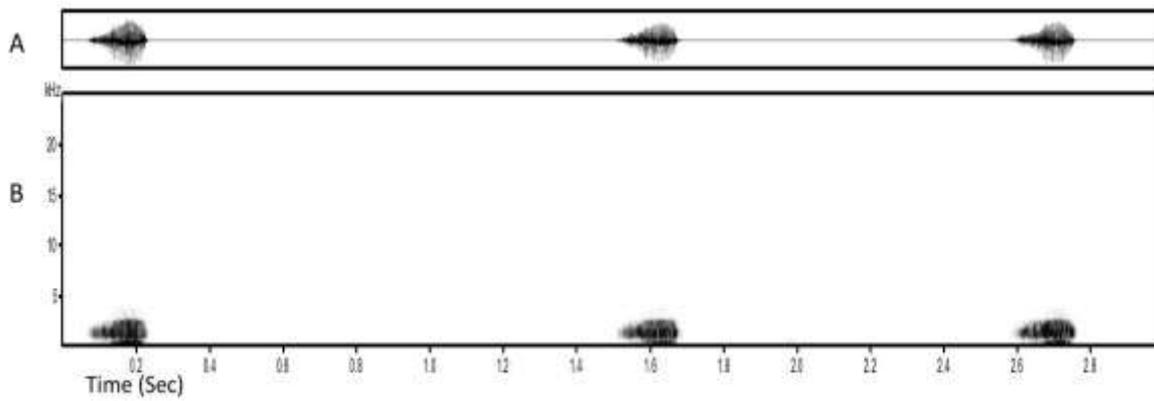


Fig. 4. *Ramanella triangularis* : A. Oscillogram B. Audio spectrogram

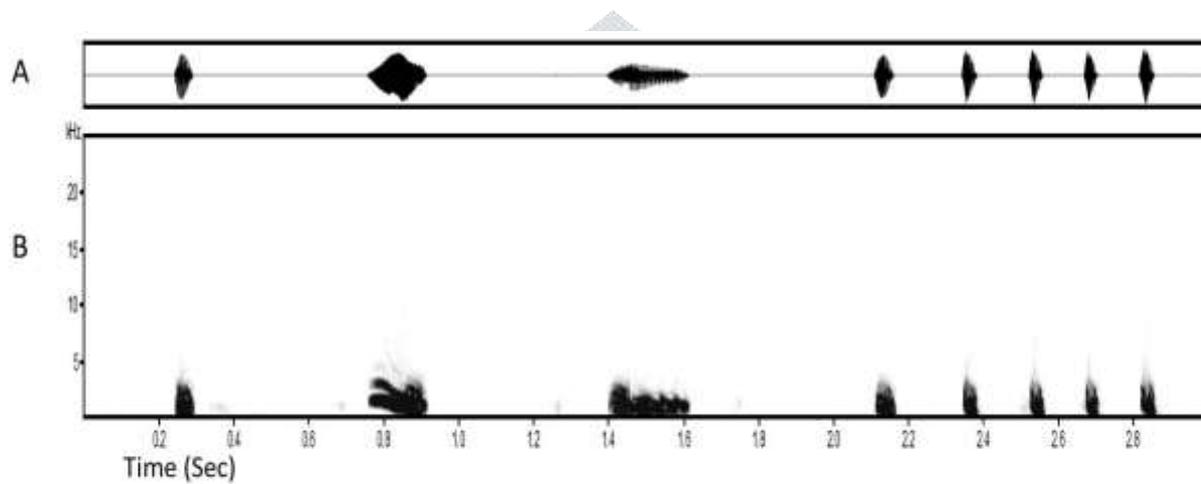


Fig. 5. *Clinotarsus curtipes* : A. Oscillogram B. Audio spectrogram

Table 1. Bioacoustic properties of 5 species of frogs in the Rajiv Gandhi National Park, Nagarahole, Western Ghats

Species	Call		Pulses		Frequency (kHz)	
	length(s)	rate(s ⁻¹)	length(s)	No./ call	Fundamental	Dominant
1. <i>Euphlyctis hexadactylus</i>	0.60	15	0.060	12	1.34	2.55
2. <i>Fejervarya granosa</i>	0.40	92	0.013	16	1.16	3.65
3. <i>Microhyla ornata</i>	0.50	24	0.006	12	1.87	3.39
4. <i>Ramanella triangularis</i>	0.22	22	0.055	22	0.84	1.92
5. <i>Clinotarsus curtipes</i>	0.90	38	0.110	8	0.63	1.77