

A Survey on Premating and Mating Behaviour of *Humerana humeralis*

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Abstract

A study on the mating behaviour of *Humerana humeralis* was done during May, 2021 and it was found that these frogs not only mate in streams but also in grounds and still waters. The observations include axillary amplexus, competitive behavioural approaches in males, propagation from one water body to other for safety, mating on the ground away from the water body, and an increase and decrease of mating calls with respect to rainfall and timing of the day.

Keywords: Premating; Mating; *Humerana humeralis*

Amphibians are one of the lesser-explored classes of animals in vertebrates. There are many unexplored arenas about amphibians chiefly encompassing their mating, life cycles and habitats and microhabitats. In India there are 384 species of amphibians with 344 species of anurans [1]. Many of the works have been done by Zoologists in different parts of world. A least explored stretch amidst the junction of West Bengal and Assam was chosen as our site of study. Anuran species *Humerana humeralis* Boulenger, 1887, commonly called Bhamo frog belongs to family *Ranidae*. Recent records and ethological parameters of this species are scanty in Southeast Asian territories. It is considered rare in Nepal and Bangladesh [2] and has not been reported from Myanmar since the collection of the type specimen, i.e. 100 years ago. (<https://indiabiodiversity.org>). Though IUCN (Red List 2004) has enlisted the species as Least Concern (LC); however, the population is in a rate of decrement [3] with not so ubiquitous presence of the species, unlike in Myanmar [4,5], Nepal [6] and Nagaland [7]. The frog *Humerana humeralis* was first documented from Assam and Arunachal Pradesh in October 2005 [8] and it was established as a new record from West Bengal from Chilapata forest, Jalpaiguri district and Jalpaiguri town [9]. The present study encompasses the mating behaviour of *H. humeralis* pre and post monsoon in a village named Panijhora (26°35.333 N, 89°31.990 E) which is in close proximity to Chilapata Forest.

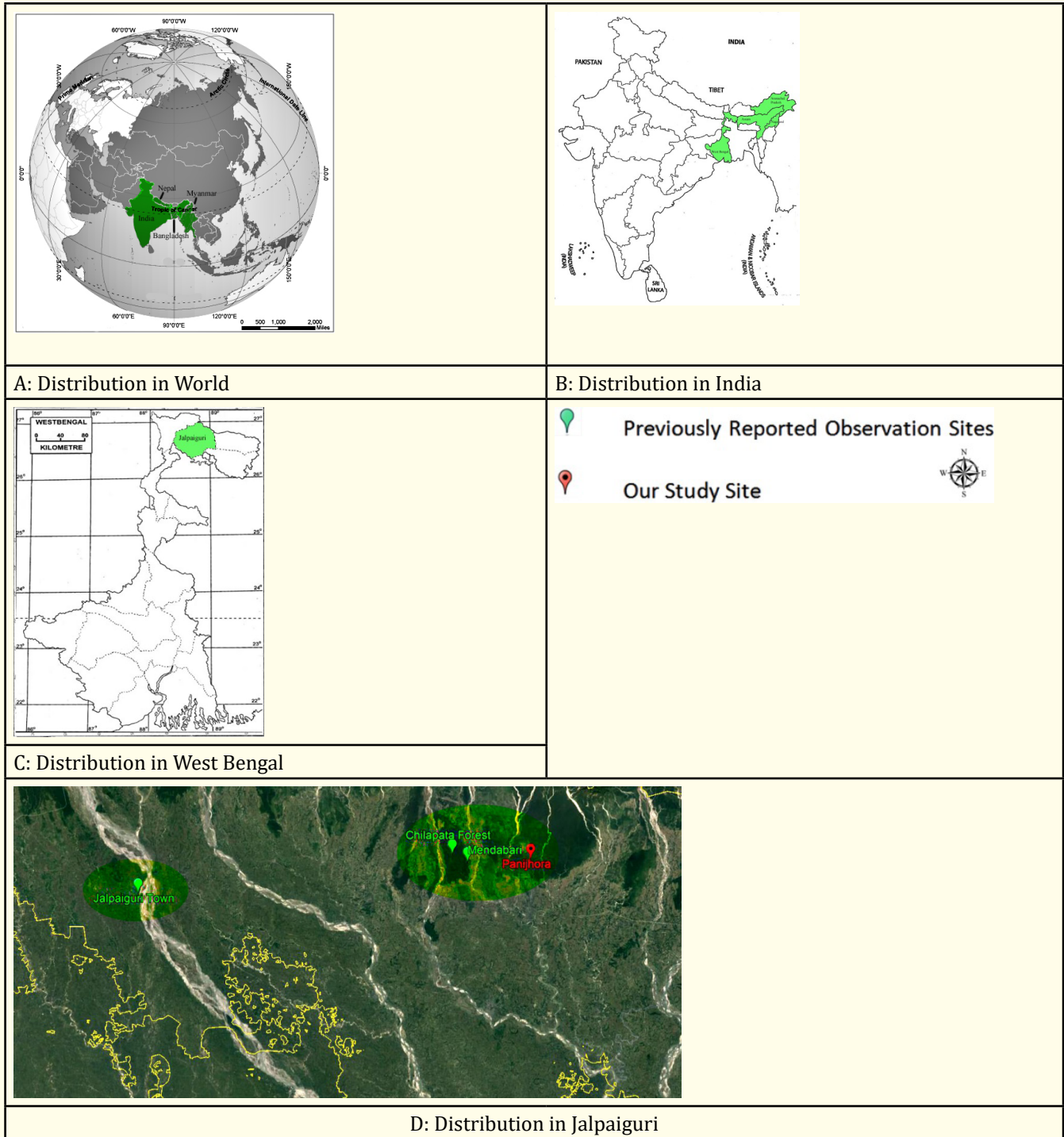


Figure 1: Habitat distribution of *H. humeralis*.

Observations were made for a few weeks and documented using Canon Powershot SX50hs camera and Eveready DL 65 LED torch at night. The area was surveyed with extreme care so as not to disturb the habitat as well as other frogs and animals. Videos are captured by Canon Powershot SX50hs from which audio files are separated and analysed in Raven Pro 1.5 Beta for sound parameters. The habitat chosen for work was the area of Panijhora adjacent to Buxa Tiger Reserve that had not been studied; the population of the frog *Humerana humeralis* was very good and the area had least human interference in spite of it being adjacent to a village. The study was made during its typical mating season and hence fine details were observed, no breeding pair was captured or disturbed in the study as it would harm the ecology. Documentations were done on the only photographic basis and call recognition of the frog species following description by Boulenger, 1887; But for the confirmation of identification five live specimens (2 males, 3 females) were captured and morphometric characters were measured, following species specific characters were identified. All length measurements were taken to nearest 0.1 mm using electronic callipers. After identification of the specimen, it was released unharmed in its natural habitat.

The frogs were found mating in several puddles, ditches as well as a small stream near the extension of Buxa Tiger Reserve Forest. A medium sized frog with an overall flattened body and two dorso-lateral folds on both sides of the body, skin dorsally smoothed but posterior part of back region showed slightly granular epidermal textures. Smoothed throat, abdomen and ventral surface of thigh with a square larger head (L - 22.37 ± 1.7 male, 23.87 ± 0.8 female and W - 21.06 ± 1.1 male, 23.65 ± 0.7 female) and a distinguished pointed snout projecting beyond the lower jaw were observed. Nostrils were near to the snout with larger eyes and the tympanum being two-third of the diameter of eye. Inter-narial distance was more than the inter-orbital distance and there was presence of distinct large, elongated rectal gland. Fore and hind limbs were elongated with long fingers and toes and the fingers were without webbing and the tips were with small discs whereas toes were almost totally webbed with two phalanges of the fourth toe free of webbing; first finger was slightly larger than the second finger. Dorsum was light brown with small black spots reaching between nostrils and eyes, while it was whitish in ventral parts. Lateral flanks were greenish with brown dorso-lateral folds. Ear drum was pink and a white line ran from flanks to upper jaw. The pupils were black and had a golden ring encircling the eye. The limbs were light brown in colour and rectal gland white. Hind limbs had black dots and the webbing on toes was dark brown. Detailed morphometric measurements are given in table 1.

Sex	Snout-vent length (mm)	Head length (mm)	Head width (mm)	Snout length (mm)	Inter-narial length (mm)	Eye diameter (mm)	Inter-orbital length (mm)	Tympanum diameter (mm)	Tibial length (mm)
Male	66.67 ± 2	22.37 ± 1.7	21.06 ± 1.1	10.77 ± 0.4	6.87 ± 0.3	7.13 ± 0.2	5.63 ± 0.1	4.35 ± 0.6	35.21 ± 1.4
Female	72.23 ± 1.3	23.87 ± 0.8	23.65 ± 0.7	11.35 ± 0.5	7.03 ± 0.3	7.82 ± 0.2	5.94 ± 0.2	5.43 ± 0.7	36.16 ± 1.6

Table 1: Morphometric measurements of the specimens (Mean ± SD).



Figure 2: Lateral view of *Humerana humeralis*, Panijhora.



Figure 3: Forelimb of *H. humeralis*.

One of the interesting findings was that the frogs were giving mating calls from small puddles formed by elephant footprints on mud. Near about thousands of frogs were seen showing activities around the water ditches as soon as the darkness of the evening set in figure 6. The calls were heard from the time the skies became cloudy and it was the season of rainfall in the region. The male frogs were seen giving continuous and competitive mating calls. *Humerana humeralis* calls were dominant in the entire area of study and in between the existed the calls of *Hylarana tytleri*, *Hylarana leptoglossa*, *Uperodon globulosus* and a few cricket frogs.

Time	Weather condition				
	Cloudy	Not cloudy	During rainfall	Before rainfall (15 - 20 minutes)	After rainfall (15 - 60 minutes)
5.00-5.30pm	Intermittent calls and few	Negligible calls	Loud calls, often continuous	Prominent, loud and continuous.	Continuous and competitive with other species
6.00-6.30pm	Frequency increased due to darkness	Intermittent calls	Loud, often continuous	Continuous, prominent and competitive (intra and inter species)	Continuous with a few mating pairs seen as conditions were dark and moist.
7.30-8.00pm	Loud calls, often seen calling from fields also.	Negligible calls although a few mating pairs seen.	Mating pairs seen abundantly, loud calls and continuous.	Mating pairs seen but not many, calls were louder with greater frequency.	Males were seen on swampy ground or water accumulated fields and many mating pairs also observed, calls lasted for many hours.
8.30-9.30pm	Mating pairs seen in increased numbers, soft calls and distant similar to murmurs.	Calls were intermittent, few mating pairs	Activity was highest near the pond and frogs were seen mating in the water and around the banks.	Calls had increased with thunder claps and mild drizzling also an increase in mating pairs were seen.	Loud and clear calls as all background noise had ceased, now mating activity was also much increased and competitive calls were seen.
10.00pm onwards till early morning	Mating pairs with a few pairs were seen transferring to other nearby water body or stream or fields.	Loud, discontinued calls with mating pairs seen but less in number and in a few days of clear skies no mating pair was seen.	High activity of mating and calls, often a mating pair was also surrounded by one or two males who were competitors	At this time of the day and before rainfall the calls were louder than usual, continuous and dominant, males and females were seen often getting close near puddles on inside them and also on fields.	High mating activity, calls dominant and throughout the night. Mating seen on ground, water both.

Table 2: Call variations and activity with time and weather condition of the day was studied and has been tabulated.

The calls were seen to be seizing completely around the morning at almost 6.00AM. The study reveals that time of the day, cloud cover and rainfall affects the day affects the mating and pre-mating behaviour of the frogs. The frogs were seen more active in mating behaviour at late night and during cloudy or days with good rainfall at regular intervals. The calls were intermittently heard during the dusk or early evening and were directly proportional to the rainfall whereas the mating activity was seen during the dark hours of the evening and late at night although accompanied with calls. A 4 seconds audio been analysed in Raven pro (Figure 4 and 5) easily differentiated a normal call with a mating call through several sound parameters (Table 3). Waveform between 3.239 second to 3.458 second is bell shaped, which denotes a mating call. Wave form between 2.916 second to 3.204 second is with almost same height and having sharp end denotes a normal call. Peak frequency of a mating call is higher than a normal call whereas peak amplitude of a normal call is higher than a mating call.

Sound Parameters	Call Type	
	Normal	Mating
RMS Amplitude (U)	5172.1 ± 10.2	5325.7 ± 11.1
Peak Amplitude (U)	25631 ± 25.3	21625 ± 27.2
Peak Frequency (Hz)	1875 ± 11.7	2062.5 ± 13.4
Max Entropy (bits)	4.249 ± 0.5	4.271 ± 0.6
Average Entropy (bits)	3.028 ± 0.4	2.834 ± 0.3
Max Power (db)	101.9 ± 1.2	101.3 ± 1.2
Average Power (db)	77.3 ± 0.9	77.3 ± 0.9

Table 3: Different sound parameters of normal and mating call.

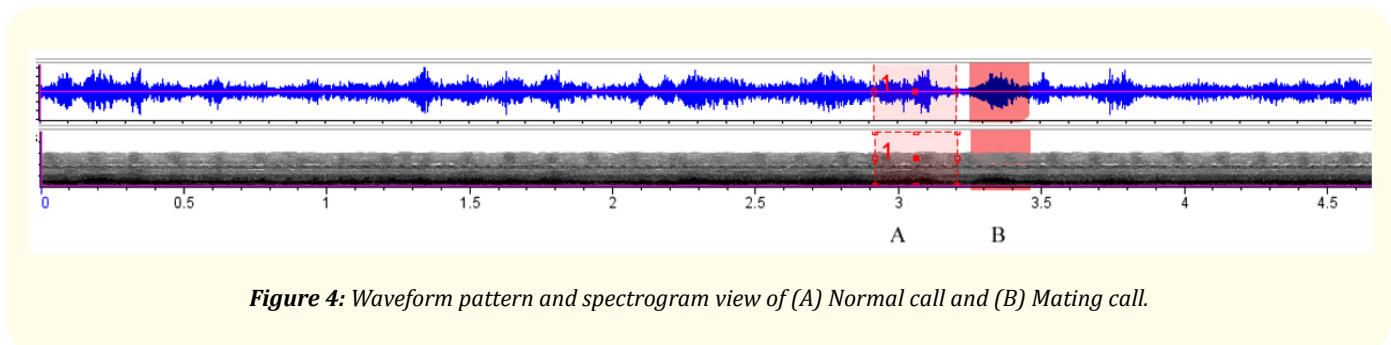


Figure 4: Waveform pattern and spectrogram view of (A) Normal call and (B) Mating call.

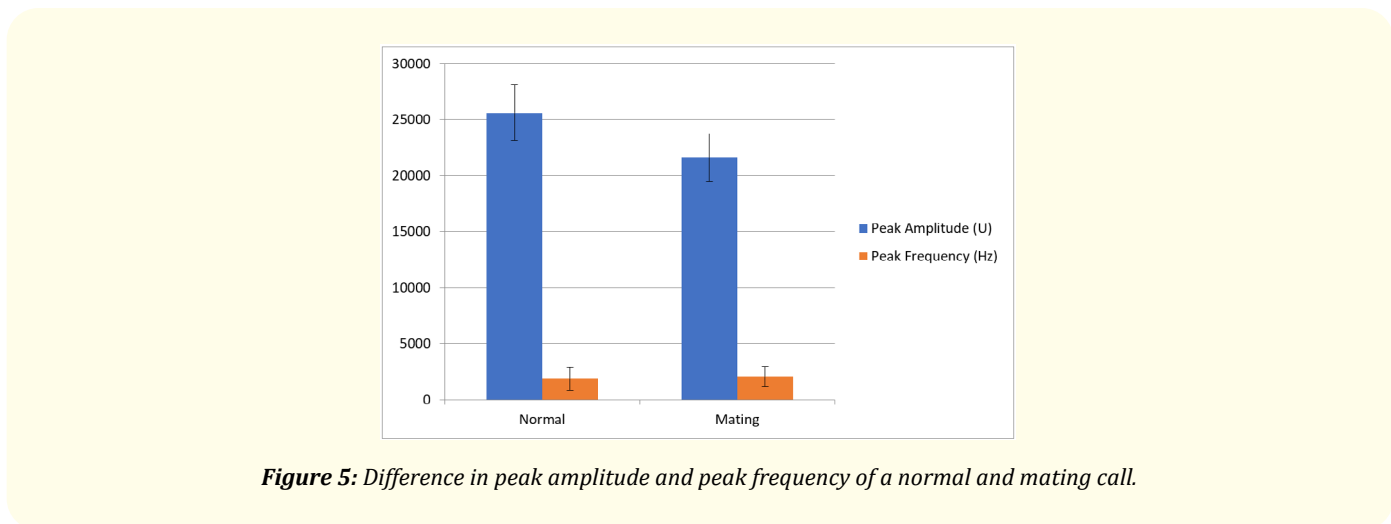


Figure 5: Difference in peak amplitude and peak frequency of a normal and mating call.

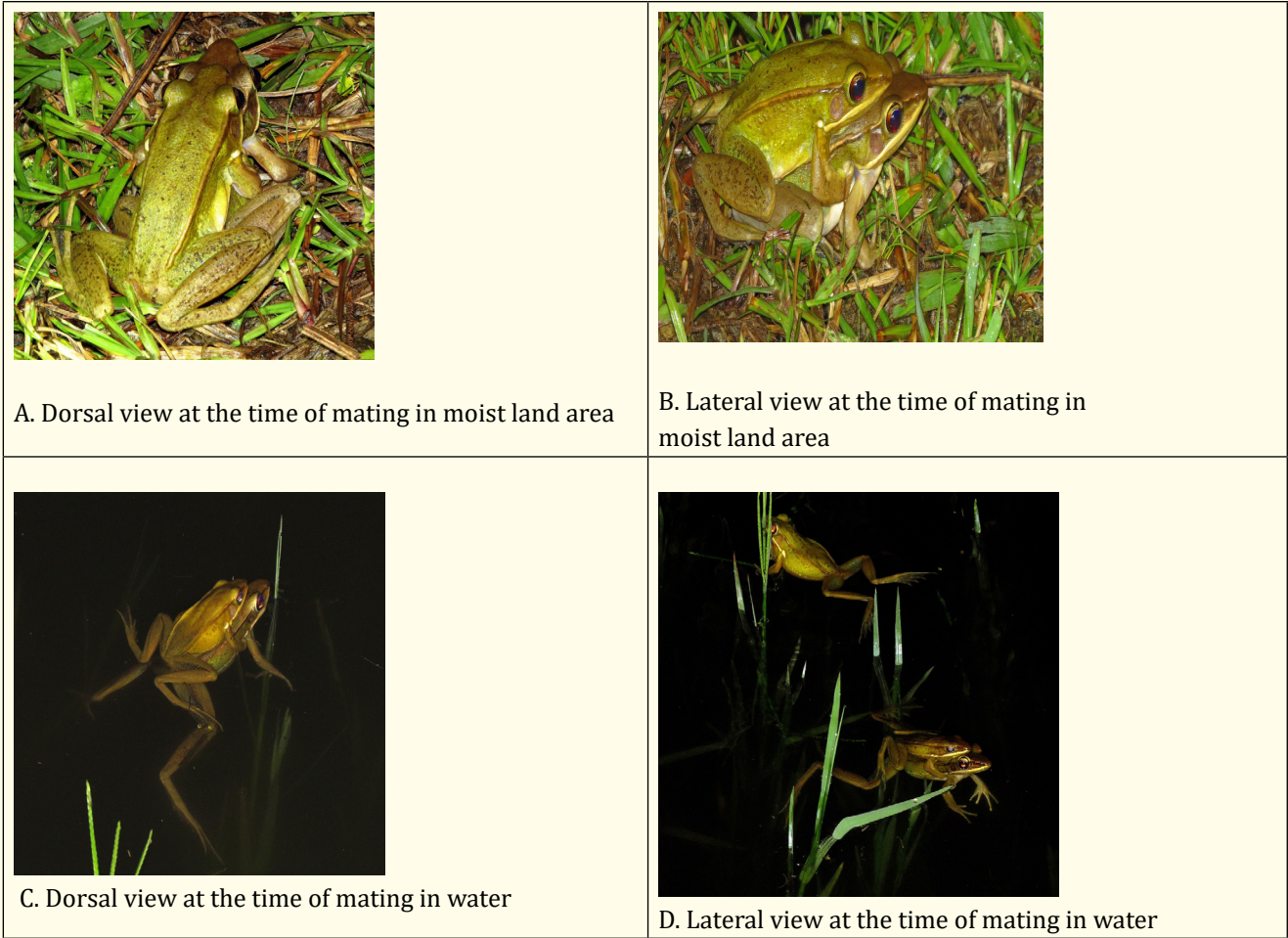


Figure 6: Mating of *H. humeralis*.

Conclusion

It can be thereby concluded that rainfall and time of the day has direct effects on the pre mating and mating behaviour. The micro factors of overcast, time of the day etc. may bring about difference in breeding rate. This can be used as an indicator of ecological balance for a locality or habitat of a certain place or if observation is macroscopic data compiled can be used for assessment of the same for the country or in larger scale. The success of breeding will hence help to assess the ambient environmental conditions and sustainable condition of a forest etc.

Conflict of Interests

The authors declare no conflict of interests.

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