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## **Annual breeding cycle and spawning behaviour of *Hyla annectans* Jerdon 1870 in Nagaland, India**

A study of the breeding cycle and spawning behaviour is essential to plan conservation measures for the species included in the IUCN red list category. *Hyla annectans* had been categorized as a lower-risk near-threatened species<sup>1</sup>. There are several contributions on these aspects of anuran amphibians from India<sup>2-6</sup>. *H. annectans* is the only species reported

from India of the family Hylidae and genus *Hyla*<sup>7</sup>. This species was recorded from Khasi hills and Upper Burma. In Nagaland (25°15'–27°04'N latitude and 93°20'–95°15'E longitude) its distribution is along the Borail range at various altitudes ranging from 1400 to 2440 m ASL. The general climatic condition of the habitat is as follows:

temperature 4°C in January to 27°C in July, humidity 44% in January to 92% in July, precipitation 3 to 15 mm in January to 289 to 489 mm in July. Vegetation is temperate evergreen forest.

The frog is leafy-green dorsally and yellowish-white ventrally (Figure 1). Male (SVL 40 mm) and female (SVL 48 mm) frogs show the same colouration. A light

brownish streak connects the eye and the nostril. A black streak on the lateral side behind the arm runs up to the groin, terminating in 2 to 3 black spots of different sizes. A few black spots are present on the inner surface of the femur and tibia.

The annual breeding cycle of *H. annectans* has been divided into 4 periods based on the activity of the frog.

The pre-breeding period is from March to April. In the beginning of March they come out of their hibernation and live deep in the sheath of banana plants, bamboo stumps and damp places. During this period the average atmospheric temperature ranges from 11.4 to 24.8°C. Relative humidity ranges from 53.55 to 78.75% and precipitation from 4.5 to 110 mm. The period from the time of emergence to beginning of amplexus (Figure 2) and spawning has been termed as the pre-breeding period.

The breeding period is from May to July. Breeding activity starts with calling of the male near water bodies. During this period, these frogs are observed near the water bodies among bushes and trees. Average atmospheric temperature ranges from 16.5 to 26.6°C and relative humidity ranges from 74.33 to 81.63%. Precipitation ranges from 128.23 to 428.33 mm and water temperature during amplexus ranges from 14 to 28.5°C. Breeding activity lasts till July end.

The post-breeding period is from August to November. During this period the frogs become mostly arboreal. They are found on trees and other vegetation. Average atmospheric temperature ranges from 14.37 to 23.85°C, rainfall from 116.97 to 307.02 mm and relative humidity from 74.32 to 79.52%. By the end of November these frogs are rarely sighted. Average atmospheric temperature recorded was 11.1 to 21.1°C, rainfall 67.5 mm and relative humidity was 66.9 to 75.2%.

The hibernation period is from December to February. The average atmospheric temperature ranges from 6.3 to 17.8°C, rainfall from 0.1 to 56 mm and relative humidity from 51.66 to 74.2%.

Spawning behaviour was observed during four breeding cycles (1996–2000). Frogs breed in temporary pond, rainpool, puddle and terraced paddy fields at the edge of the forest where water logging is observed. The depth of the water bodies where eggs are found ranged from 5 cm to 7.5 cm. Most amp-

lexing pairs were observed in shallow water bodies. Breeding grounds are normally covered by water plants and surrounded mostly by *Eupatorium* spp.

The croaking sound is loud. The vocal sac, when inflated while calling, becomes as big as the body. The male begins to call after sunset. Call by a single male is followed by the other males in an alternate manner. The male usually sits at the edge of the shallow part of the water body or on semi submerged vegetation on stones.

Females are sighted only after a few showers of rain. In comparison to males, females are fewer in number. They visit the spawning site late in the evening. Females come to the breeding site only once, whereas males visit the site every night.

Amplexing occurs during the early part of the night. Egg laying occurs from 01.00 h to 0.4 h in the field as well as in the aquarium of the laboratory. The number of eggs laid is between 570 and 630. They are laid in 6 to 10 batches, 4 to 6 cm apart. Each batch contains about 60 to 90 eggs. The eggs remain attached to twigs or grasses. The jelly coating of the egg helps in egg to egg adhesion and adhesion to the substratum. The eggs remain few millimetres below the water surface adhering to twigs or other objects with the help of the jelly film. The total period of development from egg to metamorphosis is 1550 h (64 days 14 h) at room temperature (16–22°C).

*H. annectans* is a seasonal breeder. Favourite breeding grounds are rain-fed shallow ponds, puddles and paddy fields.



Figure 1. Female *Hyla annectans*.



Figure 2. *Hyla annectans* in amplexus.

Christein and Taylor<sup>8</sup> monitored two breeding ponds of *Bufo americana* and found that males greatly outnumbered the females (7 : 1). Schaub and Larsen<sup>9</sup> reported that females of *H. regilla* have more turn-over rate than the males in their breeding ponds. Bashkov and Jameson<sup>10</sup> reported that in *Bombina variegata*, the sex ratio is three males to one female. In *H. annectans* also, males were found to outnumber the females in the breeding sites.

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MEREN AO<sup>†</sup>  
SABITRY BORDOLOI<sup>\*‡</sup>

*\*Ecology Laboratory,  
Department of Zoology,  
Cotton College,  
Guwahati 781 001, India*

*†Department of Zoology,  
Kohima Science College,  
Kohima 797 001, India*

*‡For correspondence.*