



# Breeding and Metamorphosis of the Maharashtra Golden-backed Frog (*Indosylvirana caesari*, Ranidae) from Satara, Maharashtra, India

Amit Sayyed

Wildlife Protection and Research Society, Satara, Maharashtra (amitsayyedsatara@gmail.com)

Photographs by the author.

In 2013, the Wildlife Protection and Research Society initiated a study of the Golden Frog (*Hylarana* cf. *aurantiaca*) near Thoseghar, Satara (Padhye and Ghate 2002). Biju et al. (2014) subsequently described these frogs as a new species, the Maharashtra Golden-backed Frog (*Indosylvirana caesari*). *Indosylvirana caesari* differs from all other members of the group by a snout sub-elliptically pointed in dorsal view, the dermal fringe along toe V well developed from tip of toe to heel, and by having glandular projections ending with sharp spinules in males. More specifically, it differs from the Yellowish Golden-backed frog (*I. flavescens*) and Sreeni's Golden-backed Frog (*I. sreeni*) by second-toe webbing extending medially well beyond the first subarticular tubercle (versus to first subarticular tubercle in the other two species), dorsal skin granular (versus slightly to sparsely granular in the other two species). Furthermore, it differs from *I. sreeni* by an



Fig. 2. Calling male Maharashtra Golden-backed Frog (*Indosylvirana caesari*).



Fig. 1. Male Maharashtra Golden-backed Frog (*Indosylvirana caesari*) feeding on a South Asian Cricket Frog (*Zakerana* sp.).

interorbital space wider than the upper-eyelid width; from *I. indica* by a tympanum diameter smaller than the horizontal diameter of the eye, thigh shorter than foot length in males, and granular dorsal skin; from the Large Golden-backed Frog (*I. magna*) and the Mountain Golden-backed Frog (*I. montanus*) by smaller adult size, snout sub-elliptically pointed in dorsal and ventral views, and dorsal skin granular; and specifically from *I. montanus* by a thigh shorter than foot length.

*Indosylvirana caesari* occurs in the Satara and Amboli Districts of the Maharashtra in India (Biju et al. 2014). More detailed distributional records are lacking. During this study, we conducted field surveys in the vicinities of Kaas, Thoseghar, Panchgani, and Mahabaleshwer in the western portions of Satara District, where we encountered healthy populations near Kaas and Mahabaleshwer. Herein we report on breeding and life stages of *Indosylvirana caesari* from the vicinity of Kaas.

**Table 1.** Observations of the Maharashtra Golden-backed Frog (*Indosylvirana caesari*) in the field.

Date	Time	Observations
10 NOV 2013	1900	Not found
15 NOV 2013	2230	Not found
18 NOV 2013	1920	Not found
22 NOV 2013	1930	5 calling males
24 NOV 2013	1930	11 males, 4 females
26 NOV 2013	2200	18 males, 11 females, amplexus
27 NOV 2013	1859	Amplexus, egg mass (clutch: 659 ± 50)
01 DEC 2013	1920	13 males, 5 females, egg masses (clutches: 612 ± 50, 897 ± 50, 769 ± 50)
15 DEC 2013	2200	20 males, 8 females, small tadpoles observed
02 JAN 2014	1859	Calling males, single amplexus, tadpoles
31 JAN 2014	1922	Amplexus (clutch: 607 ± 50), tadpoles
13 FEB 2014	1930	9 calling males, 3 females, tadpoles
24 FEB 2014	1938	6 males, 3 females, tadpoles
05 MAR 2014	2011	7 males, tadpoles
17 MAR 2014	1930	7 males, tadpoles, froglets
09 APR 2014	1945	5 males, tadpoles, froglets
24 APR 2014	2235	2 males, tadpoles
02 MAY 2014	1929	8 males, 2 females, tadpoles, froglets
27 MAY 2014	1943	3 males, tadpoles, froglets
09 JUN 2014	1913	2 males, froglets
21 JUN 2014	2010	Not found
12 JUL 2014	1900	Not found
25 JUL 2014	2015	Not found
06 NOV 2014	1900	Not found
11 NOV 2014	2230	1 male
15 NOV 2014	1920	10 males, 3 females, amplexus
21 NOV 2014	1930	23 males, 8 females, amplexus, egg masses (clutches: 753 ± 50, 836 ± 50)
25 NOV 2014	1930	11 males, 4 females
28 NOV 2014	2200	14 males, 10 females, amplexus (clutches: 688 ± 50, 715 ± 50, 769 ± 50*)

\*collected eggs for the study of metamorphosis

### Methods

From November 2013 to June 2015 along a stream in dense forest near the village of Kaas (17°42'23.91"N, 73°48'20.56"E), we recorded calls using a digital recorder (WRU 120) and a PMC recorder in wave format (sample rate 48,000 Hz), took photographs with a digital camera, measurements of adult frogs and tadpoles with digital calipers, temperatures using an EEE-tech infrared thermometer (IRT-4; range: -50–550 °C), and determined latitude and longitude with a Kestrel 4500. For the study of metamorphosis, we collected tadpoles and observed them in an aquarium.

### Results and Discussion

We observed no frogs in the stream when the study began on 10 November 2013 (Table 1), but other species of frogs were active in the surrounding area. On 22 November, we observed five calling males, one of which was feeding on a South Asian Cricket Frog (*Zakerana* sp.; Fig. 1) and another on a Five-fingered Frog (*Euphlyctis* sp.). On 24 November, we found eleven males and four gravid females sitting on rocks in the stream; the size of the abdomen of gravid females was 34.06–34.89 mm, whereas that of non-gravid females was 22.00–22.12 mm (Table 2). Males called from rocks in

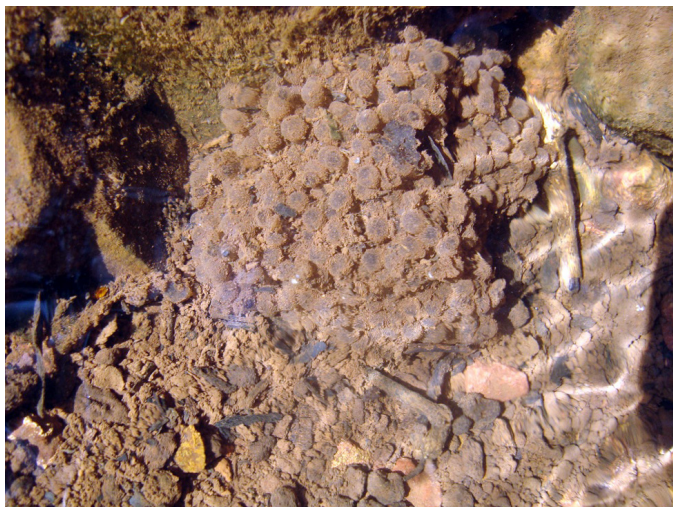
**Table 2.** Measurements of gravid and non-gravid female Maharashtra Golden-backed Frogs (*Indosylvirana caesari*).

Female abdominal size	Measurements (mm)
Non-gravid	22.00, 22.12, 22.08, 22.10, 22.05
Gravid	34.06, 34.47, 34.89, 34.22, 34.63

the stream and from the banks, vocal sacs visibly inflating when they call (Fig. 2). On 2 January 2014 at 1948 h, we observed amplexus on the ground near the stream (Fig. 3) and egg deposition at 2253 h. Females laid eggs along edges of the stream (Fig. 4) and amplexus continued until 0305 hr. Three clutches ranged from 607 to 897 ( $\pm 50$ ) eggs (Table 1). Water temperature was 20.6–25.0 °C. Breeding activity continued into June 2014, ceased with the onset of heavy rains, and began again in November 2014 (Table 1). These frogs normally are nocturnally active, but are readily seen by day during the November–January breeding season.



**Fig. 3.** Amplexing pair of Maharashtra Golden-backed Frogs (*Indosylvirana caesari*).



**Fig. 4.** Egg clutch of a Maharashtra Golden-backed Frog (*Indosylvirana caesari*).

**Table 3.** Measurements of larval Maharashtra Golden-backed Frogs (*Indosylvirana caesari*). TL = total length, SVL = snout-vent length, TLL = tail length.

Date	Measurements (mm)		
	TL	SVL	TLL
30 NOV 2014	10.89	4.21	6.68
15 DEC 2014	18.96	7.83	11.13
30 DEC 2014	23.90	9.31	14.59
14 JAN 2015	27.47	10.39	17.08
29 JAN 2015	31.94	13.37	18.57
13 FEB 2015	36.37	16.77	19.60
18 FEB 2015	36.45*	16.92	19.53
20 FEB 2015	35.90	16.57	19.33
23 FEB 2015	35.45**	16.38	19.07
27 FEB 2015	28.96	15.72	13.24
01 MAR 2015	24.69	15.23	09.46
09 MAR 2015	17.09	14.96	02.13
12 MAR 2015	14.91	14.02	00.89

\*Hindlimbs emerge, dorsolateral folds evident

\*\*Fore- and hindlimbs evident



**Fig. 5.** Tadpole of the Maharashtra Golden-backed Frog (*Indosylvirana caesari*).

Tadpoles are present from November until May. We observed developmental stages (Table 3) in nature and also in the aquarium. Tadpole size at hatching was 10.89 mm. Ground color is olive brown with black spots on the entire body and tail. The snout is triangular. The tail fin is transparent and pointed with moderately developed musculature. The height of the dorsal fin is greater than that of the ventral fin (Fig. 5). Hindlimbs emerged on day 80 and yellowish dorsolateral folds are evident (Fig. 6). Forelimbs appeared on day



**Fig. 6.** Tadpole of the Maharashtra Golden-backed Frog (*Indosylvirana caesari*) with hindlimbs on day 80.



**Fig. 7.** Tadpole of the Maharashtra Golden-backed Frog (*Indosylvirana caesari*) with fore- and hindlimbs on day 85.



**Fig. 8.** Froglet of the Maharashtra Golden-backed Frog (*Indosylvirana caesari*) with tail mostly resorbed on day 102.

85 (Fig. 7), but the tail was not resorbed for another 17 days (Fig. 8). Froglets were 10.89–14.91 mm in length at metamorphosis. Tadpoles were observed feeding on a variety of tiny organisms. Predators included other frogs, fishes, crabs, and birds.

Time to metamorphosis of tadpoles raised in the aquarium was 102 days; time in nature appeared to be slightly longer, possibly attributable to lower water temperatures (day- and nighttime aquarium water temperatures were 24–27 °C and 22–24 °C, respectively, whereas those in the stream were 23–25 °C and 20.6–23 °C).

Although no species of *Indosylvirana* have been assessed using IUCN Red List criteria (IUCN 2012), major threats include continuing loss of habitat, deforestation, and water pollution.

### Acknowledgments

I am sincerely thankful to Dr. Hemant Ghate (Retired Head, Department of Zoology, Modern College, Pune), Dr. Anand Padhye (Associate Professor, Department of Zoology, Abasaheb Garware College, Pune), Dr. Anil Mahabal (Retired Scientist, Zoological Survey of India, Pune), Mr. Subhash Shelke (Deputy Conservator of Forests, Satara), Mr. M.N. Pawar (Assistant Conservator of Forests, Satara), and the Forest Department of Satara District for their kind support. I also am grateful to Mr. Jitendra Patole, Atul Rajmane, Abhijit Nale, Akshay Bhagwat, Vinay Chavan, Gajanan Pimpale, and Rahul Thombre, members of the Wildlife Protection and Research Society of Satara, Maharashtra for help with fieldwork.

### Literature Cited

- Biju, S.D., S. Garg, S. Mahony, N. Wijayathilaka, G. Senevirathne, and M. Meegaskumbura. 2014. DNA barcoding, phylogeny and systematics of Golden-backed Frogs (*Hylarana*, Ranidae) of the Western Ghats-Sri Lanka biodiversity hotspot, with the description of seven new species. *Contributions to Zoology* 83:269–335.
- IUCN (International Union for Conservation of Nature). 2012. IUCN Red List Categories and Criteria: Version 3.1. Second edition. IUCN, Gland, Switzerland and Cambridge, UK.
- Padhye, A.D. and H.V. Ghate. 2002. An overview of amphibian fauna of Maharashtra state. *Zoos' Print Journal* 17:735–740.