

Larval Morphology and Development of Tree Frog *Polypedates Teraiensis* (Dubois, 1987)

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ABSTRACT

The life history of the tree frog *Polypedates teraiensis* was studied by raising eggs under laboratory condition. The breeding of *Polypedates teraiensis* is normally seen during monsoon between the month of April to August. However, during the present study eggs in foam nests were collected from April upto September in 2012. Observations on larval development, stage and size at hatching and larval duration was studied and is being presented here. The larvae are oval and depressed. The hatchlings measured about 7.8 mm at stage 22 (Gosner, 1960). The keratodont jaws developed at stage 25 and disappeared by stage 42. The juveniles measured about 16.2 mm. The life history (post hatching) was completed within 42 days.

Key words: *Polypedates teraiensis*, Larval development, Tadpole morphology, Cachar district, NE India.

INTRODUCTION

Anurans having a biphasic life cycle, breed in a variety of water bodies ranging from lentic to lotic water bodies. Anuran tadpoles exhibit structural diversities that are associated with their habitat, foraging behaviour and predator avoidance. The tree frog *Polypedates teraiensis* is a common rhacophorid breeding between April to August in north east India and is known to deposit eggs in the foam nest. There are at least six species of *Polypedates* currently recognized in north-eastern India (Chakravarty *et al.* 2011). However, little is known about the larval biology of these species from this region. The present study describes the oral disc, various morphometric features of the tadpoles, size and stage at hatching and duration of life history (post hatching) from Cachar district, Assam, north-east India.

MATERIALS AND METHODS

Between April to September, 2011 and 2012 several foam nests of *Polypedates teraiensis*

were sighted in manmade tanks in Assam University campus constructed for water storage for construction work. The foam nests were found adhering to the wall of the tanks slightly above the water surface. Some of the foam nests were brought to the laboratory and kept in aquaria with pond water for hatching. Tadpole rearing was done in the laboratory at the temperature 26-33 C. The clutch sizes were recorded. Data are based on three clutches. Various developmental stages were fixed in 10% formaldehyde at periodic interval and duly measured. Tadpoles were staged according to Gosner (1960). Sampling was repeated for two successive years and the average data for three different cycles are presented herein. Tadpoles were fed on fish food and algae collected from the pond. Morphometric measurements of various developmental stages were taken using vernier calliper. These include BL, TL, BD, BW, T, TH, BTMH, IO, IN, SO and SN. Abbreviations and definitions are in accordance with Altig and McDiarmid (1999). Description of oral apparatus and labial tooth row formula (LTRF) is in accordance with Altig (1970).

Abbreviations

BL-Body length, TL-Total length, BW-Body width, BD-Body depth, I-O- Interorbital distance, I-N-Internarial distance, S-O-Snout orbit distance, S-N-Snout naris distance, T-Tail length, BTMH- Basal tail musculature height, TH-Tail height.

RESULT

The frog is a seasonal breeder, breeding only during the monsoon. Depending on the rainfall the breeding season extended from April to September. During the study, the tanks were filled with rain water and the bottom was found to be covered with debris material, decaying leaves and mud. There was no other tadpoles found in the tanks, but the tanks were inhabited by other adult anurans such as *Fejervarya sp.* and *Euphlyctis cyanophlyctis*. Insect fauna was also abundant in the tank. The foam nests were found 4-5 inch above the water body adhering to the wall, some floating on the surface of water. The nest were collected from the tank and brought to the laboratory for rearing. It took 1-2 days for hatching after the collection. The number of hatching per nest ranged between 100 to 150. The hatchlings measured about 7.8 mm in total length and were at stage 22 (Gosner stage). The life history (post hatching) was completed within 42 days. Hours and days taken for development, lowest, highest and average length of different developmental stages are presented in Table 1.

Tadpole morphology

Body is oval, snout slightly rounded and depressed, eyes lateral in position. Nostrils dorsal, nearer to snout than eyes. Spiracle single sinistral, position lateral, vent dextral. Dorsal fin height is greater than the ventral fin. Both fin gradually tapering towards the pointed tip. Black spot is present all over the body and tail. Ventral side of the body is not pigmented and transparent at the abdomen region. Hence the intestinal spiracle is clearly visible through the transparent abdominal wall. Morphometric measurement of various developmental stages is presented in Table 2.

Oral disc

Mouth anteroventral, marginal papillae are biserially arranged. Teeth blunt and are not same

in height. Lower jaw 'v' shaped and jaw sheath finely serrated. Upper jaw arch shaped with a weak median convexity, both jaw sheaths edged with black. Submarginal papillae present. Disc emarginate, labial papillae and beak disappearing by stage 42

LTRF

4(2-4)/3(1). First row of the upper labium continuous whereas the 2nd, 3rd, and 4th rows are interrupted. Innermost row of lower labium slightly interrupted whereas the two other rows are continuous (Fig: 4).

Coloration

The tadpoles are light brown in colour with brown pigments all over the body and tail portion. Fin transparent.

DISCUSSION

P. teraiensis breeds in temporary pools, tanks that are filled by rain water during monsoon. The life history of this frog (post hatching) was completed with in 42 days. Relatively short period of development is characteristic of tropical species which have to take advantage of transitional aquatic habitat during the monsoons (Heyer 1973). This short period of development in this species is characteristic to take advantage, as it allows the larvae to metamorphose quickly and escape desiccation as the tanks dry up. Sheridan (2008) reported larval life (post hatching) of *Polypedates leucomystax* in 42 days from Sakaeerat, northeastern Thailand and the froglet measured about 19.4 mm. This developmental time is similar to the present report. Chakravarty *et al.* (2011) reported from Assam that metamorphosis was completed in *P. teraiensis* in 58 days. *Polypedates maculatus* completed development and metamorphosis in 55 days in Bhubaneswar (Hejmadi and Dutta, 1988). Girish and Saidapur (1999) reported the metamorphosis time of *Polypedates maculatus* as 60 days. Saidapur (2001) reported the larval duration of *Polypedates maculates* in 50-70 days and the size of metamorphosis is 21-23 mm. Metamorphosis (i.e., stages 42-46) lasts 6 days in the present study. This is similar to other available data on the duration of metamorphosis in *P. maculatus* and *R. arboreus*

which undergo metamorphosis in five days (Iwasawa and Kawasaki, 1979; Mohanty-Hejmadi and Dutta, 1988). Downie *et al.* (2004) who studied timing of metamorphosis in 14 taxonomically and ecologically diverse species from Trinidad (Daudin, 1802) reported metamorphosis ranging from 2.0 to 7.3 days. Whereas Sekar (1990) reported metamorphosis duration in *R. malabaricus* as 12 days. Chakravarty *et al.* (2011) reported metamorphosis duration of 9 days in *P. teraiensis*.

The foam nest is essential for development of this rhacophorid species, when eggs were removed from the foam nest before hatching the embryo did not develop further (Chakravarty *et al.*, 2011). This is also observed in the present study. The foam nest protects the eggs and embryo from predators and desiccation (Heyer, 1969; Downie, 1988) and also protected from thermal damage, as white foam nest reflects heat (Gorzula, 1977). Deposition of eggs away from water protects the early stages of the embryos (Mohanty and Dutta, 1988). The tadpole of small temporary ponds have been reported to spend more time in feeding and develop faster than tadpoles from larger permanent ponds, where the larvae spend more time hiding from predators and develop more slowly (Peltzer and Lajmanovich 2004).

The clutch size for *P. teraiensis* ranged between 100-150 in the present study. Chakravarty *et al.* (2011) reported from Assam that the clutch size for *P. teraiensis* consists about 100 eggs. Mohanty and Dutta (1988) reported for *P. maculatus*, the number of eggs ranged from 275-719, whereas Girish and Saidapur (1999) found the number of hatchling per nest ranged between 210-448 in *P. maculatus*. The present data is similar to the earlier published data and difference may be due to temperature and humidity variation in the present study area.

The embryonic development takes place within the foam nest, the tadpole in stage 21 stays within the nest and drops into water at stage 22. At stage 22 the larvae are very delicate and tail fins become transparent. The external gills get reduced and finally covered with development of operculum at stage 25. At stage 41 almost fully developed forelimbs are seen concealed beneath the transparent skin. The pigmentation is visible at stage 22 on the dorsal side of the body. The keratodont rows are quite distinct at stage 25 and LTRF formula is 4(2-4)/3(1). With the emergence of forelimbs at stage 42, the keratodonts and jaw sheaths have completely disappeared. In the present study the life cycle duration of 42 days is similar to an earlier study conducted in the present

Table 1: Developmental Stages of *Polypedates teraiensis*

SI No.	Stages	Corresponding stages of <i>Polypedates teraiensis</i>	Time for development	Lowest length (mm)	Highest length (mm)	Average length (mm)
1	Fertilized egg	-	0	-	-	-
2	External gill	22-24	96 hrs	6.8	12	9.43
3	Feeding	25	7 days	10.5	12.7	11.61
4	Hind limb bud development	26-30	12-21 days	14.2	26	20.05
5	Toe differentiation and development	31-39	25-32 days	25	45	33.69
6	Well developed hind limb	40	35 days	40	44	41.3
7	Forelimb visible	41	36 days	40	47	43.5
8	Both limbs	42-45	37-39 days	40	45	42.2
9	Froglet	46	42 days	15	17	16.2

Table 2: Morphometric measurements (in mm) of the tadpole of *Polydectes teraiensis* in different development stages. N=10 (X±SD; range in parenthesis)

Para meters	22	23	24	25	26	28	29	30	31	34	36	38	40	42
TL	7.8 ±0.88 (6.8-9.1)	8.92 ±0.84 (8-10)	11.58 ±0.35 (11.2-12)	11.61 ±0.69 (10.5-12.7)	16.16 ±1.16 (14.2-17.8)	19.58 ±1.22 (17.5-21)	21.76 ±0.92 (21-23)	22.7 ±1.70 (21-26)	27.59 ±1.94 (25-30)	35.9 ±0.17 (35.6-36)	44.82 ±0.24 (44.5-45)	45.14 ±3.45 (45-46.9)	48.64 ±2.63 (44-50.1)	49.3 ±5.66 (45-55.5)
BL	2.96 ±0.054 (2.9-3)	3.18 ±0.31 (2.9-3.7)	3.38 ±0.29 (3.1-3.7)	3.79 ±0.23 (3.5-4)	4.58 ±0.79 (3.1-6)	5.74 ±0.46 (5.1-6.2)	5.85 ±0.56 (5-7)	6.26 ±0.66 (5-7)	9± (8-9.8)	11.32 ±0.4 (11-11.8)	12.76 ±0.33 (12.3-13)	12.98 ±0.04 (12.9-13)	14.02 ±0.08 (13.9-14.1)	16.94 ±0.1 (17-18)
BW	1.54 ±0.39 (1-2)	1.92 ±0.10 (1.8-2)	2.06 ±0.054 (2-2.1)	2.33 ±0.50 (1.7-2.9)	3.16 ±0.56 (2.1-4.1)	3.87 ±0.69 (3-4.9)	4.12 ±0.26 (4-4.7)	4.36 ±0.55 (3.3-5)	5.61 ±0.43 (5-6)	7.04 ±0.05 (7-7.1)	7.58 ±0.82 (7-9)	8.06 ±0.08 (8-8.2)	8.56 ±0.51 (8-9)	8.06 ±0.05 (8-8.12)
BD	1.64 ±0.30 (1.2-2)	1.7 ±0.12 (1.6-1.9)	2.18 ±0.24 (2-2.5)	2.23 ±0.21 (2-2.5)	2.45 ±0.43 (2.1-3)	2.38 ±0.47 (2-3.1)	3.69 ±0.45 (3-4.2)	3.3 ±0.52 (2.5-4)	4.08 ±0.52 (3.5-5)	7.04 ±0.08 (7-7.2)	6.88 ±0.21 (6.5-7)	7.08 ±0.20 (6.9-7.3)	7.08 ±0.63 (6-7.5)	4.62 ±0.16 (4.5-4.8)
I-O	0.78 ±0.16 (0.6-0.9)	0.92 ±0.08 (0.8-1)	1.84 ±0.054 (1.8-1.9)	2.7 ±0.25 (2.5-3)	2.88 ±0.41 (2.5-3.5)	3.44 ±0.45 (3-4)	3.15 ±0.24 (3-3.5)	3.34 ±0.45 (3-4.5)	4.44 ±0.79 (3-5.5)	5.98 ±0.08 (5.9-6.1)	6.64 ±0.54 (6-7.1)	6.92 ±0.53 (6-7.3)	7.01 ±0.05 (7-7.1)	6.9 ±0.1 (6.8-7)
I-N	0.12 ±0.04 (0.1-0.2)	0.28 ±0.04 (0.2-0.3)	1.04 ±0.054 (1-1.1)	1.1 ±0.21 (1-1.5)	1.06 ±0.05 (1-1.1)	1.16 ±0.15 (1-1.5)	1.19 ±0.16 (1.1-1.5)	1.25 ±0.15 (1-1.5)	1.29 ±0.16 (1-1.5)	2.04 ±0.05 (2-2.1)	2± (1.9-2.1)	2.02 ±0.08 (1.9-2.1)	1.94 ±0.05 (1.9-2)	1.94 ±0.05 (1.9-2)
S-O	0.58 ±0.10 (0.5-0.7)	0.78 ±0.16 (0.5-0.9)	1.54 ±0.17 (1.3-1.7)	1.65 ±0.24 (1.5-2)	1.85 ±0.24 (1.5-2)	2.3 ±0.34 (2-3)	2.04 ±0.05 (2-2.1)	2.4 ±0.39 (2-3)	3.44 ±0.12 (3.2-3.5)	4.02 ±0.04 (4-4.1)	4.1 ±0.15 (3.9-4.3)	4.12 ±0.10 (4-4.2)	4.18 ±0.08 (4.1-4.3)	4.12 ±0.10 (4-4.2)
S-N	0.18 ±0.05 (0.1-0.2)	0.18 ±0.04 (0.1-0.2)	0.52 ±0.27 (0.2-0.8)	0.53 ±0.094 (0.5-0.8)	0.8 ±0.25 (0.5-1)	0.85 ±0.24 (0.5-1)	0.8 ±0.18 (0.5-1)	0.91 ±0.16 (0.5-1)	1.14 ±0.09 (1-1.2)	1.18 ±0.10 (1.1-1.3)	1.94 ±0.19 (1.7-2.2)	2.02 ±0.10 (1.9-2.1)	2.04 ±0.05 (2-2.1)	2.1 ±0.07 (2-2.2)
T	4.84 ±0.89 (3.9-6.2)	5.74 ±0.74 (5.1-6.8)	8.74 ±0.43 (8-9)	9.62 ±1.94 (7.3-12.3)	12.88 ±2.38 (10-17.3)	14.64 ±0.81 (13-16)	15.49 ±0.64 (15-16.9)	16.73 ±1.22 (15.2-19)	17.99 ±2.80 (11-20.4)	24.58 ±0.5 (23.8-25)	31.42 ±0.53 (31-32)	33.36 ±0.86 (32-34)	34.62 ±2.61 (30-36.1)	32.26 ±5.6 (28-38.8)
BTMH	0.72 ±0.16 (0.6-1)	0.76 ±0.13 (0.7-1)	1.14 ±0.089 (1-1.2)	1.20 ±0.34 (1-2)	1.98 ±0.04 (1.9-2)	2.01 ±0.45 (1.5-2.9)	2.03 ±0.04 (2-2.1)	2.95 ±0.05 (2.9-3)	5.26 ±0.23 (5-5.5)	5.28 ±0.21 (5.5-5)	5.44 ±0.51 (5-6)	5 ±0.61 (4-5.5)	5.2 ±0.27 (5-5.5)	2.94 ±0.08 (2.8-3)
TH	1.24 ±0.43 (0.8-1.8)	1.72 ±0.17 (1.5-1.9)	2.3 ±0.036 (2-2.9)	2.53 ±0.48 (2-3.2)	2.95 ±0.53 (2-3.7)	4.25 ±0.57 (3-4.9)	4.56 ±0.47 (3.9-5)	5.64 ±1.05 (4-7)	5.28 ±0.70 (5-6.1)	9.08 ±0.1 (9-9.2)	10.76 ±1.60 (9-12)	11.48 ±1.33 (9.1-12.3)	12.1 ±0.65 (11-12.5)	4.9 ±0.07 (4.8-5)



Fig.1: Foam with Eggs



Fig 2: Gosner stage 23



Fig 3: Gosner Stage 31

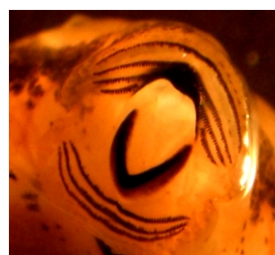


Fig 4: Mouth part at Stage 38

location (unpublished, Dey, 1997) where it was completed in 40 days.

CONCLUSION

The duration of development and metamorphosis of anurans has been found to vary from species to species. The metamorphosis is completed in 58 days in *P. teraiensis*, 55 days in *Polypedates maculates*, 94 days in *Rana cyanophlyctis*, 68 days in *Rhacophorus malabaricus*, 64 days in *Hyla annectans*, 60-61 days in *Polypedates leucomystax*, 59-60 days in *Rhacophorus bipunctatus*, 35-50 days in *Bufo melanostictus* as reported by earlier workers.

Based on the present findings, it can be concluded that foam nest is essential for the

development of this rhacophorid species. The newly hatched larvae are very delicate with a large yolk sac and external gills. The keratodont rows are quite distinct at stage 25 and LTRF formula is 4(2-4)/3(1). At stage 42 the keratodonts and jaw sheaths have completely disappeared. The life history (Post hatching) of *Polypedates teraiensis* was completed within 42 days during the month of April to September under the favourable climatic factors. These findings can be used in planning the conservation of the frog under its natural habitats

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