

Development of mouthparts in the tadpoles of *Rana tigrina* Daud.*

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Abstract. The morphology of the mouthparts of *Rana tigrina* tadpoles is studied. The development starts after hatching with distinct mouth opening and is followed by paired beaks and labial fringes. The horny teeth then start differentiating in both the labial fringes and by addition of successive rows of teeth the full complement of larval dentition is developed. The mouthparts persist upto stage 50 and by stage 51 both the beaks and teeth are shed and the labial fringes are considerably resorbed.

Keywords. Mouthparts; tadpoles; *Rana tigrina*.

1. Introduction

In most anurans the oral armature of larva differs from that of the adult. The larval mouthparts, surrounding the mouth opening, consist of a pair of horny beaks and upper and lower labial fringes bearing rows of horny labial teeth. Both the beaks and teeth are formed of keratinised epidermal cells (see Kaung 1975). The shape of beaks, papillation of labial fringes, pattern of dentition and development of tooth rows vary to a greater or lesser extent among the tadpoles of different anuran species (Smith 1924; Noble 1954; Daniel 1975).

The bull frog, *Rana tigrina* has a widespread distribution in India. Although, few reports are available on the dentition of *Rana tigrina* tadpoles (Annandale 1917; McCann 1932; Kirtisinghe 1957; Dutta and Mohanty-Hejmadi 1976), the ontogenetic development of the mouthparts still remains unexplored. Therefore, this study was undertaken to work out the morphological development of the mouthparts in the successive developmental stages of the tadpoles of *Rana tigrina*.

2. Material and methods

In the present study the tadpoles of *R. tigrina* were reared in laboratory from a single clutch of eggs collected from a rain-water pool in the vicinity of Meerut

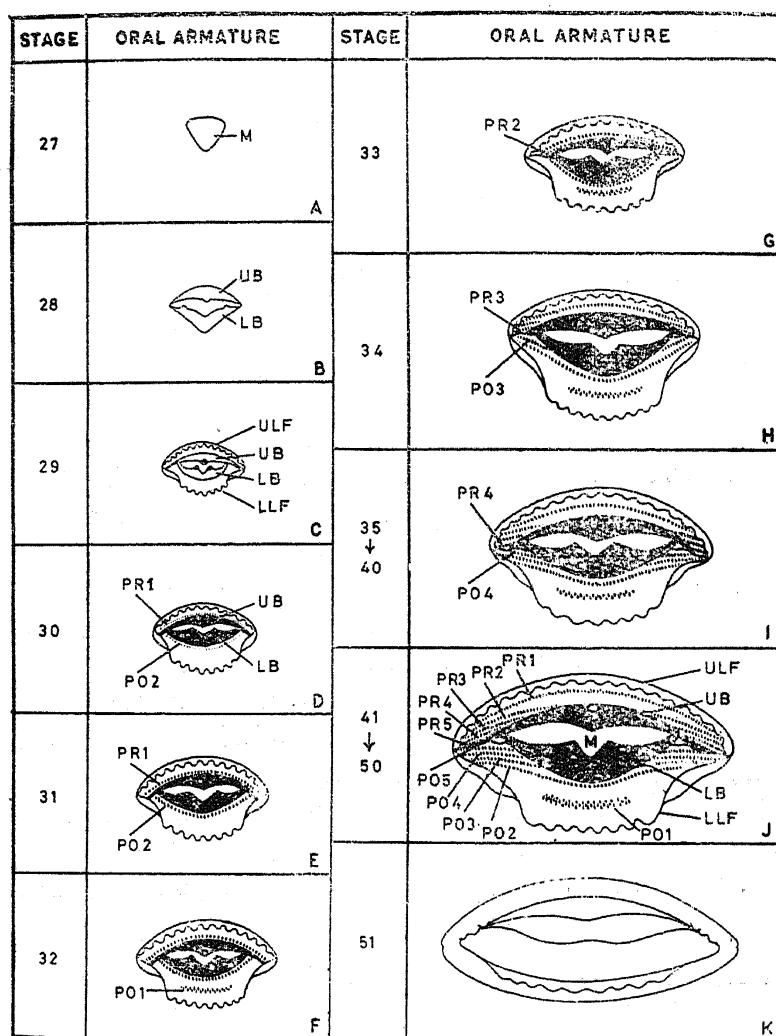
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College, Meerut. They were maintained in groups of 15–20 in large earthen troughs containing wellwater at 26°–30° C and fed maximally freshly boiled spinach. The successive developmental stages of the tadpoles were determined according to the system devised by Agarwal and Niazi (1977). The tadpoles were fixed in Bouin's solution following anaesthetisation in 1 : 4,000 solution of MS 222 (Sandoz) and then preserved in 70% ethanol.

The oral armature of the larvae of successive developmental stages were examined in stereoscopic binocular microscope and sketched with the help of camera lucida (figures A–K).

3. Observations

The development of mouthparts which constitute the oral armature of *R. tigrina* tadpoles begins after hatching at stage 27 and is completed by stage 41



Figures A–K. Development and resorption of the mouthparts of *Rana tigrina* tadpoles. (LB, lower beak; LLF, lower labial fringe; M, mouth; UB, upper beak; ULF, upper labial fringe; PO 1, first post-oral tooth row; PO 2, second post-oral tooth row; PO 3, third post-oral tooth row; PO 4, fourth post-oral tooth row; PO 5, fifth post-oral tooth row; PR 1, first pre-oral tooth row; PR 2, second pre-oral tooth row; PR 3, third pre-oral tooth row; PR 4, fourth pre-oral tooth row; PR 5, fifth pre-oral tooth row).

as illustrated in figures A-J. The epigenesis of the oral armature proceeds according to the following sequence of events:

Stage 27 : Mouth becomes oval or roughly triangular in shape (figure A).

Stage 28 : Mouth is widened and a pair of unpigmented horny beaks with faintly serrated free margins are developed. The upper and lower beaks exhibit one and two projections, respectively (figure B).

Stage 29 : The projections of the beaks become pigmented dark brown. Upper and lower labial fringes are now present and their distal edges show the characteristic papillation (figure C).

Stage 30 : Both the horny beaks are covered by dark black keratinised sheaths. The serrations along their cutting edges are prominent. A few minute brownish horny teeth appear in the upper as well as lower labial fringes (figure D).

Stage 31 : One continuous row of horny teeth (PR 1 and PO 2) has developed in each of the upper and lower labial fringes, respectively (figure E).

Stage 32 : A short but continuous row of horny teeth (PO 1) is now added in the lower labial fringe distal to the previously developed long and continuous row (figure F).

Stage 33 : In the upper labial fringe a 2nd medially interrupted row of teeth (PR 2) is added between the previously developed row (PR 1) and the upper beak (figure G).

Stage 34 : Another interrupted row of teeth is added in each of the upper and lower labial fringes (PR 3 and PO 3). The upper labial fringe has now one continuous and 2 interrupted tooth rows and the lower fringe has 2 continuous and one interrupted rows of horny teeth (figure H).

Stage 35 : With the addition of one more interrupted row in each labial fringe (PR 4 and PO 4), the upper labial fringe now has one continuous and 3 interrupted rows of horny teeth and the lower labial fringe possesses 2 continuous and 2 interrupted tooth rows (figure I). This tooth system continues upto stage 40.

Stage 41 : With the appearance of one more interrupted row in each of the upper and lower labial fringes (PR 5 and PO 5) near the beaks the oral armature typical of *R. tigrina* tadpole is now fully formed. At this time it consists of a pair of horny beaks and upper and lower labial fringes bearing rows of horny teeth. The beaks are thick, dark black in colour with the entire cutting edge serrated and toothed. The lower beak shows a V-like notch in its middle while the upper beak is roughly triangular with its apex fitting into the notch of the lower beak. The outer margin of the upper labial fringe is papillated while the lower labial fringe shows papillation only in its middle part which is markedly protruded outward. Each of the upper and lower labial fringes bears 5 rows of needle-like, dark brown horny teeth. Out of the 5 rows of upper labial or pre-oral teeth the uppermost or the first row (PR 1) is continuous while the remaining 4 rows (PR 2-PR 5) are incomplete being interrupted in the middle by the upper beak. In case of the 5 rows of lower labial or post-oral teeth the lowermost row (PO 1) is short and con-

nous, the one next to it (PO 2) is long and continuous while the remaining 3 rows (PO 3-PO 5) are incomplete being medially interrupted by the lower beak (figure J).

After its completion at stage 41 the full complement of the oral armature persists upto stage 50 with the teeth being replaced as they are shed due to wear and tear. With the beginning of metamorphosis expressed in the emergence of the first forelimb at stage 49 the labial fringes begin to be resorbed and horny teeth lost with no further replacement. By stage 51 the horny beaks as well as the labial teeth are finally shed and the labial fringes are resorbed greatly (figure K).

4. Discussion

In the present study 5 rows of horny teeth were observed in each of the upper and lower labial fringes of stages 41-50 tadpoles of *R. tigrina*. Out of these one row in the upper fringe and two rows in the lower fringe were observed to be uninterrupted. This is in agreement with the diagrams given by Annandale (1917), McCann (1932) and Dutta and Mohanty-Hejmadi (1976). Kirtisinghe (1957) observes that only one row is uninterrupted in the lower labial fringe. This might be due to observational error.

The fully developed mouthparts of *R. tigrina* tadpole consist of large upper and lower labial fringes, each containing 5 rows of horny teeth. In this respect the Indian bull frog appears to be different from the tadpoles of other species of ranids of this country, which have fewer rows of teeth as mentioned by Daniel (1975). The enlarged lips and greater number of tooth rows in the oral armature of tadpoles is often associated with their habits of living in swift-waters (Smith 1924; Noble 1954). However, bull frog tadpoles live at the bottom of stagnant waters and their enlarged lips together with greater number of rows of teeth cannot be attributed to a swift water habitat. It is possible that this may be related to their bottom detritous eating and voracious feeding habits alongwith relatively large body size.

It is suggested that the number and condition of the rows of horny teeth of the upper and lower labial fringes in *R. tigrina* may be expressed by the following formula:

$$\frac{1, (2), (3), (4), (5)}{1, 2, (3), (4), (5)}$$

In the above expression: (i) the numerator denotes the rows of teeth in the upper labial fringe and the denominator stands for the rows of teeth of the lower labial fringe, (ii) the highest number in the numerator as well as denominator indicates the total number of rows of teeth in each labial fringe, respectively. Thus, in the Indian bull frog tadpole there are 5 rows of such teeth in the upper and 5 rows in the lower labial fringes, (iii) the rows are to be counted and numbered from the distal edge of the labial fringe towards the mouth. Thus, row No. 1 is the distalmost or outermost and row No. 5 is the most proximal with respect to the mouth and innermost in the labial fringe, (iv) any figure in parenthesis indicates that the particular row is incomplete and interrupted in the middle while

unenclosed figures indicate that the tooth rows are complete and continuous. This would mean that the first row of teeth in the upper labial fringe and first and second rows in the lower labial fringe are continuous while the others are interrupted. This method of expressing the labial dentition of anuran tadpoles is suggested because different authors have used different expressions which are not always clear and understandable (Smith 1924; Sedra and Michael 1961; Zweifel 1964; Khan 1965).

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References

Agarwal S K and Niazi I A 1977 Normal table of developmental stages of the Indian bull frog, *R. tigrina* Daud.; *Proc. Nat. Acad. Sci. India* **B47** 79-92

Annandale N 1917 Zoological results of tour in the far east. Batrachia; *Mem. As. Soc. Bengal* **6** 122-155

Daniel J C 1975 Field guide to the amphibians of western India; *J. Bombay nat. Hist. Soc.* **72** 506-522

Dutta S K and Mohanty-Hejmadi P 1976 Breeding and life history of the Indian bull frog, *Rana tigrina* (Daudin); *Prakruti-Utkal Univ. J. Sci.* **13** 51-59

Kaung H C 1975 Development of beaks in *Rana pipiens* larvae; *Anat. Rec.* **182** 401-414

Khan M S 1965 A normal table of *Bufo melanostictus* Schneider; *Biologica* **11** 1-39

Kirtisinghe P 1957 The amphibia of Ceylon; Colombo 2 Charles Circus.

McCann C 1932 Notes on Indian batrachians; *J. Bombay nat. Hist. Soc.* **32** 152-180

Noble G K 1954 *The Biology of the amphibia* (New York : McGraw-Hill)

Sedra S N and Michael M I 1961 Normal table of Egyptian toad, *Bufo regularis* Reuss. with an addendum on the standardization of the stages considered in previous publications; *Cesk. Morphol.* **9** 335-351

Smith M A 1924 Descriptions of Indian and Indo-Chinese tadpoles; *Rec. Indian Mus.* **26** 137-143

Zweifel R G 1964 Distribution and life history of a central American frog, *Rana vibicaria*; *Copeia No. 2* 300-308

