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Research Article

ONTOGENY OF ANURAN TADPOLE IN WESTERN AREAS OF ODISHA

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ABSTRACT

Tooth structure of anuran tadpoles is not similar to jaws of vertebrates due to varying modes of feeding. Teeth in tadpoles are keratodonts which differs from calcified teeth and arranged in parallel transverse ridges. A total of thirty three variations of teeth row formulae were observed during all stages. Number of teeth rows both interrupted and uninterrupted on the upper and lower lips varied within a specific stage of development. Maximum interrupted teeth rows in upper lip were observed in Gosner stage thirty two and thirty seven and in the lower lip in stage thirty and forty of *Polypedates maculatus* tadpoles. Maximum of five rows in upper lip and three rows in lower lip were observed in stage thirty two. Teeth row development does not follow a definite pattern. There is no significant relationship between interrupted and uninterrupted teeth rows.

Keywords: Anuran, Gosner stage, Relationship, Teeth row.

INTRODUCTION

Vertebrate teeth are related to feeding habits. Variation in tooth structure is related to food and feeding habits and studied in sharks, bony fish, crocodiles, lizards, marsupials and placental mammals by Briggs & Crowther (2008; Geerinckx *et al*. (2007); Massare (1987); Ruber & Adams (2001); Sumida & Murphy (1987); Ungar & M'kirera (2003). Anurran tadpoles are omnivorous feeding on the bottom. Mouthparts of tadpoles are not similar to the jaws of vertebrates (Altig, 2007). Variation in feeding modes is observed due to difference in oral structure. Tadpoles may be macro carnivores (Crump *et al*., 1992), suspension feeder, surface feeder or rasping feeder. Feeding habit changes with metamorphosis. Arrangement of teeth rows and gaps in rows reflect lineage and habitats (Duellman, 1985). The significance of difference in mouthparts among species is poorly known (Wassersug & Yamashita, 2001). Labial teeth are involved in substrate anchoring and feeding mechanism. Oral disc is affixed to a substrate as a result of which jaws remain juxtaposed to surface. Labial teeth are released in a serial fashion to lift the food particle from the surface and sucked in to mouth (Taylor *et al*., 1996; Wassersug & Yamashita, 2001). Labial teeth or keratodonts differ from calcified teeth in composition and developmental pattern (Dubois, 1995; Van Dijk, 1966). Arrangement of these teeth on parallel transverse ridges is called Labial teeth row formula (LTRF) (Altig, 2007). Systematic variation in the teeth of thirty six species of tadpoles of North America was observed (Gosner, 1959) Variation in oral cavity among families, genera and species was studied. Wassersug & Heyer (1988) described the internal oral structure of leptodactyloid larvae in South America.

The oral disc is a complex structure composed of soft and keratinized parts (Vera Candioti & Altig, 2010). Vera Candioti & Altig (2010) correlated inter specific labial teeth variation with ecomorphology and phylogeny. Studies on oral structure of *Rhacophorus arboreus* and *Rhacophorus sclegelii* (Hosoi *et al*., 1995) tadpoles of *Dermatonotus muelleri*, *Rana dalmtina*, *Bobina variegate*, *Bufo bufo* and *Bufo viridis*, Bufo regularis (Bekhet, 2012), *Rhacophorus rufipes*, *Rhacophorus penanorum* and *Rhacophorus dulitensis* were carried through scanning electron microscopy for more insight knowledge. Present

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study reveals the variation in teeth row structure in *Polypedates maculatus.*

MATERIALS AND METHODS

Field survey was conducted in the evenings from 4:00 PM and continued till late at night during the breeding season (April to August in the year 2019 and 2020), which coincides with the rainy season and also during the daytime. The surveys were based on extensive search and physical verification. Tadpoles of *P. maculates* were collected from natural environment of Western Odisha for detailed review of oral structure in laboratory (Laboratory of Zoology Department, Deogarh College, Deogarh, Odisha). The tadpoles were preserved in 10% formaldehyde. Larvae from different stages (Gosner, 1959) were utilized for establishing the teeth row structure. The nomenclature of was followed to determine the teeth row formula. Larvae from external gill stage till the initiation of metamorphosis were utilized for the study of teeth row structure at various stage of development. More than one specimen (105 specimens) was examined for each stage of development to establish any intra-stage variation of teeth row structure. Inter and intra stage variation of teeth rows were observed under binocular microscope and details of oral structure were drawn diagrammatically. All the data used in the result have been statistically analysed through computer.

RESULTS AND DISCUSSION

During external gill stage (Gosner stage 21-23) the mouth of the tadpoles develop black horney beak consisting of an upper mandible with a corresponding indistinct notch for cusps. The upper and lower lips are with expanded oral papillae and the keratinised teeth rows develop on these papillae. A total of 105 tadpoles (Gosner stage 22-42) were examined for the analysis of teeth row structure. It was interesting to note that the number of teeth rows on the upper and lower lips varied within a specific stage of development. The first row on the upper lip is invigilated at the middle. A total no of 33 variations of teeth row formulae were observed during all stages (Gosner stage 22 through 42); 0/0/1, 0/0/2(1-2), 1/0/0, 1(1)/0/1(1), 1/0/3(1), 1/0/3, 2(1,2)/0/0, 2(1,2)/0/2(1,2), 2(2)/0/2(1), 2(2)/0/2, 2(2)/0/3(1), 2(2)/0/3, 3(1-3)/0/0, 3(2-3)/0/2, 3(3)/0/2, 3(2-3)/0/3(1), 3(1-3)/0/3(2-3), 3(2-3)/0/3(1), 3(1-3)/ 0/3, 3(1-3)/0/3, 4(1-4)/0/3(1-3), 4(1-4)/0/2(1-2), 4(1-4)/0/2(1), 4(2-4)/0/3(1), 4(2-4)/0/3, 5(2-5)/0/3(1-3) and only beak without oral papillae (Figure 1-22). The structural variations were marked as interrupted and uninterrupted teeth rows. Different teeth row formulae were observed in the tadpoles at the same stage of development. During a specific stage of development, the healthy tadpoles were having more uninterrupted teeth rows than the poorly developed tadpoles. Table-1 shows that no two factors are significant. Hence the length of tadpoles with relation to interrupted and uninterrupted teeth row ca not be taken in to consideration. Interrupted teeth rows in the upper lip are maximum in stage 32 and 37 and minimum in stage 33 and 35. Similarly the interrupted teeth rows in the lower lip are maximum in stage 30 and 40 and minimum in stage 31.Uninterrupted teeth rows in the lower lips are maximum in stage 27 and 35 and minimum in stage 33. The structure of teeth rows is independent of body length of tadpole. There is drastic change associated with restructuring of mouth during metamorphosis, no labial teeth rows were found in stage 42. Only beak has also been observed in stage 40. Teeth row formulae 1/0/3 and 0/0/1 were found in some tadpoles of stage 36, 38 and 39 which are the expression for underdeveloped tadpole.

Table 1. Correlation coefficients of tadpole body length with teeth row structure *Polypedates maculatus*.

	Body length	Upper interrupted	Upper uninterrupted	Lower interrupted	Lower uninterrupted
Body length	1.000				
Upper interrupted	0.041	1.000			
Upper uninterrupted	-0.377	-0.153	1.000		
Lower interrupted	0.293	0.431	-0.334	1.000	
Lower uninterrupted	-0.436	0.057	0.440	-0.465	1.000

There are few reports by Daniel, (1975); Mohanty & Dutta, (1988) with regards to ontogeny of teeth row structure in *P. maculatus*. Teeth row structure varies within and between species. (McCann, 1932) reported three rows on the upper lip with broken second and third rows. The teeth row arrangement of the species in the present study differs from McCann (1932) as varying teeth rows appear during different stages of development. Studies have been made on the teeth rows of *Rana breviceps* (Annandale & Rao, 1907; Mohanty-Hejmadi, 1976), *Rana limnocharis* (Annandale & Rao, 1907; Mohanty, 1994) and *Rhacophorus malabaricus* (Sekar, 1990). A generalized teeth row formula has been provided by (Daniel, 1975) for *P. maculatus* where stages of tadpoles are not mentioned. The present study provides teeth row formula for specific stages. One or maximum two rows are present in the upper lip of *Rana limnocharis* (Mohanty, 1994) and *Rana breviceps* (Mohanty-Hejmadi, 1976). A maximum of four or five rows of teeth is seen in *P. maculatus* tadpoles. This may be due to interfamilial differences. In *Rana limnocharis,* maximum number of teeth rows is observed at toe development stage (Gosner stage, 38). In *P. maculatus* maximum interrupted teeth rows in upper lip were observed in stage 32 and 37 and in the lower lip in stage 30 and 40. This indicates that teeth row development does not follow a definite pattern which can be confirmed from correlation coefficient of interrupted and uninterrupted teeth rows. There is no significant relationship between any two factors. The development of teeth rows and their ultimate variation in number, both at intra and inter stage change is associated with the habitat utilization and food consumption of tadpoles.

Figure 1. Teeth row structure of stage 22 showing one un-interrupted and one interrupted row in the upper and two interrupted rows in the lower jaw { 2(2)/0/2}.

Figure 2. Teeth row structure of stage 23 showing one un-interrupted and two interrupted rows in the upper and three uninterrupted in the lower jaw {3(1-3)/0/3(2-3).

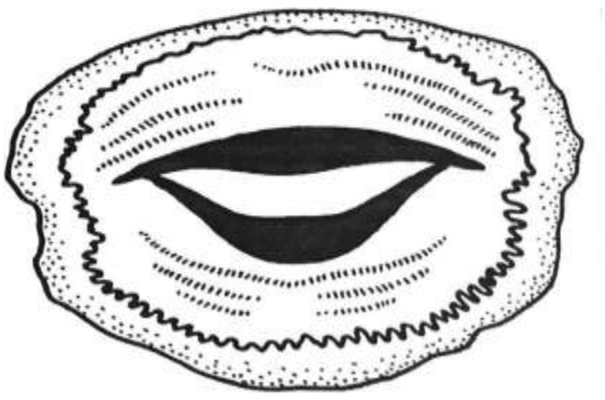

Figure 3. Teeth row structure of stage 23 showing three interrupted rows in the upper and one uninterrupted and two interrupted rows in the lower jaw {3 (1-3)/0/(2-3).

Figure 4. Teeth row structure of stage 23 showing one uninterrupted and two interrupted rows in the upper and two uninterrupted rows in the lower jaw {3(2-3)/0/2}.

Figure 5. Teeth row structure of stage 24 showing two uninterrupted and one interrupted row in the upper and two uninterrupted rows in the lower jaw {3(3)/0/2}.

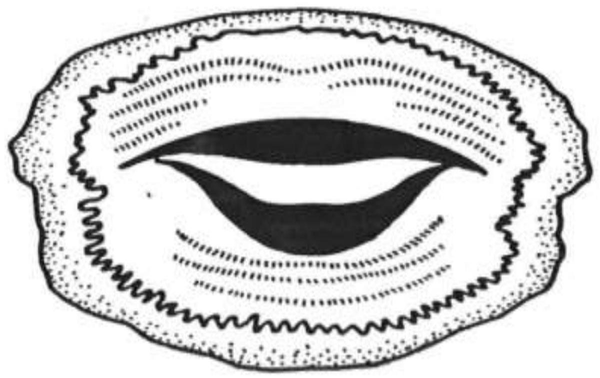

Figure 6. Teeth row structure of stage 27 showing one uninterrupted and the interrupted rows in the upper and three uninterrupted rows in the lower jaw {4(2-4)/0/3}.

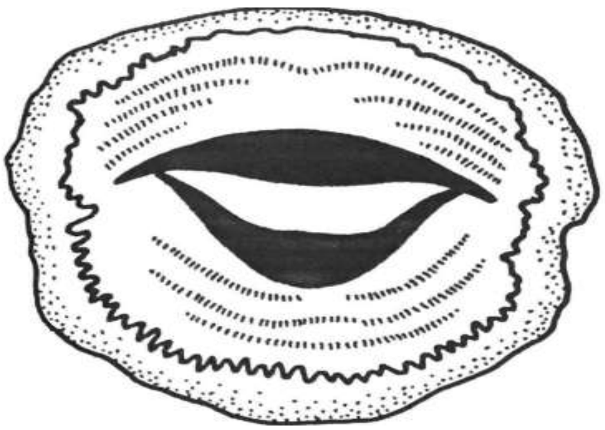

Figure 7. Teeth row structure of stage 27 showing one uninterrupted and three interrupted rows in the upper and one interrupted and two uninterrupted rows in the lower jaw {4(2-4) /0/3(1)}.

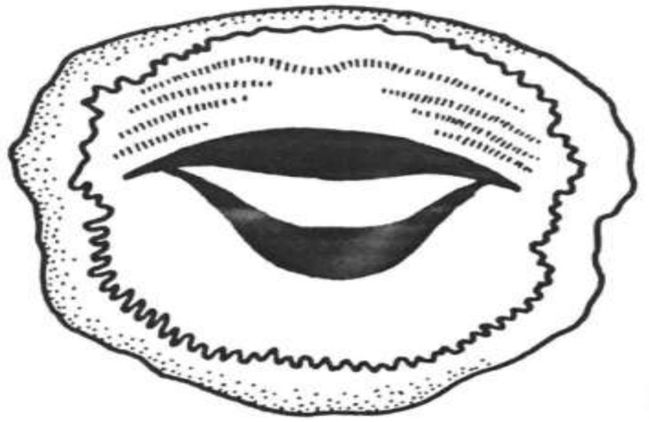

Figure 8. Teeth row structure of stage 28 showing one uninterrupted and three interrupted rows in the upper jaw {4(2-4) /0/0}.

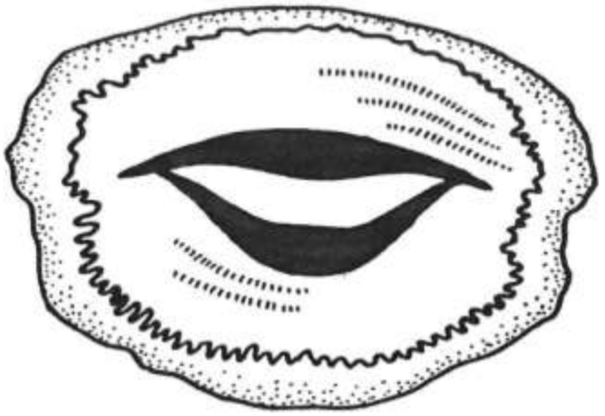

Figure 9. Teeth row structure of stage 28 showing three interrupted rows in the upper two interrupted rows in the lower jaw {3(1-3)/0/2(1-2)}.

Figure 10. Teeth row structure of stage 28 showing one uninterrupted and three interrupted rows in the upper and two interrupted rows in the lower jaw {4(2-4)/0/2(1-2)}.

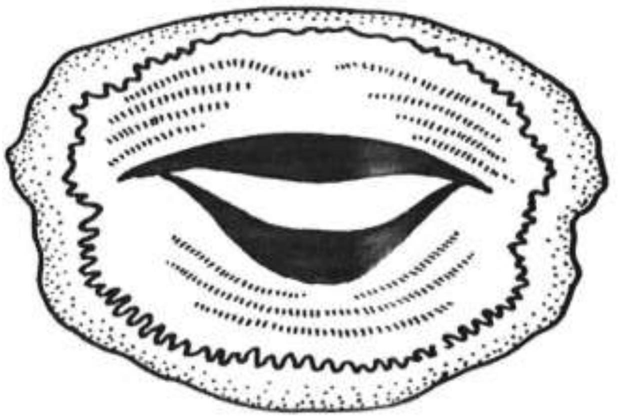

Figure 11. Teeth row structure of stage 30 showing four interrupted rows in the upper and three interrupted rows in the lower jaw {4(1-4)/0/3(1-3)}.

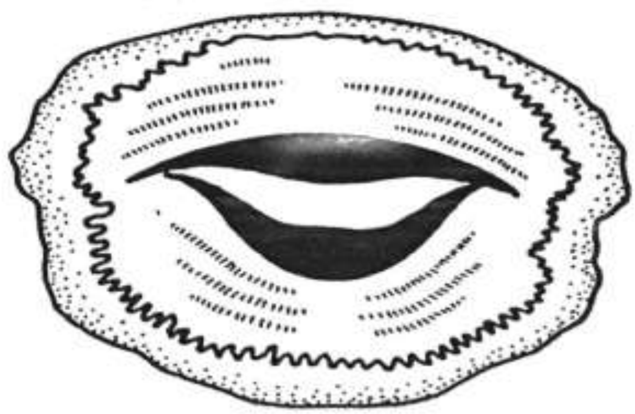

Figure 12. Teeth row structure of stage 30 showing one uninterrupted row in the upper and one interrupted and two uninterrupted rows in the lower jaw {1/0/3(1)}.

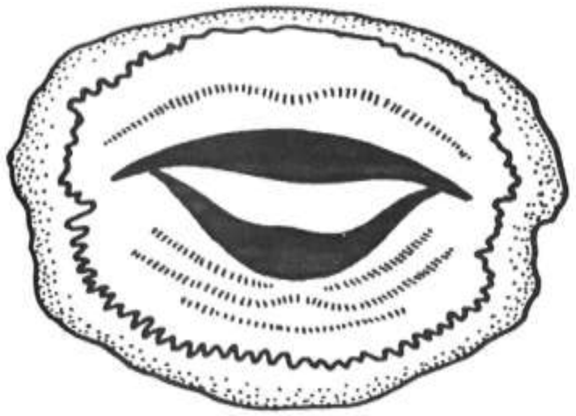

Figure 13. Teeth row structure of stage 30 showing two interrupted rows in the upper and one interrupted and one uninterrupted rows in the lower jaw {2(2)/0/3}.

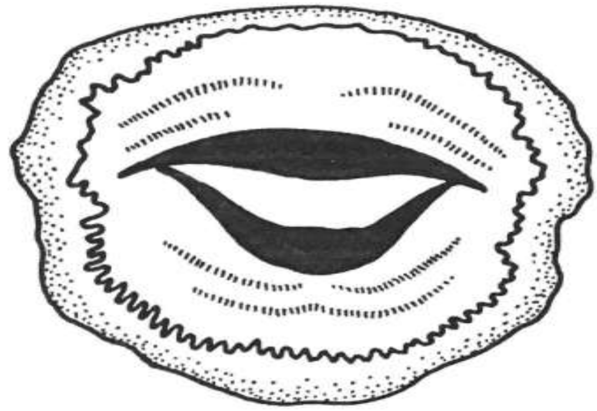

Figure 14. Teeth row structure of stage 32 showing one uninterrupted and three interrupted in the upper and one interrupted and uninterrupted row in the lower jaw {4(2-4/02(1)}.

Figure 15. Teeth row structure of stage 33 showing two interrupted rows in both upper and lower jaws {2(1-2)/0/2(1-2)}

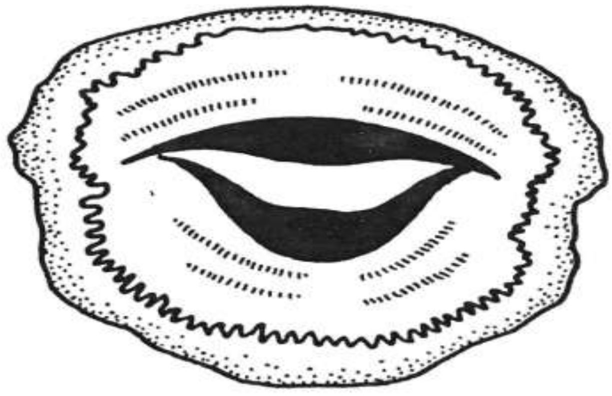

Figure 16. Teeth row structure of stage 34 showing two interrupted rows in the upper jaw {2 (1-2)/0/0}.

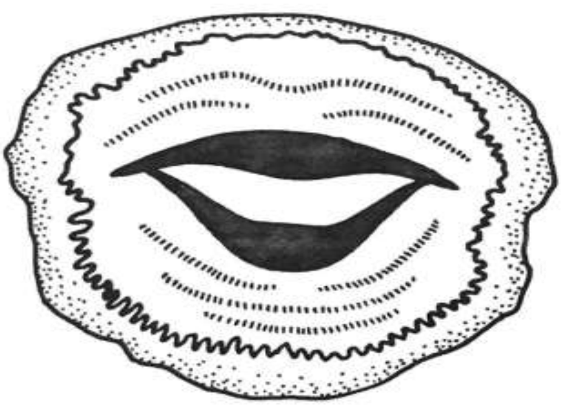

Figure 17. Teeth row structure of stage 35 showing one uninterrupted and one interrupted rows in the upper and one interrupted and two uninterrupted rows in the lower jaw {2(2)/0/3(1)}.

Figure 18. Teeth row structure of stage 36 showing one uninterrupted and three interrupted rows in upper and one uninterrupted row in the lower jaw {4(2-4)/0/1}.

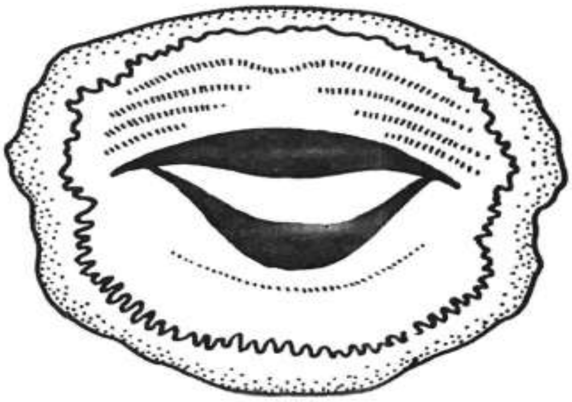

Figure 19. Teeth row structure of stage 37 showing four interrupted rows in the upper and two interrupted rows in the lower jaw {4(1-4)/0/2(1-2)}.

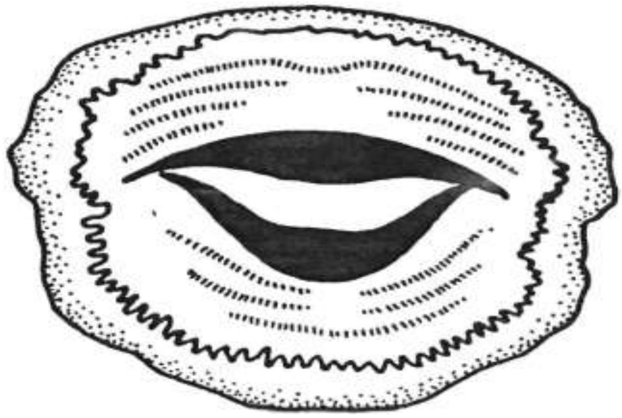

Figure 20. Teeth row structure of stage 39 showing one incomplete row in each upper and lower jaw 1(1)/0/1(1).

Figure 21. Teeth row structure of stage 41 showing one uninterrupted row in the upper jaw {1/0/0}.

Figure 22. Only beak as seen in stage 42 without any teeth row structure.

CONCLUSION

Ontogeny in anuran tadpole does not follow a definite pattern rather their changes are associated with consumption of different foods and utilization of different habitat. Interestingly the tooth row pattern of anuran tadpole of *P. maculates* is not similar to other vertebrate which describes the various mode of feeding habit.

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