



# “Composition of teeth correlating with feeding in fresh water fish *Hypothalamichthys nobilis*”

Chhaya Khillare<sup>1</sup>, Sargerao Yede<sup>2</sup>, Pravin Kharat<sup>3\*</sup>

<sup>1</sup>Late Pushpadevi Patil Arts and Science College Risod, Dist. Washim

<sup>2</sup>Gurudas Kamat Jr. College Incha Dist. Hingoli

<sup>3</sup>Nutan Mahavidyalaya, Selu Dist. Parbhani

## Abstract:

The structures related to feeding habit in *Hypothalamichthys nobilis* shows interesting modification reflecting herbivores feeding habits. The dentition in *Hypothalamichthys nobilis* fish shows interesting modifications which reflects herbivores feeding habits. Mouth is disproportionately large, lower jaws extends to past to upper jaw, The roof of the buccal cavity formed of transversally placed mucosal folds which are found to be set of papillae, roof of buccal cavity bears comb plates as a result of ‘U’ shaped notch is formed. Teeth are absent on lips but present in pharynx consisting a pharyngeal bone present in the formula of 0,4-4,0. Gill rakers are comb like providing filter feeding habitat. Teeth pad also observed.

**Keywords:** Jaws teeth, pharyngeal bone, chewing pad, gill rakers.

## Introduction:

Morphology of fish feeding apparatus is strongly correlated with feeding strategy and environmental conditions which may be instrumental to the understanding of resource utilization, ecological community, and structure and ultimately the process of speciation (Taylor A.K. and Chawala, 2014).

The mouth cavity is an important component of the alimentary canal, involved in the seizure, selection of food, rejection on undesirable items ingested by fish and pre digestive preparation of food. Among species, the mouth cavity shows great plasticity and structural adaptability for the exploitation of different food items (Gedam et.al. 2015). Teeth in the jaws, palate, floor of the mouth and inner surface of the gill arches aid in securing the prey, and their orientation assists in directing food toward the throat. Some teeth are hinged by means of a ligament that allows them of swing backward (Neil H. Ringler, Advances in fish biology).

The position and size of the mouth shows a close relationship to the location and size of food items, and the relative size of the mouth can be used to determine the size of food particles ingested (Hepher, 1988). Particles which are too small may not be detected or captured easily by the fish, while those which are too large may be too difficult to ingest quickly or whole (Lovell, 1989). Moreover, loss of nutrients from large and small food particles after soaking and softening, inevitably lead to wastage. For that mouth size appears to be limiting factor in feeding with both live and artificial diets (Anand, 2012).

The adaptation of the mouth of fishes to their food is particularly evident in the form of mouth size, shape and structure of the oropharynx, dentition, and gill rakers. All these structure are subject to diverse and significant variations and modifications in accordance with the feeding habits of different fishes. The importance of food in the daily life of fish is reflected in the form mouth and jaws, dentition, the shape and size of gill rakers and the difference in the feeding habits. (Sunil K. Anand, 2012). *Hypophthalmichthys nobilis* is commonly called as silver carp or exotic carp which is nonnative to India but successfully been grown in India. The present study emphasizes in structure of teeth in relation with the feeding habits in *Hypophthalmichthys nobilis*.

## **Materials and Methods:**

### **Study Area:**

The research lasted for 12 month, where the fishes were collected from Kaygaon Toka. The sampling station is situated at 19°37'N 75°01' E with an elevation of 462 m. This dam is located at the backwater area of Paithan dam near to small village Kaygaon in Gangapur taluka of Aurangabad district (Maharashtra, India) based on river Godavari. At this station the Pravara tributary joins the main river, hence this point is recognized as Pravara Sangam. The topography of the sampling station is deep black clay soil, depth of water varies from 0.5-10 m and width is in between 70-130 m. This location is dominated by many aquatic weeds and vegetation. During summer and winter seasons the water flow was reduced but during monsoon it was increased and sometimes fully flooded.

### **Sampling:**

Collection of *Hypophthalmichthys nobilis* was done by using diverse gears like hooks and lines, cast net (Local Name fake jali ) , hand net and some local fishing gears such as Tuti, Dalgi (Box Trap) which is mostly used to collect small size fishes. The collected samples were subjected for detailed analysis after preserving them in 10 percent formalin.

### **Methodology:**

For the study of jaws and teeth of *Hypophthalmichthys nobilis* specimens were collected from Kaigaon toka (Maharashtra, India). The specimens were immediately fixed in 10% formalin and brought to laboratory for further studies. After fixation the head gut was opened by dividing the head into an upper and lower half by cutting horizontally through the mouth to the oesophagus. The roof and floor of buccopharynx were properly washed to remove mucus and preserved in 70% alcohol and glycerin for stretching. The jaws, teeth, gills, gill rakers were properly examined for detailed studies. Photography done with Olympus sigma digital camera.

**Result:**

While studying of food analysis of *Hypophthalmichthys nobilis* revealed that it consist of algae, aquatic plants, sand and mud particles, crustaceans, diatoms, rotifers. Majority of food consist of plant oriented thus *Hypophthalmichthys nobilis* shows herbivorous type of feeding habitat.

**Mouth:**

The mouth of *Hypophthalmichthys nobilis* is disproportionally large, upturned, sub terminal consist of upper jaw and lower jaw. Jaws are small with delicate symmetrical arches perforated by pits along their entire length. Mouth is surrounded by cutaneous upper and lower lips. Lips are fused with each other by skin folds at the corner of mouth. The premaxillary and protruding mandible form rigid bony lips. Lower jaw extends past to upper jaw (Fig 1)

**Buccal cavity:**

The buccal cavity of *Hypophthalmichthys nobilis* is observed to be wide and open. The roof of the buccal cavity if formed of transversally placed mucosal folds which are found to be set of papillae, roof of buccal cavity bears comb plates as a result of 'U' shaped notch is formed. The floor of buccal cavity consists of lower lip, a fleshy tongue and brachial arches. It was observed on the floor of buccal cavity a well-developed pharyngeal bone with single rows of teeth steeply inclined towards dorso-medial orientation of the masticating surface (Fig. 2)

**Pharynx:**

The pharynx is distinguished from the buccal cavity by a 'U' shaped fold. Pharynx is divided into anterior respiratory region and posterior masticatory region. The dorso-lateral wall of pharynx is perforated by gill slits supported by branchial arches which bears gill lamellae and gill rakers. The posterior part of pharynx consists of soft, thick pharyngeal pads. The ventro-lateral side of pharynx is also perforated by gill slits supported by branchial arches which consist of gill lamellae and gill rakers. The posterior end of floor of buccal cavity possesses a pair of pharyngeal bone. Each bone consists of a row of 4 large pharyngeal teeth (Fig. 2). Chewing pad is surrounded by pharyngeal teeth for efficient grinding of food (Fig 4).

**Tongue:**

It was observed that the tongue of *Hypophthalmichthys nobilis* is fleshy, broad, triangular, pointed at anterior end which is affixed along the mid dorsal line of the floor of buccal cavity. The tongue posteriorly attached to brachial cleft. The anterior part of tongue is transparent (Fig 2.6 and (Fig 2). In fish a primary tongue which is not muscular and is used mainly for channeling water.

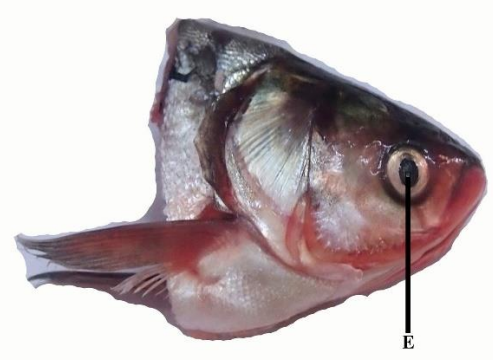
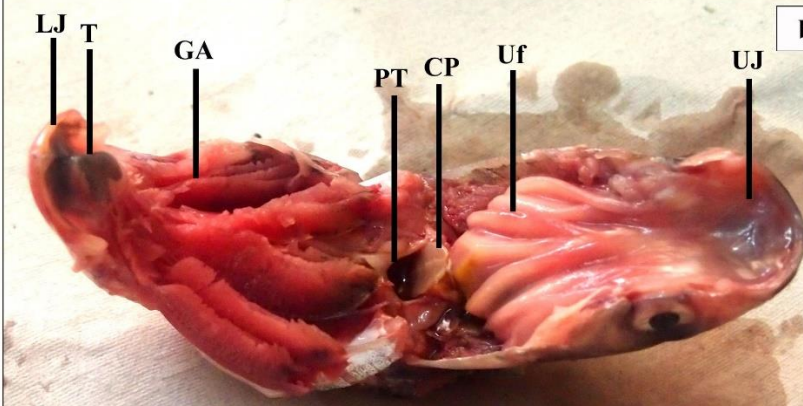

**Gill arches:**

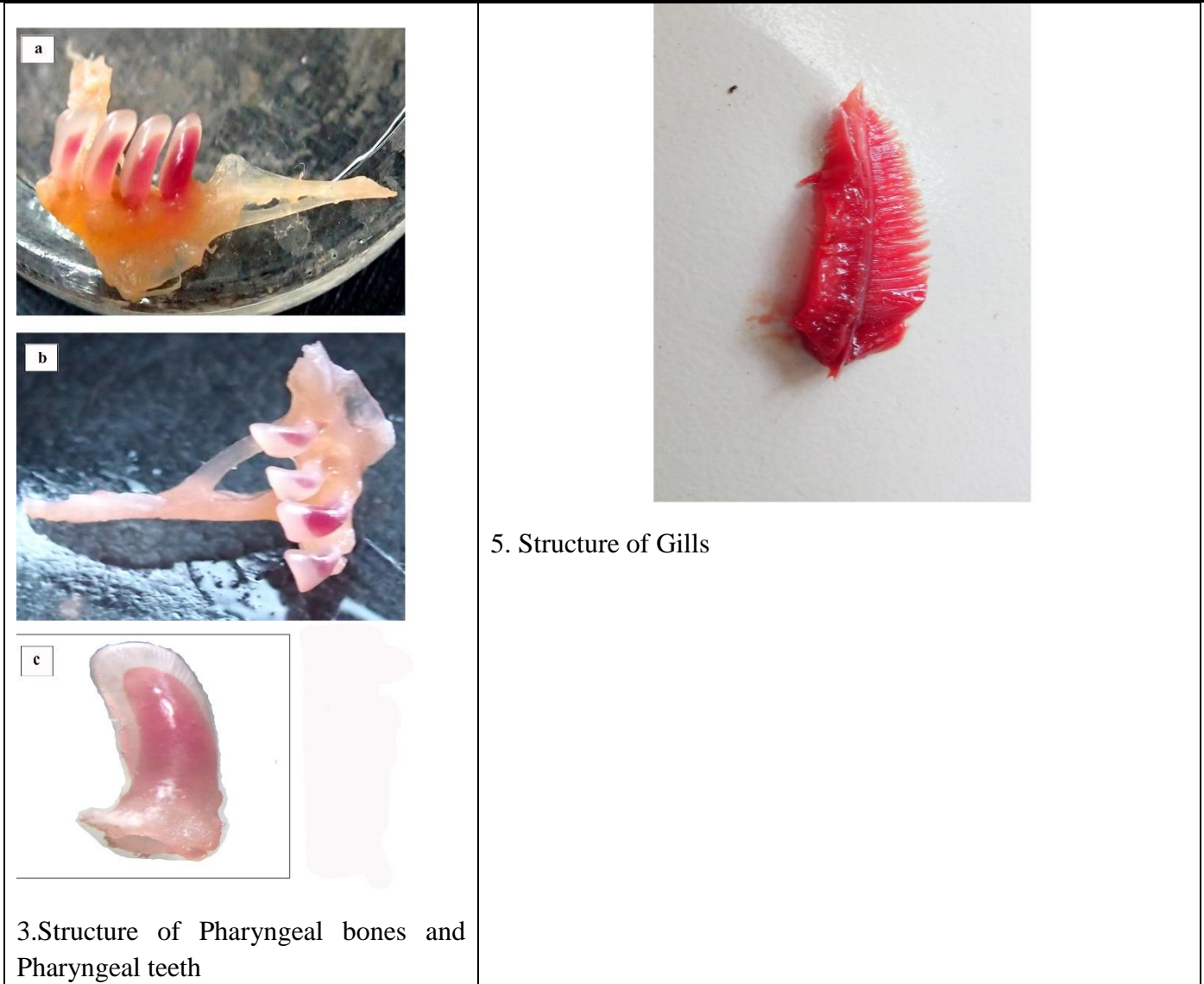
It was observed that in *Hypophthalmichthys nobilis* the ventro lateral wall of floor of buccal cavity is perforated by gill slits and the five pairs of gill arches bear gill lamellae and gill rakers (Fig 5). Gill rakers are not fused and appear like combs adapted for general use including filtration of phytoplankton and zooplankton. Comb plates and gill rakers on the gill arches articulate perpendicularly to form a remarkable sieving structure to facilitate filter feeding

**Teeth:**

It was observed that in *Hypophthalmichthys nobilis* teeth are absent in jaws, but in the posterior part of pharynx a well-developed pharyngeal bone appear with single rows of teeth steeply inclined towards dorso-medial orientation of mastication surface.

It was observed that teeth represent one of the highest specialization one row of well-developed pharyngeal teeth on the right side and one on the left side arranged uni-serially. These teeth bite against a chewing pad. Pharyngeal teeth have a dental formula of 0, 4-4, 0 with no replacement of teeth. Teeth are pinkish in color in center and transparent towards peripheral region. Teeth have fine striations which are visible with high magnifications (Fig 3 (a,b,c)). Similar results were found in *Hypophthalmichthys nobilis* teeth are absent in jaws but a well-developed pharyngeal bone is present with 4 rows of teeth.

	
<p>1. Structure of Head Showing Mouth</p>	<p>2. Buccal Cavity (UJ Upper jaw, Uf U Shaped Folds, CP- Chewing pad, PT Pharyngeal Teeth, GA- Gill arches, T-tongue, LJ-Lower Jaw</p>
	 <p>4. Chewing pad</p>



5. Structure of Gills

3. Structure of Pharyngeal bones and Pharyngeal teeth

### Discussion:

It was observed that *Hypophthalmichthys nobilis* is herbivorous feeding mostly on plant material. The morphology of jaws and teeth shows numerous modifications which support to herbivorous mode of feeding habit with morphological characters such as mouth which is equipped with firm jaws. Lower jaw extends past to upper jaw. Teeth are absent in jaws but well developed pharyngeal bone with pharyngeal teeth were found. Gills are like combs which are used for filtration of food. Doosey and Bart (2011), reported that both species *Hypophthalmichthys nobilis* and *Hypophthalmichthys molitrix* have transversely placed mucosal folds on the floor of the cavity which is found to be beset with papillae and the roof of cavity bears comb plates as a result of which 'U' shaped notch and transverse shelf are lacking. The adaptations of fish buccal cavity are quite evident from the size and shape of mouth, structure of the oro-pharynx and dentition which are subjected to variations and modifications in accordance with the feeding habits (Dasgupta, 2000; Khalaf-Allah, 2009).

Humpherys (1948) mentioned that a true herbivorous diet requires more mastication than any other to break up the cellulose capsules before digestion can proceed and entails maximum wear of the cheek teeth. Dasugupta (2009), reported on grass carp *Ctenopharyngodon idella* (Val.) like other cyprinids, has a toothless mouth but has strong specialized pharyngeal teeth for rasping aquatic vegetation. The teeth occur in 2 rows,

the upper consisting of 2 small teeth on either side or lower of strong comb like comprising 4 on right and 5 on the left pharyngeal bone. He also reported that the fishes of length 30 cm and below, the lower pharyngeal teeth tend to have serrated cutting surface while on the large fish, teeth are thicker and tend to have double and serrated cutting and rasping surface. The shape of lips in different species fish is related to the feeding habits and to their ecological niches (Agarwal and Mittal 1992) and for that they produce mucus and primary food detectors (Santos *et.al.*, 2015).

According to the Al-Hussaini (1946), the haline of the diet has a strong correlation with the form and structure of oral teeth. Fishes can have teeth in jaws, the tongue, the roof of the mouth and pharynx. Some fishes may have a combination of kinds of teeth, for example in many sharks the teeth in the upper and lower jaws can be quite different and the teeth at the front of the jaws may differ from these at the sides in shape and especially in size. The presence of jaws teeth in jaws are required to hold or grasp and to prevent the escape of small prey but to tear the food the buccal cavity may not be of much significance. In fish the tongue is primary tongue that is not muscular and is used mainly for channeling water. The tongue contributes to feeding behavior by either conducting water through mouth or by actively manipulating the prey within the parasite fishes (Bakary, 2011).

Doosey and Bart (2011), reported that occurrence of median groove that fully or partially divided into palatal organ into symmetrical lobes, occurrence of 'U' shaped notch near the junction of a buccal and pharyngeal cavities; the occurrence and condition of the pair of anterior projection on the 'U' shaped notch. Occurrence of a transverse shelf at the anterior end of the palatal organ. Chawala and Taylor (2014) mentioned that big head carp probably uses pump feeding. During feeding individuals hang almost vertical to the water surface implying the bulges of palatal organ to pin the food items against the gill rakers and then small waste particles, inorganic material and water. Elshaikh (2013), Magnuson and Heitz (1997) postulated that the number and shape as well as spacing of gill rakers reflect the feeding habits of different fish species. Gedam (2015), reported that modifications in the position, shape and size of the mouth of various species of fishes are correlated with the characters of food and the manner in which it is obtained. Coulton (1976) reported that the pharyngeal teeth of phytoplanktonivorous tilapia such as *Saratherodon* are fine, thin and hooded on the pharyngeal bones where as those of macrophytys feeders such as *Randalii* are coarse robust. Saxsena (1980) reported in *Labeo dero* that teeth are absent from jaws and palate. He mentioned that only inferior pharyngeal bones are beset with blunt teeth which form an efficient grinding surface to crush the minute plants into finer particles. Similar results were found in *Hypophthalmichthys nobilis* teeth are absent in jaws but a well-developed pharyngeal bone is present with 4 rows of teeth. Similar results were mentioned by Khanna (1962) and Lal *et.al.* (1964) in herbivorous fishes.

### **Conclusion:**

Our study highlighted basic information regarding the morphology of structures assist to feeding behavior in *Hypophthalmichthys nobilis*. The structures which helps in feeding to the respective fish which is reflects type of feeding and special adaptation the fish possesses in the structures. The finding will be useful for fishery biologist to study feeding pattern and behavior of feeding.

**References:**

1. Agarwal N. and Mittal A. (1992): Structural modifications and histochemistry of the epithelia of lips and associated structures of carps *Cirrhina mrigala*. *Canadian journal of Zoology*, 70, 71-78.
2. Ajit K Gedam, Durgesh N. Phulwade and Smita R. Sonawane (2015): Oral cavity architecture in *Oreochromis mossambicus*., *Trends in fisheries research*, 4(3),2015,1-5.
3. Al-Hussaini (1946): The anatomy and histology of the alimentary tract of bottom feeder *Mulloidés auri.flamma*., *Journal of morphology*, 78, 1946, 121-153.
4. Anand J. and Heitz G.C. (1971): Gill raker apparatus and food selectivity among mackerels, tunas and dolphins. *Fish bulletin*, 69(2), 1971, 361-370.
5. Anand S.K. (2012): Comparative morphological studies of the gastro-intestinal tracts of some freshwater fishes in relationship to their food., *Ph.D. thesis*.
6. Anil K. Taylor and Deepti Chawla (2014): Morphology of buccopharyngeal cavity of two species of genus *Hypophthalmichthys*., *International journal of applied biology and pharmaceutical technology*, 5(2), 2014, 46-51.
7. Coulton M.S. (1976): The importance of pre digestive food preparation to *Tilapia rendalli* Boulanger when feeding in aquatic macrophytes. *Transaction Rhodesian science association*, 57, 1976,22-27.
8. Dasgupta M. (2000): Adaptation of the alimentary tract to feeding habits in four species of fish of the genus *Channa*., *Indian journal of fisheries*, 47(3), 2000, 265-269.
9. Dasgupta M. (2009): Adaptation of the alimentary tract to feeding habits in the weed eating fish (grass carp) *Ctenopharyngodon idella* (Val.)., *Journal of crop and weed*, 5(1), 2009, 197-202.
10. Doosey M.H. and Bart L.H. (2011): Morphological variation of the palatal organ and chewing pad of catostomidae (Teleostei-cyprinidae). *Journal of morphology*, 272(9), 2011, 1092-1108.
11. E.H. Elsheikh (2013): Scanning electron microscopic studies of gill arches and rakers in relation to feeding habits of some fresh water fishes., *The journal of basic and applied zoology*,66,2013, 121-130.
12. Hopher B. (1988): The alimentary canal in nutrition of pond fishes (Eds. H.J. Schoonbee R.J.: Roberts K. Jauncay and M. Beveridge) 23 1845-1874
13. Humphrys H. (1948): Tooth form and function; lecture delivered at the Royal College of Surgeons of England on 19<sup>th</sup> Century, 1948. Annual report of College, Surgeons England 2. 189
14. Khanna S.S. and Pant M.C. (1964): On the study of digestive tract and the feeding habits of some teleostean fishes., *Journal of research and science*, 13, 1964, 15-30.
15. Lal M.B., Bhatnagar A.N., Kailc R.K. (1964): Studies on the morphology and histology of the digestive tract and associated structures of *Chagunius chagunia* (Ham.). *Proc. Nat. acad. Sci. India* 34B, 162-172
16. Lovell R.T. (1989): Digestion and metabolism. In nutrition and feeding of fish. Van Nostrand Reinhold, New York PP 73-80
17. N.E.R. El-Bakary (2011): Comparative scanning electron microscope study of the buccal cavity in juvenile and adult sea bass (*Dicentrachus labrax*)., *World applied sciences journal*, 12(8), 2011, 1133-1138
18. Ringler N.H. (1964): Fish foraging: adaptations and patterns., *Journal of advances in fish biology*, 1, 1964,33-59.
19. Santos L. dos, Fabio P.Arantes, Tiago C. Pessali and Jose E. dos santos (2015): Morphological, histological and histochemical analysis of the digestive tract of *Trachelyopterus striatulus* (Siluriformes: Auchenipteridae)., *Zoologia* 32(4),2015,296-305.
20. Saxsena O.P. (1980): Relationships of buccopharynx with the food and feeding habits of *Labeo dero* (Ham.). *Proc. Indian. Natn. Sci. Acad (B)*, 46, 41-47.