Trophic Morphology of Some Fish Species of Monpin "In" Meiktila Township

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Abstract

The morphology and structural modification of mouth type, teeth, gill rakers, stomach and intestine of six fish species of Monpin "In" were studied. The study six species included *Labeo calbasu, Osteobrama belangeri, Puntius sarana, Oreochromis* sp., *Glossogobius giuris and Channa panaw* having different feeding habits; carnivores, omnivores and herbivores. The study period lasted from December, 2011 to March, 2012. Based on the ratio of standard length and intestinal length, it should be concluded that, the longest in herbivores, the moderate in Omnivores and the shortest in carnivores. The steps for study procedures were presented with scaled photographs and discussed.

Introduction

Fishes like all animals, required nutrition in order to grow and survive. According to type of food consumed, the fishes are categorized as the herbivores, the carnivores and the omnivores. As for the manner of feeding, fishes can be classified according to their feeding habits as predators, grazers, food strainers, food suckers and parasites.

The digestive system, in a functional sense, starts at the mouth, with the teeth used to capture prey or collect plant foods. Mouth shape and tooth structure vary greatly in fishes, depending on the kinds of food normally eaten. Most fishes are predacious and have simple conical teeth on the jaws, on at least some of the bones of the roof of the mouth, and on special gill arch structures just in front of the oesophagus Lagler *et al* (1977). The latter are throat or pharyngeal teeth. Most predacious fishes swallow the entire prey and the teeth are used for grasping, holding and orienting prey. Some catfishes have small brush like teeth, arranged in rows on the jaws, for scraping animal from rocks. Many fishes (e.g

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Cyprinidae) have no jaw teeth at all but have a variety of throat tooth types, Lagler *et al* (1977).

Some fishes gather planktonic food by straining it from their gill cavities with numerous elongated stiff rods (gill rakers), anchored by one end to the gill bars. The food collected on these rods is passed to the throat where it is swallowed. Most fishes have only short gill rakers that help from escaping out the mouth cavity into the gill chamber.

Once reaching the throat, food enters a short, greatly distensible oesophagus, a simple tube with a muscular wall leading into the stomach. The stomach varies greatly in fishes, depending upon the diet. Food is largely digested in the stomach. The junction between the stomach and the intestine is marked by a constriction. The pyloric caeca (blind sacs) occur in some fishes at this junction and have a supplementary digestive or an absorptive function or both.

The intestine itself is quite variable in length depending upon the diet. It is short in predacious forms, sometime no longer than the body cavity, but coiled and several times longer than the entire length of the fish in herbivores. The intestine is primarily an organ for absorbing nutrients into the blood stream.

Morphology of the digestive tract is greatly determined by feeding habits. On the other hand, knowledge on the feeding habit of the fish is of utmost importance since, of the key factors to successful fish culture is the understanding of some biological fundamental especially food and feeding habits.

Monpin "In" (Lake), just beside the Meiktila Lake was formed by over flooding of irrigation from Mondaing Dam to Meiktila Lake. It covers an area of 82.426 hectares. Presence of rich nutrients in the flood water and with a sufficient penetration of sunlight to shallowness of the water depth, this conditions seem to favour the growth of lower organisms. Most abundant species were *Labeo calbasu, Osteobrama belangeri, Puntius sarana, Oreochromis* sp., *Glossogobius giuris* and *Channa panaw*. So these species were selected to study. Moreover they are economic importance and some species were reared extensively in our country.

Materials and methods

Study site

The studied fish species were obtained from Monpin "In". It was located in Meiktila Township between N 20° 50' 57.90" , E 95° 50' 40.96" and N 21° 51' 13.83" , E 95° 51' 13.68" (Fig.1).

Study period

Study period was lasted from December, 2011 to March, 2012.

Collection and identification of fish species

Diagnostic characteristics of the collected specimens were followed after Day (1889), Jayaram (1981), Talwar and Jhingran (1991) and previous local workers, June Zan (1983), Dr.Khin Lay Yee (2006) and Zin Mar Oo (2008). Local names of the studied species were informed by the local fishermen.

Study procedures

Ten specimens for each species were collected and photographic records were taken freshly. The external morphological characters and measurements were noted on fresh forms. Each specimen was then labeled and were brought back to the laboratory for further investigation. The shape and position of the mouth were determined. Mid-ventral incision was made from the hyoid region to the lower jaw, which was deflected laterally to expose the teeth. The buccal cavity was cut at the angle of the jaws and the morphology of the teeth was examined.

The structure and distance between gill rakers were recorded. The ventral wall of the specimen was opened to study the location and position of each part of the digestive tract and photographic record were taken. The external morphology of alimentary tract was examined and the whole length of tract was measured to the nearest millimeter. The ratio of the intestinal tract length to the standard length was then calculated using the following formula.

$$\text{Index value} = \frac{\text{Intestinal length}}{\text{Standard length}} \text{ (Kafuku, 1958)}$$

The internal morphology was studied by dissecting along the length. All relevant parts were photographed. The food contents along the alimentary tracts were examined and preserved in 10 percent formalin for confirmation.

Fig1. Satellite map of Monpin "In" in Meiktila, Myanmar

Source: Google

Results

Mouth type

The mouth types and lip structure of six species such as *Labeo calbasu*, *Osteobrama belangeri*, *Puntius sarana*, *Oreochromis* sp., *Glossogobius giuris* and *Channa panaw* were examined. Terminal mouth type was observed in *Channa panaw* and *Oreochromis* sp.. Subterminal are *Osteobrama belangeri* and *Puntius sarana*. Superior mouth type was recorded in *Glossogobius giuris* and *Labeo calbasu* has inferior mouth type and wide mouth opening were found in *Oreochromis* sp., *Channa panaw* and *Glossogobius giuris*. In *Labeo calbasu* the mouth was moderate gape. The small gape was examined in *Osteobrama belangeri* and *Puntius sarana*. The two pairs of barbels were found in *Labeo calbasu*. The lips were thick in *Labeo calbasu*. The lips of *Oreochromis* sp., *Glossogobius giuris*, *Channa panaw*, *Osteobrama belangeri* and *Puntius sarana* were thin. In *Oreochromis* sp. and *Glossogobius giuris*, lips were protractile (Plate 1).

Dentition

In *Labeo calbasu, Osteobrama belangeri* and *Puntius sarana,* there were no teeth on both jaws. The villiform teeth on the premaxillary, maxillary and mandibulary were arranged five rows in *Channa panaw* and *Oreochromis* sp., two rows in *Glossogobius giuris.* In *Glossogobius giuris,* vomero-palatine teeth were arranged in a crescentic band. The vomer and palatine were furnished with villiform teeth in *Channa panaw* but *Labeo calbasu, Osteobrama belangeri* and *Puntius sarana* had no vomerine and palatine teeth. There is a pair of oval-shaped upper and lower pharyngeal tooth pads which provided with numerous villiform teeth in *Glossogobius giuris* and cardiform teeth in *Oreochromis* sp. but *Channa panaw* has two pairs of oval-shaped upper and lower pharyngeal tooth pads. The lower pharyngeal teeth are comb-shaped in *Labeo calbasu* and sickle-shaped in *Osteobrama belangeri* and *Puntius sarana* (Plate 2, 3, 4).

Gill rakers

The studied fish species have gill rakers on four gill arches. In *Channa panaw, Glossogobius giuris, Osteobrama belangeri* and *Puntius sarana,* gill rakers are short; comb-shaped with gaps between them. In *Labeo calbasu and Oreochromis* sp., gill rakers are comb-shaped with very delicate and arranged in close-set, double rows (Plate 5).

Oesophagus

In all studied fish species, the oesophagus are wide, short and conical tubes, furnished on its internal surface with longitudinal folds. The walls are thick musculature and slimy with mucous. The length of oesophagus is about 1.0 cm in *Labeo calbasu,* 1.0 cm in *Osteobrama belangeri and Oreochromis* sp., 1.5 cm in *Channa panaw,* 1.0 cm in *Puntius sarana* and *Glossogobius giuris* (Plate 6).

Stomach

The stomach was divided into cardiac and pyloric stomach in *Oreochromis* sp., *Glossogobius giuris* and *Channa panaw.* The muscularis layer of the pyloric stomach is thicker than in the cardiac region. The numerous longitudinal and reticulate folds are found in internal surface.

The J- shaped stomach are found in *Channa panaw, Glossogobius giuris* and *Oreochromic* sp.. The stomach of *Labeo calbasu, Osteobrama belangeri* and *Puntius sarana* is very simple and spindle-shaped hence it could not be divided into cardiac and pyloric stomach. However, the longitudinal striations are present in *Labeo calbasu* and *Oreochromis* sp.. Reticulated folds are present in *Glossogobius giuris, Osteobrama belangeri* and *Puntius sarana* and longitudinal folds and striations are present in *Channa panaw* (Plate 6).

Intestine

The anterior and posterior intestine are slender long tube in *Labeo calbasu, Osteobrama belangeri Puntius sarana* and *Oreochromis* sp.and short tube in *Channa panaw* and *Glossogobius giuris*,. The internal surface of the anterior and posterior intestine had longitudinal striations in *Glossogobius giuris, Channa panaw, Osteobrama belangeri* and *Puntius sarana*. In *Labeo calbasu* and *Oreochromis* sp., the internal surface of the anterior and posterior intestine was smooth and longitudinal striations (Table 1, Plate 6).

Relationship of standard length and intestinal length of studied species

The intestinal length of *Channa panaw* (8.0 cm) and *Glossogobius giuris* (4.0 cm) are shorter than 1.5 times of the standard length. The intestinal length of *Labeo calbasu* (324.5 cm) and *Oreochromis* sp. (343.0 cm) are found to be longer than three times of the standard length. In *Osteobrama belangeri* (47.0 cm) and *Puntius sarana* (34.0 cm), the intestinal length was between 1.5 and 3.0 times of the standard length (Table 1 and Fig. 2).

(A) *Labeo calbasu*

(Inferior)

(B) *Osteobrama belangeri*

(Subterminal)

(C) *Puntius sarana*

(Subterminal)

(D) *Oreochromis* sp.

(Terminal)

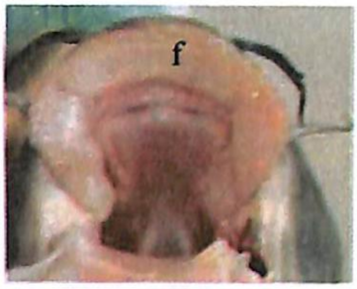
(E) *Glossogobius giuris*

(Superior)

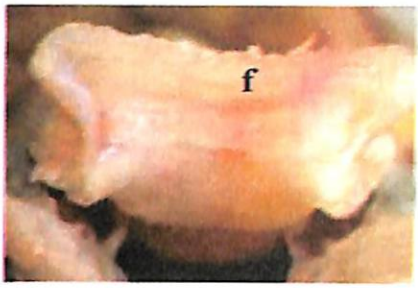
(F) *Channa panaw*

(Terminal)

Plate1. Mouth types of studied fish species



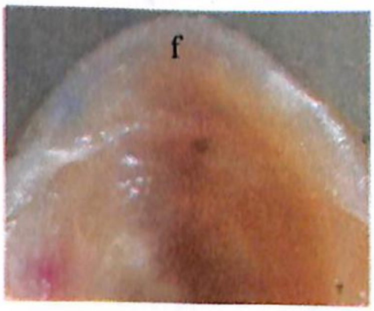
(A) *Labeo calbasu*
(Upper jaw)



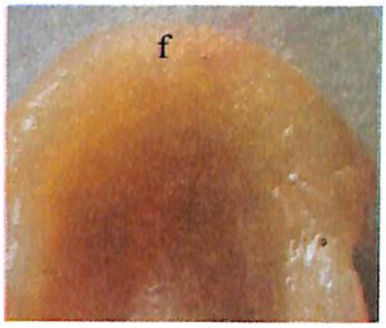
(B) *Labeo calbasu*
(Lower jaw)

(C) *Osteobrama belangeri*
(Upper jaw)

(D) *Osteobrama belangeri*
(Lower jaw)



(E) *Puntius sarana*
(Upper jaw)

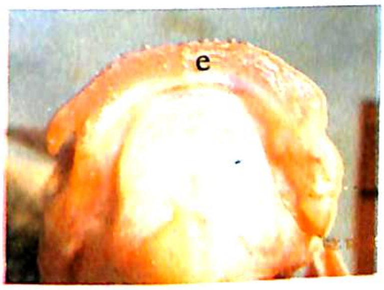


(F) *Puntius sarana*
(Lower jaw)

f- tooth less

Plate2. Teeth of upper and lower jaws of studied fish species

(A) *Oreochromis* sp.
(Upper jaw)



(B) *Oreochromis* sp.
(Lower jaw)

(C) *Glossogobius giuris*
(Upper jaw)

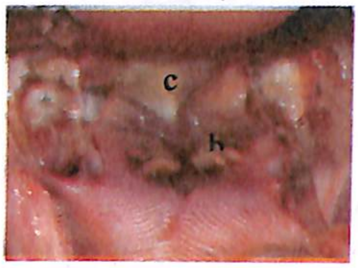
(D) *Glossogobius giuris*
(Lower jaw)

(E) *Channa panaw*
(Upper jaw)

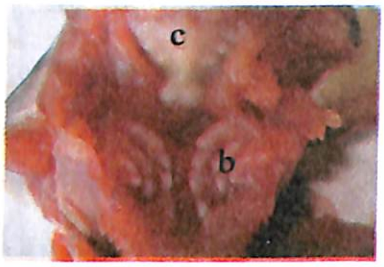
(F) *Channa panaw*
(Lower jaw)

a. premaxillary teeth
b. maxillary teeth
c. vomerine teeth
d. palatine teeth
e. mandibulary teeth

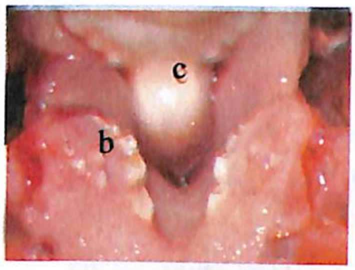
Plate3. Teeth of upper and lower jaws of studied fish species



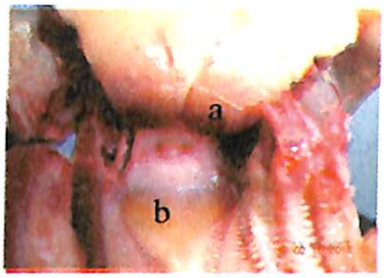
(A) *Labeo calbasu*



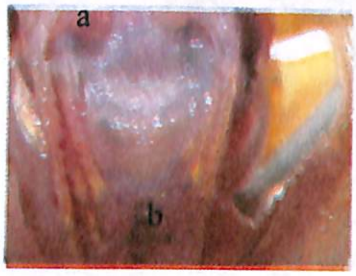
(B) *Osteobrama belangeri*



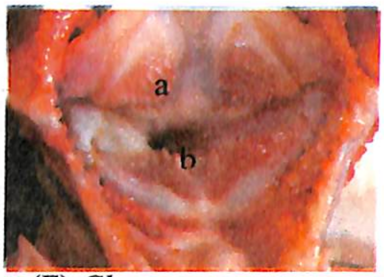
(C) *Puntius sarana*



(D) *Oreochromis* sp.



(E) *Glossogobius giuris*



(F) *Channa panaw*

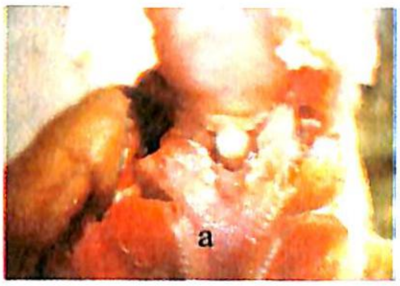
a. Upper pharyngeal teeth

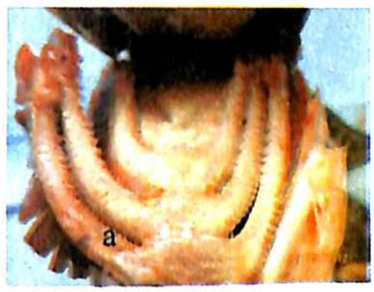
b. Lower pharyngeal teeth

c. Upper pharyngeal bone

Plate4. Pharyngeal teeth of studied fish species

(A) *Labeo calbasu* (B) *Osteobrama belangeri*





(C) *Puntius sarana* (D) *Oreochromis* sp.

(E) *Glossogobius giuris* (F) *Channa panaw*

Plate5. Gill rakers of studied fish species

fish species	standard length (cm)	intestinal length (cm)	index value	feeding habits
L.calbasu	34.0	324.5	9.54	herbivore
O.belangeri	19.0	47.0	2.47	omnivore
P. sarana	15.5	34.0	2.3	omnivore
Oreochromis sp.	22.0	343.0	15.5	herbivore
G. giuris	12.0	4.0	0.33	carnivore
C. panaw	12.0	8.0	0.66	carnivore

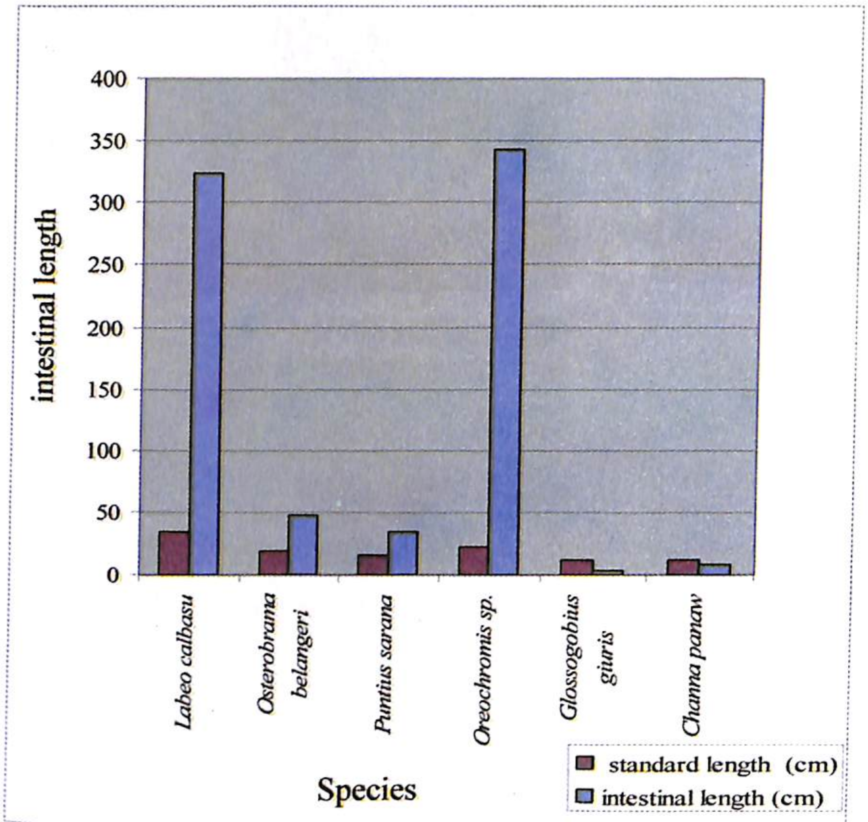
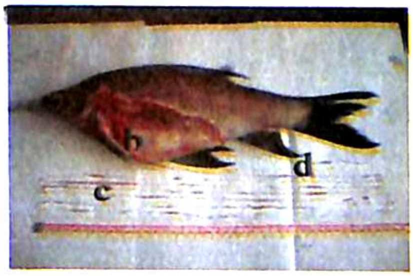
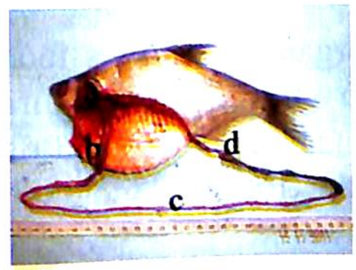


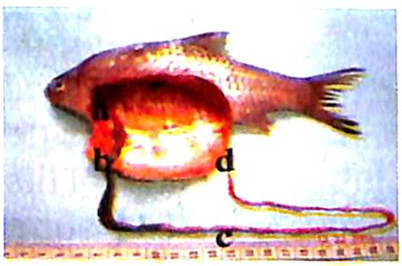
Fig2. Relationship between standard length and intestinal length of studied fish species



(A) *Labeo calbasu*

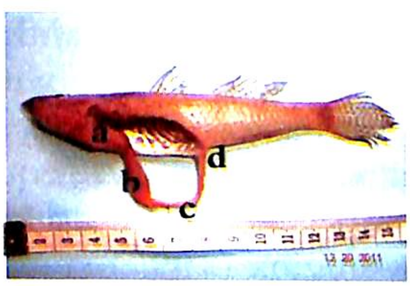


(B) *Osteobrama belangeri*



(C) *Puntius sarana*

(D) *Oreochromis* sp.



(E) *Glossogobius giuris*

(F) *Channa panaw*

a. oesophagus, b. stomach, c. intestine, d. rectum,
e. pyloric caecum

Plate6. Intestinal length and standard length of the studied fish species

Discussion

Every organism requires food for its existence. The morphology of the alimentary tracts between different species related to the different feeding habits. The feeding habit of fish is also related to its alimentary tract such as the form of mouth type, teeth, gill rakers, oesophagus, stomach and intestine.

In all six species, the position of the mouth was suitable for obtaining food from its environment. *Channa panaw* and *Oreochromis* sp. had terminal mouth type and *Osteobrama belangeri* and *Puntius sarana* had the sub-terminal mouth which indicated the mid-water feeders. In *Labeo calbasu*, fleshy modification of lips and also had well developed barbels help to locate food items from soft bottom materials. This finding agreed with that of Goulding (1981) and Chu (1935). The superior and slightly upturned mouth of *Glossogobius giuris* was indicative of their surface feeding habits.

There is strong relationship among kind of dentition, feeding habit and food eaten. *Labeo calbasu, Osteobrama belangeri* and *Puntius sarana* had no teeth on both jaws but pharyngeal teeth were well developed. The food consumed by both species basically consist of mud, fine detritus and plant materials and organisms, do not require the presence of well developed teeth on both jaws since they do not need these structures to ingest or hold the food. Veregina (1990) stated that a common adaptation for the plantivore feeding regime is the partial or complete reduction of the teeth on jaws. The predacious *Channa panaw* and *Glossogobius giuris*, teeth are present on both jaws and in the buccal region. Most of the teeth observed on both jaws are more or less canine like villiform teeth take advantage in grasping, puncturing and holding the prey.

Lagler *et al* (1977) stated that not all have a stomach, the primary criterion for being to do without the stomach does not seem to whether a fish is a herbivore or a carnivore but whether accessory adaptations for grinding the food. The pharyngeal teeth, found in all six species are responsible for grinding or dismembering the food. In *Labeo calbasu, Osteobrama belangeri* and *Puntius sarana,* the presence of well developed pharyngeal teeth are associated with the absence of a well-defined stomach, especially the mechanical function, since the teeth assume part of the function of the stomach.

The selective retention of food was made by gill rakers and the densely arranged gill rakers were regarded as herbivore has been mentioned by Al-Hussaini (1949) and Suyehiro (1942). The gill rakers of *Labeo calbasu* and *Oreochromis* sp. consist of very delicate, slender filaments arranged in close-set, double rows. The nature of the structure indicates the straining function and the plankton feeding habits of these species. On the other hand, the branchial structure of remaining species is of selective function. These species consume large food items and possess well-space rakers, permitting rejection of undesirable particles like sand grain.

According to Suyehiro (1942) and Kafuku (1958), fishes having a alimentary tract shorter than 1.5 of the standard length were judged to be carnivores, between 1.5 and 3.0 times of the standard length were considered as omnivores and longer than three times of the standard length were regarded as herbivores. In this study, *Channa panaw* and *Glossogobius giuris*, intestinal length was shorter than standard length were judged to be carnivores. In, *Labeo calbasu* and *Oreochromis* sp., intestinal length was longer than three times of the standard length were regarded as herbivores. In *Osteobrama belangeri* and *Puntius sarana*, their intestinal length was between 1.5 and 3.0 times of the standard length were considered as omnivores.

In study six fish species, having any feeding habits, the oesophagus was short and muscular with deep longitudinal folds. They are so distensible that they can accommodate anything the fish can get into their mouths. In carnivorous fish, such as *Channa panaw* and *Glossogobius giuris,* the stomach are J-shaped and muscular with longitudinal folds. A highly special distensible that they can accommodate anything the fish can get into their mouths adaptation is the modification of the stomach into a grinding organ. The gizzard like pyloric stomach fragments the food. In omnivorous fish, *Osteobrama belangeri* and *Puntius sarana,* the stomach are sac-shaped similar to that in human. Similarly the stomach is muscular with deep longitudinal and reticulate folds. A highly special adaptation is the modification of the stomach into a grinding organ. The gizzard like pyloric stomach fragments the food. According to Lagler *et al* (1977), the thick stomach helps grinding the ingested inorganic and permit rapid digestion in a short intestine. In herbivorous fish, *Labeo calbasu* do not possess well defined stomach but it is bulky. Its stomach bulb holds a large quantity of plankton and vegetations but is not as muscular as those of carnivorous and omnivorous fish.

In *Channa panaw* and *Glossogobius giuris,* the intestines were shortened because meaty food could be digested more readily than plant materials. The internal surface was thrown into reticulate folds and longitudinal striations throughout their length, creating a large surface area, adapted for efficient digestion and absorption. In omnivorous fish, *Osteobrama belangeri* and *Puntius sarana,* the intestinal length were intermediate because in their food included by mixing with animal parts and plant materials, so meaty food could be digested more readily than plant materials. The internal surface was thrown into longitudinal striations throughout their length, creating a large surface area, adapted for efficient digestion and absorption. In herbivorous fish *Labeo calbasu and Oreochromis* sp., the internal surface of the intestines had longitudinal striations and was smooth. The food spends a long time in the long intestine, thus the absence of the longitudinal folds. Pyloric caeca were found only in *Channa panaw* with two. The caeca were the major adaptation in teleosts for increasing the absorptive surface. It was thus concluded that the structure of mouth, teeth, gill rakers, oesophagus, stomach and intestine were useful in estimating the feeding habits of fish. The smallest ratio of standard length and intestinal length (<0.3) was observed in studied carnivores while largest ratio (> 15.0) was observed in herbivore. It could be assumed that longer intestine were herbivores, shorter one were carnivores and intermediate were omnivores. Intestinal length and standard length ratio can be used to assess feeding habit of fish. Six species of fishes, included in this research were grouped as carnivores (*Channa panaw, Glossogobius giuris*), omnivores (*Osteobrama belangeri, Puntius sarana*) and herbivores (*Labeo calbasu* and *Oreochromis* sp.) according to the relationship in the morphology of alimentary tracts to their feeding habits.

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