Food and Feeding Habits of Some Freshwater Fishes from Ayeyarwady River,
Mandalay District, Myanmar

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Abstract

Food and feeding habits of the 10 freshwater fish species confined to 7 genera, 6 families and four orders from Ayeyarwady River were studied and estimate between December, 2016 and March, 2017. A total of 100 fishes were randomly collected from the commercial fishermen during the study period. Observation was made for the total length, standard length, body weight, relative length of alimentary canal and qualitative and quantitative analysis of stomach contents. The relative length of alimentary canal was described in relation to feeding habit. The stomach content analysis indicated that six species were carnivores (Notopterus notopterus, Wallago attu, Eutropiichthys vacha, Channa orientalis, Channa punctatus, channa striatus), two species omnivores (Osteobrama belangeri, Oreochromis sp.) and remaining two species herbivores (Labeo calbasu, Labeo rohita). In the present study, the determination of food composition and feeding habits of studied fish species may give some important information for culture of these freshwater fish species.

Key words: fish, food, feeding habit, stomach content, Ayeyarwady River
1. Introduction

The food and feeding habits of fish is important and vital need for production of the fish. Food and feeding habits of fish are important biological factors for selecting a group of fish for culture in ponds to avoid competition for food among themselves and live in association and to utilize all the available food (Dewam and Saha, 1979). So, the knowledge of food and feeding habits help to select such species of fish for culture and produce an optimum yield by utilizing all the available potential food of the water bodies without any competition. Feeding is the dominant activity of the entire life cycle of fish (Royce, 1972). The success on good scientific planning and management of fish species largely depends on the knowledge of their biological aspects, in which food and feeding habits include a valuable portion. Therefore, the study of food and feeding habit of freshwater fish species is a subject of continuous research because it constitutes the basis for the development of a successful fisheries management programme on fish capture and culture (Oronsaye and Nakpodia, 2005). According to Sipauha-Tavares and Braga (1999), nature offers great diversity of organisms used as food by the fishes and these differ in size and taxonomic group. It is virtually impossible to gather sufficient information of food and feeding habit of fish in their natural habitat without studying its gut contents (Manon and Hossain, 2011).

The stomach content analysis is one method to know the feeding habit. Understanding the stomach contents of fish is useful in guiding towards formulation of artificial diets in fish culture (Fagade, 1978). Pius and Benedicta (2002) also reported the use of stomach content in reducing intra and inter specific multi species competition for ecological niche. The length of the gut of a species of fish or any other animal, reflects its diet and the percentage composition of food items present in the stomach also showed the feeding habits of fish (Mookerjee et al., 1941). Analysis of content in the stomach and features of the alimentary system provide information on food, feeding habits and selective feeding, if any, in fishes.
So food and feeding habit of the fish were determined on the basis of stomach contents and relative length of alimentary canal. The Ayeyarwady River flows from north to south through the center of Myanmar. It is the country's largest river and Myanmar's most important commercial waterway. It is total drainage area is about 158.700 square miles (411.000 square km). It is about 2170 km (1335 miles) long. Smith et al.(2002) stated the highest amount of fishes is produced from Ayeyarwady River and its flood plains. The study area is Ayeyarwady River at Mandalay District. The objective of the present research is

- to investigate the variation in the food composition and feeding habits of some fresh water fishes

2. Material and Methods

Study Area

The fish specimens in the present study were collected from Ayeyarwady River at Mandalay district. The study area is located at 21°59'38.96"N and 96°03'13.22". (Figure 1)

![Figure 1 Map of Study Area (Source from Google Earth)](image)

Study Period

The study period started December, 2016 to March, 2017.
Collection of Specimens

An average of ten specimens of each fish species was used in this present study. A total of one hundred fish samples were weekly collected from Ayeyarwady River with the help of local fishermen. The collected specimens were preserved in 10% formalin with fully labels in collection bottles.

Measurement of Specimens

Measurement of the fishes was recorded as their body weight in grams and the total length and standard length were measured to nearest centimeter. Each fish was dissected ventrolaterally with the help of a pair of fine scissors. After that, the alimentary canal of each fish was stretched out and the length was measured.

Analysis of Data

Stomach contents of each study specimens were analyzed for diet composition. The stomach was removed from the gut. The presence or absence of food content in the stomach was examined. These conditions were assessed on the two points, empty stomach and food contains stomach. If the stomach was found with food item, then all contents were transferred into clean petrish. The food substances found in the stomach were identified with the help of compound microscope. Food items were identified at the general level, wherever possible, using information provided by Imms (1964), Edmondson (1966), Jordan and Verma (1996). The stomach contents were analyzed using frequency of occurrence methods based on Hyslop (1980). In the frequency of occurrence method, the occurrence of food items was expressed as the percentage of the total number of stomach. Calculation of relative length of alimentary canal (RLA) was done by the Taki (1978) method.

3. Results

The food analysis of hundred specimens of ten freshwater fish species revealed the food they consumed. The total length, standard length and body weight for each studied
species were measured and recorded (Table 1). The alimentary canal length and ratio of alimentary canal length to standard length were given in Table 2. The categorizations of stomach fullness of studied species were given in Figure 2. The categorization of the percentage composition of occurrence of food items in the stomach contents of studied species were shown in Figure 3. Summary of food items of studied fish species were shown in Table 3. Determination of feeding habits of studied fish species were shown in Table 4. In the present study, determination of food composition and feeding habits of studied species has been made on the basis of occurrence of food items in the stomach contents and relative length of alimentary canal.

**Food composition and feeding habits of studied fish species**

*Notopterus notopterus* feed on fish, crustaceans, insects and plant matter. Of these food items they consumed, highest percentage of fish and insects (40%) and lowest percentage of crustaceans (10%) were observed. The length of alimentary canal ranged from 10.8 cm to 16.9 cm. The relative length of alimentary canal ranged from 0.53 to 0.7, with a mean value of 0.61 (Table 2). This ratio is shorter than 1.5 times of standard length of this species. Therefore, the feeding habit of *Notopterus notopterus* is carnivorous in nature.

The food item of *Labeo calbasu* consists of phytoplankton, zooplankton, algae, plant material and mud and sand. Of all the food items examined, the highest composition was phytoplankton (60%) and the lowest was algae and plant material (20%). The length of alimentary canal ranged from 82 cm to 182 cm. Relative length of alimentary canal ranged from 9.88 to 12, with a mean value of 11.43 (Table 2). This ratio is longer than 3 times of the standard length. Therefore, it is considered that the feeding habit of *L. calbasu* is herbivorous in nature.

According to the analysis of stomach contents, *Labeo rohita* feed on phytoplankton, zooplankton, insect, algae, plant materials and mud and sand. Of these food
items they consume, the highest percentage of phytoplankton (60%) and the lowest of insect and plant material (10%) were observed. The length of alimentary canal ranged from into 149 cm to 356 cm; whereas the relative length of alimentary canal ranged from 7.38 to 16.84 with a mean value of 12.46 (Table 2). This ratio is longer than 3 times of the standard length. Therefore, the feeding habit of *L. rohita* is determined as herbivorous fish.

*Osteobrama belangeri* feed on phytoplankton, zooplankton, insects and crustaceans and worm. Of these food items, the highest percentage of zooplankton (50%) and the lowest of worm (10%) were observed in the stomach of *O. belangeri*. The length of alimentary canal ranged from 23 cm to 40 cm, whereas the relative length of alimentary canal to standard length ranged from 1.82 to 2.6, with a mean value of 2.27 (Table 2). This ratio is intermediate between 2 and 3 time of the standard length. Therefore the feeding habit of *O. belangeri* is determines as omnivorous fish.

According to the analysis of stomach contents, *Wallago attu* feed on fish, insects, crustaceans and molluscs. Of these food items, the highest percentage of fish (60%) and the lowest of molluscs (10%) were observed in the stomach of *W. attu*. The length of alimentary canal ranged from 9 cm to 39 cm. Relative length of alimentary canal range from 0.28 to 0.68 with a mean value of 0.47 (Table 2). This ratio is shorter than 1.5 times of the standard length. Therefore, the feeding habit of *W. attu* is determined as carnivore.

According to the analysis of stomach content, *Eutropiichthys vacha* feed on fish, insect, crustaceans, arachnida and plant materials. Of these food items, the highest percentage of insect (80%) and the lowest of crustaceans and arachnida (10%) were observed. The length of alimentary canal ranged from 12.6 cm to 23.8 cm, whereas relative length of alimentary canal to standard length ranged from 0.86 to 0.96, with a mean value of 0.89 (Table 2). This ratio is shorter than 1.5 times of the standard length. Therefore, the feeding habit of *E. vacha* is determined as carnivore.
According to the analysis of stomach contents, *Oreochromis* sp. feed on phytoplankton, zooplankton, insects, crustaceans, molluscs and plant materials. In the present study, the highest percentage of phytoplankton (40%) and the lowest percentage of crustaceans, molluscs and plant materials (10%) were observed. The length of alimentary canal ranged from 170 cm to 320 cm. Their relative length of alimentary canal to standard length ranged from 8.09 to 15.79 with a mean value of 11.91 (Table 2). The ratio is longer than 3 times of the standard length. But, it feed on both plant and animal food items. Therefore, the feeding habit of *Oreochromis* sp. is determined as omnivore.

According to the analysis of stomach contents, *Channa orientalis* feed on fish, crustaceans, insect, plant materials and mud and sand. Of these items, the highest percentage of fish (60%) and the lowest of plant materials (10%) were observed. The length of alimentary canal ranged from 11.8 cm to 13.7 cm, whereas the relative length of alimentary canal ranged from 0.75 to 0.79, with a mean value of 0.77 (Table 2). This ratio is shorter than 1.5 times of standard length. Therefore, the feeding habit of *C. orientalis* is determined as carnivorous fish.

According to stomach content, *Channa punctatus* feed on fish, insect, crustaceans, worms plant materials and mud and sand. Of these food items, the highest percentage of fish (70%) and a few percentages in insect, crustaceans, worm and plant materials (10%) were observed. The length of alimentary canal ranged from 12.6 cm to 13.9 cm. The relative length of alimentary canal length ranged from 0.86 to 0.93 with a mean value of 0.91 (Table 2). The ratio is shorter than 1.5 time of the standard length. Therefore the feeding habit of *C. punctatus* is determined as carnivore.

According to the analysis of stomach contents, *Channa striatus* feed on fish, insects, crustaceans, molluscs and mud and sand. Of these food items, the highest percentage of fish (80%) and the lowest of molluscs (10%) were observed. The length of alimentary
canal ranged from 14.9 cm to 23.7 cm. Relative length of alimentary canal range from 0.84 to 0.97 with a mean value of 0.89 (Table 2). This ratio is shorter than 1.5 times of the standard length. Therefore, the feeding habit of *C. striatus* is determined as carnivore.

**Figure 2** Categorization of stomach fullness of studied fish species
PPT = Phytoplankton    ZPT = Zooplankton    F = Fish    INS = Insects    CR = Crustaceans
MOL = Molluses    W = Worm    ARA = Arachnida    ALG = Algae    PL = Plant Material
MS = Mud and Sand

**Figure 3** Percent composition in occurrence of food items in the stomach contents of studied fish species
Table 1 Measurement of body weight, total length and standard length of studied ten fish species (N=10)

| Scientific Name            | BW (g) | TL (cm) | SL (cm) |
|----------------------------|--------|---------|---------|
|                            | Range  | mean    | Range   | mean   | Range  | Mean    |
| Notopterus notopterus      | 29-206 | 95.8    | 16.6-32 | 23.62  | 15.3-28.6 | 21.65 |
| Labeo calbasu             | 10-100 | 36      | 9.18    | 12.13  | 8-17    | 11.13  |
| Labeo rohita              | 57-700 | 261.7   | 19.37-5 | 24.9   | 17.36   | 23.32  |
| Osteobrama belangeri      | 30-180 | 76.5    | 12.3-22 | 15.55  | 11.20-5 | 14.25  |
| Wallago attu              | 70-1230| 575.2   | 41.8-65 | 42.53  | 22.59   | 40.22  |
| Eutropiichthys vacha      | 20-156 | 38.18   | 15.7-33 | 18.78  | 14.5-24.7 | 16.15 |
| Oreochromis sp.           | 120-256| 196.7   | 19.5-26 | 22.37  | 17-23   | 20.85  |
| Channa orientalis         | 53-80  | 64.1    | 18.8-21.6 | 20.27  | 15.6-17.6 | 16.62 |
| Channa punctatus          | 47-75  | 56.1    | 16.19-2 | 17.29  | 13.5-16.1 | 14.63 |
| Channa striatus           | 55.1-235 | 123.24 | 19.8-32 | 25.42  | 16.2-27 | 21.56  |

BW = Body Weight
TL = Total Length
SL = Standard Length

Table 2 Measurement of alimentary canal and relative length of alimentary canal in the studied ten fish species (N=10)

| Scientific Name            | ACL (cm) | RLA |
|----------------------------|----------|-----|
|                            | Range    | Mean| Range    | Mean  |
| Notopterus notopterus      | 10.8-16.9| 13.2| 0.53-0.7 | 0.61  |
| Labeo calbasu             | 82-182   | 121.5| 0.88-12 | 11.43 |
| Labeo rohita              | 149.356  | 278 | 7.38-16.84 | 12.46 |
| Osteobrama belangeri      | 23.40    | 31.8| 1.82-2.6 | 2.27  |
| Wallago attu              | 9.39     | 20  | 0.28-0.68 | 0.47  |
| Eutropiichthys vacha      | 12.6-23.8| 14.5| 0.86-0.96 | 0.89  |
| Oreochromis sp.           | 170.320  | 247.5| 8.09-15.79 | 11.91 |
| Channa orientalis         | 11.8-13.7| 13 | 0.75-0.79 | 0.77  |
| Channa punctatus          | 12.6-13.9| 13.3| 0.86-0.93 | 0.91  |
| Channa striatus           | 14.9-23.7| 19.3| 0.84-0.97 | 0.89  |

ACL = Alimentary Canal Length
RLA = Relative Length of Alimentary Canal
Table 3 Summary of food items of studied fish species

| Animal food items       | Plant foot items   |
|-------------------------|--------------------|
| **Fish**                | **Phytoplankton**  |
| Whole body, remain of fish body scales, bones, others | Diatom |
| **Arachnid**            | **Diatom** |
| Spider                  | *Pediastrum* |
| **Insect**              | **Scenedesmus sp.** |
| legs, head, larvae, adult |                   |
| **Crustaceans**         | **Algae** |
| small prawn, head of prawn | Filamentous algae |
|                        | *Oscillatoria sp.* |
| **Molluscs**            | **Spirogyra sp.** |
| Gastropod               |                   |
| Bivalvia                |                   |
| **Worms**               | **Plant material** |
| whole body              | submerged plant material |
| **Zooplankton**         |                   |
| Roterifer               |                   |
| Copepods                |                   |

Table 4 Determination of feeding habits of studied fish species

| Fish species                | Feeding habit |
|-----------------------------|---------------|
| *Notopterus notopterus*     | Carnivore     |
| *Labeo calbasu*             | Herbivore     |
| *Labeo rohita*              | Herbivore     |
| *Osteobrama belangeri*      | Omnivore      |
| *Wallago attu*              | Carnivore     |
| *Eutropiichthys vacha*      | Carnivore     |
| *Oreochromis sp.*           | Omnivore      |
| *Channa orientalis*         | Carnivore     |
| *Channa punctatus*          | Carnivore     |
| *Channa striatus*           | Carnivore     |
4. Discussion

In the present study, various food item obtained from the stomachs of studied fish species were observed. Determination of food composition and feeding habits during the study period has been made on the basis of percentage composition of the food items in the stomach contents and relative length of alimentary canal. In the present study, frequency of occurrence method was used for stomach content analysis. According to the feed type, there are three types of fishes; carnivores, omnivores and herbivores. Taki (1978) suggested that fish having a relative length of digestive tract shorter than 1.5 times of the standard length were judged to be carnivorous and those with a relative length of digestive tract longer than three times of the standard length were regarded as herbivorous. Tentatively, fish that were intermediate in relative length digestive tract and showed no other evidence to determine their feeding habit were considered as omnivorous. In the present work six species are carnivorous, two species are omnivorous and another two species are herbivorous fishes according to the result of these methods.

Of ten species examined in the present work, carnivorous fishes include *Notopterus notopterus*, *Wallago attu*, *Eutropiichthys vacha*, *Channa orientalis*, *Channa punctatus* and *Channa striatus*. *N. notopterus*, *W. attu* and *E. vacha* mainly feed on fish and insect and few on crustaceans, molluscs, arachnids and plant materials. Rainboth (1996) recorded that the diet of *N. notopterus* consists of insects and fish. Vidthayanon (2004) mentioned *N. notopterus* as carnivore and the food items consists of fish, prawn and aquatic insects. Babare et al. (2013) reported *W attu* consume 90% food items of animal origin. Abbas (2010) recorded that the food items of *E. vacha* consists of crustaceans, insects, teleostomi, phytoplankton, zooplankton, molluscs and barbels. Khin Than Htwe (1998) also recorded *E. vacha* as carnivorous fish. In the present study, the food of lesser importance group in the stomach of *E. vacha* was arachnida that appear to have been accidentally swallowed.
Similarly, *Channa orientalis*, *Channa punctatus* and *Channa striatus* feed mainly on fish, insects, crustaceans and few on molluscs, worm, plant materials and mud and sand. Rao et al. (1998) reported that *Channa orientalis* as carnivorous fish and the food items include phytoplankton, zooplankton, annelids, crustaceans, fish and molluscs. Alikunhi and Rao (1947) Mookerjee et al. (1946) indicated that *C. punctatus* as carnivorous; feeding on insects, crustaceans and fishes. The food item of zooplankton, insect, crustaceans, annelids, molluscs, fish, plant material, mud and sand were observed in the stomach content of *C. punctatus* (Saikia et al., 2012). The food items of fish, crustaceans, molluscs, annelids, phytoplankton and zooplankton were observed in stomach of *C. striatus* (Rao et al., 1998). In addition, Khin Than Htwe (1998) and Khin Myat Maw (1998) also mentioned these three *Channa* species as carnivores. The ratio of alimentary canal length to standard length for carnivorous species ranged from 0.47 to 0.91. All relative length of alimentary canal is shorter than 1.5 times of the standard length. These ratio are 0.61 in *N. notopterus*, 0.47 in *W. attu*, 0.89 in *Eutropiichthys vacha*, 0.77 in *Channa orientalis*, 0.91 in *Channa punctatus* and 0.89 in *Channa striatus*. The longest ratio was found in *Channa punctatus* and the shortest was found in *W. attu*.

From the present study, feeding habit of *Osteobrama belangeri* and *Oreochromis* sp. were determined as omnivores. *O. belangeri* feed mainly on phytoplankton, zooplankton and crustaceans, and few on insect and worm. *Oreochromis* sp. feed mainly on phytoplankton, zooplankton, insect, and few on crustaceans, molluscs and plant material. Basudha and Vishwanath (1999) mentioned *O. belangeri* as omnivorous and Kariman et al. (2009) also mentioned *Oreochromis* sp. omnivorous. Similarly, Oso et al. (2006) recorded that *Oreochromis* sp. as omnivorous fishes. Khin Aye Han (1997) indicated that *O. belangeri* as omnivores. Khin Than Htwe (1998) reported that *O. belangeri* as omnivores and *Oreochromis* sp. as omnivores and herbivorous. The relative length of alimentary canal for
each omnivorous species arranged from 2.27 to 11.91. The ratio of 2.27 in *O. belangeri* is between 1.5 and 3.0 times of standard length and it follows the character of omnivores given by Taki (1978). Although the ratio in *Oreochromis* sp. is longer than 3 times of the standard length, this species was judged to be an omnivore based on their food items found in the stomach contents.

In the present work herbivorous fishes include *Labeo calbasu* and *Labeo rohita*. They feed mainly on phytoplankton and few on zooplankton, insects, algae, plant material and mud and sand. The result of present study is in agreement with that of Khumar and Siddigui (1989). Khumar and Siddigui (1989) reported that phytoplankton was found to be the main food and other food items of zooplankton plant materials and decayed organic matter were recorded in *L. calbasu* and *L. rohita* and determined as herbivorous. Khin Aye Han (1997) also mentioned these two species as herbivorous fishes. The ratio of alimentary canal length to standard length for each herbivorous species ranged from 11.43 to 12.46. All relative length of alimentary canal are longer than 3 time of the standard length. These ratio are 11.43 in *L. calbasu* and 12.46 in *L. rohita*. In opposite fashion from carnivores, the intestine is elongated and arranged in many loops or convolutions in predominantly herbivorous fishes.

From the stomach content analysis at is seen that there is a variation in the some food items in the study species. This variation of food items are probably related to the way fish feed and the prevalence of various food items in the water body at the time of the study. In this study, some stomachs were observed as empty stomach. Empty stomach may be due to the fact that the food items have been regurgitates or digested as the fish struggled for escape (Arthi et al., 2011). Moreover, lower percentage of empty stomach was found in this study, this indicates the food items they consume are abundance in its environment. From the present study, the determination of food composition and feeding habit of studied fish species
may give some important information for culture of these fresh water fish species.

**Conclusion**

The stomach content analysis and relative length of alimentary canal indicated that six studied species are carnivorous, two species omnivorous and another two species herbivorous. Variation in some food items and percentage composition of different food items in the studied stomach related to fish feeding habit. Low percentage of empty stomach was observed. Therefore, Ayeyarwady River provides abundance food items that consume by the fish and one of the significant areas of natural fresh water fishes.

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