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FOOD AND FEEDING HATBITS OF FRESH WATER FISH *LABEO BATA* (HAMILTON, 1822) FROM THE RIVER GODAVARI

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ABSTRACT

The food and feeding habits of fresh water fish Labeo bata was investigated during the year 2017. Gut contents showed that diatoms were formed about 18.80 of total food and represented by Cyclotella (3.22%) Diatoma (3.51%), Nitzschia (2.20%), Navicula (4.28%), Cymbella (2.55%), Gyrosigma (0.84%), Synedra (0.93%) and Surirella (1.25%). Green algae were estimated as 17.92 % and represented by Oedogonium (1.37%), Pediastrum (1.17%), Selenastrum (1.77%), Ancistrodesmes (2.54%), Scendesmes (3.43%), Spirogyra (3.01%), Crucigenia (2.65%) and Tetraspora (1.95%). Blue green algae included Nostoc (2.20%), Anabena (1.69), Microcystis (3.06) and Phormidium (1.54%) and formed about 8.50% during the year of 2017. Zooplankton represented by Crustaceans and rotifers and these are estimated as crustaceans (0.08%) and rotifers (0.17%) and formed about 0.25% during the year 2017. Sand and mud, it consisted about (22.90%) of the total food items, which were recorded in the gut throughout the study period during year 2017.

KEY WORDS

Labeo bata. Feeding intensity, Gut content analysis

INTRODUCTION

Studies on the food and feeding habits indicate the species niche in the ecosystem, their food preferences and food spectrum overlaps [1]. George Ubong Uwem *et al.,* [2] was found food and feeding habits of *Ophiocephalus obscura* (African snakehead) in the Cross-River Estuary, Cross River State, Nigeria. De Crepin de Billy *et al.,* [3] observed biplot presentation of diet composition information: an option for fish stomach contents analysis. Cristos *et al.,* [4] examined the first run through a broad investigation of the life history and feeding pattern of *G. holbrooki*, in small shallow entropic Mediterranean Lake. The species is characterized by first development, early development high level of reproductive effort and short life span.

The food and feeding habits of minor carp like *Puntius sarana* were dealt by Nisha Shukla [5]. Scanty information is available on the food and feeding habits of an important minor carp e.g. *Labeo bata* [6-10]. Faroogh Kumar and Siddiqui [11] investigated that the variety in the feeding intensity of male and female of fish were seen to be in the same pattern. In any case, the changes were more definite in female than the males. This may be a result of the way that there is more physiological stress on the females than in the males during spawning period of the fish. Very limited information is available on the food and feeding habit of *L. bata.* Hence the present study was undertaken for the first time to investigate the food and feeding habits of *Labeo bata* from river Godavari. Attention has been paid on food consumption, feeding intensity and seasonal variation of food.

MATERIAL AND METHODS

For studies on food and feeding habits a total of 300 specimens of *Labeo bata* (70 mm to 415 mm) caught from river Godavari were collected at Dowleswaram fish market. Fish were brought in fresh condition and immediately preserved in 5% formalin. Gill and drag-nets were used to catch the fish.

The preserved fish specimens brought to the laboratory were used for food analysis. The total length of the fish was measured up to 0.1 g accuracy. The fishes were sexed and their stages of gonadal maturity were determined following the scheme given by Qayyum and Qasim [12] The fish were dissected carefully and their entire gut (from the oesophagus to the last part of the intestine) were taken out carefully and were weighted on a very pan balance up to 0.5 g accuracy and preserved in 5% formalin.

Although, several methods have been suggested for gut content analysis [13-18]. In the present study, the 'point' method as described by Hynes [15] has been followed.

The entire alimentary canal was dissected. All gut contents were removed carefully by means of a soft brush into a petridish containing known volume of water. It was then thoroughly mixed and out of this 0.5 ml was taken and transferred into Sedgwick Rafter counting cell. The food items were thoroughly distributed in the counting cell and examined under microscope for detailed study. All food items from each gut were counted from 10 random squares of the counting cell and knowing the number of total squares in a counting cell, total number of each food item could be determined. Each food organism was counted and allotted a point by visual inspection, based on its relative size and number in gut contents [15, 16]. By multiplying numbers of each organism by the points allotted to it, its abundance could be estimated. Taking this as the basis, the different items in the gut contents were converted into percentages in the sample. The percentages of decayed organic matter and sand and mud were decided by eye estimation. The frequency occurrence of each food component was determined by dividing the number of huts containing the food by the total number of guts examined during that period. The number of fishes with empty guts was also recorded in each month and expressed as the percentage of total number of fishes examined in that month

RESULTS

Morphology of the alimentary canal system

The alimentary tract can be functionally divided into the following regions: Mouth, bucco-pharynx, oesophagus, intestine and rectum.

Mouth

The mouth is situated at the anterior end of the head. It is narrow, transverse and sub-interior. The mouth is bound by thin and continuous lips, having a tubercle inside lower jaw above the symphysis. There is no horny covering inside the jaws. The mouth is devoid of teeth. The oral cavity is small and begins from the lip to the end of the mouth region. The intake of water and food items occurs in the oral cavity by means of suction, achieved by an accurate timing of changes in volume in the oral, buccal, pharyngeal and opercular cavities and by adjusting the opening of the oral and opercular valves.

Bucco-pharynx region:

This region is located at the back of mouth. Base of the cranium forms the roof of the bucco-pharynx, whereas its side and floor are supported by the branchial arches and median urohyal respectively. The bucco-pharyngeal region is divided into: buccal cavity and the pharyngeal cavity.

The buccal cavity is narrow in the front and wider posteriorly. It extends from the lip to the first pair of gill arch. The pharyngeal cavity is divided into anterior pharynx including the branchial region and the posterior pharynx containing a chewing pad in its roof and pharyngeal teeth in its floor.

There are a series of apertures known as branchial apertures on the right and left sides of bucco-pharyngeal region, separated one from the other by branchial arches of which, there are four on either side. The branchial arches have a large number of fine and long branches, called gill lamellae. The branchial arches are also provided with small proturberances on either side. These are known as branchio-spines or gill rakers. These are fine and long. The branchial arches and branchio-spines together on one hand and the branchial aperture on the other, from a kind of filter through which water passes but retains the food to be transported to the oesophagus. The filter system in *L. bata* is very narrow. The branchial sieve ends at place where the epibranchial meet the palate organ.

The fifth branchial arch forms the pharyngeal jaw. It supports pharyngeal teeth, which are strong and large and disposed in three rows 5.4.2/2.4.5 in *L. bata*. These pharyngeal teeth are used for mastication and cutting the food before it goes to the intestinal bulb. *Labeo bata* lacks teeth in jaws and palate.

Oesophagus

Bucco-pharynx leads into the oesophagus, which is short and distensible. The oesophagus posteriorly ends into an intestinal bulb.

Intestine

Labeobata lacks a true stomach. The intestinal bulb is continued as a long, coiled intestine. The intestine is held in position by the mesentery. The bile duct enters the intestine at the point from where intestinal bulb is differentiated into the intestine.

The adaptations of the alimentary canal of *L. bata* to their food habits are particularly evident among others in relative length of the gut. The ratio calculated in case of *Labeo bata* individually showed no marked difference with the increase in the size of fish and also no seasonal variation. The ratio between the total length and the gut length ranged from 14.89 to 16.94 (avg. 15.91).

Rectum

The rectum is short and cannot be distinguished externally from the intestine proper. It contains mucosal folds in the form of thick longitudinal bands.

The other associated structures with digestive apparatus are liver, spleen, pancreas and the gall bladder.

Food Composition

It is evident from the present results revealed that the fish subsists mainly on phytoplanktonic organisms. Diatoms, green algae and decayed organic matter were the main food items present in the gut (Table 1). The fish also fed on zooplankton consisting of protozoans, rotifers and crustaceans. The food items in the gut of the fish were invariably found along with sand and mud. The results indicated the *L. bata* is herbivore fish feeding on bottom dwelling organisms. Table 1 shows the seasonal variations in the percentage composition of food intake of the fish.

Table-1. Seasonal variation in the food contents of *Labeo bata* during the years 2017

Food Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Green algae													
Oedogonium	4.8	2.8	2.3	1.5	0.5	0.5	0.4	0	0.1	2.9	0	0.7	1.37
Pediastrum	2.3	3.2	2.4	0.2	0.5	0.2	0	0.5	1.4	2.4	0.1	0.8	1.17
Selenastrum	3.8	2.6	1.5	2.2	1.7	1.3	0.5	1.4	1.2	4.5	0.2	0.4	1.77
Ancistrodesmes	6.9	1.5	3.8	3.7	0.5	0.9	0.2	0.1	2.4	2.6	3.5	4.5	2.54
Scenedesmus	2.6	1.3	3.5	4.5	9.8	4.2	1.2	0.5	1.1	5.6	3.1	3.8	3.43
Spyrogyra	9.4	1.6	6.2	7.2	1.2	2.1	1.5	2.7	1.5	2.2	0.1	0.5	3.01
Cruicigenea	3.2	2.7	3.1	5.9	3.5	2	0	0.6	0.1	6.2	1	3.5	2.65
Tetraspora	3.9	3.5	3.5	1.8	1.9	0.6	0.2	0	0.4	2.1	2.5	3.1	1.95
Total	36.9	19.2	26.3	27	19.6	11.8	4	5.8	8.2	28.5	10.5	17.3	17.92
Diatoms													
Cyclotella	8.1	2.7	2.6	5.8	3.2	1.6	1.6	1.3	4.5	2.8	2.2	2.3	3.22
Diatoma	2.2	8.9	7.9	3.2	1.7	3.2	3.5	1.2	1.3	3.3	3.1	2.7	3.51
Nitschia	4.1	2.3	1.3	2.5	0.5	3.6	3.1	1.9	2.1	2.4	1.2	1.4	2.20
Navicula	9.5	20.1	5.7	1.2	2.7	1.1	1.4	1.7	0.8	2.5	3.4	1.3	4.28
Cymbella	2.1	2.3	1.4	0.8	1.2	0.2	2	2.8	10.3	2.1	1.6	3.8	2.55
Gyrosigma	3.2	0.5	0.5	0.5	0.3	0.1	0.1	1.3	0.8	1	1.5	0.3	0.84
Synedra	3	1.5	1.5	0.5	0.2	0.5	0.3	0.4	0.2	0.3	1.3	1.5	0.93
Surirella	3.1	0.4	2.3	0.7	0.5	1.3	1.3	1.8	2.2	0.7	0.5	0.3	1.25
Total	35.3	38.7	23.2	15.2	10.3	11.6	13.3	12.4	22.2	15.1	14.8	13.6	18.80
Blue green algae													
Nostoc	1.9	1.9	2.7	2.9	2.8	3.6	3.3	1.3	0.8	1.7	1.1	2.5	2.20
Anabaena	1.7	1.2	0.9	1.5	2.5	2.5	3	0.4	1.5	2.5	1.6	1	1.69
Microsystis	3.1	2.8	3.5	3.8	3.1	4.1	4.9	2.5	1	2.6	1.3	4.1	3.06
Pheridium	0.8	0.9	2.1	0.8	1.8	1.2	1.5	2.4	2.3	1.5	0.7	2.5	1.54
Total	7.5	6.8	9.2	9	10.2	11.4	12.7	6.6	5.6	8.3	4.7	10.1	8.50
Desmids													
Cosmarium	0.5	2.1	1.3	0.5	0.5	0.8	0.3	3.4	2.8	0.2	0.1	0.1	1.05
Closterium	1	1.5	1.2	1.2	0.7	1.5	0.2	1.5	1.5	2.5	3.5	2.2	1.54
Total	1.5	3.6	2.5	1.7	1.2	2.3	0.5	4.9	4.3	2.7	3.6	2.3	2.59

Phytoflagellates													
Volvox	2.5	1.5	0.3	0.2	0.1	0	0	0.1	0	0.4	0.2	0.3	0.46
Total	2.5	1.5	0.3	0.2	0.1	0	0	0.1	0	0.4	0.2	0.3	0.46
Algalspores & Zytotes	4.1	7.2	5.1	7.5	7.3	10.7	11.5	13.3	11.1	9.2	7.1	4.1	8.18
Microvegetation	2.1	3.1	3.2	2.7	2.1	3.7	5.1	4.2	4.5	5.7	5.8	4.5	3.89
Decayed organic matter	6.9	25.2	7.8	11	9.2	18.5	11.8	20.7	26.4	31	23.1	15.9	17.29
Zooplankton													
Crustaceans	0.1	0.1	0.1	0	0	0.2	0	0.2	0.1	0.1	0	0.1	0.08
Rotifers	0	0.2	0.3	0.4	0.2	0.1	0.3	0	0.1	0.3	0.2	0	0.17
Total	0.1	0.3	0.4	0.4	0.2	0.3	0.3	0.2	0.2	0.4	0.2	0.1	0.25
Sand and Mud	14.1	2.5	23.1	30.1	40.2	35.7	48.9	39.8	30.5	4.9	2.5	2.6	22.90

Phytoplankton

Diatoms (Bacillariophyceae)

Diatoms formed the main food item of the fish constituting and mean values of different months were presented in table 3. During the year 2017 diatoms were formed about 18.80 of total food and represented by *Cyclotella* (3.22%) *Diatoma* (3.51%), *Nitzschia* (2.20%), *Navicula* (4.28%*)*, *Cymbella* (2.55%), *Gyrosigma* (0.84%), *Synedra* (0.93%) and *Surirella* (1.25%) respectively.

Green algae (*Chlorophyceae*)

Green algae were next items of food in order of abundance and recorded, on an average, about 16.58 of the total food items that occurred in the guts of *L. bata*. During the year 2017 green algae was estimated as 17.92 % and represented by *Oedogonium* (1.37%), *Pediastrum* (1.17%), *Selenastrum* (1.77%), *Ancistrodesmes* (2.54%), *Scendesmes* (3.43%), *Spirogyra* (3.01%), *Crucigenia* (2.65%) and *Tetraspora* (1.95%).

Blue green algae (Myxophyceae)

This group was represented by 4 genera, e.g., *Nostoc* (2.20%), *Anabena* (1.69), Microcystis (3.06) and *Phormidium* (1.54%) and formed about 8.50% during the year of 2017. Out of the total food items, *Phormidium*, *Nostoc* and *Microcystis* were the most common genera.

Zooplankton

Zooplankton represented by Crustaceans and rotifers and these are estimated as crustaceans (0.08%) and rotifers (0.17%) and formed about 0.25% during the year 2017.

Sand and Mud

It consisted about (22.90%) of the total food items, which were recorded in the gut throughout the study period during year 2017.

No appreciable difference was noted in the food consumption of male and female specimens. (Table 1)

Intensity of feeding

The values of gastro-somatic index along with given percentages of empty guts for different months are studied. It is evident from the results that the gastro-somatic index of the fish was inversely proportional to the percentage of their empty guts. In females, feeding intensity of the fish was found to be low from April to September, being extremely low during June to August. A pronounced feeding activity was recorded from October to March. In case of male specimens, the same trend of feeding activity was noticed but with a slight variation. In males, feeding intensity was extremely low during June to September, thereafter, an increase in the feeding intensity was observed from October to April. The percentage of empty guts in male specimens, when compared to that in females, showed a gradual increase from April to September, whereas in females, there was an abrupt increase in their percentage from April to August. However, the feeding intensity was higher in males than females. The lower feeding intensity may be attributed to intensive sexual stress of female as compared to that of males.

In both the sexes, the intensity of feeding was high in immature (Stage I). Intense feeding was observed in maturing and ripening fishes (Stage II and III). Ripe fish (Stage IV) consisted least amount of food showing the lowest feeding intensity. Feeding intensity suddenly increased in spent fishes (Stage V). The variation in the feeding intensity of the fish occurs from season to season and can be correlated to the gonadal cycle of *L. bata*. The feeding of the fish decreased with an increase gonad size.

DISCUSSION

Nikolsky [19] divided food of fishes into four categories according to the relationships between the fishes and their food. These categories are: i) Basic food, which the fish usually consumes comprising the main part of the gut content; ii) Secondary food, which is frequently found in the guts of fishes but in small amounts; iii) Incidental food, which only rarely enters the gut; iv) Obligatory food, which the fish consumes in the absence of basic food.

The food consumed by *Labeo bata* consists of phytoplanktonic organisms mainly diatoms, green algae and decayed organic matter. Besides, above planktonic organisms, blue green algae, phytoflagellates, macrovegetation, zooplankton: protozoa, rotifers, micro-crustacean forms, etc., also constitute the dietary items. Chaterjee *et al.,* [20] have also reported similar observations. Thus, the food taken by *L. bata* falls under the third category, i.e., soft-tough food. For such a type of food, cutting and shearing are most effective in mastication by pharyngeal teeth [21]. In *Labeo bata*, pharyngeal teeth present a molariform occlural profile. Such types of teeth have been reported in *Labeo gonius* [21] *Labeo rohito* [22] and several other cyprinids [23].

Pahwa and Mehrotra [24] and Chakrabarty *et al.* [25] have stated that among phytoplankton, diatoms were dominated during winters. This has been clearly reflected in present studies as the contribution of diatom in food items. The food and feeding habits of the fishery vary with the time of the day, size of the fishes and season of the year [26].

Dewan and Saha [27] reported that the low feeding activity of *Tilapia* in the months of February to June is associated with fecundity of the water produced by heavy rain fall, whereas the immature fishes were found to actively feeding in all other months.

From the present study it can be concluded that the fish changes its food habit with the change of seasons. These findings more or less similar with those of Dewan and Saha [27] who reported that *Tilapia nilotica* changed its food habit with the changes in seasons.

According to Mushahida-Al-Noor Syeda [28] the food contents of *Rita rita* contained a wide range of food items including dominant groups like crustaceans and copepods constituting (20.73%), insect (15.97%), followed by mollucs (14.76%), teleosts (12.98%) and fish eggs (8.608%). The present studies have also revealed that there is no any significant difference in the food of *L. bata* of different lengths and environments.

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