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# STUDIES ON THE FOOD AND FEEDING HABITS OF *LABEO BATA* (HAM.) (CYPRINIDAE: TELEOSTEI)

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*Labeo bata* (Ham.) in the adult stage, is a bottom feeder, with algae and detritus (decaying organic matters, sand and mud) being the most important items of its diet throughout the year. Selective feeding was observed in two size groups; fingerlings (30-70 mm total length) showed strong positive selection for zooplanktonic organisms, while adults (101-450 mm total length) showed a strong negative selection for zooplankton and strong positive selection for phytoplankton. No particular preference for any particular algae was shown by adults. The feeding intensity was affected by the maturation of the gonads, due to low feeding in May, June and July when the fish were either in ripe condition or were on the spawn (July).

*Key words:* Food, Feeding, *Labeo bata*.

## INTRODUCTION

The general food and feeding habits of a number of fresh water fishes have been reported from India [1-3], but to date, no attempt has been made to describe the food and feeding habits of *Labeo bata* Ham.), a widely distributed species in Indian freshwaters, and caught in fairly good numbers. The objectives of the present study were to determine the seasonal food habits of *Labeo bata* (Ham.) and food selection exhibited by two size groups, fingerlings (30-70 mm) and adults (101-450 mm).

## MATERIAL AND METHODS

Monthly samples were obtained during a period of 13 months from October, 1972 to October, 1973 and a total of 834 specimens (30-45 mm) of *Labeo bata* were examined. The fish were caught by seines and cast nets from the river Kali, a tributary of the river Ganges, between 8-10 a.m. and brought to the laboratory in ice. The river at the sampling site was about 30 m wide and 0.5-1.4 m deep.

The fish were measured to the nearest mm from the tip of the snout to the longest ray of the caudal fin, weighed to the nearest 0.1 g and sexed. The guts were carefully taken out from the oesophagus to the last part of the intestine, weighed accurately and preserved in 10% formalin.

Food items were generally found uniformly distributed throughout the alimentary canal and hence it was necessary to examine the whole gut contents. 50 mm pieces of gut were from fore, mid- and hind gut, placed in a petri dish containing a known quantity of water and all the food itmes were carefully removed. The contents were thoroughly mxied and exactly 0.5 ml was placed on a slide and examined under a microscope. Food items were identified upto generic level and counted. Their relative abundance was expressed as a percentage of the number of food items in the sample. The percentage of detritus (decaying organic matter, sand and mud) was estimated by eye [4-5].

The gastro-somatic index (gut weight expressed as percentage of body weight) was used as a measure of the intensity of feeding The percentage of fish with empty gut was also noted.

Plankton samples were collected from the river Kali using a plankton net, preserved in 5% formalin and concentrated to 100 From this a 1 ml subsample was taken and counted in a Sedwick Rafter Cell.

Electivity index (E) [6] was used as a measure of food selection where:

$$E = \frac{ri - pi}{ri + pi}$$

'ri' is the relative amount of any food item in the gut (expressed as a percentage of the total number of food items), and 'pi' is the relative abundance (%) of the same food items in the food complex of the environment.

## RESULTS

*Seasonal food composition.* Phytoplankton formed the principal food of the adult fish throughout the study (Table 1). It constituted about 58% of the total food while

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Table 1. Seasonal variation in the percentage composition of different food items of adult (101-450 mm) *L. bata*.

| | Months | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. |
| Sample size | 31 | 44 | 36 | 57 | 45 | 48 | 28 | 44 | 45 | 80 | 37 | 42 | 41 |
| *Oedogonium* | 3.2 | 2.1 | 3.5 | 4.5 | 2.5 | 2.1 | 1.2 | 0.7 | 0.3 | 0.5 | – | – | – |
| *Pediastrum* | 2.1 | 3.1 | 4.0 | 4.8 | 1.7 | 3.0 | 2.4 | 0.4 | 0.2 | – | 0.7 | 1.2 | 2.5 |
| *Selenastrum* | 0.8 | 2.7 | 1.0 | 3.8 | 2.0 | 1.0 | 2.0 | 1.4 | 1.1 | 0.5 | 1.6 | 1.1 | 4.5 |
| *Ankistrodesmus* | 0.9 | 3.2 | 3.9 | 6.8 | 1.2 | 3.8 | 3.6 | 0.3 | 1.1 | 1.1 | 0.1 | 2.5 | 2.6 |
| *Scenesdesmus* | 1.7 | 4.4 | 4.8 | 2.5 | 1.3 | 2.9 | 4.7 | 10.0 | 3.8 | 1.2 | 0.5 | 1.2 | 5.5 |
| *Spirogyra* | 0.5 | 3.4 | 2.9 | 9.2 | 1.0 | 6.0 | 7.2 | – | 2.2 | 1.5 | 2.6 | 1.9 | 2.8 |
| *Tetraspora* | 5.8 | 5.7 | 6.5 | 3.8 | 3.0 | 3.5 | 2.2 | 1.7 | – | – | 0.5 | 0.5 | 2.5 |
| *Crucigenia* | 6.5 | 5.8 | 3.7 | 2.8 | 2.5 | 2.9 | 6.0 | 3.2 | 1.9 | – | 0.8 | – | 5.9 |
| Green algae | 21.5 | 30.4 | 30.3 | 38.2 | 15.2 | 25.2 | 29.2 | 29.7 | 10.6 | 3.8 | 4.6 | 8.4 | 28.8 |
| *Cyclotella* | 2.8 | 2.4 | 2.5 | 7.8 | 1.9 | 2.9 | 5.0 | 2.0 | 1.8 | 1.9 | 1.8 | 4.1 | 3.0 |
| *Diatoma* | 1.1 | 3.4 | 2.6 | 2.0 | 8.2 | 7.8 | 2.1 | 1.5 | 2.6 | 3.1 | 1.0 | 1.0 | 2.9 |
| *Nitzschia* | 0.4 | 0.7 | 0.9 | 3.0 | 2.5 | – | 1.9 | 0.3 | 3.0 | 3.2 | 1.9 | 2.0 | 2.5 |
| *Navicula* | 2.3 | 6.0 | 2.6 | 10.5 | 21.6 | 6.8 | 1.2 | 2.5 | 1.0 | 1.5 | 2.0 | 1.0 | 2.3 |
| *Cymbella* | 1.5 | 3.7 | – | 2.5 | 1.3 | – | 1.2 | 0.2 | 1.3 | 2.0 | 2.6 | 9.5 | 1.9 |
| *Gyrosigma* | 0.1 | 0.3 | 1.4 | 3.5 | 0.5 | 0.5 | 0.2 | – | 0.1 | 0.1 | 1.7 | 0.5 | 1.0 |
| *Cocconeis* | – | – | 1.3 | 1.2 | – | 1.0 | – | – | 0.4 | – | – | 1.5 | 1.3 |
| *Surirella* | 1.5 | 0.7 | – | 2.5 | – | 2.3 | 0.3 | 0.3 | 1.3 | 1.5 | 2.0 | 2.0 | 0.5 |
| *Synedra* | 0.8 | 1.1 | – | 3.0 | 1.2 | – | – | 0.2 | 0.3 | – | – | 1.5 | 1.3 |
| Diatoms | 10.5 | 18.3 | 11.3 | 36.0 | 37.2 | 21.3 | 11.9 | 8.0 | 11.8 | 13.3 | 13.0 | 22.4 | 17.2 |
| *Nostoc* | 2.1 | 1.2 | 2.5 | – | 1.9 | 2.5 | 3.0 | 3.0 | 3.5 | 3.6 | 1.2 | – | 1.2 |
| *Anabaena* | 1.1 | – | 1.1 | 1.5 | 1.0 | – | 1.2 | 2.1 | 2.8 | 2.9 | – | – | 1.0 |
| *Microcystis* | 2.1 | 1.8 | 3.8 | 3.2 | 2.5 | 3.0 | 4.1 | 3.5 | 4.0 | 4.8 | 2.9 | 1.3 | 2.5 |
| *Phormidium* | 2.8 | 1.1 | 1.8 | 1.0 | 1.1 | 2.5 | 0.7 | 2.1 | 1.2 | 1.4 | 2.2 | 2.2 | 1.7 |
| Blue green algae | 8.1 | 4.8 | 8.2 | 5.7 | 6.5 | 8.1 | 9.0 | 10.7 | 11.5 | 12.7 | 5.9 | 3.5 | 6.4 |
| *Cosmarium* | 0.5 | 1.1 | 1.5 | 0.5 | 2.5 | 0.9 | 0.3 | 0.3 | 0.7 | – | 3.2 | 2.5 | 1.0 |
| *Closterium* | 1.2 | 1.0 | 1.4 | 1.1 | 1.8 | 1.2 | 1.2 | 0.9 | 1.2 | – | 1.1 | 1.5 | – |
| Desmids | 1.7 | 2.1 | 2.9 | 1.6 | 4.3 | 2.1 | 1.5 | 1.2 | 1.9 | – | 4.3 | 4.0 | 1.0 |
| Phytoflagellates | 2.2 | 0.4 | 1.0 | 2.5 | 1.2 | – | 0.1 | – | – | – | – | – | 2.3 |
| Algal spores and zygotes | 14.8 | 7.8 | 6.2 | 4.5 | 4.8 | 6.8 | 5.2 | 6.9 | 7.0 | 10.5 | 11.5 | 12.2 | 10.1 |
| Rotifers | 2.2 | 3.6 | – | – | – | – | – | – | – | – | 0.1 | – | – |
| Crustaceans | – | – | 1.3 | – | – | – | – | – | – | – | 0.9 | – | – |
| Detritus | 39.0 | 32.6 | 38.8 | 11.5 | 30.7 | 36.5 | 43.0 | 55.5 | 57.2 | 59.7 | 59.7 | 49.5 | 34.2 |

green algae constituted 20.1%. Green algae were abundant in the diet in most of the months except July, August and September. *Scenedesmus*, *Ankistordesmus* and *Selenastrum* occured in all months. However, *Crucigenia*, *Tetraspore* and *Spirogyra* in that order, were numerically more abundant although they were occasionally absent during some months.

*Diatoms* formed about 17.8% of the total food and occurred in large numbers in all months. Numerically, *Navicula* was the most important followed by *Cyclotella*, *Diatoma*, *Nitzschia* and *Gyrosigma*, *Synrdra* and *Surirella* were of less importance.

*Microcystis* and *Phormidium* were the main constituents of blue green algae in the diet of the fish. *Nostoc* and *Anabaena* though occurring consistently in the gut, formed a negligible portion of the diet.

Quantitatively, *detritus* (authochthonous and allochthonous) was the most important food of the fish (Table 1), and consumed in large amounts throughout the year, particularily during monsoon months (July-August).

*Feeding intensity*

*Intensity of feeding inrelations to season.* Seasonal feeding intensity was indicated by the gastro-spasmatic index and percentage of empty guts. The feeding activity increased in October, thereafter, active feeding was recorded upto February. From March to August, the feeding intensity declined and reached its lowest level during the monsoon months (June-August) (Fig. 1).

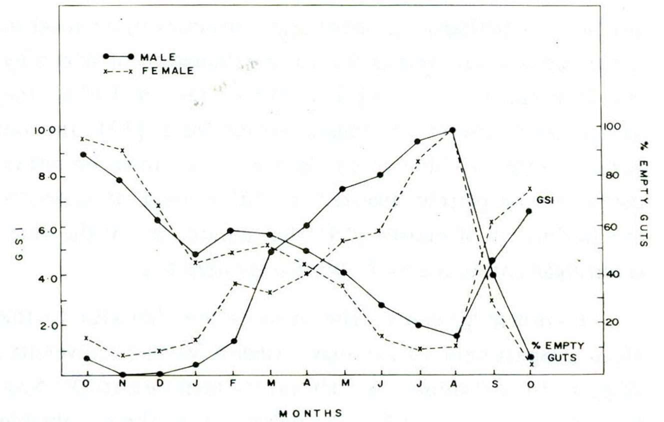


Fig. 1. Seasonal variations in the intensity of feeding of *L. bata*.

*Intensity of feeding in relation to size.* The intensity of feeding was found to increase as the fish increased in size and reached the highest level in size group III (251-300 mm); afterwards the feeding intensity decreased and continued at a moderate rate (Fig. 2).

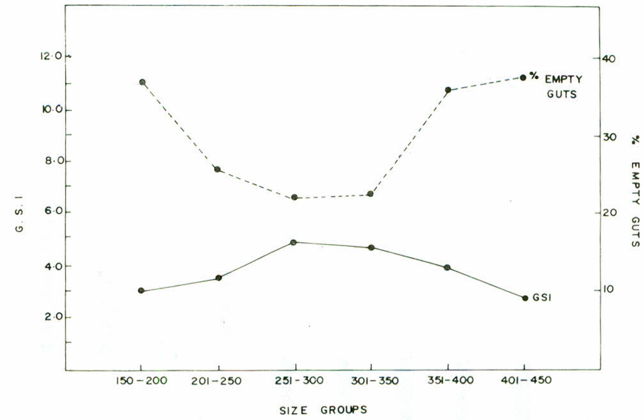


Fig. 2. Variations in the intensity of feeding with the size of *L. bata*.

*Intensity of feeding in relation to sexual cycle* Feeding intensity was high in immature fish (stage I). Maturing and ripening fish (stage II and III) consumed more food than ripe fish (Fig, 3).

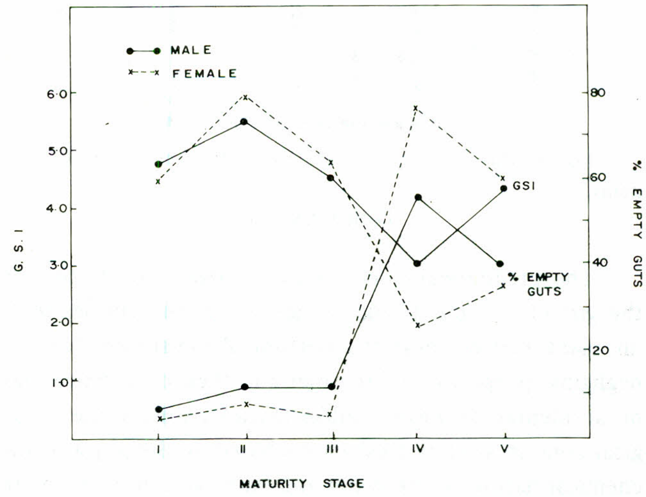


Fig. 3. Variation in the intensity of feeding with maturity stages of *L. bata*.

*Food selection.* Fingerlings showed a strong positive selection for protozoans (*Arcella* and *Difflugia*), rotifers (*Keratell* and *Brachionus*), cladocerans (*Moina* and *Daphnia*) and copepods (*Cyclops* and nauplii). Some smaller algae like desmids (*Closterium* and *Cosmarium*), phytoflagellates (Euglena), algal spores and zygotes were also consumed (Fig. 4). Other phytoplanktons, especially green algae, diatoms and blue-green algae were avoided. Detritus was also absent in the diet. Adult *L. bata* fed on detritus and algae and showed a strong positive selection for all phytoplanktonic food organisms. Zooplankton was completely avoided and consequently the value of 'E' was found to be negative.

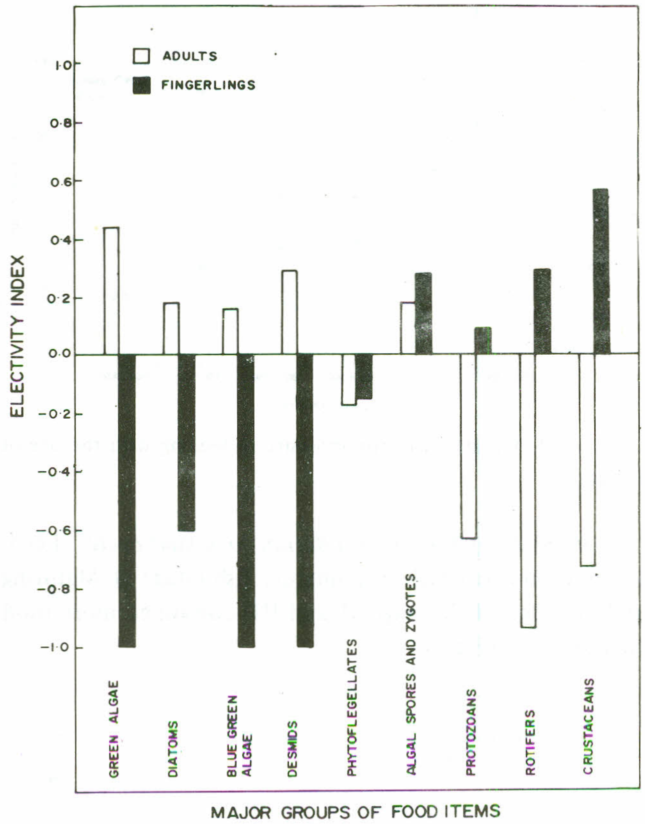


Fig. 4. The electivity indices (E) of different groups of food items.

## DISCUSSION

The predominant occurrence of algae and detritus in the gut of *L. bata* strongly suggests that this species feeds on plant matters near the bottom. Zooplankton forms a negligible proportion of the diet and their occurrence may be accidental. However, unlike marine habitats, the ecological zone in shallow freshwaters based on the physical and chemical nature of the water and fauna and flora inhabitating it, are not sharply demarcated from one another.

The relative importance of different food organisms varied from month to month. Such variations are due to varied production of each food item in the environment. A particular type of food item tends to be maximum at a particular time due to the succession of species. Since *Labeo bata* remains in one habitat throughout its life, it has to adapt to the food as available in the river in different seasons. This suggests ón opportunistic feeding. Bhatnagar and Karamchandani [2] reported similar adaptations in *Labeo fimbriatus*.

The occurrence of detritus in diet in large quantities during the monsoon months, suggests that incoming flood water from the adjacent area is the main source of organic matter. The percentage of detritus was low in winter months as compared to monsoon months.

It has become quite evident from the present investigation that *L. bata* feeds selectively. The selection of food items takes place particularily at two stages of the life. At fingerling stage selecting against most phytoplanktonic orgaanisms, while in the (adult) stage they select against zooplankton. Other fishes are known to change their feeding habits as they grow. Nikolsky [7] suggested that variation in the diet with age and size is a substantial adaptation which allows an increase in the range of food supply of the population, enabling the species as whole to assimilate a variety of food.

Food selection in other Indian cyprinids has been reported previously. Alikunhi [1] and Mitra and Mahapatra [8] in their experimental studies on the feeding of fry of major carps (*Labeo bata Cirrhina mrigala, Catla catla*) concluded that the fry fed mainly on zooplankton and avoided phytoplankton. Similar conclusions were drawn while reporting the food selection by *Labeo rohita* and its feeding relationship with other carps of North India [3].

The feeding intensity of adult *Labeo bata* was affected by the state of maturation of the gonads. Low intensity of feeding was recorded during June-August when the fish were either fully matured or spawning [9]. Suseelan and Somasekharan [10] reported a similar feeding cycle in the demersal fishes of Bombay. In this study, temperature did not influenced food intake as reported in a number of fish from the temperate region [11,12].

The rate of food intake increased during the post-monsoon months. This could be attributed to the stabilized conditions of the environment when more food becomes available or perhaps the spent fish consumes more food in the process of recovering from the exhaustion of spawning and in preparation for algal building later on. Unlike the earlier observations on *Tilapia mossambica* [13] and on *Labeo rohita* [3] blue green algae were found to be either partly or completely digested by *Labeo bata*. It supports the finding of Moriarity [14] that about 70% of the blue-green algae consumed by *T. nilotica* are digested.

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