J. Ecophysiol. Occup. Hlth. 10(2010) 13-19

The food, feeding habits and condition factor of three freshwater fishes from Tighra reservoir, Gwalior

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Abstract: *The food and feeding habit of three freshwater fishes has revealed that Sperata seenghala and Xenentodon cancila are carnivorous and Labeo boggut is a herbivorous fish. The percentage composition of various food items in stomach content of S. seenghala was 99.57% of phytoplankton, 0.14% crustaceans, 0.16% aquatic insects and 0.13% fishes and in X. cancila, it was 99.54% of phytoplankton, 0.21% crustaceans, 0.1% aquatic insects, and 0.15% fishes. Biomass of fish and crustacean was highest in comparison to other food items. L. boggut is a herbivore that feeds on phytoplankton as the sole food item. The alimento-somatic and hepato-somatic indices have every indication that S. seenghala and X. cancila are carnivorous and thus have intense liver activity, while L. boggut is a herbivorous fish having less liver activity. The conditon factor value of S. seenghala has been found to have 0.00066 ± 0.0002, X. cancila to have 0.00034 ± 0.0001 and of L. boggut to have 0.00108 ± 0.00006. These values suggest that S. seenghala and L. boggut are fairly growing, while X. cancila is a poorly growing fish.*

Key Words: Condition factor, Carnivorous, Herbivorous, Hepato- somatic, Tighra reservoir.

Introduction

Fish have great significance in the life of mankind, being an important natural source of protein and provider of certain other useful products as well as economic value to many nations. Feeding is a dominant activity of most of the organisms through out their entire life cycle and same is true with the fish (Royce, 1972). This is also a fact that the success of good scientific planning and management of growth and yield of various fish species largely depends on the knowledge of their biological aspects in which food and feeding habits constitute a valuable and distinctive feature. Schaperclaus (1933) has classified the natural food of fishes under three groups, viz., (a) main food, or the natural food which the fishes prefer under favorable conditions and on which they thrive best (b) occasional food, that is well liked and consumed as and when available, and (c) emergency food, which is ingested when the preferred food items are not available and on which the fish is just able to survive. According to David and Rajgopal (1974), there is a close relationship between the food ingested by the fishes and items of food available in the reservoir. Many species switch over to an alternate diet, if their basic food is not available due to any reason e.g., water level fluctuation and turbidity etc. According to Saksena and Kulkarni (1982), factors such as nutrient level of reservoirs, production of fish food organism and depth are influencing the growth of fish. The food and feeding habit have been studied in several fishes by several workers (Jhingran, 1971; Ahmed *et al.*, 2000; Mondol *et al.*, 2005; Prabha and Manjulatha, 2008). The importance of study of food and feeding habits of fishes lies in the fact that one can decide as to what programme should be taken up for the development of the water bodies to get more fish.

The alimento-somatic index is an indicator of feeding phase of a fish in different months. Bhatt (1970) and Vinci (1986) have correlated the feeding with that of maturation and according to them, the feeding is reduced during maturity stages, which rises again when spawning is

over. The alimento-somatic index was found to be low during spawning phase and active feeding phase was seen during monsoon and post monsoon periods (Srivastava *et al.*, 2000). It may also be mentioned that the hepato-somatic index is a good indicator of activity of liver.

The condition factor 'K' is to basically to quantify the condition of fish which is influenced by several factors including age of fish, sex, season, stage of maturation, fullness of gut, type of food, consumed amount of fat reserve and degree of muscular development. The condition factor of fish depends upon the availability and composition of food and the physico- chemical characteristics of water (Pathak, 1975; Saksena and Kulkarni, 1982; Sinha et al., 1986; Pervin and Mortuza, 2008; Saxena and Saksena, 2009). In view of above information, a study of food and feeding habits, alimento-somatic index, hepato-somatic index and condition factor of three freshwater fishes, viz., *Sperata seenghala, Xenentodon cancila and Labeo boggut* from Tighra reservoir, Gwalior has been conducted and is presented in this paper.

Materials and Methods

The samples of fishes were collected after every 15 days, at a point located near the dam, from Tighra reservoir, Gwalior, during February to April 2009. Geographically, the reservoir located at 78^0 30' East longitude and 26^0 12' North latitude and having an area of approximately 1619 ha is surrounded by hillocks. The rocky catchments area of the reservoir is approximately 412.5 sq. km. The reservoir was primarily constructed to fulfill the requirement of drinking water supply of Gwalior city. Now, this reservoir is a multipurpose one used for supply of drinking water, stocking Indian major carps by the Fisheries Department, Government of Madhya Pradesh till recently and irrigation of crop fields (Fig 1). Now, this is being developed as a tourist place and water sports area by the Department of Tourism, Government of Madhya Pradesh. The field collections were done with the help of local fishermen by using cast nets. The total length and total weight were recorded after removing the moisture by soaking them with dried cloth. The length and weight of *S. seenghala, X. cancila* and *L. boggut* have been found to be 26.76 ± 1.15 cm and 112.63 ± 13.14 g, 22.4 ± 0.95 cm and 35.5 ± 3.14 g and 17.53 ± 0.36 and 64.09 ± 3.11g respectively (Table 1). *Sperata seenghala* was formerly also known as *Mystus seenghala* and *Aorichthyes seenghala* formerly.

The fishes were dissected by giving a vertical incision on the ventral side and eviscerated to avoid regurgitation of the last meal. The gut and liver were weighed and immediately preserved in 4% formalin and were kept in marked glass vials. The preserved stomach of each fish was dissected out after a couple of days and the contents of the stomach were removed very carefully in a Petri dish and then were collected in glass vials making up the volume to 10 ml to determine the different food items eaten by the fish both qualitatively and quantitatively. The stomach contents were analyzed by following the number method of Hynes (1950) involving drop count. Alimento-somatic index and hepato-somatic index were determined during investigation using following formulae:

$$\text{Alimento-somatic Index} = \frac{\text{Total weight of the gut}}{\text{Total weight of the fish}} \times 100$$

$$\text{Hepato-somatic index} = \frac{\text{Total weight of the Liver}}{\text{Total weight of the fish}} \times 100$$

$$K = \frac{W}{L^3} \times 100$$

The growth of fish was estimated by determining the condition factor, which was calculated by the formula as suggested by Hile (1936).
Where, K = Condition factor, W= Weight of fish (g), L = Length of fish (cm).

Results and Discussion

In the stomach content of *S. seenghala,* phytoplankton, crustaceans, aquatic insects, small fishes and miscellaneous food items were observed. Numerically, the percent composition

Table 1 . Range of variation and average values along with standard error of total length, total weight, gut length, gut weight, stomach weight, liver weight of *Sperata seenghala, Xenentodon cancila and Labeo boggut.*

S. No.	Species name	Total length (cm)	Total weight (g)	Gut length (cm)	Gut Weight (g)	Stomach Weight (g)	Liver Weight (g)
1.	*Sperata seenghala*	15.2 - 38.0 26.76 ± 1.15	25.0 - 315.0 112.63 ± 13.14	15.1 - 30.5 20.33 ± 0.90	1.5 - 8.25 3.51±0.37	1.01 - 6.12 2.54 ± 0.29	0.19 - 2.5 0.81 ± 0.11
2.	*Xenentodon cancila*	10.5 - 30.2 22.4 ± 0.95	10.0 - 70.0 35.5 ± 3.14	4.5 - 14.2 8.85 ± 0.48	0.19 - 3.41 1.23 ± 0.16	0.11 - 3.03 0.59 ± 0.16	0.11 - 2.02 0.65 ± 0.11
3.	*Labeo boggut*	14.0 - 20.1 17.53 ± 0.36	30.0 - 87.0 64.09 ± 3.11	131.0 - 238.0 165.31 ± 6.22	1.1 - 5.56 3.15 ± 0.30	0.11 - 0.35 0.21± 0.01	0.04- 0.81 0.37 ± 0.05

Table 2 . Mean numerical values of phytoplankton, crustaceans, aquatic insects and fishes and their percent composition in the stomach content of certain fishes in Tighra reservoir.

S. No.	Species	Phytoplankton	Crustaceans	Aquatic insects	Fish
1.	*Sperata seenghala*	494.77 (99.57%)	0.727 (0.14%)	0.773 (0.16%)	0.636 (0.13%)
2.	*Xenentodon cancila*	456.59 (99.54%)	0.955 (0.21%)	0.455 (0.1%)	0.68 (0.15%)
3.	*Labeo boggut*	869.32 (100%)	-	-	-

of various food items in stomach was 99.57% phytoplankton, 0.14% crustacean, 0.16% aquatic insects and 0.13% fishes (Table 2). The fish and prawns found in the stomach contributed maximum biomass of food. Total 12 species of phytoplanktonic organisms belonging to 4 groups have been identified from the stomach contents of *S. seenghala*. In *X. cancila*, percent composition of various food items in stomach was 99.54% phytoplankton, 0.21% crustaceans, 0.1% aquatic insects, and 0.15% fishes (Table 2). On biomass basis, the food of this fish had maximum share and crustaceans were next in order. Total 14 species of phytoplanktonic organisms belonging to 4 different groups were identified from the stomach contents of *X. cancila*. In *L. boggut,* the phytoplankton constituted the sole food item. The percent composition of different groups of phytoplankton in the gut of the fish was found as Cyanophyceae 9.53%, Chlorophyceae 35.07%, Bacillariophyceae 49.71%, Eugleenophyceae 5.69% (Table 4). In all 16 species of phytoplankton were identified from the stomach contents of this fish. On biomass basis, it may be stated that *S. seenghala* and *X. cancila* are carnivorous fishes, as the main bulk of food are fishes and crustaceans while *L. boggut* is an exclusively herbivorous fish.

A number of workers have described the food and feeding habits in carnivorous fishes. Pillay (1953) described the food and feeding habit of carnivorous Bombay duck, *Harpodon nehereus* and found that the fish is strongly carnivorous in feeding habit; prawn and shrimp form the most important items of its food. Bhatt (1970) reported that *M. seenghala* is a carnivorous fish with cannibalistic habit. The feeding has been found to slow down with the growing specimens, particularly in females. The feeding is considerably decreased during spawning period which increased again after the spawning is over (Bhatt, 1970; Vinci, 1986; Khumar and Siddiqui, 1989; Srivastava *et al.* 2000). In *M. seenghala* as the age advances, the large portion of diet is in the form of forage fishes which take care of greater energy requirements of growing fish (Shrivastava and

Dubey, 1991). Shrivastava *et al.* (1992) reported diurnal feeding variations of four species of freshwater catfishes viz. *M seenghala, M. bleekeri, H. fosssilis* and *O. bimaculatus. O. bimaculatus* and *M.seenghala* feed mainly on smaller fish in day light and insects larva mostly during night, throughout the year. They have also reported that *M. seenghala* mainly feeds on fish, a number of insects belonging to different orders, crustaceans and few miscellaneous items. It is also observed that the utilization of food groups in different seasons is positively correlated to their occurrence in the water. Juveniles of *C. punctatus* are carnivorous in feeding habit; and feed mainly on the crustaceans, insects, molluscs, fishes, plant material (Islam *et al.*, 2004). Recently, Osman and Mahmoud (2009) studied the feeding biology of *Diplodus sargus* and *D. vulgaris* and have observed that the diet of these two species

Table 3. Phytoplanktonic forms occurring in the stomach of different fishes

S. No.	Name of fish	Group	Phytoplanktonic species
1.	*S. seenghala*	Bacillariophyceae	*Gomphonema sp., Cymbella sp., Cyclotela sp., Melosira sp., Navicula sp.*
		Chlorophyceae	*Colestrum sp., Cosmarium sp., Staurastrum sp., Xanthidium sp., Closterium sp.*
		Cyanophyceae Eugleenophyceae	*Microcystis sp.* *Euglena sp.*
2.	*X. cancila*	Bacillariophyceae	*Gomphonema sp., Cymbella sp., Melosira sp., Navicula sp., Cyclotela sp.*
		Chlorophyceae	*Colestrum sp., Cosmarium sp., Staurastrum sp., Xanthidium sp., Closterium sp., Scnedismus sp., Spirogyra sp.*
		Cyanophyceae	*Microcystis sp.*
		Eugleenophyceae	*Euglena sp*
3.	*L. boggut*	Bacillariophyceae	*Gomphonema sp., Melosira sp., Navicula sp., Cymbela sp., Cyclotela sp., Pinnularia sp.*
		Chlorophyceae	*Spirogyra sp., Colestrum sp., Cosmarium sp., Closterium sp., Staurastrum sp., Scenedismus sp., Xanthidium sp.*
		Cyanophyceae	*Microcystis sp., Spirulina sp.*
		Eugleenophyceae	*Euglena sp.*

Table 4. Number and percent Composition of different groups of phytoplankton in the stomach content of labeo boggut.

S.No.	Groups	Total Number	Percentage (%)
1.	Cyanophyceae	1933	9.53%
2.	Chlorophyceae	7112	35.07%
3.	Bacillariophyceae	10080	49.71%
4.	Euglenophyceae	1153	5.69%

Table 5. Range of variation and average values along with standard error of Alimento- somatic Index (GSI), Ratio of length of fish to the length of alimentary canal, Hepato- somatic Index (HSI) and Condition factor of *Sperata seenghala, Xenentodon cancila* and *Labeo boggut*

S. No.	Species name	Alimento -somatic Index	Ratio of length of fish to the length of alimentary Canal	Hepatosomatic Index	Condition factor Index
1.	*Sperata seenghala*	2.06 - 6.00 3.37 ± 0.23	1: 0.75	0.22 -1.16 0.73 ± 0.04	0.00027 – 0.00122 0.00066 ± 0.0002
2.	*Xenentodon cancila*	1.57 - 10.60 3.63 ± 0.45	1: 0.39	0.34 - 4.29 1.74 ± 0.20	0.00022 - 0.00064 0.00034 ± 0.0001
3.	*Labeo boggut*	2.40-10.10 4.99 ± 0.45	1: 9.43	0.07 -1.20 0.54 ± 0.08	0.0001 - 0.00117 0.00108 ± 0.00006

consisted of crustaceans, fish, polychaetes and echinoderms. The diet of *D. sargus* varied with the fish size, the abundance of polychaetes decreased with increase in fish size, while the highest occurrence in larger fish stomach was forage fish and prawn. *S. seenghala,* in the present study feeds on phytoplankton, crustacean, aquatic insects and fishes. It may be mentioned that out of 22 specimens studied, 5 specimens had empty stomachs. The cannibalism, however, was not observed in the present study.

X. cancila, also a carnivorous fish, has been shown to feed absolutely on fish (Das and Moitra, 1955). In Tighra reservoir, the food of this fish consists of phytoplankton, crustaceans and aquatic insects besides fishes. Here, the biomass of fish food is higher than all other food items. Out of 22 specimens of *X. cancila* studied, 7 specimens had empty stomachs.

Liza parsia is a herbivorous fish, feeding mainly on algae and higher plants with some preference for protozoa, crustaceans, debris, sand and mud. This fish is highly selective that avoided zooplankton and strongly selected some genera of phytoplankton, *(Volvox, Diatoma, Nostoc, Anabena*, and *Ulothrix).* Like many other fishes, this fish also changed its food with the change of season (Joadder and Hossain, 2008). *L. bogggut*, was found to be an absolutely herbivorous fish, feeding exclusively on phytoplankton. Out of the phytoplankton consumed, a clear-cut dominance of bacillariophycean algae was observed. The alimento-somatic index of *S. seenghala* ranged between 2.06 to 6.0 with a mean value of 3.37 ± 0.23. The minimum value of alimento-somatic index of *X. cancila* was recorded as 1.57 and maximum as 10.6 with a mean of 3.63 ± 0.45. In *L. boggut,* the alimento-somatic index had a range from 2.46 to 10.1 with an average value of 4.99 ± 0.45 (Table 5). The alimento-somatic index was highest in *L. boggut* than other species. This indicates the greater feeding intensity in *L. boggut* than other fishes. The alimento-somatic index serves as an indicator of feeding phase of a fish in different months. Srivastava *et al.* (2000) have shown that the alimento-somatic index in *S. seenghala* was found to be low during spawning phase and active feeding phase was seen during monsoon and post monsoon periods. The hepato-somatic index is an indicator of activity of liver. The range of variation of hepato-somatic index of *S. seenghala* was 0.22 to 1.16 and the mean value was 0.73 ± 0.04. *X. cancila* had a range from 0.34 to 4.29 with a mean value of 1.74 ± 0.23. The hepato-somatic index of *L. boggut* was recorded from 0.07 to 1.2 and the mean value was 0.54 ± 0.09 (Table 5). It is clear from the above observation that out of three fishes studied *X. cancila* had maximum liver activity and least in *L. boggut.* Thus, it is concluded that carnivorous fishes require more intense liver activity than the herbivorous fish. The average

hepato-somatic index was found to be highest in *X. cancila,* high in *S. seenghala* and lowest in *L. boggut*. This clearly points out that *X. cancila* and *S. seenghala* have high hepatic activity, whereas, *L boggut* has low hepatic activity.

The length of gut in *S. seenghala* (20.33 ± 0.90 cm) and *X. cancila* (8.85 ± 0.48 cm) was too less in comparison to *L. boggut* (165.31 ± 6.22 cm) (Table 1). The ratio between length of fish and the length of intestine is an important parameter for finding the feeding habit of the individual fish. In the present study, the ratio between total length of fish and length of intestine of *S. seenghala, X. cancila* and *L. boggut* were 1: 0.75, 1: 0.39 and 1: 9.43 respectively (Table 5). The relation between total length and alimentary canal length in the present study clearly indicate that *L. boggut* with greater ratio is a herbivorous fish while other two species with very low ratio are carnivorous species. It has been agreed upon by several authors that when the ratio of total length to length of alimentary canal is more than 1, then the fish is a herbivorous, and when it is less than 1, the fish is carnivorous fishes. Our findings agree with the statement and the works of Dewan and Saha (1979) in *Tilapia nilotica,* Islam *et al.* (2004) in *Channa punctatus*, Joadder and Hossain (2008) in *Liza parsia*.

The condition factor 'K' is the relationship between length and weight of fish. The value of 'K' is influenced by several factors such as age of fish, sex, season, stage of maturation, fullness of gut, type of food consumed, amount of fat reserve and degree of muscular development as shown in various studies. The condition factor of *S. seenghala* has been found to vary from 0.00027-0.00122 with an average of 0.00066 ± 0.0002, of *X. cancila* varied from 0.00022-0.00064 with an average of 0.00034 ± 0.0001 and of *L. boggut* ranged from 0.0001-0.00117 with an average of 0.00108 ± 0.00006 (Table 5).

Most of the workers have found that the condition factor of fish depends upon the availability and composition of food and the physicochemical characteristics of water (Pathak, 1975; Saksena and Kulkarni, 1982; Sinha *et al.* 1986). In *L. boga*, Pervin and Mortuza (2008) have shown that the condition factor is varying with the sex, which may be due to feeding intensity and gravid condition of female or due to some other factors. In a study of condition factor of culturable species, Saxena and Saksena (2009) have revealed that *Catla catla* has shown an irregular pattern of condition in different months and different length groups, whereas, *Labeo rohita*, *Cirrhinus mrigala* and *Cyprinus carpio* have shown a decreasing pattern of K value in successive months and all length groups in a culture system. On the basis of comparison of the 'K' value and the general appearance, it is concluded that *S. seenghala*, and *L. boggut* are fairly growing fishes, while *X. cancila* may be categorized as a poorly growing one.

Acknowledgements

We wish to extent our thanks to the Head, School of Studies in Zoology, Jiwaji University, Gwalior for providing necessary laboratory facilities. We are also grateful to the Coordinator, SAP- DRS (UGC) Phase ² for extending us all facilities and materials carrying out this work. One of us (DP) is thankful of Mr. Dinesh Uchchhariya for his help during the sampling of water and fish through out the tenure of work.

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