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Research Article

FOOD AND FEEDING HABITS OF *SCHIZOTHOROX RICHORDSONII* (GRAY, 1832) INHIBITING BHAGIRATHI RIVER, TEHRI GARHWAL, INDIA

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ABSTRACT

Scientific knowledge about food and feeding habits of fish is considered as an important condition factor for increasing fish production. Food as well as feeding habits preferences of the fish species, varies with the time of day, with the season of the year, with the ecological condition and with the availability of food matter present in the water body. In the present study, an attempt has been made to investigate the food and feeding habits of the *Schizothorox richordsonii* inhibiting in Bhagirathi river at Tehri Garhwal. Based on the qualitative and quantitative analysis of gut contents, *Schizothorox richordsonii* has been categorized as herbivorous. *Schizothorox richordsonii* inhabiting Bhagirathi river (a cold water hillstream river) is a periphytonic feeder, feeding on Bacillariophyceae, Chlorophyceae, Cyanophyceae, detritus, and sand in very preferential order. Enterosomatic index (ESI) indicates low feeding during spawning (October-November and February-March), while during pre- and post-spawning periods feeding increases. The mean value of the Gastrosomatic index (GaSI) and active feeding were found to be maximum 4.03 in January 2017 and minimum 1.24 in November 2016 respectively. Active feeding occurred during January-February months and also shows highest Gastrosomatic index value in winter prior to the breeding season started as well as poorer active feeding, occurred during the breeding season with the lowest Gastrosomatic index value.

INTRODUCTION

Fishes are the most nutritional, attractive, and remarkable variety of aquatic life. Food is an important factor in the ecology of fishes and required growth, reproduction and far-reaching migration. Food and feeding habits of fish are helpful for fishery biology and culture purposes. *Schizothorax richardsonii* (Gray) belongs to family Cyprinidae under an order Cypriniformes of class Pisces. This is one of the important food and game fish. These fishes are also called 'Indian Trouts' because of its semblance with family Salmonidae. They inhabit both lentic as well as lotic water bodies of Bhagirathi River. Schizothoracinae are the specialized group of fishes which inhabit snow-fed torrential streams of the Himalayas in India. *Schizothorax richardsonii* have very small scales on their body. The reduction or degeneration of scales in Schizothoracinae is a character shared by high altitude fishes of the family Cobitidae and Salmonidae. Presence of small size scales on the body is the distinguishing character of *Schizothorax richardsonii* from other species. *Schizothorax* species are characterized by inferior mouth; horny covering on the lower jaw; hard papillated band on chin; two pairs of barbels; three rows of pharyngeal teeth; last undivided ray of dorsal fin bony and posteriorly serrated. Smooth and soft skin is requisite for hill stream fishes since 'it is helpful in cutaneous respiration. *Schizothorox richordsonii* is reported to be distributed in the eastern Himalayas, through Garhwal, Mishra M. (1982), Sharma *et al.,* (2018), Kumaon, Bisht J.S. (1974) to Jammu and Kashmir Himalayas in West. In Himalayan hill streams, this genus predominates in catches in Alakananda, Badola B. S. and Singh H. R. (1981), Bhagirathi, Sharma R.C. (1988) in Jhelum river of Kashmir and in rivers Yamuna and Ganga. This paper details the food and feeding habits of *Schizothorux richardsonii,* inhabiting the Bhagirathi river. Das and Moitra (1963) have observed fishes into herbivores which feed on plant material, carnivores which feed on animal material and omnivores which feed on one or more groups of organisms, i.e., plankton, benthos. *Schizothorax richardsonii* is a bottom feeder, mainly herbivorous and their horny jaws are helpful in scraping off algae from stones and rocks in the fast running water. According to Das and Moitra

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(1956), the RLG values of herbivorous fishes such as *Labeo rohita* and *Labeo gonius* were about 12.0 and 9.5 respectively. The true stomach is absent; the esophagus is followed by an intestinal bulb. The intestinal bulb compensates for the absence of the stomach in herbivorous fishes. The juveniles feed upon aquatic insects, their larvae, and nymph, as the relative length of the gut is less than the adults. The more length of the gut in adults indicates that the fish is totally herbivorous in the adult stage. During young stage scraping mechanism in the jaws is absent and thus feed upon the insect larvae. Its food mainly consists of diatoms (Bacillariophyceae) i.e. *Navicula sp., Synedra sp., Cymbella sp., Fragillaria sp., Diatoma sp., Gyrosigma sp., Nitzschia sp., Amphora sp., Tabellaria sp. Algae* (Chlorophyceae) found in the gut contents are *Ulothrix sp*., *Spirogyra sp*., *Chara sp*., *Claadophora sp*., *Hydrodictyon sp*. and *Zygnema sp.* The average of the gut content annually constitutes 61.5% plankton (51 % diatoms and 10.50% algae), 19.5% digestive material and 19% sand in the *Schizothorax* fishes. The bottom-feeding habit of the fish is correlated with the ventral position of the mouth as the significant amount of sand was also recorded in the gut contents. This ventral position of the mouth with hard papillae plate is helpful for the scraping of algae and diatoms from the surface of rocks in torrential streams.

MATERIAL AND METHODS

Study area

The Present study area was confined along the long riverine stretch of Bhagirathi in Garhwal Himalaya. In Present study, four sampling zones have been selected. Sampling zone Z1 (Upper Bhagirathi river Basin) was selected from Bandra koti ($30^0$30'16.99 N longitude, $78^0$23'04.08 E latitude) to Jhinwali ($30^0$27'01.96 N longitude, $78^0$25'51.41 E latitude), Sampling zone Z2 (Pre impoundment of Tehri reservoir) is from Jhinwali to Tehri ($30^0$24'29.03 N longitude, $78^0$27'30.08 E latitude), Sampling zone Z3 (Post impoundment of Tehri reservoir) from Tehri to Koteshwar ($30^0$15'12.90 N longitude, $78^0$31'27.11 E latitude), Sampling zone Z4 (Lower Bhagirathi river Basin) from Koteshwar to Devprayag ($30^0$14'63.15 N longitude, $78^0$59'82.51 E latitude).

Sample collection

Fish samples were collected with a cast net (mesh size 2.5 to 3.3 cm^2) along the 50-km stretch of river Bhagirathi during September 2016 to September 2017. Fishes were preserved in 10% formaldehyde. In the laboratory, length and weight of each specimen were recorded in a conventional manner.

The total length of the alimentary canal was also recorded. Total weight of the fish, with food and without food contents, was also recorded for estimating the quantity of food consumed. Quantitative feeding expressed as an Enterosomatic index (ESI) has been calculated according to the formula.

$$\text{Enterosomatic index} = \frac{\text{Weight of food}}{\text{The weight of fish (g)}} \times 100$$

While feeding intensity was determined by Gastro-somatic index (GaSI).

$$\text{GaSI} = \frac{\text{Weight of Gut}}{\text{Weight of Fish}} \text{x} 100$$

This being a stomach less fish, by microscopic examination of anterior part of the alimentary canal, the percentage composition of different food components was determined by visual (point estimation) method. Gut contents were analyzed both qualitatively and quantitatively, Hynes (1950). The volume of food in the gut of fish was measured by Pillay (1952) and various food items are identified as per Needham and Needham (1962).The intensity of feeding was recorded on the basis of the state of distention of the gut and by determining the gastro somatic index (gut weight expressed as a percentage of body weight). Numerical count and gravimetric method as suggested by Lagler (1956) were applied for quantitative estimation of the gut content.

RESULTS

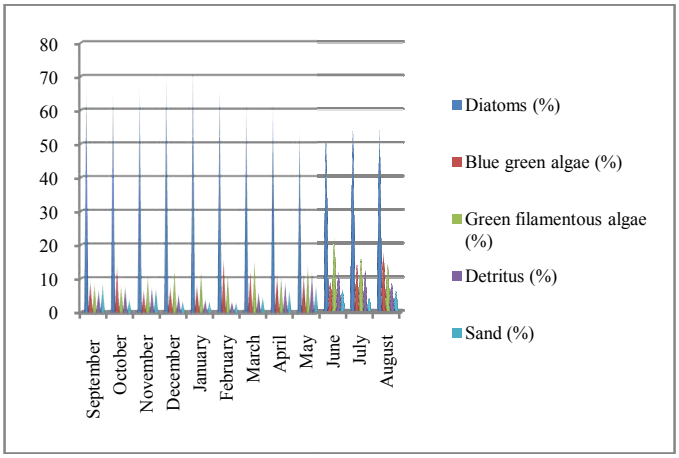


Figure 1 Monthly variations in the qualitative and quantitative feeding of *Schizothorax richardsonii.*

Table 1 Monthly qualitative and quantitative feeding variations in *Schizothorax richardsonii* inhabiting Bhagirathi river

Month	Diatoms (%)	Blue-green algae (%)	Green filamentous algae (%)	Detritus (%)	Sand (%)
September	66.3	9.4	8.9	6.9	8.5
October	65.9	14.1	8.2	7.9	3.9
November	67.3	6.8	11	7.6	7.3
December	70.5	7.9	12.8	5.5	3.3
January	71.9	8.5	12.5	3.9	3.2
February	66.5	15.9	11.4	3.3	2.9
March	61.9	12.2	15.2	6.1	4.6
April	62.3	11.3	10.8	8.9	6.7
May	53.7	11.6	14.6	12.1	8
June	51.3	8.7	21.8	11.6	6.6
July	54.1	14	15.8	12.2	3.9
August	54.0	17.3	14.1	8.5	6.1

Table 2 Monthly variations in Enterosomatic Index (ESI) of *Schizothorax richardsonii* inhabiting Bhagirathi river

Month	Enterosomatic Index (ESI)	
	Female	Male
September	8.02	6.09
October	5.76	4.88
November	4.02	2.98
December	4.01	3.12
January	3.8	3.02
February	4.15	2.86
March	5.59	4.61
April	3.76	2.97
May	4.11	4.97
June	5.92	5.93
July	11.05	10.5
August	8.79	6.68

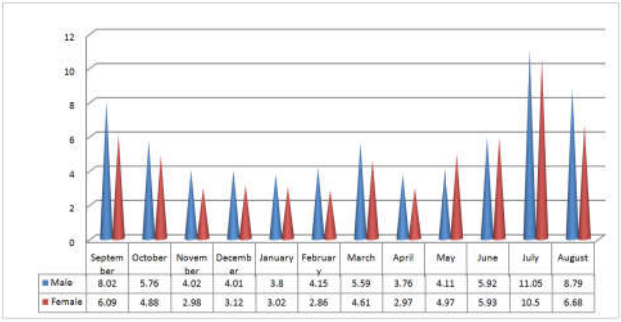


Figure 2 Variations in Enterosomatic Index (ESI) of *Schizothorax richardsonii.*

Table 3 Monthly variations in the Gastro-somatic index (GaSI) of *Schizothorax richardsonii* inhabiting Bhagirathi river

Month	Average weight of gut (g)	Average weight of fish (g)	Average GaSI
September	0.99	35.4	2.80
October	0.96	60.6	1.58
November	0.71	57.23	1.24
December	1.83	60.1	2.02
January	1.56	38.65	4.03
February	0.85	51.47	3.03
March	0.74	40.96	1.65
April	2.59	71.23	1.80
May	1.7	51.6	3.29
June	2.6	74.2	3.50
July	1.37	55.6	2.46
August	1.36	50.22	2.70

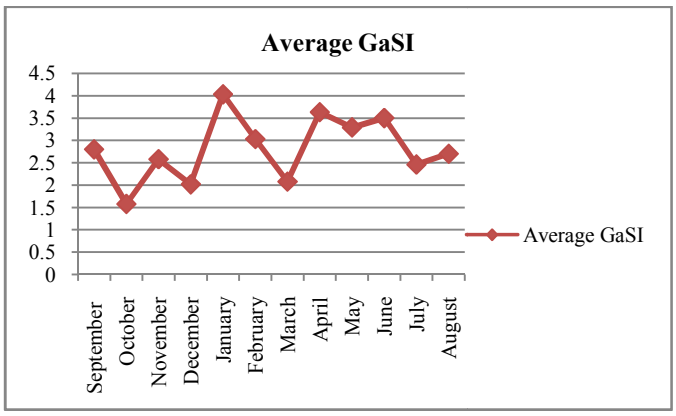
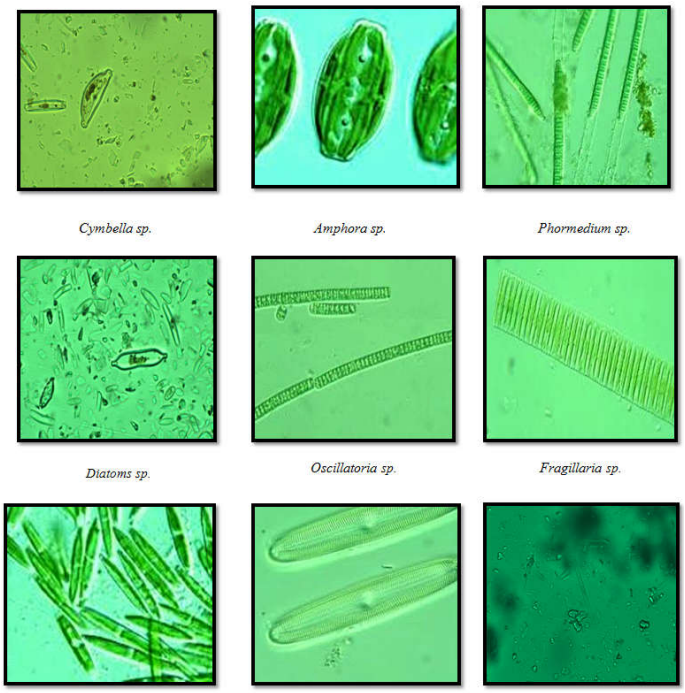


Figure 3 Variations in the Gastro-somatic index (GaSI) of *Schizothorax richardsonii*



Photoplate 1 Different species of phytoplankton present in gut of *Schizothorax richardsonii*

DISCUSSION AND CONCLUSION

Qualitative food composition

Qualitative gut analysis of *Schizothorax richardsonii* has indicated the presence of Bacillariophyceae (*Gomphonema sp., Cymbella sp., Nitzschia sp., Rhopalodia sp., Achnmthes sp., Fragillaria sp., Navicula sp., Synedra sp., Amphora sp., Pinnularia sp., Melosira sp., Chlorophyceae (Ulothrix sp., Hormdium sp., Pediashum sp.*), Cyanophyceae (*Oscillatoria sp., Lyngbya sp., Phormedium sp., Cylindrospemum sp., Stigeoclonium sp.*), respectively. During 2016-2017, annual mean percentage compositions were 62-63% of Bacillariophyceae, 11-12% of Chlorophyceae, 13-14% of Cyanophyeeae, 7-8% of detritus and 5-6% of sand. In Bhagirathi river the plant food component of *Schizothorax richnrdsonii* is reported to be 80-45%, the rest being detritus and sand. Mir S. (1986-87) reported that in Telbal and Sindh streams of Kashmir, its diet is reported to have 75% plant matter and 25% of animal matter. Due to its exclusive preference for phytoplankton (diatoms, green and blue-green algae followed by detritus and sand) the fish in Bhagirathi river, Tehri Garhwal is categorized as herbivorous, periphytonic feeder, feeding by scrapping the food from the rocks and stones. The herbivorous feeding habit of *Schizothorax richnrdsonii* is in conformity with earlier findings.

Qualitative seasonal variation in food

Table 1 reveals a well-marked seasonal variation in the various food constituents of *Schizothorax richardsonii* inhabiting Bhagirathi River. Bacillariophyceae, forming a major percentage of food throughout the year (Table I), decreases quantitatively during March-August that generally during spawning season, feeding rate would be relatively lower and it increases immediately after spawning. Low production of diatoms in response to increased velocity and water level due to snow melt in the catchment, may explain the low percentage of

this food in *Schizothorax richardsonii.* As compared to this, during September- January there is an increase in the production of diatoms due to low velocity and fall in water level which may result in their greater occurrence in the food of fish. Chlorophyceans formed the second major component of fish food which was recorded in low percentage during breeding. In May-August, following a rise in water temperature and isolation, augmented by the allogenic overflow of algae, there is a rise in algal production (Malik *et al.,* 2018). The allogenic flow of detritus and sand from the catchment, during spring rains and increased melting of snow during spring and summer, may contribute to increased percentage of detritus and sand in the gut of snow trout. (Kanna 1993) has stated that the Gastro Somatic index of several species showed seasonal variations and maximum during the post-spawning period and minimum during the breeding season. Low quantitative feeding observed presently in Schizothorax richardsonii during April-May could he due to spawning activities as per Jyoti M. K. (1976), Jan, M. A. and Das, S. M. (1970).

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