Food Spectrum of Mirror Carp in a Deep Mesotrophic Himalayan Lake

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ABSTRACT

The article discusses the qualitative and quantitative aspects of the food of the mirror carp, *Cyprinus carpio specularis* (Linn.) in Lake Manasbal, a 12.5 m deep mesotrophic waterbody of Kashmir located at 1584 m a. s. l. The fish is an illiophagic omnivore in the lake and all the size groups above one year of age showed appreciable quantities of decaying organic matter in their gut contents. Macrophytic tissues formed the most important plant food of the fish, while crustaceans, insects and fish remains contributed to the animal component of the food.

Keywords: Mirror carp, Manasbal lake, illiophagic omnivore

INTRODUCTION

Manasbal Lake (area 280 ha; maximum depth 12.5 m) is a semi-drainage type water body of Kashmir situated at 1584 m at 70° 40' E and 34° ,15' N. The lake is infested with macrophytes for the most part of its area. More than a dozen fish species have been reported from this water body (Yousuf, 1996; Enderlein and Yousuf, 1999; Kullander *et al.*, 1999) out of which *Schizothorax niger* Heckel, *Cyprinus carpio communis* (Linn.), *C. c. specularis* (Linn.), *Bangana diplostoma* (Heckel) and *Carassius carassius* (Linn.) are commercially important. A detailed round the year study was conducted on the food spectrum of the commercially important fishes of the lake. The present article discusses the changes in the food spectrum of *C. c. specularis* (Linnaeus) in the lake.

MATERIAL AND METHODS

Random samples were procured from the fishermen soon after the catches were brought to the landing centres. Each fish was immediately eviscerated after

weighing to avoid digestion of foodstuff and the viscera was preserved in 4% formalin for further examination in the laboratory.

The gut contents were scrutinized qualitatively as well as quantitatively. The food items were identified up to the generic level with the help of standard taxonomic works in the field (Smith, 1950; Edmondson, 1959; Pennak, 1978) and then expressed in terms of percentage volume and percentage occurrence to assess their importance by the Index of Preponderance in accordance with Natarajan and Jhingran (1961). The volume of the food items was estimated from direct measurements using the formula given by Vollenweider (1974) and Downing and Riglar (1984). The volume of macro-organisms like arthropods, molluscs and fish was obtained by the displacement method. For phytoplankton the volumes of different taxa given by Wanganeo and Wanganeo (1991) were also utilized. In the occurrence method the number of guts containing a particular food item were expressed as a percentage of the total number of guts examined (Hynes, 1950).

RESULTS

A detailed study of gut contents of the mirror carp revealed large quantities of detritus throughout the year, with a range of 36.96% in May – 74.02% in February (Fig. 1). All the six age groups encountered and examined during the study were observed to contain generally more than 50% by volume of decaying organic matter in their guts. The highest proportion of detritus (77.83%) was recorded in VI – year age group (Table 1). No appreciable differences were recorded in the food preferences of the fish with increasing age (Table 2).

Apart from detritus the foodstuff included plant and animal tissues. The plant food formed about 15.05% of the total gut contents of the fish. Macrophytic tissues were the main contributors of the plant food with a mean contribution of 14.46% by the index of preponderance (range 2.00 % by volume in January to 43.77% in May). Main contributors of the macrophytic tissues were *Ceratophyllum*, *Myriophyllum* and *Potamogeton*. The role of algae was very limited, contributing on an average only 0.59% of the food by volume. Among the various algal groups Bacillariophyceae was the most dominant and formed on an average about 0.46% of the foodstuff. Most frequently occurring diatoms encountered in the gut contents included *Cymbella*, *Fragillaria*, *Cymatopleura*, *Navicula*, *Gomphonema*, *Synedra*, *Pinnularia*, *Surirella*,

etc. Cyanophyceae was represented by *Aphanocapsa, Coelospaerium, Arthrospira, Lyngbya, Microcystis, Oscillatoria*, etc. and constituted only about 0.02% of the food

Table 1. Index of Preponderance of various food items in *C. c. specularis*

S. No.	Food item	Occurrence (%)	Volume (%)	Index of Preponderance	Rank
1.	Chydorids	8.888	3.981	3.84	IV
2.	Copepods	8.352	6.164	5.59	III
3.	Insects	9.565	3.752	2.86	V
4.	Fish remains	6.829	2.451	1.82	VI
5.	Mollusc remains	4.981	0.389	0.21	VIII
6.	Algae	25.056	0.631	0.59	VII
7.	Macrophytic tissue	7.952	16.76	14.46	II
8.	Detritus	9.977	62.063	67.20	I
9.	Unidentified	8.27	3.682	3.30	
10.	Miscellaneous	9.13	0.127	0.13	

contents. Chlorophyceae formed about 0.11% of the gut contents and was represented by *Cosmarium, Closterium, Coelastrum, Desmidium, Oedogonium, Staurastrum*, etc.

The animal food contributed on an average 14.32% of the gut contents. Copepoda was the most dominant component, forming about 5.59% of the gut contents. Its contribution fluctuated between 0.13% in October and 17.95% in June. However, the group was completely absent from the gut contents in December. The

most frequently observed copepods included *Acanthodiaptomus denticornis, Mesocyclops leuckarti, Cyclops vicinus, Canthocamptus* sp., etc. Cladocera (mainly Chydoridae) ranked fourth in the food as per the index of preponderance and contributed on an average 3.84% of the food material. The range of contribution of the group varied from 0.08% in November to 8.51% in April. Chief contributors were *Graptoleberis testudinaria, Camptocercus* sp., *Chydorus sphaericus, Alona rectangula, Alonella exigua, Pleuroxus similis*, etc.

Table 2. Percentage composition of food by volume in various age groups of *C. c. specularis*.

		← Age Group →					
S. No.	Food items	1+year	2+year	3+year	4+year	5+year	6+year
1.	**Cladocera**	3.64	6.13	3.10	2.72	9.61	0.71
2.	Copepoda	7.08	10.37	5.72	0.36	1.28	6.42
3.	Insect remains	7.42	3.30	6.23	-	0.15	3.00
4.	Fish remains	1.54	2.19	3.27	3.55	2.40	-
5.	Mollusc remains	1.49	-	0.06	-	0.21	12.03
6.	Algae	0.17	1.53	0.27	0.19	0.98	-
7.	Macrophtic tissue	16.13	16.60	19.52	27.10	31.12	-
8.	Detritus	63.17	57.06	61.78	66.10	54.18	77.83
9.	Miscellaneous	0.36	2.81	-	-	0.07	-

Adult and larval insect parts formed 2.8% of the food on an annual basis. The peak contribution (12.77%) of the group was recorded in March, while the least contribution was in October (0.26%). Fish remains constituted on an average about 1.82% of the gut contents, while molluscan remains formed about 0.21%. Both these food items were not encountered in some months. Protozoans, rotifers, planarians and ostracods were observed only occasionally.

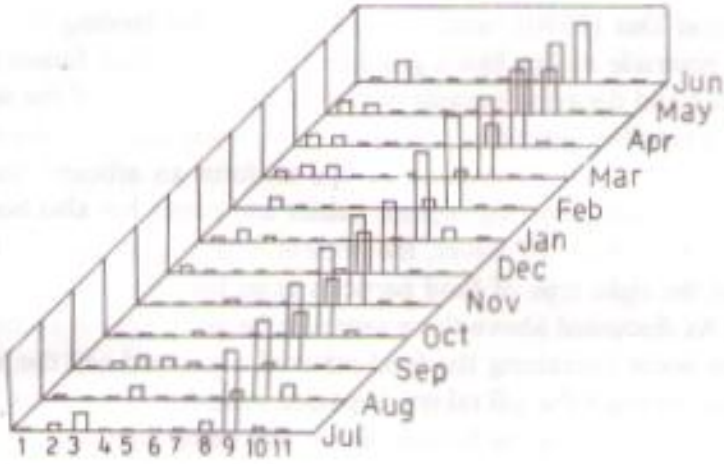

Fig. 1. Monthly changes in the food spectrum of *C. c. specularis* in Lake Manasbal, Kashmir. 1 = Cladocera; 2 = Copepoda; 3 = Insect remains; 4 = Fish remains; 5 = Mollusc remains; 6 = Insect larvae; 7 = Algae; 8 = Macrophytic tissue; 9 = Detritus; 10 = Unidentified matter; 11 = Miscellaneous.

DISCUSSION

On the basis of their importance in the diet, Nikolskii (1963) has recognized three categories of food in fishes – basic, secondary and incidental. When this classification is applied to the food spectrum of *Cyprinus carpio specularis* (Linnaeus) inhabiting Manasbal Lake, it appears that macrophytic tissues among plants and crustaceans, insects and fish remains among the animals constitute the

basic food of the fish. Since most of these food items are associated with the bottom, the fish engulfs large quantities of detritus along with the food items. Since it is not able to separate its choicest food items from the engulfed material everything retained in the pharyngeal cavity, after straining the whole with the help of gill rakers, is pushed down into the digestive tube. Algae and mollusc remains form the secondary food, while smaller animals like protozoans, planarians, rotifers etc. contribute to the incidental food of the fish.

Subla and Das (1970), while commenting on the feeding habits of this fish, reported it to protrude its lips like a grubber forming a suction funnel through which it takes in pedon and decaying organic matter from the bottom of the waterbody. The presence of appreciable quantities of detritus in the gut contents during the present study confirms their view. Protrusion of lips to form an efficient suction tube for sucking mud containing decaying organic matter and plants has also been reported by Fotedar and Qadri (1974). However, the present data do not support their view that the fish selects the right type of food particles in its buccal cavity and strains out the rejected part. As discussed above there seems to be no selection in the buccal cavity except that the water containing the food material is strained and the material, which is unable to pass through the gill rakers, is passed onto the oesophagus. However, it is possible that the fish scoops the bottom debris and water particularly at those places where its choicest food is available in good quantities. This is supported by the data of May and June when the gut contents include a good proportion of crustaceans and macrophytic tissues in addition to detritus. This is the period when rotifers are reported to have peak density in the lake (Yousuf and Qadri, 1981). However, as these animalcules are of very small size they are probably easily strained out through the gill rakers and are hence observed in the gut contents only in negligible quantities.

Subla and Das (1970), Jan and Das (1971), Fotedar and Qadri (1974) and Sunder *et al.* (1984) have categorized this fish as benthophagic / illiophagic herbivore, feeding voraciously on dead organic matter and micro- and macrophytes. The present study however, shows that the plant and the animal matter have almost equal importance in the food of the fish, as the values of index of preponderance for the two items are 15.05 and 14.32 respectively. This clearly shows that the animal matter cannot be treated as being of incidental nature and, therefore, the fish conforms to the illiophagic / benthophagic omnivorous category in the lake. The

omnivorous nature of the fish has earlier been reported by Al-Hussainy (1949). Spataru *et. al.* (1980) and Meijer *et. al.* (1990) have also reported significant proportion of zoobenthos in the gut contents of this species. So far as the importance of various plant and animal food items is concerned, it was noticed that macrophytes and crustaceans (especially chydorids and copepods) seem to be the choicest dietary items of the fish. The fish preferred these items to all others, when available. This is quite evident from the data of May and June. During this period the crustaceans record their peak population in the lake (Yousuf and Qadri, 1985) and the macrophytes are also in their bloom. Because of easy availability of crustaceans and macrophytic tissue the intake of detritus recorded an appreciable decrease in the gut contents at this time of the year.

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REFERENCES

Al-Hussainy, A. H. 1949. On the functional morphology of the alimentary canal of some fish in relation to differences in their feeding habits. Anatomy and Histology. *Quart. J. Micr. Sci.* **90**(2): 109 – 139.

Downing, J. A. and Riglar, F. H. 1984. *A Manual on Methods for the Assessment of Secondary Productivity of Freshwaters*. IBP Hand Book No. 17, Blackwell Sci. Pub. London.

Edmondson, W. T. 1959. *Freshwater Biology*. John Wiley & Sons, N. Y.

Fotedar, D. N. and Qadri, M. Y. 1974. Fish and Fisheries of Kashmir and the impact of carp, *Cyprinus carpio*, on the endemic fishes. *J. Sci. Uni. Kash.*, **2**: 79 – 89.

Hynes, H. N. B. 1950. The food of freshwater sticklebacks (*Gastereosteus aculeatus* and *Pygosteus pungitius*) with a review of the methods used in the studies of the food of fishes. *J. Animal Ecol.* **19**: 36 – 58.

Jan, N. A. and Das, S. M. 1971. Studies on the food and seasonal variation in four fishes of Kashmir valley. *Kashmir Sci.* **8**: 102 – 107.

Meijer, M. L., Lammens, E. H. R. R., Raat, A. J. P., Grimm, M. P. and Hosper, S. H. 1990. Impact of cyprinids on zooplankton and algae in ten drainable ponds. *Hydrobiol.* **191**:275 – 284.

Natarajan, A. V. and Jhingran, A. G. 1961. Index of Preponderance – a method of grading the food elements in the stomach analysis of fishes. *Indian J. Fish.* **8**: 54 – 59.

Nikolskii, G. V. 1963. *The Ecology of Fishes.* Academic Press, London.

Pennak, R. W. 1978. *Freshwater Invertebrates of United States.* John Wiley & Sons, London.

Smith, G. M. 1950. *Feshwater Algae of United States.* McGraw Hill Book Co., N. Y.

Spataru, P., Hepher, B. and Halevy, A. 1980. The effect of the method of supplementary feed application on the feeding habits of carp (*Cyprinus carpio* L.) with regard to natural food in ponds. *Hydrobiol.* **72**: 171 – 178.

Subla, B. A. and Das, S. M. 1970. Studies on the feeding habits, the food and the seasonal fluctuations in feeding in nine Kashmir fishes. *Kashmir Sci.* **7**: 25 – 44.

Sunder, S., Kumar, K. and Raina, H. S. 1984. Food and feeding habits and length-weight relationship of *Cyprinus carpio specularuis* Linnaeus of Dal Lake, Kashmir. *Indian J. Fish.* **31**: 90 – 99.

Wanganeo, A and Wanganeo, R. 1991. Algal population in valley lakes of Kashmir Himalaya. *Arch. Hydrobiol.* **12**: 219 –233.

Yousuf, A. R.and Qadri, M. Y. 1981. Seasonal abundance of Rotifera in a warm monomictic Lake. *J. Indian Inst. Sci.* **63**: 23 - 34.

Yousuf, A. R. and Qadri, M. Y. 1985. Seasonal fluctuations of zooplankton in Lake Manasbal. *Indian J. Ecol.* **12**: 354 – 359.