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RESEARCH ARTICLE

DIET COMPOSITION, FEEDING INTENSITY, GASTROSOMATIC INDEX AND HEPATOSOMATIC INDEX OF A CATFISH, MYSTUS CAVASIUS FROM CHAMBAL RIVER (NEAR, RAJGHAT) MORENA, MADHYA PRADESH

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ABSTRACT

The diet composition, feeding intensity, gastrosomatic index and hepatosomatic index of the catfish, *Mystus cavasius* were studied for a period of one year i.e., from September, 2011 to August, 2012. The catfish, *M. cavasius* was feeding on the food material of plant origin as well as animal origin. The food material of plant origin i.e., phytoplankton belonging to Cyanophyceae, Chlorophyceae, Euglenophyceae and Bacillariophyceae. The animal material i.e, zooplankton belonging to Protozoa, Rotifera, Cladocera and Copepoda, insects, parts of insects and insect larvae belonging to Diptera, Trichoptera, Coleoptera and Hemiptera. The diet consisted of a broad spectrum of food items but phytoplanktonic group, Bacillariophyceae were the dominant constituting (28.02 %) followed by Cyanophyceae (16.87 %), Chlorophyceae (7.93 %) and Euglenophyceae (5.38 %). Among the macroinvertebtrates, insects and parts of insects were 8.77 % and insects larvae belonging to Diptera with 6.34 %, Trichoptera with 4.93%, mollusca with 3.80 %, Coleoptera (3.41%) Hemiptera (0.97%) and round worms (0.80 %) were in decreasing order whereas, amongst zooplankton, Copepoda were 8.08 % followed by Protozoa 1.85 %, Cladocera were 0.54 % and rotifer were 0.20 % had occupied successive positions. The mean percentage contribution of miscellaneous food group was (2.07 %). This fish has been categorised as eury-omnivorous fish. A pronounced high feeding intensity was recorded during December and January, when the gastrosomatic index was 5.40±0.15 and 5.43±0.10 respectively and stomachs were full and contained good amount of food while the feeding intensity was generally low during June, the gastrosomatic index (2.97±0.47). Four empty out of six stomachs were observed in the month of June. The highest hepatosomatic index value of *M. cavasius* was obtained in December as 3.55±0.17, while the lowest value was recorded in June (1.87±0.39). Gastrosomatic and hepatosomatic indices indicate clearly the feeding intensity and digestive capability of fish respectively.

INTRODUCTION

Like any other organisms, fish also depend on the energy received from its food to perform biological activities such as growth, development, reproduction and other metabolic activities. Hence, food is the basic requirement of all individual fish as well as the fish population. Feeding is one of the main concern of daily living in fishes and they devote a large portion of their energy searching for food. The diet, feeding ecology and trophic interrelationship of fishes is fundamental issue for better understanding of fish life history including growth, breeding, migration and the functional role of the different fishes within aquatic ecosystem. Food plays an important role in determining the population levels, rate of growth and condition of fishes. Food and feeding habits of fishes have a great significance in aquacultural practice. Schaperclaus (1933) has classified the natural food of fishes under four groups i.e.; (a) main food or natural food which the fishes prefer under favorable condition and on which they thrive best, (b) secondary food is consumed by the fish when available, (c) incidental food enters the gut of fishes by chance with other items, and is rarely seen in the gut, (d) emergency and obligatory food is ingested by fishes in order to survive under unfavorable conditions when the natural or basic food is not available. Natural fish food may be broadly divided into four categories viz., (a) plankton (b) nekton, (c) benthos and (d) detritus. Fishes are also classified according to the amount of variations in the types of food eaten by them (Nikolsky, 1963). Accordingly, fishes are either (1) euryphagic (feeding on a wide range of food items) or (2) stenophagic (feeding on a few different types of food items), and (3) monophagic (feeding on only a single food item). Feeding intensity refers to the degree of feeding as indicated by the relative fullness of stomach. It varies along with the seasonal variation, availability of preferred food items, maturity stage of the fish and spawning season of the species. The feeding intensity of mature fish decreases during the spawning period, as compared to the non-spawning period. The feeding intensity of a fish can be determined by gastrosomatic index. Recent work on food and feeding habits of fish has done by several workers viz., Begum *et al.* (2008), Emmanuel and Ajibola (2010), Parihar and Saksena (2010), Arthi *et al.* (2011), Masdeu *et al.* (2011), Saikia *et al.* (2012), Priyadarsini *et al.* (2012), Dutta *et al.* (2013) and Mushahida-Al-Noor *et al.* (2013).

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MATERIALS AND METHODS

Study Area

A 600 Km stretch of Chambal River has been protected as the National Chambal Sanctuary. Chambal River, a principal tributary of river Yamuna, originates in the Vindhyan hill range near Mhow in Indore District in Madhya Pradesh and joins the Yamuna River Etawah at Pachnada near Bareh in Uttar Pradesh to form the greater Gangetic drainage system. Geographically, the Chambal National Sanctuary lies between 24^0 55' and 26^0 50' N latitude and $75^0$34' degree $79^0$18' E longitudes**.** Rajghat is located in Morena District and situated along the banks of Chambal River around the Road Bridge and railway bridge on Morena-Dholpur section.

Collection of the fish Samples

Specimens of *M. cavasius* were collected from Chambal River near Rajghat, Morena in the last week of every month by using cast net with the help of fisherman. The female specimens of 14.71 ± 0.21 cm in total length and 56.31 ± 0.92 gm in total weight were used for the study. The fish specimen was dissected out and the gut was stretched out and removed from adhering viscera and mesentries by using brush and blunt foreceps to prevent injury to the gut. The stomachs were detached from the gut and weight of stomach was recorded and it was preserved in 4 % formalin. Further the stomachs were dissected to collect its contents present in it. The contents were collected in a glass vial making up the volume to 1 ml to determine different food items eaten by the fish both qualitatively and quantitatively. The stomach contents were analyzed by following the method percent numerical count method by Hynes (1950) and Hyslop (1980). Gastrosomatic index and hepatosomatic index were estimated by using formulae:

Gastrosomatic index = $\frac{\text{Weight of the stomach}}{\text{Weight of the fish}} \times 100$

Hepatosomatic index = $\frac{\text{Weight of the liver}}{\text{Weight of the fish}} \times 100$

RESULTS

Results of the stomach contents analysis of catfish, *M. cavasius* has been based on the methods i.e., percentage numerical count method. The qualitative analysis of the gut contents revealed that the phytoplanktonic groups belonging to Cyanophyceae, Chlorophyceae, Euglenophyceae and Bacillariophyceae are present (table1).

Table 1 Phytoplanktonic forms occurring in the stomach of *M.cavasius*

S.No.	Groups	Phytoplanktonic Species
1.	Cyanophyceae	*Microcystis aeruginosa , Merismopedia glauca, M. tenuissima, Oscillatoria princeps, O. curviceps, Anabaena Sp.,*
2.	Chlorophyceae	*Schroederia setigera, Pediastrum simplex, Spirogyra Sp., Zygnema Sp., Genicularia Sp., Closterium Sp., Cosmarium Sp., Sorastrum spinulosum*
3.	Euglenophyceae	*Euglena acus, E. proxima, E. polymorpha, Phacus Sp.*
4.	Bacillariophyceae	*Navicula Sp., Gomphonema Sp., Cymbella Sp., Melosira Sp., Pinnularia Sp., Diatoma vulgare*

The animal material includes zooplankton belonging to Protozoa, Rotifera, Cladocera and Copepoda, round worms, insects, parts of insects and insects' larvae belonging to Diptera, Trichoptera, Coleoptera and Hemiptera and mollusc (table 2). Percentage numerical count exhibited the plant material (phytoplankton) including, Bacillatiophyceae which was the dominant group contributing (28.13 %) followed by Cyanophyceae with 16.39 %, Chlorophyceae with 7.68 % and Euglenophyceae with 5.28 % followed the dominant group (table 3).

Table 2 Animal material occurring in the stomach of *M.cavasius*

S. No.	Animal material	Species
1	Zooplankton	
A	Protozoa	*Arcella discoides*
B	Rotifera	*Brachionus Sp.*
C	Cladocera	*Bosmina longisrostris*
D	Copepoda	*Mesocyclops Sp., Thermocyclops Sp., Phyllodiptomus blanci, Nauplius larvae,*
2.	Macroinvertebrates	
A	Round worms	
B	Insects and their larvae	Diptera, Trichoptera, Hemiptera, Coleoptera, insects parts
C	Mollusca	Bivalves

Among the food organisms the next group after the phytoplankton was insects, parts of insects and insects' larvae. The insect parts encountered their highest percentage 9.02% which was followed by insect larvae belonging to Diptera of about 6.51 %, Trichoptera with 4.79 %, Coleoptera with 3.52 %, Hemiptera with 0.82 %. Mollusca under macroinvertebrates contributed 4.16 % and roundworms contributed minimum percentage among macroinvertebrates 1.06 % (table 3).

Table 3 Mean contributions of different food items on the basis of the percentage numerical count method

S.N o	Food items	Mean contribution of food items
A	Plant material	
1.	Phytoplankton	
A	Cyanophyceae	16.39
B	Chlorophyceae	7.68
C	Euglenophyceae	5.28
D	Bacillariophyceae	28.13
B	Animal material	
1	Zooplankton	
A	Protozoa	2.03
B	Rotifera	0.20
C	Cladocera	0.39
D	Copepoda	7.47
2	Macro invertebrates	
A	Roundworms	1.06
B	Insects and larvae	
1	Diptera	6.51
2	Trichoptera	4.79
3	Coleoptera	3.52
4	Hemiptera	0.82
5	Insect parts	9.02
C	Mollusca	4.16
C.	Miscellaneous	2.44

Table 4 Seasonal variation in percentage numerical count of food items present in the gut of *M. cavasius*

S.No	Food items	Sept	Oct	Nov	Dec	Jan	Feb	Marc	Apr	May	Jun	Jul	Aug
A	Plant material												
1	Phytoplankton												
A	Cyanophyceae	21.01	19.12	17.8	22.37	15.43	17.37	15.16	12.41	19.85	7.47	16.39	12.32
B	Chlorophyceae	9.97	10.55	10.61	4.91	7.71	9.45	8.55	7.15	7.28	5.6	4.5	5.88
C	Euglenophyceae	9.12	8.36	5.75	4.57	4.45	6.17	4.8	2.14	5.46	3.73	4.09	4.76
D	Bacillariophyceae	29.33	25.29	26.97	28.47	28.48	28.76	28.07	28.87	25.68	24.29	31.14	31.65
B	Animal material												
1	Zooplankton												
A	Protozoa	0.42	2.10	0.89	2.2	1.92	0	1.65	2.14	1.63	3.73	2.86	4.76
B	Rotifer a	0	0.35	0	0	0	0	0.6	0	0.54	0.93	0	0
C	Cladocera	0	0	0.53	0.16	0.44	0	0	1.43	1.27	0.93	0	0
D	Copepoda	6.15	7.17	9.35	9.33	12.46	5.79	12.16	9.78	4.91	2.8	4.5	5.32
2.	Macro invertebrates												
1	Roundworms	2.33	0	0	0	0	0	0	0	2.0	2.8	3.68	1.96
2	Insects and larvae												
A	Diptera	5.94	6.37	6.29	5.76	5.19	5.98	6.45	8.4	6.37	5.6	8.6	7.56
B	Trichoptera	4.45	4.58	5.03	5.25	5.63	5.4	4.8	5.01	5.46	3.73	4.5	3.64
C	Coleoptera	0	1.39	3.05	4.74	1.78	3.66	4.35	3.1	5.1	5.6	3.68	5.88
D	Hemiptera	0	2.58	2.51	0	2.37	1.73	0.75	0	0	0	0	0
E	Insect parts	4.03	6.97	6.65	8.13	8.6	10.03	8.4	13.57	9.1	15.88	6.96	10.92
3	Mollusca	2.97	2.39	3.23	2.2	4.15	3.47	2.85	5.01	2.91	12.14	5.32	3.36
C	Miscellaneous	3.6	2.58	1.25	1.86	1.33	2.12	1.35	2.62	2.36	4.67	3.68	1.96

Table 5 Mean annual contribution of total number of food items present in gut of *M. cavasius* from September 2011- August 2012

S. No.	Food items	Mean contribution of food items	Percentage of mean contribution of food items
A	Plant material		
1	Phytoplankton		
A	Cyanophyceae	13.73	16.87
B	Chlorophyceae	6.46	7.93
C	Euglenophyceae	4.38	5.38
D	Bacillariophyceae	22.80	28.02
B	Animal material		
1	Zooplankton		
A	Protozoa	1.51	1.85
B	Rotifera	0.16	0.20
c	Cladocera	0.44	0.54
D	Copepoda	6.58	8.08
2	Macro invertebrates		
a	Roundworms	0.65	0.80
b	Insectsand larvae		
1	Diptera	5.16	6.34
2	Trichoptera	3.98	4.90
3	Coleoptera	2.78	3.41
4	Hemiptera	0.79	0.97
5	Insect parts	7.14	8.77
c	Mollusca	3.09	3.80
C	Miscellaneous	1.69	2.07

Table 6 Mean contributions of Gastrosomatic index and Hepatosomatic index of a *Mystus cavasius* from September, 2011 to August, 2012

S.No	Months	Gastrosomatic index	Hepatosomatic index
1	September, 2011	4.10±0.08	2.73±0.08
2	October	4.65±0.07	2.71±0.13
3	November	4.97±0.11	2.99±0.13
4	December	5.40±0.15	3.55±0.17
5	January, 2012	5.43±0.10	2.82±0.26
6	February	4.56±0.17	2.59±0.03
7	March	4.81±0.08	3.22±0.24
8	April	4.95±0.11	2.87±0.08
9	May	4.62±0.08	2.72±0.12
10	June	2.97±0.47	1.87±0.39
11	July	4.22±0.22	2.62±0.17
12	August	4.06±0.18	2.01±0.18

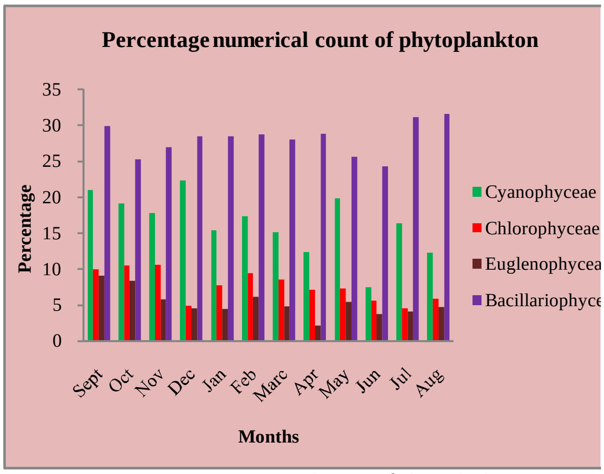

Fig. 1 Percentage numerical count of phytoplankton

Zooplankton belonging to the members of Protozoa, Rotifera, Cladocera and Copepoda. The Copepoda was dominant zooplanktonic group encountered (7.47 %) which was followed by Protozoa with (2.03 %), Cladocera (with 0.39 %) and rotifera (with 0.20 %) was observed as the least contributing food group (table 3). The miscellaneous food items (remained unidentified) contributed of about 2.44 % of the total food groups.

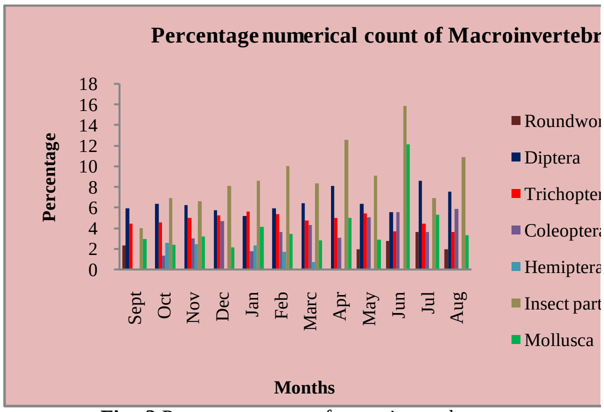

Fig. 2 Percentage count of macroinvertebrates

The fish has been categorised as eury-omnivorous as it feeds on wide range of diet including both the vegetable as well as animal diet.Seasonal variation occurred in the number of different food items in different months. It was due to abundance and deficiency of particular food items in different months, the numerical count of individual food item were different. These variations are because of variations in physic-chemical factors of the habitat.

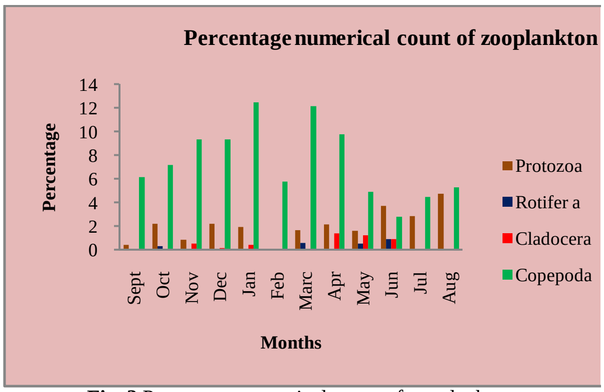

Fig. 3 Percentage numerical count of zooplankton

The results indicates that in plant material i.e., phytoplankton viz., Bacillariophyceae was found maximum during (31.65%, in August) followed by Cyanophyceae (22.37 %, in December), Chlorophyceae (10.61, % in November) and Euglenophyceae (9.12%, in September) among plant material has been shown in table 4 and fig.1, while animal material are macroinvertebrates including insects and their parts are maximum (15.88 % in June) are followed by molluscs (12.14 % in June).

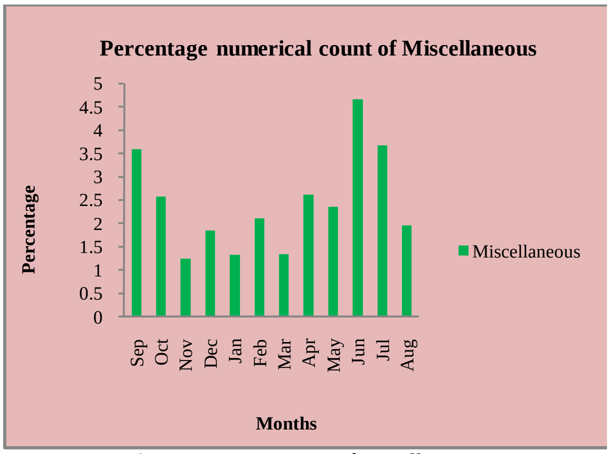

Fig. 4 Percentage count of miscellaneous

The insect larvae belonging to Diptera contribute a maximum percentage (8.60 %) in July, Coleoptera (5.88%) in August), Trichoptera (5.63 %) in January, and Hemiptera have been observed in the months of October, November, January, February, and March with maximum percent count (2.58 %) in October. The round worms have also been observed in few months viz., September, May, June, July and August with maximum percentage numerical counts (3.68 %) in July has been shown in table 4 and figure 2.

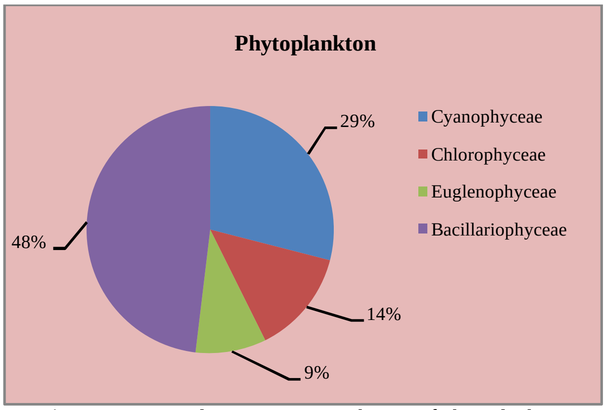

Fig. 5 Mean annual percentage contribution of phytoplankton

Zooplankton belonging to Copepoda (12.46%, in January), Protozoa (4.85% in August), Cladocera (1.74%, in August) and Rotifera (0.93 %, in June) ranked next to the macroinvertebrates (table 4 and fig.3). The miscellaneous group of food items were encountered with their maximum percentage counts as 4.67 % in June (table 4 and fig. 4). During one year study, the mean percentage contribution of all food items also indicate that among all the food groups present in the gut of *M. cavasius*, Bacillariophyceae algae was found to be most dominant food item by their mean contribution (28.02 %) followed by Cyanophyceae (16.87 %), Chlorophyceae (7.93 %) and Euglenophyceae (5.38 %) has been shown in table 5 and fig. 5.

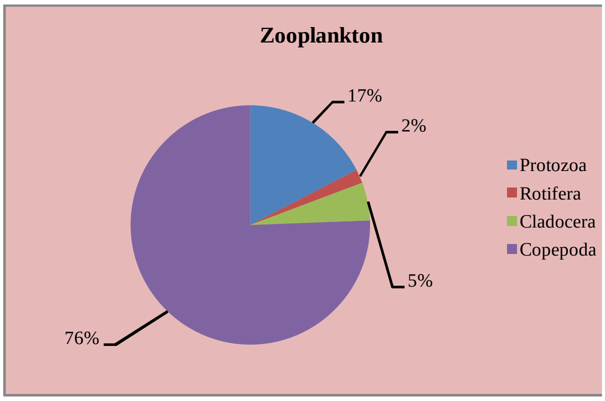

Fig. 6 Mean annual percentage contribution of zooplankton

Among the macroinvertebtrates, insects and parts of insects were 8.77 % and insects larvae belonging to Diptera with 6.34 %, Trichoptera with 4.93%, mollusca with 3.80 %, Coleoptera (3.41%) Hemiptera (0.97%) and round worms (0.80 %) were in decreasing order (table 5 and figure 7) whereas, amongst zooplankton, Copepoda were 8.08 % followed by Protozoa 1.85 %, Cladocera were 0.54 % and rotifer were 0.20 % had occupied the successive positions (table 5 and fig. 6). The percentage mean contribution of miscellaneous food group was (2.07 %) among the total food items (table 5 and fig 7).

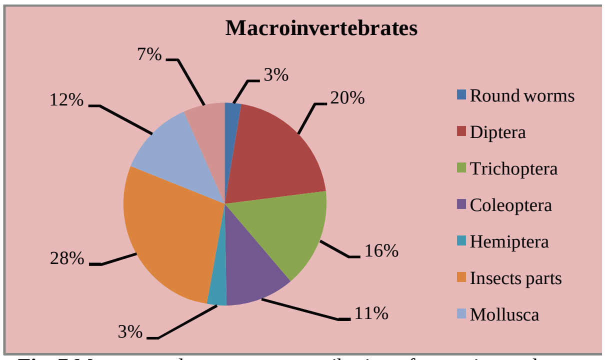

Fig. 7 Mean annual percentage contribution of macroinvertebrates and miscellaneous

Gastrosomatic index

The gastrosomatic index is related to feeding intensity of fish. The feeding intensity means the fullness of stomach. The pronounced high feeding intensity during December and January was observed when the gastrosomatic index were 5.40±0.15 and 5.43±0.10 respectively and stomachs were full and contained good amount of food, while the feeding intensity was generally low during June 2.97±0.47 when stomachs were foodless and contained poor amount of food. The feeding intensity was improved after spawning period is over. The gastrosomatic index was recorded maximum as 5.43±0.10 in January while the minimum value was observed as 2.97±0.47 in June (table 6 and fig. 8). The availability of food items was good in winters so there was maximum gastrosomatic index was observed in December and January, while in summer due to high temperature condition there was some depletion in occurrence of food groups. Maximum number of stomachs were observed empty in the month of June which happens to be peak maturity period of the gonads of the fish.

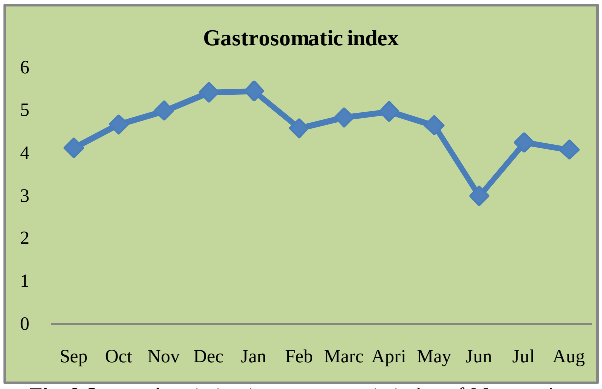

Fig. 8 Seasonal variation in gastrosomatic index of *M. cavasius*

Hepatosomatic index

Hepatosomatic index has been considered to assess the activity of liver. The range of variation in the value of hepatosomatic index of *M. cavasius* was from 1.87±0.39 to 3.55±0.17 (table 6). The highest hepatosomatic index of *M. cavasius* was obtained in December (3.55±0.17), while the lowest was recorded in June (1.87±0.39). There were variation in the hepatosomatic index value on the monthly basis and also seasonally (table 6 and fig. 9).

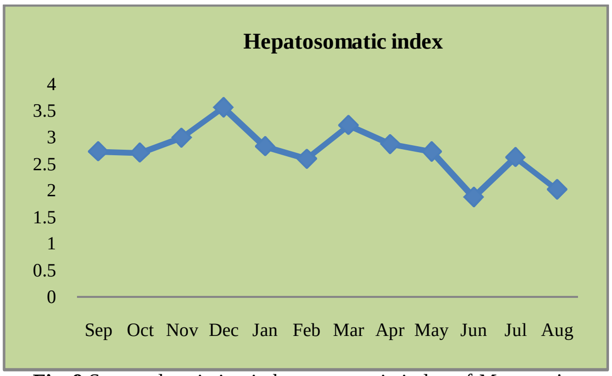

Fig. 9 Seasonal variation in hepatosomatic index of *M. cavasius*

DISCUSSION

The gut contents of *M. cavasius* were analysed on the basis by percentage numerical count method. According to the character of diet, adult fish have been classified into herbivores, if they feed on vegetable matter, carnivore, if their food comprise of animal matter, and omnivore if they subsist on mixed diet comprised of both vegetable as well as animal food. From our observations on the gut contents of *M. cavasius*, it can be concluded that this fish is a eury-omnivorous, feeding on wide range of food items i.e., phytoplankton, zooplankton, insects, their larvae and their parts, roundworms and molluscans. Insects, their larvae and parts and mollusca contribute the major portion of their food on the basis of biomass. The results obtained from percentage count stated that the plant material contributes the maximum percentage of its diet followed by insects and their larvae and insect parts. Similar food and feeding habits have been described by Abbas (2010), Arthi (2011), Masdeu *et al.* (2011), Uwem *et al.* (2011), Kanwal and Pathani (2012) and Agbabiaka (2012).

Pathak (1975) has classified the *Labeo calbasu* as an omnivorous fish. According to the study of Ayinla (1988) has found that catfish, *Clarias gariepinus* was an omnivore feeds on phytoplankton, insects, insect larvae and pupae, fish and fish remains with preference for plankton diet. According to Oso *et al.* (2006), the *Oreochromis niloticus* and *Sarotherodon galilaeus* both were omnivorous species feeding on Spirogyra, detritus, sand grains and insect parts and occupy the same ecological niche. *Gerres oblongus* was an omnivorous fish having preference for animal diet over vegetable material (Abyerami and Sivashanthini, 2008). *Mystus gulio* have been classified as euryphagus and omnivorous in food habits (Begum et al., 2008). Hanjavanit and Sangpradub (2009) observed that Barbonymus altus, Notopterus notopterus and Ompok bimaculatus were feeding on phytoplankton, zooplankton, insects and miscellaneous food items hence come under the category of omnivorous. Arthi (2011) studied that two freshwater fishes, *Ompok bimaculatus* and *O. malabaricus* were found to be omnivorous in habit, feeding mainly on vegetable matter and fish, which dominated the list with 30.04%. Agbabiaka (2012) observed that *Tilapia zilli* is an omnivorous fish with dietary preference for Algae. This observation has revealed the fact that food items eaten by the fish is dependent on food items available in the habitat and feeding intensity of fish. The present study has suggested that *M. cavasius* is a eury-omnivore in its feeding habit and capable of feeding on food items of both plant and animal material with the numerical preference for the phytoplankton. However, on the basis of the biomass of the food items accounted in the gut of this fish, is inclined towards the carnivorous in feeding habit.

Feeding intensity refers to the degree of feeding as indicated by the relative fullness of stomach. It varies along with the seasons, availability of preferred food items, maturity stage of the fish and spawning season of the species. The gastrosomatic index of *M. cavasius* exhibits variations in different months of the study. The feeding intensity of the fish was observed maximum during December and January when the availability of various food items in the habitat is good while low feeding intensity or the low gastrosomatic index was observed in the month of the June which was the peak maturity period of the gonads. The feeding intensity was reduced gradually since June but was never discontinued. The occurrence of four empty stomachs was observed in the month of June out of the six is feeding very much less during this month. The feeding intensity or the gastrosomatic index of the fish was studied by many workers in different species of the fish. *Ompok bimaculatus* and *O. malabaricus* show low feeding intensity during August and June may not be due to shortage of food items but due to the spawning season of the fish (Arthi *et al.*, 2011). The low feeding intensity was observed in *Tilapia Sp.* during February to June which was associated with the higher fecundity rendered by the replenished supply of the water produced by heavy rain fall was reported by Dewan and Saha (1979). The observations from our study revealed that the gastrosomatic index of *M. cavasius* varied from 4.10 to 5.43 from different months. The gastrosomatic index of fish is closely related to fullness and emptiness of the stomach. The gastrosomatic index (5.43) was high in January when feeding intensity was maximum. The feeding intensity was high during October to February and it was lesser during June to September. The feeding intensity of *M. cavasius* was high during October to February, when the growth of fish food organisms in an environment is good and it was non reproductive period of fish. A similar observation was found in *Tilapia* species show low feeding intensity during February to June (Dewan and Saha, 1979). The same results were reported by Mathialagan and Sivakumar (2012) and Dutta *et al.* (2013). Mushahida-Al-Noor *et al.* (2013) have also observed the maximum number of empty stomachs was in the month of June in *Rita rita.*

Low hepatic activity was measured by hepatosomatic index of Roach, *Rutilus rutilus*, Bleak, *Alburnus alburnus* and Whitebream, *Blicca bjoerkna* was observed minimum prior to the spawning season of the fish (Rinchard and Kestemont, 2003). In our observations have shown that highest value of the hepatosomatic index of the fish species was observed (3.55±0.17) during December, and it was minimum (1.87 ±0.39) in June. From the above observations, it may be said that the hepatosomatic index was maximum during the active feeding of the fish while it was observed minimum during low feeding activity of this fish species. Similar results have been described by Kingdom and Allison (2011), Ghaffari *et al*, (2011) and Sadekarpawar and Parikh (2013). The present study on freshwater catfish, *M. cavasius* shows a high hepatic activity during December (preparatory period) while low hepatic activity during spawning season.

CONCLUSION

The study on the gut contents of *M.cavasius* was based on percentage numerical count of food items suggested that *M.cavasius* feeds on material of plant origin as well as animal origin. Numerically it is largely dependent on the phytoplankton. Animal material including insects, parts of insects and insects larvae were equally preferred by the fish. If we look into the food on the basis of biomass, the animal material is in high proportion. Thus, on the basis of analysis it may be pointed out that *M.cavasius* is an omnivorous fish. However on the basis of the biomass of the food items *M.cavasius* can be easily placed under a category of carnivorous fish. The feeding intensity of the fish was varied in different seasons as the gastrosomatic index of fish was observed to be maximum during winter season (December and January) while minimum during prespawning period (June). This may be concluded that feeding intensity is maximum during winters while minimum during prespawning period (June). There were four empty stomachs were observed in the month of June due to bigger size of the gonads which occupying larger space in the body cavity and allowed a little space for the food. The hepatosomatic index of the fish was also observed maximum during winter season when the gastrosomatic index or feeding intensity of the fish was maximum. The hepatosomatic index of the fish is related with the activity of digestion.

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