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Seasonal Fluctuation of Zooplankton Community in Relation to Certain Physico-Chemical Parameters of River Bagmati of Darbhanga, Bihar

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Abstract

The study of zooplankton communities of river Bagmati was carried out during 2007-2008. During study 30 species mainly belonging to Rotifera (17), Cladocera (9) and Copepoda (4) were found. The bulk of zooplankton was shared by Rotifers (48.81%) followed by Cladocera (36.53%) and Copepoda (14.65%). The distinct peak of zooplankton was observed during summer and rainy seasons. Zooplankton also comprised some pollution tolerant species like *Brachionus, Keratella* and *Mesocyclops*. The rotifers showed negative correlation with pH, dissolved oxygen and transparency and the copepods showed negative correlation with water temperature, nitrate and phosphate whereas cladoceran showed negative correlation with pH and transparency.

Key words : Zooplanktons, Physico-chemical parameters, Coefficient, Correlation, River Bagmati.

Planktons are effective in environmental biomonitoring of aquatic systems. Phytoplankton and zooplankton are the major group of plankton. Phytoplankton play a phenomenon role in the biosynthesis of organic material while zooplankton forms an important component of secondary production. The zooplankton occupy a central position between autotrophs and other hetrotrophs and form an important link in aquatic food webs. Truly planktonic animals in fresh water are dominated by Rotifera, Cladocera and Copepoda. Rotifera are the most sensitive bio-indicators of water quality and their presence may be used as a reference to the physico-chemical characteristics of water. The zooplankton form major link in the energy transfer at secondary level in aquatic biotopes, the distribution and diversity of zooplankton in aquatic ecosystem depend mainly on the physico-chemical properties of water.

Table 1. Physico-chemical characteristics of water of river Bagmati. Value expressed in ml/1 except pH and transparency expressed in cm.

Months	Temp C Air	Water	pH	Transp	DO_2	Free CO_2	CO_3	HCO_3	NO_2	PO_4	Cl
Jan	22.5	19.5	8.5	72.4	9.4	0.9	0	88.5	0.35	0.09	24.5
Feb	21.6	19.9	8.4	69.5	9.2	0.8	0	88.6	0.40	0.09	22.5
Mar	28.9	25.6	8.1	55.6	9.0	1.0	0	87.2	0.42	0.08	27.8
Apr	32.8	23.1	7.9	49.9	8.8	1.2	0	90.9	0.48	0.11	28.4
May	34.9	28.4	7.5	45.7	8.4	1.5	0	99.5	0.52	0.12	30.5
Jun	35.8	29.0	7.5	42.5	8.3	1.9	0	90.2	0.54	0.14	32.4
Jul	35.9	30.3	7.5	38.2	7.5	1.12	0	60.1	0.56	0.16	32.1
Aug	34.6	28.9	7.4	31.1	7.7	1.15	0	52.2	0.57	0.16	28.2
Sep	33.5	26.6	7.4	29.2	6.9	1.16	0	49.5	0.60	0.17	26.1
Oct	31.8	28.9	7.6	44.5	6.8	1.2	0	50.6	0.62	0.15	25.2
Nov	29.1	25.4	7.8	46.5	7.9	1.1	0	55.7	0.45	0.12	26.1
Dec	24.1	23.2	8.0	62.3	7.7	1.0	0	41.1	0.44	0.11	24.1

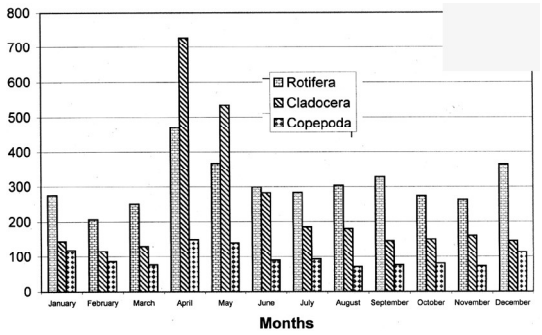

Figure 1. Month-wise distribution of zooplankton.

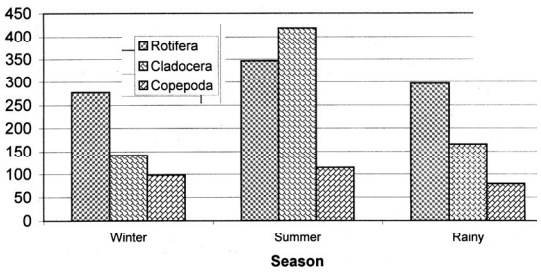

Figure 2. Seasonal variation of zooplankton.

The drastic changes in zooplankton population and thereby affect the production potential of the ecosystem is due to pollution and water bodies by different sources. The chemicals are accumulated in zooplankton by direct absorption from water and through food intake. In the present communication an attempt was made to study the community structure and population density of the zooplankton fauna with special emphasis to survey and identification of various zooplanktonic taxa, met within the river Bagmati.

Methods

The river Bagmati as an important river which is shallow towards the bank and deeper in the middle. It is navigable all the year on country boats. The river is rich repository of flora and fauna. The bank of river are used by villagers for dumping wastes and for burning purposes of corpse and thus the river generally receive the domestic effluents of the inhabitants living in the vicinity of the river.

Physico-chemical characteristics and zooplankton population of the river Bagmati were studies monthly. Surface water and zooplankton were collected on every 15 day of the month as a fixed time. Water temperature was recorded with ordinary thermometer. The pH, transparency, dissolved oxygen, carbonate, bicarbonate, chloride and phosphate of water were recorded following methods of APHA et al. (1). The collections of zooplankton were made by filtering 50 liters of water through a plankton net made up of boiling silk (no. 21) and preserved in 5% formalin. Quantities and qualitative analysis of zooplankton were made by Lackey (2), as modified by Edmondson (3). Correlation coefficients between zooplankton and certain physico-chemical parameters were done.

Results and Discussion

The physico-chemical characteristics and zooplankton population are shown in Tables 1 and 2. The year round study of zooplankton communities of the Bagmati river recorded 30 species belonging mainly to Rotifera (17), Cladocera (9) and Copepoda (4). The distinct peaks of zooplankton were observed during summer and rainy season (Table 2, Figs. 1, 2). Rotifera constitute major part (48.81%) of the biota. The next dominating group was Cladocera (36.53%) followed by Copepoda (14.65%)

The zooplankton community of the river belonging to the three groups Rotifera, Cladocera and Copepoda was represented by the following species :

A. Rotifera : *Brachionus angularis, B. forticula, B. rubena, B. falcatus.*

B. *Caudatum, Keratella tropica, K. vulga, Filriea*

Table 2. Month-wise distribution of zooplankton.

Months	Rotifera	Cladocera	Copepoda
Jan	275	145	120
Feb	206	116	86
Mar	251	131	76
Apr	470	728	150
May	367	534	141
Jun	298	282	89
Jul	283	185	92
Aug	303	180	70
Sep	327	146	75
Oct	273	151	80
Nov	263	161	72
Dec	365	146	114
Total	3681	2905	1165
Percent	48.81	36.53	14.65

Table 3. Correlation coefficient (γ) of zooplanktons with physico-chemical characteristics of water of river Bagamati.

Physico-chemical parameters	Rotifera	Cladocera	Copepoda
Water temperature	0.104	0.183	– 0.094
pH	–0.079	– 0.172	0.182
Dissolved O_2	–0.043	0.223	0.387
CO_2	0.149	0.421	0.179
Bicarbonate alkalinity	0.223	0.519	0.682
Nitrate	0.261	0.137	– 0.075
Phosphate	0.505	– 0.198	– 0.306
Chloride	0.207	0.432	0.174
Transparency	– 0.210	– 0.135	0.223

longiseta, *F. terminalis*, *Monostyal lunaris*, *M. bulla*, *Horaella* sp., *Lepadaella* sp., *Polyrthra* sp., *Cephalodella froticula, Rotaria* sp. and *Brachionus calycifourus.*

C. Cladocera : *Moina micrura, Alona longicandia, Chrodurus gibbous, Anonella* sp., *Macrothrix* sp., *Dophina* sp. *Ceriodaphnea* sp., *Phoyoxus* sp. and *Chydorus* sp.

D. Copepoda : *Heliodiaaptomus vidunus, Mesocyclops leuckarti, Mauplius* sp. and *Diaptomus* sp.

Winter peak is dominated by rotifers while summer and rainy peaks by cladoceran and copepodan. Among zooplankton, the rotifer population showed remarkable fluctuations, in general higher numbers were recorded in March and April. However the population of rotifers was minimum during summer analyzing the relative dominance whereas *Polyatha* and *Filinia* were sub-dominant but *Keratella, Horaella* and *Lepadaella* were scanty. *B. Angularis* showed two peaks, one in April and another in September ; *B. falcatus* was noticed from November to December and August to October, the maximum population being found in September.

Brachionus coudatum was observed from September to June. However, its maximum abundance was during September. *B. rubena* was noticed during February to September, maximum being in May. *B. calysiflorus* was recorded from March to October. The peak was observed during April and September.

Polyartha sp. was found from January to June, *Filibnea* sp. was noticed between January and May. *Horaella* sp. showed its presence only in November and December. *Keratella tropica* and *K. vulga* were noticed in less number in August and October.

Rotifers showed superiority over other groups, both in terms of number of species, genera and population density. The sequence of dominance of various groups was Rotifera > Cladocera > Copepoda.

According to George (4) the abundance of rotifers followed by cladocerans is an indication of the eutrophic nature of the water bodies. The abundance of rotifera may be attributed to its dependence on phytoplankton and detrital matter as food. The zooplankton peak was found during summer followed by rainy (Fig. 2). Dominance of Rotifera among zooplankton as observed in the present study is in accordance with the findings of Pennak (5), Michael (6), and Pandey et al. (7, 8). The peak value of zooplankton during summer might be due to optimal thermal and nutritional conditions and higher concentration of oxygen. The lowest zooplankton recorded during winter may be related to low temperature. Marshal and Orr (9) also observed minimum zooplankton population at lower temperature.

Presence of maximum zooplankton population in summer might be due to the presence of higher population of bacteria. Plankton depends on water quality, remain on dead decaying vegetation and burnt and half burnt bodies. This result in an increase of the organic matter and growth of the bacteria population which increases the zooplankton density. Rotifers showed numerical superiority over other groups of zooplankton. They are primary consumers feeding on various phytoplankton. Some also feed on bacteria. Some have been described as raptorial predators (10). Rotifers have a versatile capasity to thrive in different environments and as such they usually dominate over other zooplankton communities. George (4) and Bansei (11) have reported summer periodicity of rotifers, whereas Nasar (12) has shown a winter peak of rotifers. In the present investigation a bimodal pattern of abundance of rotifer population has been noticed.

The maximum abundance of rotifers occurred in summer followed by rainy and winter seasons (Table 2 and Fig. 2). This is in contrary to the observation of Green (13), but is in conformity with the observation

of Dutta et al. (14).

The cladoceran population was scanty compared to the rotiferans. The main cladoceran peaks were observed during summer and rains. Copepods were abundant during rainy season followed by winter peak. Rainy peak of copepods has also been reported by Maruthanayagam et al. (15).

Many of the total 30 species identified in the present study fall in the category of population indicator. *Ceriodaphanea* and *Chydorus* grow abundantly in grossly polluted conditions of streams and lakes. *Ophryoxus Iraciliaris* can occur in unpolluted and highly polluted conditions. The genus *Mesocyclops* can tolerate substantially low levels of oxygen indicating the organic pollution (16). *Keratella* prefers high temperature and is an indicator of grossly polluted conditions.

The analysis of the results obtained in the present study shows that several abiotic factors probably exert considerable influence on the zooplankton abundance but the role of other factors can not be neglected. To assess the importance of abiotic interaction an attempt was made to analyze the data statistically (Table 3). Rotifera showed negative correlation with pH, dissolved oxygen and transparency, while copepods revealed negative correlation with water temperature nitrate and phosphate. Cladocerans showed negative correlation with pH, transparency and phosphate.

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