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RESEARCH ARTICLE

STUDIES ON ZOOPLANKTON DIVERSITY OF AN OXBOW LAKE OF SOUTH ASSAM, INDIA

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ABSTRACT

Zooplankton are known as good bio-indicator of changes in water quality because it is strongly affected by any changes in physical and chemical conditions of water as well as the surrounding environmental condition. Zooplankton diversity and physico-chemical parameters of an oxbow lake, Madhura anua was studied for a period of one year from September 2012 to August 2013. During the study period a total of 26 species belonging to 4 groups of Zooplankton were recorded of which rotifera was represented by highest number of 16 species, Cladocera by 7 species, copepoda by 2 species and ostracoda by only 1 species showing lowest percentage of presence. Zooplankton community when correlated with physico-chemical parameters indicated that Dissolved Oxygen and free Carbon Dioxide are significantly inversely correlated ($p < 0.01$) with the occurrence of zooplankton.

INTRODUCTION

Zooplankton are microscopic free swimming heterogeneous assemblage of minute floating animal forms found in aquatic systems, are represented by wide array of taxonomic groups (Protozoa, Rotifera, Cladocera, and Copepoda). Plankton is the natural food of many species of fishes, especially zooplankton constitute important food item of many omnivorous and carnivorous fishes. The larvae of carps feed mostly on zooplankton (Dewan *et al*., 1977) because zooplankton provides the necessary amount of protein for the rapid growth and specially that of the gonad (Rajagopal 2010). The Zooplankton are often an important link in the transformation of energy from producers to consumers due to their large density, drifting nature, high group or species diversity and different tolerance to the stress. Zooplankton diversity is one of the most important ecological parameters as these are the intermediate link between phytoplankton and fish (Schriver *et al.,* 1995, Tatrai *et al.,* 1997) and plays a key role in cycling of organic materials in an aquatic ecosystem. The distribution of Zooplankton are related with a complex of factors such as change of climatic conditions, physical and chemical parameters and vegetation cover of the water body (Khan 1987 Khan 2002 and Khan 2003). They play an integral role and may serve as bioindicators and a reliable tool for determining the status of water pollution (Okogwu, 2010). Thus zooplankton association, richness, abundance, seasonal variation and diversity can be used for the assessment of water quality and for pisciculture management practices. Hence the investigation was conducted to assess the zooplankton community quantitatively and qualitatively along with their correlation with the physicochemical parameters to get a better understanding of the structure and function of this important aquatic ecosystem viz, Madhura Anua.

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MATERIALS AND METHODS

Analysis of Physico-Chemical Parameters: For analysing physico-chemical parameters of water, monthly sampling was done from September 2012 to August 2013. Water samples were collected from the study site and analysis of parameters like air temperature, water temperature, pH, Dissolved Oxygen (DO), Free Carbon dioxide (FCO_2), Total Alkalinity (TA) were done on the spot following the standard methodology of APHA, 2005.

Analysis of Zooplankton samples: The plankton samples were collected by filtering 20 litres of water through the standard plankton net (25 mesh bolting silk). Collected samples were transferred in a small vial from net properly. For the quantitative studies samples were fixed and preserved immediately after collection by adding slowly 2-4 % buffered formalin. To retain the colour of the preserved plankton samples were stored in the dark and added 1 ml of saturated cupric sulfate solution per liter.The preserved samples were stored in the laboratory for further analysis with proper labelling in the body of the sample vial.

Qualitative analysis of zooplankton: The plankton sample was taken on the cavity slide and then examined under compound microscope (Olympus CH 20 i). Zooplankton were

identified following standard literature (Michael and Sharma, 1988, Edmondson, 1992, Korinek *et al*., 1999, Sharma, 1999, APHA, 2005, Saha, 2010; Bonecker *et al*., 1994; Das. *et al*., 2011.).

Quantitative analysis of zooplankton: For zooplankton counting the S-R cell is most common device. Before filling the S-R cell with sample, the cover slip was placed diagonally across the cell and then 1ml of the sample was poured using pipette in the S-R cell. The S-R cell is then allowed to stand for 10-15 minutes. Then randomly 40 squares were selected and then zooplankton present in those was counted. Zooplankton density was calculated following APHA, 2005.

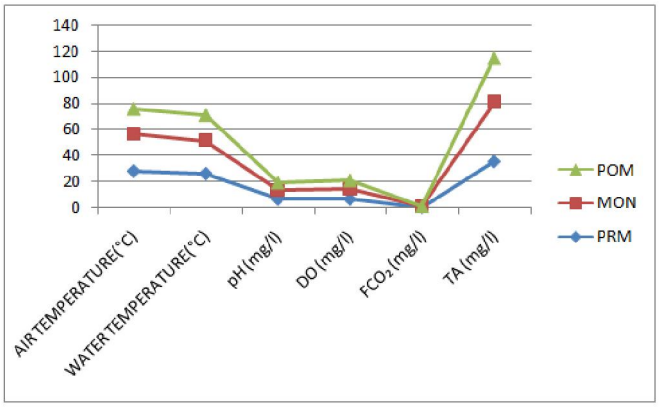
RESULTS

The data on the physico-chemical parameters of Madhura Anua during the study period of September 2012 to August 2013 is depicted in Table 1. Assessment of different physico-chemical parameters of the study site reveals the remarkable variations in air and water temperature, water temperature ranges from 18^0C to 29^0C, air temperature during the study ranges from 18^0C to 34^0C. The pH value recorded ranges from 6 to 7. The Dissolved Oxygen value ranges from 6.5 to 8. Free Carbon dioxide ranges from 0.2 to 1 and total alkalinity value ranges from lowest 22 to highest of 50. The water quality assessment shows moderate value of all the parameters tested during the study. Figure 1 depicts the seasonal variations of the water quality parameters opf the study site.

Table 1. Assessment of physicochemical parameters of water of Madhura Anua during the study period of September 2012 to August 2013

Parameters	Mean ± SD
Air Temperature (°C)	25.6±5.2
Water Temperature (°C)	23.8±3.7
pH	6.5±0.4
Total Alkalinity (mg/l)	37.7±8
DO (mg/l)	7.2±0.5
Free CO_2 (mg/l)	0.6±0.3

In the study site, Madhura Anua, a total of 26 species belonging to 4 groups of Zooplankton were recorded during the study period. Of these, a total of 7 species of zooplankton belonged to Cladocera group, 2 species belonged to Copepoda group, 16 species belonged to Rotifera group and only 1 species belonged to Ostracoda group. The group Cladocera was represented by 7 species belonging to 7 different genera viz, *Diaphanosoma excisum, Chydorus* sp., *Alonella* sp., *Ceriodaphnia cornuta, Bosminopsis deitersi, Macrothrix* sp., *Alona* sp. The group Copepoda was represented by 2 species belonging to 2 different genera was recorded which are *Mesocyclops* sp and *Neodiaptomus schamakeri*. The Rotifera group shows highest diversity of species assessed, during the study 16 species belonging to 10 different genera were recorded. The genus Brachionus was represented by 6 species (*B. quadridentatus quadridentatus*, *B. quadridentatus*, *B. angularis*, *B. calyciflorus*, *B. patulus*, *B. patulus patulus*) followed by 1 species of Filinia (*Filinia* sp.). The genus Lecane was represented by 2 species (*L. sinuate, L. curvicornis curvicornis*).



Note: PRM = Pre-monsoon; MON = Monsoon; POM = Post- monsoon.

Figure 1. Seasonal variation in physico-chemical parameters in Madhura Anua during the study period of September 2012 to August 2013

Table 2. Quantitative variations in Zooplankton groups (number/litre) in Madhura Anua during the study period of September 2012 to August 2013

Zooplankton grs./ months	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Cladocera	75	79	72	80	81	82	95	91	74	65	62	62
Copepoda	125	275	312	325	350	375	362	350	250	188	175	173
Rotifera	63	88	113	100	100	163	150	138	188	112	62	58
Ostracoda	-	-	13	25	26	29	30	12	-	-	22	-

Table 3. Correlation of Zooplankton Groups and Physicochemical parameters in Madhura Anua during the study period of September 2012 to August 2013

Parameters	Air temp.	Water temp.	pH	DO	FCO_2	TA	Cladocera	Copepoda	Rotifera	Ostracoda
Air temp.	-	.930*	.736*	.756*	.809*	.216	-.432	-.559	.152	-.132
Water temp.		-	.811*	.561	.651	-.069	-.245	-.336	.266	.019
pH			-	.351	.473	.069	.076	-.144	.423	-.243
DO				-	.925*	.588	-.793*	-.878*	-.448	-.358
FCO_2					-	.600	-.590	-.826*	-.394	-.369
TA						-	-.424	-.653	-.514	-.735
Cladocera							-	.779*	.540	.204
Copepoda								-	.620	.210
Rotifera									-	.191
Ostracoda										-

* Correlation is significant at 0.01 level.

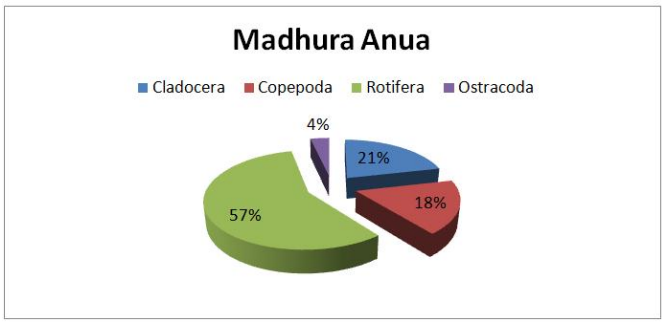


Figure 2. Percentage contribution of Zooplankton groups in Madhura Anua during the study period of September 2012 to August 2013

Whereas the genera Polyarthra (*Polyarthra* sp.), Platyias (*Platyias quadricornis*), Keratella (*Keratella tropica*), Anuraeopsis (*Anuraeopsis fissa*), Testudinella (*Testudinella brevicaudata*), Horaella (*Horaella brehmi*), Dipleuchlanis (*Dipleuchlanis propatula*) represented with 1 species each. Only 1 species of genus Cypris was recorded from the group Ostracoda depicting lowest diversity. The quantitative variations in zooplankton groups in Madhura Anua during the study period of September 2012 to August 2013 are depicted in Table 2. Groupwise percentage contribution of different zooplankton groups are shown in Figure 2. Table 3 depicts the correlation of zooplankton groups and physicochemical parameters in Madhura Anua during the study period.

DISCUSSION

The Anuas i.e., the oxbow lakes are the natural reservoir of different types of fishes and the richness of it depends a lot on its physicochemical parameters which are known to affect its biotic component in various ways. Physico-chemical parameters are the important constituents of the aquatic system as they reflect the water quality of aquatic ecosystem. Water temperature varied in accordance with the air temperature and it ranged from 18^0C (December) to 29^0C (May), pH of the water remained moderate throughout the study period and ranged lower value of 6 in December, January and ranged highest value of 7 in the month of April, May. The values of pH of the samples from the study site thus found to be in favourable condition for aquatic life. The dissolved Oxygen level varies between 6.5 to 8 which is moderately high and reveals that the oxbow lake is not in immediate threat of eutrophication. In the present study zooplankton was comprised of Rotifera (10 genera), Cladocera (7 genera), Copepoda (2 genera) and Ostracoda (1 genera). In the present work, Rotifera constituted the most dominating group contributing 57% to the total zooplankton population followed by Cladocera contributing 21%, Copepoda 18% and Ostracoda 4%. Present investigations reveals high value of species richness reflecting the suitability of the wetland for the dominant species (Arora and Mehra 2003; Arora 1962). The relationships between the zooplankton and the investigated physico-chemical parameters was established using Pearson's correlation analysis. Air temperature shows significant positive correlation ($p < 0.01$) with all other physico-chemical parameters and zooplankton occurrence whereas dissolved Oxygen and free Carbon Dioxide showed significant inverse correlation ($p < 0.01$) with the occurrence of zooplankton. Many of the investigated parameters did not however show significant correlation with the community structure of zooplankton. This is probably because many environmental factors affect zooplankton only at extreme levels (example toxic contaminants, oxygen) and will not be important in all freshwaters (Paterson, 2001).

Conclusion

Higher values of species diversity of the site depict the favourable conditions in terms of physicochemical conditions. Although zooplankton exists under a wide range of environmental conditions, yet many species are limited by DO, temperature and other physico-chemical factors. Different species of Brachionus belonging to group Rotifer were found to dominate the oxbow lake. Different species of zooplankton showed their abundance according to the favourable conditions. In the present study, the study site was characterized by a greater diversity of zooplankton taxa during the dry season. The moderate level of the physico-chemical parameters that are tested shows that the oxbow lake – Madhura Anua is suitable for aquaculture.

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