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Correlation Study on Zooplankton availability and Physico-Chemical Parameters of Kangsabati Reservoir, West Bengal, India

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Abstract

Zooplankton play a crucial role in aquatic ecosystem and a number of water parameters involved in it. The present investigation had been continued for a period of one year from March, 2010 to February, 2011 – to assess the correlation between physico - chemical parameters of water and zooplankton availability in Kangsabati Reservoir, Mukutmanipur, West Bengal. Among the zooplankton population four major groups viz. Rotifera, Copepoda, Cladocera, Protozoa and two minor groups viz. Ostracoda and Amphipoda were observed. 33 species of Rotifera, 16 species of Copepoda, 22 species of Cladocera, 4 species of Protozoa, 2 species of Ostracoda and 1 species of Amphipoda were identified. The zooplankton population showed strong correlation with the parameters like water temperature, dissolved oxygen, alkalinity, phosphate, total inorganic nitrogen, free CO_2 etc. Available species were Asplanchna reticulata, Synchaeta oblonga, Anareopsis fissa, Keratella valga tropica under rotifera ; Nauplii, Microcyclops varicans, Paracyclops fimbriatus under copepoda ; Ceriodaphnia cornuta, Daphnia ambigua, Bosmina longirostris etc under cladocera ; Amoeba proteus and Difflugia sp. under protozoa ; Cyprinotus sp. under ostracoda and Hyperia macrocephala under amphipoda. Zooplankton population was high in winter season while low in rainy season.

Keywords : Kangsabati Reservoir, Zooplankton, Physico – chemical parameter, correlation study.

Introduction

The Kangsabati Reservoir is a valuable resource for irrigation and aquaculture practices. Water is the key substance for the survival of all organisms in this globe. The quality of water in terms of physico-chemical and biological characteristics in the reservoir offers the most favourable conditions for the existence of zooplankton as well as other biota which constitute essential components of the food chain. Zooplankton play a vital role as primary consumer of aquatic food chain which in turn influence the productivity of fresh water ecosystem.

We have studied to assess the correlation between physico–chemical parameters and zooplankton availability corresponding with monthly values in both the cases during the study period from March, 2010 to February, 2011. Subsequently we can determine the trophic strength which provides support to reservoir ecosystem.

Special attention have been drawn about physico-chemical parameters, zooplankton – density, diversity, species richness, seasonal abundance, composition etc by several workers like Alam and Kabir [1], Kiran et al[2], Islam[3], Goswami and Mancodi[4], A. L. Korai et al [5], Kadam and Tiwari[6], Dhembare, A.J.[7], K.Vincent et al[8], Mukherjee et al[9], Parikh A.N. and Mankodi P.C.[10], but have no report regarding zooplankton availability in connection with water parameters of Kangsabati Reservoir. Our aim is to focus on it.

Material and Methods

Study area: Kangsabati, a man made reservoir has been set up during the year 1965-1966 on the river of Kansai and Kumari at Mukutmanipur, West Bengal, India. Geographically it is situated in between 22° 55'16.53" N - 23°2' 30.41"N latitude and 86° 37' 55.30" E - 86° 47' 23.35" E longitude. Recently this reservoir is used for various purposes like irrigation, drinking water supply, pisciculture etc. The fishery department, Government of West Bengal performs fisheries activity every year. As a result many poor people residing at villages surrounding the reservoir are benefited by catching and selling fishes in local markets.

Water sample collection and Analysis: Water samples from Kangsabati Reservoir were collected from the three spots viz. north, south and east point during last week of each month from March, 2010 to February, 2011 at 8 A.M - 9.30 A.M in clean plastic air tight bottles. For Dissolved Oxygen(D.O.) analysis, water sample was collected in clean 100 ml bottles of glass. The water and air temperature were recorded by minimum-maximum hydro-thermometer and thermometer respectively; pH by pH meter (Systronics Model – 335); conductivity by conductivity meter (Labtronics model – LT 16); dissolved oxygen by Winkler's method; photic depth by Secchi disc method; free CO_2, alkalinity, Chloride, Phosphorus, total inorganic nitrogen, Calcium, Magnesium and hardness by APHA[11]. Rainfall data of the concerned period was recorded

and supplied by the Office of the Sub divisional Officer, Kangsabati left bank subdivision no. II, Mukutmanipur, W.B.

Zooplankton collection, Preservation and Identification: Qualitative and quantitative Zooplankton analysis of the reservoir was done for the same period. From each spot 100 litre of water samples was filtered through plankton net of bolting silk No.25 (mesh size 64 micrometer). All the filtered content was then transferred to 100 ml glass container. 4% formalin and few drops of glycerin were added to it. Supernatant plankton free water was removed and sedimentary zooplankton was counted by Sedgewick-Rafter cell method – Adoni[12]. Identification of zooplankton was done under microscope using keys and monographs of Edmondson[13], Battish[14], Needham and Needham[15], Sharma[16] and with the help of experts of Zoological Survey of India, Kolkata.

Correlation analysis: The Pearson Correlation matrix(r) between physicochemical parameter and zooplankton availability has been done using Microsoft Excel (2007) to correlate among them.

Results and Discussion

The relationship between the physico – chemical parameters and zooplankton production in reservoir water influence the trophic status. The study revealed that the total number of zooplankton was low in rainy season (July – October) and high in winter (November – February) followed by summer (March – June). Highest number of zooplankton were also reported in winter in lower Manair Reservoir by Thirupathaiah *et al*[17]. A total number of 78 zooplankton species belonged to six groups namely Rotifera (33 species), Copepoda (16 species), Cladocera (22 species), Protozoa(4 species), Ostracoda (2 species) and Amphipod (1 species).

Rotifera: Rotifera was the dominant group out of total zooplankton population and represented by 33 species belonging to 12 genera. The occurrence of rotifera was highest i. e. 171 Ind./L in September, 2010 and lowest i.e. 19 Ind./L in October, 2010 (table-1). The commonly occurring rotifers were *Keratella sp., Brachionus sp., Synchaeta sp., Asplanchna sp., Anuraeopsis sp.* which were found all over the year. Rotifer population was positively correlated with D.O. (r = 0.570), P^H (r = 0.284), transparency (r = 0.556), free CO_2 (r = 0.355) etc. Chandrasekar[18] showed that the transparency, D.O. were favour for rotifer population. On the contrary, this population were negatively correlated with water temperature (r = - 0.563), rainfall (r = - 0.574), total inorganic nitrogen (r = - 0.106), alkalinity (r = - 0.485) etc. Similar observation were also registered by B. K. Sharma [19] in Loktak Lake, Manipur.

Copepoda: Nauplii, *Microcyclops varicans, Eucyclops serrulatus, Paracyclops fimbriatus, Diaptomas denticornis* were the dominant genera under the group copepod. This group was represented by 16 species belonging to 12 genera. The occurrence of copepods were highest i.e. 337 Ind./L in the month of summer season, 2010 whereas lowest i.e. 21 Ind./L in the month of winter season, 2010 (table-1). Copepods made positive correlation with water temperature (r = 0.060), alkalinity (r = 0.772), Ca (r = 0.382) while made negative correlation with photic depth, P^H, D.O., chloride, phosphate, total inorganic nitrogen etc. (table-2). Positive correlation with water temperature and negative correlation with P^H coincides with the investigation of Koli and Muley[20] in Tulsi Reservoir, Maharastra.

Table–1
Zooplankton abundance (Individuals/Liter) in 100 liter volume of water sample during the study period from March, 2010 to February, 2011

Months	Availability of Zooplanktonic Groups (Ind./L)						
	Rotifera	**Copepoda**	**Cladocera**	**Protozoa**	**Ostracoda**	**Amphipod**	**Total**
March, 2010	107	26	67	27	06	07	240
April, 2010	78	86	90	11	06	07	278
May, 2010	53	337	60	36	14	00	500
June, 2010	96	154	111	20	12	09	402
July, 2010	58	104	32	18	08	00	220
August, 2010	58	85	26	194	07	00	370
September, 2010	171	66	27	76	18	00	358
October, 2010	19	76	25	36	4	00	160
November, 2010	134	291	90	52	50	00	617
December, 2010	155	21	111	37	20	00	344
January, 2011	168	119	249	23	36	00	595
February, 2011	164	122	76	8	16	00	386
Total	**1261**	**1487**	**964**	**538**	**197**	**23**	**4470**

Cladocera: In the present study, Cladocera group were occupied by 22 species belonging to 12 genera. The population was maximum in number i.e. 249 Ind./L in the month of winter but minimum in the month of rainy season i.e. 25 Ind./L (table–1). This group was dominated by *Daphnia sp., Ceriodaphnia sp., Bosmina sp.*. Cladocerans showed markedly positive correlation with pH, conductivity, free CO_2 etc. and negative correlation with water temperature, phosphate, total inorganic nitrogen, rainfall etc (table-2). Negative correlation with phosphate had also been reported by Venkataramana and Farshad[21].

Protozoa: The members of the Protozoa were *Amoeba sp., Difflugia sp., Paramecium sp. and Arcella sp.*. The first two species were available throughout the year. The occurrence of *Paramecium and Arcella sp.* are very remarkable event. *Arcella sp.* was arisen only September and October, 2010 months. It is to be mentioned that *Paramecium and Arcella sp.* are very sensitive to physico – chemical parameters. The highest density i.e. 194 Ind./L was found in the month of August, 2010 and lowest i.e. 8 Ind./L in the month of February, 2011 (table–1). This group set up strongly positive correlation with temperature, phosphate, calcium, total inorganic nitrogen etc and negative correlation with conductivity, pH, salinity, chloride (table–2). Positive correlation with temperature and calcium were also suggested by Kedar, Patil and Yeole[22] in Rishi Lake.

Ostracoda: *Cypris* sp. and *Cyprinotus* sp. were the representative of ostracoda group which was found numerous in number i.e. 50 Ind./L in the month of winter season and very poor i.e. 4 Ind./L in the month of rainy season. This group demonstrate positive correlation strongly with D.O., free CO_2 etc. and negative correlation with water temperature, rainfall etc (table–2). This group was mostly abundant in winter season and built also positive correlation with alkalinity which was also found by Shah and Pandit[23] in Wular Lake.

Amphipod: This group includes only one species – *Hyperia macrocephala*. The occurrence of this species at the end of winter season to summer season. The highest number was 9 Ind./L and lowest 7 Ind./L (table - 1). It developed positive correlation with chloride, salinity, magnesium heavily and negative correlation with D.O., phosphate, free CO_2, transparency etc. (table-2).

Total zooplankton abundance and physico– chemical parameters: To assess the overall impact of different parameters on zooplankton abundance, correlation were made between total zooplankton population and water parameters. Zooplankton population showed notable positive correlation with conductivity (r = 0.402), D.O. (r = 0.297), alkalinity (r = 0.256), free CO_2 (r = 0.344), pH (r = 0.092) etc. On the contrary, negative correlation were made with water temperature (r = - 0.448), phosphate (r = - 0.273), total inorganic nitrogen (r = - 0.261), rainfall (r = - 0.213) etc (table–3). Dutta and Patra [17]; Veerendra et al [24] ; Rajagopal et al [25] also reported the positive correlation with pH, D.O., alkalinity and negative correlation with water temperature, salinity. Such findings corroborate our results.

Table–2
Correlation between water parameters and different groups of Zooplankton during study period

Sl. No.	Parameters	Rotifera	Copepoda	Cladocera	Protozoa	Ostracoda	Amphipod
1	Air Temperature	-0.225	0.140	-0.287	0.027	-0.351	0.290
2	WaterTemperature	-0.563	0.060	-0.660	0.170	-0.641	0.331
3	Transparency	0.556	-0.378	0.228	0.055	0.297	-0.380
4	Conductivity	0.132	0.067	0.777	-0.148	0.191	0.110
5	P^H	0.284	-0.164	0.480	-0.336	0.152	-0.220
6	Dissolved Oxygen	0.570	-0.119	0.238	0.042	0.621	-0.461
7	Alkalinity	-0.485	0.772	0.022	-0.309	0.092	0.033
8	Chloride	-0.069	-0.116	0.154	-0.169	-0.178	0.877
9	Phosphate	-0.352	-0.196	-0.483	0.657	-0.214	-0.454
10	Total inorganic nitrogen	-0.106	-0.364	-0.510	0.769	-0.207	-0.193
11	Hardness	-0.249	0.119	-0.449	0.588	0.002	-0.141
12	Salinity	-0.062	-0.113	0.158	-0.174	-0.167	0.878
13	Photic depth	0.541	-0.362	0.210	0.066	0.290	-0.362
14	Free CO_2	0.355	-0.025	0.593	-0.175	0.432	-0.344
15	Calcium	-0.209	0.382	-0.424	0.377	0.250	-0.103
16	Magnesium	-0.006	-0.012	0.057	-0.013	-0.201	0.470
17	Rainfall	-0.574	0.032	-0.477	0.647	-0.445	-0.095

Table–3
Total zooplankton basis correlation during study period

Sl. No.	Parameters	Correlation coefficient (r)
1	Air Temperature	-0.130
2	WaterTemperature	-0.448
3	Transparency	0.086
4	Conductivity	0.402
5	P^H	0.092
6	Dissolved Oxygen	0.297
7	Alkalinity	0.256
8	Chloride	-0.093
9	Phosphate	-0.273
10	Total inorganic nitrogen	-0.261
11	Hardness	-0.001
12	Salinity	-0.088
13	Photic depth	0.087
14	Free CO_2	0.344
15	Calcium	0.153
16	Magnesium	0.001
17	Rainfall	-0.213

Conclusion

The maximum number of zooplankton during winter followed by summer and rainy season indicates favourable physico - chemical condition in relation to zooplankton population. Transparency, dissolved oxygen, P^H was observed high in winter months and these provide plentiful environment for the growth of plankton. This has been confirmed by Agarwal et al[26]. In Kangsabati Reservoir, zooplankton density was greatly concerned at consumer level of reservoir ecosystem. In this reservoir chiefly contributed group were copepoda peak in May, rotifera peak in September, cladocera peak in January, protozoa peak in August, ostracoda peak in November and amphipod peak in June during the study period. A huge number of zooplankton availability was due to the richness of dissolved oxygen, pH, alkalinity, calcium, transparency. Same argument had also support to our findings by Dutta and Patra[17] and Basu, Barik, Roy [27]. pH, dissolved oxygen with rotifers; alkalinity with copepods; cladocera with free CO_2, conductivity; phosphate, total inorganic nitrogen, hardness, rainfall with protozoa ; dissolved oxygen with ostracoda; chloride, salinity and magnesium with amphipod have the positive influence to maintain the zooplanktonic abundance in the reservoir. The availability of zooplankton were rich by copepoda> rotifera> cladocera> protozoa> ostracoda> amphipoda respectively in relation to water quality. Presence of various types of plankton and its availability throughout the year assure to good ecological condition of the reservoir.

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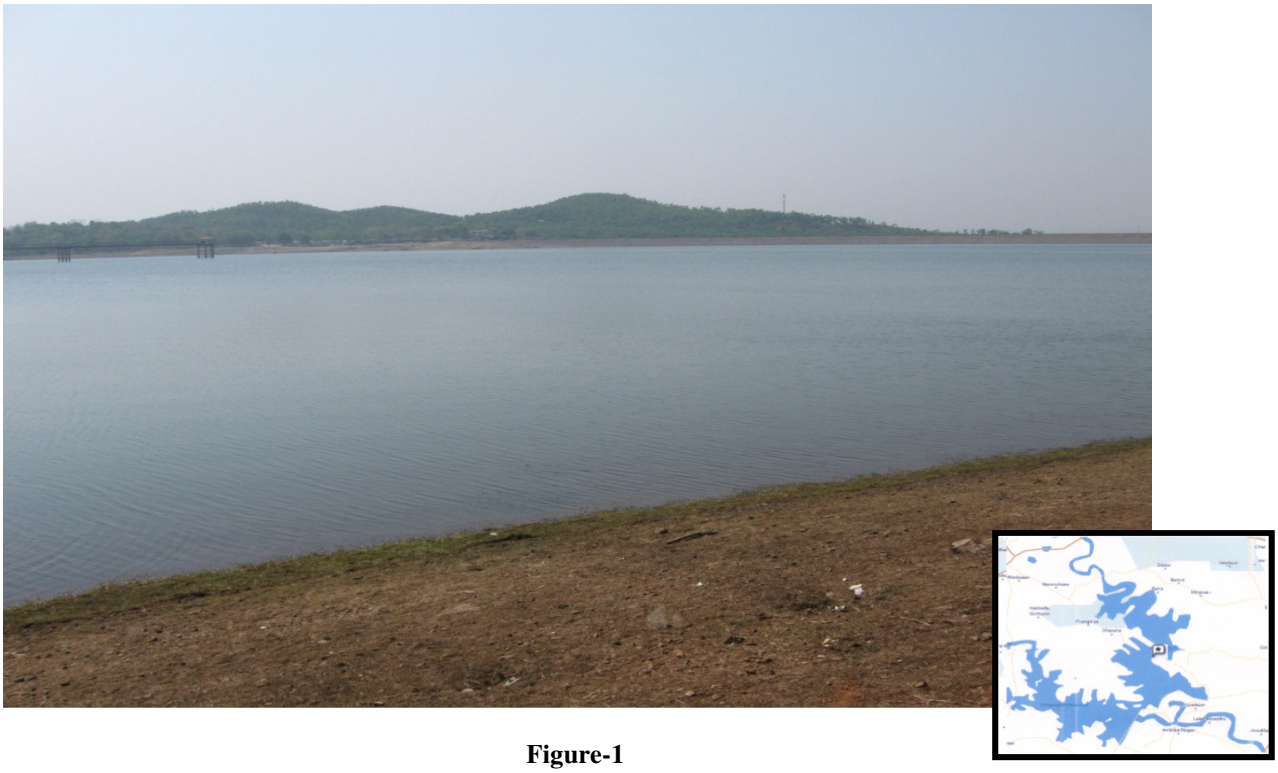

Figure-1
Open view of the Kangsabati Reservoir (Blue shaded area indicating reservoir area in inset)

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