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Report on correlation of zooplankton with physico- chemical factors from freshwater temple pond.

Tidame S.K* and Shinde S. S

Department of Zoology, Vivekanand College, Aurangabad 431 001(M.S.) India.

Abstract

In the present work, we provide quantitative information on the correlation of zooplankton with physico-chemical factors from man-made reservoir in the Nashik district. In the study period we have recorded 16 genera of zooplankton, of which 10 genera belong to rotifera, 3 genera belong to cladocera and 3 genera belong to copepoda. Among zooplankton, particularly rotifera was the dominant group throughout the study period and highest count was recorded in the monsoon season, cladocerans noted least throughout the year. The results indicate that the distribution and density of zooplankton species influenced by physical and chemical factors of the environment.

Keywords: Rotifera, Cladocera, physico-chemical factors, Nashik.

INTRODUCTION

The physico-chemical characteristics of the aquatic environment directly influence the life inhabiting it. Zooplankton is considered as one of the most important linkage in aquatic food chain and plays a major role in energy transfer studied by Kedar [7]. Rotifers, cladocerans, copepods constitute the major groups of zooplankton. They occupy an intermediate position in the food web. Zooplankton mediate the transfer of energy from lower to higher trophic level studied by Waters [23], thus zooplankton represent an important link in aquatic food chain and contribute significantly to secondary production in fresh water ecosystem observed by Sharma [19]. The zooplankton concentration and distribution are sensitive to physical and chemical changes in the water studied Ahmad [1]. Zooplanktons also play an important role as indicators of trophic condition in both cold, temperate and tropical waters reported by Sharma [19].

MATERIAL AND METHOD

For the study of zooplankton and physico-chemical parameters, samples were collected at fortnight interval from the pond surface during February 2010 to January 2011. The samples were collected during morning hours in between 8.00 to 10.00 a.m. from the three sites of the pond. To study the zooplankton diversity, physico-chemical parameters and their seasonal variations, the samples were collected during summer (February to May 2010), monsoon (June to September 2010) and winter (October to January 2011). The zooplanktons were collected by filtering 50 litres of water through plankton net of pore size 45µ. Filtered planktons then preserved in 4% formalin and few drops of glycerin were added to it which prevents hardening of zooplankton. Zooplankton sample were identified qualitatively and quantitatively under the microscope using drop count method. Planktons were identified with the help of identification keys and standard reference given in Edmondson [6], Tonapi [21], Battish [5] and A.P.H.A. [2], Pennak [13], Ward and Whipple [24].

For the study of physico-chemical analysis water samples were collected from the pond surface in a clean polythin container of one litre capacity. Some of the results were recorded at the sampling sites whereas the others were recorded in the laboratory. The parameters observed were colour, pH, hardness, calcium, magnesium, turbidity, sulphate, phosphate, DO, free CO_2, alkalinity, chloride, gross and net primary productivity and BOD. The colour of temple pond water was observed visually. The various physico-chemical parameters were analysed by following the standard methods of Trivedy and Goel [20], APHA [2]. Primary productivity was measured using dark and light bottle method and turbidity was measured by Secchi Disc method. Fortnightly data obtained were compiled to get the seasonal mean, correlation matrix.

Study Area: Amrutkund Pond

It is situated in the complex of the temple, in the middle of city Trimbakeshwar, near Nashik. It lies at $19^0$93'19" north latitude and 73^0 53'04" east longitude. Shri Nana Saheb Peshawa in 1755-1768 built this pond. This pond is stagnant, perennial and fed with rain water, underground water. In summer season water is used for drinking purpose in the temple complex. The area of pond measures about 45 x 48 feet and 85 feet deep and its access is restricted.

RESULT AND DISCUSSION

In the present study total 16 genera of zooplankton were recorded (Table: III), among them the most abundant genera were *Brachionus, Keratella, Filinia* and *Polyarthra* of rotifer and *Mesocyclops* and *Eucyclops* of Copepoda. The Shannon diversity (H) index shows the maximum diversity of rotifers were observed during summer (1.198) because high temperature increase the multiplication and metabolic rates of rotifers resulting in there abundant growth studied by Paulose and Maheshwari [12]. Genus

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*Corresponding Author

Tidame S.K
Department of Zoology, Vivekanand College, Aurangabad 431 001(M.S.) India.

Tel: +91-8888762821; Fax: +91-8888762821
Email: savita.tidame@gmail.com

Brachionus, Filinia, Polyarthra and *Keratella* were found to be perennial, whereas *Keratella* found maximum in summer and *Brachionus* was abundant in monsoon. *Brachionus* was also reported to be dominant form in and around Bikaner by Bahura [4].

Amongst the copepods *Mesocyclops, Eucyclops* and *Nauplius* larvae were recorded through out the year. The Shannon diversity (H) index shows the maximum diversity (0.8043) of copepoda is noted in summer and monsoon, and shows minimum (0.7752) in winter (Table I). Cladocera observed maximum in winter, minimum in summer and this result is supported by the findings of Rajashekhar [15]. Cladocerans observed in low number throughout the year, it is represented by three genera *Ceriodaphnia, Daphnia* and *Bosmina*. The Shannon diversity (H) index shows the maximum diversity in winter (0.689) followed by summer (0.6365) and monsoon (0.4101).

The quantitative analysis of various physico - chemical factors is presented in Table II. The water temperature varied with variation of season as lowest in winter and highest in monsoon similar results are reported by Lashari [9]. The lowest pH value was found during summer. Mali and Gajaria [10] reported that the alkaline pH was recorded throughout the year. Dissolved oxygen was recorded minimum in summer may be due to the high rate of decomposition of organic matter and highest in monsoon. The lowest amount of free carbon-dioxide is recorded in monsoon and highest in summer due to the rate of decomposition of organic matter is high during summer whereas it is low during monsoon this result is supported by Raj Narayan [14] who has recorded the high carbon-dioxide in summer and low in monsoon. The Secchi disc transparency (turbidity) shows that water is more turbid in monsoon and least turbid in winter supported by Kedar [7]. In monsoon months the flushing of water from the catchment area were increases the turbulence and suspension of particles, whereas in winter the settlement of silt, clay and heavy suspended particles result in least turbidity in winter. Hardness measures highest in summer Kaur and Sharma [8] and lowest in winter. The increase in hardness can be attributed to the decrease in water volume and increase in the rate of evaporation at high temperature.

The highest value of calcium was recorded in monsoon where as its low concentration is reported in winter. The maximum concentration of magnesium was recorded in summer and minimum in winter. Calcium and magnesium recorded low in winter due to the dilution effect. Net primary productivity was noticed maximum in summer and minimum in monsoon. Gross primary productivity was found maximum in monsoon and minimum in summer.

The minimum BOD was noticed during winter due to decrease in temperature which leads to decrease in microbial activity and algal blooms. Various workers like Sachidanandamurthy and Yajurvedi [16], Shiddamallayya and Pratima [17] reported minimum BOD in winter. The highest BOD was recorded during monsoon. The lowest concentration of chloride was observed in summer, this result is supported by Shiddamallayya and Pratima [17], Venkatesharaju [22] and highest in winter. The lowest alkalinity was observed during winter, and highest during monsoon supported by Manjare [11] due to the decomposition of organic matter in water body. The lowest concentration of phosphate was assessed during summer and highest during monsoon, this result is supported by the findings of Shinde [18] and winter. The highest content of sulphate was recorded during summer might be due to low water level during summer by Agarkar and Garode [3] and lowest during winter by Shinde [18].

The statistical analysis of the Pearson's correlation coefficient is presented in table IV. The study of correlation coefficient of various physico-chemical parameters and zooplankton groups shows that they are related with each other. The temperature is significantly positively correlated with rotifer, supported by Paulose and Maheshwari [12], BOD and inversely proportional to turbidity. The pH is positively correlated D.O. gross primary productivity, chloride, phosphate and negatively correlated with magnesium. The increase in turbidity causes decrease in calcium, alkalinity, BOD and rotifer density. Alkalinity enhances the decomposition of organic matter, which inturn increases the concentration of sulphate and BOD, similar findings are reported by Shiddamallayya and Pratima [17]. The increase in magnesium shows inverse correlation with chloride and cladocera density. The increase in carbon-dioxide shows decrease in GPP, phosphate, D.O. and increase in NPP.

Dissolved oxygen shows positive correlation with phosphate, chloride, GPP and negative with that of NPP. GPP shows positive correlation with phosphate, chloride. Increase in sulphate concentration shows increase in copepod number and decrease in cladocerans. Hardness shows significant positive correlation with sulphate, copepod density and shows inverse relation with cladocerans. Calcium shows significant positive effect on alkalinity, BOD and sulphate. Chloride shows positive correlation with phosphate and BOD shows positive effect on rotifer population. The density of copepod shows inverse relation with cladocera population.

Table I.Shannon Diversity index (H)

Zooplankton	**Summer**	**Monsoon**	**Winter**
Rotifera	1.198	0.2926	0.8819
Cladocera	0.6365	0.4101	0.689
Copepoda	0.8043	0.8043	0.7752

Table II.Seasonal representation (mean) of Physico- chemical parameters (mg/l.) and Zooplankton (org/l.) for the period of February 2010- January 2011.

Parameters	**Summer**	**Monsoon**	**Winter**
pH	7.865	8.19	8.175
Temp	21.84	25	20.62
Turbidity	52.5	35	73.75
Hardness	192.46	182.1	143
Calcium	51.96	57.83	39.1
Magnesium	76.51	67.15	63.15
Co_2	46.43	25.54	38.9
D.O.	8.25	8.45	8.4
N.P.P.	1.16	0.74	0.99
G.P.P	1.27	1.62	1.55
Alkalinity	253.68	282.87	185.31
Chloride	75.69	149.79	150.79
Po_4	0.55	0.56	0.56
So_4	34.13	32.12	18.50
BOD	2.48	2.85	1.88
Rotifers	44.875	105.625	29.875
Copepods	24.875	22.1	12.385
Cladocerans	1.5	3.5	5.5

Table III. Seasonal interpretation of Density nd Diversity of Zooplankton (org/l.) for the period of February 2010- January 2011.

Zooplankton	Summer	Monsoon	Winter
Rotifera			
Brachionus sp.	23	65.875	12.25
Asplanchana sp.	0	1.75	1.25
Elosa sp.	0	0	1.75
Filinia sp.	2.375	18	0.5
Keratella sp.	15.25	13.75	7.875
Lecane sp.	0.5	0.5	0.5
Monostyla sp.	0.5	1.5	1
Notholka sp.	1	1.75	0.5
Polyarthra sp.	2.25	1.75	4.25
Testudinella sp.	0	0.75	0
Copepoda			
Mesocyclops sp.	9.75	7.125	6.01
Eucyclops sp.	9.625	9.375	3.375
Nauplius larvae	5.5	5.6	3
Cladocera			
Ceriodaphnia sp.	0	0.5	0
Bosmina sp.	1	0	3
Daphnia sp.	0.5	3	2.5

Table IV. Correlation Matrix of Physico-Chemical Factors with Zooplankton Population for the Period of Feb. 2010 – Jan.

Parameters	PH	Temp	Turb	Hard	Cal	Mag	CO_2	D.O.	N.P.P.	G.P.P.	Alka	Chl	PO_4	SO_4	BOD	Rotif	Cope	Clad
PH	1.000	0.287	0.015	-0.631	-0.171	**-0.940***	-0.800	**0.980****	-0.830	**0.990****	-0.190	**0.999****	**0.958***	-0.565	-0.002	0.368	-0.641	0.845
Temp		1.000	**-0.954***	0.562	0.895	0.046	-0.804	0.473	-0.768	0.420	0.888	0.237	0.551	0.628	**0.957***	**0.996****	0.551	-0.270
Turb				-0.785	**-0.988****	-0.345	0.587	-0.186	0.539	-0.127	**-0.985****	0.067	-0.274	-0.833	**-1.000****	**-0.924***	-0.777	0.548
Hard					0.872	0.852	0.040	-0.463	0.098	-0.515	0.880	-0.671	-0.380	**0.997****	0.777	0.490	**1.000****	**-0.948***
Cal					1.000	0.487	-0.454	0.030	-0.401	-0.029	**1.000****	-0.223	0.123	**0.909***	**0.986****	0.854	0.866	-0.671
Mag						1.000	0.558	-0.859	0.605	-0.888	0.500	**-0.960***	-0.808	0.806	0.333	-0.040	0.859	**-0.974****
CO_2							1.000	**-0.904**	**0.998****	-0.877	-0.440	-0.768	**-0.939***	-0.042	-0.597	-0.852	0.053	-0.356
D.O.								1.000	**-0.928***	**0.998****	0.015	**0.968***	**0.996****	-0.389	0.198	0.546	-0.474	0.721
N.P.P.									1.000	**-0.914***	-0.387	-0.804	**-0.958***	0.017	-0.549	-0.819	0.112	-0.410
G.P.P.										1.000	-0.045	**0.981****	**0.989****	-0.443	0.139	0.496	-0.526	0.761
Alka											1.000	-0.237	0.105	**0.916***	**0.983****	0.845	0.873	-0.683
Chl												1.000	**0.941***	-0.608	-0.055	0.318	-0.680	0.872
PO_4													1.000	-0.304	0.286	0.620	-0.392	0.655
SO_4														1.000	0.826	0.559	**0.995****	**-0.919***
BOD															1.000	**0.929***	0.769	-0.537
Rotif																1.000	0.478	-0.187
Cope																	1.000	**-0.952***
Clad																		1.000

* = is significant at 0.05 level (2- tailed) ** = is significant at 0.01 level (2- tailed)
Turb = Turbidity, Hard= Hardness, Cal = Calcium, Mag = Magnesium,
Co_2 = Carbon-dioxide, D.O.= Dissolved oxygen,
N.P.P. = Net Primary Productivity, G.P.P.= Gross Primary Productivity,
Alka= Alkalinity, Chl.= Chloride, Po_4 = Phoshate, So_4= Sulphate,
BOD= Biological Oxygen Demand, Rotif= Rotifers, Cope= copepods, Clad= Cladocerans

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