Seasonal Fluctuations of Zooplankton Population Correlated With Some Physico-Chemical Factors in Sangmeshwar Project of Maharashtra, India

Khaire, B. S.
Dept. of Zoology, Anandrao Dhonde Alias Babaji College, Kada - 414202, Tq. Asthi, Dist. Beed, Maharashtra, India

Abstract

Limnological survey of Sangmeshwar Median water Project , Ieet district Osmanabad, Mahrashtra was undertaken for one year from Mar.2012 to Feb. 2013.with view of investigate the various changes in the hydro-biological features during different seasons and correlated the same with zooplankton productivity. Seasonal parameters like, Water temperature, transparency, Sp. Conductivity, pH, TDS, dissolved oxygen, carbon dioxide, alkalinity, hardness, Chlorides etc have been studied. The diversity and population dynamics of zooplankton is under the control of numerous physic-chemical factors. A study revealed that 17 genera of zooplanktons belonging to 4 groups viz. Rotifera, Cladocera, Copepoda and Ostracoda were observed. The population of zooplankton fluctuates along with the physicochemical factors. The present investigation showed positive correlations with parameters like DO, CO_2, transparency, conductivity where as water temperature, TDS, pH, Chlorides showed negative correlation correlations with zooplankton population. It was also observed that zooplanktons were more sensitive to temperature fluctuations.

KEYWORDS :- Zooplankton population, Correlation Coefficient, Physico-chemical factors, Sangmeshwar Project, Maharashtra

Introduction :

The quality of water is described by its physical, chemical and microbial characteristics. Freshwater ecosystems are highly diversified and having with wide range of physicochemical conditions, which greatly influences the aquatic life. The Zooplankton is an important group of micro-organisms found in aquatic ecosystems. The diversity and population dynamics of the zooplankton in fresh water ecosystem is controlled by several physico-chemical factors such as water temperature , pH, DO, free CO_2, alkalinity, chlorides etc. Zooplanktons indicates the trophic status of water body. Some of them are also acting as bio-indicators of organic and inorganic pollution of water body. The literature survey on zooplankton and biological indicators of water quality has been studied by many workers. The seasonal fluctuations of zooplankton in relation to physico-chemical factors and their correlations have been studied by many workers in India including Chandrashekhar and Kodarkar (1996), Dhanpathi (2000), Salaskar and Yeragi (2003), Surve P. R. et. al.(2004), Lendhe and Yeragi (2004), etc.

The present paper deals with the study of monthly variations in the physico-chemical parameters and their correlations with zooplankton population of Sangmeshwar mediumwater project, Ieet located in Bhoom taluka of Osmanabad district, Maharashtra, India. It lies Latitude -18- 57^0 to 19. 87^0 North and Longitude – 74. 39^0 to 76.54^0 East.

Material and Methods :

Various physicochemical observations were made during the period of March 2012 to Feb. 2013 of each month between 9.30 to 11.30 am. Physicochemical

parameters like water temperature, pH, transparency etc. were recorded at the sampling site. Other physic- chemical parameters analyzed in the laboratory as per standard methods for examinations of water given by APHA (1989), Trivedy (1984), Kodarkar (1998).

Zooplankton samples were collected by using a conical net with a mesh size of 120 µm and preserved in 4% formalin. The zooplankton species were identified with the help of identification keys given by APHA (1989), Battish (1992), Kodarkar (1998) and Dhanapathi (2000). The quantitative estimation was carried out by Sedgewick Rafter Cell method. Correlation co-efficient (r) is computed with the help of computer.

Results and discussion :-

Water contains dissolved and suspended constituents in varying proportion. They often have different physical and chemical properties along with the biological variation. The physicochemical environment of the water bodies found to be the limiting factors for controlling diversity and density of zooplanktons and other microorganisms. The present study helped to understand the effect of different physico-chemical parameters and their interactions among themselves in deciding the final biotic and abiotic environment of the water body.

Monthly values of various physic-chemical parameters are presented in Table 1. During the study period the water temperature was ranged between 19.2^0C to 28.5^0C. The minimum temperature was recorded in the month of Nov. and maximum in May. The pH of water ranged between 8 to 8.6. It was found to be minimum in winter and maximum in summer. Temperature brings out changes in pH. Singhal (1986) has obtained a direct relationship between water temperature and pH. The present study showed pH range favorable for aquatic life. The transparency ranged between 52 cm to 132.5cm. Over all transparency was observed maximum during the winter while it was observed minimum during the monsoon. Transparency decrease in monsoon is due to sewage discharge with rain water from the surrounding area. Bhatt (1999). The specific conductivity varied between 258 µ Mhos / cm to 320 µ Mhos / cm. Its maximum values were observed during summer season and least in winter. The range of TDS reported 140 mg/lit to 210 mg/lit. It was observed maximum during the month of May and minimum during the month of Nov. High values of conductivity and TDS in summer might be due to evaporation of water resulting in increased concentration of salts. Deshmukh and Ambore (2006).

Dissolved oxygen in water is the most important abiotic factor to indicate water quality. In the present investigation DO ranged between 2.8 mg/lit to 7.6 mg/lit. Peak values of DO were observed in winter followed by monsoon and summer. High values of DO in winter would be due to low temperature of water. The low DO in summer was because of high temperature. Trivedy and Goel (1988). Free CO_2 values ranged between nil to 11 mg/lit. The maximum CO_2 was recorded in the month of November and nil in the month of April &May. The absence of free CO_2 might be due to its utilization in photosynthetic activity. Sreenivasan (1974). The inhibition of CO_2 may be because of the formation of appreciable amount of carbonates in water. The alkalinity ranged from 110 mg/ lit. to 160 mg/lit. The alkalinity values of present water body generally remains higher than 100 mg/lit. indicates that the water body seems to have moderately contaminated due to domestic sewage and agricultural runoff. The hardness of water is the sum of concentration of alkaline earth metal cations present in it. In the present investigation hardness was ranged 56 mg/ lit to 104 mg/ lit. The hardness was observed maximum in summer and it may be due to

presence of high concentration of carbonates and bicarbonates. Similar results were observed by Lendhe & Yeragi (2004). The Chlorides ranged between 15.62 mg/ lit to 36.92 mg/ lit. High values of chlorides were recorded during summer months and it may be due to increased organic decomposition of animal origin. Yeole and Patil (2005). or it may be due to loss of water by evaporation. Wagh Nitin (1995). In natural water phosphates are present in small quantities. These were ranged between 0.12 mg/ lit to 0.56 mg/ lit. The values of phosphates were observed slightly more in monsoon season. Chavan R.J. (2002). The nitrates were ranged between 0.08 mg/ lit to 0.44 mg/ lit. It was recorded high during monsoon due to addition of domestic sewage and mixing of agricultural runoff.

Various physicochemical factors play an important role in the distribution and abundance of various aquatic organisms. Tonapi (1980). The physico-chemical factors such as light, pH, inorganic and organic constituents play an important role in determining the nature and pattern of fluctuations in population densities of zooplankton. Relation between various physico-chemical parameters and zooplankton diversity has been studied by many workers. Dhanpathi (2000), Salaskar and Yeragi (2003), Surve P. R. et. al.(2004), Lendhe and Yeragi (2004), etc.

A diverse collection of zooplankton reveals the presence of four groups viz. Rotifera, Cladocera, Copepoda and Ostracoda. Among the total zooplanktonic organisms group Cladocera was observed most diversified including nine genera viz. *Alonella, Bosmina, Ceriodaphnia, Chydorous , Daphnia, Moina, Sida , Simocephalus* and *Diphanosoma.* Three genera observed from group Rotifera were *Brachionus, Filinia, and Lecane.* Belonging to Copepoda, , *Microcyclops, ,Mesocyclops, Neodiaptomus , Phyllodiaptomus* these four genera were recorded. Genus *Cypris* was observed belonging to the group Ostracoda. Maximum zooplankton diversity was observed during the winter months.

Group wise population density (No./L) of zooplankton is listed in Table 2, Month wise population dynamics (density) of zooplankton components is listed in Table 3 and the correlation coefficient ('r' value) between physico-chemical parameter and zooplankton population for all possible correlation is computed and listed in Table 4.

The temperature play a prime role in the productivity of water. Temperature affects on the metabolic activities and proliferation of zooplankton. Shukla et.al. (1991). In the present study maximum number of zooplanktons were recorded during winter and they showed negative correlation (r = - 0.8535) of Zooplankton. He observed higher production of zooplankton during the period of low temperature and low production when the temperature was considerably high. Salaskar (2003) also observed negative correlation of zooplankton population with temperature. The pH is considered to be the most important factor regulating the plankton abundance. In present investigations the pH of the water showed alkaline range. The pH had negative correlation (r = - 0.7431) with zooplankton. Lendhe and Yeragi (2004) observed negative correlation between pH and zooplankton in water of Kharbhav lake of district Thane. Some workers consider transparency as limiting factor in plankton population. In the present investigation maximum transparency was observed late winter and early summer months. The transparency had a positive correlation (r = 0. 3152) with zooplankton. Salaskar and Yeragi (2003) observed weak positive correlation between transparency and zooplankton. Conductivity (- 0.7374) and TDS(-0.5945) showed significant negative correlation with zooplanktons.

Dissolved oxygen is most vital parameter which influences the plankton population. It showed significant positive correlation (r = 0.6073) with zooplankton population. Similar results were reported by Salaskar and Yeragi (2003) and Surve et.al.(2004). An inverse relationship between zooplankton and DO was reported by Asif Khan et. al (1986). Free carbon dioxide is another important parameter. Maximum values of carbon dioxide were observed in winter season when temperature was minimum. The zooplankton showed positive correlation (r = 0.2615) with free CO_2 Surve et. al (2004) recorded positive correlation between zooplankton and CO_2.

In the present investigation zooplankton population showed positive correlation with alkalinity (r = 0.4520), Surve et. al observed positive correlation between zooplankton and alkalinity. While it showed negative correlation with total hardness (r = -0.4810) and chlorides (r = -0.5513). The nutrients like phosphates and nitrates play an important role in the biological activities. The nutrient level of the water body seemed to be poor. In the present investigation zooplankton population had positive correlation with phosphates (r = 0.4478) and nitrates (r = 0.5812). Salaskar et.al (2003) observed negative correlation with nitrates.

Table 1 Monthly values of Physico-chemical parameters of Sangmeshwar water project during Mar.2012 to Feb.2013

Season	**Summer**				**Monsoon**				**Winter**			
Parameter	**Mar. 2012**	**Apr. 2012**	**May 2012**	**Jun. 2012**	**Jul. 2012**	**Aug. 2012**	**Sept. 2012**	**Oct. 2012**	**Nov. 2012**	**Dec. 2012**	**Jan. 2013**	**Feb. 2013**
Water Temp	24.7	24.8	28.5	28.4	25.4	23.5	22	20.8	19.2	19.5	21.2	23.6
pH	8.3	8.6	8.5	8.2	8.2	8.1	8.2	8.2	8.3	8	8.2	8.2
Transparency	120	115	106	96.5	52	76.5	93	110	117.5	129	132.5	130
Sp. Conductivity	296	303	320	281	272	258	264	262	272	266	268	291
TDS	186	200	210	198	172	162	158	150	140	176	180	176
Diss. Oxygen	4.2	4.6	5.2	2.8	6.6	4.8	6.8	7.2	3.3	7.6	5.8	5.4
Free CO_2	3.4	0	0	3.9	3.74	3.52	5.06	6.8	11	6.6	6.8	4.4
T. Alkalinity	160	155	135	145	130	125	130	110	125	140	145	155
T. Hardness	104	100	98	88	84	86	88	56	80	84	90	92
Calcium	32.86	34.46	28.85	30.46	27.25	22.66	23.24	16.83	27.25	23.24	21.64	28.55
Magnesium	10.72	9.74	8.77	10.23	9.74	9.25	5.84	2.92	3.41	5.84	6.33	7.79
Chlorides	29.82	31.24	36.92	29.82	22.72	29.82	26.98	15.62	18.46	19.88	21.3	21.23
Phosphates	0.29	0.12	0.42	0.34	0.56	0.32	0.42	0.34	0.32	0.26	0.34	0.32
Nitrates	0.08	0.34	0.09	0.24	0.32	0.44	0.34	0.24	0.3	0.34	0.09	0.16

Table 2. Group wise population dynamics (density) of zooplanktons during Mar. 2012 to Feb. 2013.

Season	**Summer**				**Monsoon**				**Winter**				Total
Zooplankton group	Mar. 2012	Apr. 2012	May. 2012	Jun. 2012	Jul. 2012	Aug. 2012	Sept. 2012	Oct. 2012	Nov. 2012	Dec. 2012	Jan. 2013	Feb. 2013	

Rotifera	132	195	208	141	64	64	37	88	111	106	100	100	1346
Cladocera	46	67	81	104	77	51	52	90	87	73	138	66	932
Copepoda	13	8	0	44	90	57	46	44	75	79	73	65	594
Ostracoda	40	21	26	48	18	12	42	29	37	51	30	23	377
Total	**1174**				**961**				**1214**				**3249**

Table 3. Month wise population dynamics (density) of zooplankton components during Mar. 2012 to Feb. 2013.

Season	**Summer**				**Monsoon**				**Winter**				
Zooplankton group	**Mar. 2012**	**Apr. 2012**	**May. 2012**	**Jun. 2012**	**Jul. 2012**	**Aug. 2012**	**Sept. 2012**	**Oct. 2012**	**Nov. 2012**	**Dec. 2012**	**Jan. 2013**	**Feb. 2013**	**Total**
ROTIFERA													
Brachionus sp.	52	74	88	88	22	14	15	40	55	74	84	94	**700**
Filinia	22	41	43	0	24	24	12	36	43	18	0	0	**263**
Lecane	58	80	77	53	18	26	10	12	13	14	16	6	**383**
Total	**132**	**195**	**208**	**141**	**64**	**64**	**37**	**88**	**111**	**106**	**100**	**100**	**1346**
CLADOCERA													
Alonella	0	0	0	0	21	17	21	17	13	12	7	6	**114**
Bosmina	8	35	20	22	0	0	0	0	0	0	17	23	**125**
Ceriodaphnia	22	7	15	26	8	12	8	10	6	0	21	0	**135**
Chydorus	16	8	25	23	18	0	0	13	12	14	27	0	**156**
Daphnia	0	9	6	19	9	5	6	12	15	15	26	15	**137**
Moina sp	0	0	0	0	11	7	12	22	23	11	22	12	**120**
Sida	0	8	7	14	0	0	0	7	0	9	18	10	**73**
Simocephalus	0	0	8	0	10	6	0	0	0	0	0	0	**24**
Diphanosoma	0	0	0	0	0	4	5	9	18	12	0	0	**48**
Total	**46**	**67**	**81**	**104**	**77**	**51**	**52**	**90**	**87**	**73**	**138**	**66**	**932**
COPEPODA													
Microcyclops	0	0	0	12	30	26	18	21	41	45	35	22	**250**
Mesocyclops	0	0	0	21	29	14	20	23	34	34	23	17	**215**
Neodiaptomus	0	0	0	0	15	11	8	0	0	0	15	9	**58**
Phylodiaptomus	13	8	0	11	16	6	0	0	0	0	0	17	**71**
Total	**13**	**8**	**0**	**44**	**90**	**57**	**46**	**44**	**75**	**79**	**73**	**65**	**594**
OSTRACODA													
Cypris sp.	**40**	**21**	**26**	**48**	**18**	**12**	**42**	**29**	**37**	**51**	**30**	**23**	**377**

Table 4. Showing co-relation coefficient between Zooplankton population and some physicochemical parameters.

Physicochemical parameters	**Rotifera**
Zooplankton and Water Temperature	-0.8535
Zooplankton and pH	-0.7431
Zooplankton and Transparency	0.3652
Zooplankton and Sp. Conductivity	-0.7374
Zooplankton and TDS	-0.5945

Zooplankton and Dissolved Oxygen	0.6073
Zooplankton and Free CO_2	0.2615
Zooplankton and T. Alkalinity	-0.4520
Zooplankton and T. Hardness	-0.4810
Zooplankton and Chlorides	-0.5563
Zooplankton and Phosphates	0.3633
Zooplankton and Nitrates	0.3415

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