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RESEARCH ARTICLE

Ecological studies of zooplankton found in fresh water of Khindsi lake, Nagpur, Maharashtra

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SUMMARY: A group of zooplanktons is the characteristic indicator of water quality, eutrophication and pollution status and also form an important link in the aquatic food chain. The knowledge about zooplankton present in Khindsi lake in Nagpur district of Maharashtra is not yet known. An attempt has been made to investigate the seasonal variations in zooplankton along with physico-chemical parameters. The present work was carried out for two years (June 2007 - May 2009) to collect data, abiotic and biotic components of Khindsi lake. The biological indicator *i.e.,* zooplankton attained the lowest and the highest population 123.00 ± 35.69 in 2007-2008 and 133.00 ± 42.67 in 2008-2009, respectively. Zooplanktonic communities in these years were represented by *Rotifer, Ostracoda, Cladocera* and *Copepoda*. The abundance of *Ostracoda* of total zooplankton was significantly low during the winter season when compared to monsoon and summer seasons, during which the abundance of all these variables was significantly higher. In all 768.0 zooplanktonic forms were recorded. During the entire study period fourteen positive and six negatively significant correlations were observed. The regression analysis revealed that *Rotifers* are positively correlated with chloride and T.S. *Ostracodas* were positively correlated with T.S., chloride and hardness. *Cladocera* with hardness and *Copepoda* positively correlated with hardness, T.S. and temperature. In general, group-wise composition of zooplankton communities indicated the following ranking: *Copepoda* > *Rotifers* >*Cladocera* > *Ostracoda*.

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Key Words : Zooplankton, Abundance, Khindsi lake, Regression, Eutrophication

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Zooplanktons are microscopic organisms that formulate the base of food chains and food webs in all aquatic ecosystems. They are mostly small, many of them are minute, and their structure can only be seen clearly with the aid of a binocular or compound microscope, with the exception of some large animals. Although they belong to different taxa, they have one thing in common *i.e.* lack of strong locomotory organs like fish, they are weak in locomotion and can only drift about in water at mercy of waves and currents, being incapable of moving anywhere as fish (Zheng Zhong, 1984).

Zooplankton plays an important food item of omnivorous and carnivorous fishes, (Alam *et al.,* 1987). The larva of carps feed mostly on zooplankton (Bardach *et al.,* 1972) because zooplanktons provide the necessary amount of protein required for the rapid growth and development of different organs in fishes and also brood fishes productivity. Many researchers worked on the physico-chemical conditions and seasonal variations of zooplankton (Ali and Islam, 1981; Bhuiyan *et al.*, 1981, Bhuiyan and Nessa (1998) and Cottenie *et al.,* 2001).

The present study has been undertaken to know the role of zooplankton on the seasonal variations and occurrence of some zooplankton in respect to physico-chemical parameters in Khindsi lake near Nagpur city.

EXPERIMENTAL METHODOLOGY

Morphology of lake :

This investigation has been conducted in Khindsi lake site at outskirts of Ramtek Tahsil near

Nagpur city of Vidarbha region (21^{0}24' N latitude and 79^{0}2' E longitude) and altitude of 345.0 mt. above mean sea level and 65 Km away from Nagpur.

The water of lake was clear and vegetation on the periphery was sighted during the study period. The lake water receives direct sunlight throughout the day.

Sample collection :

Water sample were collected seasonally (June 2007 - May 2009) from surface layer. Water temperature was recorded by a centigrade thermometer and pH was noted by digital pH meter. DO was determined immediately by Winkler's method (APHA-2005) and other chemical parameters such as alkalinity were estimated according to the procedure given by Welch (1952). Zooplanktons were collected by a plankton net of no. 20 count bolting cloth and the numerical assessment was done by Sedgewick-Rafter counting cell. They were identified with the help of compound microscope and by following the keys given by Ward and Whipple (1959).

EXPERIMENTAL FINDINGS AND DISCUSSION

Some selected physico-chemical parameters of water were studied which are presented in Table 1. Table 2 represents the seasonal values and diversity of zooplankton variables. Interrelation between zooplankton and environmental variables are shown in Table 3. Percentage population of plankton variables are shown in Fig. 1a,b and 2a, b.

Season wise grouped data revealed that rotifers readings were almost similar for both the years during the study period of monsoon season. The abundance of rotifers was dominant in summer season. They showed positive correlation with 15 physico-chemical variables and negative correlation with 5 variables (Table 3).

Rotifers are one of the most important organisms which determine the degree of water pollution. Certain species and genera of rotifers are used as indicators of water quality, eutrophic status and productivity of a water ecosystem (Sladeek, 1983).

In the present study, rotifers showed the strongest positive correlation (r = 1.0) with potassium (r = 0.995) with TDS (r = 0.992) with calcium hardness and negatively correlated with DO (r = -0.947) and fluoride (r = -0.812) (Joseph and Yamakanamardi , 2010).

***Ostracodas* :**

Season wise grouped data revealed that, the abundance of ostracodas was almost similar in monsoon, winter and

Table 1: Seasonal changes in the environmental (water quality) variables in Khindsi lake, Nagpur, (June 2007- May 2009)

Sr. No.	Season Parameter	Year 2007-2008						Year 2008-2009					
		Monsoon	Winter	Summer	Average			Monsoon	Winter	Summer	Average		
1.	Temperture	21	19	28	22.67	±	3.86	22	20	28	23.33	±	3.40
2.	pH	7.95	7.65	7.8	7.80	±	0.12	7.9	7.6	7.82	7.77	±	0.13
3.	Conductivity	0.231	0.219	0.312	0.25	±	0.04	0.232	0.217	0.331	0.26	±	0.05
4.	Turbidity	0	0	0	0	±	0	4	0	0	1.33	±	1.89
5.	Alkalinity	142	89	98	109.67	±	23.16	148	92	110	116.67	±	23.34
6.	Hardness	217	200	252	223.00	±	21.65	228	197	265	230.0	±	27.80
7.	Ca-Hardness	108	118	169	131.67	±	26.71	107	112	172	130.33	±	29.53
8.	Mg-Hardness	109	82	83	91.33	±	12.50	121	85	93	99.67	±	15.43
9.	T.S.	1800	1400	1700	1633.33	±	169.97	1898	1680	1980	1852.6	±	#####
10.	T.D.S.	980	980	990	983.33	±	4.71	838	981	900	936.33	±	69.63
11.	T.S.S.	820	420	710	850.00	±	168.72	1060	699	990	916.33	±	####
12.	D.O.	6.5	7.2	8.1	7.27	±	0.65	6.8	7.8	8.3	7.63	±	0.62
13.	Fluoride	0.129	0.11	0.147	0.13	±	0.02	0.11	0.113	0.149	0.12	±	0.02
14.	BOD	1.97	2.7	3.1	2.59	±	0.47	1.98	1.91	2.85	2.25	±	0.43
15.	COD	280	210	240	243.33	±	28.67	268	255	248	257.00	±	8.29
16.	Chloride	177	137	198	170.67	±	25.30	189	148	210	182.33	±	25.75
17.	Sulphate	37	39	47	41.00	±	4.32	33	45	49	42.33	±	6.80
18.	Phosphate	1.3	1.1	2.3	1.57	±	0.52	1.5	1.2	0.98	1.23	±	0.21
19.	Sodium	22	18	16	18.67	±	2.49	18	19	15	17.33	±	1.70
20.	Potassium	8	11	9.8	9.60	±	1.23	8	10	9.2	9.07	±	0.82

summer season (Table 2). In the present study, Ostracoda showed significant positive correlation (r= 0.927) with total hardness, calcium hardness (r = 0.601) and T.S.(r= 0.997) and negative correlation with sulphate, phosphate, sodium and potassium.

The regression analysis of Ostracoda in all seasons revealed that 99.7 per cent of its variation was due to total solids. They are positively correlated with 14 physico-chemical variables (Table 3).

***Cladocera* :**

The abundance of cladocera shows similar findings for both years Table 2, and shows significant positive correlation with T.S. (r=0.991), ca hardness (r=0.753), hardness (r=0.985), and negative correlation with sodium (r = -0.919) and TDS (r=-0.072) Table 3.

Towhid and Kabir (2003) studied the relationship between zooplankton abundance and physico-chemical

Table 2 : Average seasonal values and diversity of zooplankton in water of Khindsi lake during June 2007-May 2009

Sr. No.	Zooplankton variables	Season 2007 - 2008					Season 2008 - 2009				
		Monsoon	Winter	Summer	Average	Diversity	Monsoon	Winter	Summer	Average	Diversity
1.	*Rotifers*	42	17	47	35.33±13.12	424	45	22	59	42.00±15.25	504
2.	*Ostracoda*	15	9	14	12.67±2.62	152	12	8	13	11.00±2.16	132
3.	*Cladocera*	33	23	35	30.33±5.25	364	31	17	40	29.33±9.46	352
4.	*Copepoda*	47	25	62	44.67±15.20	536	51	31	70	50.67±15.92	608
5.	Total plankton	137	74	158	123.00±35.69	1476	139	78	182	133.0±42.67	1596

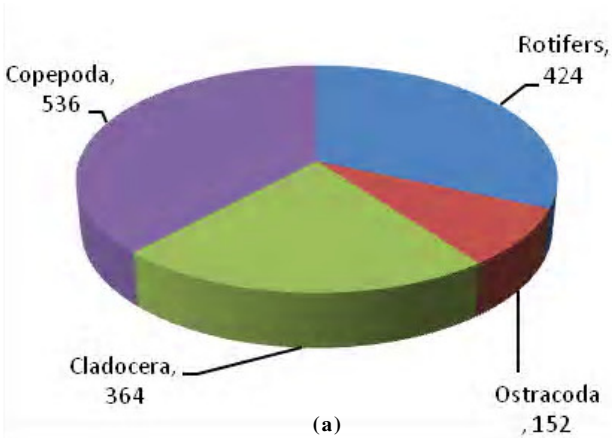


Fig. 1 : Population density of zooplankton 2007-2008

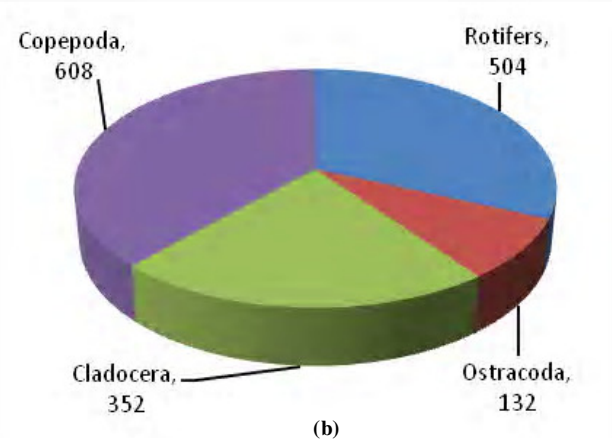


Fig. 1 : Population density of zooplankton 2008-2009

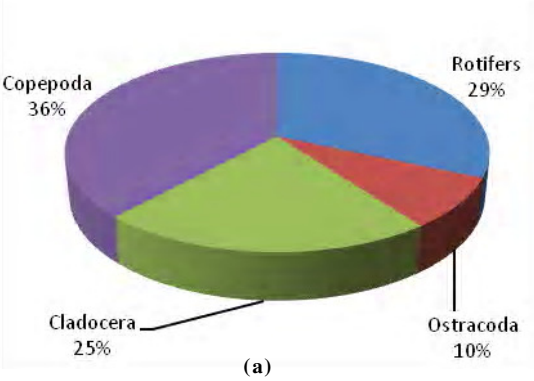


Fig. 2 : Percentage population of zooplankton 2007-2008

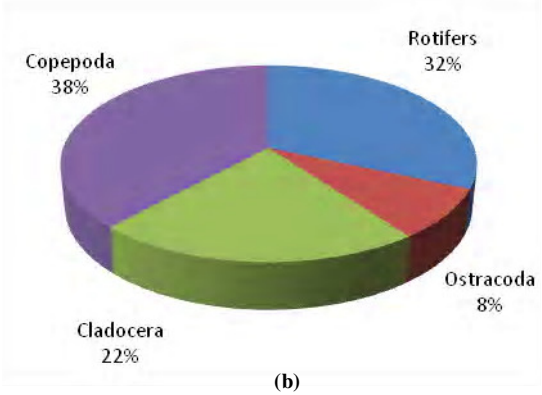
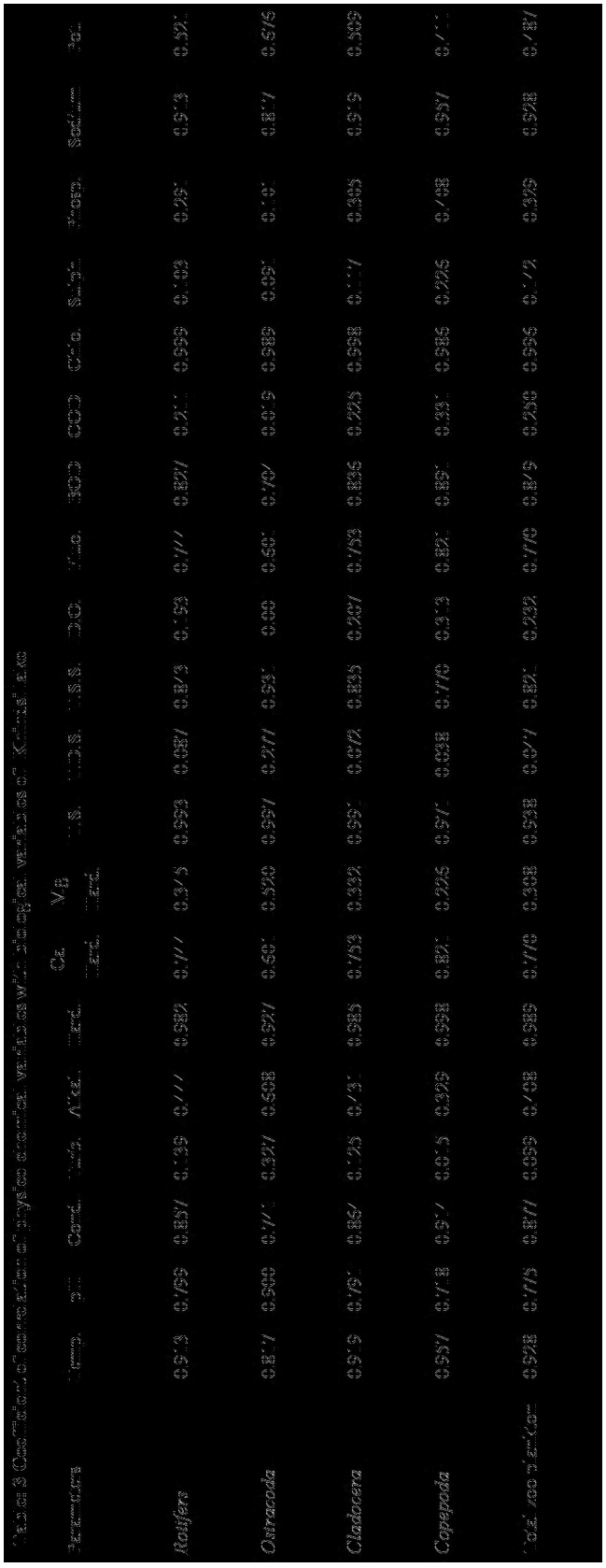


Fig. 2 : Percentage population of zooplankton 2008-2009



parameter in lake Sunderban (Bangladesh) and reported that Cladocerans were positively correlated with calcium.

In the present investigation, the regression analysis for all seasons denotes almost 100 per cent due to T.S. and hardness.

***Copepoda* :**

The copepodas constitute dominant plankton group of both fresh and marine habitats. It includes Cyclops male and female. Copepodas were significantly low during winter season as compared to summer and monsoon season Table 2.

However, the abundance of copepodas showed positive correlation with hardness (r = 0.998), ca hardness (r = 0.821) conductivity (r=0.914) and negative correlation with sodium (r=-0.957) Table 3.

The regression analysis in all the seasons shows that 99.8 per cent of the variation was due to hardness, temperature (95%) , T.S. (97.1%) and pH (71.8%) (Table 3). Munawar (1970), studied limnology of fresh water pond in Hyderabad, India and reported that the abundance of cyclopoids showed positive correlation with pH of the water.

Abundance of total zooplankton :

The sum of all zooplankton, is significantly less during winter seasons (Table 2).

A wide diversity of zooplankton was found in the lake water during the investigating period. The data of two years with reference to number of zooplanktons per season and average percentage of total population of zooplankton species are given in Fig 1a, b and 2a, b. The dominant group of zooplankton was the copepoda and rotifer during the investigating years, constituting 38 per cent and 32 per cent of total zooplankton population. The ostracoda found in the dam water was a few in numbers and their population percentage during two years was 10 per cent and 8 per cent, respectively, (Tijare and Thosar, 2010).

Environmental (water quality) variables :

The physico-chemical variables *i.e.* temp., pH, conductivity, turbidity, chloride, alkalinity, hardness, DO, fluoride, sulphate, phosphate, sodium and potassium did not show any significant difference in both the years (Table 1). Total solids and COD were significantly more during summer season, when compared to monsoon and winter seasons. These results are in good agreement with those of Khan *et al.*, (2005) who observed significant fluctuation in the physico-chemical analysis. In general, group wise composition of zooplankton communities indicated the following ranking: *Copepoda* > *Rotifers* >*Cladocera* > *Ostracoda.*

Conclusion :

It is evident from the present study that several (water

quality) variables *viz.*, temp, DO, pH, alkalinity, turbidity, phosphate, showed a little variation, but all the parameters were within the normal range and showed positive correlation with zooplankton variables. It is good indication for fish culture and ecology.

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