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Zooplankton diversity in relation to physicochemical parameters of perennial pond

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Abstract

Background & Aim: The present study deals with Zooplankton population and physico-chemical characteristics of a perennial pond of Tarikere city. **Methodology:** Sampling was done monthly between 8am and 11am, from January 2014 to December 2014 and analyzed the various parameters such as, air and water temperature, pH, Dissolved oxygen, Alkalinity hardness, calcium, and magnesium, BOD, CO_2, Sulphate, Phosphate and Chloride. **Results:** Air temperature was minimum in December (23.5°C) and maximum during June (37.5°C), and water temperature ranged from 18.4°C in December to 36.3°C in June. The pH ranged from 7.0 to 8.1. Dissolved Oxygen ranged from 3.24mg/L to 7.33mg/L. BOD ranged from 4.0mg/L to 6.88mg/L, CO_2 was maximum 7.7mg/L in February and minimum 3.1mg/L in May. Phosphate ranged from 0.31mg/L to 0.36mg/L and Sulphate ranged from 120mg/L to 170mg/L. Total 18 Zooplankton species were found under the five different groups, such as Cladocera (3 Sp), Rotifera (6 Sp), Cepepoda (4 Sp), Ostrocoda (2 Sp) and Protozoa (3 Sp). **Conclusions:** Rotifers were found to be maximum compare to other groups of Zooplankton. The large amount sewage water is introduced to the pond that leading to increasing nutrient content and amount of phosphate in the water body which indicates that water is eutrophic in nature.

Keywords*:* Water parameters, Zooplanktons, Diversity, perennial pond .

1. Introduction

Water supports life on earth and around which the entire fabric of life is woven. Ponds, as source of water, are of fundamental importance to man. However, pond may have been a natural water source exploited by man at different time to meet different needs, or may have been created for a multitude of different purpose e.g. domestic or agricultural use, for transport, defence, ritual or industrial use, social aggrandizement, swimming, fish farming or the creation of the picturesque (Rajagopal 2010; Bishnoi and Malik, 2008). The major problems of standing water bodies have been recognized for at least two decades, but their classification and quantification of environmental managers has proved elusive. The Indian environment managers/researchers have recently described the condition of Indian freshwater resources and their management as prominent environmental issues. Nutrition enrichment, acidification and domestic waste, sewage, agricultural and industrial effluents contamination by toxic substances identified as major impacts (Sachidanandamurthy and Yajurvedi, 2006; Parashar et al., 2008). The requirement of water to all living organisms, from micro-organisms to man, is a serious challenge today because all water resources are polluted due to unplanned urbanization and industrialization. In India, natural ponds are estimated to have an area of about 0.72 million ha, most of which are found in the vicinity of villages, places of religious worship and other human inhabitations. This makes them quite vulnerable for human impact and changes day by day, measuring which would probably give a clear picture about the pollution stress on them.

Zooplankton constitutes important food item of many omnivorous and carnivorous fish. The larvae of carps feed mostly on zooplankton (Dewan S, M. Ali and M.A. Islam, 1977). Zooplankton also plays a very

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important role in the food chain as they are in the second of the tropic level as primary consumers and also as contributes to the next tropic level (Qasim, S.Z., 1977). Many researchers worked on the physicochemical conditions and seasonal variations influence on zooplankton namely Ali et al 1989, Bhuiyan et al 1998 and Cottenie et al 2001.

Zooplankton mediate the transfer of energy from lower to higher tropic level thus zooplankton represent an important link in aquatic food chain and contribute significantly to secondary production in fresh water ecosystem (Sharma, 1984). Zooplankton communities respond to a wide variety of disturbances including nutrient loading, acidification and sediment input. It has immense significance in fisheries (Jhingran, 1974). Zooplanktons also play an important role as indicators of tropic condition in both cold temperate and tropical waters (Sharma, 1984). The most common and severe problem is the enrichment of the water body by a nutrient that increases the biological growth and renders the water bodies unfit for diverse uses. Nutrients that are present in fertilizers as well as in domestic and industrial waste water have been identified as main cause for changing the tropic status of water bodies from oligotrophic to mesotropic to eutropic. Although zooplankton exists under a wide range of environmental condition, yet many species are limited by dissolved oxygen, pH, salinity and other physico-chemical factors. Hutchinson (1967) have reported several other factors like dissolved oxygen, pH, alkalinity, and temperature light and grazing affect on zooplankton population.

Studies on planktonic composition and morphometric, physical and chemical characterization of water bodies are necessary to obtain basic knowledge on the biodiversity in a given region. Therefore, present work is aimed to study the physicochemical characteristics and zooplankton species diversity to measure the pollution status of perennial pond of Tarikere, Karnataka.

2. Materials and Methods

Present study was carried out on a fresh water body of perennial pond of Tarikere. The pond is used as drainage basins into which the surface runoff water and sewage from the surrounding city area is enters. Different physicochemical parameters were analyzed monthly from January 2014 to December 2014. Samples were collected from 8 am to 11 am. Air and water temperature of water were recorded and pH was determined at the sites. Dissolved oxygen analysis was performed of the sites by Winkler's modified technique according to APHA (1995).

For zooplankton analysis, samples were collected from the water body on a monthly basis. 100 litres of water is filtered by passing water through plankton net made up of bolting silk cloth having mesh size of 25 micrometer. Samples were then washed into wide mouth bottles and were preserved by adding 5% formaldehyde solution. Further analysis was done by putting 1 ml of the preserved sample on a Sedgwick-Rafter cell and studying it under an inverted microscope. For qualitative analysis, the keys given in Edmondson (1959), Needham and Needham (1941), Pennak (1978), Tonapi (1980) and APHA (1995) were utilized and results were expressed in No. /L.

3. Result and Discussion

The air temperature ranged from 23.5°C to 37.5°C, while water temperature ranged from 18.4°C to 36.3°C (Table I), pH ranged from 7.0 to 8.1. Dissolved oxygen ranged from 3.24mg/l to 7.33mg/l, due to the increased

Table I. Monthly variations in various physico-chemical parameters in study pond (mg/L)

Parameters	J	F	M	A	M	J	J	A	S	O	N	D	AVG.
Air temp (°C)	25	27.6	30.3	34.4	36.3	37.5	36.2	34	32.3	29.1	26	23.5	33.1
Water temp (°C)	22.1	24.8	26.5	30.5	34.6	36.5	35.5	33.2	30.2	27.3	23.2	18.4	31.3
pH	7	7.1	7.2	7.4	7.3	7.4	8.0	7.8	7.6	7.3	7.1	7	8.05
DO	7.33	5.12	3.24	4.13	6.05	7	5.24	5.9	6.1	6.4	7	7.2	5.89
BOD	6.12	6.41	4	5.14	6.1	6.88	5	5.5	6	6.5	6	5.5	5.76
CO_2	6.4	7.7	4.2	4	3.1	6.3	6.5	7	6.8	7.3	7	6.5	6.71
Alkalinity	130	140	150	170	160	180	210	190	170	150	140	130	164.16
Total hardness	170	185	170	176	180	200	200	180	170	175	150	160	266.66
Calcium hardness	74	84	75	78	85	95	90	87	60	65	50	58	75.08
Magnesium hardness	44.5	47.3	25.2	34.4	42.1	30.3	20.5	31.4	25	40.6	45	40	35.52
Phosphate	0.35	0.34	0.36	0.31	0.35	0.36	0.32	0.33	0.36	0.32	0.34	0.36	0.3416
Sulphate	130	120	150	170	120	160	140	130	140	120	130	140	137.5
Chloride	55.3	58.3	85.1	72.2	46.1	75.1	65.3	60	55.4	63.2	75.3	65.3	64.71
TDS	305	292	340	390	320	290	460	650	580	360	540	460	415.58

photosynthetic activity the dissolved oxygen is higher in some months, while DO is lower in some months because of its utilization in decomposition of organic matter and respiration of micro and macro organisms. BOD is ranged from 4.0 mg/l during March to 6.88mg/l in June. The minimum value 3.1mg/l of CO_2 was recorded during the May and maximum 7.7mg/l during February. Total alkalinity was lower 130mg/l was recorded in January and higher alkalinity 210mg/l was recorded in July. Varying alkalinity was found to be related with the fluctuation in the photosynthetic rate of phytoplankton. Water with alkalinity greater than 100mg/l is productive (Alikunhi, 1957). Hardness ranged from 150mg/l during November to 200mg/l during June and July. Higher value of hardness might be due to the evaporation of water of higher temperature during summer months. Phosphate ranged from 0.31mg/l in April to 0.36mg/l in March. Increased phosphate were recorded during the study period due to the incoming sewage including household detergents, kitchen waste, human excreta etc, in the present study the lower total dissolved solids (TDS) 290mg/l were recorded in June and maximum TDS 650mg/l were recorded in August. TDS shows variations due to the addition of dissolved substances and utilization by organisms and other aquatic plants and animals during different months. Lower levels of TDS might be due to loss of nutrients into sediments and their utilization by plankton and other aquatic plants. An excess amount of TDS in water tends to suffocation in aquatic fauna even in the presence of fair amount of dissolved oxygen (Trivedi and Goel, 1984).

The total zooplankton number fluctuated from 43 to 192 N/ml. The fresh water zooplankton fauna of present water body comprised of five major groups i.e. the Cladocera with 3 species, Rotifers with 6 species, Copepods with 4 species, Ostrocods with 2 species and Protozoa with 3 species (Table II). Among these Zooplanktons, Rotifers with 455 No/L (37%) are the dominant group, Cladocera are the second dominant group with 296 No/L (24%), Copepoda are 277 No/L

Table II. Distribution and abundance of Zooplankton (No. /L) in the study pond

	MONTHS												
Genera	J	F	M	A	M	J	J	A	S	O	N	D	Total
Cladocera													
Ceriodaphnia cornata	5	8	9	4	3	1	0	1	1	3	5	13	
Moina brachiata	18	6	3	4	6	5	4	2	3	5	9	14	
Daphnia Spp.	35	8	7	8	6	3	9	5	20	15	20	28	
Total	**58**	**22**	**19**	**16**	**15**	**9**	**13**	**8**	**24**	**23**	**34**	**55**	**296**
Rotifera													
Keratella tropica	3	4	3	3	2	1	0	1	1	3	2	1	
Branchionus bidentata	18	26	8	15	7	3	1	1	4	5	7	12	
branchionus angularis	28	17	13	20	14	2	4	2	7	9	16	20	
Branchionus calciflorus	10	16	15	7	1	0	0	1	1	2	4	5	
Filinia longisita	13	6	5	0	1	4	1	2	0	2	4	7	
Rotataria spp.	8	7	7	9	3	6	8	4	3	3	2	5	
Total	**80**	**76**	**51**	**54**	**28**	**16**	**14**	**11**	**16**	**24**	**35**	**50**	**455**
Copepoda													
Diaptonus spp.	8	3	2	1	0	1	0	0	4	7	5	3	
Mesocyclops spp.	2	12	2	0	1	2	1	8	13	7	9	10	
Cyclops spp.	6	4	3	5	2	1	7	3	4	6	5	6	
Tropocyclops prasimus	10	20	11	17	8	10	8	5	7	6	10	12	
Total	**26**	**39**	**18**	**23**	**11**	**14**	**16**	**16**	**28**	**26**	**29**	**31**	**277**
Ostracoda													
Cypriodopsis spp.	5	4	3	8	2	0	3	2	1	3	3	4	
Cypris spp.	17	10	8	20	0	2	1	5	8	11	9	15	
Total	**22**	**14**	**11**	**28**	**2**	**2**	**4**	**7**	**9**	**14**	**12**	**19**	**144**
Protozoa													
Amoeba	2	1	3	2	0	1	1	0	0	1	3	2	
Paramecium	3	3	2	1	2	1	0	1	0	2	1	2	
Verticella	1	2	2	0	1	0	1	0	1	0	2	1	
Total	**6**	**6**	**7**	**3**	**3**	**2**	**2**	**1**	**1**	**3**	**6**	**5**	**45**
Grand Total	**192**	**157**	**106**	**124**	**59**	**43**	**49**	**43**	**78**	**90**	**116**	**160**	**1217**

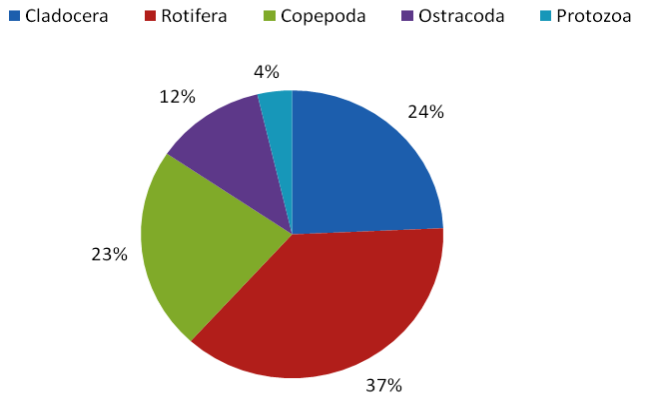

Figure I. Distribution of Zooplankton in the pond during study period

(23%), Ostrocodes are 144 No/L (12%) and protozoan are formed least group with 45 No/L (4%) (Fig I) during the study period. In the present study the Zooplanktons are abundant (192 No/L) in the month of January, the high amount of DO and pH of the water body might be influenced to enhance the Zooplankton population. And these populations are slightly decreased by increasing the water temperature and least (43 No/L) population of Zooplankton were recorded in the month of June 2010 (Fig II).

A total of 6 genera were recorded belonging to Rotifers i.e. *Keretella tropica, Brachionus bidentata, B. angularis, B. calciflorus, Filinia longisita* and *Rotataria* sp. (Table II). These are very important bioindicators (Sladecek, 1983; Berzins and Pejler, 1987). Copepods are the second most abundant group represented by *Diaptonus* sp. *Mesocyclops* sp., *Cyclops* sp. and Tropocyclops prasimus. The three genera were recorded belonging to Cladacers i.e. *Moina branchiate*, *Cornata* and *Daphnia* Sp. The Ostracoda group was represented by two genera i.e. *Cypriodopsis* sp. and *Cypris* sp. these are formed least diversity among the Zooplankton. Protozoan group was represented by three genera i.e. Protozoa, Amoeba and Verticella and these are formed very low density in present pond during the study period.

Conflict of interest

The author's declares none.

References

Ahmad V. *et al.,* 2011, Zooplankton population in relation to physico-chemical factors of a sewage fed pond of Aligarh (UP), India. Research article, biology and medicine, Vol.3 (2) Special Issue: 336-341,

Ali, S., A.N. Chowdhury, D.R. Chowdhury and S. Begum, 1989. Studies on seasonal variations of physicochemical and biological conditions in a pond. Dhaka Univ. Study. Pt. E., 4(2): 113-123.

APHA. 1995. Standard Methods for Examination of water and waste water. 19th ed., American Public Helth Association, Washington, DC, USA, p.1108.

Bhuiyan, A.S. and Q. Nessa, 1998. A quantitative study of zooplankton in relation to the physicochemical conditions of a freshwater fish pond of Rajshahi. *Univ. J. Zool.* Rajshahi Univ., 17: 29-37.

Bishnoi, M. and R. Malik: Ground water quality in environmentally degraded localities of panipat city, India. J. Environ. Biol., 29, 881-886 (2008).

Cottenie, K., N. Nuytten, E. Michels and L.D. Meester, 2001. Zooplankton community structure and environmental conditions in a set of interconnected ponds. Hydrobiol., 442: 339-350.

Dewan, S., M. Ali and M.A. Islam, 1977. Study on the size and patterns of feeding of fries and fingerlings of three major carps, eg. *Labeo rohita* (Ham), *Catla catla* (Ham) and *Cirrhina mrigala* (Ham). Bangladesh J. Agricul., 2(2): 223-228.

Edmondson, W.T, 1959 Fresh water biology 2nd edition.

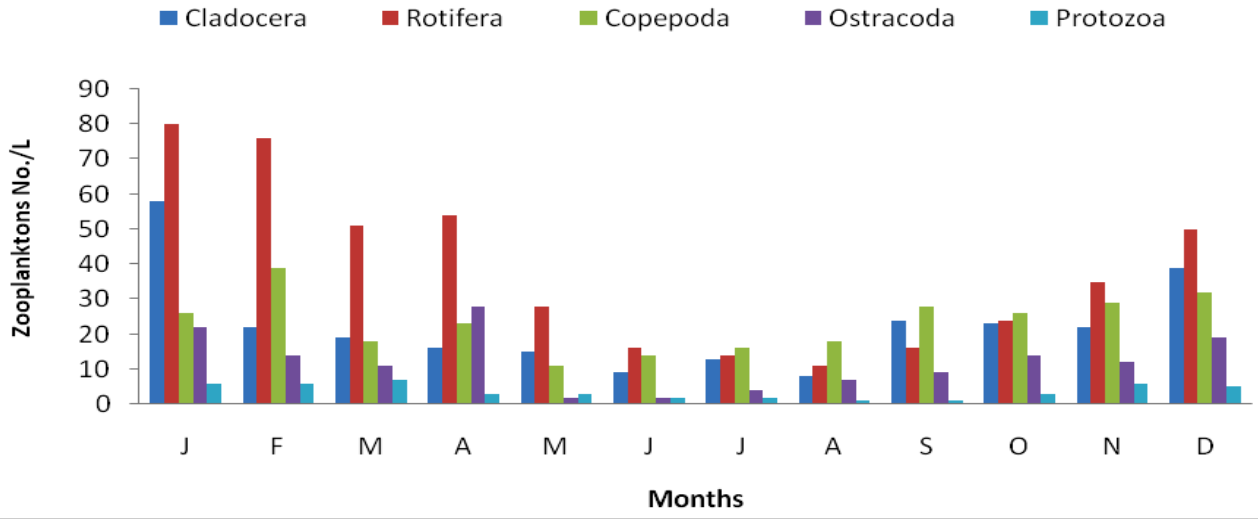

Figure II. Monthly Variations of Zooplanktons in the pond during the study period

Jhon Wiley and sons, New York, USA.

Hutchinson, G.E. 1967, A trealise on Limnology, vol.2. Introduction to Lake Biology and Limnoplankton, Jhon Wiley and sons, Inc., New York,

Jhingran, V.G. 1974 Fish and Fisheries of India. Hindustan Publishing corporation, New Delhi.

Needham J.G. and P.R. Needham 1941. A guide to the study of fresh water biology. Comstoc, Thaca, New York, USA.

Parashar, C., N. Verma, S. Dixit and R. Shrivastava: Multivariate analysis of drinking water quality parameters in Bhopal, India. Environ. Monit. Assess., 140, 119-122 (2008).

Qasim, S.Z., 1977. Contribution of zooplankton in the water environments. *Proc. Symp.* Water Zool. P. Goa. India., 700-708.

Rajagopal *T. et al,. 2010* Composition of physicochemical parameters and phytoplankton species diversity of two perennial ponds in Sattur area, T.N. Journal of Environmental Biology, 31(5) 787-794.

Sachidanandamurthy, K.L. and H.N. Yajurvedi: A study on physicochemical parameters of an aquaculture body in Mysore city, Karnataka, India.

Sharma, P.C. and M.C. Pant 1984, Abundance and community structure of limnetic zooplankton in Kumaun Lake, India, *Hydrobiology 69:91-110*

Vasanthkumar B. *et al*., 2011, Aquachemistry, Zooplankton and Bacterial diversity in three ponds of Karwar District, Karnataka. *Recrent research in Science and Technology, 3(4); 39-48.*