Research Paper Zoology

ZOOPLANKTON STUDY AND SOME PHYSICO-CHEMICAL PARAMETERS ANALYSIS OF MADIKOPPA AND BENACHI PONDS, ALNAVAR, DHARWAD TQ./DIST., KARNATAKA,INDIA

Hemalatha Bhavimani Research Scholar, Dept. of Environmental Science, Gulbarga University, Gulbarga

E.T. Puttaiah Former V.C. of Gulbarga University, Gulbarga

Mohan Naik Professor, G.K.V.K., Bangalore

ABSTRACT

Investigations on Physico-Chemical features and Zooplankton species were conducted monthly using standard methods in two ponds namely Madikoppa and Benachi of Alnavar, Dharwad Tq./Dist., Karnataka between May 2012 to April 2013. All the physico-chemical parameters are within the range prescribed by ISO 10500-1991. Zooplanktons are heterotrophic planktonic animals floating in water. They serve as good indicators of changes in water quality. The different groups of zooplanktons have their own peak periods of density which is affected by local environmental conditions prevailing at that time. Rotifer species are more in number compared to other species in both the ponds.

KEYWORDS : Physico-Chemical parameters, Zooplankton, water quality, environmental condition, Rotifer, cladocera, copepoda, ostracoda

Introduction

Water quality assessment generally involves analysis of physico-chemical, biological and microbiological parameters and reflects on abiotic and biotic status of he ecosystem (Rajagopal et al., 2010). Aquatic habitat harbor variety of plants and animals. These aquatic organisms ranging from invertebrates to vertebrates serve as important indicators of water quality and ecosystem health. Aquatic diversity of these lentic water bodies mainly encompasses of planktonic fauna (Zooplankton and phytoplankton) and macrobenthic invertebrate fauna. Zooplanktonic fauna consists of Protozoa, Rotifer, Cladocera, Copepoda and Ostracoda. These are free floating organisms and play an integral role in the aquatic food chain (Rajagopal et al., 2010). These benthic organisms react strongly and often predictably to human influences in aquatic ecosystem (Sharma K.K., 2011). They have an important function in transitional ecosystem by filtering phytoplankton and then acting as food source for larger organisms such as fish there by linking primary production with higher trophic levels. The diversity and abundance of zooplankton and macrobenthic invertebrates varies with seasons showing much influence of physico-chemical status of water body and both faunal diversity and physico-chemical values plays significant role in assessing the water quality.

Zooplanktons are microscopic drifting animal like organisms found either at or near the surface of waterbodies. (Ovie, 2011) defined zooplankton as the free floating, aquatic invertebrates often described as microscopic because of their usual small size that range from a few to several micrometers and are rarely exceeding a millimeter. According to (Suresh et al., 2011) different environmental factors that determine the characters of water have great importance upon the growth and abundance of zooplankton, thus water quality influences zooplankton abundance clustering and biomass.

The distribution of zooplankton communities depends on many factors, some of which are change of climatic conditions, physico-chemical parameters and vegetation cover. According to (Rajagopal et al., 2010) zooplankton plays an integral role and serves as bio-indicator and it is a well suited tool for understanding water pollution status.

Among zooplankton species, Rotifer respond more quickly to environmental changes and used as changes in water quality (Gannon and Stemberger, 1978). Cladocereans are tiny aquatic crustaceans and are also known as waterfleas. They are highly responsive against pollutants and hence serve as good biological indicators of water pollution. Copepods dominate most aquatic ecosystems because of their resilience and adaptability to changing environmental conditions and ability to withstand varying environmental stresses (Barnes et al., 1988). They are high in stable environmental conditions and disappear as pollution level increases (Das et al., 1996). Ostracods are mainly bottom dwellers, they live on detritus and dead phytoplanktons.

Materials and Methods

Study Area

The study area Madikoppa pond is located between 15° 31¢ 18^2 N and 74° 51¢ 08^2 E at an altitude of 655 MSL covering an area about 5.2 acres and another study area Benachi pond is located between 15° 24¢ 10^2 N and 74° 48¢ 11^2 E at an altitude of 655 MSL covering an area about 10.4 acres. These are biggest ponds coming under minor irrigation project of Dharwad district. Both ponds are artificially built for irrigation and domestic purpose.

Sample Collection and Analysis

Physico-chemical characteristics of water and qualitative analysis of zooplankton study of Madikoppa and Benachi pond were studied at monthly intervals from May 2012 to April 2013 (Table-1 & 2) by choosing fixed spot by composite sampling method using labeled plastic container of fiver litre capacity. Water parameters were analysed as per methods described in APHA (1998). Temperature was noted down on the spot with the help of thermometer and further physico-chemical parameters were analysed in laboratory without taking much time.

Chemical Parameters

- Water Temperature – Water temperature was determined with the help of thermometer.
- pH – pH was determined with the help of digital pH meter.
- Dissolved Oxygen (DO) – DO was determined by sodium azide modification of Winkler's method.
- Alkalinity (Alk) – Alkalinity was determined by titrimetric method.
- Total Hardness (TH) – TH was determined by EDTA titrimetric method.
- Chloride (Cl) – Cl was determined by Argenometric method using potassium chromate as indicator.
- Phosphate (PO_4) – Total phosphate was determined by stannous chloride method using spectrophotometer.
- Nitrate (NO_3) – Nitrates were estimated by phenol disulpheric acid method using spectrophotometer.
- Chemical Oxygen Demand (COD) – Open condensation and digestion by titration.
- Biological Oxygen Demand (BOD) – By titration.

For qualitative analysis of zooplankton, samples were collected by sieving 50 liters of water through plankton hand net made up of nylon bolting cloth (68 mm pore size) for estimation. Samples were fixed in 4% formaldehyde and lugol's solution. Zooplankton identified to the greatest possible taxonomic level by using an optical microscope and referring to a specialized bibliography of Sharma (2001), Patil and Goudar (1989).

Results and Discussions

In the present study seasonal variations in physico-chemical parameters of two ponds have been observed.

Water temperature: It influences the physical, chemical and biological conditions of the ponds. Water temperature ranged between 25.2 to 26.5 of Madikoppa pond and water temperature ranged between 29.0 to 30.1 of Benachi pond.

pH: pH ranged between 7.1 to 8.1 of Madikoppa pond and pH ranged between 7.5 to 7.7 of Benachi pond. pH indicates the acid-base balance of the water.

Dissolved Oxygen (DO): DO ranged between 7.4 to 7.9 of Madikoppa pond and DO ranged between 7.1 to 7.6 of Benachi pond. DO is a measure of amount of gaseous oxygen dissolved in an aqueous solution that plays a vital role in the biology of cultured organisms (Dhawan et al., 2002).

Alkalinity (Alk): Alkalinity ranged between 70.0 to 95.0 of Madikoppa pond and alkalinity ranged between 51.0 to 63.0 of Benachi pond. The high value of alkalinity indicates the presence of weak and strong base such as carbonates, bicarbonates and hydroxides (Jain et al., 1997).

Total Hardness (TH): Total hardness ranged between 80.0 to 120.0 of Madikoppa pond and Total hardness ranged between 66.0 to 91.0 of Benachi pond. Total hardness of water depends on the dissolved solids and pH.

Chloride (Cl): Chloride ranged between 26.0 to 40.0 of Madikoppa pond and Chloride ranged between 10.0 to 17.0 of Benachi pond. Higher concentration of chlorides in water is an index of pollution. Chloride that dissolves easily in water is toxic to most aquatic organisms because it reacts quickly with other substances in water (Padmanabha & Belagali, 2007).

Phosphate (PO_4): Phosphate ranged between 0.12 to 0.30 of Madikoppa pond and Phosphate ranged between 0.2 to 0.3 of Benachi pond. Phosphate although present in very small quantity in water is important for the production of phytoplanktons, which forms food for fishes.

Nitrate (NO_3): Nitrate ranged between 0.3 to 1.8 of Madikoppa pond and Nitrate ranged between 1.2 to 3.0 of Benachi pond. Nitrate concentration of ground water and surface water may be attributed to the biochemical and anthropogenic sources (McLeay et al., 2001) like fertilizers in agricultural practice.

Chemical Oxygen Demand (COD): COD ranged between 6.0 to 20.0 of Madikoppa pond and COD ranged between 7.0 to 21.0 of Benachi pond. The COD of water represents the amount of oxygen required to oxidize all organic matter, biodegradable and non-biodegradable by a strong chemical oxidant.

Biological Oxygen Demand (BOD): BOD ranged between 2.0 to 5.0 of Madikoppa pond and BOD ranged between 3.0 to 9.0 of Benachi pond. BOD is the amount of oxygen taken up by micro-organisms that decomposes organic waste matter water. This is an indication of both sewage and industrial pollution.

Zooplanktons

During the study period zooplankton biodiversity of Madikoppa and Benachi ponds were represented by Rotifer – 14, Cladocera – 06, Copepoda – 03 and Ostracoda – 01 of Madikoppa pond. Similarly, Rotifer – 17, Cladocera – 12, Copepoda – 06 and Ostracoda – 02 of Benachi pond respectively. Zooplankton community structure has been used as indicator of the nutrient and pollution status of water bodies (Ogbeibu et al., 2001 and Imoobe & Adeyinka, 2010).

Distribution of Zooplankton Species in both the Ponds
(+ sign : presence and – sign : absence)

Sl. No.	Zooplankton	Ponds	
	Rotifer	Madikoppa Pond	Benachi Pond
1	Asplanchna brighwelli	-	+
2	Brachionus bidentata	-	+
3	Brachionus caudatus	+	+
4	Brachionus diversicornis	+	+
5	Brachionus forficula	+	+
6	Brachionus plicatilis	+	+
7	Brachionus quadridatus	+	+
8	Brachionus urceolaris	-	+
9	Brachionus rubens	+	-
10	Brachionus falcatus	+	-
11	Brachionus angularis	+	-
12	Euchlauis dilatata	+	+
13	Filinia opoliensis	-	+
14	Filinia longiseta	+	-
15	Keratella cochlearis	+	+
16	Keratella tropica	+	-
17	Lecane leontina	+	+
18	Lepadella ovalis	-	+
19	Lacinularia socialis	-	+
20	Mytilina ventralis	-	+
21	Platyias patulus	+	-
22	Rotifer tardus	-	+
23	Trichocera similes	-	+
	Cladocera		
1	Alona cambouei	-	+
2	Alona pulchella	-	+
3	Biapertura karua	-	+
4	Bosminopsis dietersi	-	+
5	Chydorus reticulatus	-	+
6	Chydorus sphaericus	-	+
7	Chydorus barroisi barroisi	+	-
8	Ceriodaphnia cornuta	-	+
9	Diaphanosoma excisum	-	+
10	Diaphanosoma sarsi	-	+
11	Moina micrura	-	+
12	Macrothrix goeldi	+	+
13	Moina brachiata	+	-
14	Moina rectirostris	+	-
15	M. macrocopa	+	-
16	Pleuroxus denticulatus	+	+
	Copepoda		
1	Mesocyclops sp	-	+
2	Mesocyclops leuckarti	+	+
3	Paracyclops fimbriatus	+	+
4	Tropocyclops prasinus	-	+
5	Pararyclops	+	-
6	Rhinediaptomus indicus	-	+
7	Heliodiaptonus viduus	-	+
	Ostracoda		
1	Hemicypris fossulata	-	+
2	Stenocypris sp	+	+

Rotifer richness and biodiversity was found to be maximum indicating the influence of temperature, which was supported by direct relation between temperature and Rotifer population. This observation was in concurrence with the work of (Singh, 2000), who have studied zooplankton population in tropical lake.

Cladocera found to be little less in number compared to rotifers in both the ponds. The maximum population of cladocerans may be attributed to favourable temperature and availability of food in the form of bacteria, nanoplankton and suspended detritus.

Copepoda found to be lesser in number compared to rotifer and cladocerans in both the ponds. The copepoda population in both the ponds may be due to richness of organic matter. Similar observations were also made by (Somani and Pejaver, 2004) in lake Masunda.

Ostracoda species are very less in number in both the ponds compared to other species of Rotifer, Cladocera and Copepoda.

The sequence of dominance of zooplankton classes in both Madikoppa and Benachi pond were recorded in hierarchy as

Rotifer > Cladocera > Copepoda > Ostracoda

Comparative analysis among two ponds indicates high species richness in Benachi pond which may be due to plentiful organic matter and detritus in this pond and due to more anthropogenic stress along with rich macrophytic vegetation which provide food and shelter for planktons (Sharma S.P., 2002; Singh P., 2004; Saini M., 2009 and Jyoti M.K. et al., 2009).

Apart from differential species presence there is seen a alarming state of both these ponds as presence of some species namely Keratella cochlearis, Brachionus angularis, Brachionus falcatus, Keratella tropica, Bosmina Sp, Chydorus sphaericus and Mesocyclops leukarti indicated the higher tropic status of the ponds as these species are indicators of eutrophication (Wanganeo A. et al., 2006 and Kumar P. et al., 2010).

Physical Chemical Parameters

All the parameters are within the range prescribed by ISO 10500-1991.

Conclusion

The zooplankton population of the concerned habitat was found to be dominated by Rotifer followed by cladocera, copepoda and ostracoda. Presence of Brachionus Sp, Cyclops Sp, Mesocylops Sp, etc. are indicators of pollution. Awareness among local people and effective co-ordination of concerned authority are essential for present use and future management of ponds.

Table-1 : MADIKOPPA

Date	Parameters									
	Water Temp.	pH	DO	Alk	TH	Cl	PO_4	NO_3	COD	BOD
May 2012	26.3	7.8	7.5	92.0	105.0	30.0	0.2	1.3	20.0	5.0
June 2012	26.1	7.9	7.9	90.0	108.0	32.0	0.3	0.9	16.0	4.0
July 2012	25.9	8.1	7.7	92.0	104.0	33.0	0.3	0.8	12.0	3.0
Aug 2012	25.7	7.9	7.8	80.0	100.0	28.0	0.2	0.4	08.0	4.0
Sept 2012	25.5	7.7	7.9	95.0	106.0	30.0	0.3	0.3	06.0	5.0
Oct 2012	25.3	7.2	7.6	84.0	110.0	32.0	0.3	0.6	08.0	4.0
Nov 2012	25.2	7.8	7.4	88.0	96.0	35.0	0.2	0.7	10.0	3.0
Dec 2012	25.4	8.0	7.5	89.0	106.0	40.0	0.3	1.0	08.0	2.0
Jan 2013	25.8	7.6	7.7	70.0	80.0	32.0	0.2	1.2	06.0	3.0
Feb 2013	25.7	7.3	7.8	85.0	100.0	30.0	0.3	1.5	08.0	4.0
March 2013	26.3	7.1	7.9	88.0	116.0	26.0	0.2	1.8	12.0	5.0
April 2013	26.5	7.5	7.6	90.0	120.0	28.0	0.1	1.3	10.0	2.0

Table-2 : BENACHI

Date	Parameters									
	Water Temp.	pH	DO	Alk	TH	Cl	PO_4	NO_3	COD	BOD
May 2012	29.8	7.5	7.6	56.0	73.0	12.0	0.30	1.8	16.0	6.0
June 2012	29.6	7.5	7.4	59.0	81.0	11.0	0.30	1.2	13.0	5.0
July 2012	29.4	7.5	7.3	57.0	81.0	12.0	0.20	1.9	10.0	4.0
Aug 2012	29.2	7.6	7.2	57.0	77.0	11.0	0.20	2.5	07.0	3.0
Sept 2012	29.0	7.6	7.1	59.0	77.0	10.0	0.20	3.0	13.0	5.0
Oct 2012	29.2	7.7	7.2	63.0	78.0	13.0	0.30	2.0	16.0	6.0
Nov 2012	29.4	7.6	7.4	61.0	78.0	17.0	0.30	1.2	19.0	7.0
Dec 2012	29.6	7.7	7.3	63.0	85.0	13.0	0.30	1.9	16.0	6.0
Jan 2013	29.8	7.6	7.2	61.0	91.0	13.0	0.20	2.2	19.0	7.0
Feb 2013	29.8	7.6	7.3	56.0	81.0	11.0	0.20	2.0	20.0	8.0
March 2013	30.0	7.6	7.4	51.0	71.0	12.0	0.30	2.5	21.0	9.0
April 2013	30.1	7.7	7.5	53.0	66.0	12.5	0.20	2.1	16.0	6.0

References

- APHA (1998): Standard methods for examination of water APHA, AWWA, Washinton.
- Barnes, R.S.K., Calow, P. and Olive, P.J.W. (1988): The Invertebrates: a new synthesis. Blackwell Scientific Publications, London.
- Das, P.K., Michael, R.G. and Gupta A. (1996): Tropical Ecology, 37(2), 257-263.
- Dhawan, A., Karu, S. (2002): Pig dung as pond manure; Effect on water quality pond productivity and growth of carps in poly culture system. The International Centres for Living Aquatic Resources Management (ICLARM) Quarterly, Manila, 25 c 1:1-14.
- Gannon, J.E. and Stemberger, R.S. (1978): Zooplankton especially crustareans and rotifers as indicators of water quality. Trand. Am. Micros. Soc., 97:16-35.
- Imoobe, T.O.T. and Adeyinka, M.L. (2010): Zooplankton based assessment of the tropic state of a tropical forest river. International Journal of Fisheries and Aquaculture (IJFA), 2(2):064-070.
- Jain, C.K., Bhatia, K.S. and Vijay T. (1997): Ground Water Quality in Coastal Region of Andhra Pradesh. Indian J. Env. Health, 39(3):182.
- Jyoti, M.K., Sharma, K.K. and Sharma, J. (2009): Population dynamics and community structure of zooplankton inhabiting in fish pond Jammu, India. Current World Environment, 4(1):165-169.
- Kumar, P., Sonaullah, F. and Wanganeo, A. (2010): A preliminary limnological study on Shershah Suri pond, Sararam, Bihar. Asian J. Exp. Sci., 24(2):219-226.
- McLay C.D., Dragten R., Spculing G. and Selvarajan N. (2001): Predicting Ground Water Nitrate Concentrations in a Region of Mixed Agricultural Land Use : A Comparison of Three Approaches. Environ. Pollut., 115(2):191-204.
- Ogbeibu, A.E., Ezemonye, L.I.N. and Uyigue, E. (2001): The Crustacean Zooplankton of the Ovia River, Southern Nigeria. Nigerian J. of Applied Sci., 19:36-42.
- Ovie, S.I. (2011): A synopsis of the zooplankton fauna of Lakes Kainji and Jebba. In: Forty years on Lake Kainji fisheries research. Eds: Raji, A. Kiaeme, A.N. and Ibain, M.O., NIFFR, New-Bussa, Nigeria, Vol. 1:133-143.
- Padmanabha B. and Belagali S.L. (2007): Water Quality Index of Kabini River in the Kallahally village of Nanjangud Taluk of Mysore District, Karnataka. J. Environ. Sci. Eng., 49(1):48-50.
- Patil, C.S. and B.Y.M. Gouder (1989): Fresh Water Invertebrates of Dharwad. Prasaranga Karnatak University, Dharwad.
- Rajagopal, T., Thangamani, A., Sevarkodiyone, S.P., Sekar, M. and Archunan, G. (2010): Zooplankton diversity and physico-chemical conditions in three perennial ponds of Virudhunagar district, Tamil Nadu. Journal of Environmental Biology, 31:265-272.
- Saini, M. (2009): Limnological Characterization of Gharana Wetland (Reserve), Jammu. M.Phil. dissertation, University of Jammu, Jammu.
- Sharma, B.K. and Sumitra Sharma (2001): Biodiversity of Rotifers in some Tropical Flood Plains Lakes of the Brahmaputra River Basin, Assam (N.E. India). Hydrobiologia, 446/447:305-313.
- Sharma, K.K. and Chowdhary, S. (2011): Macro invertebrate assemblages as biological

indicators of pollution in a Central Himalayan River, Tawi (J&K). International Journal of Biodiversity and Conservation, 3(5):167-174.

- Sharma, S.P. (2002): Studies on the impact of anthropogenic influence on the ecology of Gharana Wetland, Jammu. Ph.D. thesis, University of Jammu, Jammu.
- Singh, D.N. (2000): Seasonal Variation of Zooplankton in a Tropical Lake. Geobios, 27-92-100.
- Singh, P. (2004): Faunal diversity and ecology of Wetlands of Jammu. Ph.D. thesis, University of Jammu, Jammu.
- Somani, V. and M. Pejawar (2004): Crustacean zooplankton population of the lake Masunda, Thane, Maharashtra. J. Aqual Biol., Vol. 19(1):56-57.
- Suresh, S., Thirumala, S. and Ravind, H. (2011): Zooplankton diversity and its relationship with physico-chemical parameters in Kundavada Lake of Davangere District, Karnataka, India. Pro. Environment, 4:56-59.
- Wanganeo, A. and Wanganeo, R. (2006): Variation zooplankton population in two morphologically dissimilar rural lakes of Kashmir Himalayas. Proc. Nat. Acat. Sci. India, 76(B)III.