

Limnological Investigation and Zooplankton Diversity of Karanja River, Karnataka

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Abstract: *The abundance, composition and distribution of zooplankton in relation to water quality parameters such as temperature, pH, dissolved oxygen, alkalinity, total dissolved salts total hardness and biochemical oxygen demand, were studied at monthly intervals from June 2011 to may2012 in Karanja river; Bidar at five locations selected. 36 species of zooplankton were identified as a total., which included 14species of rotifera 11 species of cladocera 8 species of copepoda and 3species of ostracoda...Dominant, rare and pollution indicators were studied. The affect of several physico-chemical parameters on the abundance and distribution of zooplankton is discussed. The investigation reveals that zooplankton better thrive in alkaline water and the water of Karanja river is fit for fish production and human use.*

Keywords: Physico-chemical parameters, zooplankton bioindicators, seasonal fluctuation, Karanja River

1. Introduction

The aquatic ecosystem presents a great contrast to terrestrial ecosystem and aquatic organisms display wide range of adaptation. Major constituent of aquatic organisms is the plankton- the Zooplankton and phytoplankton. Zooplankton are minute drifting invertebrates either marine or fresh water column. They are indispensable members of the aquatic food chain, connecting primary producers to higher trophic levels including economically important population of fish. The change in abundance, species diversity and community composition of zooplankton indicates environmental changes like pH, temperature, nitrates, phosphates total dissolved salt, nutrient levels, alkalinity etc. they are sensitive indicators of pollution in comparison with phytoplankton.

Deevay (1941) recorded limnological studies pertaining to specific regional water bodies. Sreenivasan (1963) reported on primary production of reservoirs in nilgiri, Ooty in Tamilnadu and recorded high production and opined primary production correlated well with the physicochemical factors and biological parameters. Seigfried et al (1983) explained interaction of various physicochemical parameters and their impact on primary production. Salmoiraghi (1984) discussed limnology of suviana in Italy. Richmen et al (1984) studied zooplankton stock, species composition and size distribution in lake Michigan. Vijayraghvan (1971) states the water temperature is important for limiting productivity. Vijay Kumar K (1991) Anjinappa (2002) Das (2002) observed high primary productivity yields high fish productivity in the reservoir.

2. Previous work

Study on water quality factors, fish fauna and plankton is done at the dam site of Karanja river. But such work is not carried out on the river water. The present one is the first humble attempt to investigate the aquatic biota and water quality parameters of Karanja river, Bidar.

3. Problem definition

Studying the relation of different physico-chemical parameters with zooplankton. Zooplankton abundance species diversity and seasonal fluctuation. Evaluating the quality of water for economically important fauna and human use.

4. Study Area

The present study is performed in Karanja River which co-ordinates latitude 180 4' 60" N and logitude770 6' 60" E at an elevation of 556 mtrs above sea land. Bidar district, Karnataka. The district falls under both the basins of Krishna and Godavari. Maximum depth is 10.5mtrs. Karanja river a major perennial river of Bidar district irrigate drought prone area of Bidar & Bhalki taluks. Agricultural lands and villages surround the river. The availability of food throughout the year made the perennial river a favorite nesting place for resident and nonresident and some migratory birds. Aquatic vegetation of river increases breeding area for fish population and the river extensively used for fishing. The selected sites for the present study includes Hunji, Joldhapka, Kanji, Ramtheratwadi and Kalwadi.

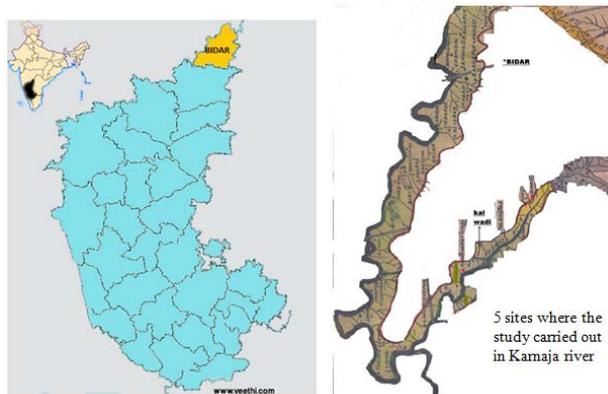


Figure 1: Five sites where the study carried out in Karanja River.

5. Methodology

Studies were conducted for a period of one year. Water and plankton samples were collected on monthly basis from five different locations. Plankton samples were collected by means of horizontal hauls using a plankton net (No.25) with a mesh size of 50 μ m. The net was hauled for 6mts. Net was washed by the river water to collect the whole plankton. It was finally concentrated in to 250ml. zooplankton where narcotized by adding Chloroform to the water sample collected. This avoids sudden contraction of the body of organism in formalin. The zooplanktons was then preserved in 4% formalin (formalin was diluted with water from sampling area to avoid osmotic change) and brought to the lab. Identification was done under microscope using plankton counting chamber (sadgewick and Rafter cell) Individuals were identified with help of literature provided by Needham and Needham (1978). Enumeration of plankton was done and reported as units or organisms /L (A.P.H.A. 1989). To carryout physico-chemical studies, water samples were collected in 500ml plastic bottles. Water temperature and atmospheric temperature were recorded at each site. Their mean value is taken for calculation water collected in BOD bottles was treated to fix oxygen and brought to laboratory for further analysis by Winkler's method (A.P.H.A.1945) According to this method various parameters like alkalinity pH, total hardness, total dissolved salts, BOD were calculated.

6. Result and discussion

Result of the study is shown in table No.1 i.e. Seasonal Fluctuation of water quality parameters, abundance of zooplankton in figure No.1, total number of species identified in table No.2, their correlation with water quality factors in table No.3 and species diversity index in table No.4.

Present study reveals a tri-model oscillation of the abundance of zooplankton. During south west monsoon (SWM) the zooplankton number is less and during the onset of North East monsoon (NEM) the number gradually increases till a peak is seen in December (1663 U/L-1). It declines in January (1584 U/L-1) and again increases as temperature rises. Maximum is observed in March (1892 U/L-1). This gets support from the view of Vijayraghvan (1971) that water temperature is important for limiting productivity. Zooplankton decline as water temperature goes high in April and May.

In the present study a total of 36 species of zooplankton is recorded. Of them 14 species of rotifera, 11 species of cladocera, 8 species of copepoda and 3 species of ostracoda are identified. *Keratella tropica*, *branchionus falcatus*, *B.calciflorous* and *B Rubens* were dominant rotiferans. Rotifers dominant in rivers (Allan 1976) due to their short generation time and high reproductive rate. The present study is in agreement with this. In cladocera the dominant members were *Diaphanosoma sars*, *D. Excisum*, *Macrothrix Laticorns*, *Daphnia Pulex* and *D. Carinats*. Cladocerans are the important food source of fish. Cladocerans attract taxonomists due to their cyclomorphic characters. The dominant species of copepoda were *Mesocyclops hyalinus*, *Neodiaptomous strigilipes*.

Ostracoda dominated by *spirocypris* *Hemicypris* and *Hyocypris*. Ayyappan and Gupta recorded high gross primary production from tank from Dakshina Kannada and they were of view that the higher rates during March and July coincide with low pH, high CO₂ and low alkalinity and high electrical conductivity. Present study also reveals this relation.

Zooplankton shows positive significant correlation with water temperature. This investigation get support from Kaushik et al 1992 that water temperature between 10 to 29^oC is suitable for zooplanktonic development. Cladocera is negatively correlated. In the present study the water temperature ranges between 23^oC to 33.4^oC. Difference in water temperature may be due to timing of collection and influence of season (Jayaraman et al 2003). Present study is in agreement with this.

pH is an important parameter which is very significant in evaluating the acid-base balance of water. During present study pH varies from 7.2 – 8.2 Maximum is recorded in summer and minimum during NEM. Rotifera, copepoda, ostracoda show positive significant correlation with pH, and negative correlation with hardness, chloride and turbidity. It is inversely correlated with temperature. Arvindkumar (2000) also observed such relation. Rotifers flourish in alkaline medium.

Dissolved oxygen (DO₂) shows both negative and positive correlation in the present observation. This is supported by Saradamani et al (1998). D.O. varies from 6.2mg/ L to 8.1mg/L. The more D.O. in summer may be due to slow flow of water. It is low during SWM. This may be due to agricultural runoff and copious quality of rain water zooplankton shows significant positive correlation with D.O. except cladocera in the present study. A decrease in D.O. is observed as the water temperature decreased (Jana and Sarkar (1971b)). Same relation is observed in the present investigation.

Total hardness is maximum during NEM and minimum during summer. Cladocera and ostracoda show positive significant correlation with total hardness. In the present study the total hardness ranges 95.3 – 125.4mg/L. It is favorable for fish production as observed by Swingle (1967) and Arvindkumar, Chandan Bohra and A.K. Singh (2000).

B.O.D is found maximum in summer because of high bacterial activity and input of organic load. Its lower value in winter might be due to reduced bacterial activity, less light intensity and low temperature (Srinivasan and Paramasivan 1981; Gupta, 2000). This view gives support to the present study.

Alkalinity ranges between 105mg/L to 215mg/L all the groups of zooplankton show positive correlation with alkalinity. In the present study high value is observed in (215mg/L) and lowest in SWM (105mg/L). High alkalinity coincides with high planktonic yield (Singh et al 2002; Sachidanantha Murthy and Yayuivedi 2006; Kiran et al 2007). In the present study also such relation is observed.

During the study period the total dissolved salts (T.D.S) was maximum during S.W.M (325.6mg/L) a minimum was during summer 104mg/L high value of T.D.S. in rainy season may be due to water turbidity and copious quality rain water which brings down agricultural runoff. Ostracods and rotifers show negative significant correlation with T.D.S.

Table 1: Seasonal fluctuation in physico-chemical parameters during June-2011 to May-2012 in Karanja River

Parameters	NE M	Summer	SW M	Mean	Standard deviation	Variance
Air temp. (0C)	28.5	39.1	24.8	30.8	6.060	36.72
Water temp.	25	33.4	23.2	27.2	4.445	19.76
pH	7.3	8.2	7.2	7.57	0.4497	0.2822
D.O	6.4	8.1	6.2	6.9	0.8524	0.7267
Total hardness	125.4	95.3	113.0	111.233	12.3516	152.5622
Alkalinity	215	123.0	105.0	147.66	48.1756	2320.89
T.D.S.	208.1	104.0	325.6	212.567	90.5229	8194.40
BOD	7.0	9.5	6.4	7.633	1.342	1.80

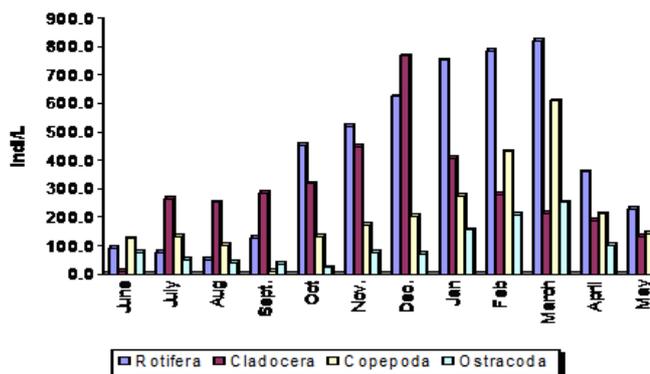


Figure 2: Monthly variation of zooplankton density from June 2011 to May 2012, Karanja River

Table 2: Zooplankton species observed in river from June 2011 to May 2012

Sl. No	Rotifera	Cladocera	Copepoda	Ostracoda
1	Keratella tropica	Diaphnasma Sarsi Richard	Mesocyclops hyalinus	Hemicypris fossulate
2	Brachionus falcatus	D. exisum	Neodiaptomus strigilipes	Spioocypris
3	B. calciflorus	Macrotrix Laticornis	Heliodiaptomus viddus	Hyocypris
4	B. Rubens	Daphnia pulex	Nauplius stage	
5	B. Forficula weizaki	D. carinata	Diaptomus blanci	
6	B. angularis	Bosmina sps deitersi		
7	Monostyla bulla gosse	Stenocypris sp		
8	Dicranophorus sp	Seriadaphnia cornuta		
9	Rotararia	Aeroperas sp		
10	Keratella vulga	Alona costata		
11	Ascomorpha	Polyphemus species		
12	Notholca sp.			
13	Trichocerea			
14	Lepadella			

Table 3: Coefficient of correlation between zooplankton and water quality parameters of Karanja river, during June 2011 to May 2012

Parameters	Rotifera	Cladocera	Copepoda	Ostracoda
Water temp.	0.581*	-0.426	0.970**	0.994**
pH.	0.518*	-0.493	0.948**	0.954**
D.O.	0.522*	-0.489	0.950**	0.983**
Total hardness	-0.031	0.857**	-0.671**	0.765**
Alkalinity	0.679**	0.972**	0.043	0.092
Total dissolved salts	-0.848**	0.048	0.990**	-0.961**
BOD	0.752**	-0.207	1.00**	-0.993**

* p < 0.01, ** P < 0.001

Table 4: Species diversity or Shannon – Weiner index

Species	pi = ni / N	ln pi	H(pi x ln pi)
Rotifera	0.39	-1.0	-0.39
Cladocera	0.3	-1.203	-0.36
Copepod	0.21	-1.56	0.34
Ostracoda	0.095	-2.41	-0.23
		- 2.302	Σ = -1.32

$$H = \sum pi \ln (pi)$$

Species diversity index = 1.32

7. Conclusion

Zooplankton are bio-indicators of both pollution and trophic conditions of a water system. They check the growth of algae and other parasitic forms by feeding on them. Rich diversity of zooplankton indicates the river is not polluted and it is suitable for fish production. The

water of karanja river is slightly alkaline which is favorable for the growth of zooplankton.

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