STUDY ON LIMNOCHEMISTRY OF RIVER GODAVARI IN NASHIK WITH REFERENCE TO ZOOPLANKTON

Jogi R.D.*

Wani P.P.

Kulkarni M.N.**

S. R. Throat

A B S T R A C T

Aquatic biodiversity is one of the most essential characteristics of the aquatic ecosystem for maintaining its stability and means coping with any environmental change. Zooplankton abundance and distribution are of ecological importance, as they are very sensitive to change, therefore zooplankton makes ideal indicators of aquatic ecosystem. In the present study, various physico-chemical factors with zooplankton were assessed over a period of one year (Feb. 2011-Jan. 2012) to note the chemistry and quality of Godavari river water at Nashik. Physico-chemical factors like pH, DO, total hardness, alkalinity, total phosphate, COD, BOD and organic matter were recorded. The Godavari River is a highly contaminated downstream with untreated sewage and industrial effluents. The high value of COD, BOD, Total Phosphate and low value of DO at discharge point indicates increase in organic pollution which has been observed in S_3 and S_4 sites of the river. Throughout the sampling station we have observed that the rotifer is a dominant zooplankton species which clearly indicates pollution load present in river Godavari, which would be very helpful for policymakers to take precautionary measures to save river Godavari from being pollute.

KEYWORDS: Godavari River, Nashik city, Zooplankton, Limnochemistry.

* R.H. Sapat College of Engineering, Management and Research, Nasik, MS, India

** School of Environmental and Earth Science, N.M.U., Jalgaon, MS, India

INTRODUCTION

Water pollution is one of the serious problems faced by human being today. As zooplankton and phytoplankton plays a significant ecological role and being extensively used as a indicator of water pollution because they are natural inhabitance of water. In Nashik area, Godavari is the main river originates at Trumbakeshwar and ultimately joins Bay of Bengal in Andhra Pradesh. The length of river in 1465km and the river Godavari receives enormous amount of industrial effluent as well as domestic sewage with high physico-chemical characteristics. It was observed that the river Godavari is polluted due to discharge of fly ash from Thermal power plant at Eklahara village and it is only the source of raw water utilized by Nashik thermal power station for generation of electricity and other use. Many workers have studies on water quality on some fresh water bodies of Tapi and other district of Maharashtra during last few decades (Gaikwad *et. al.,* 2007). Rezai *et. al.,* (2003) studied on zooplankton biomass in the Straits of Malacca in Malaysia, and they have reported that the zooplankton biomass might be slightly overestimated in their study due to contamination of materials. Chowdhury and Mamum (2006) studied on physico-chemical conditions and zooplankton population of two fish ponds in Khulna in Bangladesh and have reported maximum diversity and abundance of zooplankton in the months of August and September. Magalhaes *et al.,* (2006) studied the spatial and temporal density and biomass distribution of the copepods in Caste river in Brazil and they determined copepod biomass using regression parameters based on the relation of dry weight and body length. Adel and Mahmood, (2006) studied on the factors affecting seasonal patterns in epilimnion zooplankton community in Africa. The present paper deals with seasonal variation of zooplankton is an important water reservoir of river Godavari which shows the impact of thermal power plant and sewage of Nashik city on zooplankton community throughout the river flowing upstream to downstream of Nashik area.

MATERIALS AND METHOD:

Nashik is located in Northern Maharashtra at 600m (1968 ft) from the mean sea level. The river Godavari originates from Trimbakeshwar (24 km from Nashik) and flows through various parts of the city. The river forms the northern boundary of the city in some areas and then flows through the old residential settlement in the city.

Study area is about 10 km and during the period Feb. 2011-Jan. 2012. Four sampling sites were selected such as S_1, S_2, S_3 and S_4. S_1 – is comparatively free from anthropogenic stresses and thus considered as control site rests of the site were more or less disturbs due to various human interference. Sites were selected in river Godavari is as follows: - S_1 Godavari river water upstream (Gangawadi), S_2 Godavari river water downstream (Near Railway bridge), S_3 Godavari river water (Ramkund area), Nashik, S_4 Godavari river water (Someshwar area).

Sample collection and identification: The plankton samples were collected from Feb. 2011-Jan. 2012 from four sites, which comprised for Summer Rainy and winter. Summer season (Feb-May), Rainy season (June-September) and winter (October - January). *i.e.* Feb-May considered as summer season sample whereas June- Sept and Oct-Jan were rainy and winter collection respectively for both the rivers.

Zooplankton were collected by using 125 mesh size plankton net from 50 liters of filter water and concentrated upto 100ml and preserved in 4% formalin. The counting was done by Lacky drop (micro-transect) method (Lacky, 1938) Identification of zooplankton done according to Tonapi 1980, Wetzel, 1975). Seasonal water samples were collected from four stations for the study of water quality and zooplankton community. Some physico-chemical parameters such as pH, temperature, DO, free CO_2, BOD, COD, Nitrate and Phosphate were estimated by using standard methods of APHA, 2005.

RSULT AND DISCUSSION:

Godavari river physico-chemical characteristics and zooplankton population occurrences at four sampling sites are summarize in Table 1 & graph 1 and table 2 during the study period (Feb. 2011-Jan. 2012). The Godavari river temperature varies in the range of 18 to 22^{0}C , the pH values indicate slight alkaline nature of water; the dissolved oxygen varies from 0.8 to 5.5 respectively. It was also observed that it is associated with heavy organic matter at downstream. This results support the present findings of low DO at all the favorites of the Godavari River with other investigator found in their research (Smita *et. al*., 2009; Gaikwad *et. al*., 2004 and Gaikwad *et. al*., 2007). Maximum BOD value 61.66 was recorded at site S_3. Increasing trend of BOD and decreasing trend of DO towards downstream, clearly indicates increasing load of pollution towards downstream of the river Godavari. High COD 185 was recorded at site S_3. High value of COD than BOD indicates high degree of organic pollution (Adholia and Vyas,

1992). The low DO values and high BOD and COD values at Site S_2 and S_3 clearly indicate large scale disposal of untreated wastewater into the river Godavari. The water contains large quantity of microbes, present in S_2 and S_3 site as compare to S_1 site *i.e.* TVC and MPN value were more in which shows microbial pollution into the river water. It appears that indiscriminative discharge of industrial effluent into sewage system has led to high concentration of microbial population. Zooplankton community data recorded during Feb. 2011-Jan. 2012has presented in table 2. The greatest number of zooplankton was noted 35 species at all site.

Moderate number of Ostrocods members representatively obtained in the waters of river Godavari may be indicative of mild pollution as observed by Sharma *et. al.*, 1999. According to Tonapi (1980), the higher population of Ostracods during monsoon may be due to the abundance of fine detritus to which omnivorous organisms switch over during monsoon from their natural benthic habitat and bacteria, mould and algae as food. Patil and Auti (2005) observed seasonal variations of zooplankton from Salim Ali Lake of Aurangabad and reported the seasonal diversity of different zooplankton which indicates a characteristic pattern peculiar to water bodies in urban environment.

Moderate number of protozoa member representatively obtained in the water of river Godavari may be indicative of mild pollution as observed by Gaikawad *et. al.*, 2004. *Prorodon* species found at all sites which receives heavy dose of sewage except S_1 site. This suggests that the species are polluted water species *i.e. Difflugia, Centropyxis, Arcella, Prorodon etc.*

Rotifer populations are very useful in indicating the water quality, particular in pollution studies (Bhadra *et. al.*, 2003). Rotifers dominated zooplankton in river Godavari of the total population were noted in site S_2 and S_3. *Anuraeopsis fissa, Cephalodella* sp., *Horocella* sp. , *Asplanchna* sp., *Rotaria valgaris Monommata* sp., *Conochilus valvox Gastropus* sp., *Brachionus calyciflorus* (Pallas) *Brachionus anguleris* (Gosse) and *Brachionus quadridentatus* (Hermann) showed characteristics distribution at site S_4 was probably due to the probably due to the great alkalinity carbon and hydrocarbon which most likely favored the growth of large number of rotifer species.

Table 1: Showing Average value of physico-chemical parameters of river Godavari assess during Feb. 2011-Jan. 2012

Parameters	S_1 Gangawadi	S_2 Railway bridge	S_3 Ramkund	S_4 Someshwar

Temperature, ^{0}C	20	22	18	21
pH	7.95	7.9	7.8	8.0
Electrical conductivity, mS/cm	690	675	700	720
Total Alkalinity, mg/l	16.4	26.8	32.3	24.8
TSS, mg/l	42	76	79	86
TDS, mg/l	465	520	616	580
Total Hardness, mg/l	280	426	518	490
Chlorides, mg/l	175	210	222	208
Sulphate, mg/l	20	32	43	46
Total Phosphate, mg/l	12.2	18.20	26.40	18.14
DO, mg/l	5.5	0.8	0.6	1.2
COD, mg/l	90	160	185	210
BOD, mg/l	38	53.33	61.66	70
TVC, per ml	76.34x 10^3	110.36x 10^3	90.20x 10^3	106.43x 10^3
MPN, per 100ml	>12180	>91000	>20500	>66000

Graph 1: Showing the Limnochemistry status of River Godavari studied during Feb. 2011-Jan. 2012

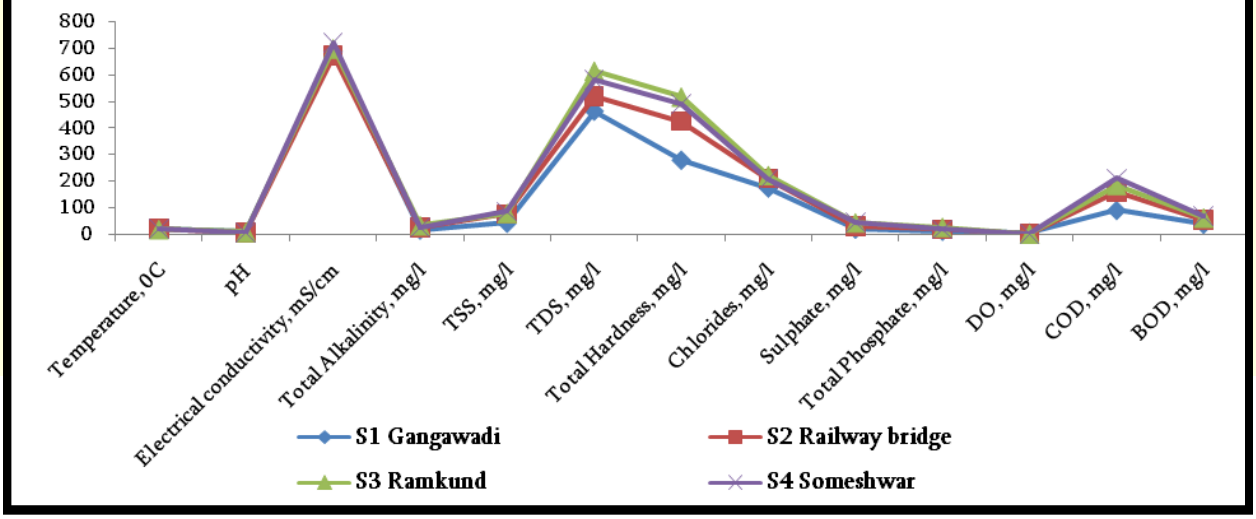

Table 2: Showing the zooplankton species observed during Feb. 2011 – Jan. 2012 in river Godavari

Zooplanktons	S_1 Site	S_2 Site	S_3 Site	S_4 Site

Ostracods (03)				
Cypris pellucida	+++	-	+	-
Cypris sp.	++	+	+	+
Macrtohrix sp.	++	-	++	-
Protozoa (04)				
Difflugia	++	-	-	-
Centropyxis	+++	-	-	-
Arcella	++++	-	++	-
Prorodon	-	+	++	++++
Rotifer (20)				
Horocella sp.	+	+++	++	-
Asplanchna sp.	++++	++	+	-
Hydatina sp.	-	++	-	++
Lecane lunaris	++	-	-	++
Notholk sp.	+++	++	-	-
Trichocerca longiseta	++	-	-	-
Keratella tropica	+	+++	++++	-
Keratella sp.	+	++	++	-
Monostyla leccanegoss	+	-	+++	-
Monostyla sp.	-	-	++	+
Monostyla decipines	++++	-	++	++++
Rotaria valgaris	+	++	+++	-
Monommata sp.	+	++	-	-
Conochilus valvox	-	+	-	++
Gastropus sp.	+	+	-	-
Brachionus quadridentatus (Hermann)	+	+++	++	-
Brachionus rubens	++	-	-	-
Brachionus cadatus	+++	++	-	-
Brachionus forficula (Wierzejski)	++	-	-	++
Brachionus sp.	-	+	-	++
Copepoda (05)				
Cyclops viridis (Jurine)	++	+	++	-
Cyclops heiodiaptomous	+	+	++	-
Mesocyclop hyalins	++	-	++	++
Diaptomas siciloides	++	-	+	-
Anopheles larvae	-	++	-	++
Cladocera (03)				

Bosmania sp.	+++	++	+++	-
Ceriodaphnia sp.	+	-	++	-
Daphenia longispina	++	-	++	-

Note: - = Absent; + = Rare (25 cellsl $^{-1}$); ++ = common (300 cellsl $^{-1}$); +++ = Dominant (500 cellsl $^{-1}$);

++++ = Abundant (800 cellsl $^{-1}$)

Gaikawad and Thorat, 2006 observed that in summer and monsoon, the factors like water temperature, turbidity, transparency, dissolved oxygen play an important role in controlling the diversity and density of rotifers. Edmonson, 1974 observed that the high rotifer population in winter can be attributed with the favorable temperature and availability of abundant food in the form of bacteria, nano-plankton and suspended detritus. In the present investigation, the rotifers numbers per liter were found maximum during summer and minimum during monsoon. The comparatively higher number of rotifer group population at sampling site S_2, S_3 may indicate input of the waste to residual area as reported by Patil *et. al.,* 2006.

During the investigation, Cladocera were found to be maximum in winter and minimum in monsoon at all sites. The maximum population of Cladocera in winter may be attributed to favorable temperature and availability of abundant food in the form of bacteria, nano-plankton and suspended detritus, Gaikwad *et. al.,* 2007. During summer and monsoon, the factors like water temperature, dissolved oxygen, turbidity, and transparency play an important role in controlling the diversity and density of Cladocera. In India, the limnetic zooplankton communities are invariably dominated by the species of Cladocera (Sharma *et. al.,* 1998). The Cladocera species observed during investigation except S_4 site are *Bosmania* sp., *Ceriodaphnia* sp., *Daphenia longispina.*

Water temperature and availability of food organism affect the copepod population. Gaikwad *et. al.,* 2004 observed the inverse relationship between high population of rotifer and Cladocera and low population of copepod during winter may be due to the feeding pressure of stocked fish on the latter and if copepods are removed then there is sudden increase in the population of rotifer and Cladocera. During winter, it is biotic interactions operating through feeding pressure rather than water quality seen to affect the zooplankton diversity and density particularly the stocked

fish species play an important role in harvesting species of copepod and Cladocera, thereby reducing their predatory pressure on other group.

The zooplankton mainly comprised of copepoda, rotifera and cladocera the other plankters included eggs, nauplii and ostracods. The significance of rotifer population as the quantitatively dominant class in zooplankton has been recorded in many Indian lakes Vaishali Somani, 2002. However in the present study they occupied the second position in the order of abundance. 20 species of rotifer were observed and varied from 50 ind/50 L to 5876 ind/50 L. The rotifera were mainly represented by *Asplanchna* sp. and *Monostyla decipines* as is common in most of the Indian Lakes. Both the genera are cosmopolitan in distribution and by far the best known genera from Indian waters Patil, 2002. Rotifera are known to be influenced by temperature, however in the present study the influence was insignificant (r=-0.1594) explaining the dominance of the copepods. Plankton production depends upon carrying capacity of environment and nutrient factors Chaudhari, 2012. Among the nutrients it has been reported that the abundance of calcium has a certain influence on rotifers Hosmani, 2002.

In the present study rotifers were negatively correlated with the calcium content in water limiting its abundance. Similarly, the PO_4-P also exhibited a negative correlation with the rotifer density. However, the nitrates and silicates were seen to favour the density of rotifers nutrient enrichment through sewage inputs further influenced their development. The zooplankton including the rotifers was mainly fed on organic detritus and bacterial population which was in abundance. The present study was carried out to know its use as tools for controlling water pollution and conserving the aquatic life in river Godavari at Nashik.

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