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Seasonal fluctuation of zooplankton in relation to industrial pollution in Irai river water, Dist. Chandrapur, (M.S.), India

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Abstract

With the view to investigate the various changes in hydrobiological features during summer, winter and rainy season and to correlate the same with zooplankton productivity, the limnological survey of Irai river Dist. Chandrapur was undertaken during the year 2003-2004. The parameters such as temperature, conductivity, TDS, pH, CO_2 DO have been studied. In the present investigation zooplankton showed low inverse correlation with temperature and pH, while moderate positive correlation with conductivity, turbidity, TDS, CO_2. However, dissolved oxygen showed strong inverse correlation with temperature, CO_2 and conductivity. In present investigation, among zooplankton *Rotifera* was the dominant group throughout the study. The highest count of zooplankton was recorded at sampling station D in winter season. The correlation coefficients between each pair of parameter for all possible correlation have been discussed in this paper.

Keywords:- *Limnology, Physico-chemical, Zooplankton, Industrial pollution*

Introduction

Zooplankton are microscopic organism, which do not have power of locomotion and move at the mercy of water current. Zooplankton occupy a central position between the autotrophs and other heterotrophs and are important link in food web of freshwater ecosystem. The occurrence and abundance of zooplankton depend on its productivity, which in turn is influenced by physico-chemical parameters and level of nutrients in water. The zooplankton belong to four main groups, *Rotifera*, *Cladocera*, *Ostracoda* and *Copepoda*. The relevant studies on various aspects of zooplankton were made by Shankar and Hosmani (2002) and Patra and Datta (2004), Gupta and Sharma (2007), Khanna *et al*. (2007) Shazia and Raja (2007), Rajkumar *et al.* (2007) But in lrai river, studies on the zooplankton characteristic are very less in number. The present study was therefore undertaken to study the zooplankton characteristic especially in relation to industrial pollution and their correlation with physico-chemical parameters.

Materials and Method

For the present investigation four sampling stations A, B, C and D were selected along the course of Irai river.

Sampling station A: The area located near the water supply pumping station of Chandrapur Super Thermal Power station (CSTPS), on Irai Dam was selected as sampling station A.

Sampling station B: The area selected as station B is about 20.98 km. away from the station A and is located at the junction of channel coming from Chandrapur Super Thermal Power Station. Apart from thermal wastes this channel also carries domestic waste from the locality settled on the bank of the channel.

Sampling station C: The area chosen as sampling station C is about 2.7 km from station B and is located near the water supply pumping station near the bridge of road coming from Ramnagar, Chandrapur.

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Sampling station D: About 1.2 km away from station C, near the junction of channel coming from Chandrapur MIDC (Datala), selected as sampling station D. This channel is seasonal and flows from monsoon to winter.

For physico-chemical and zooplankton analysis surface water samples were collected fortnightly for 12 months from Sep. 2003 to Aug. 2004 between 8.00 AM to 11.00 AM in clean plastic bottle (1500 ml) as per the standard procedure. Collected samples were analyzed in the laboratory as per the methods describe by NEERI (1986), Trivedy and Goel (1986) and Ramesh and Anbu (1996). For zooplankton analysis water sample of maximum 40 liters was collected from each station and was passed through the plankton collecting net made up of silk bolting cloth No.25. The concentrated sample collected at the bottom tube of plankton net was preserved in 5% formalin. The preserved sample was gently stirred to obtain the uniform suspension and with the help of wide mouth pipette the sample was quickly drawn and transported to the Sedgwick Rafter counting cell. The zooplankton were counted in entire Sedgwick Rafter cell as per the methodology of Michael (1973) and Michael (1986). The observations were presented in the form of the minimum and maximum numbers of plankton per liter.

Results and Discussion

The seasonal variation of physico-chemical characteristics and total number of zooplankton per liter are given in the Table-l while Table-2 depicts the list of zooplankton in Irai river at different sampling stations. The correlation coefficients ('r' values) between each pair of parameter for all possible correlation is computed and listed in Table-3.

Temperature is one of the most important physical parameter which affects the chemical and biological reactions in water. According to Prasad (1956), temperature is the determining factor in the seasonal distribution of aquatic organisms. Shukla *et al.* (1991) stated that temperature affects not only the metabolic activities of plankton but also their proliferation. In the present study maximum numbers of zooplankton were recorded during winter season at sampling station D. The temperature showed weak negative correlation with zooplankton and significant negative correlation with DO. However, pH, CO_2, TDS, turbidity and conductivity showed moderate positive correlation with temperature. George (1962) reported that temperature is the main factor regulating the production of zooplankton. Danilove (1963) and Hynes (1970) had reported that the plankton were maximum during summer and minimum in winter.

Conductivity is the capacity of water to carry on electric current and varies both with number and types of ions. Most dissolved inorganic substances in water are in the ionised form and hence contribute to conductance. Conductivity of Irai river water shows variations according to type of pollution discharge at different sampling stations. Discharge of industrial wastes from Chandrapur MIDC in river water resulted into high values of conductivity at Station D. However, at sampling station B values of conductivity were recorded in high ranges in summer due to discharge of thermal effluents and less flow of river water which offer less dilution of pollutants. The conductivity showed moderate positive correlation with zooplankton and strong positive correlation with CO_2, TDS and Turbidity while, strong negative correlation with DO.

The colloidal matter present in water impart turbidity of water. The turbidity in water may be due to clay and silt particles, organic matter, sewage, industrial effluents and presence of microorganisms. In present investigation maximum values of turbidity recorded at sampling station band D, was due to industrial effluents. The moderate positive correlation of turbidity is observed with pH, CO_2, TDS and zooplankton and moderate negative correlation with DO.

Minerals and some organic substances present in water are referred to total dissolved solids. The TDS contents varied according to seasons as well as with the increasing load of pollution. In Irai river water TDS values were well above the permissible limit throughout the study period at sampling station B and at sampling station D only during the winter season. The strong positive correlation of TDS is observed with CO_2, week positive correlation with pH and zooplankton and strong negative correlation with DO. The CO_2 content of any aquatic body is the best single

Table-1: Seasonal mean value of different parameters from Irai river water samples during the years 2003-2004

Seasons	Parameters	Station A	Station B	Station C	Station D
Winter	Temperature (°C)	24.50	28.90	26.10	27.50
	Conductivity (µmho)	250.00	1263.00	508.00	1749.00
	Turbidity (JTU)	0.90	51.80	24.30	33.50
	TDS (mg/l)	109.00	704.00	317.00	1337.00
	CO2 (mg/l)	4.70	37.10	20.20	37.70
	pH	7.90	8.50	8.00	6.60
	DO (mg/l)	8.30	4.80	5.90	4.90
	Zooplankton (unit/l)	181.00	164.00	166.00	214.00
Summer	Temperature (°C)	27.40	33.70	31.20	30.50
	Conductivity (µmho)	471.00	2045.00	736.00	412.00
	Turbidity (JTU)	1.44	134.90	28.40	22.20
	TDS (mg/l)	127.00	1107.00	513.00	441.00
	CO2 (mg/l)	8.20	51.10	28.90	18.50
	pH	7.60	8.70	8.30	7.70
	DO (mg/l)	6.50	2.90	4.80	4.10
	Zooplankton (unit/l)	163.00	150.00	121.00	148.00
Rainy	Temperature (°C)	25.50	29.80	28.20	28.50
	Conductivity (µmho)	211.00	1001.00	412.00	892.00
	Turbidity (JTU)	13.50	85.50	54.50	85.20
	TDS (mg/l)	225.00	605.00	418.00	508.00
	CO2 (mg/l)	2.70	35.50	20.60	27.80
	pH	7.50	8.30	7.60	7.30
	DO (mg/l)	7.80	4.10	5.50	5.20
	Zooplankton (unit/l)	151.00	163.00	122.00	136.00

index to decide the suitability of water for animal and other living being. It may be present in the form of gas or in combined form with other substances (Tamlurkar and Ambore, 2006). On the basis of data collected from the study carried out, it is observed that increase level of CO_2 was recorded during summer season at all sampling station except sampling station D. At sampling station D maximum values were recorded in winter season. In present investigation CO_2 shows weak positive correlation with zooplankton and strong negative correlation with dissolved oxygen. pH considered as an important ecological factor and is the result of the interaction of various substances in the water and also of numerous biological phenomenon's (Tamlurkar and Ambore, 2006). Das and Shrivastav (1956) observed that high pH values coincided with plankton peak. In the present investigation the pH of Irai river water was alkaline throughout the study period except sampling station D where pH was acidic during winter season. This decrease in pH may be attributed to the industrial sewage from MIDC area as the concentration of sewage is more in winter season as compare to the rainy season. In present study pH showed weak negative correlation with both zooplankton and DO. However, Salaskar and Yeragi (2003) reported the positive correlation between pH and zooplankton. Dissolved oxygen play an important

role in supporting life in running water but is susceptible to slight environmental change. In present investigation the concentration of dissolved oxygen was found to be maximum in winter season at sampling station A, may be due to the absence of any significant source of pollution at this station. However, minimum values of DO recorded during summer season at sampling station B. At this station the higher temperature of the water may be due to discharge of thermal effluents which may result into enhancement of microbial activities in river water resulting in depletion of DO. These observations corroborate with the findings of Fulekar and Dave (1989) in Yamuna river, Jankovic (1990) in Sava and Velica tributaries of Danube river and Wasnik (1995) in Kanhan river. In present investigation DO shows weak positive correlation with zooplankton.

Table-2: List of zooplankton of Irai River

Rotifers	Cladocerans	Copepods	Protozoa	Ostracoda
Brachionus calciflorus	Chydorus	Cyclops	Difflugia	Cypris
Brachionus fulcatus	Moina	Diaptomus		

Table-3: Simple correlation coefficient between zooplankton and physico-chemical parameters

Parameters	Temp.	Conductivity	Turbidity	TDS	CO_2	pH	DO
Zooplankton	-0.12	0.31	0.21	0.23	0.04	-0.25	0.01
DO	-0.96	-0.82	-0.57	-0.89	-0.94	-0.38	
pH	0.51	0.27	0.21	0.26	0.41		
CO_2	0.97	0.94	0.68	0.95			
TDS	0.88	0.95	0.58				
Turbidity	0.61	0.72					
Conductivity	0.84						

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