STUDIES ON PHYSICO-CHEMICAL PARAMETERS OF WATER AND ZOOPLANKTONS DIVERSITY IN KHAM RIVER, AURANGABAD DISTRICT (MS) INDIA

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ABSTRACT

The present study deals with physico-chemical parameters of water and diversity of zooplanktons from Kham River, Aurangabad district of Maharashtra state India. This investigation was carried out during January to December 2010. We found that at four sampling station along the stretch, the river water was highly contaminated downstream with untreated sewage and industrial effluents, while flowing through Aurangabad city, the high value of CO_2, BOD, COD, phosphate, nitrate, Zn, Fe, Cu and low value of DO at discharge zone indicates increase in organic pollution at III and IV. pH values indicates slight alkaline nature of water was found (Site III - 8.6) in the month of September, October and December and (Site IV – 8.5) in the month of September. The free CO_2 values were high in month of December at Site-III and IV, 64.4 and 56.16 mgl^{-1} respectively; this may result in breakdown of organic matter. High BOD (35.22mgl^{-1}) and COD (42.38 mgl^{-1}) was recorded at Site-III and in May 2010 which indicates high degree of organic pollution. In the discharge zone of the river we found species of Rotifers (36), Crustaceans (16) (Cladocera=5, Ostracoda=3, Copepoda=8), Brachiopod (2).

Key words: Kham River, Zooplankton, Domestic sewage, Aurangabad District.

INTRODUCTION

Almost all the rivers in India are polluted. The causes of pollution may also be more or less similar. The industries in the area do not have proper effluent treatment plants. The purity of the water depends on the velocity and the dilution capacity of the river. In the recent past, due to rapid progress in communications and commerce, there has been a swift increase in the urban areas along the rivers, as a result the river is no longer only a source of water but is also a channel, receiving and transporting urban wastes away from the towns and the major problem of pollution from domestic municipal sewage. The laying of sewers and the renovation of old sewerage was restricted only to that required to trap the existing surface drains flowing into the river. The pollution of the river, although classified as environmental, was the direct outcome of a deeper social problem emerging from long-term public indifference, diffidence and apathy, and a lack of public awareness, education and social values, and above all from poverty.

In Aurangabad city (19°53' 06.68" N and 75° 19' 10.60°E), Kham River flows 72km towards the south east and connect to the Godavari River. The Kham River receives enormous amount of domestic sewage, industrial waste with high physico-chemical characteristics. River is polluted due to the discharge of domestic sewage and industrial effluents of Aurangabad District. The considerable studies on water quality of some fresh water bodies of Kolhapur district have been carried out during last few decades (Khatavkar *et al.* 1989). The present work was mainly undertaken to investigate impact of sewage and industrial effluents on zooplankton community.

MATERIALS AND METHODS

For present study along the stretch of river four Sampling Stations were selected. Station I was Cantonment Area near to Aurangabad city (19°52'28.63"N and 75°18'34.16" E) Station II was Pandharpur Village (19°49'53.26"N and 75°15'08.74 E) This Village is situated Near the Industrial area of Aurangabad district and receives Industrial as well as agricultural waste, domestic sewage, disposal of religious material. The Station III is Waluj Village of Aurangabad district (19°47'41.65"N and 75°13'44.43E) receives effluents from large number of small scale industrial units also agricultural waste, and domestic sewage, Sampling Station IV (19°39, 22.76"N and 75°13'46.94"E) was near to backwater area of Jaikwadi Dam, which is built on Godavari River and a main source of water supply to all industrial area of Aurangabad district and drinking water source of Aurangabad City.

Monthly water samples were collected from the four stations for the study of water quality and zooplankton community from January 2010 to December 2010, covering the 3 seasons viz. monsoon (June to September), winter (October to January) and summer (February to May). Some physico-chemical parameters

such as pH, temperature, Dissolved Oxygen, free CO_2, BOD, COD, Total Alkalinity, Nitrates and Phosphates was estimated by using the standard methods by APHA (2005). Heavy metals like Zn, Cu, Fe were estimated with the help of Atomic Absorption Spectrometer (AAS) Perkin Elmer A- Analyst 300model (APHA, 1985). Zooplankton were collected by using 125mesh size plankton net from 100 liters of filtered water and concentrated up to 100ml and preserved in 70% alcohol. Literature was used for identification of zooplankton was done by the literature of Adoni *et al.* (1985), Tonapi (1980), Edmondson (1963).

Table 2: Occurrence of species from four Sampling Stations of Kham River during January 2010 to December 2010.
Rotifera

Sr. No.	Species	Sampling Stations			
		I	II	III	IV
1	*B. calyciflorus*	A	A	P	A
2	*B.angularis*	A	P	A	P
3	*B. cadatus*	A	P	P	P
4	*B. falcatus*	P	P	P	P
5	*B.quadridentata*	P	P	A	A
6	*B. forficula*	A	P	P	P
7	*B.bidentata*	P	P	P	P
8	*Anuraeopsis*	P	P	A	A
9	*K. tropica*	A	P	A	P
10	*K. cochlearis*	A	A	P	A
11	*K. species*	A	P	P	P
12	*K. quadrata*	P	P	P	P
13	*Platyias*	A	A	P	A
14	*Mytilina*	A	P	A	P
15	*Lepadella*	P	P	A	A
16	*Lecane*	A	A	P	A
17	*Monostyla*	P	P	P	P
18	*T. longiseta*	P	P	A	A
19	*T. multicrinis*	A	A	P	A
20	*Asomorpha*	A	P	A	P
21	*Asomorpha*	A	A	P	A
22	*Dicranophorus*	P	P	P	P
23	*Asplanchna*	P	P	A	A
24	*Harringia*	A	A	P	A
25	*Polyarthra*	A	P	P	P
26	*Filinia*	A	A	P	A
27	*Hexarthra*	P	P	P	P
28	*Pompholyx*	A	A	P	A
29	*Phiodina*	P	P	P	P
30	*Asplanchanopus*	P	P	A	A
31	*Prorodon*	P	P	P	P
32	*Pleosoma*	A	A	P	A
33	*Gastropus*	A	P	P	P
34	*Leydigia*	A	A	P	A
35	*Sinantherina*	P	P	P	P
36	*Vorticella*	A	A	P	A
37	*Oxytricha*	A	P	A	P
	Total Rotifera (36)	15	25	26	19

RESULTS AND DISCUSSION

Physico-chemical results during the study period (January 2010 to December 2010) was presented in Table 1, while occurrence of zooplankton from four sampling station was summarized in Table 2. The river water temperature varies in the range of 22°C to 30°C and rise in temperature of water was recorded from Station I to IV. The observed results were coincides with the results of Munnawar (1970). pH values indicates slight alkaline nature of water. The dissolved oxygen varies from 0.51 to 9.39mgl^{-1} at Site III and IV. The dissolved oxygen values were less, especially during February to May. It is associated with heavy organic matter at downstream. The free CO_2 values were extremely high at Site-III and IV. High values of free CO_2 may result from breakdown of

Crustaceans Cladocera

Sr. No.	Species	Sampling Stations			
		I	II	III	IV
1	*Daphnia*	P	P	P	P
2	*Sida*	P	P	A	A
3	*Moina*	A	A	P	A
4	*Alona*	A	P	A	P
5	*Bosmina*	P	P	A	A
	Total Cladocera (11)	**3**	**4**	**2**	**2**

Ostracoda

Sr. No.	Species	Sampling Stations			
		I	II	III	IV
1	*Cypris*	P	P	P	P
2	*Stenocypris*	P	P	A	A
3	*Cyprinotus*	P	P	P	P
	Total Ostracoda (10)	**3**	**3**	**2**	**2**

Copepoda

Sr. No.	Species	Sampling Stations			
		I	II	III	IV
1	*Mesocyclop*	A	A	P	A
2	*Cyclopoid copepod*	P	P	P	P
3	*Calanoid cpoepod*	P	P	P	P
4	*Cyclpos*	A	P	A	P
5	*Diaptomus*	A	P	P	P
6	*L. macrurus*	P	P	A	A
7	*S. diaptomus*	A	P	A	P
8	*Calanoids*	P	P	P	P
	Total Copepoda (22)	**4**	**7**	**5**	**6**

Brachiopod

Sr. No.	Species	Sampling Stations			
		I	II	III	IV
1	*Eubrachipus*	A	P	A	P
2	*Senecella calanoids*	A	P	P	P
	Total Brachiopod (5)	**0**	**2**	**1**	**2**

P = Present; A = Absent

Table - 1: Physico-chemical and heavy metals parameters of Kham River, Aurangabad District (M.S.) India from January 2010 to December 2010.

Parameters	pH					Temp (°C)					DO (mgl^{-1})				
Months / Stations	I	II	III	IV		I	II	III	IV		I	II	III	IV	
January	8.1	7.9	7.6	7.8		25	22	26.8	26.5		4.87	5.07	1.12	2.39	
February		8.1	8.5	7.2	7.6		22.5	27	28.5	27.5		5.18	4.57	0.41	1.22
March	8.3	7.9	7.4	7.2		28.5	28.5	29	29.5		5.79	5.48	2.39	3.10	
April	8.4	7.4	7.3	7.4		28.5	27.5	29.5	28.		5.67	4.45	2.81	3.64	
May	8.2	8.2	8	8.1		29.5	29.5	30	30		5.18	5.07	0.51	1.02	
June	7.3	7.4	7	7.2		29.5	29	30	30		5.48	4.87	2.23	2.44	
July	8.1	8.2	8	8.1		26.5	27.5	27.8	28.5		9.39	8.12	3.45	6.5	
August	8.4	8.1	8.5	8.1		25.5	26	27.5	27.5		6.09	5.68	4.16	5.18	
September	7.3	8.1	8.6	8.5		24	25.5	27	27		6.29	5.58	4.47	4.67	
October	8.2	8.3	8.6	8.1		29.5	27.5	30	30		6.09	4.77	1.93	3.86	
November	8.8	8.2	7.5	7.7		21.5	25.5	27	27		7.1	4.8	1.4	4.06	
December	8.4	8.6	8.6	8.4		22.5	26.5	23.5	25		8.10	6.48	5.67	7.28	

Parameters	CO_2 (mgl^{-1})					BOD (mgl^{-1})					COD (mgl^{-1})				
Months / Stations	I	II	III	IV		I	II	III	IV		I	II	III	IV	
January	9.9	13.2	42	30.8		6.09	18.3	24.32	30.45		10.85	12.28	27	24	
February		6.6	9.9	10.2	11		8.12	6.09	21.31	12.18		11.99	12	15.42	11.13
March	8.8	9.9	28	26.4		11	13	15	19		32	44	65	52	
April	9.9	17.6	35.2	32		4.06	6.09	33	16.01		16.27	15.99	37.97	25.98	
May	12.6	13.7	17.6	16.5		7.1	16.21	35.22	28.40		18.27	29.69	42.38	30.01	
June	11	14.3	42.9	33		5.07	19.19	31	30.01		14.28	22.84	36.82	37.12	
July	6.6	11	28.6	13.2		2.03	4.06	30.45	31		10.14	11.42	22.84	18.27	
August	7.7	14.3	28.6	23.1		18	18	26	24		4	14.28	18.56	17.7	
September	7.7	14.3	28.6	23.1		1	5.09	12.17	11.16		12	18	20	18	
October	18.7	23.1	30	29		4.06	9.13	21.18	22.08		13.42	20.56	30	17.99	
November	28.6	35	45	37		2.03	10.15	20.3	22.33		5.71	6.28	12.02	8.57	
December	15.4	24.4	64.4	56.16		2.03	9.13	26.38	28.42		10.56	13.42	29.41	17.13	

Parameters	Alkalinity (mgl^{-1})					Nitrate (mgl^{-1})					Phosphate (mgl^{-1})				
Months / Stations	I	II	III	IV		I	II	III	IV		I	II	III	IV	
January	110	130	255	210		4.73	5.9	8.2	7.8		0.114	0.165	0.486	0.32	
February		122	207	260	250		4.9	5.1	7.7	6.5		0.162	0.246	0.499	0.228
March	195	210	290	275		7.6	7.7	7.8	7.4		0.054	0.074	0.8	0.168	
April	150	110	195	160		4.4	3.6	3	3.6		0.078	0.066	0.42	0.126	
May	135	197	345	240		5.6	6.7	9.8	7		0.034	0.028	0.46	0.13	
June	135	150	165	150		6.13	7.2	11.8	9.2		0.042	0.076	0.42	0.198	
July	175	180	408	205		2	2.9	36	2.9		0.18	0.19	0.43	022	
August	170	180	200	200		2.8	3.6	7.9	6.2		0.084	0.102	0.366	0.114	
September	85	115	255	175		1.4	1.4	7	3.6		0.079	0.099	0.26	0.13	
October	115	135	275	245		0.9	1.2	5	2		0.042	0.084	0.318	0.288	
November	120	130	225	130		2	5	7.9	6.4		0.032	0.073	0.365	0.182	
December	200	200	280	240		5.6	6.8	9.3	8.4		0.071	0.072	0.47	0.35	

Parameters	Zn (ppm)					Fe (ppm)					Cu (ppm)				
Months / Stations	I	II	III	IV		I	II	III	IV		I	II	III	IV	
January	0.012	0.162	0.212	0.191		0.122	1.600	1.372	0.851		0.014	0.021	0.040	0.024	
February		0.140	0.273	0.330	0.291		0.552	0.955	1.311	1.050		0.003	0.062	0.013	0.070
March	0.139	0.265	0.311	0.301		0.985	1.332	4.217	2.161		0.062	0.040	0.200	0.070	
April	0.118	0.193	0.285	0.262		0.460	2.871	2.917	3.167		BDL	0.011	0.003	0.013	
May	0.340	0.363	1.602	0.656		0.605	2.001	4.300	0.840		0.104	0.105	0.460	0.340	
June	0.112	0.192	0.400	0.200		0.85	0.92	1.020	0.978		BDL	0.006	0.012	0.011	
July	0.196	0.247	0.449	0.298		0.5	0.57	1.2	1.4		BDL	BDL	BDL	BDL	
August	0.005	0.011	0.32	0.02		0.2	0.8	6.3	1.6		BDL	BDL	BDL	BDL	
September	BDL	0.007	0.02	0.015		0.5	0.60	3.6	2.20		0.001	0.009	0.01	0.011	
October	0.004	0.007	0.012	0.035		0.4	0.62	0.8	0.15		0.003	0.006	0.025	0.013	
November	0.190	0.200	0.301	0.411		1.558	1.559	2.191	2.191		BDL	BDL	0.004	0.001	
December	0.159	0.116	0.197	0.026		0.117	0.967	1.529	1.376		BDL	BDL	0.002	0.001	

organic matter. Ananthraj *et al.* (1987), Deshmukh (1964), Philip (1927), Prakash (1982), Lohar and Patel (1998) reported that concentration of DO is inversely proportional to the concentration of CO_2. Their results support the present findings of higher CO_2 and low DO at all the favourities on the Kham River.

Maximum BOD value (35.22mgl^{-1}) was recorded at Site-III in May 2010. Increasing trend of BOD and decreasing trend of DO towards downstream, clearly indicates increasing load of pollution towards downstream of river. High COD (42.38 mgl^{-1}) was recorded at Site-III in May 2010. 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 III and IV clearly indicate large scale disposal of untreated wastewater into the river. High alkalinity (408mgl^{-1}) at Site III is probably because of addition of waste. Mishra and Saksena (1989), Pandey *et al.* (1993),

Jesudass and Akia (1995) reported variation in the values of total alkalinity which interferes with the water quality. Nitrate range in river water was from 0.9 to 11.08mgl^{-1} and it rises with increased sources of industrial waste and addition of domestic sewage.

Phosphate concentration in river water varies from 0.028 to 0.8mgl^{-1}. It increases towards downstream due to influx of domestic sewage, detergents, agricultural effluents and industrial effluents. Hynes (1979) also noticed an increase in phosphates and nitrate concentration in downstream direction of the Poluse River (Idaho).

The water contains large quantities of zinc, iron and copper. Similar to present results, heavy metals in the sewage water were also reported in other studies by Blakeslee (1973), Bryan (1974), Arora *et al.* (1985), Augusthy *et al.* (2000). It appears that indiscriminative discharge of industrial effluent into sewerage system has led to high concentration of heavy metals. Data represented in Table 2 reveals that the large number of zooplankton were noted Rotifers (37), Crustaceans (16) (Cladocera = 5, Ostracoda = 3, Copepoda = 8), Brachiopod (2).

Moderate numbers of protozoan member representatively obtained in the water of Kham River may be indicative of mild pollution as observed by Sharma *et al.* (1999), in Tungabhadra River, from Karnataka, from Ganga Rive at Kanpur (U.P.) Ray and David (1966). Difflugia species were found at all sites except Site I which received heavy dose of sewage. This suggests that these species are polluted water species. Saxena and Mishra (1990) from industrial waste waters from Birla Nagar, Gwalior (M.P.) and Raghavendran (1992) also reported Difflugia which may be present in polluted waters.

In Kham River, total population was noted in Site IV. *Brachionus calyciflorus, Brachionus angularis, Brachionus caudatus, Brachionus falcatus, Brachionus forficula, Brachionus bidentata, Keratella tropica, Keratella. cochlearis* and *Keratella quadrata* showed characteristics distribution at site III and IV was probably due to the great alkalinity (CO_3 and HCO_3) which most likely favoured the growth of large number of rotifer species (Sankaran Unni and Naik, 1997).The comparatively higher number of the rotifer group population at sampling Sites III and IV may indicate the input of the waste to residual area as reported by Arora (1966), Patil *et al.* (2006).

Cladocera dominated zooplankton counts at Site III, were represented by Daphnia, Sida, Moina and Bosmina. Moina has been reported to dominate also in river Ganges by Bilgrami and Munshi (1985) of these Daphnia was better represented in the entire site. Gradual reduction in the abundance took place from upstream to downstream site such observation were also confirmed by Sharma *et al.* (1999). Adholia and Vyas (1992) reported Cyclops a dominant genus of copepods as pollution tolerant form.

In Ostracoda Cypris, Cyprinotus and Stenocypris were recorded at Site III and IV indicating that they are tolerant to the extreme environmental conditions prevailed in this region (Hari Krishnan and Abdul Azis, 1999). Among the zooplankton, Copepods comprises the most important group (Choudhary and Chudhury, 1994; Sarkar *et al.*, 1986). Diaptomus was highly sensitive to pollution. Among the species of *Brachionus*, the most reliable indicators of sewage pollution are *Brachionus calyciflorus, Brachionus angularis, Brachionus falcatus, Keratella cochlearis, Keratella tropica* and *Filinia*. Among *Cladocera Alona, Bosmina, Moina* and *Sida* increased under nutrient rich conditions and are indicators of eutrophication similar to rotifers at different sites of Kham River receiving sewage.

Anuropsis an important indicator species Gannon and Stemberger (1978) was represented in all sites. A notable variation was observed in Ostracoda species as reported by David (1956) and can be use as an indicator of pollution.

The Table 1 has shown comparatively high values of temperature, CO_2, BOD, COD, nitrate, phosphate and heavy metals like Zn, Fe and Cu and low values of pH and DO are responsible for relatively higher abundance of species of zooplankton at Site III and IV. In Site I and II zooplankton population is less as compare to Site III and IV may be less nutrient are available there. Nutrient enrichment through sewage inputs further influenced their development. This investigation should be used as tool for controlling the water pollution at Aurangabad city and conserving the aquatic life in the Kham River.

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