



ORIGINAL RESEARCH PAPER

Zoology

SEASONAL VARIATIONS IN THE ZOOPLANKTON DIVERSITY OF BHIMA RIVER FLOWING THROUGH KHED TAHSIL

KEY WORDS: Zooplankton, Bhima River, Khed Tehsil.

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ABSTRACT

The present paper deals with studies on the seasonal variation in the diversity. Zooplankton occurring in Bhima river flowing through Khed tahsil, District, Maharashtra. The qualitative and quantitative analysis of the river was analyzed for two consecutive years from Feb 2015 to Dec 2015. Samples collected at an interval of a month. 10 sampling stations were selected Wada, Chas, Padali, Donde, ETP plant, Khadkeshvar, Retawadi, Sangamwadi on the basis of their topology, and various incoming water bodies join to main stream. The analysis of data showed marked difference in the water quality parameters at different sampling stations, which may be due to varying inputs discharged from different sites. In all total 20 species of zooplanktons belonging 4 classes viz. Rotifera, Cladocera, Copepoda and Ostrococha. The dominance of Rotifera was observed among all zooplankton groups in all seasons. Factors like water temperature, DO and alkalinity play an important role in controlling the diversity. The study of seasonal variation of zooplankton analysis shows an average abundance of species in winter season, due to different environmental condition of water bodies.

INTRODUCTION:

Water is the nature's most magnificent. It is soul of animal and plants. It is abundant and most valuable chemical compound created by nature. It is necessary for all living organism for the continued existence on this earth planet. Out of total water available on earth's surface only 0.3% to 0.5% issuable therefore, its judicious use is crucial. It is the most abundant and elixir of life and essential chemical, but this huge natural resource has been depleted.

Zooplanktons are good indicator of changes in water quality because it is strongly affected by environmental conditions. They respond quickly to changes in environmental quality.

Zooplankton occupies a central position between the autotrophs and heterotrophs. Zooplanktons' are most fascinating group of microorganism occurs in aquatic water body.

The main four taxonomic group such as Protozoan's, Rotifers, Cladocerans, and Copepods. Among the zooplankton Rotifers are apparently the most sensitive indicators of the water quality (Sheeba et al., 2004). Therefore qualitative and quantitative assessments of zooplanktons are of immense importance. The objectives are to determine the zooplankton diversity assessment for different season in the Bhima River. The investigation may help to asses health of river due to domestic activities in the region.

Table :1 Physico chemical parameters average values for the year 2014-2015.

	pH			Temp (°C)			Conductivity (µ)			Total dissolved solid (mg/l)		
	Feb-May 14	June-Sept 14	Oct-Feb 15	Feb-May 14	June-Sept 14	Oct-Feb 15	Feb-May 14	June-Sept 14	Oct-Feb 15	Feb-May 14	June-Sept 14	Oct-Feb 15
S1	7.5	7.2	6.9	25.75	25.5	24	0.54	23.91	94.94	0.73	0.19	0.28
S2	7.6	7.5	6.3	26.25	25.75	25.5	0.55	24.34	92.2	0.83	0.24	0.38
S3	7.3	7.2	6.4	25.25	26.25	24.5	0.34	20.73	97.94	0.91	0.34	0.56
S4	7.5	7.3	6.3	27	27.5	24.5	0.39	21.93	116.32	0.09	0.41	0.68
S5	7.7	7.2	6.6	27.5	27.75	25.25	0.43	28.81	124.66	0.08	0.31	0.96
S6	7.3	6.7	6.3	29.25	28.25	26	0.63	28.53	130.26	0.08	0.47	1.03
S7	6.7	6.6	6.4	29	27.25	26.25	1.27	40.37	180.9	0.44	0.5	1.2
S8	7.2	6.5	6.4	28	27.25	27.75	0.58	41.3	182.72	0.14	0.55	1.3
S9	8.5	6.9	6.7	28.5	27.5	25.75	0.31	42.58	187.32	0.21	0.65	1.5
S10	8.5	7	7.7	29.5	28.25	25.25	0.45	42.36	185.4	0.23	0.69	1.62

Table 2 Physicochemical Parameters of Bhima River Water

	Total solids (mg/l)			Alkalinity (mg/l)			Hardness (mg/l)			Calcium Hardness (mg/l)		
	Feb-May 14	June-Sept 14	Oct-Feb 15	Feb-May 14	June-Sept 14	Oct-Feb 15	Feb-May 14	June-Sept 14	Oct-Feb 15	Feb-May 14	June-Sept 14	Oct-Feb 15
S1	0.93	0.26	0.14	311.2	335	152.8	140.55	156.5	78.52	20.94	23.49	20.72
S2	1.12	0.35	0.19	314.7	327.5	153.6	197.85	143.8	78.32	20.2	24.38	21.95
S3	0.015	0.23	0.23	678.7	631	170.2	74.5	243.5	227.72	28.31	28.84	24.82
S4	0.14	0.36	0.23	660	667.8	180.46	89.875	247.1	233.9	30.51	35.23	26.88
S5	0.05	0.44	0.54	721.25	724.3	240.26	108.15	242.3	235.84	28.96	34.69	30.23
S6	0.3	0.4	1.7	807.5	886.5	270.6	119.27	391	277	28.86	42.48	34.53
S7	0.2	0.37	1.76	1052.5	1022.3	291.54	611.52	596.5	484.74	34.26	43.58	43.01
S8	0.6	0.43	1.93	1075.5	1087.8	340.88	554.02	660.5	445.44	43.52	47.9	46.4
S9	0.5	0.55	1.97	967.5	1272.7	460.34	555.67	683.6	482.62	44.4	39.69	48.6
S10	1.5	0.67	2.14	1067.5	1238.2	501	549.42	708.07	483	44.27	54.75	46.93

Table 3 continue...

	BOD (mg/l)			COD (mg/l)			Nitrates (mg/l)			Phosphates (mg/l)		
	Feb-May14	June-Sept 14	Oct-Feb15	Feb-May14	June-Sept14	Oct-Feb15	Feb-May14	June-Sept14	Oct-Feb15	Feb-May14	June-Sept 14	Oct-Feb15
S1	1.2	1.2	1.8	2.5	1.8	2.6	1.16	0.86	1.75	0.67	0.28	0.27
S2	1.5	1.7	1.2	2.8	3.1	3.2	1.27	0.97	1.49	1.12	0.72	0.69
S3	2.8	2.3	1.8	3.5	3.8	4	1.17	1.33	1.47	1.27	1.33	1.75
S4	3.5	2.6	1.8	4.1	4	4.9	2.38	1.49	2.29	1.51	2.14	1.77
S5	3.2	3.7	4.3	6.1	4.4	5.4	3.47	1.83	3.02	2.14	1.98	2.07
S6	6.3	3.5	4.1	7.6	5.4	6.3	3.66	2.77	4.55	2.24	2.06	2.14
S7	7.4	5.5	5.7	9.4	6	7	4.23	2.8	5.36	2.93	2.33	2.49
S8	7.3	5.8	6.1	10.2	6.5	7.1	5.51	3.36	5.9	3.36	2.56	2.85
S9	7.9	7	6.9	10.8	7.2	7.9	6.49	3.52	6.58	4.27	2.75	2.84
S10	8.2	8	7.5	11.4	8.29	8.3	7.73	5.44	7.13	4.26	2.89	3.12

*All values in the table are mean of four month for each season

MATERIAL AND METHOD:

In jurisdiction of khed tahsil the survey of zooplanktons Bhima River was carried out from Feb 2014 to Feb2015. Water samples were collected in the early in morning in between 8.00 am to 11.00 am the samples were collected from the Bhima River at 10 sampling stations. The data was articulated seasonally as summer, winter and monsoon, the plankton samples were collected through 50 liters of water by standard plankton net (bolting silk cloth No. 20) and the collected samples were fixed in 4% formalin. Water samples were collected from downstream direction in a plastic container of 2 liter capacity with necessary precaution. For DO and BOD samples are collected in stopper bottles 300 ml capacity.

The parameters like pH, Temp. were determined at the field at the time of sample collection. (Ph-Henna digital pH meter, temp by thermometer) the other parameters such as total solids, hardness, chlorides, alkalinity DO ,BOD ,COD are analyzed at the laboratory. All reagents are analytical grade and solutions were made in the distilled water .the analysis of parameters by using standard methods –APHA 20th edition.

The qualitative and quantitative analysis of the organism was carried out by Sedgwick rafter cell as per the standard methods APHA (1998). Zooplankton are identified with the help of standard literature up to generic level by using standard keys of Pennak (1978), Reddy (1994), Bhoyain and Asmat (1992).Dhanapathi (2000).

Table No. 4: Zooplankton species at study area during Feb 2014 to Feb2015.

Sr. No	Zooplankton groups	Name of the species	Summer	Winter	Monsoon
A Rotifera					
1		<i>Brachionus caudatus</i>	+	+	+
2		<i>Brachionus forticula</i>	+	+	+
3		<i>Brachionus calyciflorus</i>	+	+	+
4		<i>Keratella crassa</i>	+	+	+
5		<i>Keratella quadrata</i>	+	+	+
6		<i>Lacane sp.</i>	+	+	+
7		<i>Filinia sp.</i>	+	-	-
B Cladocera					
8		<i>Daphnia sps.</i>			
9		<i>Moina brachiata</i>	+	-	+
10		<i>Moina micrura.</i>	+	+	+
11		<i>Cerodaphnia sp.</i>	+	+	-
12		<i>Bosmina longirostris</i>	+	+	+
13		<i>Diaphanosoma sarsi</i>	+	+	+

C	Copepoda			
14	<i>Mesocyclops sps</i>	+	+	+
15	<i>Thermocyclops</i>	+	+	+
16	<i>Microcyclops</i>	+	+	+
17	<i>Naupilus</i>	+	+	+
18	<i>Undinuala sps</i>	+	+	+
D Ostrocodia				
19	<i>Heterocypris</i>	+	+	+
20	<i>Stenocypris</i>	+	+	-

Table 5: Total observed Zooplankton density of different season at study area.

Sr. No	Zooplankton group	Summer	Winter	Monsoon	Total	%
1	Rotifera (No/L)	575	370	235	1180	39.93%
2	Cladocera (No/L)	320	230	125	675	22.84%
3	Copepod (No/L)	380	300	180	860	29.10%
4	Ostrocodia (No/L)	130	80	30	240	8%
	Total zooplankton	1405	980	570	2955	100%

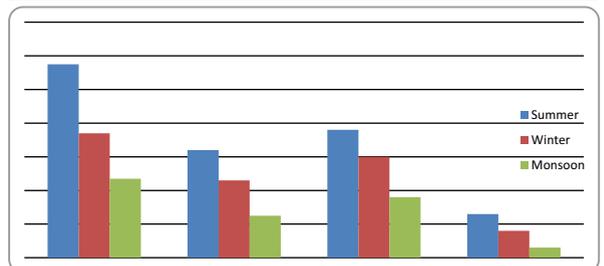


Figure 1 Total Zooplankton % in 2014-2015

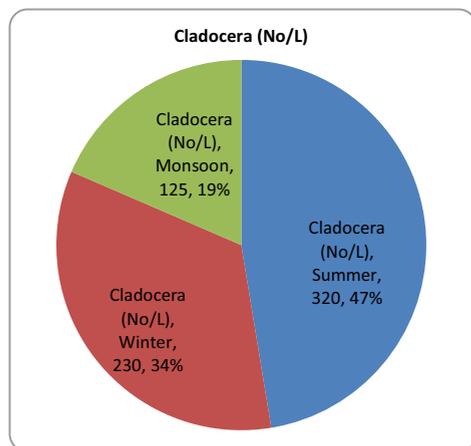


Figure 2.1 Rotifera % Seasonwise

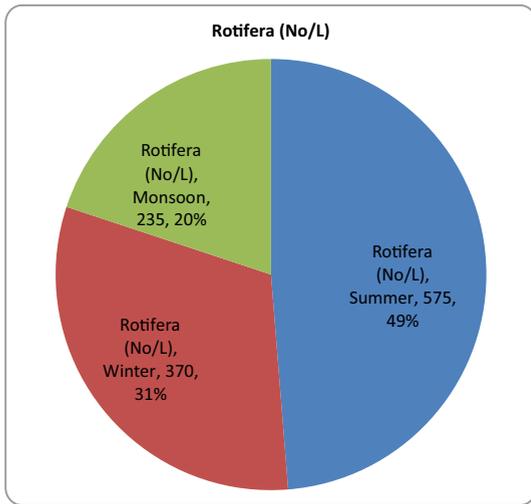


Figure 2.2 Cladocera % Seasonwise

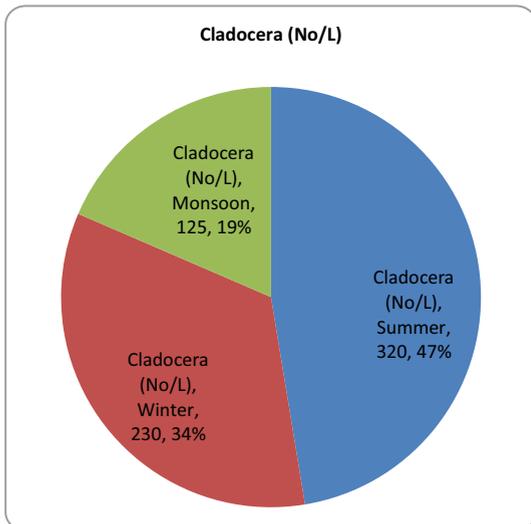


Figure 2.3 Copepod % Seasonwise

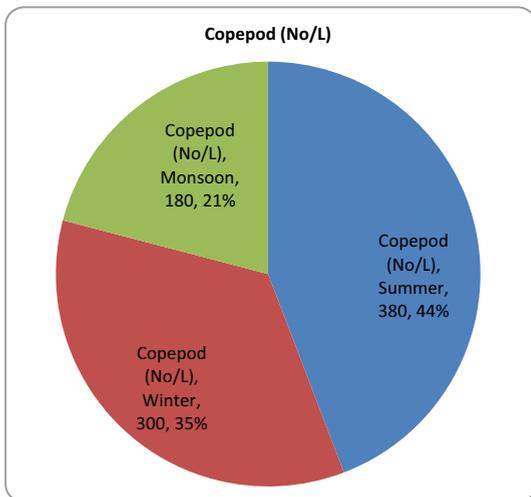


Figure 2.4 Cladocera % Seasonwise

RESULTS AND DISCUSSION:

In the present study recorded zooplankton diversity from the Bhima river flowing in jurisdiction of Khed. Taluka, Dist. Pune. In all total 20 species of zooplanktons belonging 4 classes viz. Rotifera, Cladocera, Copeopoda and Ostrocoada. (Table no 4) Among all the zooplanktons recorded from Bhima river at ten sampling sites, Rotifera was found to be the most dominant group both qualitatively and quantitatively and was

represented by seven species viz. *Brachionus caudatus*, *Brachionus forticula*, *Brachionus calyciflorus*, *Keratella crassa*, *Keratella quadrata*, *Lacane sp.*, *Filinia sp.* Rotifera represented 39.93 % (Table-5). Qualitatively Copepods were represented by *Eucyclops sp.*, *Mesocyclops sp.*, and *Nauplius* larva of Copepod. Quantitatively Copepod was the second dominant group of Zooplanktons and represents 29.10 % of the total population of zooplanktons. (Table 5) Copepods were also recorded in maximum number during summer and minimum during monsoon months.

Cladocera was the third dominant group of Zooplanktons and was represented by *Daphnia silmilis*, *Moina brachiata*, *Moina micrura*, *Cerodaphnia sps.*, *Bosminia longirostris*, *Diaphanosoma sarsi*. It represents 22.84% of total zooplankton. The group Ostrocoada was represented by two species *Heterocypris sps.* and *Stenocypris sps.* It represents the fourth group and constitutes 8.1% of total zooplankton. The population density was high in summer (49%) fig-2.1, winter (31 %) and monsoon season (20%). The *Filinia* genus was observed rarely at sampling station 7 and 9 in summer season. Similar observations are recorded by **Gadekar (2014)** in railway ponds of Gondia. The dominance of Rotifera was observed among all zooplanktonic groups in all seasons. The physicochemical parameters and zooplankton diversity Of Masooli and Yeldari reservoirs in Parbhani were analysed by **Kadam et al. (2014)**. Zooplankton composition was generally higher in summer, moderate in winter and lower in monsoon.

On the basis of qualitative study, Rotifera *Brachionus terminalis*, *Brachionus angularis*, *Brachionus falcatu*s, *Keratella tropica*, *Lecane sp* were the dominant species. *Bosmina sp.* and *Daphnia sp* were dominant among Cladocera. *Diaptomus nauplius* was recorded during all the seasons among Copepoda. (Table-4).

Temperature: Water temp plays important factor which influences the chemical biochemical and biological characteristics of water body the maximum temp is 31°C recorded in the month of May and minimum temp. 23°C in the month of December. The seasonal variation showed a similar trend at all the stations. The temperature at station no 5, 6, 7, 8 was slightly higher because of mixing of sewage and industrial effluents. Zooplanktons composition was higher in summer (Fig-1) due to increase in temp and availability of sunlight. Similar observations are recorded by **Kadam et al. (2014)**.

pH: The pH value of the drinking water is an important index of acidity, alkalinity and resulting values of the acidic basic interaction of a number of its minerals and organic components. In the present study pH values of samples varies from pH 6.11 to pH 8.44 which lies in the range prescribed by APHA. Aquatic organisms are affected by pH of water because most of their metabolic activities are pH dependent (**Balkrishnan-2013**).

Total Dissolved Solids: The total dissolved solids fluctuations from 0.01 to 1.9 mg/lit. The maximum values of TDS is recorded at the sampling stations no 9 Brick Factory in the month of Feb 15. The lowest TDS are recorded 0.01 g/lit. in the month of march at the sampling site Padali. (Table-1)

Alkalinity: the alkalinity ranges from 145 mg/lit to 1460 mg/lit. The maximum value was recorded in the month of May to July is 1460 mg/lit. and the minimum value in winter Sept to December 145 mg/lit. (Table-2) The alkalinity is maximum in summer and minimum in winter the similar results are obtained by **Hajare¹¹**, it is due to high photosynthetic rate. Total alkalinity of water was related with the fluctuations in the photosynthesis of phytoplankton.

Dissolved Oxygen: Among all the sampling stations DO is

varies from 0.6 mg/lit to 5.8 mg/lit.(Table-2) The concentration of DO among all river station is low and some sampling is high. The possible reason for low DO is due to the presence of material with rich organic content responsible for depletion of oxygen. (Das and Acharya, 2003)The higher DO at the sampling station ETP Plant, HRM college and brick factory is due to the reflection of high level of photosynthetic activity. Dissolved oxygen of water $\geq 5.0\text{mg/L}$ is desirable for good for growth of fauna and flora.

Biological Oxygen Demand: BOD test is found to be more sensitive test for organic pollution. The samples collected from the HRM College site ETP Plant and Retawadi shows highest BOD 11.5 and minimum at sampling station Wada, Chas, Saygaon it ranges from 0.74 to 11.5mg/lit .according to the royal commission of sewage disposal water having BOD more than 5 mg/lit is unsafe for domestic use. (Table-3)

Chemical Oxygen Demand: (COD) A huge range of variation is recorded among the collected water samples. The maximum COD at HRM College sampling stations and brick factory is 54.0 mg/lit minimum 1.7 mg/lit. The permissible limit of COD is 10 mg/lit⁽¹¹⁾ (Usharani *et. al.*, 2010).The high value of COD is due to the direct removal of sewage into rivers. It is observed that cod value is more than permissible limit. (Table-3)

Nitrates: Nitrates is observing in the range of 1.0 mg/lit to 30.74 .The nitrate proportion is higher at downstream in the month of April May at HRM College Brick factory and Retawadi. (Table-3) Dominancy of rotifers is the indicators of eutrophication and measures taken to minimize the aquatic pollution. Saldeek (1983).

Phosphate: The values of phosphates fluctuation from 0.2 to 12.38 mg/lit. The maximum value of phosphates is observation in the month of July and August in the sampling station HRM College brick factory. The minimum values are recorded in the month of October. The high value of phosphate is due to rain, surface water runoff; agricultural runoff waterman's activity could have also contributed to the inorganic phosphates.⁽⁶⁾ The similar results are obtained by Aravindkumar. (Table-3)

CONCLUSIONS:

Zooplankton population of the Bhima River reveals the eutropic condition of the river which is an account of activities such as domestic waste disposal in the form of sewage and solid wastes, disposal of wastes materials, dumping of dead animals, human wastes etc. The water of Bhima river becomes more turbid during summer season as the velocity of water is slow in river, the dilution of sewage and organic waste is also lesser during this season. Due to anthropogenic activities in summer adds organic waste at sight, S-8, S-9 the municipal sewage channels also add waste at these sights. Increasing load of pollution reduces number of zooplanktons in water upstream to downstream. More amount of water with high velocity in rainy season dilutes the water to greater extent, and reduces the number of zooplanktons. The physico chemical parameters are also shows the diversity zooplankton were evenly distributed and the parameters are of suitable range.

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