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Study of physico-chemical parameters and zooplanktons diversity of Bhīma River from Solapur district (m. s.) India

Pankaj V. Pawar ¹ and Sudha G. Bansode ^{2,*}

¹ School of Life Science Punyasholk Ahilyadevi Holkar Solapur University, Solapur, India.

² Shankarrao Mohite Mahavidyalaya Akluj, Dist-Solapur (M.S), India.

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Abstract

The present study is on "Physico-chemical parameters of Bhima river of Solapur District (Maharashtra)". The Study was carried on from Jan'2022 to Des'2022 at four selected sampling stations. Monthly variation of Physico-chemical Characteristics of water of Bhima River were studied and it revealed that the water quality is fairly homogeneous and suitable for drinking. Study of zooplankton showed 90 species of zooplankton belonging to 4 different classes. Rotifera 21 species (23%), Cladocera 20 species (22%), Copepoda 22 species (24%), Protozoa 27 species (30%). The investigation on Physico-chemical characteristics at different sites revealed its alkaline nature, suitable for aquaculture practices. Significant site variations have been recorded due to the interference of sewage and agricultural wastes. All the Zooplankton groups, Rotifera, Protozoans, Copepoda recorded dominance.

Keywords: Bhima River; Physico-chemical Parameters; Zooplanktons

1. Introduction

Zooplankton study is important as it could provide ways to predict the productivity of fresh water aquatic system (Borgmann et al., 1984; Morgan et al., 1978). In deciphering trophic status and biomonitoring of aquatic habitats, zooplankton play a vital role (Krishnamurthy et al., 1979). The biodiversity and distribution of zooplankton in aquatic ecosystem depend mainly on the physico-chemical properties of water. Pollution of water bodies by different sources results in drastic change in zooplankton populations, and thereby affects the production potential of the ecosystem (Singh and Mahajan, 1987; Harikrishnan and Azis, 1989). Zooplankton communities are highly sensitive to environmental variation. Hence, they are effective tools in environmental biomonitoring of an aquatic system. Changes in the zooplankton species composition have been used as indication of increased eutrophication of fresh waters (Wanganeo and Wanganeo, 2006). Some species flourish in highly eutrophic waters while others are very sensitive to organic or chemical wastes (El-Enany, 2009). In India, several important contributions on zooplankton and their diversity, density, ecological importance has been made in different parts of the country such as Ganapati (1949); Gulati (1964); Khan and Rao (1981); Subla et al., (1984); Patil and Goudar (1989); Wanganeo and Wanganeo (2006); Ramachandra et al., (2006); Raina et al., (2009) Chakrapani et al., (1996); Das et al., (1996) Dadhick and Sexena (1999); Dhanapathi (2000); Sharma (2009) and Kumar et al., (2011). But, information regarding the zooplankton diversity has not been thoroughly investigated in Maharashtra and especially in Solapur district. Thus, the present work aimed to assess the biodiversity of Zooplankton and their Relation to the physico-chemical parameters of Bhima river which is mainly used for irrigation purposes, commercial fishing practices and recreation.

* Corresponding author: Sudha G. Bansode

2. Material and Methods:

2.1 Study site

The area selected for the present study is Bhima river of From Solapur District Maharashtra. It is 90 Km from the City centre near to the Pandherpur.

2.2 Study Period

The investigation was carried out for a period of 12 month from Jan' 22 to Dec' 22.

2.3 Physio-chemical parameters of water

Temperature was measured with the help of centigrade thermometer. Transparency was recorded with sacchi disk pH was determined by using a pH meter. Specific conductivity was estimated by using a conductivity meter. Standard methodologies of APHA (2005), Jhingran et al (1967), Dey and others were followed to measure dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, dissolved phosphate and nitrate. Samples were collected on monthly basis.

2.4 Zooplankton Analysis

In the present study, zooplankton sampling was taken monthly for one year (Jan' 2022 to Dec' 2022) at four different sampling sites (North, South, East and West).

2.5 Collection

Zooplankton net (mesh size 25µm) was swept from 1 to 4m depth and zooplanktons collected were transferred into separate plastic bottle/containers. 50 lit of water were sieved through zooplankton net to obtain planktons.

Fixation: - Zooplanktons were fixed and preserved in 4% formalin.

Identification: - 1 ml of the plankton sample was transferred into a Sedgwick rafter plankton counting slide. The chamber was covered and plankton was examined under low power of a microscope. The number of plankton taxon (N) per liter is given by the equation.

$$N = A \times C \times 100 / V = A \times C \times 1000 / 50$$

A = no. of plankton in 1 ml of the sub sample filling the Sedgwick-rafter chamber.

C = ml of the plankton setting volume of plankton.

V = volume of the water sample filtered = 50 liter.

2.6 Systematic Account

According to the research, four types of classes of zooplanktons and their subspecies have been found in the water sample taken from Bhima river. They are mentioned below;

- Rotifera: 3 species namely *Brachionus Caudatus*, *B. falcatus* and *Conochilus arboreus* was seen. *b. Falacatus* was more numerous in April' 22 & Oct' 22 where as *B. Caudatus* and *Conochils*.
- Cladocera: - It represents 4 genera, *Ceriodaphnia cornuta*, *Moina micrura*, *Moina brachiata* and *Diaphanosoma sarsi*. In June' 22 & Des' 22 *Ceriodaphnia coruta* & *Moina micrura* was found in highest numbers.
- Copepods: - This class was represented by three genera, Cyclops, Nauplius and *Heliodiptomus viduus*. Cyclops & Nauplius was observed from highest number.
- Protozoans: This class was represented by 3 genera namely Amoeba, Paramecium & Heliozoans. Amoeba & Paramecium was found in highest number July' 22.

3. Result and discussion

3.1 Observation No. 1(Physico-chemical Parameters)

- **Water Temperature:** Surface water temperature ranged from 18°C to 29°C. In the present investigation the season wise analysis showed that the average air and temperature in river was maximum during summers, comparatively less during monsoon and least during winter season.
- **Transparency:** Transparency ranged from 57cm to 72.9cm. It was maximum in month of March, April and November ensuring a high water column taking part in the primary process.
- **pH:** The pH ranged from 6.8 to 7.7 during the study period. In the present study, season wise analysis of pH in the river showed minimum value in winter and maximum in summer. The water having pH range of 6.5 to 9.0 are most suitable for aqua culture.
- **Dissolved Oxygen:** In the present investigation DO ranged between 4.8 mg/l to 6.4 mg/l. The maximum DO was observed in the post monsoon and winter months.
- **Free carbon dioxide:** CO₂ ranged from 2.4 mg/l to 12.2 mg/l. It was minimum in the post winter months and maximum in May. In some river absence of free carbon dioxide and higher pH resulting in the conversion of carbon dioxide into bicarbonate and carbonate.
- **Total alkalinity:** Total alkalinity noted between 106 mg/l to 133 mg/l. Total alkalinity is used as a measure productivity. Natural alkalinity are rocks containing carbonate, bicarbonate and hydroxide compounds that are abundantly present.
- **Total hardness:** It ranged between 38.6 mg/l to 78.6 mg/l. This indicates that water is soft. Degrees of hardness are as follows:
0-75 mg/l = Soft,
75-150 mg/l = Moderately hard,
150-300 mg/l = Hard,
Above 300 mg/l = very hard.
In present investigation the total hardness varied from 38.6 mg/l to 78.6 mg/l which indicated that water is soft and is suitable for drinking and irrigation purpose.
- **Phosphate:** In the present study the Phosphate level varied from 0.16 mg/l to 0.72 mg/l. The phosphate is one of the most important major nutrients that is required to biota. Highest seasonal mean values were reported during monsoon and lowest during winter.
- **Nitrate:** The nitrate content in the river ranged from 9.6 mg/l to 16.6 mg/l. Highest value of nitrates were recorded in winter.
- **Specific Conductance:** The electrical conductivity value ranged between 210 to 282. The EC values showed maximum during summer and minimum during winter.

Physico chemical parameters of water of Bhima river are presented in table No. 1 and seasonal variations have been represented in table No. 2.

Table 1 Monthly variation of Physico chemical parameters in Bhima river (unit/ml) X ± of four observations

Parameter	Jan 22	Feb 22	Mar 22	Apr 22	Ma 22	Jun 22	Jul 22	Aug 22	Sep 22	Oct 22	Nov 22	Des 22
Temperature (°C)	18± 2.84	21± 3.15	23± 1.61	26± 3.5	29± 2.9	28± 4.3	23± 0.72	23± 1.7	22± 0.83	21± 1.93	19± 0.8	18± 0.82
Transparency (cm)	66± 2.15	67± 3.36	71.3± 3.3	72.9± 3.7	67.3± 2.8	66.7± 3.4	57.2± 2.5	60.4± 3.1	64.2± 3.35	65.3± 3.66	72.3± 2.6	67.4± 3.61
pH	6.8± 0.84	7.2± 0.77	7.3± 0.7	7.5± 0.8	7.7± 0.9	7.6± 0.5	7.5± 1.3	7.3± 0.7	7.3± 0.97	7.2± 0.55	7.2±0.8	6.9± 0.56
DO(mg/l)	6.4± 0.33	6.3± 0.28	6.1± 0.7	5.9± 0.2	4.8± 0.5	5.1± 0.6	5.9± 0.5	5.6± 0.4	5.8± 0.54	6.2± 0.12	6.2± 0.28	6.4± 0.3
Free CO ₂ (mg/l)	3.4± 0.44	4.3± 0.38	5.6± 0.2	8.9± 0.2	12.2± 0.1	11.1± 0.2	7.2± 0.3	7.1± 0.1	5.6± 0.23	4.4± 0.38	4.2± 0.3	2.4± 0.45

Total alkalinity (mg/l)	128±2.25	126±2.83	127±2.47	129±4.22	132±2.92	133±2.93	120±3.54	106±3.2	112±2.35	118±2.63	120±2.3	122±2.43
Total Hardness(mg/l)	42.6±7.01	48.8±5.2	56.3±7.4	68.8±11.73	78.6±6.24	74.1±4.36	68.2±5.88	67.1±8.14	65.6±3.43	54.3±10.01	46.6±7.68	38.6±8.64
PO4(mg/l)	0.35±0.040	0.43±0.016	0.56±0.023	0.54±0.048	0.48±0.024	0.36±0.012	0.40±0.018	0.60±0.023	0.61±0.028	0.72±0.034	0.26±0.024	0.16±0.03
NO3(mg/l)	16.6±0.58	16.1±0.46	10.6±0.34	9.6±0.50	10.1±0.30	11.6±0.52	13.8±0.36	13.6±0.24	12.8±0.28	12.2±0.49	12.4±0.30	14.3±0.32
Specific Conductance	210±17.16	216±15.96	222±14.32	2.29±9.82	250±22.02	242±11.22	230±11.11	282±12.72	227±16.32	220±8.22	212±6.08	208±19.92

Table 2 Seasonal variation of Physico chemical parameters in Bhima river from Jan'22 to Dec' 22

Season Parameters	Summer (Mar' 22 To June' 22)	Mansoon (July' 22 To Oct' 22)	Winter (Nov' 22 To Dec' 22 & Jan' 22 To Feb' 22)
Temperature(°C)	26	22	19
Transparency(cm)	69.5 ± 3.3	61.7 ± 3.1	68.0 ± 4.30
pH	7.52 ± 0.22	7.32 ± 3.15	7.02 ± 4.30
DO(mg/l)	5.47 ± 0.5	5.87 ± 0.39	6.32 ± 0.32
Free CO2 (mg/l)	9.44 ± 3.00	6.14 ± 1.28	3.66 ± 0.78
Total alkalinity (mg/l)	130.25 ± 3.13	114.5 ± 2.93	124.5 ± 2.45
Total Hardness(mg/l)	69.45 ± 7.42	63.88 ± 6.88	44.15 ± 7.13
PO4(mg/l)	0.48 ± 0.025	0.46 ± 0.025	0.29 ± 0.020
NO3(mg/l)	10.47 ± 0.415	13.16 ± 0.34	14.85 ± 0.41
Specific Conductance	233.5 ± 14.34	239.75 ± 12.09	211.5 ± 14.78

3.2 Observation No. 2 (Zooplankton Analysis)

The monthly variations in the occurrence of zooplankton in Bhima River have noticed and presented in the table no.3. Totally 90 different species of zooplankton belonging to four different classes were noticed.

- **Rotifera**:- 3 genera namely *Brachionous Caudatus*, *B.falcatus* and *Conochilus arboreus* were observed. *B.falactus* was more numerous in April' 22 & Oct' 22 whereas *B. Caudatus* were more in July '22.
- **Cladocera**:- It was represented by 4 genera namely *Ceriodaphnia cornuta*, *Moina micrura*, *Moina brachiata* and *Diaphanosoma sarsi*. *Ceriodaphnia cornuta* was found more in number during June and Dec' 22. *Moina micrura* was more numerous during June' 22 and Dec'22. *Moina brachiata* was not seen. *Daiphanosoma* showed irregular presence throughout the year.
- **Copepods**:- This class was represented by 3 genera namely *Cyclops*, *Nauplius*, and *Heliodiaptomus viduus*. *Cyclops* sp.was highly observed from Nov'22 . It was numerous from Jan ' 22 to July' 22. *Nauplius* sp.was observed throughout the year except in Nov' 22 and June' 22. *Heliodiaptomus viduus* was observed Nov' 22.
- **Protozoans**: This class was represented by 3 genera namely *Amoeba*, *Heliozoans*, *Paramecium*. *Amoeba* found in more number during June'22 and *Paramecium* found in less number but *Heliozoans* not seen in during season.

The monthly variations in the Zooplanktons in Bhima river presented in table no. 3 total 90 different species of Zooplankton belonging to four different classes.

Table 3 Monthly variation of occurrence of Zooplankton in Bhima river (unit/ml) X ± SD of four observations

Zooplankton	Jan 22	Feb 22	Mar 22	Apr 22	May 22	Jun 22	July 22	Aug.22	Sept.22	Oct.22	Nov.22	Dec.22
<i>A. Rotifera</i>												
1. <i>Brachionus Caudatus</i>	1	-	-	-	-	-	2	1	-	-	-	-
2. <i>B.Falcatus</i>	1	2	2	3	1	-	1	1	2	3	1	-
3. <i>Conochilus arboreus</i>	-	-	-	-	-	-	-	-	-	-	-	-
<i>B. Cladocera</i>												
1. <i>Ceriodaphnia Cornuta</i>	-	-	-	-	2	3	-	-	-	-	2	3
2. <i>Moina Brachiata</i>	-	-	-	-	-	-	-	-	-	-	-	-
3. <i>Diaphanos Omasarsi</i>	-	-	-	-	1	1	-	-	-	-	1	1
4. <i>Moina micrura</i>	-	-	-	-	-	3	-	-	-	-	-	3
<i>C. Copepods</i>												
1. <i>Cyclops</i>	1	1	1	1	1	1	1	-	-	-	2	1
2. <i>Nouplius</i>	1	-	1	-	-	2	-	1	1	1	-	2
3. <i>Heliodiapt omus viduus</i>	-	-	-	-	-	1	-	-	-	-	2	-
<i>D. Protozonas</i>												
1. <i>Amoeba</i>	2	1	1	-	3	1	4	1	1	1	1	1
2. <i>Heliozonas</i>	-	-	-	-	-	-	-	-	-	-	-	-
3. <i>Paramecium</i>	1	-	-	1	1	1	1	1	1	1	1	1
Total No. of Individuals	7	4	5	5	9	13	9	5	5	6	10	12
Total No. of Species	6	3	4	3	6	8	5	5	4	4	7	7

Table 4 Percentage composition of various classes of Zooplankton of Bhimariver

Month	<i>A. Rotifera</i>	<i>B. Cladocera</i>	<i>C. Copepods</i>	<i>D. Protozoans</i>	Total
Jan. 22	2	-	2	3	7
Feb. 22	2	-	1	1	4
Mar. 22	2	-	2	1	5
Apr. 22	3	-	1	1	5
May 22	1	3	1	4	9
June 22	-	7	4	2	13
July 22	3	-	1	5	9
Aug.22	2	-	1	2	5

Sept.22	2	-	1	2	5
Oct.22	3	-	1	2	6
Nov.22	1	3	4	2	10
Dec.22	-	7	3	2	12
Total	21	20	22	27	90

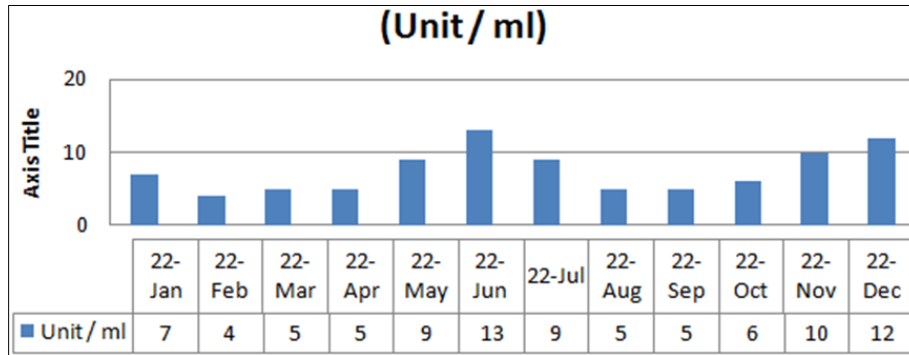


Figure 1 Monthly variations of Zooplanktons

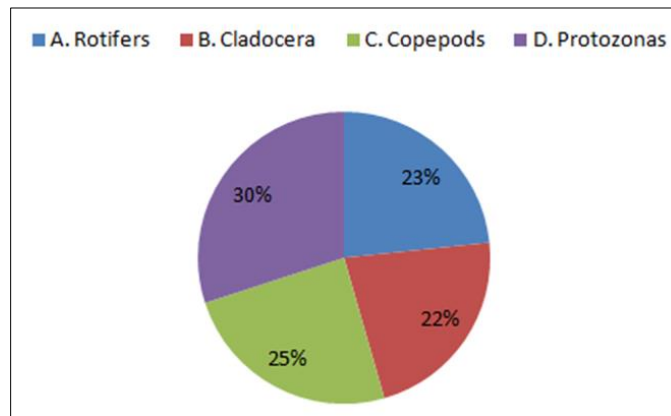


Figure 2 Percent composition of various classes of Zooplanktons

4. Conclusion

The result showed that water of Bhima river is suitable for drinking and fish culture. Zooplanktons study was carried out to understand its relation with water quality parameters and Zooplanktons Copepods, Protozoans and Rotifera showed dominance.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest to be disclosed.

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