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Physicochemical characteristics and zooplankton diversity in a Beehar River at Rewa district (M.P.) India

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Abstract

The primary objective of the existing investigation was to evaluate the water quality of the Beehar River situated in the densely inhabited region of Rewa, Madhya Pradesh. Over a span of six months, spanning from January 2023 to June 2023, specimens were procured for examination. These specimens underwent analysis for various physicochemical parameters in accordance with the established guidelines outlined by APHA (1998). These parameters included pH, temperature, hardness, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, total dissolved solids, total suspended solids, electrical conductivity, nitrate, phosphate, chloride, carbonate, bicarbonate, and others. The recorded values for these parameters were notably above the specified benchmarks recommended by diverse organizations like BIS (1991) and WHO (1997), signifying the contaminated condition of the water. Furthermore, an investigation on zooplankton was executed using a separate batch of samples from the same site, which unveiled a limited variety and concentration of zooplankton, thereby implying the elevated pollution levels in the river water.

Keywords: Physicochemical parameters, hardness, conductivity, zooplankton diversity

Introduction

Water is an indispensable resource for sustaining life and the environment on our planet, as emphasized by Mishra and Bhatt (2008) ^[6]. The presence of water is indispensable within ecosystems, being vital for the survival of all organisms, according to WHO (2004) ^[4]. Water plays a fundamental role in supporting life and preserving environmental balance, as noted by Dikio (2010) ^[5]. Additionally, water serves as a habitat for a variety of aquatic species. The availability of freshwater resources is crucial for the continuation of human civilization, as our daily activities are heavily dependent on its presence, as highlighted by Mishra *et al.* (2008) ^[6]. These water bodies, constructed by humans for storage purposes, can be viewed as semi-natural ecosystems, according to Yadav *et al.* (2013) ^[7]. Therefore, it is not surprising that human settlements have historically been located near these invaluable water sources.

Zooplankton, which are small organisms that drift in bodies of water, play a crucial role in maintaining aquatic ecosystems (Murugan *et al.*, 1998) ^[8]. While some of these organisms are too small to be seen without a microscope, others are visible to the naked eye. Positioned at the second trophic level, they are essential in various ecosystem functions such as food chains and the flow of energy (Ramachandra, 2008) ^[9]. The abundance and variety of zooplankton species are impacted by climate change and alterations in the physical and chemical properties of water bodies (Neves *et al.*, 2003) ^[10]. Additionally, the diversity of zooplankton species is closely linked to the physicochemical characteristics of the aquatic environment (Brraich and Kayr, 2005) ^[11]. In fact, zooplankton are commonly utilized as bio indicator species to evaluate pollution levels in water bodies (Mikschi, 1989) ^[12].

In modern times, there has been a significant emphasis on researching the impact of fluctuations in water conditions on living organisms. The analysis of physicochemical parameters yields valuable information about water quality and assists in evaluating pollution levels in aquatic environments. Therefore, the objective of the current study was to assess both the physicochemical parameters and the variety of zooplankton species present in the river water of Rewa.

Materials and Methods

It is one of the most important river of Rewa district. Beehar river is North westernly flowing river of Rewa district and is about 97 kilometers long. The river originates in the Kaimore hills of Kharamkheda village (Satna district) at the elevation of 600 meters above sea level in the Satna district (M.P.). After its origin in Kharamkheda, it flows through the hilly tract of

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Amarpatan, courses through plateau of Huzur and Sirmour tehsil, reaches the edges of plateau of Chachai village, where with its other tributaries, it forms a water fall, known as "Chachai fall". The river descends about 115 meters below its normal level and flow through a plain, to join the tons rivers, which is one of the important tributaries of Ganga river. Its catchment covers an area of about 1685 sq.km. out of which 636 sq.km. is in Satna and rest 1049 sq.km. in Rewa district.

Three different sampling sites were selected near industrial area named as sampling station I (Rajghat), II (Jayanti kunj) and III (Ajjarha). Water sample were collected on monthly

basis regularly from January 2023 to June 2023. Samples were taken in plastic bottles (0.5L and 1L) and brought to laboratory for estimation of physicochemical parameters using APHA standard methods (APHA, 1998) ^[1]. Plankton collection was done using plankton collecting net.

Results and Discussion

Results of the present study are given in table 1 and table 2 that represent measurement of various physicochemical parameters and occurrence of zooplankton species respectively. These results are discussed below.

Table 1: Showing values of various physicochemical parameters during study period at Beehar river in Rewa district

Parameters	Sampling stations	Jan.2023	Feb.2023	Mar.2023	Apr.2023	May2023	Jun.2023
Temp. (°C)	I	20.3	21.6	30.8	31.5	35.2	38.6
	II	18.2	23.5	27.3	28.6	32.7	37.2
	III	19.8	22.9	26.6	30.2	33.2	36.9
pH	I	8.6	8.4	7.8	8.5	7.7	7.8
	II	7.5	7.2	7.6	7.7	8.3	8.4
	III	8.3	8.1	8.9	8.1	8.5	8.2
Electrical conductivity (µmhos/cm)	I	411	448	421	404	392	351
	II	424	442	431	411	388	362
	III	459	446	428	407	395	358
Dissolved Oxygen (mg/l)	I	0.81	0.86	0.80	0.68	0.56	0.46
	II	0.67	0.78	0.70	0.60	0.48	0.38
	III	0.92	0.81	0.79	0.72	0.55	0.43
TSS (mg/l)	I	143	165	149	140	149	164
	II	148	159	162	146	154	176
	III	142	154	159	141	153	186
Hardness (mg/l)	I	207	225	231	244	247	267
	II	295	257	279	295	325	318
	III	240	264	287	292	308	307
COD (mg/l)	I	27.93	29.45	30.48	32.33	47.5	50.42
	II	27.6	28.11	32.25	38.45	42.16	44.14
	III	28.12	28.95	31.55	35.47	39.57	41.62
BOD (mg/l)	I	47.6	51.2	50.5	44.3	41.0	41.5
	II	46.8	47.0	47.9	38.9	30.14	39.6
	III	56.8	42.6	48.2	37.8	32.4	41.6
Chloride Conc. (mg/l)	I	14.45	15.13	14.64	16.21	16.93	17.05
	II	15.93	16.66	16.77	17.22	18.10	18.95
	III	15.01	16.60	16.20	17.01	17.96	18.30
Phosphate concentration (mg/l)	I	0.33	0.38	0.22	0.44	0.50	0.54
	II	0.40	0.42	0.30	0.37	0.48	0.66
	III	0.30	0.60	0.33	0.41	0.55	0.58
Nitrate concentration (mg/l)	I	0.88	0.87	0.92	1.02	1.12	1.46
	II	0.79	0.68	0.81	0.83	1.22	1.26
	III	0.77	0.82	0.78	0.80	1.18	1.32
TDS (mg/l)	I	330.8	324.5	356.5	351.7	365.2	421.5
	II	328.2	326.9	351.2	359.5	374.5	435.2
	III	333.4	329.2	354.7	360.8	368.4	446.8

Table 2: Zooplankton percentage of different groups in different sampling site at Beehar river in Rewa district

Group	Site-1	Site-2	Site-3
Rotifera	44%	47%	40%
Cladocera	35%	32%	36%
Copepod	14.5%	13%	17%
Ostracod	6.5%	8%	7%

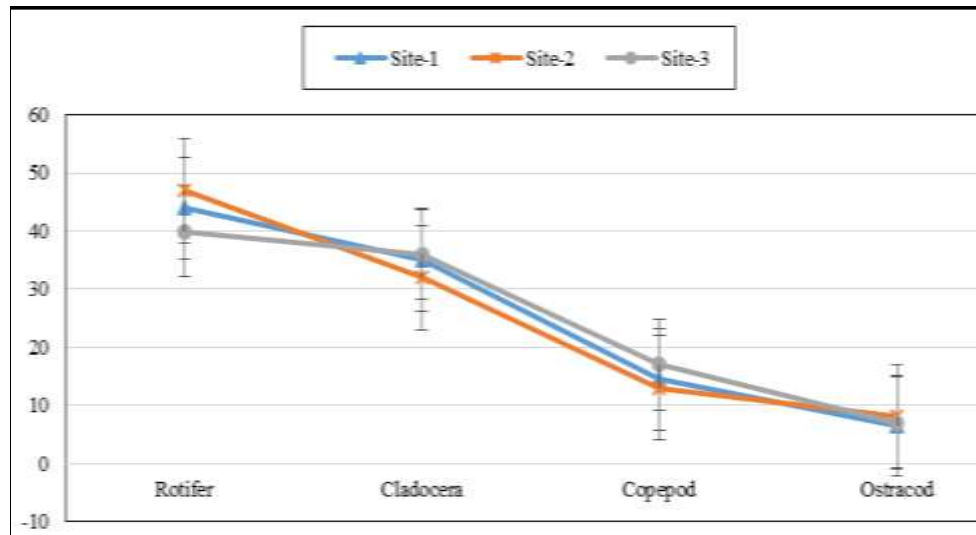


Fig 1: Graph analysis of Zooplankton percentage of different groups in different sampling site at Beehar river in Rewa district

Temperature value in present study shows upward trend from January to June. Desired limit of temperature to sustain life is 28-30 °C. Minimum value was recorded in January (18.2 °C) and maximum was observed in June (38.6 °C). The pH value ranges between 7.2 to 8.9 in water samples which indicates alkaline nature of water mainly due to carbonate and bicarbonate. According to BIS (Bureau of Indian Standard) [1] the permissible limit of pH should be 6.5-8.5. Dissolved Oxygen (DO) value indicated the high pollution level as it was very less than the required amount (2-4 mg/L) of oxygen to sustain life (Francis-Floyd 2003) [13]. The total hardness values found in range of 207-334 mg/L. The maximum value was found in May and minimum in January. Maximum recorded value of Biochemical Oxygen Demand (BOD) was 56.8 mg/L in month of January and minimum value was 30.14 mg/L recorded in month of May. Chemical Oxygen Demand (COD) COD value were found in range of 27.6-50.42 mg/l in which minimum value observed in January and maximum in June. Recorded value of EC (Electrical Conductivity) were ranged from 351 to 459 Ω/cm. The maximum value of conductivity was found in January. Total Solids represents both dissolved solid and suspended form. Total dissolved solids (TDS) in present study water found in between 324.5-446.8 mg/ L. minimum value of TDS was observed in February. Total Suspended Solid (TSS) values were found in range of 140 to 186 mg/L. Phosphate concentration was maximum in June (0.66 mg/L) and minimum was found in March (0.22 mg/L). Nitrate concentration is affected by action of microorganisms. Maximum concentration was found in June (1.46 mg/L) where as minimum was observed in February (0.68 mg/L). Chloride concentration value ranged between 14.45-18.95 mg/L. Highest concentration observed in June and the lowest recorded value of chloride was in January. The relationship between the diversity and abundance of zooplankton and the physicochemical characteristics of water has been emphasized by Poongodi *et al.* (2009) [14]. The study involved careful and consistent identification and quantification of various species of zooplankton. Analysis of collected samples indicated the presence of four distinct groups of zooplankton, as detailed in Table 2. Rotifers were found to be the most dominant group, whereas ostracoda were identified as the least populous. Notably, a peak in zooplankton density was observed during the summer months, particularly in June. This increase can be attributed

to the heightened activity of plankton due to warmer temperatures, as discussed by Dhanasekaran *et al.* (2017) [15].

Conclusion

This study demonstrates the exceeding of permissible limits for various physicochemical parameters, thereby indicating the polluted state of the water. The scarcity of plankton diversity and reduced population further signifies the high pollution levels in aquatic environments. Through the analysis of these physicochemical parameters, the assessment of water quality becomes possible, providing valuable information for the implementation of pollution mitigation strategies to prevent the adverse health effects associated with contaminated water. Additionally, the examination of zooplankton species assumes significance as they serve as reliable indicators of pollution.

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