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Biomonitoring as a tool in assessing the water quality of Ghodha Pachad Dam (district Bhopal, M.P.) during summer season

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Abstract
Macrozoobenthos comprise an important group of aqua fauna by way of their contribution to ecosystem stability, besides acting as potential bio indicators of trophic status. Numerous plants and animals that have benthic aquatic and terrestrial components-which are essential for life-find habitat in rivers. The Ghodha Pachad Dam, which is found in the Bhopal district's Huzur tehsil, was the subject of the current study. Rainwater is the primary source of water for this dam. In this investigation, two sampling locations were used. To determine the Ghodha Pachad Dam's level of contamination, samples were taken and examined. The study's objective was to evaluate the water quality using Macrozoobenthos. Utilizing the BMWP and ASPT Scoring Index as well as physicochemical characteristics recommended by APHA, the water quality was evaluated. A total of 21 species of macrozoobenthos were observed in Ghodha Pachad Dam belonging to three phyla *viz*., phylum Arthropoda, phylum Mollusca and phylum Annelida BMWP and ASPT scores, combined with biological and physico-chemical characteristics of the water, can be used to correlate the level of contamination at the dam.

Keywords: Ghodha Pachad Dam, macrozoobenthos, bio indicators, BMWP scores, ASPT scores

Introduction
Benthic macroinvertebrates are aquatic ecosystem organisms that live on the bottom of bodies of water. Their make-up, abundance, and pattern of distribution serve as an ecosystem index, revealing the trophic structure, water quality, and degree of eutrophication of the environment (Mehdi *et al*., 2005) [8] As the invertebrate community shifts in response to changes in physicochemical parameters and available habitats, macro-invertebrates are utilised as markers of pollution (Sharma and Chowdhary, 2011) [13]. Since it allows for the inexpensive examination of a large number of locations, the method for evaluating the biotic communities of surface water has gained widespread use in recent years (Rosenberg and Resh, 1993) [11]. These water bodies operate as reservoirs for organic waste because of anthropogenic pressure and growing urbanization (Pani and Misra, 2000) [10]. Benthic organisms can be utilised as a bioindicator to access the water quality since benthic organisms are studied for monitoring and analysing water quality through the process of biomonitoring. The condition of physicochemical parameters characterising the quality of water in any given water body can be predicted by the presence or absence of macrozoobenthos. The presence of highly tolerant species implies poor water quality while the abundance of families of highly intolerant species suggests good water quality.

Material and Method
Study area
Samples were collected from two selected sites *viz* Mazar and Kokta of Ghodha Pachad Dam in the summer season, 2021. Its coordinates are 23º 16' 0" N 77 º 31' 15" E.

Methods
The sampling was done by using net of mesh size (500 m) for collecting the macro-invertebrates. The sampling area's large, pickable boulders and cobbles were all removed, and the gathered organisms were properly hand-washed. Finally, the substrate with smaller pebbles was agitated three to four times, resulting in the collection of the creatures into the net.

The organisms were cautiously removed from the net and then immediately preserved in 70% ethanol for additional identification. In non-reactive Borosilicate glass vials that had been sterilised and dried, samples were gathered for biological analysis. The samples were obtained in plastic containers and analyzed for physicochemical parameters using standard methods suggested by American Public Health Association APHA (1998) [3]. With the aid of Needham, Needham, and Trivedy's identification keys, the biological assessment was completed.

Result and Discussion

Physico chemical parameters: The present study was carried out in Summer season (2021). The physico-chemical characteristics of the water were examined in accordance with APHA (1998) [3] and ADONI (1985) [2].

Table 1: Physicochemical parameters of summer season (2021)

Physico chemical Parameters	Site Ist (Mazar)	Site 2nd (Kokta)
Air temp (°C)	34	35
Water temp (°C)	27.5	28
Ph(Units)	8.5	8.3
Transparency	66	53
Conductivity(µS/cm)	140	190
Total Dissolved Solids(mg/l)	99	119
Total Alkalinity(mg/l)	96	126
Total Hardness(mg/l)	85	120
Nitrate(mg/l)	0.22	0.37
Phosphate(mg/l)	0.0076	0.01
Chloride(mg/l)	26	32
Dissolved Oxygen (mg/l)	5.9	3.8
Biological Oxygen Demand(mg/l)	1.2	4.6

Changes in physical and chemical properties can have an impact on the biological diversity of water bodies (Khan and Ganaie, 2014) [7]. In the current inquiry, site 1 had the highest pH value of 8.5 and site 2 had the lowest pH value of 8.3. Additionally, pH levels between 8.3 and 8.5 were recorded by Adhikari (2003) [1], indicating that the water body is productive in nature, which is good for fish survival and food growth. High pH values on the alkaline side were reported by Wanganoo (1984) [16] to increase the rate of photosynthetic activity. Site I (Mazar) recorded relatively high value of D.O compared to site II (Kokta). At site 1 and site 2, respectively, the total hardness was 85 mg/l and 120 mg/l. According to Yousuf *et al*. (2006) [8], anthropogenic activities appeared to have an impact on the water's hardness. In aquatic ecosystems, temperature is crucial because it controls the biological processes that occur there. The range of the water's temperature was 27.5 to 28 degrees Celsius. According to Das *et al*., (2008) [5], the water temperature in Halali reservoirs ranged from 19.7 °C to 29.5 °C. At site I of the current investigation, the air temperature was 34 °C, while site II was having 35 °C. In North Bihar's Ganga River, Sandwar and Tiwari (2006) [12] noted an air temperature range of 22.7 °C to 37.5 °C. Site I had the highest transparency, 66, while site II had the lowest, 53. The sites with the highest and lowest conductivities, respectively, were second site (190 S/cm) and first site (140 S/cm). The characteristics of the water body's catchment area affected the conductivity of the water. According to Grey (2004) [6], rising urban and agricultural land runoff into the water was to blame for the increase in conductivity toward the downstream. The sites with the greatest and lowest values of DO were site Ist and 2nd, respectively. B.O.D values ranged from 1.2 mg/l at site 1 to 4.6 mg/l at site 2, with site 2 recording the highest values. The biotic elements of the water body are directly impacted by these differences in the physicochemical parameters.

Biological data

The total number of genera observed in the current survey was 21, and they belonged to 19 families and 11 orders. (Table 2). With the aid of the keys from Trivedy (1995) [14] and Needham, Needham (1988) [9], identification was completed. At site 1, a total of 14 families were found, including 11 families from the phylum Arthropoda, 3 families belonging to the order Mollusca, and no families from the genus Annelida. The Arthropoda subphylum contained the dominant species. Site 2nd reported a total of 12 families under 10 orders and 13 genera, of which 8 families are members of the phylum Arthropoda, 3 families are members of the phylum Mollusca, and 1 family is a member of the phylum Annelida.

Table 2: Macrozoobenthic invertebrates recorded during Summer season (2021)

S. No.	Taxa	Site Ist(Mazar)	Site 2nd (Kokta)
Phylum:Mollusca			
Class: Gastropoda			
Order: Mesogastropoda			
Family: Viviparidae			
1	Bellamya bengalensis	+	+
2	Bellamya dissimilis	-	+
3	Viviparus contectus	+	-
Family: Thiaridae			
4	Thiara tuberculata	+	-
Order: Littorimorpha			
Family: Bithynidae			
5	Bithynea tenticulata	-	+
Order: Basomatophora			
Family: Lymnaeidae			
6	Lymnaea sp.	-	+
Class: Bivalvia			
Order: Unionida			
Family: Unionidae			
7	Unio tigridis	+	-

Phylum: Arthropoda			
Class: Insecta			
Order: Ephemeroptera			
Family: Ephemeridae			
8	Ephemera sp	+	-
Family: Caenidae			
9	Caenis sp	+	+
Order: Diptera			
Family: Tipulidae			
10	Tipula sp	+	+
Family: Chironomidae			
11	Chironomous sp	+	+
Order: Odonata			
Family: Libellulidae			
12	Libellula sp	+	-
Family: Cordulidae			
13	Epicordulia sp	+	-
Family: Gomphidae			
14	Gomphus sp	-	+
Family: Aeshnidae			
15	Anax junis	+	-
Family: Cordulegasteridae			
16	Cordulegaster sp	+	+
Order: Coleoptera			
Family: Hydrophilidae			
17	Hydrophilus sp	+	+
Family: Dytiscidae			
18	Cybister sp	+	-
Order: Hemiptera			
Family: Nepidae			
19	Nepa sp	-	+
Order: Plecoptera			
Family: Nemouridae			
20	Nemoura sp	+	+
Phylum: Annelida			
Class: Oligochaeta			
Order: Arhynchobdellida			
Family: Hirudinidae			
21	Hirudineria sp	-	+

Table 3: BMWP and ASPT scores for site 1st and site 2nd of Ghodha Pachad Dam during summer season (2021)

S No	Invertebrate Families	Site 1(Mazar)	Site 2(Kokta)
1	Ephemeridae	10	-
2	Cordulegasteridae	8	8
3	Gomphidae	-	8
4	Cordulidae	8	-
5	Libellulidae	8	-
6	Aeshnidae	8	-
7	Nemouridae	7	7
8	Caenidae	7	7
9	Thiaridae	6	-
10	Uniondale	6	-
11	Viviparidae	6	6
12	Tipulidae	5	5
1	Hydrophilidae	5	5
13	Dytiscidae	5	-
14	Nepidae	-	5
15	Bithynidae	-	3
16	Hirudinidae	-	3
17	Lymnaedae	-	3
18	Chironomidae	2	2
	BMWP Score	91	62
	ASPT Score	6.5	5.2

Abbreviation: BMWP-Biological monitoring working party, ASPT-Average score per taxon.

Table 4: The BMWP and ASPT score table (Hawkes, 1998) showing biological quality and water quality

BMWP Score	Biological Quality	ASPT Score	Water Quality
Over 130	A. Very Good Biological Quality	Over 7	Very Good
81-130	B. Good Biological Quality	6-6.9	Good
51-80	C. Fair Biological Quality	5-5.9	Fair
11-50	D. Poor Biological Quality	4-4.9	Poor
0-10	E. Very Poor Biological Quality	3.9 or less	Very Poor

The BMWP score calculated for site 1st was 91 and the ASPT value was 6.5. The BMWP score for site 2nd was 62 and ASPT value was 5.2 (Table-3). The obtained score at site 1st reveals that water is of good biological quality and belongs to class B (Table-4). The ASPT scores of site 1st reveals that the water is of Good quality. The obtained score of BMWP at Site 2nd reveals that water is of Fair Biological Quality and belongs to class C and the ASPT reveals that water is of fair quality. Thus the result of physico chemical and biological parameters both confirms that at site 2nd (Kokta) water is of fair quality while at site Ist (Mazar) water is of good quality.

Conclusion

The biological study of water of Ghodha pachad Dam confirmed that the use of macro invertebrates as bio indicators is a valuable monitoring tool in comparison to the physicochemical analysis in assessing quality of water, as it provides cumulative assessment of the water body. The biological assessment reveals that the site 2nd (Kokta) of Ghodha Pachad dam is having an impact of the anthropogenic activities from the surrounding areas. The need of the hour is to create environmental awareness among the nearby inhabitants regarding quality of water and effect of pollution on water body so that the quality of water may reach from fair to good biological quality.

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