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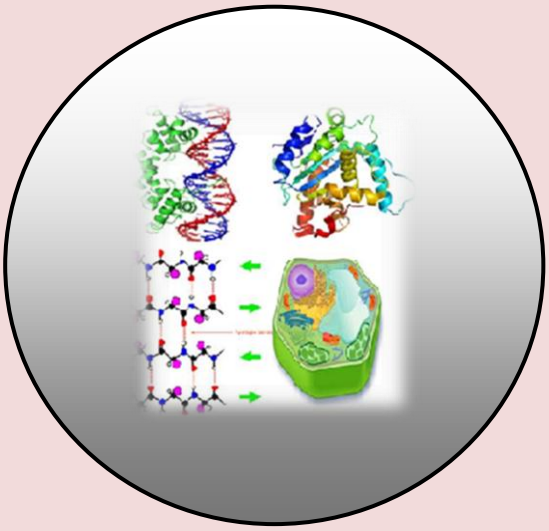

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RESEARCH PAPER

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Role of Benthos in Determination of Water Quality in a River

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ABSTRACT

Benthic macroinvertebrates are the bio-indicators which are used in assessing the water quality. Where the water samples were collected to assess the physic-chemical parameters. The collection and analysis of macrozoobenthos were done from a body. During the investigation period total 25 genus were found belonging to 19 families of macrozoobenthos. The presence of chironomaids and annelids in the inlet indicates that water is highly polluted. Presence of chironomidae and molluscan species at site. Second sample shows that the water was moderately polluted, while at the third site presence of arthropods and molluscans indicates that the water is less polluted. The Physicochemicals parameters show correlation with the findings of macro benthic observations which were carried out using BMWP and ASPT scores as a tool. The results can explain the degree of pollution in a water body.

Keywords: Macro-invertebrates, Physico-chemical parameter, BMWP and ASPT scores.

INTRODUCTION

The present study is focused on assessment of macrozoobenthic invertebrates in relation to water quality of a water body. Macro invertebrates play significant role in responding to a variety of environmental conditions of rivers and streams and therefore may be used as a bioindicator for water quality assessment. Macro invertebrates are the animal that lack back-bone and generally are visible with naked eyes. The macro-invertebrates are highly popular pollution indicators (Hallawell 1986). Macrobenthic organisms respond to environmental changes and are helpful in accessing the impact of industrial waste, agricultural waste, municipal waste and various other types of wastes taking place by anthropogenic activities around the water body in space and time. Benthic invertebrates are sedentary or sluggish in habitat that allows effective spatial analysis of pollution. These organisms have relatively long life cycle then other groups of fresh water organisms which give us clear picture of temporal changes caused by perturbations. Benthic Macro-invertebrates are detrivorus and form an integral part of the food web in the aquatic ecosystem; therefore these are the best indicator for bio-assessment. The biological indices, BMWP and ASPT (Alba Terecedor and Prat, 1992) are used to evaluate the water quality of a water body especially like rivers.

Physico-chemical parameters give the information about the suitability of water for its uses and for the betterment of the existing conditions. Water quality monitoring provides the current information about the water bodies.

Due to excessive human population and increased anthropogenic activities along the water bodies accumulation of various pollutants can take place, affecting the DO and BOD and other parameters of lake (Solanki et. al., 2007 and Patra et. al., 2010). The present study was carried out to assess the water quality of Gomti River in winter seasons by using macrozoobenthic invertebrates, physicochemical parameters and biological indices.

MATERIAL AND METHODS

The present study was conducted in river Gomti. Three samples were collected from selected locations for the present work.

The sampling was done using net of 500 µm mesh size for collecting the macro-invertebrates. From each samples the organisms were picked up and washed vigorously by hand into the net. Finally, the substrate with smaller boulders was disturbed by kicking by feet 3 – 4 times such that the organisms are collected into the net. These organisms were carefully picked up from the net and finally preserved immediately in 80 % ethanol for further identification. Identification of collected macrozoobenthos was carried out with the help of keys of Needham, Needham (1988) and R.C Trivedi (1984). The samples were collected in plastic container and analyzed for physicochemical parameters using standard methods suggested by American Public Health Association APHA, (1998).

The BMWP is a family based scoring system higher BMWP scores are considered as the indicators of fresh water, whereas families with low BMWP scores are considered as the indicators of the polluted water. ASPT is the average scoring system ranging between 1 to10. Higher ASPT score are considered as indicator of fresh water and lower ASPT scores are considered as indicator of polluted water.

RESULTS AND DISCUSSIONS

In the present study pH value was being recorded from 6.3 to 7.3. The highest value of pH 7.3 was recorded at site 3rd and lowest value of pH 6.3 was recorded at site 1st. The pH is an important ecological factor which results due to the interaction of various substances dissolved in the water. It is the scale of the intensity that can describe the acidity, basicity and alkalinity of water. (Gautam and Shrivastava, 2017) reported the pH values in between 6.7 to 7.2.

The value of TDS ranged between maximum value of 400 ppm Site 2nd and minimum value of TDS recorded was at 3rd site ppm. Low value of TDS recorded at third site indicates good quality of water. High concentration of TDS indicates more ionic concentration of water which is hazardous to the health of consumers. Increase in the concentration of the TDS results due to improper surrounding sanitation (Mohammad Musaddiq, (2000).

Alkalinity is a primarily composed of Carbonate and bicarbonate ions. Alkalinity acts as a stabilizer for pH. The alkalinity ranges from a minimum value of 124 mg/l at third site and maximum value 280 mg/l at 1st site. High concentration of the alkalinity was due to excessive use of soap and detergents (Bhargava et. al., 2007).

Table 1. Details of observation of physico-chemical parameters are as follows.

Names of physicochemical Parameters.	Samples		
	1	2	3
pH (units)	6.3	6.7	7.3
Water temp (0ºC)	19.5	20.3	19.5
Air temp (0ºC)	29.1	26.8	27.3
Total dissolved solids (ppm)	347	400	168
Dissolved oxygen (mg/l)	4.1	4.6	7.1
Turbidity (FAU)	19	51	28
Total alkalinity (mg/l)	280	202	124
Total hardness (mg/l)	225	160	100
BOD (mg/l)	5.9	8.8	2
COD (mg/l)	15	28	8

Dissolved oxygen ranges Between 4.1 to 7.1 mg/l. Higher dissolved oxygen at site 3rd and low dissolved oxygen at site 1st is attributed to the impact of sewage and effluents from the surrounding area. Low dissolved oxygen nearby polluted sites of some water body as reported by Bhatanagar (1928) in the lower, Agarkar (1994) in the upper site. Ladkoun and Onni (2015) observed that when DO is high the pollution is low when the DO is low, the pollution level is high. The reason for the low dissolved oxygen content was due to higher composition of organic matter, which indicates a high pollution load in the water.

The total hardness of river ranges between the minimum value at site 3rd 100 mg/l (Moderately Hard Water) and maximum value 225 mg/l (Hard Water) at site 1st. At site 1st increase in the total hardness is due to the anthropogenic activities. Klein (1956) and Sawyer (1960) had classified water on the basis of hardness. Moderately hard water ranges between 75 to 150 mg/l, hard water up to 300 mg/l and very hard water above 300mg/l. BOD and COD are important index of organic pollution in the river. The value of BOD and COD are increased with influx of pollutant at site 2nd. Organic load was indicated by comparatively high BOD level. BOD range was too high (8.8mg/l) showing wide presence of organic matter. Water with BOD levels <4mg/L are deemed as clean, while those >10 mg/L are considered polluted and unsafe. Turbidity varies from site 1st to site 3rd.

The maximum value of bicarbonate alkalinity 196 mg/l was recorded at site 2nd due to agricultural wastes and the minimum value were recorded at site 1st 120 mg/l. In the present study the concentration of chloride fluctuate between 37 to 64.2 mg/l. The maximum value of chloride (64.2mg/l) at the 1st site and minimum value of chloride (37mg/l) by the Munawar (1970) is of the opinion that a higher concentration of chlorides indicates higher degree of pollution.

Biological data

In present survey Total 25 generas were identified belonging to 20 families and 9 orders (Table -2).

Table 2. Macrozoobenthic invertebrates recorded from a river.

S. No.	Genus	Genus name	1	2	3
Phylum : Mollusca Class: Gstropoda Order: Mesogastropoda Family: Viviparidae					
1	Genus	Bellamya bengalensis	-	-	+
Order: Littorinimorpha Family: Bithynidae					
2	Genus	Bithynia tentaculata	-	+	+
Order: Basommatophora Family: Lymnaeidae					
3	Genus	Lymnaea sp.	+	+	-
Order: Heterobranchia Family: Physidea					
4	Genus	Physella sp.	+	+	-
Family: Planorbidae					
5	Genus	Indoplanrobis sp.	-	+	+
Class: Bivalvia Family: Unionoida Order:Unionoidae					
6	Genus	Unio sp.	+	+	+
Phylum: Arthropoda Class: Insecta Order: Hemiptera Family:Nepidae					
7	Genus	Rantra sp.	-	+	+

Family: Naucoridae					
8	Genus	Pelcoris sp.	-	+	+
Family: Notonectidae					
9	Genus	Notonecta sp.	-	+	-
Family: Corixidea					
10	Genus	Micronecta sp.	-	-	+
11	Genus	Sigara sp.	-	-	+
Order: Diptera Family: Chironomidae					
12	Genus	Chironomous sp.	+	+	+
Family: Tipulidae					
13	Genus	Tipula sp.	+	-	-
Order: Ephemeroptera Family: Caenidae					
14	Genus	Hexagenia sp.	-	-	+
Family: Ephemerllidae					
15	Genus	Ephemerella sp.	-	-	+
Family: Baetidae					
16	Genus	Baetis sp.	-	-	+
Family: Gomphidae					
17	Genus	Gomphus sp.	-	-	+
Family: Lestidae					
18	Genus	Lestes sp.	+	-	+
Family: Perlidae					
19	Genus	Perlinae sp.	-	-	+
Phylum: Annelida Class: Clitellata Order: Haplotaxida Family: Naididae					
20	Genus	Tubifex sp.	+	+	-

Total number of 7 families was observed at site 1st belonging to 6 orders and 7 Generas, out of which 3 families belong to Mollusca, 2 families were from Phylum Arthropoda and 1 family belongs to phylum Annelida. The dominating species were of phylum Mollusca which indicates the poor quality of water.

11 families were recorded at site 2nd under 6 orders and 11 Generas, out of which 4 families belongs to phylum Arthropoda, 5 families to phylum Mollusca and 1 family belongs phylum Annelida. The dominating species was of phylum Mollusca which indicates the alkaline nature of water.

At site 3rd, 13 families were recorded belonging to 7 orders and 20 Generas, out of which 4 Families belongs to Phylum Mollusca, 9 families were from Phylum Arthropoda. The dominating species was from phylum Arthropoda, which indicates that the water is of good biological quality but slightly impacted.

Table 3. Winter Seasons in BMWP and ASPT scores for site 1, site 2 and Site 3 of River.

Winter Season				
S. No.	**Invertebrate Families**	**BMWP Scores**	**BMWP Scores**	**BMWP Scores**
		Site 1st	**Site 2nd**	**Site 3rd**
01	Ephemeridae	-	-	10
02	Ephemerellidae	-	-	10
03	Perlidae	-	-	10

04	Lestidae	8	-	8
05	Gomphidae	-	-	8
06	Caenidae	-	-	7
07	Viviparidae		6	6
O8	Bithynidae	-	6	6
09	Unionidae	6	6	-
10	Nepidae		5	5
11	Naucoridae		5	5
12	Tipulidae	5	-	-
13	Notonectidae	-	5	
15	Baetidae	-	-	4
16	Planorbidae	-	3	3
17	Physidae	3	3	-
18	Lymaneidae	3	3	-
19	Chironomidae	2	2	2
20	Naididae	1	1	-
	Total	28	45	82
	ASPT SCORE	4	4.09	6.3

Table 4. The BMWP and ASPT score table showing biological quality and water quality.

BMWP		**ASPT**	
BMWP Score	**Biological Quality**	**ASPT Score**	**Water Quality**
Over 130	A. Very good biological quality (natural)	Over 7	Very good (natural)
81 – 130	B. Good biological quality	6.0 – 6.9	Good
51 – 80	C. Fair biological quality	5.0 – 5.9	Fair
11 – 50	D. Poor biological quality	4.0 – 4.9	Poor
0 – 10	E. Very poor biological quality	3.9 or less	Very poor

The biological monitoring working party (BMWP) is a procedure for measuring water quality using families of macroinvertebrates as biological indicators.

The method is based on the principle that different aquatic invertebrates have different tolerances to pollutants. In the case of BMWP, this is based on the sensitivity/tolerance to organic pollution (i.e. nutrient enrichment that can affect the availability of dissolved oxygen). It is important to recognize that the ranking of sensitivity/tolerance will vary for different kinds of pollution. In the case of BMWP/Organic pollution rankings, the presences of mayflies or stoneflies for instance indicate the cleanest waterways and are given a tolerance score of 10. The lowest scoring invertebrates are worms (Oligochaeta) which score 1. The number of different macroinvertebrates is also an important factor, because better quality water is assumed to contain fewer pollutants that would exclude "sensitive" species - resulting in a higher diversity.

Kick sampling, where a net is placed downstream from the sampler and the river bed is agitated with the foot for a given period of time (the standard is 3 minutes), is employed. Any macroinvertebrates caught in the net are stored and preserved with an alcohol solution, and identified to the family level, this can be done with the live organisms as well.

The BMWP score equals the sum of the tolerance scores of all macroinvertebrate families in the sample. A higher BMWP score is considered to reflect a better water quality. Alternatively, also the Average Score Per Taxon (ASPT) score is calculated. The ASPT equals the average of the tolerance scores of all macroinvertebrate families found, and ranges from 0 to 10. The main difference between both indices is that ASPT does not depend on the family richness. Once BMWP and ASPT are calculated, the Lincoln Quality Index (LQI) is used to assess the water quality in the Anglian Water Authority area.

Other indices that can be used to assess water quality are the Chandler Score, the Trent Biotic Index and the Rapid Bioassessment Protocols.

The BMWP score is an index for measuring the biological quality of water body by using species of macro invertebrates as biological indicators **(**Hawkes, 1998). Bio-monitoring along with the physicochemical analysis of water quality would display the total health of the water body. The BMWP score calculated at site 1st was 28 and ASPT calculated was 4. (Table 3) The BMWP score calculated for site 2nd was 45 and ASPT value was 4.09 and the BMWP score for 3rd site was 82 and ASPT value was 6.3. The obtained score of BMWP and ASPT at site 1st and 2nd revealed that water is polluted and belongs to class D. The obtained scores of BMWP and ASPT at site 3rd were 82 and 6.3 which belongs to Class B. Thus the result of biological parameters and physicochemical parameters both confirms the pollution status of a river at different sites.

CONCLUSIONS

Use of macro-invertebrates as bio-indicator is a valuable monitoring tool in comparison to physicochemical analysis in accessing quality of water body. The biological assessment and physicochemical parameters reflects that first two sites of river are polluted and 3rd site is having good biological as well as physicochemical water quality which could be used for fisheries and other purposes. The polluted sites are to be taken care off by the concerned authorities.

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