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Full Length Research Paper

Water Quality Assessment of Narmada River using Benthic Macro-invertebrates at (Rajghat) Barwani, Madhya Pradesh, India.

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ABSTRACT

The macro-invertebrates are the most valuable indicators of environmental quality in aquatic ecosystem because of stable mode of life, their convenient size and distinct characters which offers an easy sorting and identification of these organisms (Krishnamoorthi and Sarkar 1979). Benthic macro-invertebrates vary greatly, both spatially and temporally, over virtually all scales in polluted and non polluted flowing waters. Changes in presence/absence, number, morphology, physiology or behavior of these organisms can indicate whether the physical and chemical water quality conditions are above their prescribed limits (Sharma, M.P. et al 2010). The present study deals with the population density and species diversity of Benthic macro invertebrates of Narmada River at Rajghat (Barwani) and their correlation coefficient in (2009-2010). The physico-chemical analysis of water was performed as per methods given in APHA (2002), Welch (1998), Trivedi and Goel (1986) and Golterman (1978). The benthic organisms were identified with the help of APHA (2002), William & Feltmate (1992), Pennak (1989), Tonapi (1980), Needham & Needham (1969), etc. During the study period 7 species of oligochaeta, 10 species of insect, 11 species of gastropoda and 8 species of pelecypoda were recorded. Our study shows that the water quality of Narmada River at Rajghat region is moderately polluted.

Introduction

Water is necessary for the existence of man, who appeared on the earth in the early Pleistocene age above two to three million years ago. In the recent years rapid increase in growth of population took place. These have brought stress on agricultural and industrial sector to cope up with the demand. The current thinking is that the primordial earth has no ocean and perhaps very little atmosphere. It is believed that volatile constituents trapped inside the earth's surface came out through volcanic eruption, intensive rock moment and hard spring condensed to form ocean and the atmosphere. Water evaporates from oceans and returns to the earth in the form of precipitation resulting in "gigantic hydrological cycle" (Dar, H.A. 2011). The study was undertaken with the following objectives; To estimate the physico-chemical parameters which affect the life in water.; To study the population dynamics of benthic macro invertebrates; To study the correlation coefficient between physico-chemical parameters and benthic macro invertebrates.

Material and methods

Study area

The study area is (Rajghat) Barwani, it is also known as Siddh Nagar, in Barwani District in the state of Madhya Pradesh, India. The town is situated near the left bank of Narmada river. The great Narmada river flows through Barwani (just 5 km from city). Barwani is located 150 km away from Indore. It's Latitude (DMS) 22°10'60"N and Longitude (DMS) 74°54'0"E. River Narmada is considered one of the important rivers of the country. The Narmada basin extends over an area of 98.796 sq. km and lies between east longitudes 72°32' to 81°45' and north latitude 21°20' to 23°45'.

Data/Sampling collection methodology and time

The work of present study carried out during September 2009 to August 2010. Important physico-chemical parameters were estimated on the monthly basis. Monthly samplings of biological parameters of this station was made (2009-2010). A hand net was used in collecting the sample and sieving them for isolation. The bigger animal species picked up by hand, where as the smaller forms

were isolated by sugar floatation method and studied them under low power (x50) microscope. They were preserved by narcotizing them by Methanol and Chloral hydrate and late 70% Alcohol.

Results

The physico-chemical and Biological parameters and their correlation coefficient as reported in Table 1, 2 and 3.

Table 1. Monthly fluctuations in physico-chemical parameters at rajghat (barwani) in narmada river during 2009-2010

S.No.	Parameters	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
1.	Water Temp. (°c)	28	25	23.5	19	16	20.5	21	27	27.5	30	22	23.5
2.	Transparency (cm)	19	26	24	22	42	46	37	29	22	20	15	12
3.	Hydrogen ion concentration	7.6	7.9	8.2	7.9	7.7	8.1	7.4	8.9	9.2	8.8	7.5	7.4
4.	D. O. (mg/l)	7.4	7.5	7.9	7.8	8.0	8.2	8.3	8.1	7.8	7.6	8.1	8.2
5.	B.O.D. (mg/l)	2.3	2.4	2.5	2.8	2.6	2.8	3.0	2.7	2.5	2.6	2.0	2.2
6.	Total hardness (mg/l)	155	145	140	130	135	150	165	155	140	150	135	150
7.	Chloride (mg/l)	40	35	29	18	22	25	28	37	32	30	35	30
8.	Phosphate (mg/l)	2.80	2.90	3.25	3.50	4.20	4.70	4.50	5.20	5.70	5.50	2.70	2.50
9.	Calcium (mg/l)	33.50	35.2	37.5	40.5	42.5	45.2	48.4	50.2	52.0	48.5	30.20	25.5
10.	Nitrate (mg/l)	2.50	2.25	2.75	2.05	3.20	3.50	3.75	4.50	4.80	4.55	2.65	3.25
11.	Sulphate (mg/l)	8.5	9.8	10.5	10.9	11.5	12.0	14.0	15.5	12.2	16.5	8.6	5.5

Biological Analysis

Oligochaeta

During the study period, 7 species belongs to Oligochaeta group were recorded named *Tubifex tubifex*, *Tubifex albicola*, *Limnodrilus hoffmeisteri*, *Telmatodrilus multispinosus*, *Branchiodrilus hortensis*, *Dero dorsalis* and *Stylaria fossularis*.

Insecta

During the study period, 10 species belongs to Insecta group were recorded named *Baetiella ladakae*, *Baetis solangensis*, *Baetis simplex*, *Baetis festivus*, *Caenis sp.*, *Ephemera nadinae*, *Epeorus gilliesi*, *Heptagenia nubila*, *Chironomus chironomus* and *Chaoborus chaoborus*.

Gastropoda

During the study period, 11 species belongs to Gastropoda group were recorded named *Pila globosa*, *Bellamya bengalensis*, *Vivipara bengalensis*, *Thiara scabra*, *Thiara lineata*, *Thiara tuberculata*, *Melanoides tuberculatus*, *Lymnea acuminata*, *Lymnea auricularia*, *Digioniostoma pulchella* and *Gyraulus convexiusculus*.

Pelecypoda

During the study period, 8 species belongs to Pelecypoda group were recorded named *Corbicula striatella*, *Musculium indicum*, *Pisidium clarkeanum*, *Parreysia caerulea*, *Parreysia favidens*, *Lamellidens corrianus*, *Lamellidens consobrinus* and *Lamellidens lamellatus*.

Table 2. Monthly variation in macro-invertebrates diversity at rajghat (barwani) in narmada river during 2009-2010

Name of group /Species	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.
Oligochaeta (/M ²)												
<i>Tubifex tubifex</i>	10	15	20	10	15	19	14	18	22 [^]	18	NIL	5 [*]
<i>Tubifex albicola</i>	NIL	13	19	NIL	13	11	13	17	20 [^]	13	NIL	4 [*]
<i>Limnodrilus hoffmeisteri</i>	3	7	18 [^]	3	7	09	7	6	9	5	NIL	2 [*]
<i>Dero dorsalis</i>	7	9	10	7	9	12	4 [*]	10	7	5	15 [^]	10
<i>Stylaria fossularis</i>	3	5	7	3	5	14 [^]	8	7	4	2 [*]	5	8
<i>Telmatodrilus multispinosus</i>	8	14	22 [^]	8	14	18	10	12	13	NIL	NIL	4 [*]
<i>Branchiodrillus hortensis</i>	8	6	9	8	6	13 [^]	9	4	10	7	8	3 [*]
Insecta (/M ²)												
Baetidae -												
<i>Baetiella ladakae</i>	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
<i>Baetis solangensis</i>	NIL	NIL	10	18	22	26 [^]	17	10	07	09	05 [*]	NIL
<i>Baetis simplex</i>	NIL	NIL	12	18	20	22 [^]	13	11	08	11	08	04 [*]
<i>Baetis festivus</i>	NIL	NIL	10	07	08	18 [^]	11	09	05	06	02 [*]	NIL

Caenoidae -												
<i>Caenis sp.</i>	NIL	NIL	08	15	10	24 [^]	15	11	08	05	02 [*]	NIL
Ephemeridae -												
<i>Ephemera nadinae</i>	NIL	NIL	02 [*]	05	08 [^]	04	NIL	NIL	NIL	NIL	NIL	NIL
Heptageniidae -												
<i>Epeorus gilliesi</i>	NIL	NIL	15	27 [^]	24	22	17	14	08	05	02 [*]	NIL
<i>Heptagenia nubila</i>	NIL	NIL	07	12	17	21	24 [^]	15	12	05	02 [*]	NIL
Chironomidae-												
<i>Chironomus chironomus</i>	10	22	29	38 [^]	27	21	17	14	18	22	09	02 [*]
<i>Chaoborus chaoborus</i>	07	10	12	15	08	05	20	15	22 [^]	17	08	03 [*]
Gastropoda(/M ²)												
<i>Pila globosa</i>	12 [*]	28	37	60 [^]	44	30	25	18	12 [*]	39	40	NIL
<i>Bellamyia bengalensis</i>	23	50	67	47	39	12 [*]	29	45	68 [^]	52	40	15
<i>Vivipara bengalensis</i>	18	22	30	44 [^]	10 [*]	23	28	31	39	24	NIL	NIL
<i>Thiara scabra</i>	18	21	37	39	45 [^]	35	25	21	20	16	15 [*]	NIL
<i>Thiara lineate</i>	19	20	26	12 [*]	27	15	30	36	40 [^]	32	13	NIL
<i>Thiara tuberculata</i>	19 [*]	23	32	35	40	34	37	44 [^]	31	27	25	NIL
<i>Melanoides tuberculates</i>	15	19	24	29	37 [^]	10 [*]	25	29	25	20	12	NIL
<i>Lymnea acuminata</i>	NIL	30	47 [^]	40	33	18	12 [*]	37	32	28	42	35
<i>Lymnea auricularia</i>	18 [*]	22	29	37	45	32	25	35	40	47 [^]	22	NIL
<i>Digionostoma pulchella</i>	22	35	21	42	38	18	10 [*]	22	45	50 [^]	36	18
<i>Gyraulus convexiusculus</i>	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Pelecypoda (/M ²)												
<i>Corbicula striatella</i>	35	42 [^]	15	10 [*]	28	17	20	16	25	34	21	NIL
<i>Musculium indicum</i>	9 [*]	30	26	35	40	38	45	9 [*]	30	50 [^]	40	12
<i>Pisidium clarkeanum</i>	9 [*]	30	26	35	40	38	45	9 [*]	30	50 [^]	40	32
<i>Parreysia caerulea</i>	12 [*]	22	25	28	33	37	40 [^]	35	27	38	17	NIL
<i>Parreysia favidens</i>	NIL	20	44	32	75 [^]	54	48	NIL	39	30	27	15 [*]
<i>Lamellidens corrianus</i>	25	45	33	25	20	18	15 [*]	28	39	48	55 [^]	25
<i>Lamellidens consobrinus</i>	28	36	39	49	52 [^]	42	34	28	25	22	21 [*]	NIL
<i>Lamellidens lamellatus</i>	35	42 [^]	15	10 [*]	28	17	20	16	25	34	21	NIL

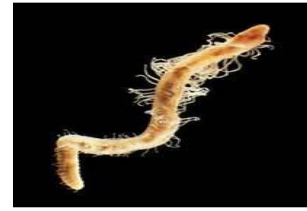
NIL = absent, * = minimum, ^ = maximum



Tubifex tubifex



Limnodrilus hoffmeisteri



Branchiodrilus hortensis

SPECIES OF INSECTA



Baetis salangensis



Chironomus chironomus



Chaoborus chaoborus

SPECIES OF GASTROPODA



Bellamya bengalensis



Thiara scabra



Vivipara bengalensis

SPECIES OF PELECYPODA



Parreysia caerulea



Lamellidens consobrinus

Correlation Coefficient between physico-chemical parameters and benthic macro-invertebrates

To study the relationship between the physico-chemical parameters and benthic macro-invertebrates during study period (September 2009 - August 2010) Karl Pearson's correlation coefficient (r) method was used.

During the study period, annelida shows low negative correlation with temperature and chloride, low positive with D.O., nitrate and sulphate, moderate positive correlation with transparency, pH, BOD, phosphate and calcium while high positive correlation with hardness. Arthropoda shows low negative correlation hardness, moderate negative with temperature and high negative correlation with chloride while low positive correlation with pH, D.O. and nitrate, moderate positive correlation with phosphate, calcium and sulphate, high positive correlation with transparency and BOD. Mollusca shows low negative correlation with temperature and D.O., moderate negative with hardness and chloride while low positive with nitrate moderate positive correlation with pH, transparency, BOD, phosphate, calcium and sulphate.

Table 3. Correlation between physico-chemical parameters and benthic macro-invertebrates at rajghat (barwani) 2009-10

S No.	Parameters	Annelida (Oligochaeta)	Arthropoda (Insecta)	Mollusca (Gastropoda / Pelecypoda)
1	Temperature	-0.040	-0.568	-0.214
2	Transparency	0.604	0.763	0.425
3	Ph	0.475	0.188	0.415
4	Dissolved oxygen	0.151	0.389	-0.175
5	BOD.	0.456	0.836	0.454
6	Hardness	0.074	-0.147	-0.430
7	Chloride	-0.135	-0.763	-0.449
8	Phosphate	0.458	0.536	0.536
9	Calcium	0.522	0.649	0.629
10	Nitrate	0.317	0.165	0.154
11	Sulphate	0.370	0.554	0.639

Discussion

Nnaji et al (2010) observed nitrate value ranged between 1.6 to 2.4 mg/l in river Galma, Nigeria. Chandra et al (2011) recorded temperature between 26 ° C to 31 ° C, BOD values between 1.6 to 7.2 mg/l, sulphate values ranged between 2 to 57 mg/l in various rivers of India. Murhekar (2011) recorded temperature ranging between 21 ° C to 29 ° C, nitrate value ranged between 0.19 to 7.1 mg/l in different locations around Akola city. Sharma and Chowdhary (2011) observed transparency ranged between 20cm to 112 cm, pH values between 6.8 to 9.4, DO variation between 0.4 to 8 mg/l, chloride ranged between 21.95 to 59.88 mg/l in the river Tawi. Krishna, J.M. (2012) recorded total hardness value between 72.33 to 198.73 mg/l and calcium value between 12.13 to 54.73 mg/l in Kaveri river, Kudige, Kodagu, Karnataka. Sujitha, P.C. et al (2012) recorded total hardness varied between 32 to 71, phosphate varied between 0.06 to 1.52 mg/l and sulphate varied between 0.49 to 2.60 mg/l in Karamana river, Trivandram, Kerala. Sharma, S. et al (2013) recorded water temperature varied between 25 ° C to 42 ° C, pH varied between 7.61 to 9.22, DO varied between 7.21 to 9.12 mg/l, BOD varied between 3.1 to 5.63mg/l, Total Hatrdness varied between 71 mg/l to 190 mg/l, Chloride varied between 0.3 mg/l to 53.4 mg/l, phosphate varied between 0.5 mg/l to 0.49 mg/l, nitrate varied between 0.11 mg/l to 0.131 mg/l in Kunda river, Khargone (M.P.). Hamaidi, C. F. et al (2013) observed phosphate ranged between 0 to 0.94 mg/l, calcium ranged between 90 to 104 mg/l in Chiffa river, Algeria. Sharma, M.P. et al (2010) identified total 67 taxon of macro invertebrates belonging to 8 taxonomic groups during the study at various sampling locations on Kosi river. Panday, R.K. (2010) detected 53 families of benthic organisms under 13 orders of river Narmada in the Eastern Zone of M.P. Sharma, K. K. and Chowdhary, S. (2011) were recorded 20 taxa of macrobenthic invertebrate fauna during the period of study belonging to 3 major phyla viz: Annelida, Arthropoda and Mollusca. Among these phyla, Arthropoda (70.54%) dominated and were followed by Annelida (28.11%) and Mollusca (0.95%) in Central Himalayan River, Tawi (Jammu and Kashmir). Nautiyal and Mishra (2012) recorded the arthropod (Class Insecta, Crustacea), mollusc (Class astropoda, Pelecypoda) and annelid (Class Oligochaeta, Polychaeta) elements consisting of 22 taxa constitute the benthic macroinvertebrate fauna of the Ken river. The insects occur in high numbers at all the selected stations, the mayfly (Class Insecta, Order Ephemeroptera) occur in very high numbers in the river Ken. Negi, R.K. and Mangain, S. (2013) recorded total 31 benthos belonging to three phylum, 4 classes and 10 orders with Insecta emerging as the most dominant class. Sharma, S. et al (2013) reported forty-two species from Kunda river, Khargone (M.P.), India.

Conclusion

On the basis of our study we can conclude that the water quality of Narmada River at Rajghat region is moderately polluted.

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