Distribution of Macrozoobenthos in River Narmada near Water Intake Point

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Abstract
Rivers support vast biodiversity of flora and fauna, provide food and shelter to organisms that thrive in. Macrozoobenthos play an important role in aquatic ecosystem as primary and secondary consumers and form the trophic relationships include those that feed on them directly or indirectly like fish and bird population. Presently, the study was carried out on a selected reach of river Narmada near water intake point. Aim of the study was to assess the distribution of macrozoobenthos near water intake point on river Narmada. Loss in the distribution of macrozoobenthos fauna was recorded in lower reaches and in front of water intake point which indicates that ecological conditions are degrading and in near future situation can be alarming in the respect of ecology.
Keywords: River Narmada, Macrozoobenthos, Water intake point.

1. Introduction

Rivers provide habitat to many plants and animals. These habitats consist of benthic, aquatic and terrestrial components which are lifeline for organisms thrive in. Macrobenthic organisms occupy the bottom of water body. The composition, abundance and distribution of benthic organisms over a period of time provide an index to the ecosystem. They are large enough to be retained by a mesh size of 200-500 µm (Rosenberg and Resh, 1993). Macrozoobenthos play a fundamental role in the transfer of energy through the food chain and help in recycling the organic debris that settles to the bottom of any water body and play an important role in aquatic ecosystems as primary and secondary consumers includes mineralization mixing of sediment, cycling of organic matter and assessing the quality of inland water. They have sedentary lifestyles that reflect local sediment conditions, life spans that integrate contaminant impacts over time, they live in the sediment and water interface where contaminants accumulate and most importantly they show differential levels of tolerance to contaminants (Dauer, 1983). Distribution of macrozoobenthos is determined by a number of factors such as physical nature of the substratum, depth, nutritive content of the water body. However, most studies have investigated streams and relatively small rivers and there is a pressing need to obtain biological information on the large rivers many of which are under pressure due to population growth and urbanization (Petts *et al.,* 1993).

Present study was carried out in a small reach on the right bank of River Narmada in the central zone from Shahganj village to Jahanpur village in the month of September-November 2011 near water intake point with an objective to assess the distribution of macrozoobenthos. Such study has not been conducted yet on the river Narmada and this study shall provide first hand and base line information about distribution of macrozoobenthos near water intake point.

2. Material and Methods

2.1 Study Area

River Narmada is the fifth largest river of India and the Narmada basin, hemmed between Vindhya and Satpura ranges, extends over an area of 98,796 km^2 and lies between East longitude 72º 32´ to 81º 45´ and North latitude 21º 20´ to 23º 45´ lying on the northern extremity of the Deccan plateau. The basin covers longest distance 1077 km in Madhya Pradesh out of 1312 km. Present study was carried out in a selected reach of river Narmada from Shahganj to Jahanpur village between these villages one water intake point has been constructed near Hirani village to supply drinking water for Bhopal city, the capital of Madhya Pradesh (Figure 1).

2.2 Sampling Station

During the study, five sampling stations were chosen for sampling. Station I is located down to Shahganj village and lies on 77° 47.59'E and 22° 50.23'N longitude and latitude. Station II is located on the upstream of water intake point (pumping station) and lies between 77° 47.46'E and 22° 49.93'N longitude and latitude. Station III is located in front of water intake point at Hirani village and lies between 77° 47.43'E and 22° 49.82'N longitude and latitude. Station IV is located at the downstream of water intake point and lies between 77° 47.35'E and 22° 49.78'N longitude and latitude. Station V is located near Chandni nalla at upstream of Jahanpur village and lies between 77° 46.98'E to 22^o 49.17'N longitude and latitude (Figure 2).

2.3 Collection, Preservation and Identification

Benthic samples were collected using Peterson's grab from each sampling site. Sieving was done using 0.6 micron mesh size sieve. Brush and forceps were used for cleaning and picking of organisms. Macrozoobenthic

organisms were collected and preserved in screw caped broad mouth plastic bottles followed by 5% formalin and transferred to the laboratory safely. Macroinvertebrate organisms were sorted and identified upto genus and species level using available keys like, A Guide to the study of Fresh water Biology by J. G Needhem and P. R. Needhem (1962), Aquatic Entomology: The Fishermen's and Ecologist Illustrated Guide to insects and their relatives by W. Patrick, McCafferty (1981), Fresh water molluscs of India by N. V. Subba Rao (1993), Handbook on India Fresh water molluscs by Ramakrishna Anirudha Dey (2007), Fresh water Animal of India and Ecological Approach by G. T. Tonapi (1980).

2.4 Data Analysis

In ecology, diversity index is a statistic which is intended to measure the biodiversity of an ecosystem. More generally, diversity indices can be used to assess the diversity of any population in which each member belongs to a unique species. Diversity was measured by Shannon-Wiener's diversity index introduced by Claude Shannon (1949).

$$H= -\sum_{i=1}^{s} pi\ log pi.$$

Density represents the number of organisms per metre square. It is calculated by using the below mentioned formula from Adoni *et al.,* (1985).

$$\text{Individual/ m}^2 = \frac{N}{a} x\ 10000$$

Where,

N= average number per sample

a= area of the sampler (cm^2)

Result is expressed as number of total benthic organisms / m^2.

3. Results and Discussion

A total of 35 taxa were found from the five sampling stations belonging to three phylum *viz.,* Mollusca, Annelida and Arthropoda. Among them 11 species of molluscan community was represented by two classes *viz.,* Gastropoda and Bivalvia. Gastropoda was represented by two orders, *viz.,* Mesogastropoda and Basomatophora with five families, seven genera and nine species. Class Bivalvia was represented by order Unionida with two families, two genera and two species. Whereas, in insect community two are of Annelida phyla belongs to one class, two families and two genus, while 22 species of Arthropoda phyla belongs to three classes, nineteen families and twenty two genus distributed at different sampling stations (Table 1). All the taxa were categorized under major groups and percentage composition of those groups of macrozoobenthos were analysed (Figure 3).

The distribution of macrozoobenthos at sampling station I was excellent from all the stations and 31 species were recorded. Phyla Mollusca was in dominated condition than Arthropoda and Annelida. Among the molluscan group *Bellamya bengalensis* and *Bellamya dissimilis* species were the most ubiquitous and were dominant. Similar observations were made by Roy and Gupta (2010) in River Barak. Phylum Arthropoda was represented by orders Odonata, Diptera, Hemiptera, Tricoptera and Ephemeroptera among these Odonata was in dominant position and Plecopterans were absent. Yap *et al.,* (2003) also reported high arthropods diversity in Semenyih River of Malaysia. From Annelida phylum only two *Lumbriculus* and *Tubifex sps.* were present. Some species of freshwater prawn and water mites were also recorded from this station. Shannon diversity index is 2.75 at this station and 2801 individuals/m^2 of macrozoobenthos individuals was recorded which shows high diversity.

At sampling station II distribution of macrozoobenthos species was similar than station I and 23 species were recoded. Among the entire phylum Mollusca was in dominant position followed by Arthropoda. In Mollusca gastropods were dominant than bivalvia. Among Arthropoda order Diptera and Hemiptera were in dominant position while Odonata and Ephemeroptera was lesser in number. Some species of freshwater prawn and water mites were found during the study. Annelids were present. Khan *et al.,* in 2007 also reported that molluscan communities were dominant at River Mouri and Roy and Gupta in 2010 were observed these species in dominant condition in River Barak. Shannon diversity at this station is 1.44 shows poor diversity conditions. 2057 individuals/m^2 of macrozoobenthos animal was recorded at this station.

Sampling station III lies in front of water intake point and here diversity of macrozoobenthic fauna was poor than all stations and only 9 species were reported. The habitat structure was altered from the construction of water intake well. Mollusca phyla were in dominant position. Absence of Annelids and only *Gomphus* species from phylum Arthropoda was recorded from this station. Several studies were done at different river systems and higher molluscan diversity was reported (Fisher and Williams, 2006; Khan *et al.,* 2007 and Roy and Gupta 2010). Shannon diversity index of this station is 1.99 shows poor diversity condition of macrozoobenthic fauna due to construction of water intake point. 816 individuals/m^2 of macrozoobenthic density was recorded at this station which is lesser among all the sampling stations.

Station IV is lies at the downstream of the water intake point where habitat has been altered due to construction and at this station 14 species of macrozoobenthos was reported. Lesser number of insect communities was

presented followed by Dipterans and Hemipterans groups only Odonata group was in dominant condition. Molluscan communities were again in dominated position than insect groups. Some individuals of freshwater prawns were reported belonging to class crustacean i.e. *Palaemonetes sps* and water mites from class Archnida. Annelids were absent. Shannon diversity index of this station is 2.53 shows good diversity of macrozoobenthos after station I. 1241individuals/m^2 density of macrozoobenthic fauna was recorded from this station.

Station V was located near Chandni nalla and here distribution and diversity of macrozoobenthic animals was much similar than station I and 19speceis were recorded. At this station all three phyla were reported *viz.,* Mollusca, Arthropoda and Annelida. In all phyla Molluscans were in dominant position than Arthropods and Annelids. Gastropods were in dominant condition than Bivalvia. Odonata, Hemiptera, Diptera and Coleoptera orders from phylum Arthropoda were reported during the study while other orders were absent. One species from Annelida phylum was recorded. Some species of freshwater prawns and water mites were reported from this station. Molluscan diversity was found dominant form Arthropoda, similar observations were made in River Barak in Assam (Roy and Gupta, 2010) and Fisher and Williams (2006) from River Nile. Yap *et al.,* (2003) reported highest Arthropods diversity in Semenyih River. Shannon diversity index of this station is 2.13 shows good diversity. Density of macrozoobenthos at this station was reported 1986 individuals/m^2.

Osborne *et al.,* (1976) observed values ranging from a minimum of 0.14 to a maximum of 2.69 whereas Godfrey (1978) found the value ranging from 1.938 and 5.34 of Shannon-Wiener index. Present investigation is supported by the above findings (Figure 4). Khan *et al.,* (2007) reported abundance of benthic community in individuals/m^2 in Mouri River, Khulna, Bangladesh.

4. Conclusion

The present investigation depicted about the distribution and diversity of macrozoobenthos in the upper reaches, lower reaches and in front of water intake point and reported about the loss of macrozoobenthic distribution in the region due to construction of water intake point which causes habitat alterations. During the study it was observed that at sampling stations I and IV diversity of macrozoobenthos fauna was excellent than II and V but at station III loss in distribution of macrozoobenthos was recorded. Riverine condition and habitat structure is being altered from this water intake point and shows that in near future ecology will be much affected from this well. The study revealed about the future research prospects in this area for studying the environmental impact assessment of water intake point on the ecology of River Narmada.

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Table 1: List of Macrozoobenthos recorded during the Study

S.N.	TAXA	Sampling Stations				
		Site-1	Site-2	Site-3	Site-4	Site-5
MOLLUSCA						
GASTROPODA						
Order	**Mesogastropoda**					
1	Bellamya *bengalensis*	+	+	+	+	+
2	Bellamya *dissimilis*	+	+	+	+	+
3	Thiara *scabra*	+	+	+	-	+
4	Thiara *tuberculata*	+	+	+	+	+
5	Tarebia *lineata*	+	+	+	+	+
6	Pila *globosa*	+	+	-	-	-
Order	**Basomatophora**					
7	Lymnaea *acuminata*	+	+	-	-	-
8	Gyraulus *convexiusculus*	+	+	-	-	+
9	Indoplanorbis *exustus*	+	-	+	-	-
BIVALVIA						
Order	**Unionida**					
10	Parreysia *occata*	+	-	+	-	-
11	Lamellidens *corrianus*	+	+	+	-	+
ANNELIDA						
OLIGOCHEATA						
Order	**Lumbriculida**					
12	Lumbriculus *sps.*	+	+	-	-	-
Order	**Haplotaxida**					
13	Tubifex *sps.*	+	+	-	+	+
ARTHROPODA						
INSECTA						
Order	**Diptera**					
14	Chironomus *sps.*	+	+	-	+	+
15	Culex *sps.*	-	+	-	-	-
16	Black flies *sps.*	+	+	-	-	-

17	Stratiomys *sps.*	+	-	-	-	-
Order	**Odonata**					
18	Aphylla *sps.*	+	-	-	+	-
19	Gomphus *sps.*	+	+	+	+	+
20	Cordulegaster *sps.*	+	-	-	+	-
21	Anax *sps.*	+	-	-	+	+
22	Enallagma *sps.*	+	-	-	-	+
Order	**Plecoptera**					
23	Common Stone Flies *sps.*	-	-	-	+	-
Order	**Hemiptera**					
24	Water Boatmen *sps.*	+	+	-	+	-
25	Ranatra *sps.*	+	+	-	-	+
26	Nepa *sps.*	+	+	-	-	+
27	Hydrometra *sps.*	-	+	-	-	+
28	Pelocoris *sps.*	+	-	-	-	-
Order	**Ephemeroptera**					
29	Caenis *sps.*	+	+	-	-	-
Order	**Coleoptera**					
30	Dineutus *sps.*	+	-	-	-	+
31	Peltodytes *sps.*	-	-	-	-	+
32	Berosus *sps.*	+	+	-	-	-
Order	**Trichoptera**					
33	Potamyia *sps.*	+	-	-	-	-
	CRUSTACEA					
Order	**Decapoda**					
34	Palaemonetes *sps.*	+	+	-	+	+
	ARACHNIDA					
Order	**Araneae**					
35	Water mites and Water Spiders *sps.*	+	+	-	+	+
	Total	**31**	**23**	**9**	**14**	**19**

Figure 1: Map of the Study Area

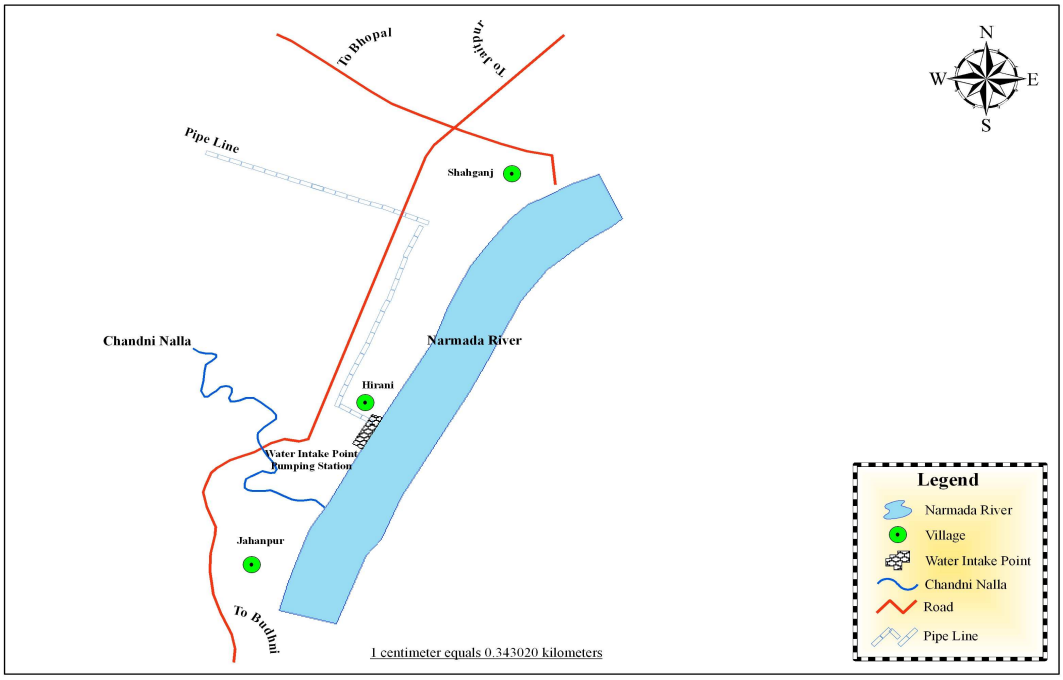

Figure 2: Sampling Stations of the Study Area

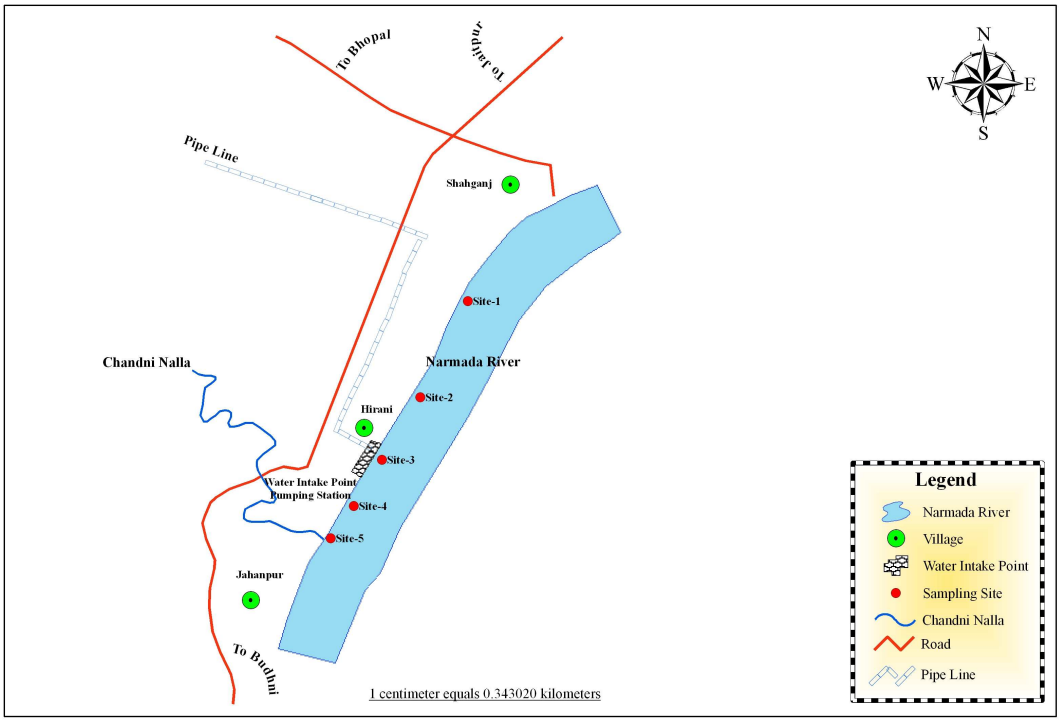

Figure 3: Percent Composition of Major Groups of Macrozoobenthos in the Study Area

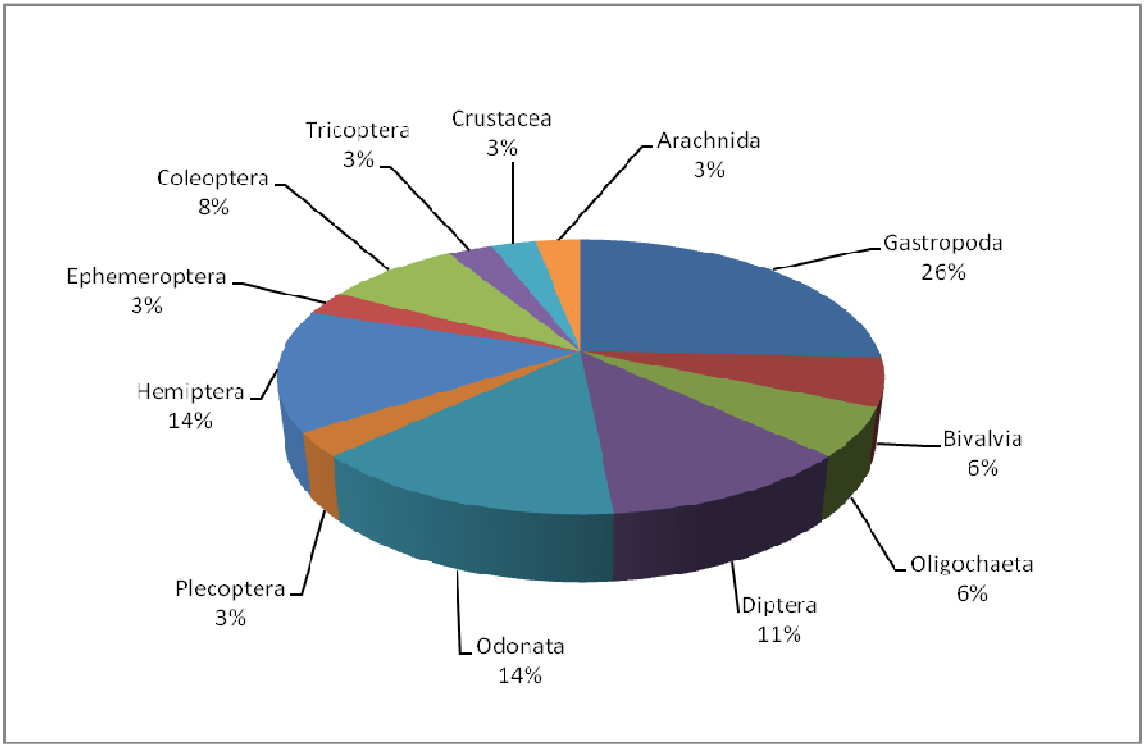

Figure 4: Shannon-Wiener Index of Macrozoobenthic fauna in the Study Area