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Diversity of Macrozoobenthos in Morand River- A Tributary of Ganjal River in Narmada Basin

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Abstract The aim of present study was to assess the diversity of macrozoobenthos in Morand River which is the major tributary of Ganjal River and comes under Narmada basin. For the present investigation, eight sampling stations were selected at different locations and results revealed that 31 taxa of macrozoobenthos were recorded from these sampling stations. During the rapid study, it was observed that phylum arthropoda was in dominant position than phylum mollusca and annelida. Macrozoobenthos diversity was assessed by using Shannon diversity index and Margalef diversity index.

Keywords *Diversity; Macrozoobenthos; Morand River*

1. Introduction

River ecosystem encircles a wide spectrum of habitats spanning a continuum from small mountain springs to large lowland rivers [1]. Rivers are the most important fresh water resources for living being and provide a home to many plants and animals including macrophyte, plankton, insects and molluscs etc. Benthic communities are very important in aquatic ecosystem and common inhabitants of lakes and streams. These organisms usually inhibiting the bottom substrate for at least part of their life cycle [2]. Macrozoobenthos are generally visible with the naked eyes, and have limited mobility which plays a significant role in the food chain because of their ability to convert low quality and low energy detritus into better quality food for higher organisms in the food web. The abundance and distribution of macrozoobenthos have been used as biomonitoring tool for fresh water pollution.

In the present study, diversity of macrozoobenthos was carried out on the Morand River with the objective to collect first hand and baseline information about diversity of macrozoobenthos as there is no previous data on this river.

2. Material and Methods

2.1. Study Area

Morand river is a perennial river which originates from Satpura mountain range near Chicholi village in Betul district of Madhya Pradesh at 78^0 16'E longitude and 22^0 00'N latitude. Morand is a rain fed river having length of 136.29 km, watershed area of 1143.52 sq km which makes this river the only major tributary of Ganjal River, which is a tributary of River Narmada in the central region of Narmada basin. After covering different types of landscapes Morand River meets the Ganjal River near Timarni Bridge in Hoshangabad district. Local people called Morand River *"The Baghin of Satpura"* because of its sudden increase in water level and flow during monsoon season. The location of the study area is shown in Figure 1 (Map 1).

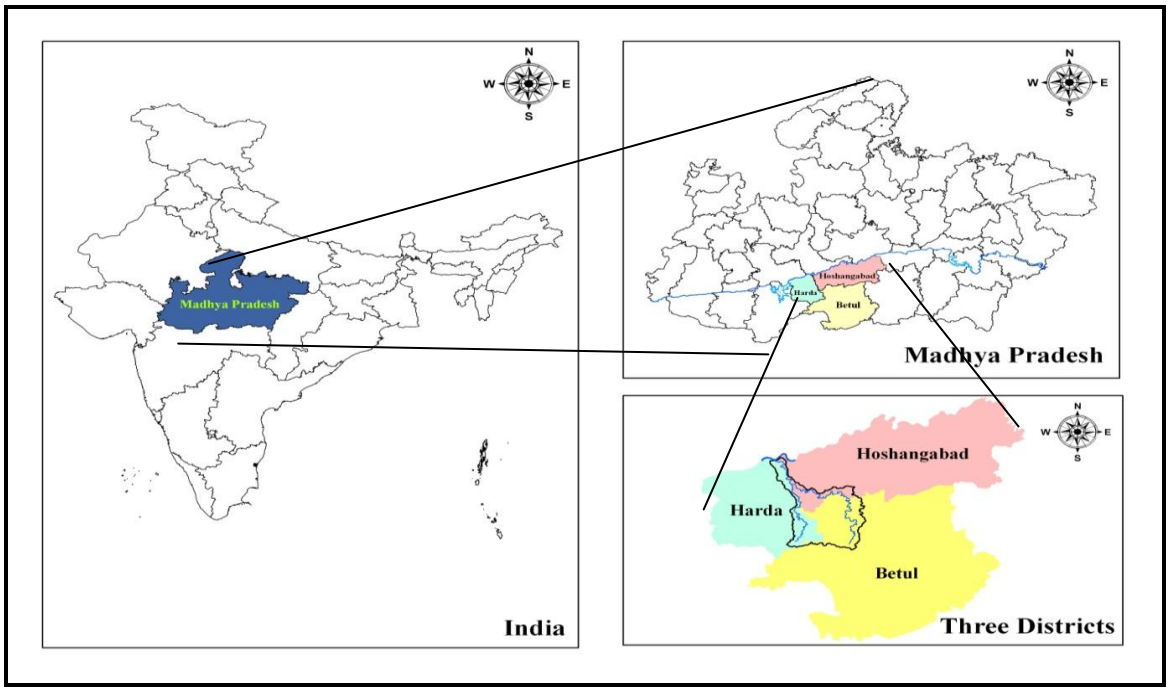

Figure 1: *(Map 1) Location of the Study Area*

2.2. Sampling Stations

Eight sampling stations were selected for the present study which is shown in Map 2. Geographical co-ordinates of all sampling stations are shown in Table 1, whereas these stations are systematically arranged from origin of the river up to the confluence with Ganjal River.

Table 1: *Geographic Position of the Sampling Stations*

S. No.	Sampling Station	Longitude	Latitude
1.	Kondhar	77^0 39' 53.6" E	22^0 1' 39.52" N
2.	Jhapal	77^0 39' 39.07" E	22^0 7' 10.08" N
3.	Sangwani	77^0 38' 1.85" E	22^0 12' 11.47" N
4.	Bainth	77^0 36' 12.13" E	22^0 21' 30.49" N
5.	Lokhartalai	77^0 26' 12.13" E	22^0 21' 40.21" N
6.	Ranipur	77^0 24' 0.8" E	22^0 21' 25.6" N
7.	Amlara Khurd	77^0 20' 46.44' E	22^0 22' 38.55" N
8.	Confluence with Ganjal	77^0 18' 59.49" E	22^0 24' 6.05" N

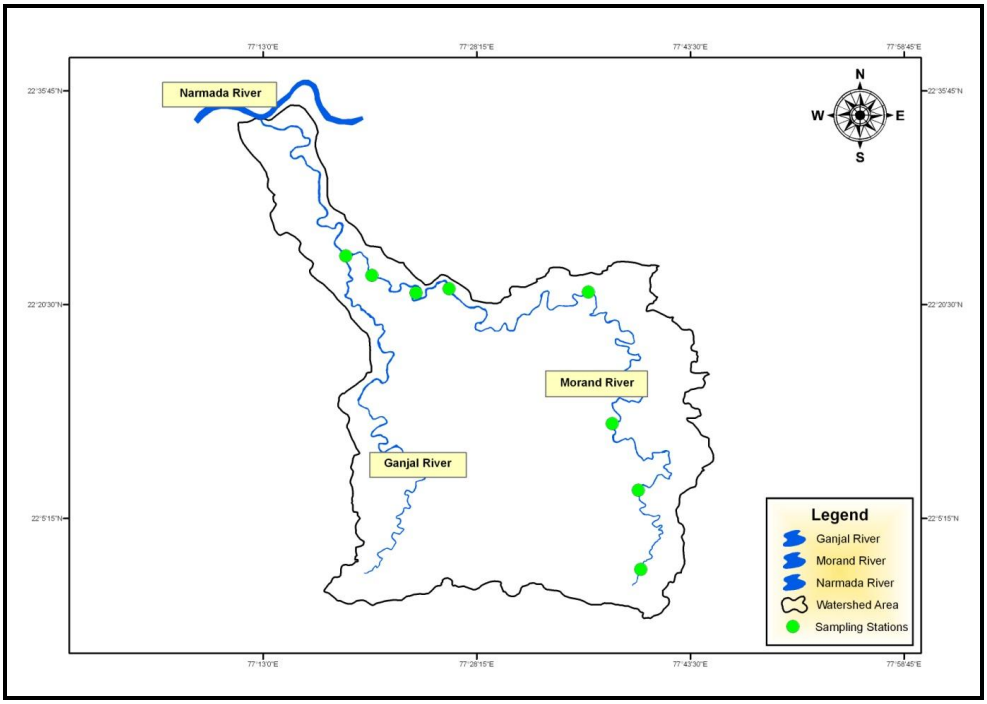

***Figure 2**: (Map 2) Selected Sampling Stations on Morand River*

2.3. Collection, Sieving, Sorting, Preservation and Identification of Macrozoobenthos

First of all, habitats of macrozoobenthos were identified in the river to collect samples. Different gears were used to collect macrozoobenthos from different types of habitats. Where the depth was less than 1 meter; Surber sampler was used, from macrophytes where macrozoobenthos fauna was in attached form D- Frame net was used, in some areas where large stones, pebbles were found, here Kick net was used to collect the macrozoobenthos fauna [3].

Collected samples were sieved from brass sieve having mesh size of 0.5 to 0.6 micron. Animals were washed properly and sorting was made on the field using forceps and brushes. Separate screw cap wide mouth reagent grade plastic bottles were used for storage of animals followed by 5% formalin as preservative.

After completion of field procedure samples were transferred to the laboratory with utmost care. Macrozoobenthos fauna were identified to the lowest possible taxonomic levels as per requirement. Stereo microscope and hand lens with 6x zoom capacity were used to observe the finest details about the animals. In this process, organisms were identified up to the genus or species level using different monographs or key which are subject of availability in the laboratory [4, 5, 6, 7, 8].

2.4. Data Analysis

Analysis of raw data is a logistic support towards making proof of any work. After generation the raw data were compiled properly. In the process of statistical analysis two diversity indices were analyzed i.e. Shannon and Margalef. Shannon index is an index applied to biological systems by a mathematical formula used in communication area by Shannon in 1948 [9]. This is the most preferred and common index among the other diversity indices and its values are between 0.0 and 5.0. Generally, results come between 1.5 and 3.5, and it exceeds very rarely up to 4.5 [10]. Above 3.0 value indicates about the structure of stable and balanced habitat whereas, under 1.0 value indicates about the pollution and habitat degradation in habitat structure.

$$H' = \sum [(n_i / N) * (\ln n_i / N)]$$

H'= Shannon Diversity Index
n_i = number of individuals belonging to i species
N = Total number of individuals

Margalef diversity index has no limit value and it shows a variation depending upon the number of species and used to calculate species richness. It can be used for comparison of sites [10].

$$d = (S - 1) / \ln N$$

d = Margalef Diversity Index
S = Total number of species
N = Total number of individuals

3. Results and Discussion

During the investigation, 31 taxa of macrozoobenthos were recorded from eight sampling stations with total of 295 individuals belonging to three phyla *viz.,* mollusca, annelida and arthropoda. Among them 10 species are of molluscan community which are represented by two classes *viz.,* gastropoda and bivalvia. Class gastropoda was represented by only one order mesogastropoda with two families, four genera and five species. Class bivalvia was represented by two orders *viz.,* trigoinoida and veneroida with three families, four genera and five species. Phylum annelida was represented by only one class, order, family and genera. As we know that phylum arthropoda is the largest phylum in animal kingdom and here it has been represented through three classes *viz.,* insecta, crustacea and arachnida. Class insecta is represented by five orders with thirteen families and seventeen genera, while class crustacea is represented by only one order, family and genera whereas, class arachnida is represented by two orders, two families and two genera. During the study, phylum arthropoda was in dominant condition than mollusca and annelida and its percent composition is shown in Figure 3. Similar findings were observed in the study of macroinvertebrate fauna in Ken River of central India [11]. Class level distribution with numbers of taxa is shown in Figure 4. Diversity of various macrozoobenthos species at different sampling stations is shown in Table 2.

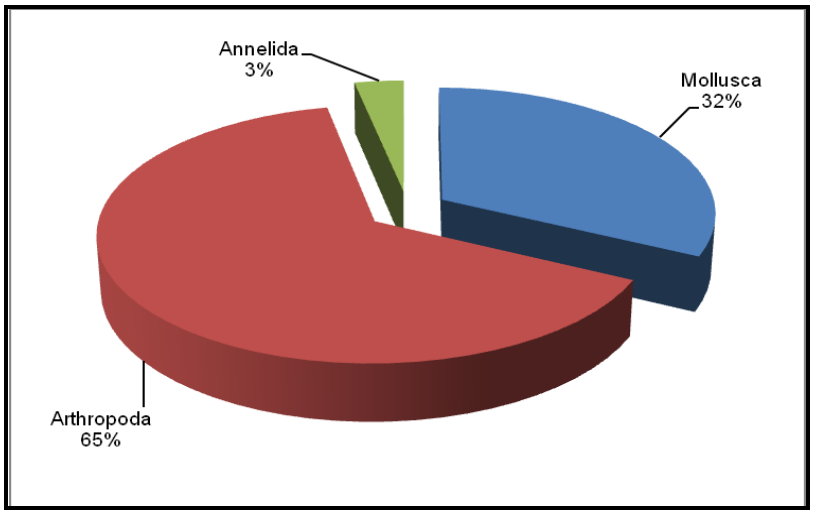

Figure 3: *Percent Composition of Higher Taxonomic Groups*

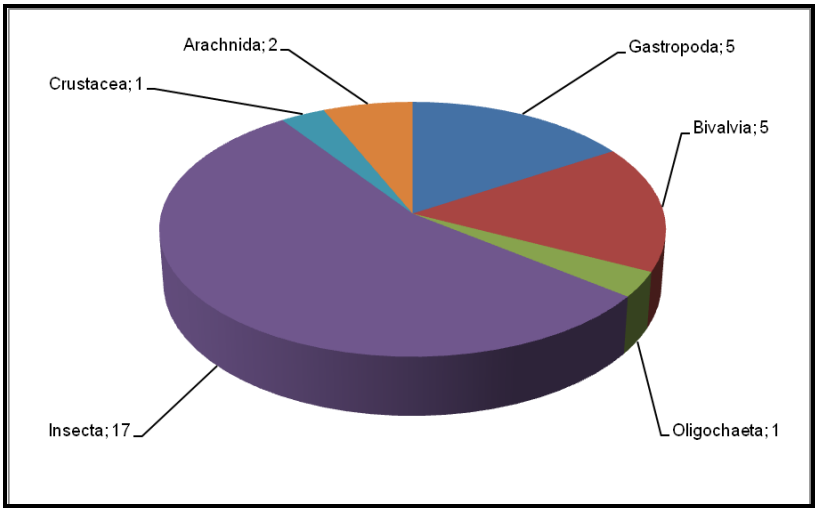

Figure 4: *Class Level Distribution of Macrozoobenthos*

Table 2: *Diversity of Macrozoobenthos Fauna*

S. N.	Taxa	Sampling Stations							
		Station-1	Station-2	Station-3	Station-4	Station-5	Station-6	Station-7	Station-8
Phylum	**Mollusca**								
Class	**Gastropoda**								
Order	**Mesogastropoda**								
1	Bellamya *bengalensis*	+	-	+	+	-	-	-	+
2	Thiara *scabra* (Muller)	+	-	-	-	-	-	-	+
3	Thiara (Melanoides) *tuberculata* (Muller)	+	+	-	-	-	-	-	+
4	Tarebia *lineata* (Gray)	+	+	-	+	-	+	-	+
5	Tarebia *granifera* (Lamarck)	+	-	-	+	-	+	-	+
Class	**Bivalvia**								
Order	**Trigoinoida**								
6	Parreysia (Radiatula) *occata* (Lea)	-	-	-	-	+	-	-	-
7	Parreysia *corrugata*	+	-	-	-	+	+	-	+
8	Parreysia (Radiatula) *shurtleffiana* (Lea)	-	-	-	-	+	+	-	-
9	Lamellidens *corrianus* (Lea)	-	-	-	-	+	+	-	-
Order	**Veneroida**								
10	Corbicula *striatella* (Deshayes)	+	-	-	-	-	+	-	+
Phylum	**Annelida**								
Class	**Oligochaeta**								
Order	**Haplotaxida**								
11	Tubifex *sps.*	-	-	+	-	-	-	-	-
Phylum	**Arthropoda**								
Class	**Insecta**								
Order	**Odonata**								
12	Gomphus *sps.*	-	+	-	-	-	+	+	-
13	Cordulegaster *sps.*	-	+	-	-	-	+	+	-
14	Anax *sps.*	+	-	-	-	-	+	+	+
15	Enallagma *sps.*	-	+	+	-	-	-	-	-

16	Lestes *sps.*	-	+	-	-	-	-	-	-
Order	**Hemiptera**								
17	Notonecta *sps.*	-	-	-	+	-	-	+	-
18	Ranatra *sps.*	-	-	+	-	+	-	-	-
19	Nepa *sps.*	-	-	+	-	-	-	-	-
20	Sigara *sps.*	-	-	-	+	-	+	+	-
21	Belostoma *sps.*	-	+	-	-	-	+	-	-
Order	**Diptera**								
22	Culex *sps.*	-	-	-	+	-	-	-	-
23	Tabanus *sps.*	+	+	+	-	-	-	+	+
Order	**Ephemeroptera**								
24	Ephemerella *sps.*	+	+	+	+	-	-	+	+
25	Caenis *sps.*	-	-	-	-	-	-	+	+
Order	**Coleoptera**								
26	Dytiscus *sps.*	+	+	-	-	-	-	-	+
27	Berosus *sps.*	-	+	+	+	-	+	-	+
28	Stenelmis *sps.*	-	-	-	-	-	+	-	-
Class	**Crustacea**								
Order	**Decapoda**								
29	Palaemonetes *sps.*	-	+	+	+	-	-	-	-
Class	**Arachnida**								
Order	**Araneae**								
30	Dolomedes *sps.*	-	+	-	-	+	-	-	-
31	Tetragnatha *sps.*	-	+	-	-	+	-	-	-
	Total	**11**	**14**	**9**	**9**	**7**	**13**	**8**	**13**

Observations revealed that phylum arthropoda is in dominant position and out of eight sampling stations genus Ephemerella (16 individuals) recorded from 6 sampling stations, Tabanus (8 individuals) recorded from 5 sampling stations, Berosus (11 individuals) recorded from 5 sampling stations, Anax (54 individuals) recorded from 4 sampling stations and Palaeomonetes (31 individuals) recorded from 3 sampling stations. High dominance of phylum arthropoda was observed in Ken River [11], in River Narmada [12], in Tons river [13] and in streams of a national park in Turkey [14].

Phylum mollusca is in second position after arthropoda and observations depicted that out of eight sampling stations in class gastropoda Tarebia *lineata* (Gray) with 26 individuals present on 5 sampling stations, Tarebia *granifera* (Lamarck) with 12 individuals present on 4 sampling stations and Bellamya *bengalensis* with 8 individuals recorded from 4 stations respectively. On the other hand in class bivalvia Parreysia *corrugata* with 10 individuals recorded from 4 stations and Corbicula *striatella* (Deshayes) with 6 individuals recorded from 3 stations. In River Narmada dominance of Tarebia *lineata* (Gray), Tarebia *granifera* (Lamarck), Bellamya *bengalensis* and Corbicula *striatella* (Deshayes) was also reported [15]. Similar observations were reported in River Barak and its tributary in Assam [16] and in River Nile [17].

At station 2, 6 and 8 taxonomic richness was higher than other stations due to presence of heterogeneous substrate type (Boulder>Cobble>Pebble>Gravel>Sand) and dense macrophytic growth with negligible human disturbance. It is well known that land use and land cover of catchment area and habitat structure largely affect the diversity of macrozoobenthic fauna. Similar results have been obtained in Ken river [11], Tons river [13] and in Barna stream network comes under Narmada basin [18].

3.1. Statistical Findings

Shannon Diversity Index

In this study, the value of Shannon diversity index was between 1.40 and 2.26 (Figure 5, Table 3). The highest value of index was found at station 2 which shows diversified species composition of macrozoobenthos whereas, lowest value of index was observed at station 5 which shows minimum diversity of organisms rather than others. Observations revealed during the study of River Narmada the value of Shannon diversity index was between 1.14 and 2.75 [12] and in Mouri river of Khulna, Bangladesh with the range of 1.20 to 1.49 [19].

Margalef Diversity Index

The value of Margalef diversity index was between 2.41 and 3.18 (Figure 5, Table 3). This index depends on the number of species or species richness recorded at different sampling stations at different sampling occasions. During the investigation, highest value of index was recorded at station 2 while minimum value of this index was recorded at station 5 in comparison with all sampling stations. In the Semenyih River of peninsular Malaysia the species richness as reflected by the value of Margalef index ranged between 0.08 and 1.90 at seven sampling stations [20].

Table 3: *Numeric Data of the Study*

Sampling Stations	S	N	H'	d
Station -1	11	48	1.97	2.58
Station -2	14	60	2.26 **	3.18**
Station -3	9	26	1.93	2.46
Station -4	9	20	2.04	2.67
Station -5	7	12	1.40 *	2.41*
Station -6	13	54	2.00	3.01
Station -7	8	18	1.95	2.42
Station -8	13	57	2.22	2.97

Where,

S: Number of species
N: Number of individuals
H': Shannon diversity index
d: Margalef diversity index
* The lowest biodiversity diversity index value
** The highest biodiversity index value

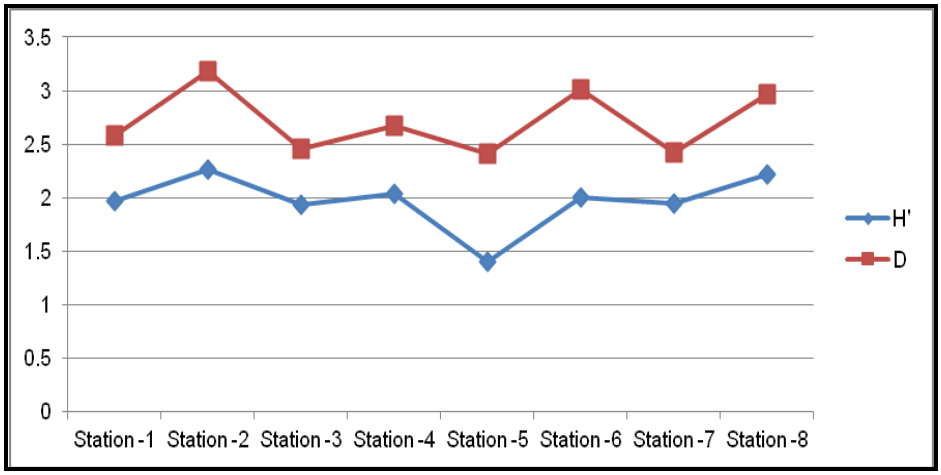

Figure 5: *Graphical Representation of Statistical Findings*

4. Conclusion

The findings of this rapid study will form baseline information as the catchment of river is experiencing gradual changes in land use pattern. The agriculture activities and road connectivity will increase human disturbance in this area. Moreover, dams are also proposed on tributaries of River Narmada and this will change habitat structure of the pristine stream condition.

Acknowledgement

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References

[1] Hynes H.B.N. *The Stream and Its Valley.* Verndlungen. Int. Vereinigung Limnol. 1975. 19; 1-15.

[2] Rosenberg D.M. and Resh V.H., 1993: *Introduction to Fresh Water Biomonitoring and Benthic Macro Invertebrates*. In: D.M. Rosenberg and V.H. Resh (Eds.). Fresh Water Biomonitoring and Benthic Macro Invertebrates, Chapman and Hall, New York, 1-9.

[3] Barbour M.T., Gerritsen B.D., Snyder, and Stribling J.B., 1999: *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrate and Fish.* 2nd Ed. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

[4] Needham J.G. and Needham P.R., 1962: *A Guide to the Study of Fresh Water Biology.* Publishers Holden Day San Francisco, U.S.A. 108.

[5] Tonapi G.T., 1980: *Freshwater Animal of Indian an Ecological Approach*. Oxford and IBH Publishing Co., New Delhi.

[6] Patrick Mc. and Cafferty W.P., 1998: *The Fishermen's and Ecologist Illustrated Guide to Insects and Their Relatives: Aquatic Entomology.* Jones and Bartlett Publishers, Sudbury, MA, US. 1-448.

[7] Subba Rao N.V., 1989*: Handbook Freshwater Mollusks of India.* Zoological Survey of India.

[8] Dey R.A., 2007: *Handbook on India Fresh Water Molluscs.* Zoological Survey of India, Calcutta.

[9] Mandaville S.M., 2002: *Benthic Macro Invertebrates in Fresh Water-Taxa Tolerance Values, Metrics and Protocols*, Project H-1 (Nova Scotia: Soil and Water Conservation Society of Metrohalifax).

[10] Kocataş A., 1992: *Ekoloji ve Çevre Biyolojisi,* Ege univ. Matbaasi, İzmir, 546.

[11] Nautiyal P. and Mishra A.S. *Longitudinal Distribution of Benthic Macroinvertebrate Fauna in a Vindhyan River, India.* International Journal of Environmental Sciences. 2012. 1 (3) 150-158.

[12] Vyas V., Bharose S., Yousuf S., and Kumar A. *Distribution of Macrozoobenthos in River Narmada near Water Intake Point.* Journal of Natural Sciences Research. 2012. 2 (3) 18-24.

[13] Mishra A.S. and Nautiyal P., 2012: *Longitudinal Distribution of Benthic Macroinvertebrate Assemblages in a Central Highlands River, the Tons (Central India).* Proceedings of National Academy of Sciences, India, Section B- Biological Sciences.

[14] Türkmen G. and Kazanci N. *Applications of Various Biodiversity Indices to Benthic Macroinvertebrate Assemblages in Streams of a National Park in Turkey.* Review of Hydrobiology. 2010. 3 (2) 111-125.

[15] Kumar A. and Vyas V., 2012: *Diversity of Molluscan Communities in River Narmada, India.* Journal of Chemical, Biological and Physical Sciences. 2 (3) 1407-1412.

[16] Roy S. and Gupta A. *Molluscan Diversity in River Barak and Its Tributaries, Assam, India.* Assam University Journal of Science and Technology: Biological and Environmental sciences. 2010. 5 (1) 109-113.

[17] Fisher M.R. and Williams W.P. *A Feasibility Study to monitor the Macro Invertebrate Diversity of the River Nile Using Three Sampling Methods.* Hydrobiology. 2006. 556; 137-147.

[18] Vyas V. and Bhawsar A. *Benthic Community Structure in Barna Stream Network of Narmada River Basin.* International Journal of Environmental Biology. 2013. 3 (2) 57-63.

[19] Khan A.N., Kamal D., Mahmud M.M., Rahman M.A., and Hossain M.A. *Diversity, Distribution and Abundance of Benthos in Mouri River, Khulna, Bangladesh.* International Journal of Sustainable Crop Production. 2007. 2 (5) 19-23.

[20] Yap C.K., Ismail A.R., Ismail A., and Tan S.G. *Species Diversity of Macrobenthic Invertebrates in the Semenyih River, Selangor, Peninsular Malaysia.* Pertanika Journal of Tropical Agricultural Science. 2003. 26 (2) 139-146.