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# A Study on Species distribution and Diversity of macro-fauna of River Tawa - A Tributary of River Narmada in Madhya Pradesh, India

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**Abstract**

This study is aimed to collect information about the macrofauna diversity of Tawa River. The Tawa River joins to Narmada at district Hoshangabad (Madhya Pradesh). During the study 8 sites were selected for the investigation. collections of samples were done from the eight sampling sites of the river. Collected samples were identified up to species level and their diversity and richness were analyzed. Shannon index for diversity and margalef index for richness were used for the study. Total 48 taxa of macrofauna have been recorded from the identified sampling stations. Benthic fauna of phylum Arthropoda was found in dominant position in the study and phylum Mollusca was found in second position.

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Tawa River.

## Introduction

River ecosystems are most important lotic fresh water habitats for many aquatic animals and benthic animals are one of these animal. Benthic animals are generally found in both of fresh water habitats i.e. – lotic habitats and lentic habitats. Benthos spends their whole life in bottom of aquatic ecosystem because of their feeding nature. Basically they are detritus feeders and divided in to two types – microzoobenthos and macrozoobenthos. Macro benthos are those animals which can be seen with naked eyes. Their diversity and distribution are good indicators of water quality of an ecosystem that's why they are known as bioindicators. In the present investigation diversity and distribution of Macroinvertebrates were recorded for the period of two years from July 2017 to June 2019. The study was focused on two main phyla of

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macrozoobenthos community of arthropoda and mollusca. Macrozoobenthos show sessile and sedentary behavior. Aquatic organisms are common indicator of aquatic environmental conditions.[1] Macrozoobenthic fauna serve as a biological indicator of aquatic ecosystem.[2] Physicochemical quality of water is the factors that influence species composition of a water body.[3] Macrobenthos are good source of fish food and their food chain.[4] They are Ecological engineers of ecosystems.[5] Fresh water ecosystem was the conservation priority during International decade Action[6] and in the present time also. Periodical bioassessment of taxonomic diversity of aquatic ecosystem play an important role for nature and ecological protection. Different measures are used in bioassessment for fresh water.[7] Macrozoobenthos due to their special characteristics are indicator of the water quality of an aquatic ecosystem.[8,9] The abundance of macrozoobenthos are depending on its surrounding environment.[2] composition of benthic community is directly related to water quality.[10] The present research was aimed to study the distribution of benthic macro fauna of Tawa river.

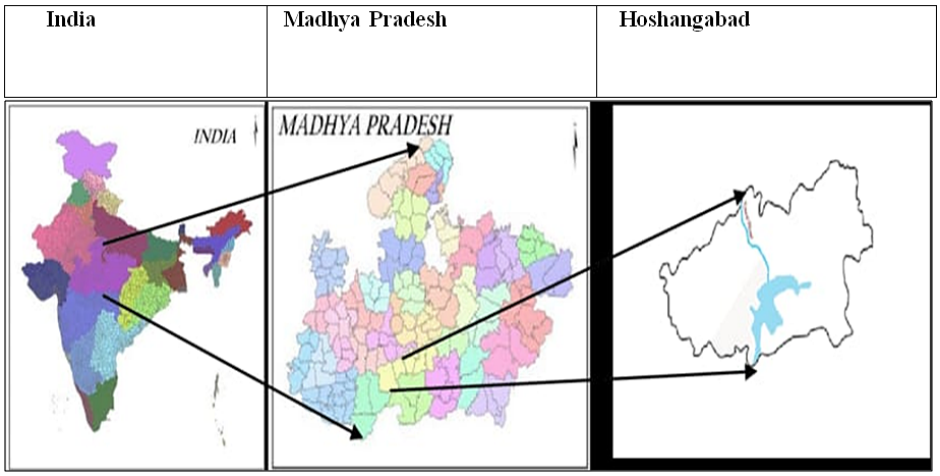


**Fig. 1: Map showing position of Tawa River**

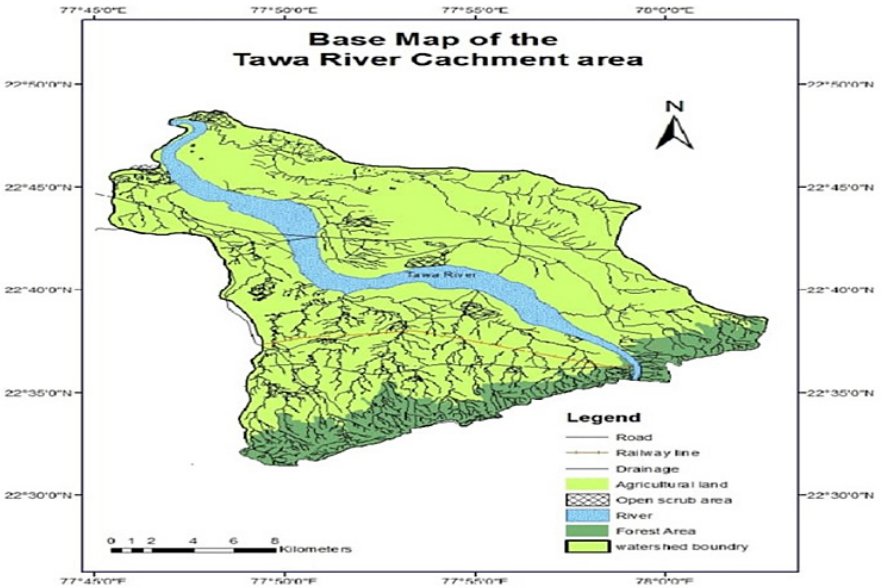


**Fig. 2: Map showing catchment area of River – Tawa**

## Material and Methods

### Study area

Tawa River is one of the major tributaries of Narmada in the central India. The Tawa originates from Satpura hills of Betul district and flows towards Hoshangabad District of (Madhya Pradesh). The Tawa joins to Narmada river at Bandrabhan village of Hoshangabad. The preserve forest BORI is situated along the Tawa. Bori sanctuary of the preserve forest is very famous part of Biosphere of Panchmarhi of Hoshangabad district.

### Study Ssites

Total 8 sites were identified for the research. Their geographical positions are shown in the Table 1. These sites arranged from upstream to downstream and joins to Narmada in Bandrabhan village at district Hoshangabad.

**Table 1: position of sampling stations**

| Sampling station | Name of sites | Latitude | Longitude |
|---|---|---|---|
| S1 | Sarni (power plant area) | 22.05068 | 78.1300 |
| S2 | Ghoradondri (banspur) | 22.1610 | 77.996 |
| S3 | Bhoura (khapa) | 22.2620 | 77.927 |
| S4 | Ranipur(dam area) | 22.5747 | 77.98004 |
| S5 | Maharghat | 22.684 | 77.831 |
| S6 | Babai bridge | 22.7104 | 77.83144 |
| S7 | Raipur | 22.71785 | 77.7254 |
| S8 | Bandrabhan (Tawa-Narmada confluence point) | 22.7441 | 77.7369 |

### Protocoll

Selected sites were visited periodically to gather samples of benthic macro-fauna. To collect samples, various types of gears like surber sampler, D-net sampler, kick net sampler, and grab sampler etc. were used according to river bed of the sites. 0.5 to 0.6 micron mesh sized sieve were used to collect benthic macro fauna. Separated fauna were washed carefully and stored in labeled plastic bottles. 4% formalin were used for benthos preservation. Collected animals were identified upto the species level. Microscope and hand lens were used to observe detailed features of the animals.

### Diversity and Richness Index

collected samples were recorded in a manner of tabulation chart. After the collection of data, statistical analysis was done. In the present paper two important diversity index were analysed.

### Diversity Index of Shannon

Shannon index is very common index which is used for diversity calculation of a habitat.[11] The index value ranges between 0.0 and 5.00.

**Table 3: index value and diversity of Shannon index**

| Index value | Diversity |
|---|---|
| 1.5 to 3.5 | Common |
| 3.6 to 4.5 | Rich |
| 4.5 to 5.0 | Very rich |

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

H'= Shannon Diversity Index

ni = number of individuals belonging to i species

N = Total number of individuals of all species

### Richness Index of Margalef

The margalef index formula is used to calculate richness of species.[12] This index shows richness of species in a habitat.r

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

d = Margalef Diversity Index

S = Total number of species

N = Total number of individuals

**Result and Discussion**

During the study, total 48 taxa of macrozoobenthos belonging to phylum Mollusca and Arthropoda were noted form eight sampling station of the study area. Out of these 48 taxa, 17 taxa of class Gastropoda represented by two orders Megastropoda and Hygrophila with 4 and 1 families respectively. Class Bivalvia was represented by three orders with four families Amblemidae, Unionidae, Corbiculidae and Lymnaeidae. Phylum Arthropoda has been recorded with two classes Insecta and Malacostraca. Class Insecta were represented by 6 orders and 17 families with 25 taxa while class Malacostraca represented by one order with a family. Class Insecta of phylum Arthropoda and class Gastropoda of phylum Mollusca were main representatives of macrozoobenthos of the river. Similar observations were recorded at Ganjal River, Ken River and Streams of Yedigoller National Park.[14, 15, 16]. *Bellamya bengalensis* of mollusca is a dominant species and found at all eight sampling stations and Total 41 individuals were collected. More than 20 taxa of phylum arthropoda and mollusca were recorded from four sampling sites S-1, S-2, S-3, and S-5. Maximum taxa varieties were noted from site1 and 5. Lowest number of taxa was observed from site 4 and 6. *Bellamya bengalensis* (family-Viviparidae) and *Brotia costula* (family-Thiaridae) of phylum mollusca were recorded from all the sampling stations. Phylum Arthropoda are dominant in position than Mollusca. Dominancy of phylum arthropoda in the river ecosystem was reported by Vyas, *et al*., Sharma, *et al*. and Khan.[17, 18, 19] It may be due to favorable habitat conditions and food availability for Arthropods in the river. The finding of this study reports the current position of macrozoobenthos diversity of river Tawa.

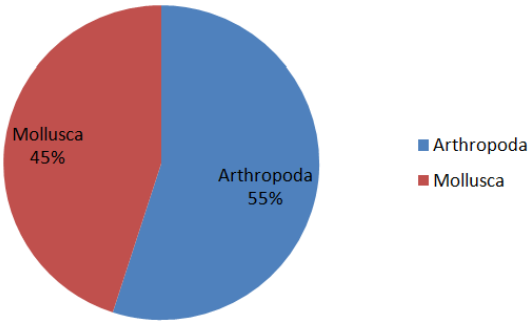


**Fig. 3: Composition of Taxonomic Group of macrozoobenthos**

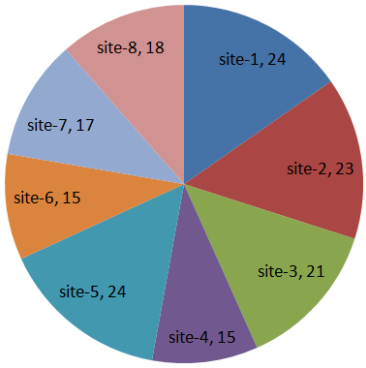


**Fig. 4: Species Level Distribution Of Macrozoobenthos at different sampling sites**

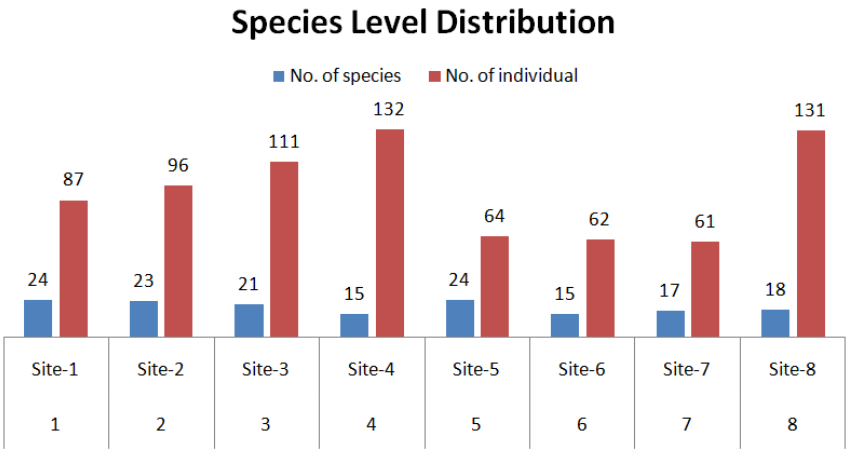


**Fig. 5: Graphical presentation of species level distribution**

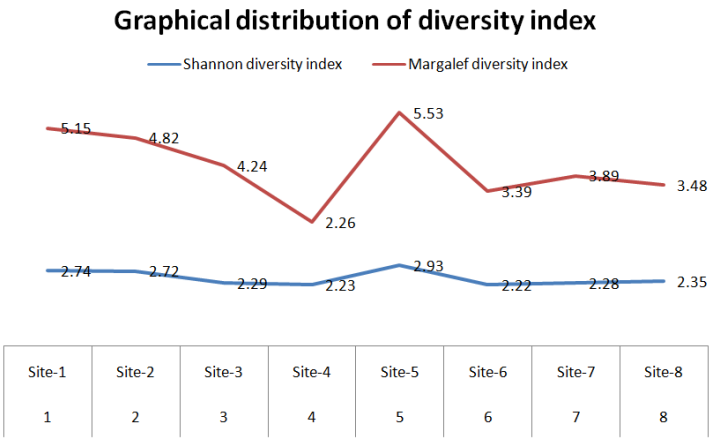


**Fig. 6: Graphical presentation of Shannon and Margalef Diversity index of sampling sites**

**Table 2: Diversity of Macrozoobenthos of Tawa River**

| S.No. | Taxa | Sampling Stations | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **S1** | **S2** | **S3** | **S4** | **S5** | **S6** | **S7** | **S8** |
| **Phylum** | **Mollusca** | | | | | | | | |
| **Class** | **Gastropoda** | | | | | | | | |
| **Order** | **Megastropoda** | | | | | | | | |
| **Family** | **Viviparidae** | | | | | | | | |
| 1 | *Bellamya bengalensis* | + | + | + | + | + | + | + | + |
| 2 | *Bellamya dissimilis* | - | + | - | + | + | + | + | + |
| 3 | *Bellamya heliciformis* | - | + | + | - | - | - | + | + |
| 4 | *Bellamya crassa* | - | - | + | - | + | - | - | - |
| 5 | *Angulyagra microchaetophora* | - | - | + | - | + | - | + | - |
| **Family** | **Thiaridae** | | | | | | | | |
| 6 | *Melanoides tuberculata crebra* | + | + | - | + | + | + | - | + |
| 7 | *T. Melanoides tuberculata* | - | + | + | + | + | - | + | - |
| 8 | *Tarebia granifera* | - | - | + | - | - | + | - | - |
| 9 | *Thiara (M.) tigrina raoi* | + | + | + | - | + | - | - | + |
| 10 | *Brotia costula* | + | + | + | + | + | + | + | + |
| 11 | Brotia costula juvenile | + | + | + | - | - | + | - | + |
| **Family** | **Bithyniidae** | | | | | | | | |
| 12 | *Gabbia travancorica* | - | + | + | + | - | - | + | - |
| 13 | *Digoniostoma cerameopoma* | - | - | + | - | - | - | - | + |
| **Family** | **Pilidae** | | | | | | | | |
| 14 | *Pila globosa* | + | - | - | + | + | - | - | - |
| Order | *Hygrophila* | | | | | | | | |
| **Family** | **Planorbidae** | | | | | | | | |
| 15 | *Gyraulus velifer* | + | + | + | + | + | - | - | + |
| 16 | *Gyraulus rotula* | + | - | + | + | + | - | - | + |
| 17 | *Indoplanorbis exustus* | - | - | - | + | - | - | - | - |
| **Class** | **Bivalve** | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Order** | **Trigoinoida** | | | | | | | | |
| **Family** | **Amblemidae** | | | | | | | | |
| 18 | *Parreysia radiatula crispisulcata* | + | + | + | + | + | - | - | - |
| 19 | *Parreysia R. caerulea* | + | + | + | + | + | + | - | + |
| **Family** | **Unionidae** | | | | | | | | |
| 20 | *Lamellidens narainporensis* | + | - | - | + | - | + | - | - |
| **Order** | **Veneroida** | | | | | | | | |
| **Family** | **Corbiculidae** | | | | | | | | |
| 21 | *Corbicula striatella* | + | + | - | - | + | + | + | - |
| **Order** | **Basomatophora** | | | | | | | | |
| **Family** | **Lymnaeidae** | | | | | | | | |
| 22 | *Lymnaea accuminata* | + | - | + | + | + | + | + | + |
| **Phylum** | **Arthropoda** | | | | | | | | |
| **Class** | **Insecta** | | | | | | | | |
| **Order** | **Odonata** | | | | | | | | |
| **Family** | **Gomphidae** | | | | | | | | |
| 23 | *Gomphus vastus* | - | + | - | - | - | - | - | - |
| 24 | *progomphus larva* | + | + | - | - | - | - | - | - |
| **Family** | **Aeshnidae** | | | | | | | | |
| 25 | *Anux sps.* | - | + | - | + | + | + | - | - |
| | **Lestidae** | | | | | | | | |
| 26 | *Lestes sps* | - | + | - | - | - | - | - | - |
| **Family** | **Libellulidae** | | | | | | | | |
| 27 | *Libellula luctuosa* | - | + | - | + | - | - | - | - |
| 28 | *Libellula larva* | - | - | - | - | + | + | - | - |
| **Family** | **Cordulegastridae** | | | | | | | | |
| 29 | *Cordulegaster larva* | - | - | - | - | - | - | - | + |
| **Family** | **Petalurdaei** | | | | | | | | |
| 30 | *Tachopteryx larva* | - | - | + | - | - | - | - | - |
| **Family** | **Coenagrionidae** | | | | | | | | |
| 31 | *Enallagma sps.* | - | - | + | + | - | - | - | - |
| 32 | *Enallagma larva* | - | - | + | + | + | - | + | + |
| **Family** | **Macromiidae** | | | | | | | | |
| 33 | *Macromia larva* | + | - | - | - | + | + | + | - |
| **Order** | **Hemiptera** | | | | | | | | |
| **Family** | **Nepidae** | | | | | | | | |
| 34 | *Ranatra sp.* | - | + | + | - | + | - | + | - |
| 35 | *Nepa sp.* | - | - | + | + | + | - | - | + |
| **Family** | **Corixidae** | | | | | | | | |
| 36 | *Sigara sp.* | - | + | - | - | - | - | - | - |
| **Order** | **Diptera** | | | | | | | | |
| **Family** | **Culicidae** | | | | | | | | |
| 37 | *Culicinae larva* | - | - | - | - | - | + | - | - |
| 38 | *Culex pipiens larva* | - | - | - | - | - | - | + | - |
| 39 | *wyeomyia larva* | - | - | - | + | - | - | - | - |
| **Order** | **Lepidoptera** | | | | | | | | |
| **Family** | **Noctuidae** | | | | | | | | |
| 40 | *Bellura larva* | - | + | + | - | - | - | - | - |
| **Order** | **Ephemeroptera** | | | | | | | | |
| **Family** | **Baetidae** | | | | | | | | |
| 41 | *callibaetis larva* | - | - | - | + | - | - | + | - |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Family** | **Siphlonuridae** | | | | | | | | |
| 42 | *ameletus larva* | - | - | + | + | - | - | - | + |
| **Family** | **Behningiidae** | | | | | | | | |
| 43 | *Dolamia larva* | - | - | - | - | + | - | - | - |
| **Order** | **Coleoptera** | | | | | | | | |
| **Family** | **Carabidae** | | | | | | | | |
| 44 | *Omophron adult* | - | - | - | + | - | - | + | + |
| 45 | *Bembidion adult* | - | - | - | + | - | - | - | - |
| **Family** | **Elmidae** | | | | | | | | |
| 46 | *Optioservus adult* | - | - | - | - | + | + | + | - |
| 47 | *Stenelmis adult* | - | - | + | - | + | - | - | - |
| **Class** | **Malacostraca** | | | | | | | | |
| **Order** | **Decapoda** | | | | | | | | |
| **Family** | **Palaemonidae** | | | | | | | | |
| 48 | *Palaemonetes sp.* | - | - | - | - | - | - | + | - |

**Table 3: Shannon and Margalef index of the sampling sites**

| Sampling sites | No. of species | No. of individual | Shannon diversity index | Margalef diversity index |
|---|---|---|---|---|
| Site-1 | 24 | 87 | 2.74 | 5.15 |
| Site-2 | 23 | 96 | 2.72 | 4.82 |
| Site-3 | 21 | 111 | 2.29 | 4.24 |
| Site-4 | 15 | 132 | 2.23 | 2.26 |
| Site-5 | 24 | 64 | 2.93 | 5.53 |
| Site-6 | 15 | 62 | 2.22 | 3.39 |
| Site-7 | 17 | 61 | 2.28 | 3.89 |
| Site-8 | 18 | 131 | 2.35 | 3.48 |

In the study, Diversity index was from 2.22 to 2.93. The diversity value of site no. 5 was highest and lowest value of index was noted at site 6. Site1 and 2 shows similar diversity composition of species with index value 2.7. The Margalef index shows richness of species. The value margalef diversity index ranges between 5.53 to 2.26 and highest value was recorded at site 5.Taxonomic richness at sampling site 1 and 5 may be due to favorable habitats for macrozoobenthos. Similar conclusion was made by Vyas at Barna Stream[13] and Mouri River by Khan *et al*.[20]

## Conclusion

In the present study of macrozoobenthos diversity of Tawa river, dominant phylum was Arthropoda followed by Mollusca. The range of Shannon diversity index was lies between 2.93 to 2.22 which are indicating moderate pollution level in the sampling sites. Species diversity value in the range of 1.00 to 3.00 indicates moderate pollution in the water. Margalef diversity index value varied from 2.26 to 5.53 in the study and indicates low species richness. Road connectivity increased human activities in the study area. Moreover, Agriculture activities, dam, activity of power plant, over exploitation and human disturbance in the study area may be cause to change habitat structure and low of species richness.

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**Conflict of Interest**
The authors do not have any conflict of interest.

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