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Distribution and Diversity of Benthic Macroinvertebrates in the Dilawara Reservoir of Dhar Tehsil (District- Dhar, MP)

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Abstract

Benthic macroinvertebrates are organisms that are found at the bottom of water body living on or in the substrate. Macroinvertebrate metrics are helpful tools for the assessment of water quality and overall aquatic ecosystem health. The present study aimed to identify the diversity and composition of benthic macroinvertebrates in the Dilwara reservoir of Dhar District. Benthic samples were collected from the four monitoring stations during the two consecutive years 2017 and 2018. The monthly Average quantitative percentage composition of Macro-invertebrates was used to estimate the diversity indices The results revealed a total of 21 species of benthic macro –invertebrates were identified, of which Phylum Mollusca Class- Gastropoda was the most dominant group (11 species) followed by Phylum Annelida Class- Oligochaeta (7 species) and the least diverse was Phylum Arthropoda Class-Insecta. There was variation in occurrence in number of benthic macro invertebrates in different months of both the years (2017 and 2018) and the highest Shannon's diversity index was shown by phylum Mollusca (2.35) and (2.37) respectively. Similarly, the highest Simpson index was shown by phylum Annelida (0.360) during the year 2017 and phylum Arthropoda (0.365) during 2018. In conclusion, both indices showed that the health of the Dilwara reservoir is in moderate condition.

Keywords: Benthic macroinvertebrates, composition, diversity indices, water quality

1. Introduction

Benthic (meaning "bottom-dwelling") macroinvertebrates are small aquatic animals and the aquatic larval stages of insects **(Environmental Protection Agency [EPA], 2016).** Benthic macroinvertebrates are a highly diverse faunal group that inhabit many niches and habitats in freshwater systems **(Obade and Moore 2018).** Benthic macro invertebrates are often found attached to rocks, vegetation, logs and sticks or burrowed into the bottom sand and sediments. Diversity and density of the macrobenthos is dependent on chance settlement

of pelagic larval forms of different species, affinity to suitable substratum and also the degree of stress effect caused by strong waves and tide currents **(Kumar and Khan, 2013).** Macroinvertebrate diversity and abundance are significant community attributes that are controlled by a variety of mechanisms at different spatial scales. Benthic macroinvertebrates provide a more precise understanding of changes in aquatic conditions when compared to chemical and microbiological data, which rather present short-term fluctuations **(Ghasemi and Kamali 2014).**Changes in water body characteristics, habitat, and environmental resources can strongly influence patterns of distribution in benthic communities **(Buss *et al.*, 2002).**The distribution of macroinvertebrate taxa across a river system is mainly dependent on the availability of microhabitats and food resources. A number of studies have documented how macroinvertebrate assemblages respond to environmental variables and which variables best explain their distribution and abundance **(Buss *et al.*, 2002).** Benthic macro invertebrates are commonly used as indicators of the biological condition of water bodies. They are reliable indicators because they spend all or most of their lives in water, are easy to collect and differ in their tolerance to pollution (**EPA, 2016).** The relative stability of benthic communities and their sensitivity to changes in the aquatic environment have made many species as bio-indicators of water quality **(Ogbeibu and Oribhabor, 2001).** Thus, changes in the macroinvertebrate composition and community structures can be used to establish environmental alterations in aquatic ecosystems.

To date, no scientific literature regarding pollution from the various human activities along the reservoir and its impact on aquatic biota has been conducted. The aim of the present study was to provide a baseline data on the diversity and distribution of benthic macro invertebrates of Dilawara reservoir.

2. Materials and Methods

The present investigation was carried out at an interval of 1 month from January-2017 to December-2018 in all the four selected sampling stations. Benthic samples were collected from all four sampling stations using a Vanveen grab of 0.6m2 surface area. The sediment samples collected were kept in a polythene bags, labelled and brought to the laboratory for analysis. These sediments samples were diluted with water and passed through the sieve with 0.5 mm mesh sizes to collect the benthos **(George *et al.*, 2009).** The benthos was washed and poured into a white enamel tray with water for sorting. The benthos was sorted out into different groups and preserved in 4% phosphate buffered formalin in small glass jars. Collected samples were then pinned, dried and examined under a stereoscope microscope andwere identified using cited taxonomic literature. At last, samples were assigned tofamily/species using taxonomic keys Samples were assigned to a family/species usingtaxonomic keys; **(APHA, 2005); (Welch, 1998); (Tonapi, 1989).**

Calculation

Percentage of occurrence =

$$\frac{\text{number of individuals belonging to ith family}}{\text{total number of individuals}} \times 100$$

3. Results

In the present study, Total 21 species of benthic macro –invertebrates were identified from all the four monitoring stations during the two consecutive years 2017 and 2018 as summarized in table **1a-b-2a-b** and depicted by **figure 1a-b** respectively. 7 species of Phylum Annelida Class-Oligochaeta *viz: Tubifex tubifex, Limmodrilus hoffmeisteri, Telmatodrilus multispinosus, Dero dorsalis, Stylaria fossularis, Branchiodrillus hortensis and Tubifex albicola* were identified. 11 species were identified in Phylum Mollusca Class- Gastropoda like *Limnaea auricularia, Bellamva bebgalensis, Digoniostoma punchella, Melanoides tuberculatus, M.lineatus, Thira scabra, Indoplanovbis exustus, Pissidium clarkeanum, Vivipara bengalensis, Unio sp* and *Pila sp.* However, only 3 species of Phylum Arthropoda Class-Insecta *chironomus sp., Chaoborus sp.* and *Procladius sp.* were identified.

Table 1a: Species Average of Benthic Macro-invertebrates of Dilwara reservoir during 2017.

Benthic Macro Invertebrates	Species Average
Oligochaeta	*Tubifex tubifex* **(28.48)**
	Limmodrilus hoffmeisteri **(15.10)**
	Telmatodrilus multispinosus **(17.93)**
	Dero dorsalis **(20.65)**
	Stylaria fossularis **(17.85)**
	Branchiodrillus hortensis **(20.52)**
	Tubifex albicola **(16.30)**
Molluscus	*Limnaea auricularia* **(33.29)**
	Bellamva bebgalensis **(21.04)**
	Digoniostoma punchella **(42.43)**
	Melanoides tuberculatus **(34.021)**
	M.lineatus **(18.74)**
	Thira scabra **(17.91)**
	Indoplanovbis exustus **(21.39)**
	Pissidium clarkeanum **(21.82)**
	Vivipara bengalensis **(42.25)**
	Unio sp. **(29.28)**
	Pila sp. **(21.68)**
Arthropods	*chironomus sp.* **(47)**
	Chaoborus sp. **(47.89)**
	Procladius sp. **(47.16)**

Table. 1b Average quantitative percentage composition of Macro-invertebrates of Dilwara reservoir during 2018.

Benthic Macro Invertebrates	Species Average
Oligochaeta	*Tubifex tubifex* **(34.46)**
	Limmodrilus hoffmeisteri **(21.19)**
	Telmatodrilus multispinosus **23.97**
	Dero dorsalis **(24.02)**
	Stylaria fossularis **(24.02)**
	Branchiodrillus hortensis **(26.72)**
	Tubifex albicola **(22.63)**
Molluscus	*Limnaea auricularia* **(40.45)**
	Bellamva bebgalensis **(27.95)**
	Digoniostoma punchella **(50.15)**
	Melanoides tuberculatus **(41.43)**
	M.lineatus **(26.21)**
	Thira scabra **(25.6)**
	Indoplanovbis exustus **(29)**
	Pissidium clarkeanum **(29.36)**
	Vivipara bengalensis **(50.02)**
	Unio sp. **(37.21)**
	Pila sp. **(31.29)**
Arthropods	*chironomus sp.* **(58.75)**
	Chaoborus sp. **(59.66)**
	Procladius sp. **(54.79)**

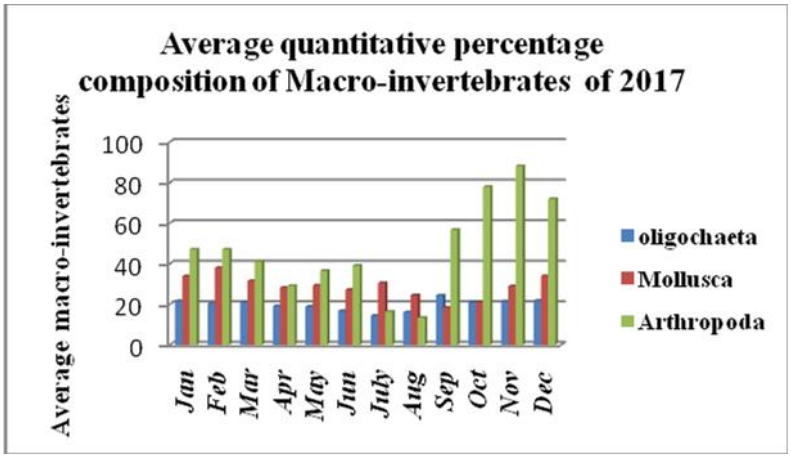
Table.2a Species Average of Benthic Macro-invertebrates of Dilwara reservoir during 2017.

Bentic Macro-Invertebrates (2017)	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Oligochaeta	25.57	26.35	25	25.96	24.57	21.89	18.48	27.55	27.12	27.64	27.5	29.44
Molluscus	40.97	45.22	37.11	35.63	36.04	34.29	29.26	26.57	26.13	29.68	37.77	42.72
Arthropods	56	61.3	43.4	40.1	47.9	48.6	25.5	23.8	79.5	92.4	102.2	79

Table 2b: Average quantitative percentage composition of Macro-invertebrates of Dilwara reservoir of 2018.

Bentic Macro-Invertebrates (2017)	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Oligochaeta	21.64	20.42	20.91	19.10	18.89	16.75	14.4	16.00	24.31	21.00	21.46	21.78
Molluscus	33.81	38.02	31.54	28.18	29.27	27.18	30.45	24.52	18.30	20.93	29.00	33.93
Arthropods	47.00	47.00	41.2	29.1	36.6	39.1	16.4	13.4	56.7	78	88.2	72.00

Graph 33a: Average quantitative percentage composition of Macro-invertebrates of Dilwara reservoir of 2017



Graph 33b: Average quantitative percentage composition of Macro-invertebrates of Dilwara reservoir of 2018.

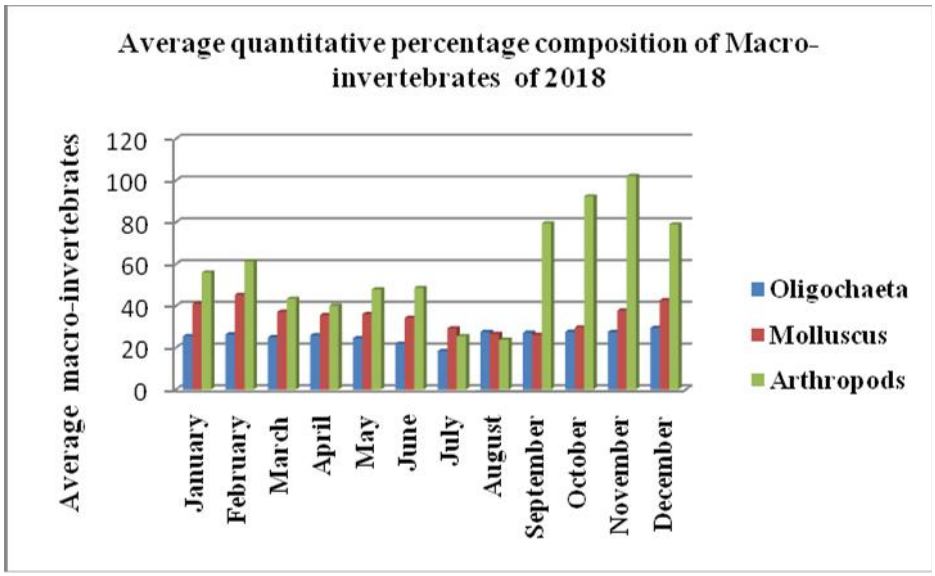


Table 42: Simpson and Shannon weiver index of two consecutive years from January 2017 to December 2018

	Annelida		Arthopoda		Mollusca	
Diversity indices	**Simpson index**	**Shannon index**	**Simpson index**	**Shannon index**	**Simpson index**	**Shannon index**
2017	0.146	1.933	0.360	1.054	0.099	2.35
2018	0.146	1.932	0.365	1.046	0.096	2.37

Monthly Average and Diversity indices of benthic macro invertebrates

The monthly Average quantitative percentage composition of Macro-invertebrates of Dilwara reservoir was used to estimate the diversity indices table 29b. There was variation in occurrence in number of benthic macro invertebrates in different months of both the years (2017 and 2018). During the year 2017, monthly Average of phylum Annelida recorded varied from 14.4 in the month of July to 24.31 in the month of September, Average quantitative percentage of Mollusca recorded varied from 18.30 in September to 38.02 in the month of February. However, the monthly average of phylum Arthropod observed varied from 13.4 in August to 88.2 in November. The Diversity indices – the highest Shannon's diversity index was shown by phylum Mollusca (2.35) followed by followed by phylum Annelida (1.933), while the least Shannon's diversity index (1.054) was shown by Arthropoda. Similarly, the highest Simpson index was shown by phylum Annelida (0.360) followed by Arthropoda (0.146) and Mollusca (0.099)

During the year 2018, monthly Average table 30bof Annelids recorded varied from 18.48 in the month of July to 29.44 in the month of December, Average quantitative percentage of Mollusca recorded varied from 26.13 in July to 45.22 in the month of February. However, the monthly average of phylum Arthropoda observed varied from 23.8 in August to 102.2 in November. The Diversity indices – the highest Shannon's diversity index was shown by phylum Mollusca (2.37) followed by followed by Annelida (1.932), while the least Shannon's diversity index (1.046) was shown by Arthropoda. Similarly, the highest Simpson index was shown by phylum Arthropoda (0.365) followed by Annelida (0.146) and Mollusca (0.096).

4. Discussion

In present investigation, Total 21 species of benthic macro –invertebrates were identified. 7 Species of Phylum Annelida,11 species were identified in Phylum Mollusca only 3 species of Phylum Arthropoda were identified of which phylum Mollusca was the dominating group. **(Sharma and Chowdhary, 2011)** observed 20 taxa benthic macro-invertebrate fauna during the study period belonging to three major phyla such as Arthropoda, Annelida and Mollusca. **(Panday, 2007)** recorded 53 families of benthicmacro-invertebrates under 13 orders of Narmada river of Madhya Pradesh.**(Sharma et al., 2013)** recorded 43 species of benthic macro-invertebrates; 9species of phylum Annelida 8 species of phylumArthropoda,10 species of aquatic insects, 16species of phylum –Mollusca. Themost common benthic macro-invertebrate organisms belong to Oligochaeta, Crustacea, Insecta and Gastropoda during the study period. Their variation in abundance depend upon physico-chemical parameters of water and environmental. Conditions**(Kennen *et al.*, 2010)** conducted a study on benthic macro-invertebrates in 67 small and medium sized catchment areas in America and revealedthe positive association between hydrological characteristics of flow and species richness index.**(Sharma *et al.*, 2013)** noticed Annelida group as least abundant among all the species and constitutes 18.26 % of total macro-benthic fauna of pond. The diversity and evenness indices at the various sampling sites seemed to reflect the water quality conditions. High species diversity was associated with less unimpacted or unpolluted conditions, while a lower diversity signified environmental pollution due to increasing human activities, **(Esenowo and Ugwumba 2010).**

5. Conclusion

The presence of Benthic Macro-invertebrates in a pond, lakes, rivers etc. contributes to their habitat in a different way, by participating in a food chain or by representing the quality.

On the basis of present investigation, a remarkable variety and abundance of macroinvertebrates with the phylum Annelida, phylum Arthropoda and then phylum Molluscawere recorded. The benthic macroinvertebrate abundance and diversity followed the observed water quality differences at the study sites. It has also been concluded that macro-invertebrates (Zoobenthos and other fauna) serves as a link between primary producers and higher trophic levels in the fresh water ecosystem. This works helps in generating baseline data for future research in the diversification of Benthic Macro-invertebrates and determining the water quality.

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7. Conflict/s of interest

We declare no conflict/s of interest related to this work.

8. References

A.P.H.A. (2005). American water works Association and Water Pollution Control Federation Standard methods for the examination of water & waste water 21 Edition American Public Health Association (A.P.H.A.) Washington D.C.

Buss, D. F., Baptista, D. F., Silveira, M. P., Nessimian, J. L, Dorvillé, L.F.M. (2002). Influence of water chemistry and environmental degradation on macroinvertebrate assemblages in a river basin in South-East Brazil. *Hydrobiologia*. 481(1/3):125–136.

Esenowo, I. K., Ugwumba, A. A. A. (2010). Composition and abundance of macro-benthos in Majidun RiverIkorodu Lagos State, Nigeria. *Res J Biol Sci*. 5(8):560–556

EPA. (2016). Indicators: Benthic Macroinvertebrates Retrieved August 16, 2018 from https://www.epa.gov/national-aquatic-resourcesurveys/indicators-benthicmacroinvertebrates.

George, A. D. I., Abowei, J. F. N. and Daka, E. R. (2009). Benthic macroinvertebrate fauna and physico-chemical parameters in Okpoka Creek sediments, Niger Delta, Nigeria. *Int. J . Anim. Vet. Adv*. 1: 59-65.

Ghasemi, A.F., Kamali, M. (2014). Benthic macroinvertebrates along the haraz downstream in Southern Caspian Sea Basin: In gradient of the physicochemical parameters. *Int J Zool*. 2014:1–7.

Kennen, J. G., Riva-murray, K., Beaulieu, K. M.(2010). Determining hydrologic factors that influence stream macroinvertebrate assemblages in the northeastern US. Ecohydrol. ;106:88–106.

Kumar, P. S and Khan, A. B. (2013). The distribution and diversity of benthic macro invertebrate fauna in Pondicherry mangroves, *Ind. Aquat. Biosyst*. 9(1): 3-18.

Obade, V. D., Moore, R. (2018). Synthesizing water quality indicators from standardized geospatial information to remedy water security challenges: a review. *Environ Int*. 119:220–231.

Ogbeibu, A.E and Oribhabor, B.J, (2001). Ecological impact of stream regulation using benthic macroinvertebrates as bioindicators. Journal of Aquatic science. 16: 000-0002. *Nigeria Association for Aquatic Sciences* (ISSN). 0189-8779.

Pandey, S. (2007). Biodiversity of benthic macro-invertebrates and their tropic relationship with shore birds and fishes of Yashwant Sagar reservoir, Indore, (M.P.). Ph.D. Thesis, Devi Ahilya Vishwavidyalaya, Indore, (M.P.).

Sharma, K. K. and Chowdhary, S. (2011). Macro-invertebrates assemblages as biological indicators of pollution in a Central Himalayan River, Tawi (J & K). International Journal of Biodiversity and Conservation, 3 (5), 167-174.

Sharma, S., Patel , B., Barkale, S. and Dave, V. (2013). Benthic macro-invertebrates use as a tool of water quality assessment of fresh water resources. The Journal of Ecology. Photon 107(2013)216-225.

Tonapi, G. T. (1989). Fresh water animals of India-an Ecological approach. Oxford and IBH Publishing Co. New Delhi; 341.

Welch, P. S. (1998). Liminological methods Mcgran Hill Book Co. New York.

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