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Diversity of Macrozoobenthos in Dudhi River- A Tributary of River Narmada in the Central Zone, India

Ankit Kumar[1], Reetu Sharma[1] and Vipin Vyas[2*]

[1]Department of Environmental Sciences and Limnology, Barkatullah University, Bhopal, (M.P.) India, 462026,
[2]Department of Bioscience, Barkatullah University, Bhopal, India

*Corresponding Author E-mail: vyasvipin992@gmail.com

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ABSTRACT

Around the world, freshwater habitats are being subjected to increased levels of human disturbance results strong indications that inland water ecosystems are suffering the greatest negative impact from human activities at present. Importance of biomonitoring and identifying areas of riverine biodiversity for long term conservation of the freshwater habitats aims at characterising and monitoring the conditions of the aquatic resources. Present study was focused on the diversity of macrozoobenthos which are known as ecological indicator. In the present investigation 26 taxa of macrozoobenthos were recorded from eight sampling stations chosen on Dudhi River which is a tributary of River Narmada in the central zone. On major sharing of taxonomic composition arthropods was found dominant (77%) than mollusca (23%), while in the composition of functional feeding group predators was found dominant than others and range of Shannon diversity index was found between 1.53 to 2.28 indicates alteration in habitat structure.

Key words: *Dudhi River, Macrozoobenthos, River Narmada, Tributary*

INTRODUCTION

Macrozoobenthos, an important component of aquatic ecosystems breakdown organic matter and cycle the nutrients and, in turn become food for fishes[1,2]. They are used for biological monitoring of aquatic ecosystems worldwide because they are found in different types of habitats having limited mobility, relatively very easy to collect using different types of sampler as well as with established sampling techniques and there is a diversity pattern of macrozoobenthic fauna ensures a wide range of sensitivities to change in both water quality and habitats [3, 4]. Survival, distribution and abundance of macrozoobenthos depends on the characteristics of their environment such as organic matter content, soil texture, sediment particles, substratum and depth[5,6]. Dudhi River is a tributary of River Narmada in the central zone and a rapid survey of the river was done. In present study diversity of macrozoobenthos was assessed which provides baseline and first hand information about Dudhi River.

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MATERIALS AND METHOD

Study area

Dudhi River originates from the hilly ranges of Satpura Mountain at 78° 44' E longitude and 22° 22' N latitude near Satalba village of Chindwara district, Madhya Pradesh. It flows through north westerly to join with River Narmada from left side near Umardha village of Hoshangabad district, Madhya Pradesh at 78° 26' E longitude and 22° 58' N latitude (Figure- 1). During the present investigation in a rapid survey eight sampling locations were chosen and from those stations samples of macrozoobenthos were collected. Geographical location of stations are given in Table- 1 which is systematically arranged from its origin to confluence with River Narmada and shown in Figure- 2.

Collection of Macrozoobenthos

During the study, macrozoobenthos were collected from sampling stations using different gears like D-frame net, Surber sampler and Peterson's Grab Sampler from different types of habitat[7,8].

Sieving, Storage, Preservation, Sorting and Transportation of samples

The delicate process of sieving was performed very carefully in order to avoid any damage to the fragile organisms and to ensure that all animal present in the sample were collected. In order to separate macrofauna, a brass sieve of 0.5 mm mesh size was used[9]. Organisms were picked up using soft brushes and forceps, and were stored in screw cap wide mouth reagent grade plastic bottles. During the study, organisms were placed into most commonly used fluid 4% solution of formaldehyde which is used as preservative. Specimens were sorted on the field and placed in separate containers according to the main taxonomic groups. All containers were labelled using tags and marker, and transported to laboratory for further process.

Identification of Macrozoobenthos

Once sorted, animals were identified upto their lower taxonomic level for this study. This was done by using a dissecting stereomicroscope and hand lens of 6x zoom to observe the finest details of the organisms. Available identification keys and monographs were used during the study to identify organism upto genus or species level[10,11,12,13,14 and 15].

Statistical Analysis

Diversity of macrozoobenthos was statistically analysed using Shannon-Wiener's diversity index (H'), Margalef diversity index (d) and Pielou evenness index (J').

Shannon diversity index (H')

$$H' = -\sum [(n_i / N) * (\text{Log } N\ n_i / N)]$$

H': Shannon Diversity Index

n_i: Number of individuals belonging to *i* species

N: Total number of individuals

LN: Natural Log base N of the number

Margalef diversity index (d)

$$d = (S-1) / \text{Log } N\ (N)$$

d: Margalef Diversity Index

S: Total number of species

N: Total number of individuals

LN: Natural Log base N of the number

Pielou evenness index (J')

$$J' = H' / H'_{max}$$

J': Pielou evenness index

H': The observed value of Shannon index

H'_{max}: LN(S)

LN: Natural Log base N of the number

S: Total number of species

RESULTS AND DISCUSSION

In the present study 26 taxa of macrozoobenthos were recorded from eight sampling stations of Dudhi River which belongs to phylum Arthropoda and Mollusca (Table- 2).

Phylum mollusca was represented by 2 classes i.e. Gastropoda and Bivalvia. Class gastropoda was represented by 1 order, 2 families and 4 genera, whereas class Bivalvia was also represented by 1 order, 2 families and 2 genera. Phylum arthropoda was represented by 3 classes i.e. insecta, crustacea and arachnida. Class insecta was represented by 4 orders, 11 families and 17 genera, whereas class crustacea was represented by 1 order, 1 family and 1 genus, whereas class arachnida was represented by 2 orders and 2 genera. During the study phylum arthropoda was found in dominant position with 77% followed by phylum mollusca with 23% of total faunal assemblage (Figure- 3). Arthropoda was also found dominant in Bhagner stream[16], in

Kaliyadeh stream[17], in Chandni nalla[18], in River Narmada[19], in Morand River a tributary of Ganjal River[7], near water intake point of River Narmada[20] and in Ganjal River a tributary of River Narmada[21]. The variation in the share of arthropoda and mollusca was due to change in substrate particle size and type from headwater to mouth. Land use also emerged as most important factor, probably because of greater variability than substrate in the river as a unit[22]. These factors have been also considered important for assemblages in South American Plateau rivers[23]. Evidently, land use, slope, discharge and substratum were the major force structuring the macroinvertebrate assemblages[22, 24]. The presence of mollusca was observed because of favourable environmental conditions prevailing in the river including abiotic and biotic components such as quality of water, presence of calcium content, quality of suitable substrate and presence of macrophytic vegetation[25]. Mcivor[26] also discussed the potential role of fresh water mussels i.e. bivalves as "living bio-filters" due to their key participation in removal of suspended particulate matter in the river ecosystems. The freshwater molluscs play a massive role in nature and help in assessment of ecological status of the water bodies. Being herbivores, they form the lower strata of aquatic trophic linkages and perform many other ecological activities[25]. In the present study, predators were found in dominant position with 54% of total composition (Figure- 4) which was attributed to the presence of fine sediment and gentle flow[27,28,29]. Scrapers were found at second position with 23% in total composition. Percentage of scrapers increase with the increase in algal production (periphyton) which appears where the use of fertilisers for agriculture leads to cumulative increase in nutrient concentrations which favours the growth of benthic algae which accounts for the abundance of scrapers[30,31]. Filtering collectors and gathering collectors contributed 8% and 8% respectively with normal position. Similar observations were observed in the tropical[32,33] and subtropical rivers[34, 35, 36] of the world. Minimum percent of shredders i.e. 7% was observed during the present study of River Narmada while in Ken and Tons river of central India (Bundelkhand region) minimum presence of shredders was observed[37]. Range of Shannon index was observed between 1.53 and 2.28 (Figure- 5). Minimum range was found at station- 2 and maximum was recorded at station- 1. Values of Shannon index ranged between 0.0 – 5.0, while results are generally in 1.5 – 3.5 and it exceeds 4.5 very rarely as well as this is sensitive indicator of pollution and its value do not fluctuated widely[38]. Observation of this index for present study indicates moderate pollution with altered habitat structure[39]. Similar findings were observed in Mouri River of Bangladesh [40] and on four sampling stations of courtallam hills of Western Ghats[41]. According to their findings all selected stations fall under moderate pollution condition. In present study, Margalef index range varied from 1.52 to 3.19 (Figure- 6). Minimum value was observed at station- 4 and maximum was recorded at station- 1. This is a species richness index and is expressed by simple ratio between total species and total number (or importance value N), proposed by Margalef in 1958. Larger the index value the more healthy the body of water, but when it tend towards 1.0, pollution is thought to increase and damage should be suspected. Higher diversity index values reflect the suitability of habitat for the organism; on the other hand the high species diversity has been reported to be correlated with longer food chain and complex food web of the ecosystems and also more stable community[39]. This index has no limit value and it shows a variation depending upon the number of species[38]. Results of this index for present study indicates extremely low species richness and low abundance with physically distributed areas in poor condition of colonization by aquatic organism[42].Values of Pielou evenness index was recorded between 0.64 and 0.98 (Figure- 7). Minimum range was found at station- 2, whereas maximum was recorded from station- 4. Pielou index play an important in species diversity and is derived from Shannon index, proposed by Pielou in 1966. This index denotes a balance relationship between species and its individual richness of a sample. It ranged between 0 – 1 which

express the absolute distribution of relative abundance of species at specific site [39]. Range of this index for present study showed equitability in the apportionment of individuals among the species at all sampling stations. Higher values of evenness index indicate a low concentration of dominance of species diversity at a specific site[43].

Table 1: Geographic position of sampling stations in Dudhi River

Dudhi River			
S. No.	**Sampling Station**	**Longitude**	**Latitude**
1	Singwani	78° 43’ 32” E	22° 32’ 39” N
2	Khapasani	78° 43’ 43.44” E	22° 38’ 37.13” N
3	Jamgaon	78° 41’ 11.1” E	22° 39’ 29.6” N
4	Parav Forest	78° 41’ 11” E	22° 44’ 29.09” N
5	Murgidhana	78° 38’ 1.9” E	22° 45’ 42.6” N
6	Junehta	78° 37’ 9.45” E	22° 47’ 38.2” N
7	Panagar	78° 36’ 11.6” E	22° 50’ 5.29” N
8	Dudhi Narmada Confluence	78° 34’ 31.8” E	22° 57’ 21.3” N

Table 2: Diversity of macrozoobenthos at sampling stations

S. No.	Taxa	Sampling Stations at Dudhi River								Functional Feeding Group Categorisation
		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*	+	-	+	-	-	+	+	-	SC
2	Thiara *scabra* (Muller)	-	-	-	-	-	+	+	-	SC
3	Thiara (Melanoides) *tuberculata* (Muller)	+	-	-	-	+	-	+	-	SC
4	Tarebia *lineata* (Gray)	+	+	-	-	-	-	+	-	SC
Class	**Bivalvia**									
Order	**Trigoinoida**									
5	Parreysia (Radiatula) *occata* (Lea)	+	-	+	-	-	-	+	-	FC
6	Lamellidens *marginalis* (Lamarck)	-	-	-	-	-	-	+	-	FC
Phylum	**Arthropoda**									
Class	**Insecta**									
Order	**Odonata**									
7	Gomphus *sps.*	+	+	+	+	+	+	+	+	PR
8	Cordulegaster *sps.*	+	-	+	+	-	-	+	+	PR
9	Anax *sps.*	+	+	+	+	-	+	+	+	PR
10	Enallagma *sps.*	-	+	+	-	+	-	-	-	PR
11	Lestes *sps.*	-	-	-	-	+	-	-	+	PR
12	Archilestes *sps.*	-	-	-	-	+	-	-	-	PR
Order	**Hemiptera**									
13	Ranatra *sps.*	-	-	-	-	+	-	-	-	PR
14	Nepa *sps.*	-	+	-	-	-	-	-	-	PR
15	Siagra *sps.*	-	+	+	-	-	-	-	-	SC
16	Pelocoris *sps.*	-	+	-	-	+	-	-	-	PR
17	Notonecta *sps.*	+	-	-	-	-	+	-	-	PR
Order	**Ephemeroptera**									
18	Ephemerella *sps.*	-	+	+	+	-	+	+	+	GC
19	Caenis *sps.*	-	-	-	-	-	-	-	+	GC
Order	**Coleoptera**									
20	Dytiscus *sps.*	+	+	+	+	-	-	-	+	PR
21	Dineutus *sps.*	+	+	+	+	-	-	-	+	PR
22	Cybister *sps.*	-	-	-	-	+	-	-	-	SC
23	Berosus *sps.*	-	+	+	-	+	-	-	-	SH
Class	**Crustacea**									
Order	**Decapoda**									
24	Palaemonetes *sps.*	+	-	-	-	+	-	-	+	SH
Class	**Arachnida**									
Order	**Araneae**									
25	Dolomedes *sps.*	-	-	-	-	-	-	+	+	PR
26	Tetragnatha *sps.*	-	-	-	-	-	-	+	+	PR
	Total	**11**	**11**	**11**	**6**	**10**	**6**	**12**	**9**	

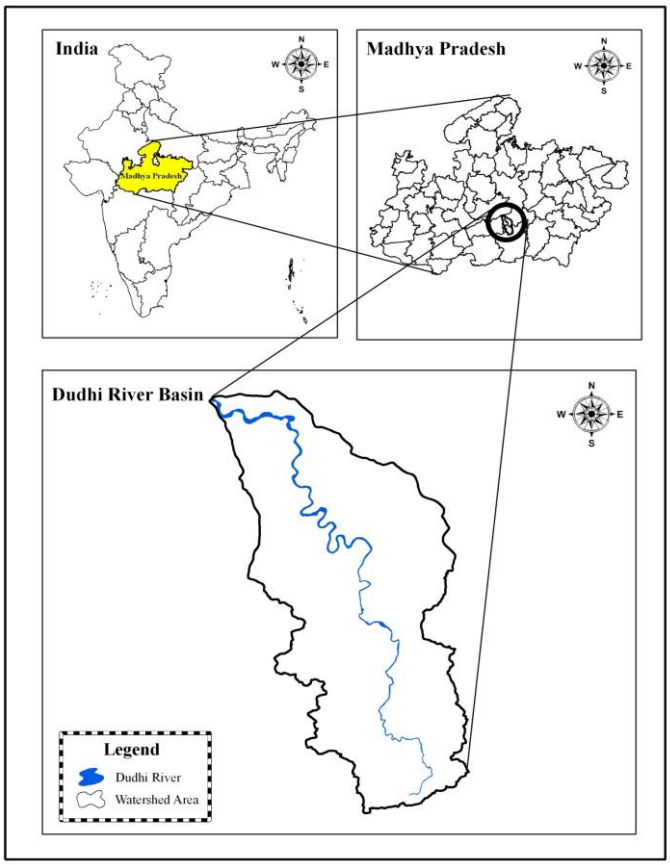

Fig. 1: Location map of the study are

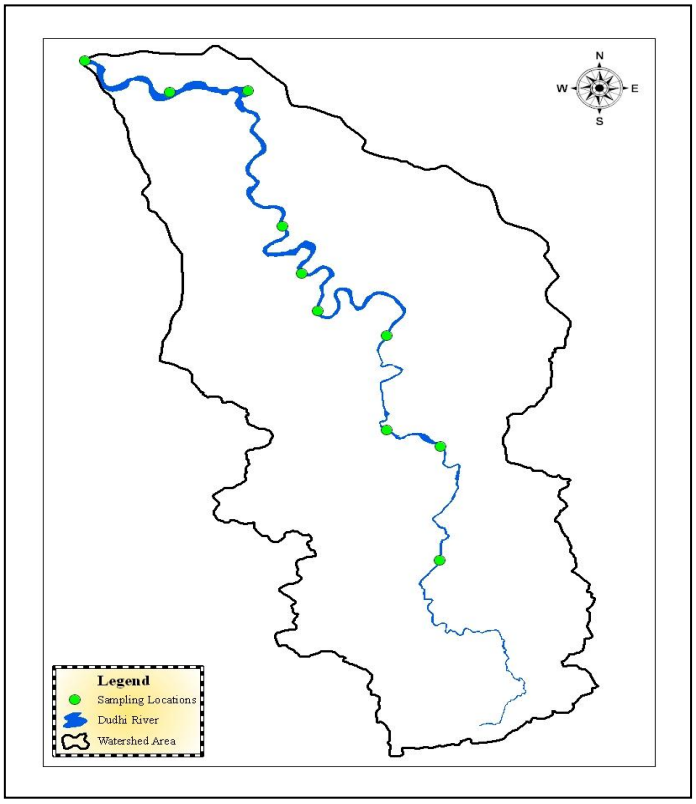

Fig. 2: Sampling stations of the study area

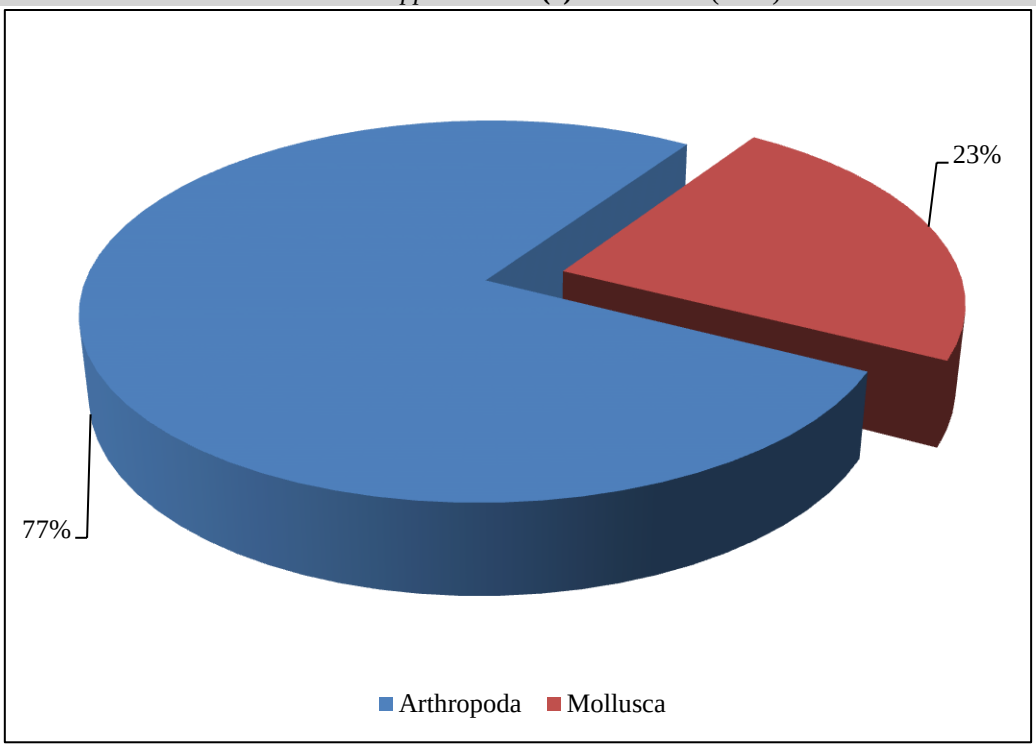

Fig. 3: Percent composition of major taxonomic groups

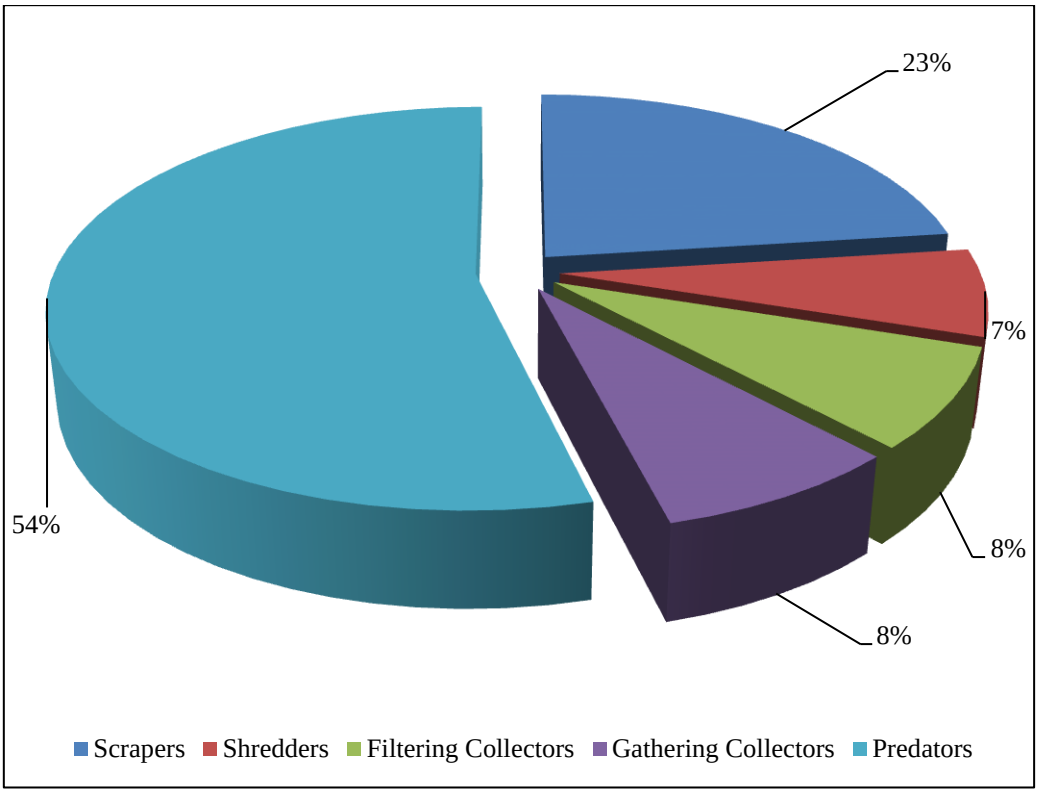

Fig. 4: Percent composition of Functional feeding groups

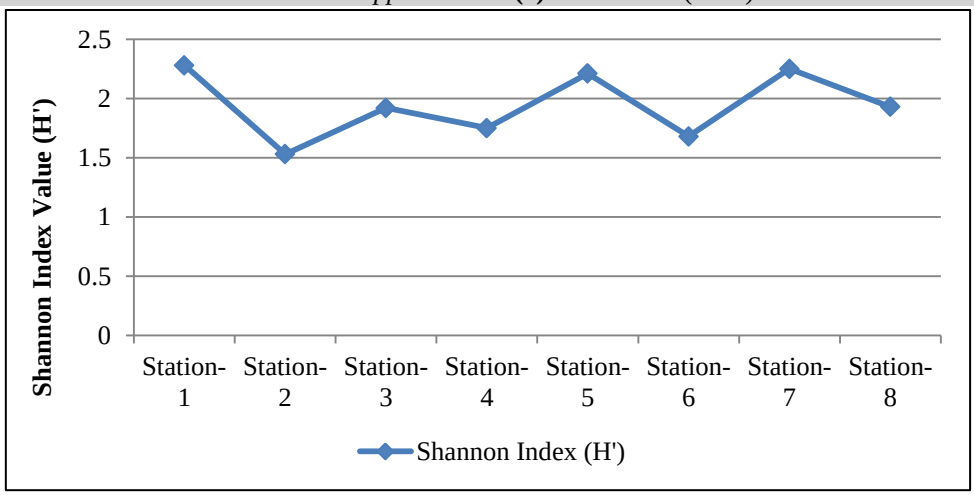

Fig. 5: Range of Shannon Diversity Index

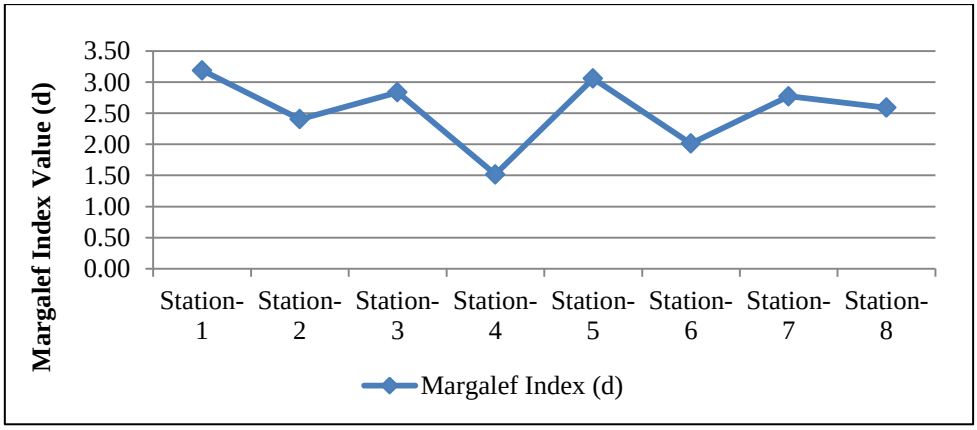

Fig. 6: Range of Margalef Diversity Index

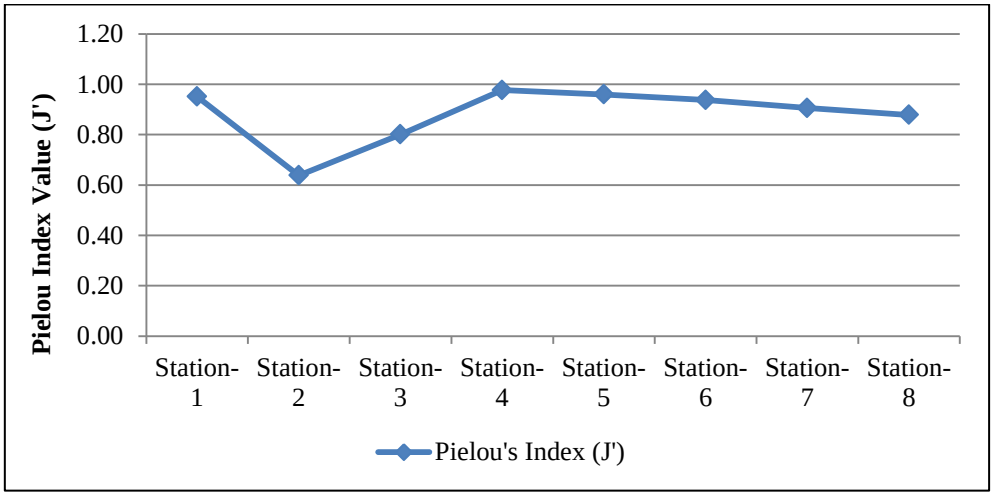

Fig. 7: Range of Pielou Evenness Index

CONCLUSION

According to the baseline information of the study it can be concluded that diversity of macrozoobenthos was good at some stations but introduction of human activities altered habitat structure at some places so minimum diversity was recorded. Regular monitoring or care should be taken otherwise human interventions can be altered the ecology of Dudhi River in near future.

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REFERENCES

1. Beauger, A., Lair, N., Reyes-Marchant, P and Peiry, J.-L. (2006). The distribution of macroinvertebrate assemblages in a reach of the river Allier (France), in relation to riverbed characteristics. *Hydrobiologia*. 571: 63-76. DOI: 10.1007/s10750-006-0217-x.
2. Hynes, H.B.N. (1970). The Ecology of Running Waters. Liverpool University Press, England, 555 pp.
3. Hellawell, J.M. (1986). Biological indicators of Freshwater pollution and Environmental Management. Elsevier, London, 518 pp.
4. Abel, P.D. (1989). Water Pollution Biology. Ellis Horwood, Chichester, UK, pp 232.
5. Dahanayakar, D.D.G.L and Wijeyaratne, M.J.S. (2006). Diversity of macrobenthic community in the Negombo estuary, Srilanka with special refrences to environmental condition Srilanka. *J.Aguat. Sci.* 11: 43-61.
6. Perkins, E.J. (1974). The biology of estuarine and coastal waters, Academic Press, London, 678 pp.
7. Sharma, R., Kumar A and Vyas V. (2013). Diversity of Macrozoobenthos in Morand River- A Tributary of Ganjal River in Narmada Basin. *International Journal of Advanced Fisheries and Aquatic Sciences.* 1(1): 57-65.
8. 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.
9. Tagliapietra, D and Sigovini, M. (2010). Benthic fauna: collection and identification of macrobenthic invertebrates. NEAR Curriculum in Natural Environmental Science. *Terre et Environnement.* 88: 253–261. ISBN: 2–940153–87–6.
10. 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 pp.
11. Tonapi, G.T. (1980). Freshwater Animal of Indian an Ecological Approach. Oxford and IBHPublishing Co., New Delhi, 341 pp.
12. McCafferty, W.P and Provonsha, A.V. (1998). The fishermen's and ecologist illustrated guide to insects and their relatives: Aquatic Entomology. Jones and Bartlett Publishers. 448 pp.
13. Rao, N.V.S. (1989). Handbook Freshwater Mollusca of India. Zoological Survey of India, Calcutta, 289 pp.
14. Dey, R.A. (2007). Handbook on India Fresh Water Molluscs. Zoological Survey of India, Calcutta, 399 pp.
15. Bouchard, Jr., R.W. (2004). Guide to Aquatic Invertebrates of the Upper Midwest. Identification manual for students, citizen monitors and aquatic resource professionals. Leonard C. Ferrington, Jr. and Mary L. Karius (editors). Regents of the University of Minnesota. United States. 207 pp.
16. Bashir, T., Kumar, A and Vyas, V. (2015). Assessment of various ecological parameters of Bhagner stream- A tributary of River Narmada in the central zone, India. *International Journal of Research in Natural and Applied Science.* 5(1):1-6.
17. Pandey, S., Kumar, A and Vyas, V. (2015). Study on the ecological status of Kaliyadeh stream- Atributary of River Narmada. *Science Insights: An International Journal*. 5(1): 1-8.

18. Chaurasia, A., Kumar, A and Vyas, V. (2015). Study on the ecological status of Chandni nalla- A tributary of River Narmada in the central zone, India. *International Journal of Research in Environmental Science and Technology*. 5(1):1-9.
19. Kumar, A and Vyas, V. (2014). Diversity of macrozoobenthos in the selected reach of River Narmada (Central Zone), India. *International Journal of Research in Biological Sciences*. 4(3): 60-68. ISSN 2249-9687.
20. Vyas, V., Bharose, S., Yousuf, S and Kumar, A. (2012). Distribution of Macrozoobenthos in River Narmada near water Intake point in India. *Journal of Natural Sciences Research.* 2(3): 18-24 ISSN 2224-3186 (paper), ISSN 2225-0921(online).
21. Sharma, R., Kumar, A and Vyas, V. (2016). Assemblage of macrozoobenthos in Ganjal River- A tributary of River Narmada in the central zone, India. *International Journal of Environmental Sciences.* 6(6): 1096-1112. ISSN 0976-4402.
22. Mishra, A.S and Nautiyal, P. (2012). Longitudinal distribution macroinvertebrate assemblages in a central highlands river, the Tons (Central India). *Proceeding of the National Academy of Sciences, India* (Author's Personal Copy). DOI: 10.1007/s40011-012-0083-4.
23. Miserendino, M.L. (2001). Macroinvertebrate assemblages in Andean Patagonian rivers and streams: environmental relationships. *Hydrobiologia*. 444: 147-158.
24. Negi, M and Singh, H.R. (1990). Substratum as determining factor for bottom fauna in the River Alaknanda. *Proc. Nat. Acad. Sci. India. Sect. B,* 56: 417-423.
25. Sharma, K.K., Bangotra, K and Saini, M. (2013). Diversity and distribution of mollusca in relation to the physico-chemical profile of Gho-Manhasan stream, Jammu (J&K). *International Journal of Biodiversity and Conservation*. 5(4): 240-249. ISSN: 2141-243X. DOI: 10.5897/IJBC12.127.
26. Mcivor, A.L. (2004). Freshwater mussels as biofilters. Dissertation submitted to the University of Cambridge for the degree of Doctor of Philosophy, Pembroke College.
27. Merritt, R.W and Cummins, K.W. (1996). Trophic relations of macroinvertebrates. In Hauer FR, Lamberti GA, editors. Methods in stream ecology. Academic press: San Diego. 453-474 pp.
28. Schmera, D and Erős, T. (2004). Effect of riverbed morphology, stream order and season on the structural and functional attributes of caddisfly assemblages (Insecta: Trichoptera). *Annales de Limnologie-International Journal of Limnology*. 40: 193–200. doi: http//dx.doi.org/10.1051/limn/2004017.
29. Príncipe, R.E., Gualdoni, C.M., Oberto, A.M., Raffaini, G.B and Corigliano, M.C. (2010). Spatial-temporal patterns of functional feeding groups in mountain streams of Córdoba, Argentina. *Ecología Austral*. 20: 257–268.
30. Stone, M.K and Wallace, J.B. (1998). Long-term recovery of a mountain stream from clear cut logging: the effects of forest succession on benthic invertebrate community structure. *Freshwater Biology*. 39: 151–169.
31. Grubaugh, J.W., Wallace, J.B and Houston, E.S. (1996). Longitudinal changes of macroinvertebrate communities along an Appalachian stream continuum. *Canadian Journal of Fisheries and Aquatic Sciences*. 53: 896–909.
32. Miserendino, M.L and Pizzolón, L.A. (2003). Distribution of macroinvertebrate assemblages in the Azul-Quemquemtreu river basin, Patagonia, Argentina. *New Zealand Journal of Marine and Freshwater Research*. 37: 525-539.
33. Hyslop, E.J and Hunte-Brown, M. (2012). Longitudinal variation in the composition of the benthic macroinvertebrate fauna of a typical North coast Jamaican river.

Revista de Biologia Tropical. 60(1): 291–303.

34. Burton, T.M and Sivaramakrishnan, K.G. (1993). Comparison of the insect community in the streams of the Silent valley National Park in the Southern India, *Tropical Ecology*. 34(1): 1–16.
35. Jiang, X., Xiong, J., Xie, Z and Chen, Y. (2011). Longitudinal patterns of macroinvertebrate functional feeding groups in a Chinese river system: A test for river continuum concept (RCC). *Quaternary International*. 244: 289–295. doi:10.1016/j.quaint.2010.08.015.
36. Mishra, A.S and Nautiyal, P. (2011). Factors governing longitudinal variation in benthic macroinvertebrate fauna of a small Vindhyan river Central Highlands ecoregion (Central India). *Tropical Ecology*. 52(1): 103-112. ISSN: 0564-3295.
37. Mishra, A.S and Nautiyal, P. (2013). Functional composition of benthic macroinvertebrate fauna in the plateau rivers, Bundelkhand, Central India. *Journal of Threatened Taxa*. 5(13): 4752-4758. doi: http://dx.doi.org/10.11609/JoTT.o3226.4752-8.
38. Türkmen, G and Kazanci, N. (2010). Applications of Various Biodiversity Indices to Benthic Macroinvertebrate Assemblages in Streams of a National Park in Turkey. *Review of Hydrobiology*. 3(2): 111-125.
39. Golwarkar, R.D., Banoo, S., Mustaq, T., Diwan, S., Kumar, A and Vyas, V. (2016). Diversity of benthic macro-invertebrates in four tributaries of River Narmada in the Central zone, India. *Int. J. of Life Sciences*. 4(1): 107-115.
40. Khan, A.N., Kamal, D., Mahmud, M.M., Rahman, M.A and Hossain, M.A. (2007). Diversity, distribution and abundance of benthos in Mouri river, Khulna, Bangladesh. *Int. J. Sustain. Crop. Prod*. 2(5): 19-23.
41. Wilhm JL and Dorris TC (1966) Species diversity of benthic macro-invertebrates in a stream receiving domestic and oil refinery effluents. *Am Midl. Nat*., 76: 427-449.
42. Bhandarkar, SV and Bhandarkar, WR (2013) A study on species diversity of benthic macro invertebrates in freshwater lotic ecosystems in Gadchiroli district Maharashtra. *Int. J. of Life Sciences*. 1(1): 22-31.
43. Mukherji M and Nandi NC (2004) Studies on macrozoobenthos of Rabindra sarovar and Subhas sarovar in Kolkata in relation to water and sediment characteristics. Res. Zool. Surv. India. Occ. Paper No. 225: 1-119.