International Scholars Journals

African Journal of Environmental and Waste Management ISSN 2375-1266 Vol. 11 (9), pp. 001-005, September, 2024. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Study of Zooplankton Composition in the Tungabhadra River Near Harihar, Karnataka and Assessment of Water Quality through Saprobiological Indicators

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Accepted 30 October, 2020

The plankton constitutes the basic food source of any aquatic ecosystems, which supports fish and other aquatic animals. Zooplanktons are microscopic animals that eat other plankton. The zooplankton community analysis and saprobiological characteristics of the Tungabhadra River using diversity index during December 2004 to November 2005. The present investigation can enrich knowledge on bio-indicators in understanding the point and non point sources of pollution and also its stress on the aquatic life. The study indicates lower diversity values in the study area. Nearly sixty four different zooplankton species were recorded in the lotic ecosystem. Zooplankton population composed of four species of protozoans, sixteen species of rotifers, fourteen species of crustaceans and three groups meroplankton organisms mainly nymph/larval forms. It is found that among zooplankton community rotifers (43.24%) were dominated group followed by crustaceans (37.84%) protozoan (10.81%) and meroplankton (8.11%). By saprobiological analysis of zooplankton, it has been concluded that the greatest number of indicator organisms belongs to rotifers and crustaceans community. In the present study variations were noticed in the distribution of zooplankton at different selected stations. The zooplankton population dynamics is found to have an influence by sand mining and other human activities.

Key words: Zooplankton, diversity index, richness, dominance, Tungabhadra river.

INTRODUCTION

Plankton is part of aquatic life, which is composed of tiny organisms living and drifting in the direction of water current. It acts as the main source of food for most fauna, both in lotic and lentic water ecosystems. Zooplanktons are microscopic animals that eat other plankton. Zooplanktons occupy a central position between the autotrophs and other heterotrophs and form an important link in food web of the freshwater ecosystem. Zooplanktons constitute the food source of organisms at higher trophic levels. The Zooplankton and fish production depend to large degree on the phytoplankton (Boney, 1975). Zooplankton is a good indicator of changes in water quality because it is strongly affected by environmental conditions and responds quickly to changes in environmental quality. Protozoans, rotifers, cladocerns, copepods, ostrocoda and meroplankton are the main groups of zooplankton. Among the zooplankton Rotifers are apparently the most sensitive indicators of the water quality (Sheeba et al., 2004). Hence qualitative and quantitative assessments of zooplanktons are of great importance. The aim of this paper is determine the zooplankton community assessment in the Tungabhadra River. The investigation may help to asses the environmental condition of region and also health of river due to industrial activities including sand mining and other domestic activities in the region.

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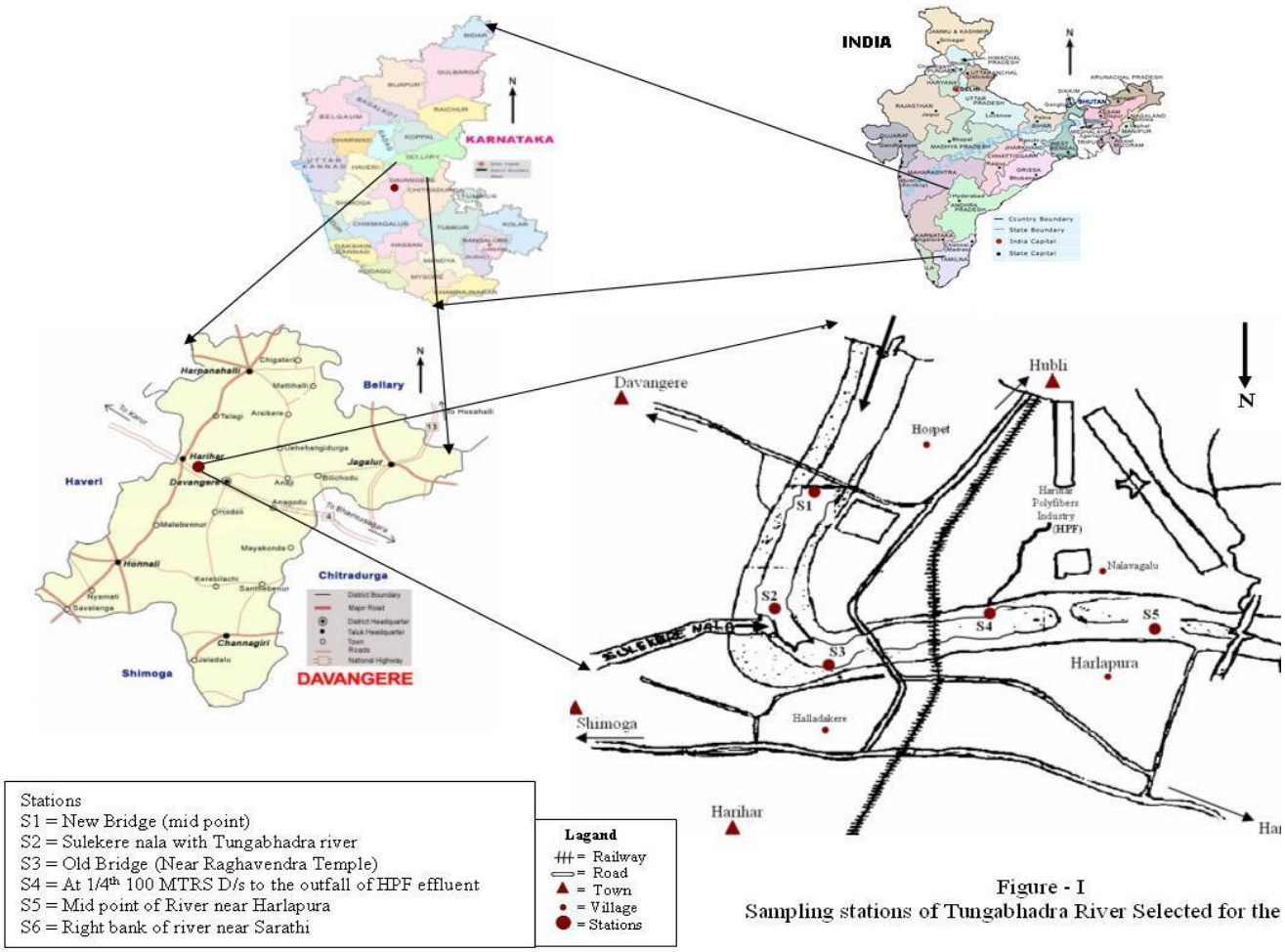

Figure 1. Sampling stations of Tungabhadra river selected.

MATERIALS AND METHODS

Description of the study area

Krishna. It has a drainage area of 71, 417 sq.km out of which 57,671 sq.km lies in the state. It covers a distance of 293 km. Harihar in Davangere district is an ancient town situated on the right bank of Tungabhadra river. The Tungabhadra river bifurcates Davangere and Haveri district near Harihar. The district Davangere is located in the central part of Karnataka state (India) between latitude 14°17' to 14°35' N and longitude 75°50' - 76°05' E covering an area of 6500 sq. km at an average altitude of 540 m above Mean Sea Level (MSL). Sampling stations of Tungabhadra river selected for the study are given in Figure 1.

Sampling and counting

Zooplankton samples were collected monthly at six sampling stations from December, 2004 - November, 2005. Samples were collected between 8 and 12 am with a 76 µm size, approximate 45% open area, silk No 20 plankton net and samples were fixed with 4% formalin solution for further studies (APHA, 1995). For zooplankton counting the Sedge wick-rafter (S-R) cell was used, which is 50 mm long, 20 mm wide and 1 mm deep. Number of zooplankton in the S-R cell was derived from the following formulae (Alam and Kabir, 2003).

$$\text{No. mL}^{-1} = \frac{\text{Nc} \times 1000\ \text{mm}^3}{\text{L} \times \text{C} \times \text{W} \times \text{S}}$$

Nc = Number of organisms counted
L = Length of each strip (S-R cell length) in mm
D = Depth of a strip (whiipple grid image width) in mm
S = Number of strips counted

Number of cells per mm was multiplied by a correction factor to adjust the number of organisms per liter. The zooplankton groups were studied using the indices of dominance, evenness, richness and diversity (Shannon and Weaver, 1963; Pielou, 1966).

RESULTS AND DISCUSSION

Thirty seven zooplankton species were identified from the Tungabhadra River (Table 1) and they were composed of protozoa (4), rotifers (16), cladocera (7), copopoda (4), ostrocoda (3) and meroplankton (3). The zooplankton fauna of Tungabhadra River were dominated by the Roti-

Table 1. Zooplankton in Tungabhadra river during the period 2004 - 2005.

Rotifera	Protozoa	Copepoda
Ascomoprpha sp.	*Arcell sp.*	*Cyclops sp.*
Brachiionus falcatus	*Diffugia sp.*	*Eucyclops sp.*
Brachiionus calciflrous	*Euglypha sp.*	*Eudiaptomus gracilis sp*
Brachiionus angularis	*Paramecium sp.*	*Megacyclops sp.*
Dicranophorus sp.		
Embata sp.	Cladocera	Ostracoda
Keratella vulga	*Acroperus sp.*	*Crpris sp.*
Kellicotia sp.	*Bosminapsis deitersi*	*Cyprinus*
Lacane sp.	*Ceriodaphnia cornuta*	*Potamocypris*
Lepadella	*Chydrous sphaericus*	
Monostyla	*Diaphanosoma excisum*	Meroplankton
Notholca sp.	*Colopoda sp.*	*Nymp of mayfly*
Philodina sp	*Stenocypris sp.*	*Nymp of stonefly*
Rotararia		*Midge larva*
Sinantherina sp.		
Trichocerea		

fers and followed by Crustaceans, protozoan and meroplankton.

Monthly variation in the species diversity index (H), richness index (s), dominance index (d) and evenness index (e) have been calculated and presented in Table 3 for all the six stations. The diversity index in Tungabhadra River ranged from 0.69 to 1.19 for the different selected stations. When the indices were seasonally examined it could be seen that evenness index of zooplankton ranges from 0.41 to 0.82. It is maximum in August at station S1 and minimum in April at station S4. Where as richness index recorded maximum during the May and minimum during April at all the selected stations except station S3. The dominance index for different seasons observed between 0.35 (August) and 0.57 (April) at station S1 and station S4 respectively. The lowest diversity was recorded in the study area, on the other hand diversity and evenness followed the same trend at all the stations. High diversity index was associated with high evenness index, reflecting the multi dominance pattern in cluster (Balloch, 1976). Richness index showed a different trend, which decreased with increasing diversity and evenness index.

In general thirty seven major zooplankton groups were identified. The dominance and percentage of groups are shown in (Table 2 and Figure 2). Rotifers are dominated zooplankton genera in abundance throughout the year, forming 43.24% of total zooplankton composition. Other dominant zooplankton groups, in order of profusion were crustaceans (37.84%), protozoans (10.81%) and meroplankton (8.11%).

Among the zooplankton, rotifers and crustaceans were recorded more dominating in selected stations during winter and summer. This pattern may be attributed to the abundance of phytoplankton. The present investigation is in agreement with the findings of Goswami and Selvakumar 1977.

Table 2. Percentage of Zooplankton in Tungabhadra river during the period of 2004 - 2005.

Sl. No	Species	Genera	%
1.	Rotifers	16	43.24
2.	Protozoa	4	10.81
3.	Cladocera	7	18.92
4.	Ostrocera	4	10.81
5.	Copepoda	3	8.11
6.	Insecta	3	8.11

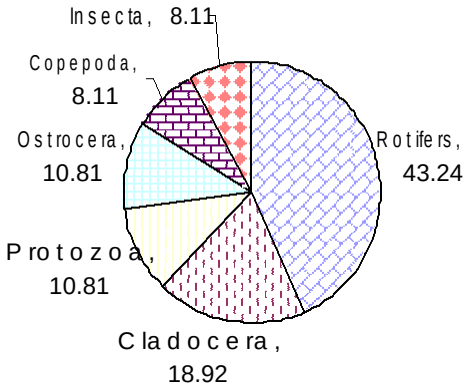

Figure 2. Percentage of Zooplankton in Tungabhadra river during the period of 2004 - 2005.

Diversity indices are good indicators of pollution in aquatic ecosystem (Mason, 1998). Diversity index greater

Table 3. Different Indices of Zooplankton at different stations of Tungabhadra River During the Period of 2004 - 2005

	Station 1				Station 2				Station 3				Station 4				Station 5				Station 6			
Months	**H**	**s**	**d**	**e**	**H**	**s**	**d**	**e**	**H**	**s**	**d**	**e**	**H**	**s**	**d**	**e**	**H**	**s**	**d**	**e**	**H**	**s**	**d**	**e**
Dec '04	1.09	0.22	0.42	0.71	1.07	0.22	0.43	0.72	0.96	0.22	0.50	0.63	1.12	0.22	0.42	0.74	1.00	0.22	0.45	0.65	0.98	0.22	0.48	0.65
Jan '05	1.04	0.23	0.46	0.71	1.07	0.24	0.42	0.75	1.06	0.24	0.42	0.75	1.05	0.25	0.42	0.42	1.00	0.24	0.47	0.69	1.08	0.24	0.42	0.75
Feb '05	1.05	0.23	0.43	0.72	0.96	0.21	0.49	0.61	0.89	0.21	0.53	0.57	0.95	0.21	0.49	0.62	0.98	0.22	0.47	0.64	0.92	0.21	0.53	0.57
Mar '05	1.04	0.23	0.41	0.71	0.95	0.23	0.48	0.64	0.91	0.22	0.50	0.61	0.93	0.22	0.48	0.62	1.01	0.20	0.44	0.63	0.93	0.22	0.49	0.61
Apr '05	0.73	0.19	0.56	0.43	0.78	0.19	0.53	0.46	0.69	0.19	0.57	0.41	0.80	0.19	0.53	0.48	0.72	0.19	0.55	0.43	0.94	0.20	0.49	0.58
May '05	1.02	0.26	0.42	0.76	0.97	0.24	0.49	0.67	0.92	0.23	0.52	0.63	0.99	0.23	0.47	0.68	0.99	0.25	0.46	0.71	0.96	0.23	0.50	0.66
Jun '05	1.05	0.22	0.43	0.70	0.99	0.22	0.46	0.65	0.97	0.21	0.46	0.63	1.05	0.25	0.44	0.68	0.96	0.21	0.46	0.60	0.96	0.21	0.47	0.62
July '05	0.83	0.20	0.53	0.52	0.84	0.20	0.52	0.53	0.81	0.20	0.54	0.50	0.88	0.20	0.52	0.55	0.84	0.20	0.51	0.52	0.81	0.20	0.53	0.49
Aug '05	1.19	0.23	0.35	0.82	1.11	0.22	0.41	0.72	1.12	0.22	0.40	0.74	1.08	0.21	0.43	0.70	1.10	0.22	0.41	0.72	1.14	0.22	0.40	0.74
Sep '05	1.11	0.24	0.39	0.78	0.98	0.21	0.49	0.63	1.09	0.22	0.44	0.71	0.92	0.22	0.50	0.60	0.96	0.21	0.50	0.62	1.08	0.22	0.43	0.71
Oct '05	1.09	0.23	0.41	0.73	1.08	0.23	0.43	0.72	1.07	0.24	0.42	0.74	1.04	0.24	0.43	0.75	1.08	0.23	0.42	0.74	1.07	0.24	0.42	0.74
Nov '05	1.07	0.24	0.41	0.74	1.05	0.23	0.43	0.72	1.04	0.25	0.40	0.75	1.09	0.24	0.41	0.76	0.95	0.24	0.47	0.66	1.04	0.25	0.40	0.75
	H - species diversity index												s – richness index											
	d – dominance index												e – evenness index											

than 3 indicates clean water, values in the range of 1 - 3 are characteristics of moderately polluted conditions and values less than 1 characterizing heavily polluted condition (Mason, 1998). In the present study the diversity of zooplankton observed are ranging from 0.69 to 1.19. Which are less than 3 throughout the study period and study area therefore water quality in this stretches is poor and is polluted in the river from moderately polluted to heavily polluted conditions (Table 3). All the species are found to that increase in their population at some time during the year which is present in the water as small residual populations.

Margalef (1968) recorded that higher diversity is a clear indication of longer food chains. Evenness index of zooplankton species were observed higher during the premonsoon and lower in post monsoon period in the study period. The results were showing competition under optimum condition because no adverse environmental factors were noticed in this bionetwork.

Odum E. P (1971) observed that when stress occurs in a community dominated by a few species, a large number of dominated species is eliminated and evenness increases. In the present study in the Tungabhadra River, zooplanktons species were showing maximum diversity and species richness during the pre monsoon and the post monsoon when conditions were relatively stable. Results obtained also indicates low diversity and low species richness during the monsoon period may be due to environmental stress as per Hawkes (1979) opinion that low diversity is reflection of environmental stresses.

According to Whiltaker (1963) the value of dominance index is always higher where the community is dominated by a fewer number of species and when the dominance is shared by a large number of species. This is agreed with the present study. Higher value of dominance index in the Tungabhadra River was registered during the monsoon periods. The present investigation also indicates that, whenever dominance index of zooplankton species was higher the evenness index was lower and vice versa (Walting et al., 1979).

In general, in all the stations, richness and evenness of zooplankton was comparatively low in pre-monsoon and post monsoon periods. During this periods the phytoplankton abundance also low due to rain. Due to rain water causes strong currents which wash away the phytoplankton, Ramanujan (1994) the depletion of phytoplankton naturally affects the population of zooplankton. Whenever the dominance index was higher, the evenness index was lower and vice versa the present study confirms the earlier findings (Watling et al., 1979).

The zooplankton population dynamics might have been influenced by sand mining and other human activities in some selected stations of Tungabhadra River. Zooplankton depletion will adversely affect normal food web pattern of the

river water and intern this leads destruction of environmental conditions of the river. So the conservation and maintenance of the river is very essential for future generations.

ACKNOWLEDGEMNTS

Authors are grateful to Management of Bapuji Educational Association (R) and Principal, Bapuji Institute of Engineering and Technology, Davangere, for providing necessary facilities and encouragement in this study. Authors are also thankful to National River Conservation Directorate, New Delhi for their financial assistance under National River Conservation Programme.

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