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Assessment of water quality of Tapi river with reference to rotifera community

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Abstract
The present work was aimed to study on water quality of Tapi river with reference to rotifera community. Various water quality parameters like, water temperature, pH, total solids, total dissolved solids, total suspended solids, dissolved oxygen, total hardness, calcium, magnesium, chloride, phosphate, nitrate, biochemical oxygen demand and chemical oxygen demand were monitored during one year of study period (March-2015 to February-2016). Quantitative and qualitative analysis of rotifera community were also carried out. Correlation analysis was also performed to understand the relationship among the water quality parameters and rotifera abundance. The present study revealed that among all selected water quality parameters, phosphate and BOD values were found higher at downstream stretch of Tapi river. During present study, total 17 genera of rotifers were recorded and abundance of rotifers were found varied according to various abiotic and biotic factors of Tapi river ecosystem. Population of rotifers were recorded higher in months of monsoon and post-monsoon at downstream stretch of Tapi river indicating higher load of organic matter.

Keywords: physico-chemical properties, rotifera abundance, phosphate, BOD, Tapi river

Introduction
Water is critical component for the existence of all living organisms, but this vital component of life is increasingly being threatened by various anthropogenic activities like domestic use, agriculture practices, power generation and industrial production. Human population expands and rapid industrialization, demand more water of high quality [1] causing deterioration of water quality that induces directs impact on aquatic ecosystem [2]. Among all the water resources, rivers are the most valuable freshwater resources on earth. The river water mainly utilized for drinking purpose, agriculture production, transportation, electricity generation, recreational purposes and utilized as fishery resources; besides these, rivers also play an important role as carrying off municipal and industrial wastewater and run-off from farm land [3, 4].

Tapi River is the second largest west flowing and sixth largest riverine system in the Indian peninsula. Tapi River originates near Multai reserve forest in Betul district of Madhya Pradesh. The total length of river from origin to out fall into Arabian Sea is 724km [5]. The flow of Tapi river covers Maharashtra, Madhya pradesh and Gujarat state and it empties into the Arabian sea in gulf of Khambhat after flowing through Surat city, Gujarat. Tapi river is a sole source of drinking water for people of Surat city. The freshwater zone of Tapi river supports highly diversified biological communities. Among all biological communities of aquatic ecosystems, Rotifers are highly diversified assemblage of minute aquatic faunal zooplankton community. Composition, abundance and distribution of rotifers reflect the current status of aquatic ecosystem. As the occurrence and density of rotifers directly affected by environmental condition as well as it responds quickly against variation in water quality, they are widely used as bioindicator [6-8] in ecological monitoring of aquatic ecosystems. Thus, present study was planned to assess water quality of Tapi river with reference to Rotifera community.

Materials and Methods
For the purpose of present investigation, three sampling sites along freshwater zone of Tapi river were selected. Site-1 (21°16'51.1572" N 73°5'0.4776" E) was located near to Galteshwar temple, Timba village of Kamrej Taluka, having least disturbance by human activities. Site-2 (21°13'33.3"N 72°51'58.0"E) was located near gas based thermal power plant, Utran, receiving

domestic waste of urban area and Site-3 (21°13'42.4"N 72°50'51.2"E) was near to Ashwanikumar crematorium, receiving waste from cremation ground and also influenced by various anthropogenic activities.

Water samples were collected on monthly basis during March-2015 to February-2016 from three different selected sites. The water quality parameters such as, water temperature, pH, total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), dissolved oxygen (DO), total hardness (TH), calcium, magnesium, chloride, phosphate, nitrate, biochemical oxygen demand (BOD) and chemical oxygen demand (COD) were analysed by standard methods [9].

For Rotifera community, plankton samples were collected on monthly basis by filtering 50L of water through plankton net having 20µ mesh size. The samples were concentrated up to 100ml and preserved with 5% Formalin. The quantitative estimation of rotifers were carried out by Lackey drop method [10] using following formula:- Organisms (No./L)= $C \times A_t \times 1000/A_s \times S \times V$; where, C= number of organisms counted; A_t= are of cover slip, mm^2 ; A_s = area of one strip, mm^2; S= number of strip counted and V=volume of sample under the cover slip (ml). Rotifers were identified by using standard literatures [11-13]. Pearson Correlation analysis between water quality parameters and rotifers abundance was carried out by using software SPSS (ver. 16.0).

Results and Discussion

In the current investigation, all the recorded annual average values of selected water quality parameters of tapi river from selected three sites are shown in Table-1. Correlation analysis between water quality parameters and rotifer abundance is depicted in Table-3.

Table 1: Annual average values of water quality parameters of tapi river from three selected sites:

Parameter	Site-1	Site-2	Site-3
Water Temperature (°C)	22-32 (26.83±0.82)	24-33 (27.67±0.69)	23-33 (27.42±0.82)
pH	7.2-8.43 (7.59±0.12)	7.32-8.64 (7.81±0.11)	7.16-8.78 (7.84±0.12)
Total Solids (mg/L)	425-560 (476.92±10.77)	445-600 (512.08±12.43)	400-772 (526.25±26.86)
Total Dissolved Solids (mg/L)	318-412 (361.17±8.06)	278-389 (328.50±10.02)	275-436 (363.25±14.54)
Total Suspended Solids (mg/L)	48-176 (115.75±10.57)	124-322 183.58±14.70	40-370 163.00±27.26
Dissolved Oxygen (mg/L)	6.08-12.36 (8.34±0.52)	5.87-8.71 (7.29±0.24)	5.67-8.31 (6.91±0.23)
Total Hardness (TH) as $CaCO_3$ (mg/L)	132-200 (163.67±5.90)	148-194 (172.00±4.17)	108-192 (163.33±7.30)
Ca as Ca (mg/L)	20.8-40 (30.40±1.74)	19.2-38.4 (31.27±1.85)	16-44.8 (32.60±2.27)
Mg as Mg (mg/L)	13.44-28.8 (21.04±1.51)	12.48-30.72 (22.52±1.63)	10.56-25.92 (19.64±1.14)
Chloride (mg/L)	16.00-39.98 (29.45-2.39)	15.99-45.98 (33.53-2.65)	13.99-46 (35.49-2.87)
Phosphate (mg/L)	0.012-0.685 (0.17±0.06)	0.03-1.68 (0.37±0.12)	0.03-1.4 (0.33±0.10)
Nitrate (mg/L)	0.549-2.764 (1.92±0.19)	1.67-9.88 (4.34±0.69)	2.431-7.17 (4.69±0.61)
Biochemical Oxygen Demand (mg/L)	2.23-48 (13.12±3.98)	9-36 (19.96±2.83)	7-42 (20.58±3.20)
Chemical Oxygen Demand (mg/L)	24.24-247.43 (102.64±19.87)	50-171.86 (111.89±12.07)	46.15-188.22 111.82±13.26

Table-2 Monthly variation in rotifer abundance (No./L) from three selected sites of tapi river:

Months	Site-1	Site-2	Site-3
Mar-15	23	16	12
Apr-15	22	12	14
May-15	35	20	24
Jun-15	21	24	12
Jul-15	41	22	30
Aug-15	63	20	30
Sep-15	54	50	108
Oct-15	44	63	106
Nov-15	31	47	60
Dec-15	24	36	47
Jan-16	38	50	44
Feb-16	42	51	36

Table 3: Correlation analysis between water quality parameters and rotifer abundance:

	Temp.	pH	TS	TDS	TSS	DO	TH	Ca	Mg	Cl^-	PO_4^-	NO_3^-	BOD	COD	Rotiabun
Temp	1														
pH	.602**	1													
TS	.087	.289	1												
TDS	-.161	-.081	.188	1											
TSS	.175	.315	.817**	-.414*	1										
DO	.061	-.003	-.047	.297	-.218	1									
TH	-.312	-.102	.156	.549**	-.178	.435**	1								
Ca	-.155	.153	.330*	.413*	.063	-.114	.380*	1							
Mg	-.181	-.222	-.111	.205	-.224	.517**	.672**	-.429**	1						
Cl	.027	.194	.080	-.076	.119	-.570**	-.253	.163	-.378*	1					
PO_4	.238	.079	-.223	-.267	-.050	.050	-.067	-.528**	.357*	.241	1				
NO_3	.334*	.484**	.286	.090	.212	-.176	.065	.339*	-.208	.466**	.207	1			
BOD	-.218	.093	.209	.105	.132	-.482**	.080	.582**	-.388*	.437**	-.377*	.238	1		
COD	-.136	-.129	.109	.298	-.074	.183	.216	.165	.079	-.057	-.140	-.008	.444**	1	
Rotiabun.	.126	.449**	.506**	.024	.455**	-.074	.008	.442**	-.346*	.340*	-.020	.326	.307	-.048	1

**. Correlation is significant at the 0.01 level (2-tailed), *. Correlation is significant at the 0.05 level (2-tailed).

Water temperature plays a key role in growth and development of aquatic organisms as it directly affecting the metabolic reactions of aquatic organisms. Water temperature during present investigation was varying in the range between 22 °C to 33 °C; this fluctuation in water temperature was mainly due to the seasonal variation in atmospheric temperature. The pH of an aquatic ecosystem is important because it is closely linked to biological productivity as it affecting the population, composition and distribution of aquatic organisms in aquatic ecosystem. pH of water is attributed to climatic condition, photosynthetic activities by primary producers and various anthropogenic activities like washing of cloths, sewage disposal and agricultural and industrial activities [14]. pH was found alkaline throughout the study period and it was fluctuated between 7.16 to 8.78. Clays and silts from soil erosion, re-suspended bottom sediment; organic detritus from domestic sewage disposal and industrial waste are the major sources contribute to increasing the total solids in waterbodies. During present study, TS, TDS and TSS of tapi river were ranged from 400 mg/L to 772 mg/L, 275 mg/L to 436 mg/L and 40 mg/L to 370 mg/L respectively. DO of water is most important factor that directly influencing the life of waterbodies. Concentration of dissolved oxygen of tapi river during present study was ranged from 5.67 mg/L to 12.36 mg/L. Total Hardness of tapi river water samples were varied between 108 mg/L to 200 mg/L. Calcium influences the growth and population dynamics of freshwater flora and fauna both directly and indirectly [15]. During current study, Calcium concentration was varied from 16 mg/L to 44.8 mg/L. Magnesium is also an essential nutrient for primary producers and aquatic plants as it is a vital component of chlorophyll. Magnesium was fluctuated between 10.56 mg/L to 30.72 mg/L. Chloride is a naturally found lower in all natural water resources. In case of current water quality monitoring of tapi river, it also found lower and varied from 13.99 mg/L to 46 mg/L. In aquatic systems, Nitrogen and Phosphorus are the two nutrients that most commonly limiting the growth of primary producers. Higher concentration of phosphorus and nitrogen in water triggers the uncontrolled growth of cyanobacteria. In present study, Phosphate and nitrate concentration in tapi river water sample were ranged from 0.012 mg/L to1.68 mg/L and 0.549 mg/L to 9.88 mg/L respectively. In current study, higher phosphate concentration might be due to agricultural runoff and detergent used for household activities. BOD and COD are two common measures reflect the degree of organic matter pollution of a water bodies. During present investigation, BOD values were found comparatively higher at downstream stretch than upstream stretch and COD values were recorded much more higher in monsoon months. BOD varied from 2.23 mg/L to 48 mg/L. COD values of tapi river water samples ranged from 24.24 mg/L to 247.43 mg/L. Higher organic matter in downstream stretch of Tapi river might upset the production balance of Tapi river aquatic ecosystem. Correlation analysis depicted that each water quality parameter influences other parameters of water as well as indicating direct relationship with rotifera community. Correlation analysis showed that rotifer abundance had significant positive correlation with pH, TS, TSS, calcium and chloride but negatively correlated with magnesium, DO, phosphate and COD (Table-3).

During present study, the abundance of rotifers were ranged from 12 No./L to 108 No./L (Table-2). The abundance of rotifers are more or less governed by the interactions of numbers of physical, chemical and biological processes [16]. Various abiotic factors like physico-chemical properties of water and biotic factors of aquatic ecosystems such as, primary productivity, competition between species for dominance [17] and availability of food [18] directly affecting the occurrence, abundance and diversity of rotifera community. Total 17 genera of rotifera viz. *Brachionus spp., Plationus sp., Keratella spp., Platyias sp. Notholca spp., Euchlanis sp., Dipleuchlanis sp. Lepadella spp., Lecane spp., Cephalodella spp., Trichocerca spp., Asplanchna spp., Polyarthra sp., Testudinella sp., Filinia sp., Rotaria sp.* and *Philodina sp.* were recorded during present study from three selected sites of Tapi river. According to present study, abundance and diversity of rotifers attributed to the location of sites and varied according to water quality parameters which are altered due to interference of human activities such as sewage disposal and agricultural runoff. It was found that during months of summer and early months of monsoon, the abundance of rotifers found lower with compare to other seasons. The abundance of *Brachionus sp.,* found higher due to the presence of high levels of organic matter in the River. [19] In addition to *Brachionus sp.,* presence of other rotifers such as, *Keratella sp., Monostyla sp., Lepadella sp., Asplanchna sp., Filinia sp.* and *Rotatoria sp.* also indicating eutrophication of waterbodies [20-22].

In this study, among all selected water quality parameters, phosphate and BOD values were found higher at downstream stretch of Tapi river indicating that tapi river quality deteriorated from upstream to downstream due to various

human activities. It was also observed that rotifera community varied according to environmental factors and physico-chemical properties of Tapi river. Higher population of rotifera at downstream stretch in months of late monsoon and post monsoon indicating the higher load of organic matter in Tapi river at downstream stretch which might be due to agricultural runoff and direct sewage disposal from urban area so, this current study would be useful for further ecological monitoring of Tapi river with special emphasis on rotifers as bioindicator.

References

1. Gupta N, Pandey P, Hussain J. Effect of physicochemical and biological parameters on the quality of river water of Narmada, Madhya Pradesh, India, Water Science 2017;31:11-23.
2. Liyanage CP, Yamada K. Impact of Population Growth on the Water Quality of Natural Water Bodies, Sustainability 2017;9(1405):1-14.
3. Prasanna MB, Ranjan PC. Physico chemical properties of water collected from Dhamra estuary, International Journal Of Environmental Sciences 2010;1(3):334-342.
4. Kamble SK, Nagarnaik PB, Shrivastava RR. Water Quality Data Analysis for Kanhan River, Current World Environment 2014;9(2):447-455.
5. Water year Book 2015-16: Tapi Basin. Central Water Commission, Narmada & Tapi Basin Organization Hydrological Observation Circle, Gandhinagar 2017.
6. Sladecek V. Rotifer as indicator of water quality. Hydrobiologia 1983;100:169-201.
7. Saksena DN. Rotifers as Indicators of Water Quality. Acta hydrochimica et hydrobiologica 1987;15(6):481-485.
8. Karuthapandi M, Rao DV, Innocent Xavier B. Rotifer Diversity of Osmansagar Reservoir, Hyderabad, Telangana, India. Records of zoological Survey of India 2015;115(Part-1):39-49.
9. APHA. Standard Methods for the Examination of Water and Wastewater (21st edition), New York 2005.
10. Lackey JB. The manipulation and counting of River plankton and changes in some organisms due to formalin preservation. Public Health Reports 1938;53:2080.
11. Edmondson WT. Freshwater Biology, 2nd edition, John Wiley and Sons, Inc., New York 1959.
12. Battish SK. Freshwater Zooplankton of India. Oxford and IBH Publications, New Delhi 1992.
13. Sharma BK. Freshwater Rotifers (Rotifera: Eurotatoria). Zoological Survey of lndia, State fauna Series 3. Fauna of West Bengal 1998;11:341-461.
14. Saravana Bhavan P, Selvi A, Manickam N, Srinivasan V, Santhanam P, Vijayan P. Diversity of Zooplankton in a Perennial Lake at Sulur, Coimbatore, India. International Journal of Extensive Research 2015;5:31-44.
15. Wetzel RG. Limnology: Lake and River ecosystems (3rd Edition), Academic press 2001,176.
16. Manickam N, Saravana Bhavan P, Santhanam P, Muralisankar T, Srinivasan V, Vijayadevan K *et al*. Biodiversity of freshwater zooplankton and physico-chemical parameters of Barur Lake, Krishnagiri District, Tamil Nadu, India, Malaya Journal of Biosciences 2015;2(1):1-12.
17. Cleetus Retina I, Asha CV, Suson PS, Nandan S Bijoy. Species Diversity and Community Assemblage of Planktonic Rotifers from Vembanad Estuary-Kerala, India, International Journal of Oceanography and Marine Ecological System 2015;4(1):1-15.
18. Gadhikar YA, Sawale SP. Seasonal Abundance and Diversity of Rotifers of Shahanoor Dam, Amravati District, India, Universal Journal of Environmental Research and Technology 2016;6(2):82-90.
19. Zahida Bano, Chuahan Rajendera, Mahmood Sameena. Distribution of zooplankton in River Narmada at Hoshangabad, Madhya Pradesh India, International Journal of Zoology Studies 2017;2(6):96-100.
20. Rajagopal T, Thangamani A, Sevarkodiyone SP, Sekar M, Archunan G. Zooplankton diversity and physico-chemical conditions in three perennial ponds of Virudhunagar district, Tamilnadu, Journal of Environmental Biology 2010;31:265-272.
21. Gurav Minakshi N, Pejaver Madhuri K. Effect of Pollution on Rotifer Diversity in River Gadhi and Deharang reservoir, Bionano Frontier 2012;5(1).
22. Bhandarkar Sudhir V. Species Diversity of Rotifers in Lentic Ecosystem of Dhukeshwari Temple Pond Deori with Reference to Cultural Eutrophication, International Journal of Current Microbiology and Applied Sciences 2015;4(9):736-743.