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Diversity Indices of Rotifer from Dynaneshwar Water Rahuri, Ahmednagar, Maharashtra

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ABSTRACT

In the present study tried to assess rotifer species' Shannon-Weaver index, Simpson's index, Index of Dominance, Index of Evenness and Species Richness of Dynaneshwar dam and predict the state of water according to rotifer and physico-chemical parameters. The indices were evaluated at individual species level and varied species to species. In the work 21 species of rotifer from two orders Ploimida and Gensiotrocha were observed. Out of 21 species recorded, 9 families belonged to Ploimida and 4 families to Gensiotrocha were encountered. It showed seasonal variations and the density was higher in summer [38%] > winter [35%] > rainy [27%]. Rotifer constitute the tendency in order such as Ploimida [54%] > Gensiotrocha [46%]. In the rotifers Ploimida is dominated.

Key words: Rotifers, Shannon-Weaver Index, Simpson's Index, Index of Dominance, Index of Evenness, Species Richness, Dynaneshwar reservoir.

INTRODUCTION

Rotifers are often common denizens of the ecosystem and they have been considered as an indicator species of inhabited water. Population of rotifer is sensitive indicators of aquatic ecosystem. One of the major priorities in conserving rotifer in monitoring their population to find methods with diversity indices is useful for long term survival. Abundance, density, diversity, seasonal variables, species richness, limnology, etc has been evaluated on rotifer [Segers, 2008; Tijare & Thosar, 2008; Yeole et al, 2008; Sharma, 2009; 2010]. But diversity indices are also important to evaluate and predict the species information especially on rotifer community, which was lacking. Hence, diversity indices incorporated in the present study.

Recent studies have shown that diversity, density, abundance of rotifer is sensitive to change in limnological variables. There is no in-depth analysis if the structure and dynamic of the rotifer community in freshwater habitat, which is fundamental as primary producer for the management and the assessment of the trophic state. The aims of the present study were to determine the rotifer taxonomic composition, abundance and diversity indices to represent its pattern and to reference their basic ecological frame during the study.

MATERIALS AND METHODS

Study area: Dynaneshwar reservoir a 26 TMC man made water body is located at Rahuri, Ahmednagar District MS [19⁰20' to 19⁰35' N latitude and 74⁰25' to 74⁰36' E longitude at 572 m MSL]. The dam was artificially built across the Mula River in 1962 and capacity is 840847 m³. It experiences an average rain fall 58 cm. Maximum depth is 67.97 m. The reservoir bottom is composed of detritus-mud layer in the littoral zone. The physiographic of basin is semi agricultural and semi-arid with cultivated top soil bank. The dam water has been used for drinking and irrigation by the people of Ahmednagar city and districts.

Collection and Bio-identification: The rotifers were collected from January 2008 to December 2009. Water samples were collected bimonthly from the reservoir, during the early [7 to 9 am] hours. The plankton samples were collected by filtering 50 liters of water through standard planktonic net [75 μ] and the concentration samples were preserved in 5% formalin. The rotifers were sorted and identified with standard key [Williamson, 1991; Dhanapathi, 2000]. The enumeration of rotifer was done by drop method [Dhanapathi, 2000]. The quantitative analysis of rotifer organisms was carried out using Sedgwick-Rafter counting cell and presented in table 1.

Physico-chemical analysis: The pH and temperature of water samples were recorded on the spot with the help of gun [pen] pH meter and thermometer respectively. The analysis of filtered water samples was carried out for the parameters, as Electrical Conductivity [EC], Total Dissolved Solids [TDS], Total Hardness [TH], Major Constituents [cationic- Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K) and anionic- Chloride (Cl), Total Alkalinity (TA), Sulphates (SO₄), Minor Constituents [Phosphate (PO₄) and Nitrate (NO₃)], indicator parameter [Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)]. The samples were done according to standard methods APHA [1998].

Diversity indices analysis: To evaluate the diversity indices such as Shannon-Weaver Diversity Index, Simpson Diversity Index, Species Richness, Index of Evenness, and Index of Dominance were used. These indices were used to obtain the estimation of species diversity, species richness and species evenness using respectively equations/formulae. All individual species indices are also evaluated.

Shannon-Weaver [1945] diversity index value was obtained using the following equation:

$$S\text{-WDI} = \sum p_i^2 - \log_2 p_i$$

Where $p_i = n_i / N =$ No individuals of species

$N =$ Total no of all the individuals of all the species

Log_2 = Can be calculated from the value of log_{10}

Simpson's Diversity Index [SDI] according to Simpson [1949] equation:

$$\text{SDI} = N(n-1) / \sum n(n-1)$$

Where SDI = Simpson's Diversity index

N = Total No. of individuals of all species

n = No. individuals per samples

\sum = sum

While comparing species at two or more locations the percent value. If falls short of past value, will indicate distributed Species Richness [SR] was obtained using the formulae by Menhinick [1964].

$$\text{SR}_2 = S / N$$

Index of Evenness [IE] was calculated according to formulae:

$$\text{IE} = H / \log^s$$

Where H = the Shannon index

S = No. of species

The Index of Dominance [ID] represents the percentage of abundance contributed by two most abundant species and calculated according to formulae:

$$\text{ID} = 100 * Y_1 + Y_2 / Y$$

Where Y_1 = most abundant species

Y_2 = second abundant species

Y = total abundance of all species

RESULTS AND DISCUSSION

In the present investigation 21 species of rotifer from two orders Ploimida and Gensiotrocha were observed. Out of 21 species recorded, 9 families belonged to Ploimida and 4 families to Gensiotrocha, were encountered. Rotifers particularly order Ploimida was dominant than the order Gensiotrocha. Order Ploimida represent 14 species and these species are from 9 families. Gensiotrocha represents 7 species from 4 families [Table 1]. In rotifer 4 species belonging to Epiphanidae family, 2 species to Lecanidae, Natommtidae, Philodinidae, 3 species to Flosecularidae and 1 species each to Colurellidae, Proalidae, Scarididae, Trichocercidae, Asplanchinidae, Gastropodidae, Conochilidae and Testudinellidae family. It showed seasonal variations and the density was higher in summer [38%] > winter [35%] > rainy [27%]. Rotifer constitute the tendency in order such as Ploimida [54%] > Gensiotrocha [46%]. In the rotifers Ploimida is dominated.

The Shannon- Weaver diversity index [S-WDI] ranged from 0.08 to 0.25 bits ind⁻¹. It indicates conditions of intermittent surface distribution where, certain rotifer taxa have better environmental conditions to reach higher individual numbers than others in the study, when the numbers of taxa were relatively higher and constant. The S-WDI values remain 0 to 1 bits ind⁻¹ in overall species. The rotifer abundance decline due to connection with redistribution of number of individuals in a water body or less possibilities to stay in the euphotic zone where photosynthesis occurred. The alteration between high and low densities shows that phytoplankton is related to hydrographic factors [Talling & Talling, 1986]. Dash [1996] reported high value of S-WDI, with plankton diversity. In the study low value of S-WDI was recorded in *B. angularia* [Family-Epiphanidae] and high value was recorded in four species of Ploimida order in studied reservoir. This report gain supports from Kannon & Job [1980], Adesalu & Nwankwo [2008]. They found that the S-WDI to be suitable indicator for water quality assessment.

During ecological sampling Simpson's Diversity Index [SDI] in measuring distributed area and found total 21 species in two orders of rotifer. The SDI number of species per liter was 0.20 [*B. angularia*] to 1.51 bits ind⁻¹ [*P. dicipiens*]. The SDI remains in between 0.20 to 1.51 bits ind⁻¹ during the study period.

Table 1. Showing diversity indices of rotifer from Dynaneshwar reservoir

Order	Family	Genes and species	S-WDI	SDI	SR	IE	ID
Ploimida	Epiphanidae	1. <i>E. clavulata</i>	0.09	0.22	0.24	0.07	23.73
		2. <i>B. angularia</i>	0.08	0.20	0.22	0.06	26.70
		3. <i>B. calyciflorus</i>	0.11	0.32	0.33	0.83	41.55
		4. <i>K. tropica</i>	0.14	0.53	0.48	0.11	94.58
	Colurellidar	1. <i>C. bicuspidata</i>	0.14	0.44	0.44	0.10	76.91
	Lecanidae	1. <i>L. pyriformis</i>	0.25	1.15	1.08	0.18	94.97
		2. <i>L. verecunda</i>	0.25	1.05	0.99	0.18	91.97
	Proalidae	1. <i>P. dicipiens</i>	0.25	1.51	1.11	0.18	86.11
	Notommatidae	1. <i>C. mucronata</i>	0.23	1.03	0.97	0.17	83.62
		2. <i>T. decipiens</i>	0.24	1.06	0.99	0.18	94.94
	Scarididae	1. <i>S. longicaudatum</i>	0.25	1.14	1.07	0.74	91.97
	Trichocercidae	1. <i>T. longiseta</i>	0.24	1.11	1.04	0.18	100.91
	Asplanchinidae	1. <i>A. brightwell</i>	0.23	1.32	0.97	0.17	86.11
Gastropodidae	1. <i>G. hyptopus</i>	0.23	1.02	0.96	0.17	91.73	
Genstiotrocha	Floscularidae	1. <i>L. ceratophylli</i>	0.20	0.82	0.78	0.15	62.32
		2. <i>L. flosculosa</i>	0.21	0.86	0.81	0.16	50.47
		3. <i>S. spinosa</i>	0.20	0.80	0.77	0.15	53.44
	Conochilidae	1. <i>C. dossuarius</i>	0.22	0.97	0.91	0.17	65.26
	Testudinellidae	1. <i>T. patina</i>	0.21	0.88	0.83	0.17	79.94
	Philodinidae	1. <i>R. rotatoria</i>	0.21	0.88	0.84	0.16	80.08
		2. <i>M. quadricornifera</i>	0.24	1.10	1.03	0.18	86.08

S-WDI = Shannon -Weaver's Diversity Index

SDI = Simpson's Index

SR = Species Richness

IE = Index of Evenness

ID = Index of Dominance

In the study Index of Dominance [ID] in measuring distributed area were found to be maximum (100) in *T. longiseta* species and minimum [23.73] in *E. clavulata* sp. The bits per individuals ID vary species to species, family and order of rotifers because their number is varied in population.

In rotifer species, Species Richness [SR] index was found high [1.11 bits ind⁻¹] in *P. dicipines* species [family- Proalidae]. Mostly in rotifer species order Ploimida revealed higher values of SR index than other. The lowest [0.22] value noticed from *B. angularia* of Epiphanidae family. Rajagopal et al. [2010] focused SR index on zooplankton and reported that the SR values varies species to species. It might be due to limnological and geographical condition of studied water body and predict statistical values.

The rotifer community of Dynaneshwar reservoir categorized by Index of Evenness [0.06 to 0.83 bits ind⁻¹] which in turn indicates a differences in between species to species. It showed peak [0.83 bits ind⁻¹] in *B. calicifloures* and lower [0.06 bits ind⁻¹] in *B. angularia* of Epiphanidae family. The present result indicates significant higher species diversity than the report of Sharma [2000] and Sharma & Hussan [2001].

The relationship between rotifer indices were evaluated and noticed higher relation in between the pairs as S-WDI-SDI [r=0.95], S-WDI-SR [r= 0.99] and SDI-SR [r=0.97] while lower association in the pairs of S-WDI-IE [r=0.10] and IE-ID [r=0.08].

The temperature of water samples ranged from 21.9 °C in winter to 26.9 °C in summer. The decrease in water temperature is allows well mixing of water column. The pH ranged from near neutral [7.2] during rainy to alkaline [7.9] during winter, with maximum [8.2] in summer. The reduced buffering capacity of this system total alkalinity [58.6 ppm] allows strong changes in pH [Merino et al. 2008]. High and low values of DO and pH are associated with pulses and decrements of plankton, respecting zooplankton.

Electric conductivity [EC] ranged from 71 to 128 µmho cm⁻¹. This ionic concentration can be ranged as being intermediate. According to Talling & Talling [1965] classification, it belong to class-I [<600 µmho cm⁻¹]. COD values were ranged from 20.3 to 33.3 ppm, with minima value during rainy and maxima in summer. It coincided with a period of low densities.

Nitrates were detected in low concentration [<1 ppm] during study period with minimum value in rainy [0.58 ppm] and reaching maximum in summer [0.95 ppm]. Orthophosphate were highest [1.22 ppm] in summer and lowest value [0.58 ppm] during rainy. The magnitude of N and P values in studied water indicates a distributed environment that receives a nutrient overload of anthropogenic activities. Based of PO₄ concentration the water body could be classified as mesoeutrophic water body [Monbet & McKelvie, 2007].

CONCLUSION

In conclusion the species indices and distribution of rotifers were greatly influenced by seasonal and species to species due to various factors. From the aforesaid result it could be made out that the availability of water, safe habitat and food sources for rotifer in reservoir are important for

the occurrence and abundance. Water quality are the important that influences the distribution indices of rotifer. The proper and regular maintenance of dam would further increase the planktonic population. The result of the study helps to conserve the organisms which are useful in aquaculture [fishery] due to food web in reservoir.

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