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RESEARCH ARTICLE

ROTIFERA DIVERSITY INDICES: ASSESSMENT OF AQUATIC HEALTH OF AN OX-BOW LAKE ECOSYSTEM IN WEST BENGAL

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ABSTRACT

A survey of the zooplankton communities of a water body was conducted from April 2013 to March 2014 in the Chhariganga oxbow lake in Block of Nakashipara of Nadia district, West Bengal, India and an analysis of rotifer group of zooplankton with using diversity indices like Shannon-weaver and Simpson diversity index, species richness and evenness, composition trends with total abundance was also carried out to assess the water quality and aquatic health of the oxbow lake ecosystem. Nine species of rotifer zooplanktons identified were *Asplanchna sp, Notholca sp, Keratella sp, Anuraeopsis sp, Cephalodella sp, Monostyla sp, Platyias sp, Testudinella sp, Ascomorpha sp.* Species Richness values of 5, 3, 4; Species Evenness of 0.96, 1.00, 0.96; Shannon-Weiner Index values of 1.55, 1.10, 1.33 and Simpson diversity index values of 0.22, 0.33 and 0.27 were found respectively during pre monsoon, monsoon and post monsoon in the oxbow lake. Total abundance of rotifer group showed density values of 280, 120, and 125 numbers per litre of water during those three seasons in a year. In the present study low diversity values of Shannon and Simpson diversity clearly stated that the selected lake is polluted and has high anthropogenic activity and this lake water is not suitable for aquaculture.

INTRODUCTION

Studies on fresh water bodies, natural or manmade have gained much importance in recent years mainly because of their multiple uses. Several workers have attempted to study the hydro biological profile of varied water bodies with intent of assessing the quality of water. Plankton forms an important component of fish food in aquatic environment and as such, the knowledge of their production and abundance is essential for successful management of fishery. Zooplanktons occupy a central position between the autotrophs and other heterotrophs and on an important link in food of fresh water ecosystem. Zooplankton community is cosmopolitan in nature and they inhabit all freshwater habitats of the world. These spices are not only useful as bio indicators, but are also helpful for ameliorating polluted waters. They have been widely used in assessment of aquatic pollution because of their sensitivity to small changes in environment, short generation time. Rotifers form a significant component of the zooplanktons. The rotiferans exhibit a very wide range of morphological variations and adaptations. Among the zooplankton rotifers respond more quickly to the environmental changes and used as a change in water quality (Gannon and Stemberger 1978). Rotifers are regarded as Bio-indicators of water quality. Hence qualitative and quantitative studies of Rotiferans group of zooplankton diversity are of great importance.

In the present study, a survey of the rotifer group of zooplankton and analysis of rotifers with using diversity indices like Shannon-weaver and Simpson diversity index, species richness, and evenness, structure, composition trends along with the total abundance to assess the water quality and aquatic health of the ecosystem of Chhariganga oxbow lake was conducted from April 2013 to March 2014 in Nadia district, India.

MATERIALS AND METHODS

Study area

The Chhariganga oxbow lake, abandoned, fractioned and derived from the river Ganga is located in Nakashipara development block of Nadia district, West Bengal, India. It is situated at 23.5800° N latitude, 88.3500° E longitude, about 90 Km away from Kalyani University Campus, Nadia. It is a fresh water open type oxbow lake and receives water from the river Ganga during monsoon through a narrow channel at the North East corner of a loop of the river. The oxbow lake is spread over an area of 145.69 Acres with an annual average depth of 8.5 ft. It also stores rain water. The catchment area of the oxbow lake is 600 hectare.

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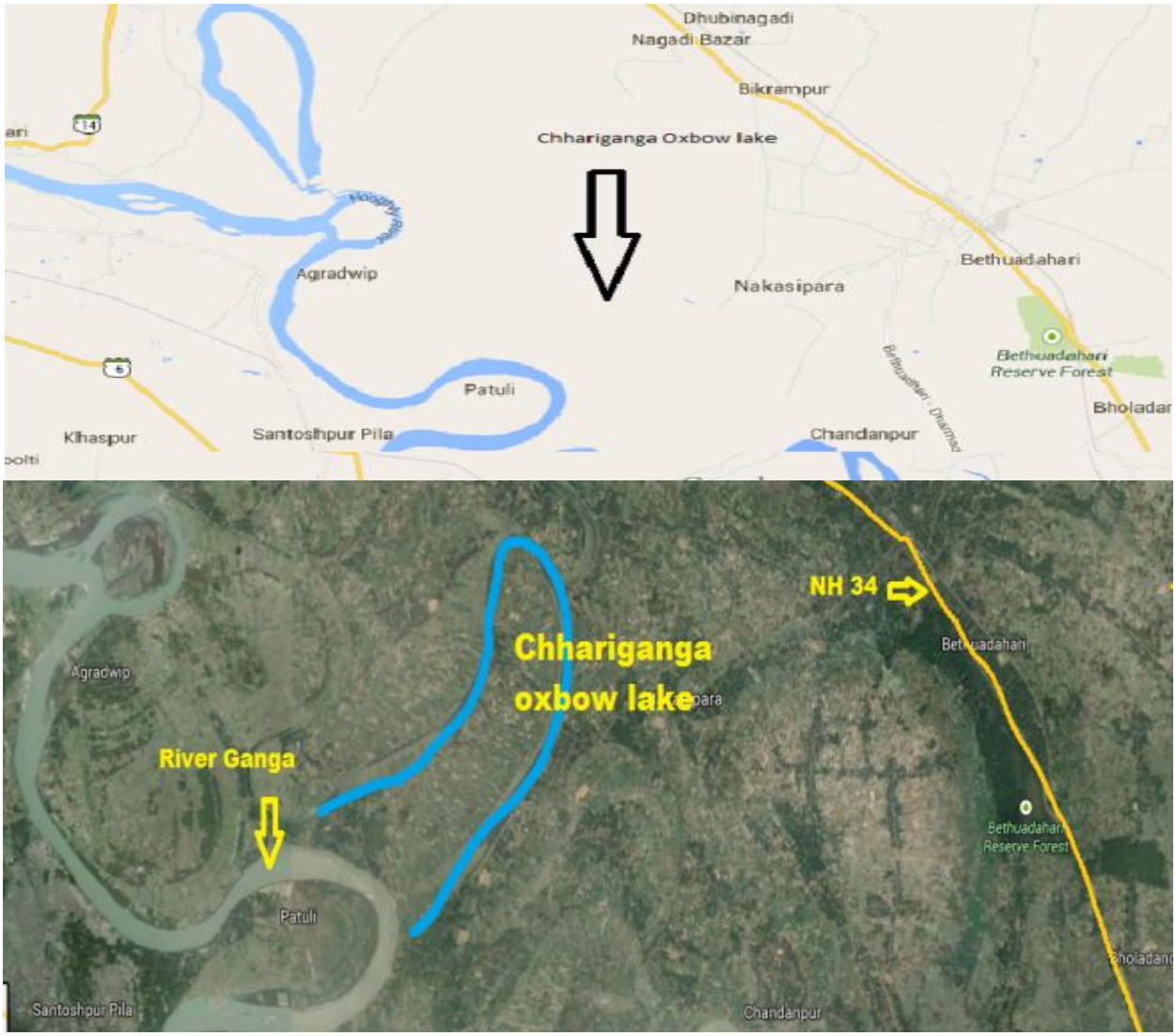

Rotifera collection, preservation, identification and density analysis

The samples of rotifer group of zooplankton were collected from each selected study site of this tropical oxbow lake for a period of one year (April 2013 to March 2014). Collection was made by filtering 50 liters of water through conical shape plankton net made of nylon blotting silk cloth of 60µ mesh size and of reducing cone (having filtering area three times larger than the area of the mouth) with the bottle at its end. For a precise collection of zooplankton, the plankton net was towed in open water area of each site three times (horizontally, vertically and obliquely). Care was taken to avoid trapping of floating debris while towing the net. The net was lowered as close to the bottom as possible without disturbing the sediment and carefully hauled to allow the water to drip. The net was rigged with a weight to enhance vertical sinking. Three replicate samples were combined to make a composite sample. Samplings were made between 7 to 10 AM. Immediately after the collection of the samples, the plankton was preserved with 4% formaldehyde solution and samples were kept for setting for a period of 48 hrs for quantitative estimation. In the laboratory each sample was diluted, stirred well and sub-sampled with a 5ml syringe before microscopic examination.

One ml of sample was transferred to Sedge wick Rafter cell (S-R cell) and examined under the microscope at x40 magnification.

Qualitative and quantitative plankton analyses were done up to the genus and planktonic organisms were numerically counted, identified and confirmed by following using various monographs, books and other published literature Ward, Henry Baldwin *et al.* (1945); Needham *et al.* (1972); Patil and Gouder (1982), Pace *et al*. (1990), Battish (1992) and Ndebele (2012). After an accurate identification of each genus, the density of the zooplankton was calculated as per the Lackey's drop method (Lackey, 1938). The species diversity was determined. Statistical analysis was done by using the following diversity index formulas:-

Simpson's diversity index (Krebs, 1994)

The Simpson's diversity index (D) is calculated using the following equation:

$$D = \frac{\sum_{i=1}^{s} n_i(n_i - 1)}{n(n-1)}$$

D = Where 'ni' is the proportion of individuals of the i^{th} taxon in the community. Simpson's index gives relatively little weight to the rare species and more weight to the common species. It ranges in value from 0 (low diversity) to a maximum of (1-1/s), where s is the number of taxa.

Shannon-Wiener Index (Williams and Feltmate, 1992)

This is a widely used method of calculating biotic diversity in aquatic and terrestrial ecosystems and is expressed as:

$$H' = \sum_{i=1}^{s} \frac{n_i}{n} \ln \frac{n_i}{n}$$

Where H= index of species diversity s= number of species ni= proportion of total sample belonging to the i^{th} species. A large H value indicates greater diversity, as influenced by a greater number and/or a more equitable distribution of species.

Taxon Evenness

This is relative distribution of individuals among taxonomic groups within a community) and is expressed as

$E = H / ln(R)$

Where E= Taxon Evenness, R is the Taxon Richness defined as total no. of distinct taxa in a population.

RESULTS AND DISCUSSION

The season wise composition and different species percentage of the rotifer group are shown in Table No.1 As many as nine species of rotifer zooplanktons were identified in this oxbow lake. Among the five species of *Asplanchna sp, Anuraeopsis sp, Cephalodella sp, Platyias sp, Ascomorpha sp* identified in the lake during pre monsoon both *Asplanchna sp and Anuraeopsis sp* lead among all species of rotifer group with 28.57 % each while the remaining three species contributed 14.29 % each. Three species each with 33.33 % observed during monsoon in the lake were *Keratella sp, Platyias sp* and *Ascomorpha sp.* Among the four species *Ascomorpha sp* leads with 40 % while *Notholca sp, Monostyla sp, Testudinella sp* each with 20 % of the rotifers was observed during post monsoon.

Species Richness values of 5, 3, 4; Species Evenness of 0.96, 1.00, 0.96; Shannon-Weiner Index values of 1.55, 1.10, 1.33 and Simpson diversity index values of 0.22, 0.33 and 0.27 were found respectively during pre monsoon, monsoon and post monsoon. Total abundance of rotifer group showed density values of 280, 120, and 125 numbers per litre of water in the oxbow lake during those three seasons (Table 2).

Table 1. Rotifera species composition of Chhariganaga Oxbow lake in %

Zooplankton group	*Genus*	Pre monsoon	Monsoon	Post monsoon
Rotifera	*Asplanchna sp*	28.57	-	-
	Notholca sp	-	-	20.00
	Keratella sp	-	33.33	-
	Anuraeopsis sp	28.57	-	-
	Cephalodella sp	14.29	-	-
	Monostyla sp	-	-	20.00
	Platyias sp	14.29	33.33	-
	Testudinella sp	-	-	20.00
	Ascomorpha sp	14.29	33.33	40.00
Total Rotifera		100.00	100.00	100

Table 2. Rotifera as an Aquatic Ecosystem Health indicator of Chhariganga Oxbow lake

Metrics	Measurement	Pre monsoon	Monsoon	Post monsoon
Rotifera Diversity indices	Species Richness:	5	3	4
	Shannon-Weiner Index:	1.55	1.10	1.33
	Species Evenness:	0.96	1.00	0.96
	Simpson Index	0.22	0.33	0.27
Total Rotifers abundance	Density (no.s/Lit)	280	120	125

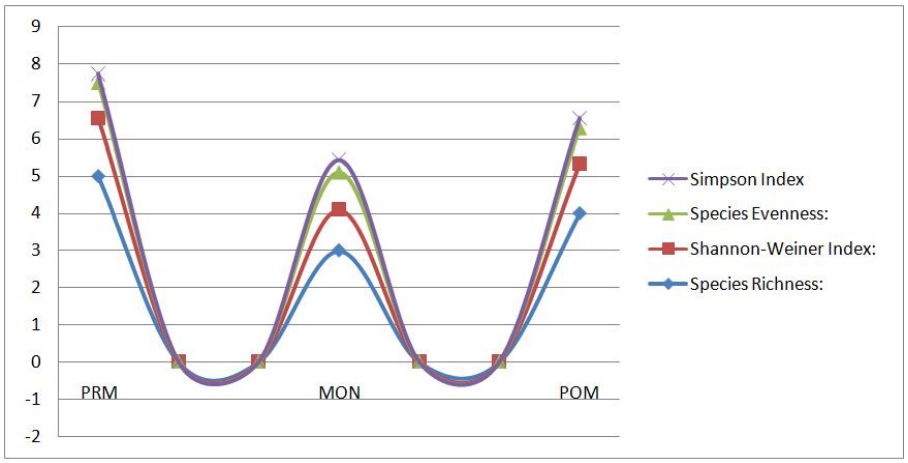

Figure 1. Rotifera diveristy indices in Chhariganga Oxow lake

The structure and composition trends of rotifer group of zooplankton in the surveyed water body may be related to both intensity of predation and limitation by environmental factors, which may include the nature of the water bodies, and food quality and quantity. Rotifer group of zooplanktons showed high species richness, Shannon and low Simpson diversity indices values during the pre monsoon and post monsoon season whereas low richness and Shannon and high Simpson diversity values during the south west monsoon season respectively (Figure 1). This is due to positive correlation with water temperature, pH, dissolved oxygen and nutrients such as ammonia cal nitrogen and phosphorous. Similar results were observed by Shashikant (2012), Priyavada *et al.* (2012) and Balakrishna *et al.* (2013). The species evenness of the rotifer group showed high values during monsoon and remained unchanged during rest of the year.

Conclusion

In the present study low diversity values of Shannon and Simpson diversity clearly stated that the selected lake is polluted and has high anthropogenic activity and this lake water is not suitable for aquaculture.

REFERENCES

Balakrishna, D*., Mahesh, T*., Samatha, D.* and Ravinder Reddy, T. 2013. Zooplankton Diversity Indices Of Dharmasagar Lake, Warangal District (A.P.). *International Journal of Research in Biological Sciences*, 2013, 3(3): 109-111.

Battish, S. K. 1992. Freshwater zooplankton of India. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. Pp. 130.

Gannon, J.E. and R.E. Stemberger, 1978. Zooplankton (especially crustaceans and rotifers) as indicators of water quality. *Trans. Am. Micros. Soc.,* 97: 16-35.

Lackey, J. B. 1938. *Public Health Reports*, 53: 2080-2093

Ndebele M. M. R. 2012. Biological monitoring and pollution assessment of theMukuvisi River, Harare, Zimbabwe. *Lakes & Reservoirs: Research and Management,* 17: 73–80.

Needham, J. G. and P. R. Needham 1972. A guide to the study of Fresh Water Biology Holden day Ins. San- Francisco, U.S.A. 108.

Pace, M. L., G. B. Mc Manus and S. E. G. Findlay. 1990. Planktonic community structure in a temperate lake. *Limnol. Oceanogr*., 35: 795-808.

Patil, C. S. and B. Y. M. Gouder. 1982. Freshwater fauna of Dharwad (Karnataka State, India): Cladocera. *J. Karnataka Univ. Sci*., 27: 115-126.

Priyavada Devi, Shirisha, D. and Gandhi, N. 2012. Quantitative and Qualitative analysis of Zooplankton from Aquaculture ponds in and around Bhimavaram, West Godavai District Int. *J. Nature Envt. and Pollution Tech.,* 11(3): 507-509.

Shashikant R. Sitre, 2012. Assessment of biodiversity of rotifers in Ambazari lake of Nagpur city with respect to water quality. *Int.indiscipinary Res. J.,* Vol-II 104-110.

Ward, Henry Baldwin and Whipple, Chon. 1945 .Freshwater Biology. New York, *John Wiley and Sons.,* Inc. London. Chapman and Hall limited.

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