



Diversity of Rotifer (Rotifera) With Special Reference to Physico-Chemical Parameters from a Tropical Reservoir, Kullurchandai, Virudhunagar District, India

Amsha Devi V.¹ and Suresh Kumar R²

¹Department of Zoology, V.V. Vanniaperumal College for women, Virudhunagar, Tamil Nadu, INDIA

²Department of Zoology, R.D. Government Arts College, Sivagangai, Tamil Nadu, INDIA

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Abstract

We have studied the rotifer community composition of Kullurchandai reservoir, a chief source for the nearby Virudhunagar town, during May 2007 to April 2008. Temperature, pH, dissolved oxygen, free carbon-di-oxide, alkalinity, chlorinity, salinity, total hardness, and phosphorus were measured simultaneously. We have identified 40 species of rotifers with various categories such as, eurythermal, stenothermal, alkaliphilic and eutrophic indicators. Among these species, the genera *Brachionus* and *Lecane* were dominant in their presence. The physico-chemical parameters were recorded within the tolerance limit of rotifer species. The plenty of rotifer density was observed in February, 2008, while the lowest was recorded during August, 2007. The Diversity indices were recorded highest during February 2008 (1.9889) and lowest during October 2007 (1.1205) which showed a clear picture not only on the dynamics of the rotifer community but also on the nature of water body.

Keywords: Reservoir ecology, Rotifers, physico-chemical parameters, diversity indices..

Introduction

The biological resources are threatened by water quality and quantity due to climatic conditions. Over exploitation due to increase in human as well as live stock population and changing livelihood pattern resulting in devastation of habitats and natural ecosystems. The conservation of bio diversity involves a number of parameters, such as, number of species, their population dynamics, distribution habitat, structure, microhabitats, physical environment and climate. Hence in the present work, we have selected a reservoir which serves as the central source for the nearby town, Virudhunagar. Kullurchandai reservoir is located in Kullurchandai village, Virudhunagar district, 6km away from Virudhunagar town. It irrigates all the surrounding fields. About 2702 tons of food production is being done every year. The reservoir is polluted with sewage water from river Kowsiga, a tributary of river Arjuna, which in turn receives sewage from Virudhunagar town. It is a famous picnic spot with the facilities for boating, bird watching and trekking. The reservoir is also used for fisheries, irrigation, bathing and washing purposes. Since it is a huge aquatic body with greater variations and disturbances, it is proposed to analyze the physico-chemical parameters; to inventorize the rotifer fauna; to investigate the influence of water quality on the diversity and abundance of rotifera; to compute the diversity indices of rotifer groups and to test the efficiency of water bodies for fish culture.

Water resource' is becoming scarce element due to rising population and poor water management. The world population

already crossed 700 crores and the global deficit in water to an extent of 40 percent is forecast by the year 2030. For India, the annual water demand is expected to increase to almost 1500 cubic kilo- meters by the year 2030¹. Unplanned growth of industrialization and urbanization leads to increase in addition of anthropogenic sources to water. Hence the study of physico-chemical parameter is important².

Rotifers are the microscopic zooplanktonic fauna, occurs prevalently in fresh waters. They form the basic live food for fishes. In this paper we have documented the changes in the rotifer diversity with special reference to various physico-chemical parameters during 2007- 08. Rotifera can be useful for effective management of water bodies as it acts as effective pollution indicators³. It is therefore desirable to have quantitative records of the rotifer community structure through time, which could be helpful for the management of reservoir. Diversity indices were also calculated to know the species richness and evenness among the rotifer populations.

Material and Methods

Surface water sample was collected from the Kullurchandai reservoir (90^o20' and 90^o72' north latitude and 77^o20' and 78^o70' east longitude) once in a fortnight in the early hours of the day (6 am to 8 am). The water samples were collected using one litre container for the estimation of water quality parameters. The collected samples were taken to the laboratory and the analysis was done following the standard procedures⁴.

Zooplankton were collected by filtering hundred liters of water through a plankton net (mesh size 30µ) and were preserved in 50ml of 5% neutral formalin. The various zooplanktonic groups were separated and rotifers were identified based on the key characters provided by different authors^{3,5,6}. The quantitative analysis of rotifers was carried out using Sedgwick Rafter's plankton counting chamber. For the diversity analysis, two types of samples, one at the surface of the water and the other at a depth of one meter, were collected from 3 different places of the reservoir. Richness, evenness and species diversity of rotifers were worked out using software packages⁷.

Results and Discussion

Monthly variations of Physico-chemical parameters of Kullurchandai reservoir were presented in the Table-1. The air temperature and water temperature ranged between 27-32°C and 25-29°C respectively. The maximum air temperature was observed during April 2008 and the minimum air temperature was observed during December 2007. This is in accordance with the results reported by Salam A. et al⁸. The dissolved oxygen was found to increase in the reservoir during the period of investigation whereas the amount of free CO₂ was found to be slightly fluctuating. In Phirange Kharbav Lake, more dissolved oxygen was reported in December (10.8mg/l) and minimum in June (3.2 mg/l). The increase in dissolved oxygen value could

be attributed to high water current and the biological activity of phytoplankton⁹. In the absence of free carbon-dioxide, the bicarbonates were converted into carbonates releasing carbon-dioxide which is utilized by autotrophs, thus making the water more alkaline¹⁰. Free CO₂ and pH are greatly related to each other. Due to the consumption of CO₂ during day time for photosynthetic activity, the pH of water increases, whereas decreases at night due to respiratory activity. The pH value ranged from 7.2-8. The different pH values indicate basic medium, and it nearly matches the normal pH of household sewage (7.5 –8.5)¹¹.

The difference in rotifer density of the reservoir has also been observed. The reservoir is a permanent water body, where the accumulation of nutrients are more due to sewage entry, which in turn improve the growth of phytoplankton, thereby the zooplankton number also increases. The monthly variations in the occurrence of rotifer of the reservoir was observed and presented in the table-2. A total of 40 species of rotifers have been reported (figure-1), of these, 16 species belonging to the family Brachionidae. *Brachionus caudatus*, *Brachionus calyciflorus* and *Keratella tropica* were found to be higher in number. The presence of *Brachionus species* and *Asplanchna* indicate the trophic status of the water body and their suitability for supporting the growth of fishes¹².

Table-1
Monthly variations of Physico-chemical parameters of Kullurchandai reservoir (2007-2008)

parameter	May 2007	June 2007	July 2007	Aug. 2007	Sep. 2007	Oct. 2007	Nov 2007	Dec 2007	Jan 2008	Feb 2008	Mar 2008	Apr 2008
Temperature (°C)	32	30	29	29	28	28	26	27	30	30	29	32
Air water	29	27	28	27	27	26	27	25	28	28	27	29
pH	7.5	7.5	7.6	7.5	7.6	7.6	7.2	7.5	7.5	8.0	7.8	7.5
Total Hardness (ppm)	135.20	132.40	85.70	148.70	150.20	157.50	104.10	77.85	103.75	131.00	137.00	122.50
Dissolved Oxygen (mg/l)	5.25	4.80	6.15	3.80	4.12	4.33	5.66	6.66	6.86	7.10	7.22	7.95
Free carbon dioxide (mg/l)	3.50	1.64	2.21	1.85	2.10	2.40	4.11	3.95	1.87	3.26	0.69	5.69
Total Alkalinity (ppm)	107.3	184.2	164.2	191.2	285.2	305.00	160.00	205.00	92.50	110.00	97.50	118.00
Salinity (ppm)	177.2	151.2	210.6	284.5	375.2	419.15	171.71	204.77	123.72	192.27	174.91	188.90
Chlorinity (ppm)	95.2	100.4	154.2	98.7	153.2	232.20	95.15	113.43	92.16	106.34	96.89	104.64
Phosphate (mg/l)	0.23	0.17	0.26	0.31	0.29	0.48	0.33	0.21	0.24	0.17	0.29	0.33

Table-2
Monthly variations of occurrence of Rotifer species in Kullurchandai Reservoir (units/ml)

Zooplankton	May 2007	June 2007	July 2007	Aug2007	Sep 2007	Oct 2007	Nov 2007	Dec 2007	Jan 2008	Feb 2008	Mar 2008	Apr 2008	\bar{X}
<i>Brachionus caudatus</i>	6	3	Nil	2	2	8	3	17	4	12	9	5	5.92
<i>B. forficula</i>	2	1	1	Nil	Nil	3	1	1	1	5	5	3	1.92
<i>B. calyciflorus</i>	Nil	Nil	5	7	8	8	4	4	Nil	5	3	Nil	3.67
<i>B. falcatus</i>	2	5	1	Nil	1	4	Nil	3	5	14	1	1	3.1
<i>B. angularis</i>	1	1	5	1	Nil	Nil	Nil	1	Nil	10	4	Nil	1.92
<i>B. quadridentatus</i>	Nil	Nil	1	Nil	Nil	Nil	1	Nil	Nil	1	Nil	Nil	0.25
<i>B. plicatilis</i>	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	0.083
<i>B. aculeatus</i>	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.083
<i>B. urceolaris</i>	Nil	Nil	1	Nil	Nil	Nil	1	Nil	1	Nil	Nil	Nil	0.25
<i>B. sensilis</i>	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.083
<i>B. diversicornis</i>	Nil	3	2	Nil	Nil	4	Nil	1	1	4	7	1	1.92
<i>B. patulas</i>	2	1	1	Nil	Nil	1	Nil	Nil	1	Nil	Nil	Nil	0.50
<i>B. patulas macrocanthus</i>	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.083
<i>B. bidenta</i>	Nil	Nil	2	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	0.25
<i>B. durgae</i>	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	0.083
<i>Lecane(L) pupuana</i>	Nil	Nil	1	Nil	Nil	Nil	4	2	Nil	Nil	2	1	0.83
<i>L(M).bulla</i>	1	Nil	1	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.25
<i>L(M).hamata</i>	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.083
<i>L.lunaris</i>	Nil	1	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.17
<i>L(L). luna</i>	Nil	1	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.17
<i>L.aculeata</i>	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.083
<i>L.levistyla</i>	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	0.083
<i>L(L).curvicornis</i>	Nil	Nil	1	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	0.17
<i>L.closterocerca</i>	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	0.083
<i>L.inermis</i>	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	2	Nil	Nil	Nil	0.17
<i>Filinia longiseta</i>	Nil	Nil	2	Nil	Nil	4	2	1	Nil	Nil	1	Nil	0.83
<i>F. terminalis</i>	1	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.17
<i>Ascomorpha ovalis</i>	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	0.083
<i>Asplanchna brightwelli</i>	Nil	Nil	Nil	Nil	2	Nil	1	Nil	Nil	1	2	1	0.58
<i>Itura aurita</i>	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.083
<i>Platyas quadricornis</i>	Nil	Nil	Nil	1	Nil	Nil	6	Nil	Nil	2	Nil	Nil	0.75
<i>Dipleuchanis propatula</i>	Nil	Nil	Nil	Nil	Nil	Nil	4	Nil	Nil	Nil	Nil	1	0.42
<i>Platyonus patulus</i>	Nil	Nil	Nil	Nil	Nil	Nil	6	Nil	Nil	Nil	Nil	Nil	0.50
<i>Testudinella parva</i>	Nil	1	Nil	Nil	1	2	Nil	1	1	2	2	Nil	0.83
<i>T. patina</i>	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	0.083
<i>T. emarginula</i>	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	Nil	Nil	0.083
<i>Keratella cochlearis</i>	Nil	Nil	Nil	Nil	Nil	1	Nil	1	Nil	Nil	Nil	Nil	0.17
<i>K. tropica</i>	Nil	2	1	1	Nil	5	4	11	2	1	5	1	2.75
<i>K. procurva</i>	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	1	Nil	Nil	Nil	0.083
<i>Lepadella minuta</i>	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	2	Nil	0.17

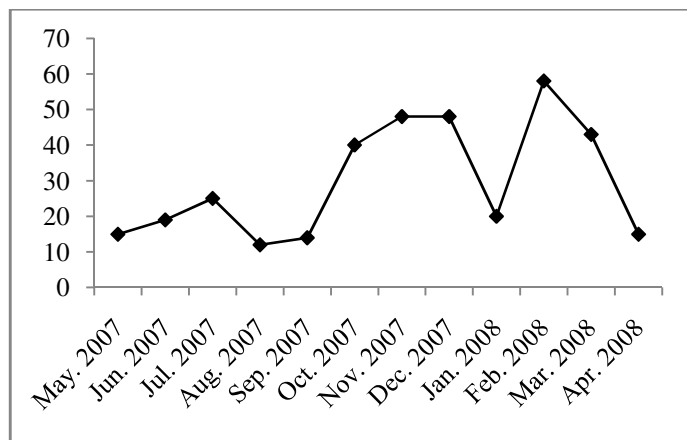


Figure-1

Total number of rotifers recorded in each month between May 2007 and April 2008

The impact of sewage water on the population density of zooplankton and advocated the adverse impact on the abundance of rotifers¹³. The temperature plays a key role in seasonal variation of zooplankton such as rotifers¹⁴. The abundance and diversity of rotifers vary according to limnological features and the trophic state of freshwater bodies. Also, it was suggested that the total rotifers may increase with increasing eutrophication¹⁵. Further, the eutrophication affects the specific composition of rotifers through physical and chemical alternatives of the environment¹⁶.

In the present investigation, the presence of rotifers in the water bodies indicating the nature of pond. The rotifers population density greatly depends up on the availability of food and temperature¹⁷. *B. caudatus*, *B. calyciflorus*, *B. falcatus*, *B. forficula*, *Filinia longiseta*, *Keratella tropica* and *Asplanchna brightwelli* are the alkalophilic species indicating that the water body is alkaline in nature. *Lecane aculeata*, *K. tropica*, *B. falcatus* are the warm stenothermal species. These species were obtained in the water body only at the time of moderate temperature due to that they have narrow tolerance of temperature. *B. angularis*, *B. calyciflorus*, and *Testudinella patina* are eurythermal species, found in the reservoir even in severe temperature. *B. angularis*, *Filinia longiseta* are the eutrophic indicator species present at the time of eutrophication of the water body. The pollution indicator species such as *Filinia*, *K. cochlearis* etc., were reported at the time of pollution in the water bodies¹⁸. A diversity index is the measure of species diversity in a given community. Species diversity includes both species richness and evenness. The relative abundance of rare and common species is called evenness. Communities with a large number of species that are evenly distributed are the most diverse and communities with few species that are dominated by one species are the least diverse.

The maximum value of Margalef's index (R1) was found in November 2007 (8.1753) and minimum value in March 2008 (4.0289) whereas the maximum value of Menhinick's index

(R2) was recorded in November 2007 and minimum was observed in February 2008(2.1653). The use of R2 presupposes that a functional relationship exists between S and n in the community. Higher diversities are considered to indicate longer food chains with complicated nutritional relationships in the ecosystem¹⁹. The various evenness indices (E1 to E5) in reservoir range from 0.3564 to 1.1642, indicating that the distribution of zooplankton in the selected water bodies are more or less even. In tropical pond near Sivakasi, the E1 to E5 was ranged from 0.73 to 1.12²⁰.

In the present study, Simpson's index (λ) Shannon's index (H') and Hill diversity numbers (N1 and N2) have been worked out to elucidate the rotifer community. Simpson's Diversity Index is a measure of diversity which takes into accounts both richness and evenness. It is used to quantify the biodiversity of a habitat. The λ value ranged from 0.1186 in December 2007 to 9.6551 in April 2008.

The Shannon's index (H') is a measure of overall biodiversity. It is used to know not only the number of species but how the abundance of the species is distributed among all the species in the community. In the present study an increasing trend from 1.1205 in October 2007 to 2.1375 in April 2008 was observed. The Hill's first diversity number (N1) of Kullurchandhai reservoir ranged from 28.257 in November 2007 to 11.275 in April 2008. These diversity indices indicate that the selected water body has a well-balanced rotifer community that enjoys an even representation of several species indicating the dynamic nature of this aquatic ecosystem.

The rotifers showed negative correlation with temperature, pH, free CO₂, total hardness and salinity whereas positive correlation with DO, alkalinity and phosphates, which was given in Table-3. The present report was adhered with reports of Phirange Kharbav Lake, where it showed positive correlation with phosphate (+0.1219)⁹. Generally aquatic bodies received phosphate from agricultural runoff, domestic sewage water²¹. Eutrophication is the process by which ponds are enriched naturally or by human activity with the key nutrients, such as, nitrogen and phosphorous²². The nutrients showed large seasonal fluctuations, which seems to be related to the water level variations.

pH is considered to be the most important factor regulating plankton density²³. When the water is alkaline more number of rotifer is observed and showed less abundance in acidic water²⁴. When there was an increase in dissolved oxygen content, an increase in the number of both phytoplankton and zooplankton is eminent²⁵ and similar kind of results is observed in the present study. It was reported that calcium and magnesium salts are used as micronutrients for the growth of plankton²⁶. Hence the correlation is negative in the present study. The high level of alkalinity is found to be associated with high photosynthetic activity leading to increase in rotifer density²⁷.

Table-3
Correlation co-efficient between physico-chemical parameters and rotifer population of Kullurchandai reservoir

Physico-chemical parameter	Rotifer population
Temperature (^o C)	-0.3130
pH	-0.6444
Dissolved Oxygen (mg/l)	+0.5601
Free CO ₂ (mg/l)	-0.2107
Total hardness (ppm)	-0.3370
Total alkalinity (ppm)	+0.2047
Phosphate (mg/l)	+0.1219
Salinity (ppm)	-0.0671

Conclusion

The present study is an attempt to explore the faunal components of a reservoir, which is widely utilized by the local community, and the results show greater diversity of invertebrate planktonic faunal groups, especially the rotifers. It is concluded that most of the physico-chemical and biological parameters in the Kullurchandai reservoir showed a monthly pattern. From the observations, it is observed that the rotifers showed a greater abundance and diversity. The rich variety of rotifers indicates the trophic status of the water body as well as its nature for the survival of fishes.

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