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Diversity and Parameter of Lentic Ecosystem With reference to Eutrophication

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ABSTRACT: Water is important natural resource for the survival of all living beings. Zooplankton constitutes an important link in food chain as grazers (primary and secondary consumers) and serves as food for fishes directly or indirectly. Rotifers were found to contribute to the zooplankton richness and plays a key role in the tropho-dynamics, ecological energetic, cycling of material and aquaculture productivity due to incredibly high reproductive rate characterized by parthenogenetic production During the course of an extensive faunistic survey of lentic ecosystems at Sakkar Talao, twelve species of rotifer are recorded first time. Taxonomic notes with a key for their identification are appended and their role as indicators of eutrophy discussed.

KEY WORDS: Zooplankton, Rotifers, Bioindicators, Sakkar Talao, Eutrophication.

I. INTRODUCTION

Conservation of natural resources is an important aspect of sustainable development. Water is important natural resource for the survival of all living beings. Water reservoirs (both saline and fresh), specially lakes, dams, ponds (both natural and man made), rivers, are dynamic systems in which plants and animals not only interact but also influence the habitat profoundly and thus maintain ecological balance of flora and fauna in water. To conserve these valuable resources from deterioration there is a need for regular monitoring of the aquatic ecosystem. A comprehensive biomonitoring process involves both physicochemical and biological approach and gives the exact status of the aquatic ecosystem. Biomonitoring of water bodies also helps to understand the composition of biota and its dynamics.

Zooplankton constitutes an important link in food chain as grazers (primary and secondary consumers) and serves as food for fishes directly or indirectly. Therefore any adverse effect to them will be indicated in the wealth of the fish populations. Thus, monitoring them as biological indicators of pollution could act as a forewarning for the fisheries particularly when the pollution affects the food chain (Mahajan, 1981). Zooplankton also helps in analysis of water quality, development of cause-effect relationships between water quality and environmental data and judgments of the adequacy of water quality for various uses. Zooplankton has been used recently as an indicator to observe and understand changes in the ecosystem because it seems to be strongly influenced by climatic features (Beaugrand*et al.*, 2000, Le Fevre-Lehoerff*et al.*, 1995 and Li *et al.*, 2000). The variability observed in the distribution of zooplankton is due to abiotic parameters (e.g. climatic or hydrological parameters: temperature, salinity, stratification, advection), to biotic parameters (e.g. food limitation, predation, competition) or to a combination of both (Beyst*et al.*, 2001, Christou, 1998, Escribano and Hidalgo, 2000 and Roff*et al.*, 1988). Although zooplankton exists under a wide range of environmental conditions, yet many species are limited by temperature, dissolved oxygen, salinity and other physico-chemical factors.

Rotifers were found to contribute to the zooplankton richness and plays a key role in the tropho-dynamics, ecological energetic, cycling of material and aquaculture productivity due to incredibly high reproductive rate characterized by parthenogenetic production (Herzig,1983) , high fecundity, short development period and assimilation efficiency, and were found to be dominant group Chakrabarty*et al.*, (1959), Das *et al.*, (1996), Sarkar and Choudary (1999)**.**Sunkad and Patil (2004), amongst other zooplanktons, Rotifers comprises an integral pail in aquatic food chain their role as link between non planktons and carnivorous zooplanktons is well established. They play key role in cycling of organic matter (Mishra and Saxena, 1998) a many species of rotifers are primary consumers and feed on phytoplankton's,

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particulate organic matter, free swimming algae. Rotifers can populate vacant niches with extreme rapidity and convert primary production into a form usable for secondary consumers producing up to 50% of the total plankton biomass (Nogrady et al, 1993).

Rotifers are valuable live food for larval fish and crustacean culture. Several characteristics of rotifers, including their nutritional quality, body size and relatively slow motility have contributed to their usefulness as good prey for active larvae. According to Nikolsky (1963) rotifers act as basic food for fishes at early stages of their external feedinghence it forms several links in food web and occupy diversity of tropic levels in aquatic ecosystem. Rotifers exhibits remarkable ability to colonise diversified freshwater biotopes and are sensitive indicators of water properties (Ruttener- Kallisko, 1971). Rotifers are microscopic aquatic animals first describe by John Harris in 1696 (Hudson and Gosse, 1886). These are the most important soft-bodied metazoans (invertebrates) among the plankton.

The rotifers make up a phylum of microscopic and near-microscopic pseudocoelomateanimals. Most rotifers are around 0.1-0.5 mm long, and are common in freshwater throughout the world with a few saltwater species. Rotifers get their name (derived from Latin and meaning "wheel-bearer"; they have also been called wheel animalcules) wheels of cilia, known as corona, used for locomotion and sweeping food particles towards the mouth. The mouth is generally anterior and the digestive tract contains a set of jaws (trophi) to grasp the food particles and crush them. A number of studies have evaluated rotifer species as indicator of eutrophication (Sladecek 1983, Takmura et al 1989, Verma and Munshi 1987, Dhanapati 1997).

II. MATERIALS AND METHODS

The water samples for rotifer analysis were collected simultaneously in all sampling points. Collection of surface water sample was mainly done using a plastic bucket, polyethylene bottles, collected samples were so handled that it was not deteriorated before it is analyzed. Samples collected strictly as per the instructions given in a book "Standard Methods for the Examination of Water and Wastewater. 20th Edition, Edited by Tenore S. Clescerei, Arnold E. Greenberg, Andrew D. Eaton (1998)" for collection and preservation of samples.During investigation, sampling period was of one year, January 2012 to December 2012. The samples are well mixed and stored in two liter plastic cans. Sample collection was usually completed during hours between 6.00am to 9.00 am. The sampling sites were chosen and three sampling stations were fixed during the complete study for collection of biological samples. The details of these three sites are.

Site 1: Located at south, this site was selected for sample collection because it is comparatively less swampy part of the dam.

Site 2: Located at west and is characterized by shallow water.

Site 3: Located at north, characterized by shallow water, rid in zooplanktoncommunity.

III. OBSERVATION AND RESULT

Rotifer exist under wide range of environmental conditions such as dissolved oxygen, temperature and salinity etc., they play an important role indicating the presence or absence of certain fish species or in determining the pollution.

During Jan 2012- Dec 2012, SakkarTalaoexhibited a heavy bulk of total rotifers all through the period of investigation, the month May 2012 exhibited maximum (2010 org/1) at station I and minimum (197 org/1) in the month of July at station II, rotifers per liter respectively **(Table 1,2,3& Fig 1a, 2a ,3a, 1b, 2b ,3b).** Rotifers were represented by 7 genera and 12 species. *Brachionuscalyciflorus*dominated the reservoir and were observed at all the sampling stations. Station wise abundance of rotifers was in the order I > II > III**.** Pollution indicator rotifers like *Monostyla, Lepadella,* and *Brachionusfalcatus*were found in the water sample of whole reservoir. Among pollution indicator species*falcatus*was abundant at all stations; the reservoir represented the highest number of the species of the genus *Brachionus***.** Five species of this genus were recorded duringthe period of investigations. Similarly the genus *Keratella*with two species and remaining 5genera were represented by one species each **(PhotoPlate).**

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Brachionus species show decreases in March than Feb, about constant in April and May, shows decreasing trends from June to August (rarely found in August), strengthen in September and shows increasing towards December, January .Keratella at all spots shows near about constant population from February to July, Rarely found in August and September, few in October and about constant in November, December and January.

The rotifers were observed average in summer but asharp decrease in their number was noticed on the onset of rainy season reaching to its minimum in July. During winter, again a slight increase in abundance of rotifers was seen. This type of seasonal fluctuation is in confirmation with the findings of Seenayya (1973) and Davis (1976). Zooplankton established peak in May, June & December. This anomaly could be due to the feeding habits of the Zooplankton along with the high nutrient level. This is well in agreement with the observations of Davis (1976); Sharmaand Sahai (1990); Adholia and Vyas (1993); Bais and Agrawal (1995).Minimum density of zooplankton in monsoon months may be due to the influx of rainwater and dilution effect as reported by Chapman (1972) and Davis (1976). On the other hand zooplanktons might have consumed by fish population. Turbidity might have also caused death of zooplankton during rainy season. P^H had no direct bearing effect on the rotifers (Berzins and Pejler, I989) even though it appeared to be important in the distribution of various species. It was also reported by Haque et al., (1988). Most of the observed species comprised typical planktonic taxa reported to occur in alkaline waters and were known to tolerate a certain range of pH variation Koste, (1978). The present study is in support with the findings of Michael (1968); Nayar (1970) and Damodare R. A. (2004) relating tocoincidence of rotifer abundance with higher total alkalinity.

Table 1. Monthly variation of Rotifers (Org/L) at Station I of SakkarTalao

Species	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total	Avg
Branchionus Calyciflorus	420	42	60	806	450	0	0	84	33	72	0	1216	3183	265.25
Branchionus Caudatus	126	84	96	124	150	216	0	210	198	108	93	152	1557	129.75
Brachionus diversicornis	252	210	240	248	150	72	34	42	66	288	651	304	2557	213.08
Brachionus farficula	28	0	0	434	150	72	0	0	0	144	0	0	828	69
*Branchionus Falcatus**	42	84	96	0	200	0	0	0	66	0	0	0	488	40.66
Keratella quadrata	476	252	126	52	100	72	0	126	0	108	0	0	1312	109.33
Keratella tropica	0	0	0	62	800	0	34	0	33	0	186	76	1191	99.25
*Lepadela patella**	0	0	0	0	10	0	56	0	33	0	0	28	127	10.58
Monostyla closterocera*	14	0	15	20	0	0	25	0	0	0	0	13	87	7.25
Lecane arculata	0	42	0	35	0	0	35	0	0	0	0	0	112	9.33
Cepalodellagibba	28	42	0	0	0	0	26	0	42	0	0	0	138	11.5
Polyarthravularis	0	25	0	20	0	0	15	0	36	0	0	0	96	8

*** indicates pollution indicator species**

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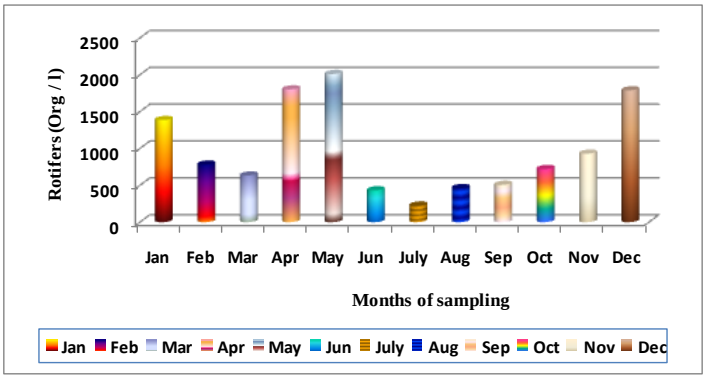

Fig. 1a.Monthly variation of rotifers at station I of SakkarTalao during Jan to Dec 2012.

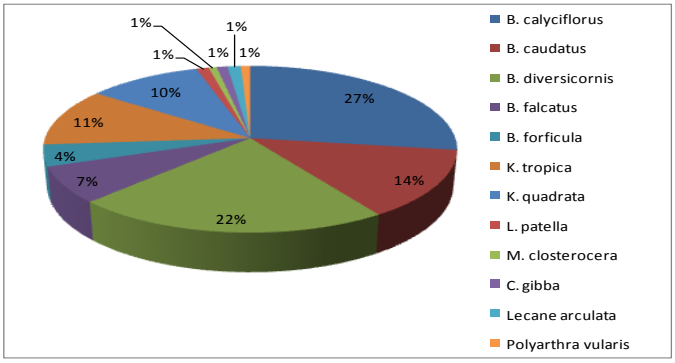

Fig 1b. Percentage of different species of rotifers at station I of SakkarTalao during Jan to Dec2012

Table2. Monthly variation of Rotifers (Org/L) at Station II of SakkarTalao

Species	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total	Avg
Branchionus Calyciflorus	378	41	56	852	396	0	0	86	43	68	0	752	2672	222.66
Branchionus Caudatus	112	78	87	138	125	209	5	128	184	128	90	142	1426	118.83
Brachionus diversicornis	146	190	262	242	135	72	21	37	76	265	642	321	2409	200.75
Brachionus farficula	22	0	0	432	126	56	0	0	0	123	15	0	774	64.5
*Branchionus Falcatus**	35	80	78	0	210	0	7	0	62	0	0	6	478	39.83
Keratella quadrata	456	278	156	52	109	65	0	122	0	112	23	0	1373	114.41
Keratella tropica	20	0	15	56	430	0	24	0	34	0	168	68	815	67.91
*Lepadela patella**	0	25	0	0	25	0	48	0	26	0	0	24	148	12.33
Monostyla closterocera*	12	0	22	26	0	16	21	0	12	0	0	22	131	10.91
Lecane arculata	0	40	0	35	0	0	32	13	0	32	27	0	179	14.91
Cepalodellagibba	32	36	0	0	12	15	24	0	38	0	0	5	162	13.5
Polyarthravularis	0	25	0	22	0	0	15	8	23	12	0	0	105	8.75

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* indicates pollution indicator species

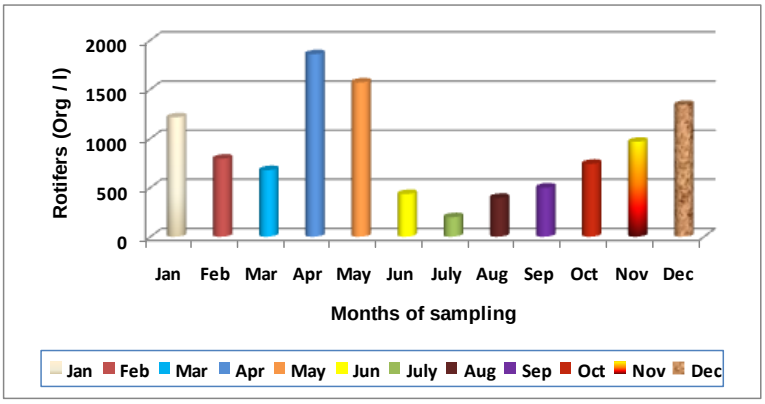

Fig. 2a.Monthly variation of rotifers at station II of SakkarTalao during Jan to Dec 2012.

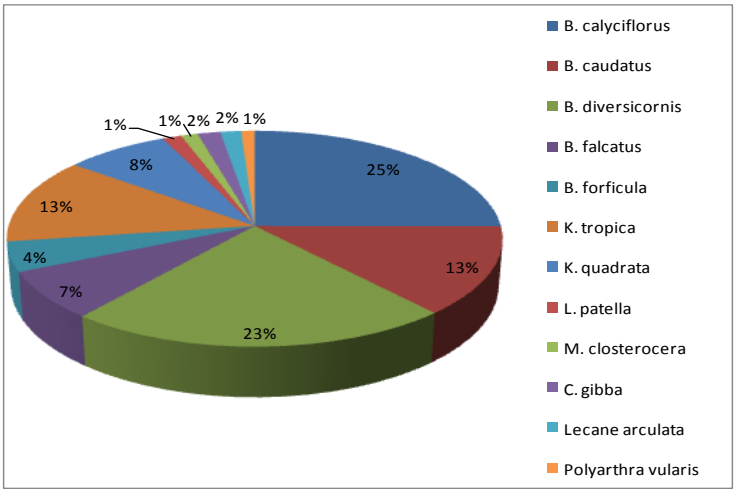

Fig 2b. Percentage distribution of different species of rotifers at station II of SakkarTalao during Jan to Dec 2012

Table 3. Monthly variation of Rotifers (Org/L) at Station III of SakkarTalao

Species	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total	Avg
Branchionus Calyciflorus	412	38	52	725	365	0	0	82	31	68	0	645	2418	201.5
Branchionus Caudatus	112	72	86	123	145	231	0	214	176	112	91	147	1509	125.75
Brachionus diversicornis	265	206	235	242	124	72	38	65	62	268	325	296	2198	183.167
Brachionus farficula	22	0	0	356	156	56	0	0	0	142	0	0	732	61
*Branchionus Falcatus**	36	82	92	0	225	0	0	0	59	0	0	0	494	41.16
Keratella quadrata	426	261	132	48	107	65	0	128	0	115	0	0	1282	106.83
Keratella tropica	0	0	0	56	564	0	42	0	46	0	192	84	984	82
*Lepadela patella**	0	0	0	0	35	0	58	0	32	0	0	42	167	13.91

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Monostyla closterocera*	23	0	12	28	0	0	22	0	0	0	0	23	108	9
Lecane arculata	0	36	0	32	0	0	36	0	0	0	0	0	104	8.66
Cepalodellagibba	22	42	0	0	0	0	29	0	38	0	0	0	131	10.91
Polyarthravularis	0	23	0	25	0	0	12	0	29	0	0	0	89	7.41

*Indicates pollution indicator species

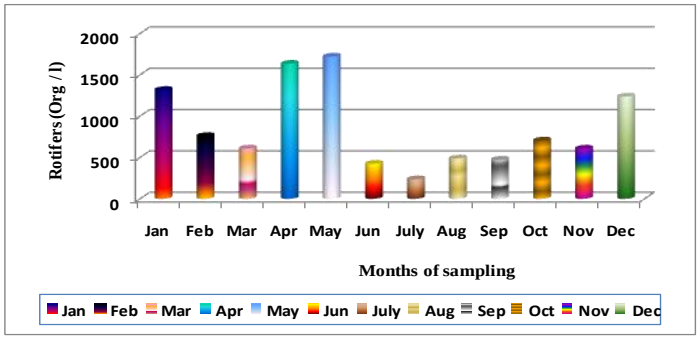


Fig. 3a.Monthly variation of rotifers at station III of SakkarTalao during Jan to Dec 2012.

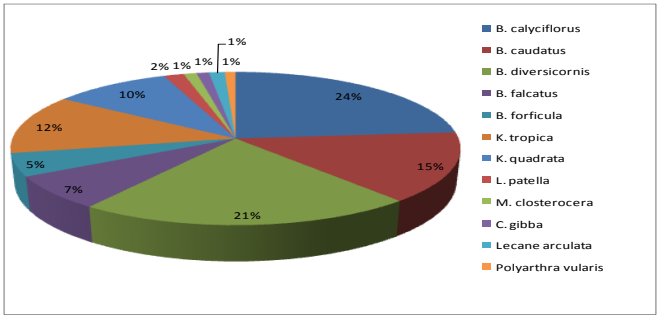
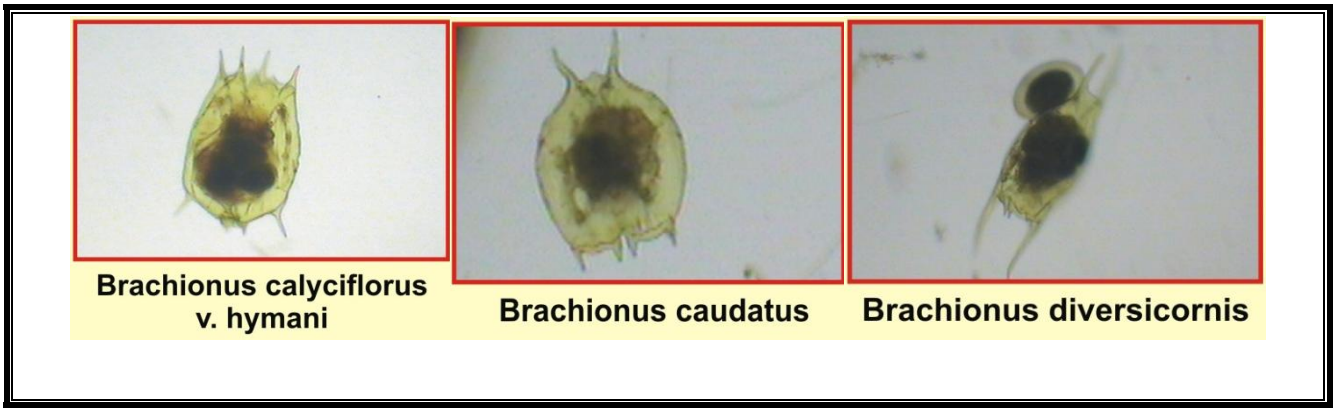


Fig 3b. Percentage of different species of rotifers at station III of SakkarTalao during Jan to Dec 2012



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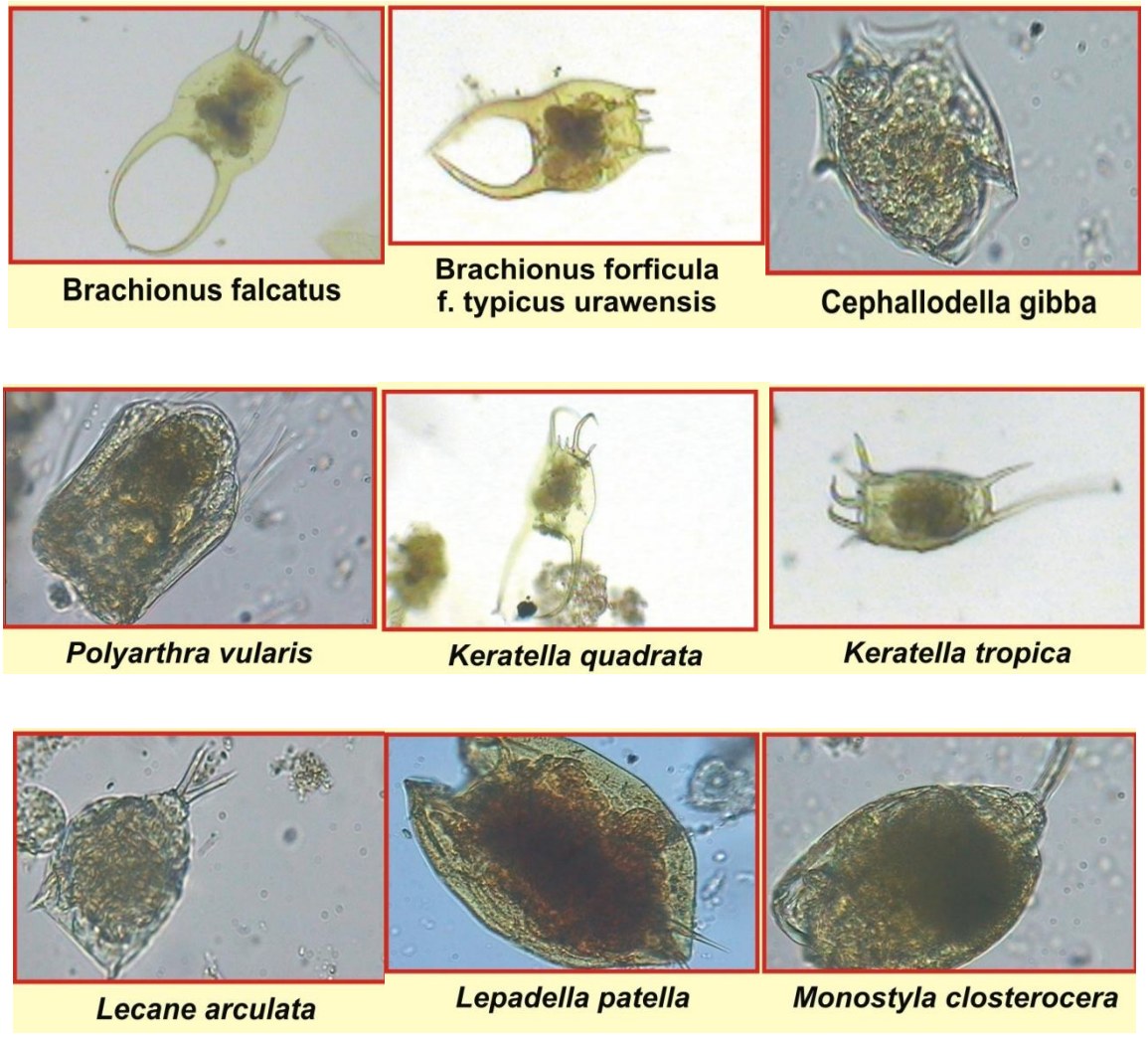

IV. DISCUSSION

Rotifers in general are very sensitive to change in environment and constitute in aquatic food webs. Therefore any adverse effect on rotifers will reflect on productivity of system and hence rotifers are most suitable indicator groups for assessment of any kinds of aquatic pollution. (Chandrasekhar, 2003)

Srinivas et al reported that Hussainsagarlake has been subjected varying degrees of pollution and consequent eutrophication. The current pattern of plankton biodiversity in the lake revealed a marked decline in the species diversity and only pollution resistance species dominated replacing the freshwater indicating forms of earlier studies.

The Rotifers observed during this investigation shows abundance in summer but a sharp decrease in their number was noticed on the onset of rainy season reaching to its minimum in August. During winter, again a slight increase in abundance of rotifers was seen. This type of seasonal fluctuation is in conformation with the finding of Seenayya (1973) and Davis (1976). Similar result were reported by Michael (1969) and Sharma and Sahai (1990). The low abundance of rotifer in January might have been resulted due to low water temperature. This coincides with the finding of Sparrow (1966); Vasisht (1968)

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In present study Rotifera was represented by 12 species of 7 genera and were found to be maximum in the month of May at station I **(Table 1,2,3& Fig 1a, 2a ,3a, 1b, 2b ,3b)** This type of specific distribution indicated that higher temperature and less nutrients and low oxygen content favored them to flourish. This is in confirmation with the observation of Arora (1966). Among observed Rotifers three Species (*B. falcatus, L. patella and M. closterocera*) were pollution indicators and they were found abundant at sampling station I, *B. falcatus* were found abundant at station III. The distribution of these species was typical at specific sampling sites and all sampling stations represented all the pollution indicator species. This type of species distribution indicated not only the different food habit of the Rotifers but also the type of pollutant in the water. At sampling Station I, the depth of water was comparatively less than that of station III and the activities of herbivorous vertebrates and human being with respect to different types of washing habits were predominant. These specific factors might have developed unstable condition and hence the much resistant Rotifers i.e. (11676 org/l) were observed from the sampling station I. Sudzuki (1964) also observed more resistant species of rotifers at unstable polluted regions of various lakes in Japan.

pH had no direct bearing effect on the Rotifers (Berzins and Pejler (1989) even through it appeared to be important in the distribution of various species. It was also reported by Haqueet. al, (1988). Most of the observed species comprised typical planktonic taxa reported to occur in alkaline waters and were known to tolerate a certain range of pH variation Koste, (1978). The present study is in support with the finding of Michael (1968); Nayar (1970); and Vasisht and Sharma (1976) and Domodare R.A. (2004) relating to coincidence of Rotifers abundance with higher total alkalinity.Almost constant pH of dam water towards alkaline side indicates lesser degree of eutrophication, which is further, substantiated by the low concentration and controlled presence of anions in the dam water. On considering total alkalinity, pH, nitrates, CO_2, Dissolved oxygen and Phosphate, it become quite evident that phosphates, CO_2 and dissolved oxygen are negatively correlated and it must the combine effect of these parameters, which would have governed the plankton population of the dam. The nutrient status of the dam has not attended a stage, which could favor the luxurious water blooms, and hence this dam water had never resumed the form of a green soup during the tenure of this project work. The biological indicators of pollution indicates the degree of determination of water quality, Arora (1961) opined that Rotifera occurs only in the polluted water and is absent in clean water. The occurrence of *L. patella* and *M. closterocera* in the water of Chilai reservoir is sufficient enough as an evidence of deterioration of water quality of the reservoir.

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