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Research Article

ZOOPLANKTON (PROTOZOAN & ROTIFERAN) POPULATION IN THE SEWAGE WATER

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ABSTRACT
Water is concerned with the microorganisms that live in water, or can be transported from one habitat to another by water can support the growth of many types of microorganisms. The microbiological examination of water has significant importance in case of pollution studies. Zooplankton are minute aquatic animals that are non motile or are very weak swimmers and they drift in water column of ocean, seas or fresh water bodies to move any great distance. In order to find out the extent of pollution and the relationship between inorganic matters and microbiota, a quantitative and qualitative analysis of zooplankton in various types of sewage waters, namely sewage water by the residential colonies (group I), industrial waste water (group II), sewage treatment hub (group III), unorganized collected waste water (group IV) and old residential waste collection center (group V), of Bikaner city (Rajasthan, India) was carried out from February, 2010 to May, 2010. Water samples were taken from surface only owing to low depth and investigated for various abiotic factors (viz. transparency, pH, carbonate, bicarbonate, total alkalinity, total hardness, salinity, chloride, calcium, magnesium, sulphate, nitrate, silica, and inorganic phosphorous) and biotic factors (viz. number and diversity of zooplankton). The average zooplankton count ranged from 21.2no./l (Group I) to 55.0no./l (Group III).

Keywords: *- Sewage, Zooplankton, Rajasthan*

INTRODUCTION
Water is synonymous to life as it is essential commodity for living beings including animals and plants, without which neither life nor development is possible. Domestic sewage is the major source of pollution of surface water in India which contributes pathogens, the main source of water borne diseases along with depletion of oxygen in water bodies. The abundance and distribution of microorganisms in aquatic ecosystems result from a complex of environmental factors and trophic interactions among a multitude of biotic components. Water microbiology is concerned with the microorganisms that live in water, or can be transported from one habitat to another by water can support the growth of many types of microorganisms. Microbes of concern in water microbiology are protozoa. The two protozoa of the most concern are *Giardia* and *Cryptosporidium.* Isamu Morishita (1976) worked on Protozoa in Sewage and Waste Water Treatment Systems. They reported Species of some 50-60 genera have been recorded, with peritrich ciliates being of most common occurrence. Use of such biological indices may be considered a distinct advantage in determining the state of water quality or the condition of activated sludge material. Water quality monitoring facilitates evaluation of nature and extent of pollution and effectiveness of pollution control measures, water quality trends and prioritisation of pollution control efforts. So in order to find out the extent of pollution, a study was conducted to know the relationship between inorganic matter and distribution of genera and population of bacteria in various types of sewage waters.

MATERIALS AND METHODS
The investigations of sewage of Bikaner city was carried out from February, 2010 to May, 2010 (4 month). The results are presented as average of four months. The water samples were taken from the surface, as the depths were very low, during morning between 7.00 a.m. to 12.00 a.m., and were investigated for various abiotic and biotic factors. Among abiotic factor included essential physicochemical parameters viz. transparency, pH, carbonate, bicarbonate, total alkalinity, total hardness, salinity, chloride, calcium, magnesium, sulphate, nitrate, silica, and inorganic phosphorous (Table 1).

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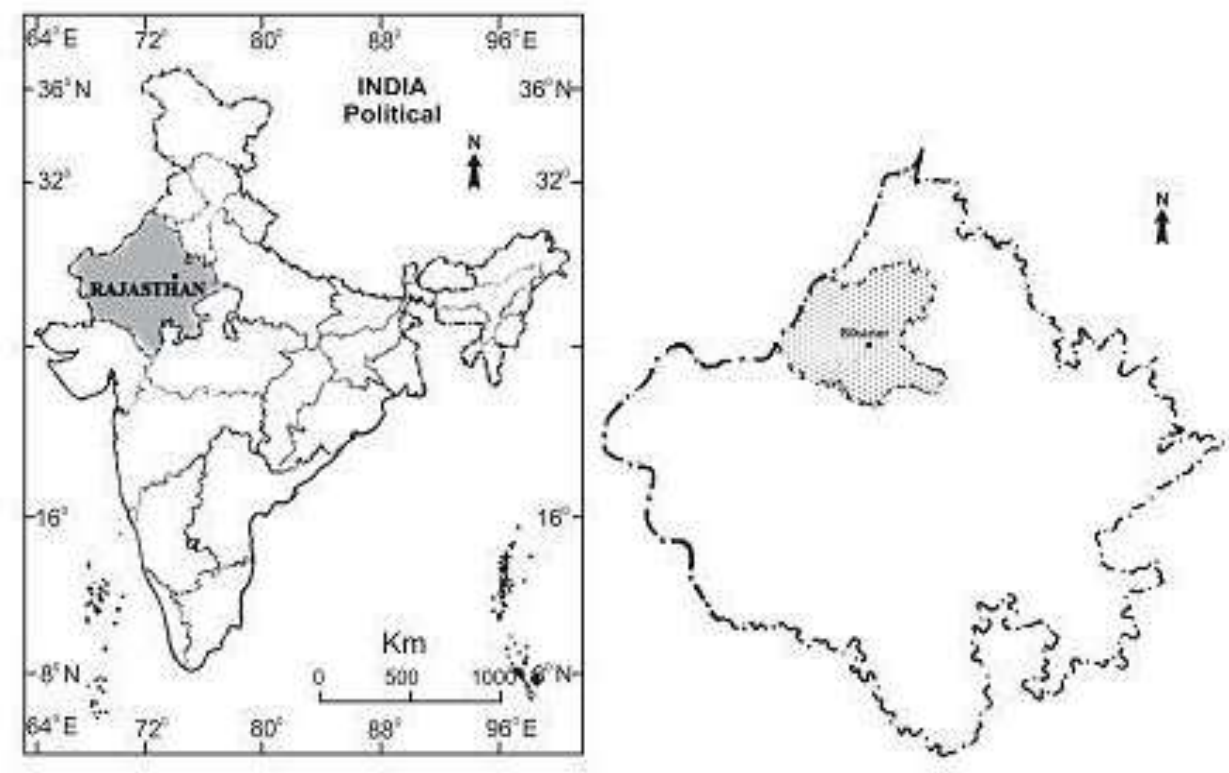
Biotic factors included number and diversity of zooplankton. For the collection of zooplankton, 25 litre water was filtered through zooplankton net made up of bolting silk (No. 25, Mesh size 55µ). The samples were transferred to narrow mouthed duly labeled bottles of 100 ml. 4% formaldehyde is then added in these bottles for the preservation of zooplankton collected. Zooplankton samples were transferred into a counting chamber and each zooplankter was identified and counted under a binocular research microscope. The identification of zooplankton organisms was done according to Edmondson (1966), Needham and Needham (1978) and Tonapi (1980).

Table-1: Physico-chemical characters of waste water of Bikaner, Rajasthan

Physico-chemical characters	***Group I***	***Group II***	***Group III***	***Group IV***	***Group V***
Transparency (m)	0.54	0.34	0.07	0.09	0.90
pH	8.49	7.76	7.29	7.89	8.29
Bicarbonate (mg/l)	31.4	35.6	21.45	21.3	20.15
Carbonate (mg/l)	0.01	0.01	0.02	0.03	0.015
Total Alkalinity (mg/l)	35.6	40.14	32.4	30.12	29.7
Salinity (gm/1.)	102.43	164.1	136.58	132.54	129.2
Total Hardness (mg/l)	50	51	49	61	46
Calcium (mg/l)	9.92	11	10.9	12.01	9.6
Magnesium (mg/l)	7.8	7.27	7.52	7.01	6.91
Chloride (mg/l)	42.36	60.21	58.14	56.73	49.5
Sulphate (mg/l)	38.9	24.5	23	20	41.3
Nitrate (mg/l)	13.9	12.1	11.58	10.79	13.19
Silica (mg/l)	1.61	1.001	0.961	0.95	0.91
Phosphate (mg/l)	0.233	0.413	0.382	0.390	0.290



Location of study area

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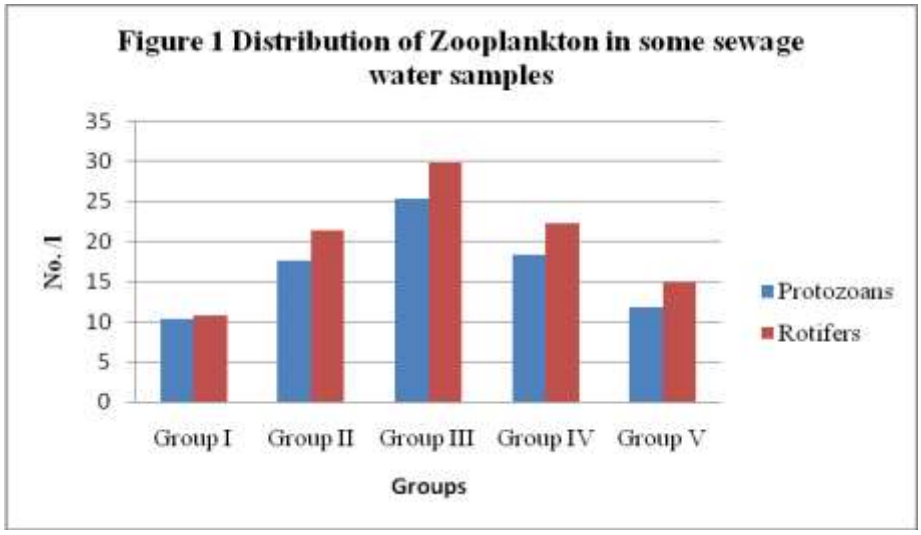

RESULTS AND DISCUSSION

Zooplankton population of the five groups of sewage waters was poor in diversity. They belonged to the major groups of protozoa and rotifer (Figure 1). The average zooplankton count ranged from 21.2no./l (Group I) to 55.0no./l (Group III). Zooplanktons are sensitive to changes in habitat and pollution, especially to organic pollution (Ramachandra T.V. Ahalya N., and Rajasekara Murthy C, 2005). Sharma, *et al.,* (2010) worked on Water Quality Status of Historical Gundolav Lake at Kishangarh as a Primary Data for Sustainable Management. They resulted that eutrophic condition of the lake is clearly indicated by the presence of pollution indicator species, viz. protozoans (*Paramecium caudatum, Oxytricha ovalis, O. oblongatus, Holophyra simplex* and *Cyclidium glaucoma*) Rotifers (*Brachionus calcyflorus, B. forficula, Keratella tropica* and *K. procurva*) and copepods (*Neodiaptomus schmackari, Mesocyclops leuckarti* and *M. hyalinus*). Rotifera was dominated in all groups quantitatively. In terms of percentage Rotifers were the most dominate form followed by Protozoans. Protozoa was represented by three genera namely, *Paramecium sp., Peranema sp, Glaucoma sp.* Its count ranged from 10.3 (Group I) to 25.2 (Group III). *Paramecium* was dominated in all the types of sewage waters while *Peranema comes next to paramecium and Glaucoma* was the lowest in the series (Table 2). Rotifera was represented by three genera (Table 2).

Table 2: Zooplankton populations in sewage water samples in different groups in Bikaner city

Zooplanktonic Genera	***Group I* (No./l) Aver.**	***Group II* (No./l)Aver.**	***Group III* (No./l) Aver.**	***Group IV* (No./l) Aver.**	***Group V* (No./l) Aver.**
PROTOZOANS					
Paramecium sp.	4	8	10	7.2	4.5
Peranema sp.	2.3	6.5	8.2	9.1	5.3
Glaucoma sp.	4	3	7	2	2
***Total* Protozoans**	**10.3**	**17.5**	**25.2**	**18.3**	**11.8**
ROTIFERS					
Asplanchna sp.	6	3	5	4	5
Brachionus sp.	nil	16	14	9	10
Kertella sp.	4.8	2.3	10.8	9.2	nil
***Total* Rotifers**	**10.8**	**21.3**	**29.8**	**22.2**	**15**
***Total* Zooplankton**	**21.2**	**38.8**	**55.0**	**40.5**	**26.8**

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The water was turbid in all the types of sewage water due to silt. The sechhi disc transparency of Group V (Mini sursagar) was found to be highest 0.90m. While at Group III (Sewage treatment plant) it was minimum i.e. 0.07 m. The water of all types of sewage was found to be alkaline as their pH was above 7.29. The various ionic species that contribute mainly to alkalinity includes bicarbonates, carbonates, hydroxides, phosphates, borates, silicates and organic acids. Carbonates ($CaCO3^{-}2$) were always less than bicarbonate ($HCO3^{-}$). Carbonate alkalinity of sewage water was recorded to be highest 0.03 mg/l (Group IV) and minimum 0.01 mg/l (Group I, Group II). While bicarbonate alkalinity was highest in Group II (35.60 mg/l) and minimum in Group V (20.15 mg/l). In General, carbonate alkalinity showed inverse relationship with bicarbonate. Hence it is evident bicarbonate alkalinity was major contributor to the alkalinity. Salinity has the constant relationship with chlorinity. Infact, salinity is the amount of chloride ions present in gm/l water. Therefore these two parameters are discussed together. In present study it's ranged between 102.43 gm/l to 164.1 gm/l. The concentration of chloride ions was maximum (60.21 mg/l) in Group II, while it was minimum (49.50 mg/l) in Group V. (Table-1). Water of Group IV was observed to be hardness (Total Hardness 61 mg/l as CaCO3). While it was reported to be only 46 mg/l as CaCO3 in Group V. In other types of sewage water the value remains between 46mg/l as CaCO3 to 61 mg/l as CaCO3. In the present study, calcium was the dominat ion, its maximum concentration was recorded to be minimum (9.60 mg/l) in Group V. whereas it's maximum concentration was record in Group IV (12.01 mg/l). In the present study sulphate ions ranged from 20.0 mg/l (Group IV= Vallabh Garden) to 41.3 mg/l (Group V= Mini sursagar) in all the sewage water. Magnesium was reported to be lesser than the Calcium in all the types of sewage water samples i.e. 6.91 mg/l (Group V) to 7.8 mg/l (Group I). Nitrate is the highest oxidized form of nitrogen. The highest concentration of nitrate was observed in Group I as 13.5 mg/l, where as it was recorded to be lowest (10.79 mg/l) Group IV and silica was found to be between 0.910 mg/l (group V) and 1.61 mg/l (group I). The concentration of phosphate ions (orthophosphate, inorganic phosphorous) was observed to be lowest order to be all other ions. In the present study was observed between 0.223 mgt/l (Group I) to 0.413 mg/l (Group II).

Total rotifer an population ranged from 10.8 no./l (Group I) to 29.8 no./l (GroupIII). Among rotifers *Brachionus sp.* and *Kertella sp*. Dominated in Group III while *Asplanchna sp*. remained more or less constant in all the sewage water (Table). The zooplankton population of the waterbody understudy was poor as its population fluctuated between 21.2 no./l to 55.0 no./l in the sewage water groups. The population of zooplankton was well within the range a reported by earlier workers in Bikaner region. Bahura, 1990 recorded lowest zooplankton count (2.89 no./l) in Kolayat lake amongst the eight water bodies studied. Whereas she reported 1733.16 no./l in Harsholav pond. Bahura, 1989, reported 745.6 no./l of zooplankton in Shivbari temple tank, Bikaner. Lubana (1991) noted 41.05 to 87.0 no./l zooplankton in Kodamdesar pond. Among protozoa Paramecium sp. was observed during April and June. Its highest population (68.1%) was recorded during early June when the peak of zooplankton population was observed by Bahura, C.K. *et al.,* (1993).

The zooplankton population was represented by members of Protozoa & Rotifera. The zooplankton population was dominated by Rotifers over the all groups (Saxena and Bhargava, 1981). Its percentage in the total zooplankton population was almost consistent at surface (51.42% to 55.98%). The dominance of Rotifera have also been reported in other waterbodies in this region (Bahura, R., 1990; Bahura,C.K., 1989; Sidhu, 1991; Lubana, 1991; Nayar, 1970; Unni, 1985; Rao, 1985).Among Rotifera, *Asplanchna, Brachionus* and *Keratella* species, as not iced in the present study. *Brachionus* and *Keratella* were reported from other waterbodies in this region (Bahura, R. 1990; Sindhu, 1991; Lubana, 1991; Bahura, C.K., *et al.,* 1993). Saxena and Bhargawa (1981) reported *Asplanchna sp*. in polluted pond of Jodhpur. It is a rotifer and its population showed an increasing trend. This species flourished even when conditions caused by the pollution were the most stressful, viz. low oxity and pH. As such, this rotifer appears to be a biological indicator of saprobic condition of water. Sampath *et al.,* (1979) also regarded rotifers as biological indicators of water quality in Cauvery river.

In terms of total zooplankton biomass responsible for biodegradation of putrisable faecal material, rotifers dominant in oxidation ponds and manmade lakes receiving domestic sewage (Bogdon *et al.,* 1980). Arora

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(1963) has listed rotifer species as indicators of water quality classified into clean, polluted and heavily polluted categories. Accordingly among *Brachionus species, calyciflorus* and *angularies* indicate polluted water. Arora (1966a) studied Indian rotifers and found that *Brachionus* species inhabit only grossly polluted water (diluted sewage of oxidation ponds). In fact, rotifers were found to be characteristic zooplankton of the zones of pollution (Das and Pandey, 1978). Geeta Nair, *et al.*, (1999) studied on temporal organization in population density of protozoans in septic tank sewage. They analysed time series data to validate statistically significant annual rhythms in population density of protozoans. Results reveal that rhythmic patterns in population density of various species of sarcodines appear to be highly synchronized with peaks occurring in between mid-March and the first week of July. During the comparable time period at least 6 species of flagellates and 1 species of ciliates showed temporal synchrony with that of the sarcodines. Results of this study may help in optimizing sewage treatment practices involving protozoans.

Conclusions

Water is contaminated with human wastes which may carry disease germs and parasites. In urban areas they may use water in toilets to carry these wastes away. Animal wastes may also carry disease germs which can get into water and pollute it. These wastes not only carry diseases and other dangerous things, they also may be high in nitrogen nutrients. Too high a level of nutrients can make algae grow too fast in streams, lakes or lagoons, smothering other kinds of life and building up until they start to rot and kill the fish. If the nitrogen compounds get into drinking water, they can be turned into nitrites which have been linked to cancer in humans. Higher value of rotifers (Group II, III, IV) indicating a biological indicator of saprobic condition of water.

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