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A Study on Relationship Between Zooplanktonic Community and Ionic Regime of Water in a Lake in The Indian Desert

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Abstract - A limnological investigation was carried out for 12 months in Gajner lake at Bikaner, the desert region of Rajasthan with special reference to Zooplanktonic community and its relationship with ionic regime. A general trend of anions was recorded as Cl>HCO3>SO4>CO3. On annual mean basis it was found that chloride was the major (102.32 mg/ltr.) and bicarbonates, carbonates and sulphates were the minor anions (21.54-66 mg/ltr). Among cations the trend was recorded as Mg>Ca>K>Na depicting that sodium and potassium were the major cations. During the present investigation, total zooplankton population ranged from 4 no./ltr to 130 no./ltr. Various genera of protozoans dominated zooplanktons community, while Turbellaria as at the lowest end while Rotifers were moderate. The major group Protozoa was represented by 10 genera of which Stenter *coruleus*, Euglena *sociabilis*, Paramecium *caudatum* were major ones.

Keywords- water lake, Protozona, Bikaner.

I. Introduction

Among the six natural life supporting ecosystem types of the earth, deserts occupy roughly one-seventh of the land surface. The state of Rajasthan marks the western territory of the country. The panoramic view of the state is mesmerizing with its lofty hills of the Aravali and the golden sand dunes of the Great Indian Desert. In this desert fewer but varied bodies of water are present in the form of ponds, tanks, reservoirs and a few perennial lakes.

Surface water in the hot deserts are scarce and stressed resources. These are prone to harsh environmental conditions and are therefore, characteristic in their physical, chemical and biological features. Wide daily and seasonal thermal variations, better illumination, closed shallow basins,

high evaporative loss leading to concentration of electrolytes, characteristic ionic composition and long dry periods are the common features experienced by such water.

Bikaner represents the extreme arid conditions wherein various limnological and hydrobiological investigations have been made over last three decades. Zooplanktons are myriads of diverse floating and drifting animals, which play a vital role to study fauna, biodiversity of aquatic ecosystem

It represents the channel of transmission of energy flux from primary producers to top consumers. Zooplanktons are highly sensitive to environmental variation, as a result of which change in their abundance species diversity or community composition can provide important indication of environmental change or disturbance. The present study is aimed at evaluating zooplanktons community of desert water with special reference to ionic regime of the medium.

II. Materials and Methods

The study was carried out on Gajner lake situated about 35 kms. away from Bikaner in 2015-16. Gajner is famous as a historical place with a palace and a wildlife sanctuary. Limnological parameters, viz. temperature, pH and EC were recorded by a battery operated digital portable water analyzer kit (Model: Century CK710). Depth of water was measured using a weight tied to a graduated nylon rope. Transparency was recorded with the help of standars Secchi disc of 20 cm diameter. DO was estimated by Winkler's titration method. The Free Co2, Total alkanility, Calcium, Nitrate, Phosphate, Silica, Sulphate, Sodium and Pottasium were analyzed by spectrophotometric and flamephotometric methods respectively. Standard methods as prescribed by APHA-AWWA-WPCF (1975), Stickland and Parsons (1972), Golterman et al., (1978) and Saxena (1989) were followed. Zooplankton were collected by filtering 50L of water through aplankton net made of bolting silk (No.25, 0.3mm mesh). The samples were transferred to the narrow mouthed bottles of 100 ml and preserved with 4% formaldehyde. Systematic identification of zooplanktons was made following Edmondson (1966), Michael (1973), Needham and Needham (1978) and Tonapi (1980).

III. Result and Discussion

Table 1 provides data on physical-chemical limnology of the lake. Minimum water temperature was noted during December (13.5 °C) which thereafter continuously increased touching the peak of 35°C in May. The lake water was always alkaline with pH ranging between 7.1 to 9.1. Within this narrow range, however, the pH erratically fluctuated. The electrical conductance of water ranged from.072 to 0.127 mmho/cm. It was constantly low during monsoon seasons, while there was a constant decrease during summer. The water was found to be well aerated. The dissolved oxygen content varied between 0.9 mg/ l to 11.3 mg/ l. Among cations, sodium, potassium,calcium and magnesium were assessed; of these sodium and potassium predominated. Although for most part of the year the concentration of sodium ranged only between 0. 24mg/l to 23.39 mg/l. But in the month of July, it touched a peak of 72.02 mg/l. Concentration of potassium ions ranged from as low as 7.41 mg/l in March to as high as 84 mg/l in November. Calcium, a dominant cation, presented irregular fluctuations in its concentration ranging from 14.12- 87.23 mg/l. Magnesium presented a trend precisely similar to that played by calcium. It ranged from 33.96 mg/l to 117 mg/l. Among anions, carbonates bicarbonates, chloride and sulphates were monitored. However, other minor anions having a role of plant nutrients, including phosphate, silica and nitrate, were also assessed. Carbonates ranked second to bicarbonates among anions. It ranged from 22.17 mg/l (Jan) 3 8.7 mg/l (Oct). The concentration of bicarbonate ranged from 33.6 mg/l (Dec) to 1 50.4 mg/l (Mar). Chloride and sulphates presented highly erratic

annual trend. The lowest chloride concentration was recorded in May as 62.09 mg/l while the highest chloride concentration evident in October was 163.07 mg/l. Sulphates were least among major anions. Their concentration ranged from as low as 20.96m/l (April) to the maximum 72.32 mg/l (Jan.) Concentration of phosphate ions ranged from as low as .0002 mg/l (June) to as high as .008 mg/l (Sep.). The lowest silica concentration was recorded in July (.9733 mg/l) and highest in January (4.0 27 mg/l). The concentration of nitrates ranged between .024 mg/l to .227 mg/l.

ZOOPLANKTON COMMUNITY

Table 2 represents the abundance and distribution of zooplankton is guarded by a variety of ecological factors. However limnological parameters are extremely variable from time to time. In such conditions it is rather difficult to draw specific illusions about their individual effects of these parameters on population densities of zooplankton. But it can be expressed in general that the fluctuation patterns of physico- chemical conditions of water effects the distribution of zooplanktons. The protozoans from the dominant group showed 10 genera. Tonapi (1980) has opined that protozoans occur in all the conceivable habitats, over a wide range of chemical and physical environment. Total zooplankton population ranged from 4 no./l to 130 no./l. Various genera of protozoans dominated the zooplanktons community. The major group protozoa was represented by 10 genera of which Stenter Coeruleus , Euglena Socialibis, Paramecium caudatum were major ones. From monsoon to winter there was a continuous rise in protozoan population.

Total zooplanktons were negatively influenced by EC, potassium and chlorides while these were favoured by dissolved oxygen ($p < 0.001$) depth and phosphates($p < 0.1$). Concentration of sodium sulphates and nitrates had little bearing on zooplanktons. Rotifers showed 8 taxa and also its maximum count noticed in spring season. Hutchinson (1967) observed that Brachionus species are very common in temperate and tropical waters which indicates alkaline nature of the water. The abundance of mud, debris and decaying matter of the lake provides suitable management for the survival and growth of annelids so it is followed by oligochaetes and one hirudin. The population rises to a higher level in the winter as a result of favourable environmental conditions, including temperature, dissolved oxygen and the availability of abundant food in the form of bacteria, nanoplankton and suspended detritus. The summer population of total Zooplankton falls during the monsoon due to a dilution effect. Similar results have been shown by Bais and Agrawal (1993). Thus the study has determined that the abundance of zooplanktons has been governed by the cumulative effect of physico- chemical and biological variables.

Variable	Months												
	Dec	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Average
Air temp	15	23	25	35	39	43	36	32.0()00	32	30	30	18	29.8333
Water temp	13.5	15.5	24.5	24	25.5	35	32	30	29	28	24.5	15.5	24.75
Depth (m)	2.5	3.2	1.5	2.3	2.1	1.27	1.2	1.65	2.3	1.65	3	2	3.8317
pH	8.5	8.4	8.5	8.8	8.3	7.1	7.6	7.8	8.5	9	9.1	9.1	8.4
EC (mmhos)	0.072	0.093	0.083	0.128	0.113	0.153	0.127	0.121	0.098	0.086	0.077	0.137	0.1073
DO (mg/l)	6.12	7.7	8.6	8.8	0.9	0	0	4.46	4.12	6.9	7.7	11.3	5.55
Free CO2	0	0	0	0	12	8	18	60000	0	0	0	0	3.6667
Alkalinity	57	75	52	76	130	107	124	78	67	46	54	48	75.8333
Hardness	75	25	65	104	147	162	129	120	77	140	74	74	99.3333
Salinlty	254.01	179	130	179	1,340,000	124.13	155.97	169.15	170.12	195	299.23	260	187.4842
Sodium	1.2	16.43	13.32	12.5	17.28	23.02	4.73	72.02	20.12	23.39	23.39	0.24	18.97
Potassium	13.1	14.3	9.32	7.41	8.23	12.15	16.2	12.2	9.7	10.4	40.1	84	19.7592
Calcium	19.14	17.12	14.12	63.14	87.23	73.14	70.42	59.02	53.97	22.72	23.99	46	45.8425
Magnesium	47.72	40.97	33.96	91.6	117	102.02	95.6	89.3	79.1	45.4	44.1	75	71.8142
Carbonate	32.15	22.17	33.24	32.89	0	0	0	0	37.14	38.2	38.7	24.1	21.5492
Bicarbonates	33.6	42	47.2	150.4	69.3	56.2	70.2	90.7	74.2	62.2	45.6	50.4	66
Chloride	141.82	99	70.914	99.21	72.12	62.09	84	92.18	94.14	106.3	163.07	142.8	102.3212
Nitrate	0.079	0.224	0.239	0.287	0.113	0.101	0.034	0.124	0.132	0.227	0.217	0.024	0.1501
Phosphate	0.0004	0,0003	0.007	0.0007	0.0009	0.001	0.0002	0.0007	0.002	0.008	0.0006	0.0009	0.0019
Silica	3.1423	4.0217	3.2479	2.7807	3.3202	2.5138	0.9832	0.9733	1.2712	1.0422	1.4232	1.9033	2.2186
Sulphate	26.84	72.32	43	63.44	20.96	31.34	60.08	92.72	23.72	21.66	33.22	31.22	43.3767

	Months											
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
PROTOZOA												
Euglena sociabilis	3	2	1	0	1	0	1	0	0	1	2	5
Euglena spirogyara	1	0	0	1	0	0	0	1	0	2	0	1
Paramecium caudatum	34	15	4	1	0	0	2	0	0	0	2	1
Litonotus fasciola	2	0	2	0	0	0	0	0	0	0	0	1
Chilodonella cucullulus	0	4	2	0	1	2	0	2	1	3	2	10
Stylonychia pustulata	2	1	2	0	1	0	0	0	0	2	2	1
Coleps hirtos	6	3	0	1	0	0	0	0	0	0	0	2
Stentor coerulus	35	62	6	9	0	0	0	2	4	1	0	2
Amoeba proteus	0	0	0	0	0	0	0	0	0	4	0	0
Amoeba radiosa	0	0	1	0	0	0	0	0	0	2	0	0
Total Protozoans	83	87	18	12	3	2	3	5	5	15	8	23
TURBELLARIA												

Porhynchella minuta	0	0	4	2	1	0	0	0	0	0	0	0
Total Turbellaria	0	0	4	2	1	0	0	0	0	0	0	0
ROTIFERA												
Kerarella cochlearis	2	1	2	4	1	0	0	3	2	4	3	2
Keratella Valga	1	0	0	0	0	0	0	0	0	0	2	0
Brachionus calyciflorus	1	0	0	0	0	0	0	0	0	2	0	1
Brachionus havanaensis	2	0	0	0	0	0	0	1	0	0	0	2
Platyias platulus	0	0	3	1	0	0	0	1	0	0	2	0
Keratella quadrata	5	2	0	1	0	0	0	0	0	0	2	1
Monostyla lotica	3	0	0	0	0	0	0	0	0	0	4	2
Lecane lorica	1	2	0	0	0	0	0	1	0	0	2	1
Total Rotifers	15	5	5	6	1	0	0	6	2	6	15	9
OLIGOCHAETA												
Tubifex	3	0	0	0	0	0	2	2	0	0	0	0
Aeolosoma hemprichi	2	2	0	0	0	0	0	0	0	0	3	0
Total Oligochaeta	5	2	0	0	0	0	2	2	0	0	3	0
HIRUDINEA												
Hemiclapsis marginata	0	2	3	0	0	0	0	0	0	0	0	0
Total Hirudinea	0	2	3	0	0	0	0	0	0	0	0	0

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