



Zooplanktonic Fauna in Relation to Physico-Chemical Characteristics in Madar Tank, Udaipur, Rajasthan, India

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Abstract

Aquatic ecosystems consist of physico-chemical and biotic components. Physico-chemical parameters are directly affecting to diversity of flora and fauna of water bodies. Madar Tank (24°41'3"N 73°36'20"E) was mainly built as a storage reservoir to fill water in Fatehsagar through a canal. Study was undertaken (seasonal study for two annual cycles) to assess different physico-chemical parameters, primary production and Zooplanktonic fauna of Madar. The mean value of physico-chemical parameters of water were analyzed such as pH (7.85), depth of visibility (81.38 cm), electrical conductance (0.745 mS/cm), TDS (476.61 ppm), chloride (115.83 ppm), alkalinity (124 ppm) and hardness (177.33ppm) that showed low mean values. Average dissolved oxygen level was recorded as 6.9 ppm while average nitrate and phosphate levels were 3.478 ppm and 2.6802 ppm respectively. The primary production was analyzed 261.64mgc/m²/hr. On the basis of water quality parameters in general, Madar tank was found to be mesotrophic. During the present investigation, 10 species of Protozoans belonging to 9 genera, 31 species of Rotifers belonging to 14 genera were recorded. Along with these 17 species of Cladocerans belonging to 10 genera, 4 species of 4 genera belonging to Copepoda and 2 forms of Ostracods were also enlisted. After including occasional zooplankters like insects and their larvae, crustacean larvae, spiders and mites (2) total 68 forms of zooplankters were recorded.

Key words: Physico-chemical parameters, madar tank, primary production, zooplankters, mesotrophic.

Introduction

Biodiversity is a precious heritage which is blessed by nature to save the planet and mankind. It is a variety of life which encompasses different genus, species, community and ecosystem along with their relative abundance¹. Fresh water ecosystem includes primary producers as phytoplankton, algae and hydrophytes, primary consumers as zooplankton as well as phytophagous fishes and secondary, tertiary consumers as fishes and some other organisms.

Zooplanktons are small animals that float freely in surface water, column of water bodies and whose distribution is primarily determined by water waves and current. Zooplanktons of Indian freshwaters have been studied by various researchers²⁻¹². Rapid development in recent years has led to an increased demand for water and it does depend on ground water¹³⁻¹⁴. The freshwater Zooplankton consists mainly of 4 major groups *i. e.* Protozoa, Rotifera and two orders of Crustacea *viz.*, Cladocera and Copepoda.

The lakes of South Rajasthan harbour diverse planktonic flora and fauna¹⁵. Limnology of Rajasthan waters with special reference to zooplanktonic composition and density have been studied by various researchers on their important contribution¹⁵⁻¹⁸. A notable contribution in assessing limnological status and trophic structure

of freshwater bodies has been made by another researcher¹⁸⁻²². Bada Madar Tank was mainly built as storage reservoir to fill water in Fatehsagar through a canal. Although, water is also used for irrigation in and around Madar village. Water spread area of the pond is 0.8 Sq. Km. with maximum depth of 7.31m. This is surrounded by hill. Present study focuses only on the physicochemical parameter and zooplanktonic fauna in Bada Madar Tank.

Material and Methods

Study area: Water body investigated is Bada Madar Tank (73° 36' 28" E and 24° 41' 1" N) which water to Fateh Sagar through Chikalwas feeder also known as Madar Nahar. The catchment area of Bada Madar is 87 Sq. Km. and its gross capacity is 2.38 mcm. Its water spread is 0.8 Sq. Km. and total depth is 7.31 m. The length and width of the lake are 2.75 Km and 1.5 Km respectively (figure-1).

Collection of water samples: During the study water samples were collected at seasonal intervals from winter 2008 to monsoon 2010 from pre-selected stations of the Lake. The water quality parameters such as air and water temperature, pH, depth of visibility, alkalinity (Carbonate and bicarbonate), dissolved oxygen and primary productivity were measured in the field itself. However, for the electrical conductivity, nitrate nitrogen,

orthophosphate, silicates and fluorides samples were brought to laboratory in plastic bottles of 500 ml. capacity and analyzed within 24 hours. Primary productivity was estimated using light and dark bottle method. Physico-chemical characteristic were analyzed immediately²³⁻²⁴.

Collection and analysis of Zooplankton samples: For the collection of plankton samples, 50 litres of surface water was filtered through Plankton net made up of bolting silk no. 30. The plankton samples so obtained were preserved in 70% alcohol. For the qualitative and quantitative studies in the laboratory, Plankton analysis was made using a C Z inverted microscope then analyzed²⁵.



Figure-1
Udaipur Rajasthan (INDIA)



Figure-2
Fateh Sagar Lake Udaipur



Figure-3
Bada Madar Tank Udaipur

Results and Discussion

Observations pertaining to different physico-chemical parameters and primary production of Bada Madar Tank are given in the table 1.

Temperature: During the study period, there was a marked variation in different water quality characteristics. Hutchinson²⁶ stated that temperature is important in controlling both the quality and quantity of plankton flora. In the present study, the recorded surface water temperature is 20.2°C to 43.3°C. The statistical computation indicated that water temperature had positive significant relationship with visibility, nitrate, and phosphate. This supports by various observation^{27, 20, 28-29}.

Depth of Visibility: The variation in depth of visibility ranged from a minimum of 66.6 cm to maximum 101.4 cm. The statistical computation indicated positive significant correlation of water clarity with hardness, nitrate, phosphate, conductivity, TDS, and chlorides.

pH value: The pH value of water was moderately alkaline and varied from 7.5 to 8.2 during the present study. Chisty²⁹ noted a pH range of 7.8 to 8.4 in Bada Madar during winter 1997 to monsoon 1998. The statistical computation indicated positive significant correlation of pH with dissolved oxygen, conductivity, TDS, visibility, hardness, phosphate, and temperature. In general the solubility and availability of nutrients is affected by oxygen content of water and therefore the productivity of aquatic ecosystem³⁰.

Dissolved Oxygen: The dissolved oxygen content in Bada Madar Tank during the study period varied between minimum of 6.7 mg/l to the highest 7.5 mg/l. Chisty²⁹ observed minimum and maximum value of 4.3 mg/l and 8.9 mg/l in Bada Madar Tank during winter 1997 to monsoon 1998. High dissolved oxygen is a sign of oligotrophic waters. Dissolved oxygen showed a positive correlation with temperature, chlorides, hardness, nitrate, phosphate, and pH.

Total Alkalinity: During the present study, total alkalinity varied between 103 ppm to 142 ppm while the recorded average value of total alkalinity in Bada Madar Tank as 124 ppm. The statistical computation indicated a positive significant correlation to total alkalinity with TDS, conductivity, nitrate and dissolved oxygen. An increase in total alkalinity may be related with increase in pH as suggested³⁰.

Electrical Conductivity: The electrical conductivity, which represents the total ionic load of water, had the average values of 0.745 mS/cm. The electrical conductance showed positive significant relationship with nitrate, phosphate, visibility, chlorides and TDS.

Total Hardness: The total hardness of water is the sum of cations present in it. These parameters ranged between the lowest value of 136 ppm and the highest values of 262 ppm. During the present study, total hardness showed positive relation with visibility, phosphate, nitrate, pH, and total zooplankton density. However, the relation was inversely with alkalinity, gross primary production and dissolved oxygen.

Chloride: As depicted, chloride concentrations varied between 67 mg/l to 179 mg/l with average values of 115.83 mg/l.

Total Dissolve Solid: In the present study, TDS ranged between 178 to 728 with an average value of 476.61. TDS shows a positive relationship with visibility, conductivity, nitrate, phosphate, pH and alkalinity.

Phosphate: Phosphorus is one of the important nutrients governing overall algal growth. It plays a pivotal role in productivity of water bodies. During the present study phosphate ranged between 1.2546 to 4.956 mg/l with average value of 2.6802 mg/l. Chisty²⁹ noted phosphate range of 0.0641 to 1.0115 mg/l in Bada Madar Tank during winter 1997 to monsoon 1998. The comparative low level of phosphate indicated that water free from effluent contamination³¹. Phosphate shows a positive relationship with pH, Hardness, visibility, temperature and nitrate.

Nitrate: Nitrate is one of the most stable forms of nitrogen, which enhances the growth of plankton, their density, and primary production. In the present study, the values of nitrate varied from 2.412 to 4.654 mg/l. Chisty²⁹ observed nitrate ranged between 0.121 to 0.43 mg/l in Bada Madar Tank during winter 1997 to monsoon 1998. The statistical computation indicated a positive correlation of nitrate with phosphate, conductivity, TDS, alkalinity, chloride and visibility.

Gross primary production: During the present study, gross primary production has been estimated by light and dark bottles methods. The overall mean values gross primary production in Bada Madar Tank was 261.64 mgc/m²/hr. Russel Hunter³² categorised lakes into ultraoligotrophic, oligotrophic, mesotrophic, eutrophic and hypereutrophic lakes having mean primary production range of <50, 50-300, 250-1000, and 10, 000 mgc/m²/day respectively. As per this classification, Bada Madar Tank comes in mesotrophic category.

Observation of Zooplanktons: During the present investigation, 10 species of Protozoans belonging to 9 genera, and 31 species of Rotifers belonging to 14 genera were reported to represent these Phyla among Zooplankton. Along with these 17 species of Cladocerans belonging to 10 genera, 6 species of 3 genera belonging to Copepoda and 2 forms of Ostracods were also enlisted. After including occasional zooplankters like insects and their larvae, crustacean larvae, spiders and mites (2) total 68 forms of zooplanktons were recorded (table 2). In the group Protozoa, *Volvox* sp. *Vorticella* sp. And *Peridinium* sp. Were dominant. *Keratella tropica*, *Brachionus calyciflorus*, *Monostyla bulla*, *Filinia longiseta*, *F. opoliensis*, *F. terminalis* and *Asplanchna brightwelli* were dominant in group Rotifera. In the group of Cladocera, *Ceriodaphnia rigaudi*, *Daphnia pulex*, *Daphnia lumholtzi*, *Moina micrura*, *Macrothrix gordii* were dominant. The group of Copepoda was dominated by *Cyclops leuckarti*, and *Allodiaptomus raoi*. In the group of Ostracoda, *Heterocypris* was dominant.

Table-1
Physico-chemical parameter of Bada Madar Tank

	Parameters	2008-09			2009-10			Average
		Winter	Summer	Monsoon	Winter	Summer	Monsoon	
1.	Air temperature (°c)	23.8	43.2	34.8	25.7	41.0	36.0	34.08
2.	Water temperature (°c)	20.2	34.5	28.2	22.5	36.2	31.0	28.76
3.	Depth of visibility (cm.)	101.4	79.3	66.2	98.0	80.2	63.2	81.38
4.	pH	7.9	8.1	8.2	7.6	7.8	7.5	7.85
5.	Dissolved oxygen (ppm)	7.5	6.7	6.9	6.7	6.9	6.7	6.9
6.	Alkalinity (ppm)	142	134	112	125	103	128	124
7.	Hardness (ppm)	162	142	262	157	205	136	177.33
8.	TDS (ppm)	470	728	550.9	268.8	178	664	476.61
9.	Conductivity (mS/cm)	0.735	1.14	0.861	0.420	0.278	1.04	0.745
10.	Chlorides (ppm)	179	156	93	102	98	67	115.83
11.	Nitrates (ppm)	3.224	4.215	3.112	3.251	4.654	2.412	3.478
12.	Phosphates (ppm)	2.012	4.221	1.2546	2.1145	4.956	1.5232	2.6802
13.	Primary Production (mgc/m ² /hr)	265	325.8	198.5	326.56	265	189.5	261.64

Table-2
Zooplankton fauna of Bada Madar Tank

Zooplanktons	2008-09			2009-10		
	W	S	M	W	S	M
Protozoa						
<i>Volvox</i> sp.	1	-	1	1	-	1
Euglenidae						
<i>Euglena acur</i>	-	-	2	1	-	-
<i>Euglena</i> sp.	1	-	1	-	1	1
Class – Rhizopodea, Order - Amoebida						
<i>Amoeba</i> sp.	2	-	-	1	-	-
Order – Arcellinida, Family – Arcellidae						
<i>Arcella discoida</i>	-	2	-	1	-	1
Family – Diffflugidae						
<i>Diffflugia</i> sp.	-	-	1	-	2	-
Sub-phylum Ciliophora, Class – Ciliata						
<i>Paramecium</i> sp.	1	-	-	-	1	-
Order – Peritricha, Family – Vorticellidae						
<i>Vorticella</i> sp.	3	-	-	1	-	1
Family – Peridiniaceae						
<i>Peridinium</i> sp.	3	1	3	2	-	1
Family – Frontonida						
<i>Phacus</i> sp.	-	-	1	2	-	-
Rotifera						
Family – Brachionidae						
<i>Brachionus angularis</i>	-	-	-	1	1	-
<i>Brachionus calyciflorus</i>	2	3	-	1	2	-
<i>Brachionus diversicornis</i>	-	-	3	-	-	-
<i>Brachionus quadridentatus</i>	-	-	-	-	-	2
<i>Brachionus falcatus</i>	-	-	-	-	-	2
<i>Brachionus forficula</i>	1	-	1	-	1	-
<i>Brachionus caudatus</i>	-	-	2	1	-	-
<i>Brachionus rubens</i>	-	-	4	-	-	-
<i>Brachionus plicatilis</i>	-	-	4	-	-	3
<i>Keratella tropica</i>	-	2	2	2	-	1
<i>Keratella cochleris</i>	2	-	-	-	-	-
<i>Keratella procurva</i>	-	-	2	-	-	-
<i>Mytilina ventralis</i>	-	-	-	1	-	1
<i>Anuraeopsis fissa</i>	2	-	-	-	-	-
Family – Lecanidae						
<i>Monostyla bulla</i>	2	1	3	-	-	2
<i>Monostyla lunaris</i>	-	-	1	-	-	-
Family – Calurinae						
<i>Lepadella ovalis</i>	-	2	2	-	1	1
<i>Lepadella patella</i>	-	1	1	-	1	-
Family – Trichocercidae						
<i>Tricocerca longiseta</i>	-	-	-	1	-	-
<i>Platyias patulus</i>	1	-	1	-	-	1

Zooplanktons	2008-09			2009-10		
	W	S	M	W	S	M
Family – Asplanchnidae						
<i>Asplanchna herricki</i>	-	1	-	-	1	-
<i>Asplanchna brightwelli</i>	-	-	2	1	-	-
<i>Asplanchna priodonta</i>	-	1	-	-	-	2
Family – Synchaetidae						
<i>Polyarthra vulgaris</i>	-	-	1	-	-	1
<i>Polyarthra appendiculata</i>	-	1	-	-	-	-
Family – Testudinellidae						
<i>Filinia longiseta</i>	1	1	1	1	2	5
<i>Filinia opoliensis</i>	-	2	-	2	4	-
<i>Filinia terminalis</i>	1	5	1	-	1	-
<i>Horella mira</i>	-	1	1	1	-	-
Family – Hexarthridae						
<i>Hexarthra mira</i>	-	-	-	-	1	1
Family – Conochilidae						
<i>Conochilius arborius</i>	2	-	-	-	1	-
Cladocerans – Family – Sididae						
<i>Diphonosoma leuchtenbergianum</i>	1	-	-	-	-	1
<i>Diphonosoma brachyurum</i>	1	-	1	-	-	-
Family – Daphnidae						
<i>Ceriodaphnia rigaudi</i>	4	-	5	4	5	3
<i>Ceriodaphnia lacustris</i>	-	-	-	4	-	2
<i>Daphnia lumholtzi</i>	2	2	-	3	3	-
<i>Simocephalus vetulus</i>	-	1	2	-	1	-
Family – Moinidae						
<i>Moina micrura</i>	2	4	1	3	2	1
<i>Moina macrocopa</i>	2	1	2	1	-	-
<i>Moina rosea</i>	1	-	-	1	2	-
Family – Bosminidae						
<i>Bosmina coregoni</i>	2	1	-	1	1	-
Family – Macrotrichidae						
<i>Macrothrix gorldi</i>	1	2	1	1	2	1
Family – Chydoridae						
<i>Chydorus sphaericus</i>	-	1	-	-	3	2
<i>Chydorus faviformis</i>	1	-	1	-	-	-
<i>Leydigia</i>	-	1	-	-	1	-
Sub Family – Aloninae						
<i>Alonella globulosa</i>	1	-	2	1	-	-
<i>Alonella dentifera</i>	1	-	-	-	1	-
<i>Alonella diaphana</i>	1	1	-	-	1	-
Phylum – Arthropoda						
Class – Crustacea						
Order – Calanoida						
Family – Diaptomidae						
<i>Allodiaptomus raoi</i>	-	-	1	-	1	-
<i>Neodiaptomus</i>	-	1	-	-	-	-

	2008-09			2009-10		
	W	S	M	W	S	M
Zooplanktons						
Order – Cyclopoida, Family – Cyclopidae						
<i>Eucyclops agilis</i>	-	-	1	-	-	-
<i>Cyclops leuckarti</i>	1	-	-	1	5	4
<i>Mesocyclops leuckartii</i>	1	-	-	-	1	-
Family – Canthocamptidae						
<i>Nauplii</i>	-	-	-	-	1	-
Ostracoda						
<i>Heterocypris</i>	-	1	1	-	1	1
<i>Stenocypris</i>	1	1	-	1	-	-
Arthropoda insecta						
<i>Insects larva</i>	1	-	-	-	-	1

Conclusion

The Madar Tank has been found as mesotrophic. The presences of a number of Zooplanktons also indicate that Madar Tank is little organically rich water body. In this tank we reported some zooplanktons are related to oligotrophic water bodies whereas some are related to eutrophic water bodies and some of them are showing their special preference to mesotrophic environment. Madar Tank is unique due to its spatial division i.e. Southern dam side part of this lake is related to human activities (Domestic and agriculture use) and some of the area towards north-east side is free from any contamination.

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