

Variations in the Physico-chemical Factors and Zooplankton Diversity during Monsoon and Post-monsoon Period of a Bavori in JDB College Campus Kota, Rajasthan, India

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Abstract

Introduction: The zooplanktons play an important role in an aquatic ecosystem, and they are sensitive bioindicators too. Any change in water quality due to the addition of pollutants affects the diversity and abundance of the organisms residing in it.

Aim: The present investigation was carried out to study an aquatic ecosystem in its simpler form. Till now most of the study of zooplankton was done in polluted aquatic systems. Therefore, we focused our attention on aquatic ecosystem which is free of any direct pollution source.

Materials and Methods: The present study was conducted during the monsoon and the post-monsoon periods from July 2010 to December 2010 of a Bavori situated in the JDB college campus of Kota city. The physicochemical and biotic factors of the Bavori were observed. Among the abiotic factors pH, water temperature, dissolved oxygen, free CO₂, alkalinity, salinity and total hardness were estimated.

Results: The water temperature ranged from 20°C to 31°C. The pH always indicated alkaline values (8.3–8.9). The dissolved oxygen varies from 3.5 to 8.3; while free CO₂ ranged from 2.0 to 8.9 mg/L. The alkalinity showed variation from 150 to 170 mg/L. The hardness observed from 38.0 to 62.0 mg/L, it is high in late monsoon. The zooplankton community protozoans, rotifers, annelids, and arthropods predominantly showed their existence 8 orders and 11 species of protozoans, 2 orders and 11 species of rotifers, one order with only one species of annelids, and 11 orders with 21 species of arthropods were seen.

Conclusion: During the monsoon season abundance of the protozoans, rotifers, arthropods and annelids were seen. But with the onset of post-monsoon their quality and quantity decreased significantly. A total 22 orders and 43 species were observed in the present study. This showed a hotspot of species diversity which needs measures of its conservation to protect them.

Key words: Freshwater, Physico-chemical variations, Zooplankton

INTRODUCTION

The freshwater deposit (Bavori) was selected for the present investigation to study an aquatic ecosystem in its simpler form. Till now most of the study of zooplankton

was done in polluted aquatic systems.^[1,2] Therefore, we focused our attention on the aquatic ecosystem which is free of any direct pollution source. The Bavori is free of any direct anthropogenic interference and is the main source of water availability to the animals living around it, e.g. various colonies of *Rhesus macaca*, *Pavo cristatus*, *Corvus splendens*, and many other local and migratory birds among terrestrial vertebrates. This vertebrate's dependency can be seen directly, but for invertebrates, the dependency always remains hidden. The purpose of the present study is to prove the importance of this Bavori and others such sites, for various biological reasons and to conserve the delicate interwoven food-webs found in nature. The various physico-

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chemical factors were also observed to study the abiotic factors prevailing around such important habitat areas.

Biodiversity is the diversity of biotic communities which encompasses different genera, species, communities, and ecosystems and their relative abundance. A good aquatic ecosystem is reflected by the rich diversity of organisms found in it and any change in water quality due to the addition of pollutants affects the diversity and abundance of the organisms residing in it. The zooplankton play an important role in an aquatic ecosystem (Sharma, 1998) and they are sensitive bioindicators too. Due to their small size, delicacy and shorter lifespan, they respond quickly to the changing environmental conditions. The Rajasthan is a part of the Thar Desert, but the Kota city constitutes the mesic zone of Rajasthan, due to the river Chambal passing through it.

Study Area

The Bavori is situated in the south-west side of the college campus in Kota city. The Kota city lies between 24° 25' and 25°51' North latitudes and 75°31' and 77°26' East longitudes with a total area of 5767.97 sq. km. "Kota city" is located at the extreme south of it at 25°11' North latitude and 75°51' East longitude occupying a total area of 238.69 sq. km, with an average height of 253.30 m from the sea level. The district Kota touch the boundaries of Sawai Madhopur, Bundi and Tonk district in Northwest, Chittorgarh in West, Jhalawar in South and Baran in East.

Kota is a prime industrial town of Rajasthan with the historical importance of its own. In last decade it has emerged as "Educational city" of India, mainly due to its excellence in coaching for entrance examinations of national and state level technological institutes for engineering and medical courses. Kota is also well known for its "Kota Sarees and Kota Stone" it is well connected with all major cities of India by the broad gauge railway system. National Highway 12 Jaipur to Jabalpur and 76 Shivpuri to Pindwara passes through the city.

Geomorphologically Kota city is situating in the Northern part of the Malwa Plateau. The only perennial river "Chambal" originating from the hills of western Madhya Pradesh passes through the district.

MATERIALS AND METHODS

Different physico-chemical parameters were analyzed from July 2010 to December 2010. Sampling was done after every 15 days, between 8 am and 11 am to work out the parameters such as water temperature, dissolved oxygen, free CO₂, alkalinity, salinity, and total hardness. The water temperature was noted using a mercury thermometer, pH of the water was determined using portable electronic

digital pH meter. Dissolved oxygen, free CO₂, alkalinity, salinity, and total hardness were evaluated as described in standard methods for the estimation, by American Public Health Association (APHA) 1995.^[3]

For the study of zooplankton samples were collected twice a month. They were studied under the microscope in free-floating state in cavity slides, and some zooplankton were studied using coverslips on it. Their study was conducted to identify them by their feeding, breeding, and locomotory habits. For qualitative analyses, the keys given in Edmondson (1959), Needham and Needham,^[4] Pennak,^[5] Tonapi,^[6] Battish^[7], and APHA^[3] were utilized.

RESULTS

The zooplankton species recorded from the surface-water of the Bavori are enlisted below. The results indicated the presence of *Paramecium caudatum*, *Euglena*, *Chrysamoeba*, *Chlamydomonas*, colonies of *Volvox*, *Arcella*, *Vorticella*, *Stentor*, *Diatoms*, *Philodina*, water spiders, aquatic beetles, *Daphnia*, *Anopheles*, and *Culex* larvae, many types of insects and crustaceans larvae in the month of July. In the first 2 weeks of August, the presence of colorless flagellates, *Paramecium*, *Philodina*, *Brachionus*, *Notonecta*, *Cypris*, *Centro cypris*, *Heterocypris*, aquatic beetles, *Dytiscus*, *Tubifex*, larva of dragon fly, and *Anopheles* larvae were seen. While in the late the August, the richness of *Centro cypris*, *Notonecta*, and *Colurella obtusa* was seen. During the month of September *Rotifers*, *Shredder*, *Centro cypris* and in the 1st week of October presence of *Centro cypris*, *Daphnia*, many types of insects larvae, *Brachionus*, *Asplanchna*, *Priodonta* and various types of *Protozoans* were seen. In November, the presence of *Decapods* and *Brachionus* were observe while in the month of December mostly *Brachionus* and small number of crustaceans were observed.

Among the abiotic factors [Table 1] temperature, dissolved oxygen, free CO₂, alkalinity, salinity, and total hardness of water were evaluated. The temperature showed the variation from 18°C to 31°C. In the Bavori, the pH always remained alkaline, i.e., it showed variation in between 8.3 and 8.9. The dissolved oxygen contents remained in between 3.5 and 8.3 mg/L, while free CO₂ ranged from 2.0 to 8.9 mg/L. Alkalinity showed a variation of 150–172 mg/L. The salinity ranged in between 7.2 and 29.1 mg/L. The hardness varied in between 38 and 62 mg/L.

List of Zooplanktons Found in Bavori of JDB College Campus, Kota

1. Phylum – Protozoa

Subphylum – Sarcomastigophora

Supper class – Flagellata
 Class - Phytomastigophorea
 Order – Chrysomonadida
 Organism – *Chrysamoeba*

Order – Euglenida
 Organism – *Euglena*, *Trachelomonas hispida* (Shell)

Order – *Volvacida*
 Organism – *Chlamydomonas*, *Volvox*

Order – Chrysomonadida
 Organism – *Chryseomonas socialism*

Supperclass – Sarcodina (Rhizopoda)
 Class – Rhizopoda
 Order – Arcellinida (Testacida)
 Organism – *Arcella discoides*, *A. vulgaris*

Subphylum – Ciliophora
 Class – Ciliata
 Subclass – Holotricha
 Order – Hymenostomatida
 Organism – *Paramecium* [Figure 1]

Subclass – Peritricha
 Order – Peritrichida
 Organism – *Vorticella*

Subclass – Spirotrichia
 Order – Heterotrichida
 Organism – *Stentor*

2. *Phylum – Rotifera*
 Class – Monogononta
 Order – Ploima
 Organism – *Asplanchna priodonta* [Figure 2], *Brachionus angularis*, *B. bidentus*, *B. calceifloris*, *B. caudatus*, *B. forphileula* [Figure 3], *B. pala* [Figure 4], *B. precatilis* [Figure 5], *B. quadridentus* [Figure 6], *Keratella* [Figure 7]

Class – Bdelloidea
 Organism – *Philodina roseola*

3. *Phylum – Annelida*
 Class – Oligochaeta
 Order – *Plesio pora plesio the cta*
 Organism – *Tubifex* [Figure 8]



Figure 1: *Paramecium*



Figure 2: *Asplanchna*

Table 1: Physico-chemical characteristics of the Bavori in monsoon and post-monsoon period

Parameters	Monsoon period			Post-monsoon period		
	Peak	Mid	Late	October	November	December
	July	August	September			
Water temp.	28°C	31°C	29°C	29°C	25°C	18°C
pH	8.5	8.3	8.4	8.5	8.7	8.9
Dissolved oxygen	8.0	8.3	7.8	4.8	3.5	6.5
Free CO ₂	2.0	5.5	8.9	8.6	6.3	3.5
Alkalinity	170	169	172	150	125	155
Salinity	7.2	21.5	29.1	16.7	16.2	17.3
Hardness	38	40.8	44	48.6	56	62

All values in mg/L. except temperature and pH

4. *Phylum – Arthropoda*
Subphylum – Chelicerata
Class – Arachnida
Order – Araneae
Organism – Water Spiders

Subphylum – Mandibulata
Class – Crustacea
Organism – *Nauplius* larva [Figure 9]



Figure 3: *Brachionus forficula*



Figure 6: *Brachionus quadridentus*

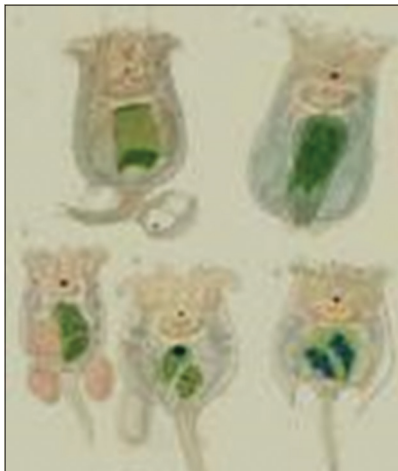


Figure 4: *Brachionus pala*



Figure 7: *Keratella*

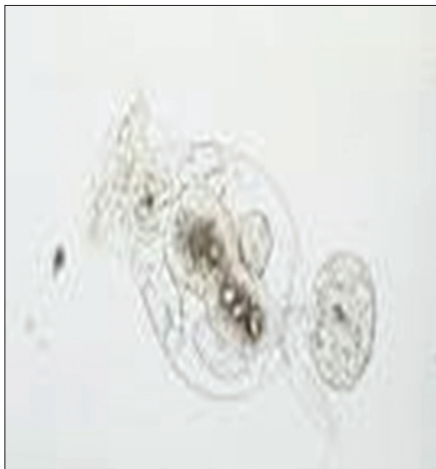


Figure 5: *Brachionus plicatilis*



Figure 8: *Tubifex*

Subclass – Branchiopoda

Order – Anostraca

Organism – *Notonecta*, *Belostoma* [Figure 10]

Order – Diplostraca or Cladocera

Organism – *Daphnia* [Figure 11], *Chydorus gibbus* [Figure 12]

Subclass – Ostracoda

Order – Podocopa

Organism – *Cypris* sp., *Heterocypris* sp., [Figure 13], *Stenocypris* sp.

Subclass – Copepoda

Order – Cyclopoida

Organism – *Cyclops*

Subclass – Malacostraca

Order – Mysidacea

Organism – *Mysis* sp.

Class – Insecta

Subclass – pterygota (Metabola)

Order – Ephemeroptera

Organism – Ephemer (Mayfly) Nymph [Figure 14]

Order – Odonata

Organism – Dragon fly Nymph

Order – Hemiptera

Organism – *Notonecta*, *Bellohtoma*, *Gerris* sp., *Corixa*, *Laccotrephes* [Figure 15]

Order – Coleoptera

Organism – Water beetles, *Dytiscus*

Order – Diptera

Organism- *Culex* larva, *Chilomonas*

DISCUSSION

The zooplankton are the microscopic organisms and include mainly Protozoans, Rotifers, Annelids, and Arthropods. They occupy an intermediate position in the food-web. Zooplanktons mediate the transfer of



Figure 9: *Nauplius*



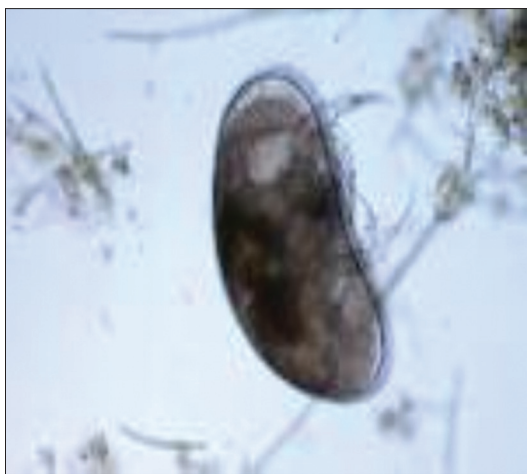
Figure 11: *Daphnia*



Figure 10: *Belostoma*



Figure 12: *Chydorus gibbus*

Figure 13: *Heterocypris*Figure 15: *Laccotrephes*Figure 14: *Mayfly nymph*

energy from lower to higher trophic level.^[8] According to Reid (1961), the development and maintenance of a population of organisms depends on harmonious balanced between environmental conditions and variations in these conditions. The parameter of temperature is of utmost importance, for its effects on metabolism, species composition and reproduction of the aquatic organism. It acts as a catalyst, an activator, a stimulator, a controller and a regulator. It plays an influential role in the aquatic system. The peak monsoon showed 28°C while midmonsoon showed 31°C temperature. This was due to cloudy weather conditions. The temperature declined in post-monsoon to 18°C as winter approached. In this Bavori pH was always alkaline, ranged from 8.3 to 8.9, indicating the preferences of alkaline water. Bayars (1960) and Fogg *et. al.*^[9] too reported that zooplankton preferred the alkaline nature of water. Lesser values of the dissolved CO₂ i.e., 2.0 mg/L may be due to rapidly increasing phytoplankton population and their utilization for photosynthesis. While the midmonsoon showed the higher value of the CO₂ due to rapid growth and increasing

activities of the zooplankton, their CO₂ expiration increased exponentially. Lesser values of the salinity in the peak-monsoon might be due to higher dilution, which latter on increases in the mid- and the post-monsoon due to the mixing of water with sediments. While in the post-monsoon period showed a decreasing value due to gradual sedimentation. Lesser value of the hardness in the peak monsoon showed dilution of the water which due to evaporation increases gradually. Due to this reason, the number of delicate species too gradually decreases in post-monsoon period. Present results indicated the presence of *Insecta*, *Rotifera*, and *Crustacean* species in the post-monsoon months. Kurasawa (1975) reported dominance of *Copepoda* in the oligotrophic lakes and *Cladocera* or *Rotifera* in the eutrophic lakes as confirmed by our result too. In our result, *Cladocera*, *Podocoda*, *Cyclopoida*, *Odonada*, *Ploima*, and *Bdelloidea* showed the presence with increasing eutrophication in Bavori confirmed the above findings. *Brachionus* was also reported to be the dominant form in Bikaner^[10] and in Ramgarh Lake.^[11,12]

This Bavori was found rich in diversity with respect to the zooplankton. However, a clear seasonal fluctuation was observed in the diversity of the zooplankton in the months of monsoon and post-monsoon. In the monsoon abundance of *Protozoans*, *Rotifers*, *Arthropods*, and some forms of *Annelids* were observed. While in the desiccating seasonal water bodies, the decreasing diversity of the zooplankton were observed in the post-monsoon months.

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