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Seasonal zooplankton diversity in relation to physico-chemical parameters of perennial pond of Chaibasa, West Singhbhum, Jharkhand, India.

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Abstract: Plankton have immense value as food and play an important role in disposal of sewage and natural purifiers of water. Zooplankton diversity is one of the most important ecological parameter in water quality assessment. In this study we try to assess the seasonal zooplankton species richness and diversity, for a period of One-year (April 2014 – March 2015) data on the seasonal studies of zooplankton diversity of jubilee pond, Chaibasa, West Singhbhum, Jharkhand, India revealed the presence of 29 zooplankton species. A limited number of these were recorded throughout the year, while others were distributed in different seasons mainly in winter and summer seasons. During winter, Cladocerans were the most dominant group followed by Copepoda. On the other hand, rotifers and Cladocerans were the most dominant during summer. Certain species e.g. *Brachionus calyciflorus, Brachionus falcatus, Monostyla quadridentatus, Trichotria sp., Cyclops sp., Cypris sp.,* and *Daphnia carinata* were recorded throughout the year. Physico-chemical analysis of Temperature, pH, dissolved oxygen, free carbon-di-oxide, alkalinity, chlorinity, salinity, total hardness, and phosphorus were observed during the study period.

Key words: Jubilee Lake, Rotifers, cladocera, Copepods, Physico-Chemical Analysis.

Introduction

Zooplankton holds a central position in the food chain of most of the lakes and reservoirs and is highly sensitive to environmental variations which as a result bring changes in their abundance, species diversity or community composition.

Zooplankton is microscopic organisms which do not have the power of locomotion and move at the mercy of the water movements and wind. Rotifers, cladocerans, copepods and ostracods constitute the major groups of zooplankton. They occupy an intermediate position in the food web. Zooplankton mediate the transfer of energy from lower to higher tropic level (Waters, 1977), thus zooplankton represent an important link in aquatic food chain and contribute significantly to secondary production in fresh water ecosystem (Sharma, 1998). Biological production of any aquatic body gives direct correlation with its Physico-chemical status which can be used as tropic status and fisheries resource potential (Jhingran 1969). These Organisms offer several advantages as indicators of environmental quality in both ponds and lakes. The distribution of zooplankton community depends on a complex of factors such as, change of climatic conditions, physical and chemical parameters and vegetation cover (Rocha *et al.,* 1999; Neves *et al.,* 2003). Their Species composition and abundance of zooplankton communities can be influenced by a number of physical, chemical and biological factors. In a general way, factors such as temperature (Edmondson, 1965), salinity (Egborge, 1994), pH (Sprules, 1975) and electrical conductivity (Pinto-Coelho *et al.,* 1998) can affect this community with regard to both composition and population density.

George (1962) and Hutchinson (1967) have reported several other factors like dissolved oxygen, pH, alkalinity, and temperature light affecting zooplankton population. Therefore, this work aimed to study the zooplankton population in relation to Physico-chemical factors of a perennial pond of Chaibasa.

Materials and Methods

Study area

The Perennial pond of Chaibasa was selected for this investigation, i.e. Jubilee pond. Jubilee pond is situated in a region characterized by low latitude high temperature and favorable light condition year round and from ancient time in the Chaibasa of District West Singhbhum in the state of Jharkhand. The average elevation of Chaibasa is 222 meter approx. 728 feet above sea level. The latitude and longitude of Chaibasa is 22.57N: 85.82E. Jubilee pond receives domestic effluents from town and surface run off from agriculture field during rainy season. The Pond is enriched with several types of vegetation but free from macro vegetation. The water of pond is used for pisiculture (mainly major carp such as Catla, Rohu, Mrigala, Silver carp and common carp), irrigation and domestic purposes like bathing and washing of cloths.

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Samples and Sampling:
Different Physico-chemical parameters were analyzed monthly from January 2014 to December 2015. Samples were collected from 8 am to 10 am. Air and water temperature were recorded by mercury thermometer graduated upon 100°C. pH of water was determined at the sites by using a portable electronic digital pH meter. Dissolved oxygen analysis was performed at the sites by Winkler's modified technique according to APHA (2005).

Turbidity, Dissolved oxygen, Total alkalinity, Chloride, Sulphate, Phosphate, Magnesium, Free carbon di oxide, Nitrate, Ammonia and Total hardness were analyzed using standard techniques. Various Physico-chemical parameters of pond water were analyzed according to APHA (2005).

Identification of Zooplankton:
Zooplankton were collected by filtering hundred liters of water through a plankton net (mesh size 25µ) and were preserved in 50 ml of 5% neutral formalin. Plankton collections were made during different seasons periodically from different sites. The preserved samples were brought to the laboratory and observations were taken under research microscope. The procedure was repeated five times to get an average for quantitative and qualitative analysis. Counting of the plankton was done by using a Sedgwick-rafter cell method. For qualitative and qualitative analysis, the keys given in Edmondson (1959), Needham and Needham (1962), Pennak (1978), Tonapi (1980) and APHA (2005) were utilized and results were expressed in U/L.

Result and Discussion

The data on environmental parameters presented in Table 1, revealed wide variation. During the entire investigation period, the pond surface temperature fluctuated between 17°C to 36°C. The water temperature followed a seasonal pattern, with a maximum close to 36°C in July and a minimum below 17°C in January. The pH values ranged from 7.3 to 8.6, finding indicates an alkaline nature of pond water. Our analysis indicates that the higher pH value was recorded during July 2014; this alkalinity could be attributed to the low level of water and high photosynthesis rate of micro-macro organisms resulting in high production of free carbon dioxide during the equilibrium towards alkaline side. Pond was well aerated with dissolved oxygen values ranged from a minimum of 5.1 mg/L to a maximum of 12.2 mg/L. The high value of hardness was recorded during winter, whereas low concentration was perceived during rainy with values varied from 90 to 110 ppm. According to the results of the present study, the mainly Physico-chemical variables (water temperature, DO and pH) of the study area were found to be suitable for life cycle of identified zooplankton population.

Data obtained from the study indicates that a total of 29 zooplankton species (Table 2) were recorded in pond comprising of 12 species of rotifers, 9 copepods, 5 cladocerans, and 3 ostracods. High numbers of Zooplankton species were recorded during summer whereas it is lowest during rainy season. Rotifers are the richest group with 12 species. Rotifers population was the most abundant during summer. Singh *et al.,* (2002) reported that higher rotifer population occurs during summer and winter might be dominant due to hyper tropical condition of pond at high temperature and low level of water. Copepoda formed the second most abundant group of Zooplankton represented by Cyclops, Calonoid Copepode etc. Cladocerans were represented by Daphnia, Diaphanosoma sp., Moina daphnia, Diaptomas mesocyclops.

Table 1: Seasonal variation of Physico-chemical parameter of water at Jubilee pond from April 2014 – March 2015.

Parameter	Summer	Rainy	Winter
Temperature	28.5-36.5°c	28.5-36.5°c	17.0-19.5°c
Turbidity	83-320	90-450	70-205
pH	8.2 –8.4	7.3 –7.5	8.3 – 8.6
Colour	Green	Dark brown	Light brown
Dissolved oxygen	5.1-7.2	7.4-8.1	8.9-12.2
Total alkalinity	135 –200	130 – 190	125 – 150
Chloride	40-55	40-45	25-35
Sulphate	15 – 60	10 – 40	10 – 45
Phosphate	2.8 – 5	6 1.5 – 2.4	2.0 – 4.0
Magnesium	7.5 – 17.5	8.5 – 23.5	6.9 – 12.6
Free CO_2	12-16	5-8	9-10
Calcium	11.7 – 27.5	25.8-30.2	40.1-50.4
Nitrate	1.6 – 3.3	2.0 – 3.9	4.1 – 9.0
Ammonia	5.2 – 10.2	4.5 – 7.0	2.5 – 5.0
Total hardness	95-107ppm	90-110ppm	220-280ppm

All values are in mg/l except water temperature, colour and PH.

Table 2: Zooplankton diversity in Jubilee pond

Zooplankton	Summer	Rainy	Winter
Rotifera			
1. Brachionus calyciflorus	12-25	1-5	11-18
2. B. quadridentatus	4-16	2-6	9-23
3. B. angularis	2-18	1-3	8-15
4. B. caudatus	15-26	1-3	9-11
5. B. urceolaris	8-6	1-6	3-6
6. B. falcatus	9-23	2-5	10-21
7. Keratella tropica.	2-4	0-1	5-6
8. Monostyla quadridentatus	2-14	1-2	5-18
9. Notholca sp.	5-9	0	8-11
10. Trichotria sp	6-13	5-10	5-14
11. Lecane lunaris	2-5	1-3	6-9
12. Euchlanis sp.	1-3	0	1-6
Cladocera			
1. Daphnia carinata	9-21	12-19	14-32
2. Diaphanosoma sp	5-20	3-6	11-19
3. Moina sp.	4-14	2-4	9-16
4. Moina daphnia	6-21	3-5	6-13
5. Alonella sp.	3-15	2-3	2-10
Ostracoda			
1. Cypris sp	1-9	5-12	8-15
2. Stenocyprismalcolmsoni	10-15	3-9	12-22
3. Cyprinotus sp.	6-14	2-6	6-9
Copepoda			

1. *Mesocyclopshyalinus*	2-5	1-3	6-13
2. *Diaptomus sp.*	1-4	0-1	2-6
3. *Cyclops sp.*	6-29	5-11	8-24
4. *Spicodiaptomuschilo spinus*	4-11	2-8	6-23
5. *Heleodiaptomus viduus*	1-2	0	4-6
6. *Calonoid copepod*	0-1	2-3	8-19
7. *Tropocyclops sp.*	1-3	3-8	8-15
8. *Thermocyclops sp.*	4-6	0-1	7-16
9. *Nauplius*	12-25	11-26	18-17
Total =29			

However, the rotifers were high in summers and winter season and low in rainy season. (Table 2). The value of total hardness fluctuation from 90 to 280 ppm at Jubilee pond. High value of hardness was recorded during winter whereas low during rainy season. High range of total hardness obviously was due to high loading organic substance, detergents, chlorides and other pollutants. The total hardness showed significant positive correlation with zooplankton production, water temperature, alkalinity and phosphate, whereas significant negative correlation with salinity and rainfall. Similar findings were observed by Ratushnyak *et al.,* (2006), Mathivanan *et al.,* (2007) and Park and Shin (2007). Meshram (2005) has reported that calcium hardness is essential for normal growth and development of many aquatic ecosystems.

Dissolved oxygen (DO) is an important aquatic parameter whose measurement is vital in the context of culture of any aquatic animal as oxygen plays a crucial role in its life processes. Dissolved oxygen ranged from 5.1 to 12.2 ppm at Jubilee pond. Low concentration of DO was recorded during summer. This may be due to low solubility at high temperature and high degradation of organic substances. In jubilee pond DO value showed significant positive correlation with rotifer, while negative correlation with copepoda Singh and Singh (1993) drew similar conclusion.

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