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Diurnal variations in zooplankton in the waters of Taj Baj ka pokhra and Mamu-Bhanja ka pokhra of Hajipur town, Bihar

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Abstract- In the present project, a comprehensive study was done on Diurnal variations in zooplankton in the waters of Taj Baj ka pokhra and Mamu-Bhanja ka pokhra of Hajipur town, Bihar. The pond is situated in the heart of the town and is of utmost importance on account of its historical aspect. Different varieties of fishes are cultured in this pond. Especially carp culture is common. Hajipur town is an important part of Vaishali district. Fresh water of Taj Baj ka pokhra and Mamu-Bhanja ka pokhra of Hajipur town, Bihar have been selected for research work. For analysis of diurnal variation of zooplankton, samples were collected from two perennial ponds i.e. Taj Baj ka pokhra and Mamu-Bhanja ka pokhra of Hajipur town. In this DIAL study, zooplankton including rotifers, cladocerans, copepods and their larvae show a definite diurnal pattern with a decrease in daylight hours and an increase in morning hours over the three seasons in both ponds. Current data indicate that zooplanktonic organisms avoid bright light and take shelter at the soil-water interface during the day and later climb to the surface at night. In the study we found a total of 15 species of zooplankton and 13 species of zooplankton collected in Taj Baj ka pokhra and Mamu-Bhanja ka pokhra of Hajipur town during the mid-summer season, during the diurnal cycle of the monsoon month, total 12 species and 11 species of zooplankton in both the ponds were collected and a total of 2 species of copepoda and their nauplii larvae were collected in each of the two ponds during the winter month.

Key words: Zooplanktons, rotifers, cladocerans, copepods, DIAL

INTRODUCTION

At a time when the focus is on conservation and creation of more water bodies for rainwater harvesting and climate resilience across India, many ponds in northern Bihar are disappearing and others are being encroached upon or ruined is being filled. Official records show that by the early 1990s, there were 250,000 ponds in Bihar. Locally known as ponds or puddles, the number of these water bodies has come down to 93,000 today. In the last two decades, we have filled the ponds with garbage, mud

and other things. This is set to impact the natural water harvesting, its ability to easily recharge groundwater and provide water security during monsoon. Despite this, Bihar has huge reserves of water resources in the form of fresh water. A great diversity in geomorphological features as well as an equally high variability in monsoon rainfall provides a wide variety of freshwater habitats of great scientific interest besides constituting the country's inland fishery resources. The first limnological studies in India appeared in the early twentieth century. Prasad (1916)¹ conducted the first limnological investigation to unravel the mystery of the water body. Therefore, he can be considered as the foremost activist in limnology of India.

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Pruthy (1933)² described the seasonal and India museum tank in Calcutta and Sewell (1934)³ reported the abundance and seasonality of zooplankton in the same museum tank. As a result, limnology has expanded greatly with the more extensive study of diverse water bodies and its application in a variety of disciplines.

Hajipur town is the headquarters and largest city of Vaishali district within the state of Bihar. It is located at 25.69°N 85.22°E. The city of Hajipur is bounded by the Gandak River in the west and the holy river Ganga in the south. The area looks lush green with plants and trees growing in the semi-tropical monsoon climate. However, the months of May-June are hot, and December-January is cold. Many ecosystems are connected by water and a greater biodiversity of species has been found in ponds than in large freshwater lakes or river systems. As such, ponds are habitats for a wide variety of organisms including plants, amphibians, fish, reptiles, waterfowl, insects and even some mammals. Ponds are used for breeding these species, but also as shelter and even drinking/feeding places for other wildlife. A defining feature of a pond is the presence of standing water that provides habitat for a biological community commonly referred to as pond life. Notable contribution are those of Stephenson (1930)⁴, Edmondson (1959)⁵, Penac (1978)⁶ Singh M (1995)⁷, Kant S, Vohra S (1990)⁸ and Bosc S.K. & LarKra M.P.(1994)⁹

STUDY AREA

The fresh water of Taj Baj ka pokhra and Mamu-Bhanja ka pokhra of Hajipur town, Bihar has been selected for research work. Taj Baj ka pokhra is situated in the heart of Hajipur city whereas Mamu-Bhanja ka pokhra Hajipur is situated slightly away from the main city.



Fig. 1- Mamu-Bhanja ka pokhra Hajipur



Fig. 2- Taj Baj ka pokhra Hajipur

MATERIALS & METHODS

For analysis of diurnal variation of zooplankton, samples were collected from two perennial ponds i.e. Taj Baj ka pokhra and Mamu-Bhanja ka pokhra of Hajipur town, Bihar at monthly intervals from September, 2019 to August, 2020, for comparative study of zooplankton can go of two ecologically distinct waters. To study diurnal variations in zooplankton in different seasons (winter, summer and monsoon), samples were collected at 3 hours intervals in each of the two ponds from 07:00 to 06:00 the next day. Each time 50 liters of surface water was filtered through plankton net made of bolting silk number-21. The zooplanktons were analyzed in the Zoology laboratory of R N College, Hajipur by the same procedure and formula as in the study of monthly changes.

Benthic macro-invertebrates

The term benthic fauna refers broadly to the flora and fauna that are associated with any available substrate, including bottom sediments, in an aquatic system. The fauna components of benthos are called macro-benthic organisms, they are generally sessile and slow-moving in nature and their species composition, abundance and distribution in aquatic ecosystems is mainly controlled by water quality. For the analysis of the macro-benthic fauna, five randomly selected samples were taken from each of the two ponds on a continuous monthly basis from September 2019 to August 2020. The benthic organisms were sampled via Ekman's 15.2 × 15.2 cm size dredge. The dredge material was filtered through a 425/μm mesh-screen (brass sieve no.-40 ISS) and the residual organism was preserved in the laboratory of the Department of

Zoology, 5% formalin. In the laboratory, the material was transferred to white enamel trays from which the animals were culled manually following standard laboratory procedures. The taxonomic level was identified. The identity of some enumerated organisms up to the species level was finally confirmed courtesy of Zoological Survey of India and ZSI, Patna Regional Office. The calculations were done as per Jhingaran *et al.* (1969)¹⁰ by converting the average density value of five samples per meter square using formula:

$$N = n/ah,$$

Where:

N is the number of macro-benthic organism in square meter,

n is the number of macro-benthic organism per sample,

a is the area of Ekman's dredge used, and

h is the number of hauls taken.

RESULTS & DISCUSSION

In the DIAL study, zooplankton consisting of rotifers, cladocerans, copepods and their larvae show a definite diurnal pattern of decrease in daylight hours and increase in the early morning hours over the three seasons in both ponds. Current data indicate that zooplanktonic organisms avoid bright light and take shelter at the soil-water interface during the day and later climb to the surface at night. This is in line with the finding of George (1961)¹¹, Michael (1966)¹², APHA (1985)¹³. The abundance of total zooplankton in Taj Baj ka pokhra showed significant positive correlation with carbonate alkalinity ($r = 0.952$), pH ($r = 0.977$) and transparency ($r = 0.926$) at 0.1 per cent during summer, monsoon and winter, respectively. Whereas in Mamu Bhanja ka pokhra, it shows significant positive correlation at 0.1 percent with bicarbonate alkalinity ($r = 0.934$) only during winter. During the summer the total zooplankton i.e. rotifers ($r = 0.971$), cladocerans ($r = 0.945$) and copepods ($r = 0.968$) at one percent. During the daily study, rotifers that dominated zooplankton populations reached a surface migration peak in the early morning hours in all three seasons in both ponds. Ahmed & Singh (1993)¹⁴ observed that rotifers were more abundant in nocturnal collections. In this study a large number of *Daphnia carinata*, *Moina dubia* occurred only at night. The abundance of cladocerans and copepods was observed during the night hours by several workers.

DIAL cycle in summer

In this study, a total of 15 species and 13 species of zooplankton were collected in Taj Baj ka pokhra and Mamu Bhanja ka pokhra, respectively, during the mid-summer season. In Taj Baj ka pokhra, the highest density of total Zooplankton (276 Unit/L) was observed at 03:00 and the lowest was 66 Unit/L at 18:00 hours. Whereas, in Mamu Bhanja ka pokhra their maximum and minimum number of 232 units/l and 40 units/l were recorded at 09:00 and 15:00 respectively. In the present DIAL study, it was observed that the Rotifera were the most diverse group of zooplankton as compared to the other groups and were commonly found in both the water bodies. In Taj Baj ka pokhra, the cladoceran, *Daphnia carinata* showed a maximum population density of 28 units/L at 03:00 and a minimum of 6 units/L at 12:00 hours and 15:00 hours and there were a total of 2 species of Copepoda and their nauplii in the two ponds collected in each.

DIAL cycle in monsoon

It was found that during the dial cycle of the monsoon month, a total of 11 species and 11 species of zooplankton were collected in both the ponds. A total of 7 species and 6 species (92 units/L) of Rotifera fauna were recorded at 09:00 hours and the lowest 16 units/L at 18:00. Whereas, in other ponds their maximum and minimum densities of 50 units/l and 10 units/l were observed at 06:00 h and 15:00 h, respectively. In the Taj Baj ka pokhra of Hajipur, only 2 species of Copepoda and Naples larvae were collected during the monsoon cycle.

DIAL cycle in winter

In this DIAL study, a total of 2 species of copepoda and their nauplii larvae were collected in each of the two ponds. In Fist Pond, the Cyclops species showed its highest density of 16 units/l at 09:00 and 24:00 and the lowest at 6 units/l at 15:00. The maximum and minimum densities of nauplii larvae (36 unit/l and 8 unit/l) were recorded at 03:00 hours and 15:00 hours, respectively. Whereas, in Taj Baj ka pokhra, maximum number of Cyclops species (14 units/l) was observed at 03:00 hours and minimum 2 units/l were observed at 15:00 hours and 18:00 hours. The highest and lowest densities of Naupli larvae (16 units/l and 2 units/l) were recorded at 03:00 hours and 15:00 hours, respectively.

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