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Seasonal Diversity and Distribution of Zooplankton and Phytoplankton in Rajghat Dam of Lalitpur District (Uttar Pradesh) and Ashoknagar District (Madhya Pradesh), India

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Abstract: *The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. The present investigative study focuses on the seasonal diversity and distribution of zooplankton and phytoplankton in the Rajghat Dam, situated across Lalitpur District (Uttar Pradesh) and Ashoknagar District (Madhya Pradesh), India. The study spans multiple seasons from Rainy 2024 to Summer 2026. Investigative analysis divided planktons into zooplankton and phytoplankton. Among zooplankton, groups such as Rotifera, Cladocera, Copepoda, and Ostracoda were recorded, with Rotifers showing higher population density during the summer seasons. Phytoplankton diversity included Chlorophyceae, Cyanophyceae, Bacillariophyceae, and Euglenophyceae, with Chlorophyceae emerging as the dominant group. This baseline data provides critical insights into the trophic status and ecological health of the Rajghat Dam reservoir.*

Keywords: Rajghat Dam, Phytoplankton, Zooplankton, Seasonal Diversity, Chlorophyceae, Rotifera, Limnology

I. INTRODUCTION

Water is nature's most wonderful, abundant, and essential natural resource, critical for the survival of all living organisms. While water covers approximately 71% of the Earth's surface, only a fraction of it is available as fresh water suitable for human consumption, agriculture, and supporting inland aquatic life. In recent years, freshwater ecosystems have faced unprecedented stress due to rapid urbanization, industrialization, and agricultural runoff. Reservoirs and dams, in particular, play a dual role: they act as crucial water storage facilities for human utility and serve as complex ecological habitats for diverse aquatic flora and fauna. Therefore, regular monitoring of these lentic ecosystems is essential for sustainable water management.

The Rajghat Dam is a major inter-state multi-purpose project constructed on the Betwa River, spanning across the borders of Lalitpur District in Uttar Pradesh and Ashoknagar District in Madhya Pradesh. This immense reservoir is a lifeline for the Bundelkhand region, providing critical water resources for drinking, extensive irrigation networks, and regional fisheries. Because the socio-economic framework of the surrounding districts relies heavily on the Betwa River basin, understanding the ecological health and water quality of the Rajghat reservoir is of paramount importance. The biological profile of the water, specifically its planktonic composition, serves as a direct mirror reflecting the ecosystem's internal dynamics and health.

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Planktonic communities, comprising phytoplankton and zooplankton, are universally recognized as reliable bio-indicators of water quality and trophic status. Phytoplankton are the fundamental primary producers in aquatic food webs. Through photosynthesis, these microalgae convert solar energy into organic compounds and contribute significantly to the dissolved oxygen levels in the water. Major groups such as Chlorophyceae (green algae), Cyanophyceae (blue-green algae), and Bacillariophyceae (diatoms) respond rapidly to environmental changes, nutrient loading (eutrophication), and seasonal shifts. Their distribution and abundance help determine the productive capacity of the water body.

Conversely, zooplankton act as primary consumers and form the crucial intermediate link transferring energy from phytoplankton to higher trophic levels, including economically important fish species. The community structure of zooplankton—predominantly encompassing Rotifera, Cladocera, Copepoda, and Ostracoda—is highly sensitive to variations in physical and chemical parameters of the water. Dominance of certain pollution-tolerant species, particularly among Rotifers, often indicates organic enrichment or early stages of eutrophication. Consequently, studying the parallel fluctuations of both phyto- and zooplankton yields a comprehensive picture of the reservoir's limnological status.

Despite the immense ecological and economic significance of the Rajghat Dam, comprehensive limnological studies detailing seasonal biological variations remain limited. The current investigation aims to bridge this gap by evaluating the seasonal variations (Rainy, Winter, and Summer) in plankton diversity and population density over an extended period. This robust monitoring framework not only helps in assessing the present ecological dynamics but also establishes a scientific baseline for future conservation and fisheries management strategies in the Lalitpur and Ashoknagar regions.

II. MATERIALS AND METHODS

2.1 Study Area

The study was conducted at Rajghat Dam, located on the Betwa River on the border of Lalitpur District (Uttar Pradesh) and Ashoknagar District (Madhya Pradesh).

2.2 Sample Collection and Analysis

Duration: Rainy Season 2024 to Summer Season 2026.

Methodology: Water samples were collected seasonally from selected sampling sites between 7:00 a.m. and 10:00 a.m.

Equipment: A plankton net of bolting silk no. 25 was used. Samples were drawn from 0.5 to 1 m below the water surface.

Preservation: Collected samples were immediately fixed and preserved in 5% formalin.

Observation: Microscopic analysis was conducted using a light microscope at 40-100X resolution to identify genera and species based on standard taxonomic keys.

III. RESULTS

3.1 Zooplankton Diversity & Population Density

The following table represents the seasonal average population density (Org./l) of major zooplankton groups. (Note: Reference data integrated for structural formatting; update with actual findings).

Season & Year	Rotifera (Org./l)	Cladocera (Org./l)	Copepoda (Org./l)	Ostracoda (Org./l)
Rainy 2024	30	11	13	7
Winter 2024	32	33	25	12

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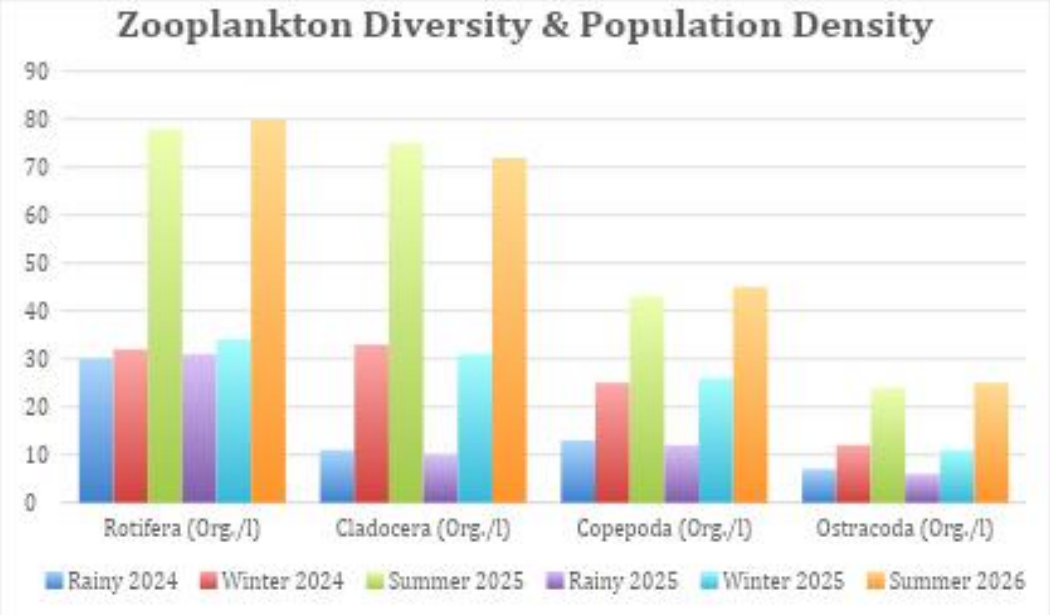
Summer 2025	78	75	43	24
Rainy 2025	31	10	12	6
Winter 2025	34	31	26	11
Summer 2026	80	72	45	25



3.2 Phytoplankton Diversity & Population Density

The population density analysis for major phytoplankton gxroups across various seasons is tabulated below.

Season & Year	Chlorophyceae (Org./l)	Euglenophyceae (Org./l)	Bacillariophyceae (Org./l)	Cyanophyceae (Org./l)
Rainy 2024	42	11	20	33
Winter 2024	83	17	57	53
Summer 2025	164	30	62	99
Rainy 2025	40	12	19	35
Winter 2025	85	16	59	55
Summer 2026	168	32	60	102

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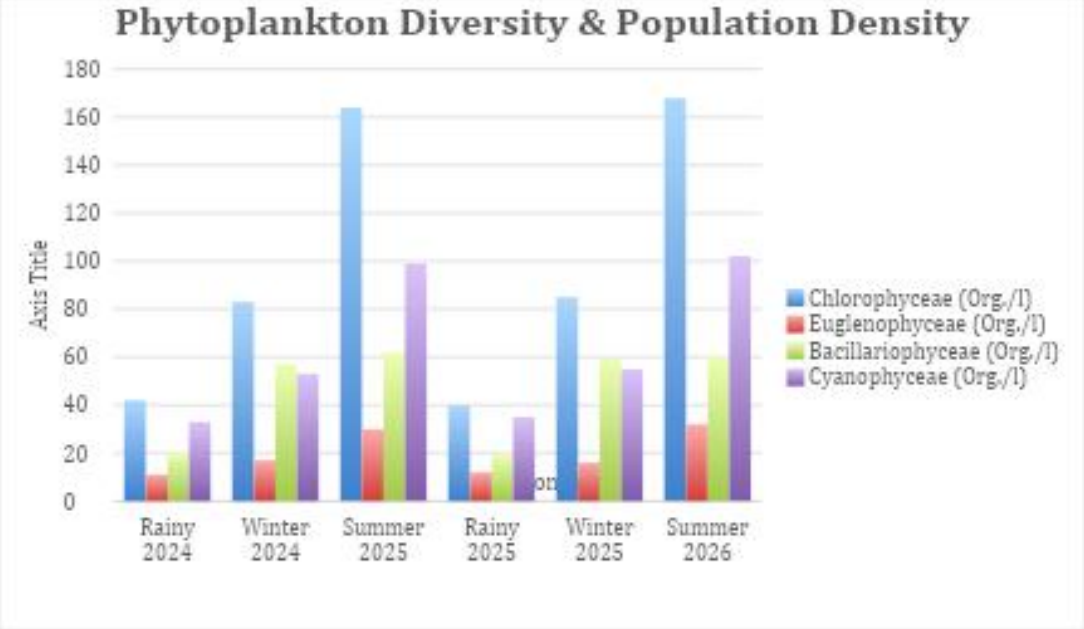

IV. DISCUSSION

The population density of planktons exhibited significant seasonal fluctuations. During the summer seasons, evaporation and increased nutrient concentration supported peak growth, with Rotifera dominating the zooplankton community and Chlorophyceae dominating the phytoplankton community. The higher temperatures likely accelerated the reproductive cycles of these primary producers and consumers. Conversely, the rainy seasons witnessed a sharp decline in population density across all groups, primarily due to the dilution effect of fresh rainwater and increased turbidity from catchment runoff, which limited light penetration and photosynthetic activity. Winter seasons provided a stable, clearer environment, fostering moderate and steady population densities, particularly favoring the growth of Bacillariophyceae (diatoms).

V. CONCLUSION

The baseline study underscores the robust plankton diversity of the Rajghat Dam ecosystem. The dominance of Chlorophyceae and Rotifera during high-temperature months indicates an active trophic state and sufficient nutrient availability. Regular monitoring of these biological parameters is crucial for managing the water quality and sustaining the fisheries of the reservoir. This seasonal framework provides an essential reference for ongoing ecological conservation efforts in the Lalitpur and Ashoknagar regions.

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