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# Phytoplankton And Zooplankton Populations In Sambhar Lake, Rajasthan

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***Abstract:*** Sambhar Lake, the largest saline lake in India, situated in the arid Thar Desert of Rajasthan, provides a unique environment for studying aquatic ecosystems under extreme conditions. The study investigates the dynamics of phytoplankton and zooplankton communities in Sambhar Lake, with a focus on their seasonal variations and responses to fluctuating salinity and nutrient levels. Monthly water samples were collected from two sites (SLS 1 and SLS 2) over a period from February 2021 to May 2022. Seasonal patterns in both phytoplankton and zooplankton densities reflect the lake's dynamic environmental conditions, emphasizing the influence of salinity and nutrient fluctuations. The study highlights the ecological significance of Sambhar Lake as a natural laboratory for understanding the impacts of extreme conditions on aquatic life. Continued monitoring and management are crucial for addressing challenges such as eutrophication and salinity fluctuations, ensuring the sustainability of this vital aquatic ecosystem. The findings reveal significant insights into the lake's ecological dynamics, highlighting the effects of salinity, temperature, and nutrient availability on plankton populations.

***Keywords:*** Sambhar Lake, Phytoplankton, Zooplankton

## INTRODUCTION

Sambhar Lake, situated in the arid Thar Desert of Rajasthan, India, is the largest saline lake in the country, with an area of approximately 230 square kilometers. The lake is a remnant of a large inland sea that existed millions of years ago and has been a significant ecological and economic resource throughout history (Smith, 1973). The lake's high salinity, fluctuating water levels, and extreme climatic conditions create a unique environment for studying aquatic life, particularly the primary and secondary producers that underpin its ecosystem.

Phytoplanktons are microscopic plants that drift in the water column and are primary producers in aquatic ecosystems. They are responsible for the majority of photosynthetic activity in these environments, converting solar energy into chemical energy and forming the base of the aquatic food web (Shapiro, 1973). Phytoplanktons are sensitive indicators of environmental change, reflecting alterations in water chemistry, nutrient levels, and light availability. Their dynamics are influenced by various factors including temperature, salinity, and nutrient concentrations, which are often variable in saline and arid regions like Sambhar Lake (Gaur, 1994).

Zooplanktons, on the other hand, are small, free-floating animals that graze on phytoplankton and serve as a crucial link between primary producers and higher trophic levels such as fish and other aquatic predators. They include various groups such as rotifers, cladocerans, and copepods. Zooplankton populations are influenced by the abundance and composition of phytoplankton, as well as by environmental factors such as salinity and temperature (Harris, 1994).

The ecological significance of Sambhar Lake extends beyond its role as a habitat for aquatic organisms. The lake is an important site for bird migration, providing critical stopover points for numerous species. Additionally, it has been a traditional source of salt production, which impacts the local economy and environment (Ganapati, 1960). The lake's saline waters and unique ecological conditions make it a valuable natural laboratory for studying the impacts of salinity and nutrient dynamics on aquatic life.

Saline lakes like Sambhar Lake present challenging conditions for aquatic organisms due to high salinity levels, which can exceed the tolerance limits of many freshwater species. However, some phytoplankton and zooplankton have adapted to these extreme conditions. Cyanobacteria, for example, are particularly well-suited to high-salinity environments and can form extensive blooms under eutrophic conditions. These blooms can significantly alter the lake's nutrient dynamics and affect the overall health of the ecosystem (Gaur, 1994; Palmer, 1969).

Zooplankton in saline environments often exhibit adaptations to cope with high salinity, such as alterations in osmoregulatory mechanisms and changes in reproductive strategies. Understanding the diversity and distribution of zooplankton in Sambhar Lake can provide insights into how these organisms adapt to varying salinity and nutrient conditions (Kapoor & Arora, 2000).

## MATERIALS AND METHODS

### Study Area

Sambhar Lake is situated in the arid region of Rajasthan, surrounded by salt pans and characterized by a highly saline environment. The lake's salinity varies seasonally, influenced by precipitation and evaporation rates. The study focused on three representative sites: northern, central, and southern regions of the lake, chosen to capture spatial variations in plankton communities.

Two Sampling sites were selected

SLS 1: Towards Nawa (North-Western)

SLS 2: Towards Jhapok (South-Eastern)

### Sampling

Monthly water samples were collected from each site using a standard plankton net with a mesh size of 60 µm for zooplankton and a phytoplankton sampling bottle for phytoplankton. Sampling was conducted at a depth of 0.5 meters to ensure representative samples from the upper water column where plankton concentrations are highest (APHA, 2017).

### Analysis

Phytoplankton samples were preserved in Lugol's iodine solution, while zooplankton samples were fixed with formalin. Phytoplankton were identified using a compound microscope at 400x magnification, while zooplankton were examined under a 100x magnification. Species identification followed standard taxonomic keys, and the abundance and biomass of each group were calculated using standard methods (APHA, 2017).

## RESULTSAND DISCUSSION

The phytoplankton and zooplankton communities in Sambhar Lake exhibit complex interactions with their environment. Cyanobacterial dominance, particularly *Microcystis aeruginosa*, indicates a eutrophic state influenced by high nutrient levels and temperature variations. This is consistent with findings from other saline and eutrophic lakes, where cyanobacteria thrive under nutrient-rich conditions (Gaur, 1994; Palmer, 1969).

### Phytoplankton

A total of 30 phytoplankton species were identified across the sampling sites. The dominant groups included Cyanobacteria, Chlorophyceae, and Diatomaceae. Cyanobacteria, particularly *Microcystis aeruginosa*, were the most abundant, especially during the summer and post-monsoon periods. This species is known for its ability to thrive in high-nutrient and high-temperature conditions, which aligns with our observations of peak abundance during these periods (Gaur, 1994; Shapiro, 1973).

Chlorophyceae, such as *Chlorella vulgaris*, were less abundant but showed increased numbers during periods of lower salinity and moderate nutrient levels. Diatoms, including species of *Navicula*, were present throughout the year but showed higher abundance during cooler months (Lin, 1972).

The data shows the total phytoplankton density (No/ml) in two sampling sites, SLS 1 and SLS 2, over a period from February 2021 to May 2022. In SLS 1, phytoplankton densities range from a minimum of 124 No/ml in August to a maximum of 217 No/ml in January 2022. Similarly, in SLS 2, the lowest density is observed in November (83 No/ml), while the highest is in January 2022 (143 No/ml).Seasonalvariations are evident, with phytoplankton densities generally peaking during the late winter and early spring months (January to March) in both sites, particularly in January 2022, and declining in the late summer and autumn months (August to November). The higher densities in SLS 1 across most months suggest potentially more favorable conditions for phytoplankton growth compared to SLS 2, possibly due to differences in nutrient availability, water quality, or other environmental factors. Overall, the data indicates a clear seasonal fluctuation in phytoplankton populations in both study sites.

**Zooplankton**

The zooplankton community comprised Rotifera, Cladocera, and Copepoda. Rotifers, especially *Brachionus* spp., were the most abundant group, with peak densities observed during the monsoon season. Cladocerans, such as *Daphnia* spp., and copepods, including *Cyclops* spp., exhibited lower densities due to their sensitivity to high salinity and variable environmental conditions (Kapoor & Arora, 2000; Harris, 1994).Rotiferswere dominant in the central and southern regions of the lake, while Cladocerans and Copepoda were more common in the northern region. The spatial variation in zooplankton distribution reflects the influence of salinity and nutrient gradients across the lake (Reyssac&Pletikosic, 1990).

The table presents data on total zooplankton density (No/L) at two sampling sites, SLS 1 and SLS 2, from February 2021 to May 2022. In SLS 1, zooplankton densities range from a low of 48 No/L in August to a high of 122 No/L in January 2022. In SLS 2, densities fluctuate from a minimum of 43 No/L in July to a maximum of 121 No/L in September.A seasonal pattern is observed in both sites, with zooplankton densities generally increasing during the winter months (January to March) and decreasing in the summer months (July to August). Peaks are seen in SLS 1 during March 2021 (121 No/L) and January 2022 (122 No/L), whereas SLS 2 shows its highest densities in September (121 No/L) and October (111 No/L). The data suggests higher zooplankton densities in SLS 1 compared to SLS 2 during most months, except for certain periods (e.g., September and October), which may indicate differences in environmental conditions such as water temperature, nutrient availability, or predation pressure.

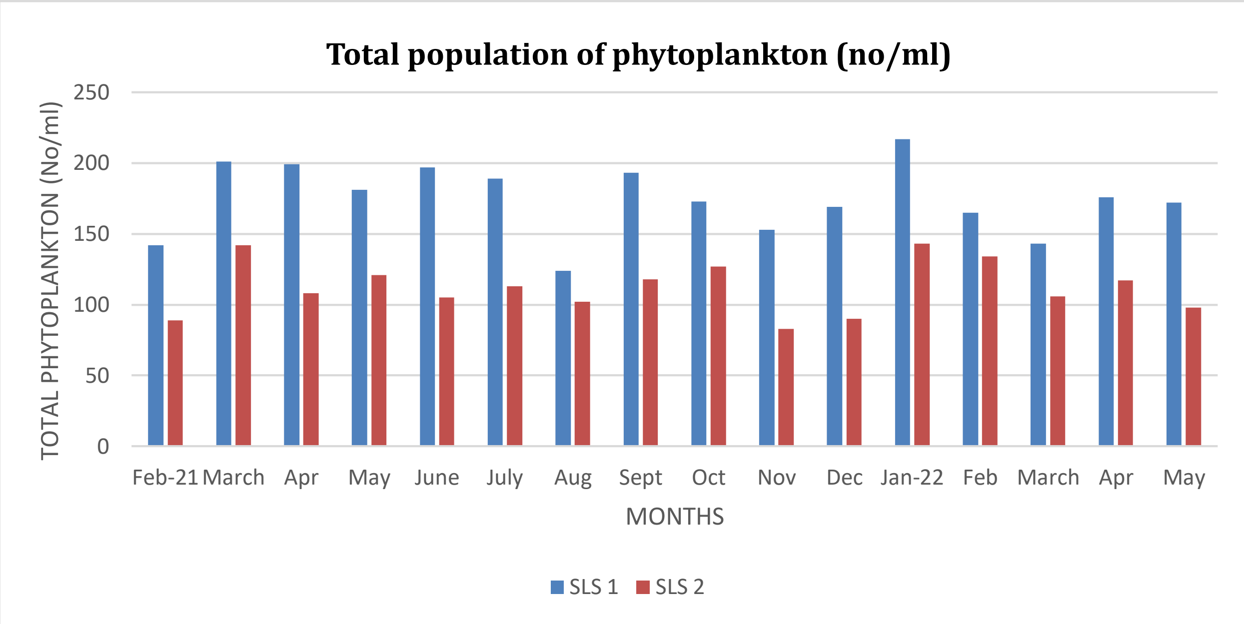
Overall, the zooplankton community exhibits distinct seasonal variation, likely driven by changing ecological factors, which warrants further investigation to understand the underlying causes of these fluctuations.

Zooplankton communities, dominated by rotifers, reflect the lake's salinity and nutrient conditions. The lower abundance of Cladocerans and Copepoda under high salinity conditions highlights their sensitivity to environmental changes. The seasonal variations in zooplankton densities, with higher numbers during the monsoon and lower numbers during extreme salinity conditions, underscore the importance of stable environmental conditions for maintaining healthy zooplankton populations (Harris, 1994; Reyssac & Pletikosic, 1990).

The results of this study contribute to our understanding of the ecological dynamics of Sambhar Lake. The observed phytoplankton and zooplankton patterns highlight the need for continued monitoring and management to address issues such as eutrophication and salinity fluctuations. Effective management strategies are essential for preserving the ecological balance and ensuring the sustainability of this vital aquatic resource (Ganapati, 1960; Steinberg & Hartman, 1988).

**Table 1. Total population of Phytoplankton (No/ml)**

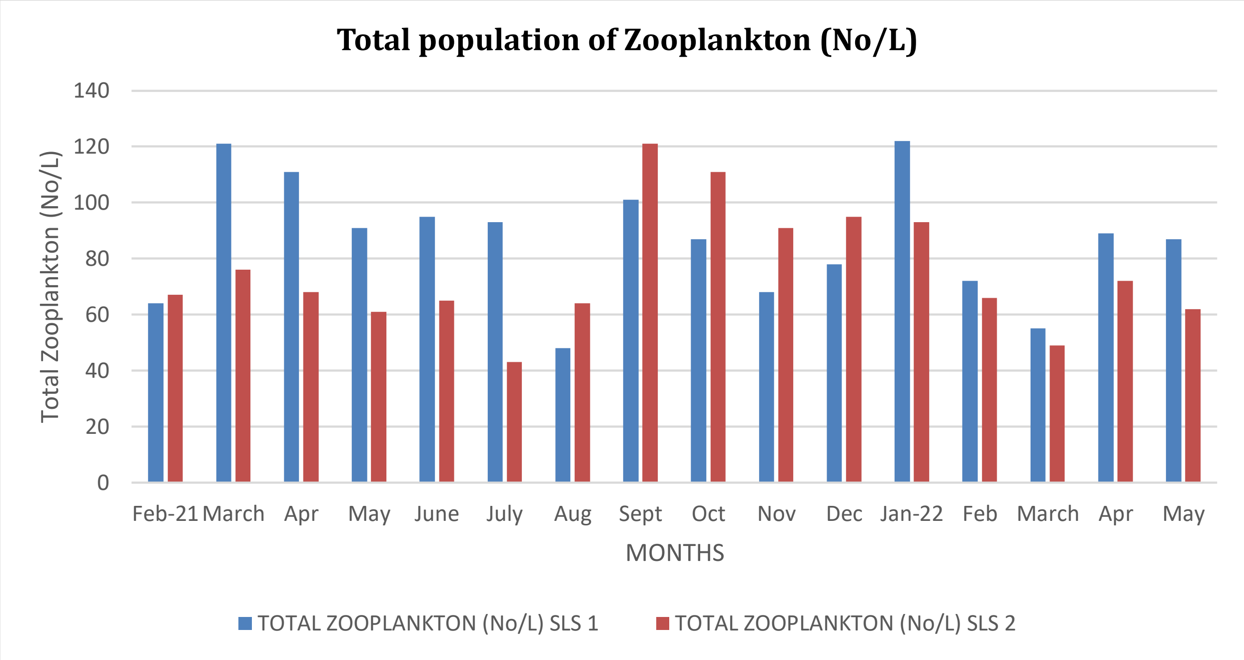
| Months | TOTAL PHYTOPLANKTON (No/ml) | |
|---|---|---|
| | SLS 1 | SLS 2 |
| Feb-21 | 142 | 89 |
| March | 201 | 142 |
| Apr | 199 | 108 |
| May | 181 | 121 |
| June | 197 | 105 |
| July | 189 | 113 |
| Aug | 124 | 102 |
| Sept | 193 | 118 |
| Oct | 173 | 127 |
| Nov | 153 | 83 |
| Dec | 169 | 90 |
| Jan-22 | 217 | 143 |
| Feb | 165 | 134 |
| March | 143 | 106 |
| Apr | 176 | 117 |
| May | 172 | 98 |




Graph 1. Total population of phytoplankton (no/ml)

Table 2. Total population of Zooplankton (No/L)

| Months | TOTAL ZOOPLANKTON (No/L) | |
|---|---|---|
| | SLS 1 | SLS 2 |
| Feb-21 | 64 | 67 |
| March | 121 | 76 |
| Apr | 111 | 68 |
| May | 91 | 61 |
| June | 95 | 65 |
| July | 93 | 43 |
| Aug | 48 | 64 |
| Sept | 101 | 121 |
| Oct | 87 | 111 |
| Nov | 68 | 91 |
| Dec | 78 | 95 |
| Jan-22 | 122 | 93 |
| Feb | 72 | 66 |
| March | 55 | 49 |
| Apr | 89 | 72 |
| May | 87 | 62 |




**Graph 2. Total population of Zooplanktons (No/L)**

## CONCLUSION

This study provides a detailed analysis of phytoplankton and zooplankton dynamics in Sambhar Lake, revealing significant insights into the ecological health and functioning of this saline lake. Continued research and monitoring are essential for developing effective management strategies to address the challenges facing Sambhar Lake and other similar ecosystems. The findings underscore the need for ongoing monitoring and management to address ecological challenges such as eutrophication and salinity fluctuations, ensuring the lake's sustainability as a key aquatic habitat.

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