Chapter-48

Taxonomic Composition and Ecological Baseline of Phytoplankton in Kambe Lake, Bhiwandi, Maharashtra

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Abstract

Phytoplankton communities serve as fundamental biological indicators of the ecological integrity and trophic status of freshwater ecosystems. As the primary producers of the aquatic food web, their community composition and seasonal succession are highly sensitive to environmental perturbations and nutrient enrichment. This study presents a comprehensive taxonomic assessment of the phytoplankton diversity in Kambe Lake, Maharashtra, conducted over a twenty-four-month period from February 2014 to January 2016. By employing standard limnological sampling and microscopic identification techniques, the investigation catalogs the distribution and structural diversity of the resident planktonic flora. The study evaluates the ecological significance of various taxonomic groups, including rare occurrences, to understand the lake's response to its surrounding environment. These findings establish a vital baseline for assessing the lake's biological health, facilitating a better understanding of its ecological stability. Ultimately, this research provides essential data to support future conservation, sustainable management, and long-term monitoring strategies for Kambe Lake's freshwater resources.

Keywords: Kambe Lake, Phytoplankton Diversity, Bio-indicators, Freshwater Ecology, Bhiwandi.

Introduction

Lentic ecosystems—ranging from small ponds to expansive reservoirs—function as critical nodes of regional biodiversity and are indispensable for local water security [1]. Within these systems, phytoplankton communities occupy the foundational niche as primary producers, governing the flow of energy through the aquatic food web while responding with high sensitivity to physical and chemical fluctuations [2].

In the Bhiwandi region, Kambe Lake exists within a mosaic of agricultural and domestic influences, subjecting it to varying degrees of anthropogenic pressure. This complexity necessitates a robust understanding of its baseline biological health to differentiate between natural seasonal successions and human-induced ecological degradation. Documenting the phytoplanktonic assembly is essential for monitoring the impacts of nutrient loading—specifically nitrogen and phosphorus—which are often the primary drivers of community shifts [3, 4].

The functional stability of such lakes is not an isolated phenomenon but is deeply interconnected with the surrounding catchment area's management. As anthropogenic inputs increase, the shift in community structure often serves as an early-warning signal for impending eutrophication, potentially disrupting higher trophic levels, including zooplankton and native fish populations [5, 6]. Furthermore, given the regional climatic

variability characteristic of Maharashtra, understanding how monsoon cycles regulate water column stability is vital for interpreting the taxonomic resilience of the reservoir [7].

Materials and Methods

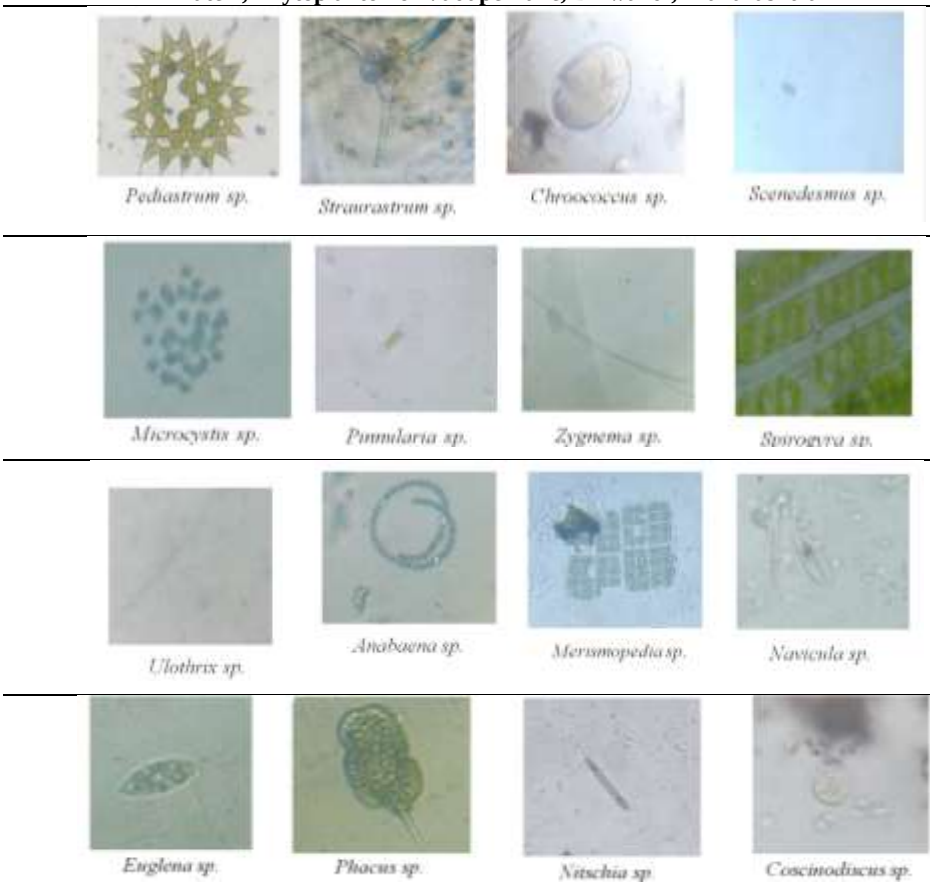
Sampling was performed monthly from February 2014 to January 2016 at two designated stations. Samples were fixed with Lugol's iodine (1:100 v/v) and preserved in 4% buffered formalin [8]. Identification was carried out using high-resolution microscopy and taxonomic keys, including Adoni (1985) and Altaff (2004) [9, 10].

Observations-

Table 1. Checklist of Phytoplankton Genera Identified in Kambe Lake.

Taxonomic Group	Number of Genera	Genera Identified
Chlorophyceae	12	Ankistrodesmus sp., Desmidium sp., Pediastrum sp., Oedogonium sp., Closterium sp., Staurastrum sp., Zygnema sp., Volvox sp., Crucigenia sp., Spirogyra sp., Chlamydomonas sp., Ulothrix sp.
Bacillariophyceae	9	Cymbella sp., Navicula sp., Nitzschia sp., Pinnularia sp., Synedra sp., Gyrosigma sp., Cyclotella sp., Fragilaria sp., Rhizosolenia sp.
Cyanophyceae	7	Anabaena sp., Cylindrospermopsis sp., Microcystis sp., Nostoc sp., Oscillatoria sp., Aphanizomenon sp., Synechococcus sp.
Euglenophyceae	2	Euglena sp., Phacus sp.
Coscinodiscaceae	1	Coscinodiscus sp.
Total	**31**	

Plate 1, Phytoplakton of Vadape Lake, Bhiwandi, Maharashtra



Results

The study identified a total of 31 phytoplankton genera across the two-year sampling period in Kambe Lake. The taxonomic assembly was primarily dominated by Chlorophyceae, which accounted for 38.7% (12 genera) of the total richness. This was followed by Bacillariophyceae at 29.0% (9 genera), Cyanophyceae at 22.6% (7 genera), Euglenophyceae at 6.5% (2 genera), and the rare appearance of Coscinodiscaceae at 3.2% (1 genus).

Discussion

The phytoplankton community in Kambe Lake can be analyzed through the lens of the "Intermediate Disturbance Hypothesis" (IDH), which posits that moderate levels of environmental disturbance—such as the seasonal monsoon-driven flushing and periodic nutrient pulses typical of the Bhiwandi region—promote higher taxonomic richness compared to either stable or highly stressed environments [3, 5]. The identification of 31 genera suggests that Kambe Lake experiences a dynamic temporal mosaic of physical conditions, facilitating the coexistence of both opportunistic "r-strategist" species, such as *Microcystis sp.*, and more stable "K-strategist" diatoms [6]. This successional complexity is a hallmark of resilient ecosystems capable of rebounding from seasonal hydrological flux [6, 11].

Furthermore, the comparative assessment with Vadape Lake highlights the significant spatial heterogeneity inherent to reservoir ecosystems in the Thane district. The presence of *Coscinodiscus sp.* in Kambe Lake points to a "silica-rich" window in its seasonal nutrient budget, which is vital for the development of diatom assemblages. According to Wetzel (2001), diatoms often dominate in early spring or post-monsoon phases where high silicate availability and sufficient turbulent mixing prevent the sedimentation of these heavy cells [1]. The total absence of *Coscinodiscaceae* in Vadape Lake suggests that it may undergo a more rapid progression toward eutrophication or possesses a distinct light-attenuation profile that suppresses diatom growth earlier in the seasonal cycle [12].

This spatial variability—observed even between geographically proximal lakes—suggests that regional water conservation policies cannot adopt a "one-size-fits-all" approach to lake management. Future management of Kambe Lake should prioritize the maintenance of the delicate diatom-cyanobacteria balance, as the transition to permanent cyanobacterial dominance could irreversibly alter the lake's functional stability and significantly reduce the quality of water available for secondary consumers, such as fish and zooplankton [4, 13]. As anthropogenic nutrient loading continues to threaten regional water bodies, the integration of long-term biological assessments with continuous physico-chemical monitoring becomes paramount [14]. Such a dual-monitoring approach is essential for developing predictive models that accurately forecast the lake's long-term trophic evolution and safeguard its role as a vital resource for the Bhiwandi community [15].

5. Conclusion

The two-year investigation into the phytoplankton community of Kambe Lake reveals a biologically rich and functionally complex freshwater ecosystem. With the identification of 31 distinct genera, the lake demonstrates a higher level of taxonomic diversity compared to neighboring water bodies in the Bhiwandi region. The dominance of *Chlorophyceae* and the presence of *Bacillariophyceae* underscore the reservoir's inherent

productive capacity, while the detection of bloom-forming *Cyanophyceae* genera—such as *Microcystis* and *Oscillatoria*—serves as a critical bio-indicator of emerging organic enrichment.

The unique occurrence of the family *Coscinodiscaceae* (*Coscinodiscus sp.*) distinguishes Kambe Lake as a unique ecological niche, potentially governed by distinct silicate availability and hydrological cycles. While the lake currently maintains a state of ecological equilibrium, the coexistence of sensitive diatom species with pollution-tolerant blue-green algae suggests that the system is at a trophic threshold.

To ensure the long-term sustainability of Kambe Lake, the following management strategies are recommended:

- **Nutrient Mitigation:** Implement stringent controls on agricultural and domestic runoff to reduce nitrogen and phosphorus loading, which are the primary drivers of cyanobacterial dominance.
- **Regular Biological Monitoring:** Establish a long-term surveillance program that tracks the ratio of diatoms to blue-green algae as an early-warning metric for further eutrophication.
- **Integrated Watershed Management:** Protect the riparian buffer zones to reduce turbidity and stabilize sediment dynamics, thereby preserving the environmental conditions necessary for diatom-rich communities.

  By integrating these scientific findings into regional water management plans, Kambe Lake can be preserved as a healthy, functional, and biodiverse freshwater resource for the Bhiwandi community.

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