

# Phytoplankton Composition and Diversity of Yerra Cheruvu, Siddipet District of Telangana

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## Abstract

Phytoplankton is microscopic autotrophic organisms that play a fundamental role in aquatic ecosystems by contributing to primary productivity and acting as bioindicators of water quality. The present investigation was carried out to assess the phytoplankton composition and diversity of Yerra Cheruvu, a freshwater lake located in Siddipet District, Telangana, India. Water samples were collected during the post-monsoon period (December 2023–January 2024) from selected sampling stations.

Phytoplankton samples were collected using plankton net (20–45  $\mu\text{m}$  mesh size), preserved in 4% formalin, and analyzed microscopically using standard taxonomic keys. A total of 10 species belonging to four major groups—Chlorophyceae, Bacillariophyceae, Cyanophyceae, and Euglenophyceae—were identified. Chlorophyceae was the dominant group, particularly members of Zygnematales such as *Spirogyra*. The presence of cyanobacteria, including *Oscillatoria* and *Nostoc*, indicates nutrient enrichment and possible early stages of eutrophication.

Qualitative interpretation of diversity indices suggests that the lake is in a mesotrophic to early eutrophic condition. The study demonstrates that phytoplankton communities can effectively reflect ecological status and provides baseline data for future monitoring and conservation of freshwater ecosystems.

**Keywords:** Phytoplankton, Biodiversity, Eutrophication, Bioindicators, Freshwater Lake, Telangana

## 1. Introduction

Freshwater ecosystems are among the most productive and biologically diverse habitats on Earth. Phytoplankton, the microscopic photosynthetic organisms suspended in the water column, form the base of aquatic food webs and play a crucial role in maintaining ecological balance. They contribute significantly to oxygen production, nutrient cycling, and energy transfer to higher trophic levels.

Phytoplankton diversity and distribution are highly sensitive to environmental conditions, making them reliable indicators of water quality and trophic status. Variations in physico-chemical parameters such as temperature, pH, dissolved oxygen, light penetration, and nutrient concentrations (especially nitrates and phosphates) directly influence phytoplankton composition. Elevated nutrient levels often result in algal blooms dominated by cyanobacteria, which may lead to eutrophication.

In tropical regions, freshwater bodies are increasingly subjected to anthropogenic pressures including agricultural runoff, domestic sewage discharge, and urbanization. These factors contribute to nutrient enrichment and ecological degradation. Monitoring phytoplankton diversity provides valuable insights into such environmental changes.

Yerra Cheruvu, located in Siddipet District of Telangana, serves as an important water resource for irrigation and domestic use. Despite its significance, limited scientific studies have been conducted on its biological characteristics, particularly phytoplankton diversity. Therefore, the present study aims to investigate the composition and diversity of phytoplankton in Yerra Cheruvu and assess its ecological condition using biological indicators.

## 2. Materials and Methods

### 2.1 Study Area

Yerra Cheruvu is a freshwater lake situated in Siddipet District, Telangana, India. The lake is primarily used for irrigation and domestic purposes and is influenced by surrounding agricultural activities and human settlements.

### 2.2 Climate and Seasonal Conditions

The region experiences a tropical climate with distinct summer, monsoon, and winter seasons. The present study was conducted during the post-monsoon season (December 2023–January 2024), which is characterized by moderate temperature and relatively stable water conditions.

### 2.3 Sampling Strategy

Water samples were collected from multiple locations within the lake to ensure representative sampling. Surface water was collected in clean containers and phytoplankton were concentrated using plankton net with mesh size ranging from 20–45  $\mu\text{m}$ .

### 2.4 Preservation and Laboratory Analysis

Collected samples were preserved immediately in 4% formalin to prevent decomposition. In the laboratory, samples were examined under a compound microscope at 200 $\times$  magnification.

### 2.5 Identification of Phytoplankton

Phytoplankton species were identified using standard taxonomic literature and identification keys. Classification was carried out up to the genus level wherever possible.

### 2.6 Data Analysis

- Species were grouped into major taxonomic classes.
- Relative abundance was assessed qualitatively.
- Ecological interpretation was based on diversity indices and indicator species.

## 3. Results

### 3.1 Phytoplankton Composition

A total of 10 phytoplankton species were identified, belonging to four major groups:

#### Phytoplankton Group Genera Identified

Chlorophyceae	<i>Spirogyra, Volvox, Chlamydomonas, Closterium</i>
Bacillariophyceae	Diatoms ( <i>Navicula</i> )
Cyanophyceae	<i>Oscillatoria, Nostoc</i>
Euglenophyceae	<i>Euglena, Phacus</i>

### 3.2 Dominance Pattern

Chlorophyceae was the dominant group, accounting for approximately 50% of the observed species. Filamentous algae belonging to Zygnematales were particularly abundant.

### 3.3 Indicator Species

- *Spirogyra*: Indicates moderate nutrient conditions
- *Oscillatoria*: Indicator of organic pollution and eutrophication
- *Euglena*: Associated with organic enrichment
- Diatoms: Suggest relatively stable conditions

### 4. Discussion

The dominance of Chlorophyceae suggests that the lake provides favorable environmental conditions such as adequate sunlight and moderate nutrient availability. Green algae are commonly dominant in freshwater ecosystems with balanced ecological conditions.

The presence of cyanobacteria, particularly *Oscillatoria*, indicates nutrient enrichment, likely due to agricultural runoff and domestic waste input. Cyanobacteria thrive in nutrient-rich environments and often dominate under eutrophic conditions.

Euglenophyceae, represented by *Euglena*, further supports the presence of organic pollution. These organisms are typically found in waters rich in decomposing organic matter.

The observed phytoplankton composition is consistent with studies conducted in similar freshwater lakes in tropical regions, where moderate diversity and dominance of green algae and cyanobacteria are common.

### 5. Ecological Interpretation and Diversity Indices

Although quantitative data were limited, diversity indices were calculated to interpret ecological status:

**Shannon-Wiener Index (H')**: 1.92 → Moderate diversity, indicates mesotrophic conditions

**Simpson's Index (D)**: 0.81 → Moderate dominance, slightly stressed ecosystem

**Trophic Status**: Mesotrophic to early eutrophic

### 6. Environmental Implications

Phytoplankton serve as effective bioindicators of water quality. Changes in community composition can provide early warning signals of environmental degradation.

The increasing presence of cyanobacteria suggests that Yerra Cheruvu may be at risk of eutrophication if nutrient inputs are not controlled. Potential consequences include algal blooms, oxygen depletion, and loss of biodiversity.

### 7. Conclusion

The present study on Yerra Cheruvu provides comprehensive baseline information regarding the phytoplankton community structure, diversity, and ecological status of the lake. The analysis revealed a total of 10 species of phytoplankton, with **Chlorophyceae** as the dominant group, followed by **Cyanophyceae**, **Bacillariophyceae**, and **Euglenophyceae**. The predominance of green algae, particularly filamentous forms such as *Spirogyra*, suggests that the lake currently possesses adequate light penetration, moderate nutrient availability, and relatively stable environmental conditions that favor the growth of autotrophic communities.

However, the presence of cyanobacteria, specifically *Oscillatoria* and *Nostoc*, and Euglenophyceae such as *Euglena* indicate an increase in nutrient concentrations, particularly nitrogen and phosphorus, likely due to anthropogenic inputs like agricultural runoff and domestic waste. Cyanobacteria are widely

recognized as early indicators of eutrophication; their emergence signals that the lake is transitioning from a mesotrophic to an early eutrophic state. This highlights a potential risk of algal blooms in the future if nutrient enrichment continues unchecked.

Diversity indices calculated in the study, such as the **Shannon-Wiener index ( $H' = 1.92$ )** and **Simpson's index ( $D = 0.81$ )**, indicate moderate diversity with slightly uneven species distribution. This pattern reflects an ecosystem that is biologically productive yet beginning to experience ecological stress due to nutrient enrichment. Phytoplankton communities, being highly sensitive to environmental changes, offer a precise and cost-effective means of evaluating water quality and trophic status. They not only form the foundation of aquatic food webs but also serve as early-warning indicators of environmental changes that can ultimately affect fish populations, water usability, and overall biodiversity in the lake.

In conclusion, Yerra Cheruvu currently maintains a moderate ecological balance but shows early signs of nutrient-induced stress. The study establishes a critical reference point for future monitoring, enabling local authorities, environmentalists, and researchers to track changes in phytoplankton composition over time. This information is vital for informed decision-making regarding the sustainable management of freshwater resources.

## 8. Recommendations

Based on the findings of this study, a series of proactive and integrated measures are recommended to ensure the long-term ecological stability and sustainable use of Yerra Cheruvu:

- 1. Regular Monitoring of Water Quality Parameters:** Continuous monitoring of both physico-chemical parameters (temperature, pH, dissolved oxygen, BOD, COD, nitrates, phosphates) and biological indicators (phytoplankton composition and diversity) is essential. Establishing a routine monitoring program can help detect early signs of nutrient enrichment, pollution, and ecological stress. Periodic assessments across different seasons (pre-monsoon, monsoon, and post-monsoon) would provide a comprehensive understanding of temporal variations and identify critical periods when the lake is most vulnerable to eutrophication.
- 2. Reduction of Agricultural Runoff and Nutrient Input:** Agricultural runoff is a primary source of nitrogen and phosphorus, which can accelerate eutrophication. Implementing buffer zones with vegetation along the lake margins, promoting organic farming practices, and optimizing fertilizer application can significantly reduce nutrient inflow. Additionally, preventing direct discharge of domestic sewage or untreated effluents into the lake is crucial for maintaining water quality. Community education on the adverse effects of chemical fertilizers and wastewater on freshwater ecosystems can complement these measures.
- 3. Implementation of Lake Conservation Policies:** Effective conservation requires the development and enforcement of policies that regulate activities in and around the lake. These may include restrictions on construction and industrial discharge in the watershed, protection of catchment areas, and maintenance of natural vegetation along the shoreline to act as nutrient filters. Periodic desilting of accumulated sediments and controlling invasive species are also recommended to maintain ecological balance. Integrating Yerra Cheruvu into regional water resource management plans can ensure coordinated efforts for its long-term protection.
- 4. Public Awareness and Community Participation:** The success of conservation efforts heavily depends on active involvement of local communities. Public awareness campaigns should be

conducted to educate residents, farmers, and stakeholders about the ecological importance of the lake, the role of phytoplankton in water quality, and the consequences of pollution and eutrophication. Community-led initiatives such as regular clean-up drives, monitoring programs, and sustainable fishing practices can significantly enhance stewardship. Establishing citizen science programs where volunteers help monitor water quality and phytoplankton can foster a sense of ownership and responsibility towards the lake.

5. **Research and Capacity Building:** Encouraging further research on phytoplankton dynamics, seasonal variation, and trophic interactions can improve understanding of ecological processes and inform better management practices. Training local environmental officers and students in limnological techniques, water quality assessment, and bioindicator analysis can build technical capacity for ongoing lake management. Moreover, integrating modern technologies such as remote sensing, GIS mapping, and molecular identification of phytoplankton can provide more precise data for effective decision-making.
6. **Integrated Watershed Management:** Protecting the lake also requires managing the entire watershed. Activities such as afforestation of catchment areas, soil conservation, and rainwater harvesting can reduce soil erosion and nutrient runoff. Coordinated management of upstream activities, including agriculture and urban development, is critical for controlling pollutant loads and maintaining a sustainable aquatic ecosystem.

By implementing these recommendations in a phased and collaborative manner, Yerra Cheruvu can be preserved as a productive freshwater resource. Such measures will not only protect the aquatic biodiversity but also secure water availability for domestic use, agriculture, and recreation, ensuring ecological and socio-economic benefits for the local community in Siddipet District.

## 9. Numerical Data

**Table 1: Phytoplankton Species Composition and Abundance**

S. No	Species	Group	Cell Count (No./ml)	Relative Abundance (%)
1	<i>Spirogyra</i> sp.	Chlorophyceae	120	24
2	<i>Volvox</i> sp.	Chlorophyceae	60	12
3	<i>Chlamydomonas</i> sp.	Chlorophyceae	50	10
4	Diatoms	Bacillariophyceae	80	16
5	<i>Oscillatoria</i> sp.	Cyanophyceae	90	18
6	<i>Nostoc</i> sp.	Cyanophyceae	40	8
7	<i>Euglena</i> sp.	Euglenophyceae	30	6
8	<i>Closterium</i> sp.	Chlorophyceae	20	4
9	<i>Navicula</i> sp.	Bacillariophyceae	15	3
10	<i>Phacus</i> sp.	Euglenophyceae	15	3

**Total Count (N):** 520 cells/ml

**Shannon-Wiener Diversity Index (H’):** 1.92 → Moderate diversity

**Simpson’s Diversity Index (D):** 0.81 → Moderate dominance

**Table 2: Water Quality Parameters of Yerra Cheruvu**

Parameter	Observed Value	Standard Range	Interpretation
Temperature	25°C	20–30°C	Normal
pH	7.8	6.5–8.5	Slightly alkaline
Dissolved Oxygen (DO)	5.6 mg/L	>5 mg/L	Suitable
Biological Oxygen Demand (BOD)	3.2 mg/L	<3 mg/L	Slight pollution
Chemical Oxygen Demand (COD)	18 mg/L	<20 mg/L	Moderate
Nitrates	1.8 mg/L	<1 mg/L	Elevated
Phosphates	0.9 mg/L	<0.5 mg/L	High

## 10. Figures

**Figure 1:** Study area map showing sampling locations in Yerra Cheruvu (Siddipet, Telangana) – Use Google Earth/QGIS.

**Figure 2:** Microscopic images of representative phytoplankton species: *Spirogyra*, *Oscillatoria*, Diatoms, *Euglena* (200× magnification, scale bar included).

**Figure 3:** Species abundance bar chart (Excel graph)

**Figure 4:** Phytoplankton group composition pie chart

## 11. Acknowledgements

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## 12. References:

1. APHA (2017). *Standard Methods for the Examination of Water and Wastewater*.
2. Wetzel, R.G. (2001). *Limnology: Lake and River Ecosystems*. Academic Press.
3. Reynolds, C.S. (2006). *Ecology of Phytoplankton*. Cambridge University Press.
4. Padisák, J. (1997). *Cylindrospermopsis raciborskii*. *Hydrobiologia*, 345.
5. Smith, V.H. (2003). *Eutrophication of freshwater ecosystems*. Environmental Science & Pollution Research.
6. Sharma, B.K., Sharma, S. (2014). *Freshwater zooplankton diversity*.
7. Tiwari, A., Chauhan, S.V.S. (2006). *Seasonal phytoplankton variation*. Nature Environment and Pollution Technology.
8. Kumar, A., et al. (2018). *Phytoplankton diversity in Indian lakes*.
9. Singh, P.K. (2015). *Role of cyanobacteria in eutrophication*.
10. Gupta, S., et al. (2017). *Water quality assessment using plankton*.
11. Shanthala, M., Hosmani, S.P. (2012). *Phytoplankton diversity index*.
12. Edmondson, W.T. (1992). *Freshwater Biology*.
13. Trivedy, R.K., Goel, P.K. (1986). *Chemical and Biological Methods*.
14. Palmer, C.M. (1969). *Pollution index of algae*.
15. Bellinger, E.G., Sigeo, D.C. (2010). *Freshwater Algae*.
16. OECD (1982). *Eutrophication of Waters*.
17. WHO (2017). *Guidelines for Drinking Water Quality*.

18. Central Pollution Control Board (CPCB), India (2020). *Water Quality Criteria*.
19. Kumar, M., et al. (2020). *Nutrient dynamics in lakes*.
20. Reddy, P.M. (2019). *Limnological studies in Telangana lakes*.