

Seasonal Variation study of Algae in Toranmal from Satpura Mountain Maharashtra

Mamata H. Shinde¹, Sanjay A. Khairnar²

Department of Botany, KRT Arts, BH Commerce and AM Science (KTHM) College, Nashik 422002, (M.S), India. Affiliated to Savitribai Phule Pune University, Pune

Abstract—Algae play a crucial role in an aquatic ecosystem as primary producers and bioindicators of quality and pollution of water bodies. This study investigated the seasonal variation in algal diversity across selected freshwater bodies in the Toranmal region, a highland plateau in the Satpura ranges of Maharashtra and characterized by a tropical monsoon climate. Algal samples were collected from selected sites namely SitaKhai waterfall and Yashawant Lake during the monsoon (June–September); post-monsoon/winter (October–February), and summer (March–May) seasons. Analysis and laboratory studies of water samples showed presence of total of 48 algal taxa belonging to five major groups of Algae i.e. Cyanophyceae, Chlorophyceae, Bacillariophyceae, Desmidiaceae, and Oedogoniales.

The highest species diversity in algae was observed during the winter season; with Chlorophyceae and Desmids were dominating group of algae and Cyanophyceae were more abundant group of algae during the monsoon; likely due to increased nutrient runoff. The summer season showed a decline in overall diversity, but filamentous green algae such as Oedogonium thrived under warmer and shallower water conditions. Statistical analysis revealed strong correlations between algal abundance and physico-chemical parameters such as temperature, dissolved oxygen, and nutrient concentrations.

The results highlight the influence of seasonal environmental changes on algal community structure and underscore the importance of regular ecological monitoring of water bodies. This study provides foundational data for algal dynamics of Toranmal and contributes to future water quality assessment and biodiversity conservation of this ecologically sensitive region.

Index Terms—Freshwater algae, Seasonal variation, Toranmal Satpura

INTRODUCTION

Algae are a diverse group of photosynthetic organisms that thrive across aquatic ecosystems, from mountain streams to man-made reservoirs. They serve as primary producers, forming the base of aquatic food webs, and are critical to nutrient cycling and oxygen production. Their sensitivity to environmental parameters makes them valuable bioindicators for water quality and ecological health.

In mountainous and hilly region like Toranmal, seasonal variations in temperature, light, rainfall, and nutrient input significantly influence algal occurrence and growth. Cyanobacteria tend to flourish in nutrient-rich, warm conditions, while green algae and diatoms thrive in clearer, cooler waters with higher oxygen content.

Toranmal, located in the Satpura hill ranges of northern Maharashtra, offers a unique ecological landscape comprising lakes, streams, and seasonal reservoirs. Despite being part of a biodiversity rich region, studies on freshwater algal diversity in this region is seen limited.

This research aims to fill the knowledge gap by conducting a comprehensive seasonal survey of algal communities at SitaKhai waterfall and Yashavant Lake. The study seeks to:

- Document the taxonomic composition of algae across seasons
- Analyze seasonal patterns in species diversity
- Correlate algal trends with physico-chemical water parameters

The findings will aid in an ecosystem monitoring, bloom prediction, and conservation planning for the Toranmal region.

II. STUDY AREA

The Toranmal region is located in the Nandurbar District of northwestern Maharashtra, sitting at an elevation of ~1,150 meters in the Satpura Hills. The area is characterized by:

- Tropical monsoon climate with three distinct seasons: monsoon, post-monsoon (winter), and summer
- Average annual rainfall: ~1,400 mm

- Rich forest cover and freshwater ecosystems
Two water bodies were selected:
- SitaKhai waterfall– A perennial freshwater body surrounded by forest cover, fed by monsoon runoff
- Yashavant Lake – A human-managed lake near Toranmal village used for local water needs

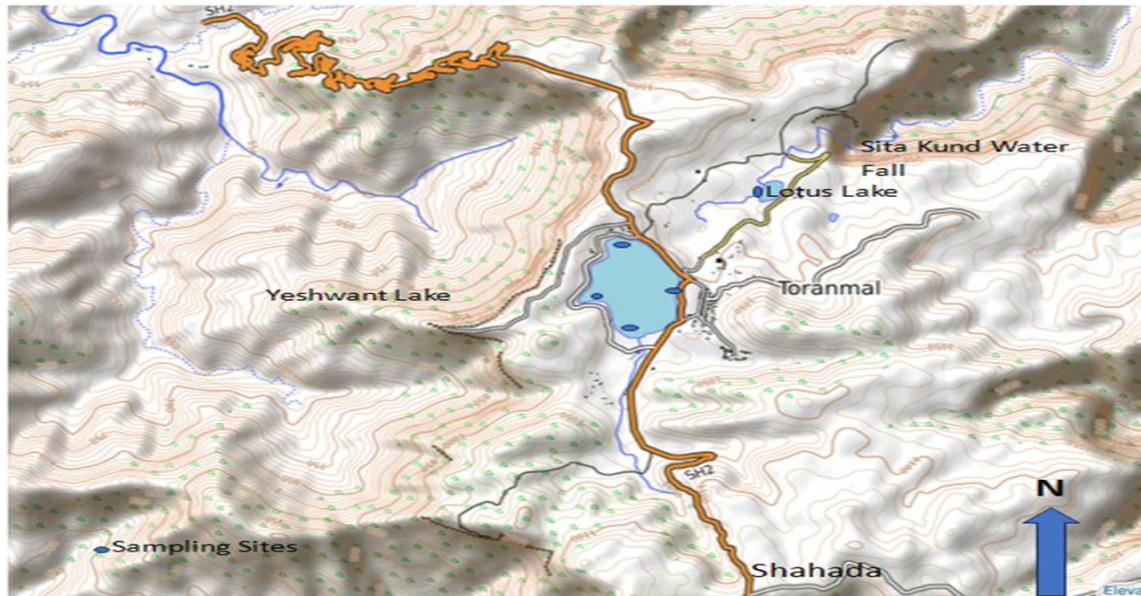


Fig.: Map of study area showing sites of sampling

III. REVIEW OF LITERATURE

Several studies across Maharashtra and nearby regions have documented the diversity and seasonal fluctuations of freshwater algal communities, providing important context for the present investigation in the Toranmal region. In a study conducted at the Natawad Dam, Nayka et al. (2023) reported 24 species of Cyanophyceae, with *Oscillatoria* being the dominant genus. These findings emphasize the adaptability of blue-green algae to nutrient-rich monsoonal environments, which is relevant to highland lakes such as those in Toranmal that receive heavy seasonal runoff.

Research focused on the Shivan Dam by More (2025) highlighted the presence of 16 species of desmids a group of green algae particularly sensitive to ecological changes belonging to genera like *Closterium*, *Euastrum*, and *Spondylium*. The ecological preference of desmids for clear, well-

oxygenated water aligns with observations in Toranmal's winter season, where such taxa tend to flourish due to improved water clarity and reduced turbidity. Dhale (2017) conducted a detailed taxonomic assessment of Oedogoniales (including *Oedogonium*, *Bulbochaete*, and *Oedocladium*) in Dhule and parts of Nandurbar District, recording 23 taxa some of which were new to Maharashtra and India. These filamentous green algae have also been recorded in the warmer, shallower waters of Toranmal's summer season, where conditions favor their growth and proliferation.

Seasonal studies in other regions of western Maharashtra provide comparative insights. For example, Sanap et al. (2020) examined algal populations in reservoirs of Koregaon (Ahmednagar) and noted that Chlorophyceae dominated year-round, with seasonal peaks in summer and winter, and a noticeable decline during the monsoon. Similar patterns have been observed in Toranmal, where green

algae show a post-monsoon resurgence following turbidity reduction.

A long-term investigation of Pashan Lake in Pune by Zaware et al. (2004) documented clear seasonal shifts in algal composition: Cyanophyceae peaked during the monsoon due to increased phosphate availability, Chlorophyceae flourished in the winter due to better light penetration, and Bacillariophyceae (diatoms) were consistently present except during periods of heavy sedimentation. These patterns strongly correlate with Toranmal's lake conditions across similar seasons.

Lastly, Bhuyar and Ratnaparkhi (2025) analyzed the seasonal variation in physico-chemical parameters of the Prakasha Barrage on the Tapi River, noting significant influences on algal dynamics. Their study reinforces the importance of correlating algal data with environmental variables like dissolved oxygen, pH, nutrients, and water temperature—an approach similarly adopted in the present Toranmal study.

Together, these studies underline the ecological sensitivity of algal communities to seasonal fluctuations and establish a strong foundation for investigating algal diversity in lesser-explored high-altitude ecosystems like Toranmal, which had remained underrepresented in limnological research until now.

IV. MATERIALS AND METHODS

- Sampling Sites: SitaKhai waterfall and Yashavant Lake, Toranmal

- Sampling Period: Monthly sampling from June to May, covering monsoon, post-monsoon/winter, and summer seasons

Algal Collection

- Water samples collected using plankton nets (20 µm mesh size)
- Preserved in Lugol's iodine solution
- Algae identified under compound microscope using standard keys (Prescott, 1951; Desikachary, 1959)

Physico-chemical Analysis

- Parameters measured: Temperature, pH, Dissolved Oxygen (DO), nitrate, phosphate, TDS, alkalinity

- Standard APHA (2012) methods were followed

Data Analysis

- Computed relative abundance, Shannon-Wiener Diversity Index
- Correlation analysis conducted between algal groups and environmental variables

V. RESULTS

Seasonal Composition of Algae

A total of 48 algal taxa were identified, classified into algal groups:

- Cyanophyceae (Blue-green algae) – 14 species
- Chlorophyceae (Green algae) – 18 species
- Bacillariophyceae (Diatoms) – 9 species
- Desmidiaceae (Desmids) – 5 species
- Oedogoniales – 2 species

Table 1: Seasonal Algal Diversity

Season	Total Species Observed	Dominant Groups	Most Abundant Genus
Monsoon (Jun–Sep)	30	Cyanophyceae, Bacillariophyceae	Oscillatoria, Navicula
Winter (Oct–Feb)	38	Chlorophyceae, Desmidiaceae	Closterium, Scenedesmus
Summer (Mar–May)	25	Chlorophyceae, Oedogoniales	Oedogonium, Ulothrix

Table 2: Quantitative Analysis – Mean Cell Counts (cells/mL)

Group	Monsoon	Winter	Summer
Cyanophyceae	450	320	210
Chlorophyceae	320	600	420
Bacillariophyceae	280	310	190
Desmidiaceae	100	250	120
Oedogoniales	40	60	150

Table 3: Shannon-Wiener Diversity Index

Site	Monsoon	Winter	Summer
Sita Khai	2.11	2.89	2.05
Yashavant Lake	2.04	2.83	2.12

VI. DISCUSSION

The present study provides valuable insights into the seasonal variation of freshwater algal communities in the Toranmal region, highlighting how climatic and physico-chemical changes influence algal diversity and abundance. The data indicate distinct seasonal patterns in algal composition, with Cyanophyceae dominating during the monsoon, Chlorophyceae and Desmidiaceae peaking in winter, and Oedogoniales thriving in the summer. The monsoon season, characterized by high rainfall and surface runoff, led to increased nutrient levels particularly phosphates which favored the proliferation of blue-green algae such as *Oscillatoria*, *Anabaena*, and *Microcystis*. These genera are known for their tolerance to nutrient-rich, turbid environments and are often associated with eutrophication and bloom conditions, which were observed during the early monsoon months in Sita Khai waterfall.

In contrast, the winter or post-monsoon season exhibited the highest species richness and diversity. Improved water clarity, higher dissolved oxygen levels, and lower temperatures created favorable conditions for green algae and desmids. Species such as *Closterium*, *Euastrum*, and *Scenedesmus* were particularly abundant, reflecting the ecological stability of this period. These taxa are typically sensitive to environmental fluctuations and serve as indicators of good water quality. Summer, while marked by reduced overall diversity, supported the growth of filamentous green algae like *Oedogonium* and *Ulothrix*, which are adapted to warmer, shallow, and sometimes nutrient-depleted waters. This seasonal shift in algal groups is closely linked to changes in temperature, dissolved oxygen, nutrient availability, and water depth.

Correlation analyses further reinforce these observations. Cyanophyceae showed a strong positive correlation with elevated temperatures and phosphate concentrations, while Chlorophyceae and Desmids were positively associated with higher dissolved oxygen, transparency, and alkalinity. Diatoms (*Bacillariophyceae*), though present in all seasons, were more prominent during early monsoon when silicate levels were higher, and turbidity had not yet peaked. The diversity indices also clearly reflected seasonal trends, with the highest values during winter and the lowest during summer. These patterns are

consistent with similar studies from other regions in Maharashtra, suggesting that the seasonal responses of algal communities in Toranmal follow broader ecological trends, though local microclimatic and geographic conditions add unique dynamics.

VII. CONCLUSION

This study demonstrates the significant impact of seasonal environmental changes on the structure and composition of freshwater algal communities in the Toranmal region of Maharashtra. A total of 48 algal taxa were documented across three major seasons, with notable differences in species richness and abundance linked to temperature, nutrient input, water clarity, and oxygen levels. Cyanophyceae were predominant during the monsoon due to high nutrient influx from runoff, while Chlorophyceae and Desmidiaceae flourished during the clearer and cooler winter months. The summer season, although less diverse, supported thermophilic filamentous algae such as *Oedogonium*, reflecting their ecological adaptation to shallow and warmer waters.

The study confirms that algal communities serve as sensitive indicators of freshwater ecosystem health and respond predictably to seasonal and physico-chemical changes. The correlations observed between algal groups and environmental parameters underline the importance of integrating biological and chemical monitoring for effective ecological assessment. Given the ecological sensitivity and tourism potential of Toranmal, it is imperative to implement regular algal monitoring and sustainable watershed management practices. This research not only contributes to the baseline understanding of highland freshwater biodiversity in Maharashtra but also offers a foundation for future long-term studies, particularly in the context of climate variability and increasing anthropogenic pressures.

VIII. ACKNOWLEDGEMENT

Authors are thankful to Authorities of research center and Maratha Vidya Prasarak Samaj for their kind support for the research work

REFERENCES

- [1] Bhuyar, A. R., & Ratnaparkhi, V. H. (2025). Geographical study of seasonal variation in water quality parameters of Prakasha barrage on the Tapi River in Nandurbar District. *International Journal of Geography, Geology and Environment*, 6(1B), 88–92.
- [2] Dhale, D. A. (2017). Oedogoniales from Dhule and Nandurbar District, Maharashtra (India). *Current Botany*, 8(1), Article 3204. <https://doi.org/10.19071/cb.2017.v8.3204>
- [3] Mamata H. Shinde, Sanjay A. Khairnar, "Seasonal Variations in Algal Diversity and Physicochemical Parameters of Water in Toranmal, Nandurbar District, Maharashtra.", *IJRAR - International Journal of Research and Analytical Reviews (IJRAR)*, E-ISSN 2348-1269, P- ISSN 2349-5138, Volume.11, Issue 3, Page No pp.741-746, September 2024, <http://www.ijrar.org/IJRAR24C3003.pdf>
- [4] More, R. R. (2025). Desmids diversity and variation in Shivan Dam of Nandurbar District (MS) India. *International Journal of Advance Research in Engineering, Science and Management (IJARESM)*, 8(9). <http://www.ijaresm.com/>
- [5] Nayka, J. S., Gautam, P. K., & Valvi, A. B. (2023). Diversity of Cyanophyceae from the Natawad Dam of Nandurbar District, Maharashtra, India. *Scholarly Research Journal for Interdisciplinary Studies*, 10(75), 18028–18034. <https://www.researchbib.com/view/paper/385969>
- [6] Sanap, R. R., Shevare, B. P., & Barwant, M. M. (2020). Monitoring freshwater reservoirs in Koregaon with special reference to algal flora: Seasonal variation noted. *International Journal of Research - Granth Alayah*, 8(9), 16–21. <https://doi.org/10.29121/granthaalayah.v8.i9.2020.1106>
- [7] Zaware, B. N., Shinde, M. M., & Pingle, S. D. (2004). Seasonal variation of physicochemical parameters and freshwater algae in Pashan Lake, Pune. *Mapana Journal of Sciences*, 2(2), 43–53. <https://journals.christuniversity.in/index.php/mapana/article/view/313>