

Distribution and Diversity of Euglenoid flagellates in Safilguda Lake, Hyderabad (India)

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Abstract. The Euglenoid flagellates found in Safilguda lake are the focus of this research article. To accomplish this, physico-chemical factors were examined for the water samples obtained from three sampling stations of the lake from May 2022 to April 2023. Statistical tests are used to know the link of phytoplankton and physico-chemical variables. Multiple regression analysis is one of the statistical methods used to measure the impact of the physico-chemical factors on the growth, development and spreading of Euglenoids. Dissolved oxygen had adverse effect in MRA and organic matter was positively related to Euglenophyceae showing higher growth of Euglenoids as algal blooms as oxygen level is low and there is high supply of organic matter in the lake. The euglenophycean species found in the lake include *Euglena*, *Phacus*, *Trachelomonas*, and *leptocinlis*. *Euglena* and *Phacus* had a high species diversity among them. Euglenoids belong to polluted water species thus deteriorate the water quality of the lake indicating eutrophication creating water unfit and unsafe for drinking, domestic, agricultural and recreational uses.

1 Introduction

Euglenoid flagellates are classified as phytoplankton. Free living, phototrophic and unicellular are their characteristics [1]. Euglenoids are fresh water forms which produce water blooms in ponds and lakes [2]. Euglenophycean members are found in large numbers in aquatic ecosystems rich in higher concentration of organic matter [3]. Occurrence of euglenoid flagellates in fresh water bodies indicate eutrophication and act as pollution indicators. Euglenoids are unique to nutrient rich water bodies due to their richness and abundance of species [4]. Based on the correlation between euglenophyceae and other physico-chemical characteristics, water quality is a key factor in determining where these organisms are found [5]. Regression analysis is a statistic measure that assists in understanding the relationship between many variables. In order to get a good representation of the relationship in the population, multiple regression looks at how one dependent variable is related to a number of independent variables [6]. In this current study, MRA was employed to determine how the physico-chemical factors affect the diversity and distribution of euglenoids in Safilguda Lake. The present study also identifies the algae as bio-indicators of pollution.

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2 Materials and Methods

Samples of water from surface of Safilguda Lake were gathered at all the three sampling stations monthly from May 2022 to April 2023 in clean polythene containers of one litre capacity. The samples were analyzed by APHA's standard methods of 2005 [7] for determining physico-chemical characteristics shown below.

1. Temperature: Measured onsite using a Mercury thermometer
2. pH : Determined using a portable pH meter to evaluate water acidity or alkalinity
3. Carbonates and Bicarbonates: Measured using the titrimetric method
4. Chlorides: Estimated using Argentometric titration
5. Dissolved oxygen (DO): Measured using the Winkler's titration method
6. Organic matter (OM) : Measured using Potassium permanganate titration
7. Chemical oxygen demand (COD) : Measured using Potassium dichromate titration
8. Total Hardness, Calcium and Magnesium : Measured using EDTA titration
9. Nitrate and Phosphate Concentrations: Analyzed using UV-Visible spectrophotometry.
10. Total Dissolved Solids (TDS) : Measured using a portable TDS meter

2.1 Frequency measurement of Euglenophyceae

Three different stations in Safilguda Lake were used to collect around a litre of water samples. 2 to 3ml of 4% formaldehyde was added to fix and preserve the euglenoids in each water sample. The samples were not disturbed so much but took approximately one month so that the organisms could settle. Distillation was used to reduce the samples to 100 ml. The bottom becomes covered with the concentrated sediments. We used the concentrated material to identify species of euglenophyceae and to assess frequencies.

At each location, the frequency of several euglenophyceae species was measured using the drop technique [8]. Carefully pipetting out ten drops of the concentrated sample and mounting them on ten glass slides—that is, one drop of water per slide—was the procedure. To remove any extra sample from the slide, blotting paper was used. Twelve fields, each with a high magnification of fifteen by forty-five degrees, were measured at uniform intervals. Therefore, in order to record the species composition, 120 fields were enumerated from each concentration using a high power microscope. The concentration of several microorganisms in milliliters was determined. In order to measure the field size, the microscope was standardized.

2.2 Sampling stations

The whole Safilguda Lake was sampled from three different locations. The three sites cover the left side, right side and middle of the lake which are shown in figure 1, 2 and 3 as station I, II and III.

Station I is the starting point for the journey to Safilguda Lake, where the immersion of Ganesh idols is performed. Puja items and other waste material during Ganesh immersion

are thrown in this station by the people. This station also receives drain water from the nearby colonies surrounding the lake.

Station II is the middle of the lake which is open water zone. Water in this station is turbid due to dumping of garbage.

Station III is the right side of the lake surrounded by residential areas which discharge sewage.



Fig. 1. Station I



Fig. 2. Station II



Fig.3. Station III

Standard multiple regression (MRA) was subjected to the estimation of physico-chemical variables on growth, development and distribution of euglenophyceae members. The physico-chemical factors are employed to get to understand the change in algal number or algal variance and it is presented as R^2 (Coefficient of determination) [9]. Algal variance is a variable that is explained by insignificant and significant factors as a matter of magnitude as the stepwise regression analysis will eliminate less significant factors to reflect significant explanations.

3 Results and Discussion

Table 1 is included with the average analytic determination of every physico-chemical parameter of the three stations throughout the period of investigation.

Table 1. Values of Physico-chemical Parameters of Safilguda Lake
All the data are reported in mg/L except Temperature and pH

S.No	Physico-chemical parameters	Safilguda lake
1	Temperature	25.3
2	pH	8.4
3	Carbonates	35
4	Bicarbonates	300.6
5	Chlorides	497.8
6	DO	2.5
7	OM	20.5
8	COD	355.6
9	Total hardness	510.2
10	Calcium	160.4
11	Magnesium	99.6
12	Phosphates	14.6
13	Nitrites	0.32
14	TDS	845

The table indicates that higher concentration of bicarbonates, chlorides, total hardness, organic matter and total dissolved solids have been mentioned and low concentrations of dissolved oxygen are mentioned always. The lake’s pH of 8.4 indicates that it is alkaline. High chlorides indicate presence of high organic matter due to sewage pollution. Low values of dissolved oxygen indicate high organic matter and high nutrient loading [10]. It is possible that detergents in sewage

contribute to the high hardness. Higher values of total dissolved solids are due to domestic sewage [11].

3.1 Diversity and Distribution of Euglenophyceae

About 120 species of algae have been identified from Safilguda Lake. Euglenophyceae are the most prevalent algal species in the lake. All stations have recorded this group and continued to be in good numbers during the complete study period. At all of the locations, the abundance of euglenoid flagellates peaked in the summer and then declined in the winter. The lake has four genera of Euglenoids namely *Euglena*, *Phacus*, *Trachelomonas* and *Lepocinclis*. *Euglena* and *Phacus* were diverse in terms of species within them. Eutrophic condition of the lake is also indicated by high density of euglenoids in the lake as they are the pollution indicators. The most frequently recorded species in this observation were *Euglena acus*, *E. polymorpha*, *E. tripteris*, *Phacus orbicularis*, *Ph. longicauda*, *Ph. acuminatus*, *Trachelomonas hispid* and *Lepocinclis ovum* identified by standard books and monographs [12].

3.2 Multiple regression analysis (MRA)

At stations I, II, and III, the linear MRA shows an R2 value of 0.865, 0.602, and 0.909, respectively, for all sixteen independent components.

All of the physico-chemical factors were determined to impact euglenid development to a degree of 86.5% at station I, 60.2% at station II and 90.9% at station III as shown in the linear MRA analysis in table 2. The six physico-chemical characteristics that affect euglenoids to the highest extent (95%) are temperature, organic matter, dissolved oxygen, chemical oxygen demand, nitrites and phosphates.

Table 2: Results from a Multiple Regression Analysis of Physical and Chemical Factors of the Euglenophyceae

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.752	.865	.523	50.642
2	.873	.602	.709	39.508
3	.930	.909	.814	31.628

Poor concentration of dissolved atmospheric oxygen increases the algae. Consequently, negative effects were exhibited on the euglenoid flagellates distribution by the level of dissolved oxygen in the water column. High temperature

enhanced the growth of euglenids[13-15].

3.3 Relationship between Physico-chemical factors and Euglenophyceae

Euglenophyceae’s growth, development and periodicity are greatly influenced by water temperature. The number of euglenids increases in summer and decreases in winter in Safilguda lake. The growth of euglenids is luxuriant in effluents that are rich in organic compounds but have DO less. The increase in concentration of the nutrients such as nitrites and phosphates ensures an abundant growth of the members of Euglenophyceae that is symbolized by the figure 4.

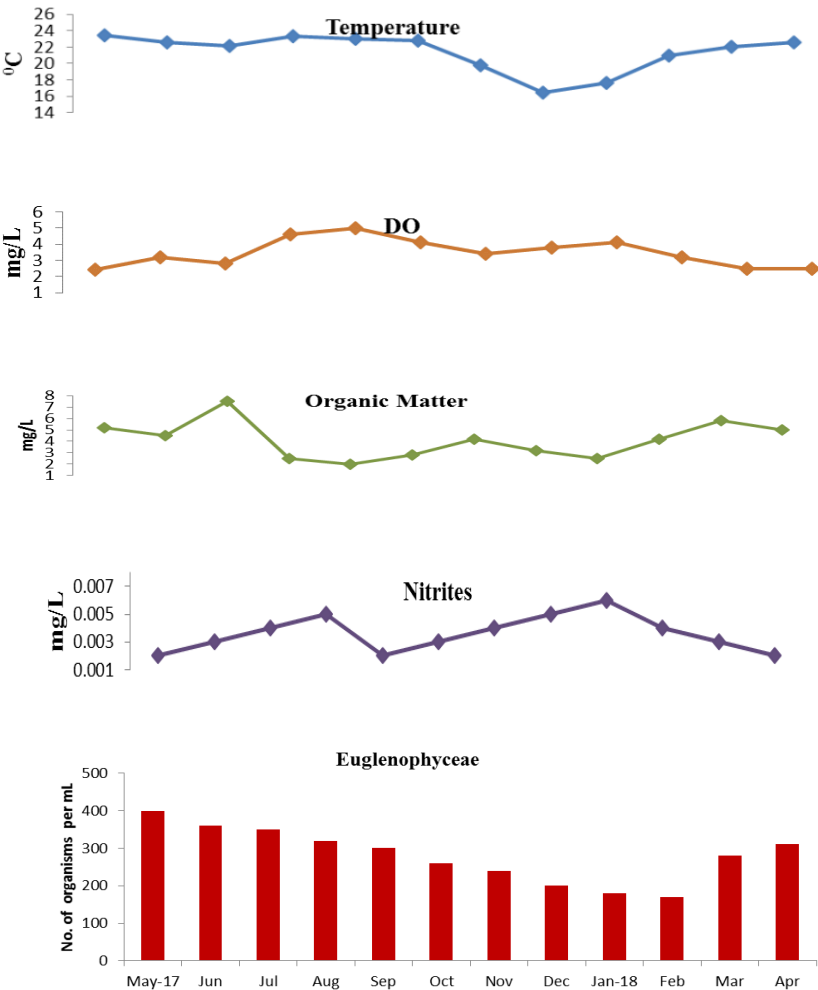


Fig. 4. Relationship between Physico-chemical factors and Euglenophyceae

Dominant organisms of Euglenophyceae are represented in table 3.

Table 3. Dominant species of Euglenoids

Name of the Organism	Number of organisms
<i>Euglena acus</i>	220
<i>Euglena oblonga</i>	110
<i>Euglena polymorpha</i>	230
<i>Euglena tripteris</i>	115
<i>Phacus arbicularis</i>	130
<i>Phacus longicauda</i>	120
<i>Phacus acuminatus</i>	115
<i>Trachelomonas hispid</i>	150
<i>Trachelomonas pulcherrima</i>	110
<i>Lepocinclis ovum</i>	125
<i>Lepocinclis fusiformis</i>	115

4 Conclusions

Euglenophycean diversity and distribution in Safilguda Lake were discussed in the current study. About 120 species of phytoplanktonic algae were identified in Safilguda lake and Euglenophycean members are the most prevalent species. All of the lake’s physico-chemical characteristics and euglenoids have a link with one another according to correlation and regression analysis. High organic content, low dissolved oxygen and high temperature favoured euglenoids to grow more. To determine relative significance of physical and chemical parameters on algal development, multiple regression analysis is very helpful method. Significant relationships were found between the euglenoids and organic matter, dissolved oxygen, water temperature, nitrites and phosphates. The statistical analysis indicates that euglenophycean members are effective ecological indicators for assessing water quality and pollution levels in Safilguda Lake, which deteriorates the lake’s water quality and signals eutrophication rendering lake unsafe for all uses and activities. Some of the phytoplanktonic algae of Euglenophyceae reported in Safilguda lake are *Euglena proxima*

var. amphoraeformis Szabados, Lepocinclis playfairiana Deflandre, Lepocinclis playfairiana Deflandre, Lepocinclis capito Wehrle, P. arbuticularis Huebne, Phacus tortus (Lemmermann), Trachelomonas pulcherrima var.minor Playfair Trachelomonas pulcherrima Playfair, Lepocinclis fusiformis.

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