



Composition, Density and Diversity of Phytoplankton in Rathi Cheruvu, Bhadradi Kothagudem, Telangana, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The current study deals with composition, density and diversity of phytoplankton during January 2023 to December 2023 monthly in the Rathi cheruvu, Bhadradi Kothagudem, Telangana, India. Samplings were collected from different locations of the study site during a one year research period. Several physico-chemical parameters were studied from two sampling stations such as water temperature, pH, DO, BOD, SO₄, NO₃, PO₄ and Cl⁻, of which pH, DO and BOD were shown to be the most significant in growth and development of phytoplankton. In the current study revealed a total number of 43 species of phytoplankton belonging to four major classes i.e. Chlorophyceae with 16 species, Bacillariophyceae with 14 species, Euglenophyceae with three species and Cyanophyceae with 10 species. The maximum population of phytoplankton diversity was observed

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during summer followed by monsoon with a total 1058 phytoplankton species during one year of study period. Finally the study showed that the study site has a well balanced phytoplankton community.

Keywords: Phytoplankton community; diversity indices; aquatic ecosystem.

1. INTRODUCTION

The Rathi cheruvu is a minor irrigated freshwater ecosystem situated at the lap of the hill Paloncha and surrounded by hill forest. The lake being studied is an important part of the water that is subjected to some degree of cultural eutrophication and is therefore considered to be more appropriate production studies in its restoration scheme.

The Rathi cheruvu have played a significant role in the district's tribal and economic progress during the past three decades. Without the Rathi cheruvu the villagers and tribal would have been thirsty, hungry, dark land and draughts. Reason to do research on this, the Lake occupies about 3.8% of the district's geographical area and a good place for tourists as it has a wide variety of flora and fauna and aquatic plants. The study area stores precious rainwater to irrigate farmlands, supply drinking water and save surrounding villages from floods and draughts. Two sampling stations from Rathi cheruvu were taken into consideration for the present study. Nowadays, Environmental change and global warming are a threat to mankind's security. The availability of various water systems and food chains are even more important.

Phytoplankton is one of the tiny and most abundant organisms living in lakes, which play a key role in aquatic ecosystems. In addition to being involved in photosynthesis, they form a food base for other living beings in aquatic ecosystems. Their absence and high growth is detrimental to water resources. There are many aspects to this that affect the growth and diversity of Phytoplanktons. The main reason for the change in species diversity and population abundance is the key changes in the surrounding environment. Less or no research studies on water quality and phytoplankton availability in Rathi Lake have been done. Hence, current research has fully studied the Phytoplanktons, water quality and resources of this lake.

2. MATERIALS AND METHODS

The Topography of the study site is usually referred to for rolling with frequent mounds, hills

are seen. The area is bounded by 17°35'30" N and 80°70'57"E at Paloncha area, Bhadradi Kothagudem, Telangana State. The Lake is very close to the hill station as it is very far from the transport and as well as pollution. That is why the aquatic plants and animals in this Lake look very healthy. The water from the study site is being used for drinking, and irrigation purposes. Water samples were collected on a monthly basis from the Lake for a period of one year January to December 2023 at Rathi cheruvu. The Lake is around 100 years old water body associated with an ancient temple.

2.1 Collection of Samples

The water samples for phytoplankton analysis were collected separately in wide mouth reagent bottles with the help of plankton nets of 55 µm mesh size with some amount of Lake Water and immediately preserved in 4% formalin solution. The samples were collected from different locations of the study site, samplings were done in monthly interval in early morning hours and brought to the Laboratory and stored in Low temperature as followed by Mittal and Sengar [1].

2.2 Isolation

Isolation of phytoplankton is made through a subsequent serial dilution process [2]. For isolation of Unicellular and Filamentous Algae different dilutions were prepared. The individual phytoplankton colonies were picked up and transferred to the 4% formalin solution in flasks.

2.3 Seasonal Succession

Phytoplankton community in the study site showed major patterns of seasonal succession. Cyanophyceae (*Microcystis aeruginosa*) dominate in winter, Bacillariophyceae (*Synendra ulna*) dominate in the whole summer. Overall algal development is the minimum amount during the rainy season.

2.4 Identification

The phytoplankton Identifications were made with the help of relevant standard available

literatures and Monographs of Desikachary [3], Iyengar and Desikachary [4], Anand [5], Misra [6] and Dwivedi [7]. The count of phytoplankton was done by using the Sedwick Rafter plankton counting cell. Main important physico-chemical characteristics of water including water temperature, color, pH were analyzed onsite

using mercury thermometer, visual, digital pH meter respectively. While dissolved oxygen and Total dissolved solids were analyzed onsite with water quality monitoring kit at the sampling sites. Rest of the parameters was analyzed according to standard methods [8].



Fig. 1. Rathi Cheruvu



Fig. 2. Map of Telangana State



Fig. 3. Map of Bhadradi Kothagudem District

3. RESULTS AND DISCUSSION

All the collections from the study site recorded a pH value above 7.0. Dissolved oxygen is an important indicator of water quality which also determines the distribution and abundance of phytoplankton population. In the present lake investigated the value of dissolved oxygen was found above 6.8 mg/l indicating the satisfactory range. Organic matter, total hardness, Calcium and Magnesium were indicating the satisfactory range (Table1).

The study in water bodies of Rathi Cheruvu showed a rich diversity of phytoplanktons belonging to various classes. The list of phytoplankton collected from the study area is

presented in Table2. The total number of Phytoplankton consisted of 43 taxa belonging to Chlorophyceae (16 species), Bacillariophyceae (14 species), Euglenophyceae (three species) and Cyanophyceae (10 species) (Tables 2,3).

Phytoplankton shows the level of water quality as bio-indicators and also indicates diversity in the aquatic ecosystem [9]. The distribution of phytoplankton exclusively depends upon the chemical parameters of the water, available nutrients and substrata [10]. Bacillariophyceae members are the most significant colonizers of the river stones [11]. In the present investigation revealed that Diatoms dominated over the other group of phytoplanktons (Fig. 4).

Table 1. Annual averages of physical – chemical parameters of Rathi Cheruvu.

S.No.	Physico – Chemical Parameters	Mg/l
1	Temperature ($^{\circ}$ C)	29.19
2	pH	7.85
3	CO_3^{2-}	23.54
4	HCO_3^{-}	114.84
5	Cl ⁻	95.76
6	DO	8.49
7	BOD	9.25
8	TH	81.87
9	Ca ²⁺	42.25
10	Mg ²⁺	20.18
11	PO_4^{3-}	0.025
12	SiO ₂	7.41

Table 2. Composition of Phytoplankton in Rathi Cheruvu

Class	Organisms / ml	Percentage Composition
Chlorophyceae		
<i>Ankistrodesmus falcatus</i> (Corda) Ralfs	28	9.03
<i>Chlorella vulagris</i> Bayerinck	61	19.67
<i>Cladophora glomerata</i> (L.) Kutz	21	6.77
<i>Closterium diana</i> Ralfs	05	1.61
<i>C. elegans</i> Brebisson	05	1.61
<i>C. regulare</i> Brebisson	04	1.29
<i>Monoraphidium arcuatum</i> (Korshikov)	11	3.54
<i>Mougeotia scalaris</i> Hass.	02	0.64
<i>Netrium digitus</i> Ehrenberg ex Ralfs	05	1.61
<i>Pediastrum tetras</i> Ehrenberg ex Ralfs	101	32.58
<i>Scenedesmus armatus</i> (Chod) G.M. Smith	06	1.93
<i>S. quadricauda</i> Brebisson	08	2.58
<i>Spirogyra macrospora</i> (C.B.Rao) Krieger	14	4.51
<i>S. singularis</i> Nordstedt	11	3.54
<i>Ulothrix limnetica</i> Lemmermann	16	5.16
<i>Zygnema subcylindricum</i> Krieger	12	3.8
Bacillariophyceae		
<i>Achnanthes inflata</i> (Kutz) Grun	15	2.77
<i>Cyclotella glomerata</i> Bachm	18	3.33
<i>Cymbella cymbiformis</i> Ag	16	2.96
<i>C. turgidula</i> Grun	42	7.77
<i>Diatoma tabulatum</i> Agardh	60	11.11
<i>Fragillaria pinnata</i> Her	28	5.18
<i>Gomphonema lenceolatum</i> Ehr	45	8.33
<i>G. olivaceum</i> Kutz	32	5.92
<i>Melosira varians</i> Her	54	1.0
<i>Navicula cryptocephala</i> Kuetz	46	8.5
<i>Nitzschia dubia</i> W. smith	14	2.5
<i>Pinnularia gibba</i> Her	28	5.1
<i>P. major</i> (Kutz) Rabenhorst	21	3.8
<i>Synendra ulna</i> (nitzsch) Ehr	121	22.40
Euglenophyceae		
<i>Euglena acus</i> Huebner	10	32.25
<i>E. elastic</i> Prescott	11	35.48
<i>Phacus nordstedtii</i> Lemmermann	10	32.25
Cyanophyceae		
<i>Anabaena circinalis</i> Rabenhorst ex Born.	15	8.47
<i>A. sphaerica</i> Born	14	7.90
<i>Gloeocapsa gigas</i> W. & GS West	03	1.69
<i>Gloeocystis ampla</i> (Kutz) Rabenhorst	08	4.51
<i>Lyngbya ceylanica</i> Wille	14	7.90
<i>Microcystis aeruginosa</i> Kutz	43	24.29
<i>M. flosaquae</i> Kutz	21	11.86
<i>Oscillatoria limosa</i> Ag	21	11.86
<i>O. princeps</i> Vaucher	24	13.55
<i>Phormidium inundatum</i> Kutz	14	7.90

Table 3. Phytoplankton species in Rathi Cheruvu

Class	Organisms / ml	Percentage Composition
Chlorophyceae	310	29.30
Bacillariophyceae	540	51.03
Euglenophyceae	31	2.9
Cyanophyceae	177	16.72

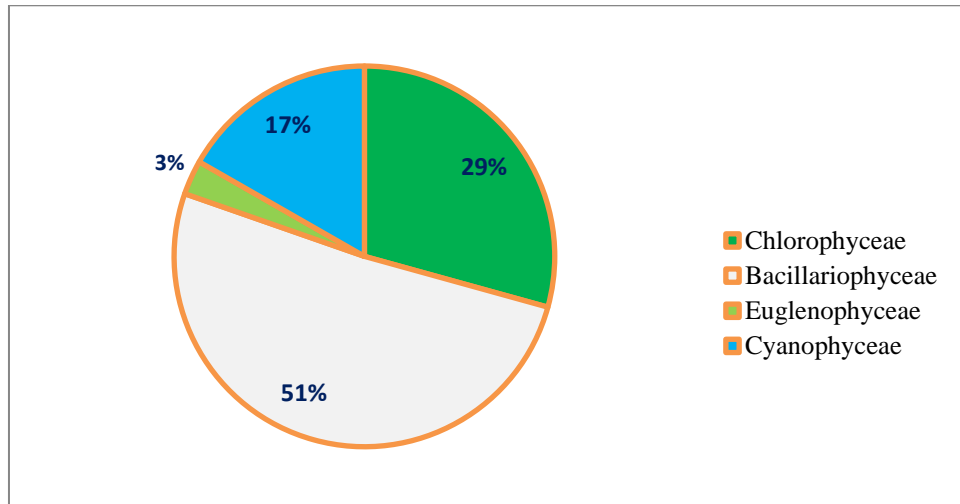


Fig. 4. Composition of Phytoplankton

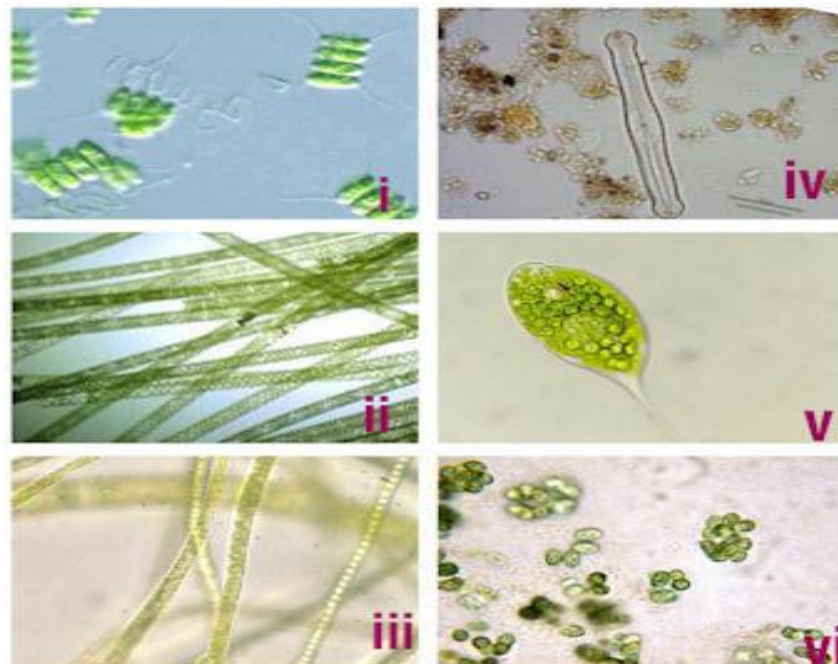


Plate 1. Microphotograph of Phytoplankton

- | | |
|---|--|
| i. <i>Scenedesmus armatus</i> (Chodt) | iv. <i>Pinnularia gibba</i> Ehrenberg |
| ii. <i>Spirogyra macrospora</i> (C.B.Rao) Krieger | v. <i>Phacus nordstedtii</i> Lemmermann |
| iii. <i>Ulothrix limnetica</i> Lemmermann | vi. <i>Microcystis aeruginosa</i> Otsuka |

Table 4. Phytoplankton diversity Indices response to the Trophic state of the Rathi Cheruvu

S.No.	Biodiversity indices	Diversity Value
1	Shannon's Diversity Index (H)	1.11
2	Shannon's Equitability Index (EH)	0.797
3	Simpson's Index (D)	0.37
4	Simpson's Evenness	0.66
4	Margalef Richness Index (d)	3.29

Table 5. Correlation coefficient of phytoplankton in Rathi cheruvu

Class	Chlorophyceae	Bacillariophyceae	Euglenophyceae	Cyanophyceae
Chlorophyceae	1			
Bacillariophyceae	0.002057	1		
Euglenophyceae	-0.06617	0.021825	1	
Cyanophyceae	-0.00619	0.572826	-0.48758	1

The development of integrated phytoplankton diversity indices is beneficial for environmental regulation in hydrological related aquatic lifestyle [12-17].

The phytoplankton diversity calculated and the indices were represented in Table3. The Margalef diversity index (d) revealed the highest index value (3.29). Shannon's (1.11) and Simpson's index (0.37) followed the similar pattern. Correlation coefficient was calculated among the phytoplankton and represented in Table5, insignificant correlation was observed.

4. CONCLUSION

Diversity indices provide significant information regarding uncommonness and commonness of phytoplankton in a community. Diversity indices are a significant tool to understand community structure. As a result the present study concludes that the diversity of phytoplankton not only plays a major role in formation of the aquatic community and uniqueness in the study site it can also be a good indicator of environmental assessment. Anyhow the composition, density and diversity of phytoplankton in this polluted environment are at a very satisfactory level.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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