IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES

ISSN PRINT 2319 1775 Online 2320 7876

 UGC CARE Listed (Group -I) Journal Volume 13, Iss 04, 2024

Ecological patterns of phytoplankton in Kamuni Lake, Shamshabad, Rangareddy District, Telangana.

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ABSTRACT

The variety of phytoplankton seen in water bodies, specifically Kamuni Lake in Shamshabad, Rangareddy district, Telangana is the study area of current research. The current research was carried out in two years, in 2022 and 2023. About 67 species, representing four major groups *Bacillariophyceae, Chlorophyceae, Euglenophyceae*, and *Cyanophyceae* were found to be present in Lake Water body during research period, according to the algal diversity survey, among which the *Chlorophyceae* predominated over all other group of phytoplaktons. The descending order of phytoplankton diversity as follow *Chlorophyceae> Bacillariophyceae>Euglenophyceae>Cyanophyceae* about 22 species of *Bacillariophyceae*, 25 species of *Chlorophyceae, 6 species of Cyanophyceae and 14* species of *Euglenophyceae* ,which contribute 38% species of *Chlorophyceae*, and 33% species of *Bacillariophyceae, Euglinophyceae* 20% and *Cyanophyceae* is about 9% According to the study, there were significant variations between these phytoplankton types and the indicators of water quality.

Key words: Phytoplankton, Algal diversity, Water quality, Chlorophyceae.

INTRODUCTION

Aquatic ecosystems are impacted by sewage discharge, improper agricultural practices, urban runoff, and inland water bodies that become eutrophic [(1)] Green algae, blue-green algae, diatoms, desmids, and Euglenoid flagellates are the basic components in all aquatic plants' food chains and are ecologically relevant [(2)]. Since freshwater lakes have a much different chemical composition than seawater, no single type of algae dominates in freshwater phytoplankton. In freshwater lakes, however, members of the families Chlorophyceae and Cyanophyceae are more common and diverse.

Primitive prokaryotes called Cyanobacteria are important in determining lake water quality because blue-green algae prefer to gather near the surface. In large water bodies with no current speeds, phytoplankton's are more prevalent in lentic (still water) habitats and less common in lotic (flowing water) ecosystems [(3)]. Phytoplankton is the base of the food web of aquatic organisms and is present throughout the water column, except stratified lakes and temperature-sensitive biological processes. For fish, zooplankton, and other aquatic species, they are the main source of food [(4)].

Numerous studies have been conducted on the ecology of phytoplankton by Moss [(5,6)]. Plankton population dynamics and algal biodiversity are strongly influenced by the physico-

ISSN PRINT 2319 1775 Online 2320 7876

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chemical properties of water. When describing species diversity patterns within various algal communities, diversity indices are a useful tool. In aquatic environments, phytoplankton is the base of the nutrient cycle and is essential for preserving the harmony between biotic and abiotic elements. Algae are both damaging organisms and environmental cleaners. Seasonal variations and phytoplankton diversity are indications of the variety of ecological niches. Because they play a crucial part in the turnover of organic matter and energy, plankton are a key component of ecosystems and react swiftly to changes [(7)]. Micro and macroscopic, suspended or free-floating, non-motile or motile, unicellular, colonial, or filamentous algae are considered phytoplankton. They are microscopic algae suspended in water, whose movements are less dependent on currents. Phytoplankton is ecologically significant, as it forms the foundation of the food chain for all aquatic animals [(8)].

Due to their short lifespans and fast rates of reproduction, planktonic organisms react quickly to many water pollutants. Phytoplanktons are the first organisms impacted by pollution since they are the main producers in aquatic environments. They are found in all sorts of water and their presence or absence indicates the quality of the water. They are an essential food source for aquatic species like fish and crustaceans. In addition to serving as animal feed, soil conditioners, bio fertilizers, bio indicators, bio monitors, and rehabilitators of damaged ecosystems through the bio absorption of contaminants, phytoplankton are important players in environmental management. The biological aspects of reservoirs must be examined since they are essential to the preservation of ecological equilibrium. The chemical and physical qualities of the water have a direct impact on the condition of different aquatic life forms. Several biological processes are influenced by physical and chemical conditions, which promote the emergence of biotic diversity.[(9)]

Scientists have published a great deal of study on the aquatic environment and the ecology of freshwater phytoplankton, including. Type of phytoplankton indicates the pollution level in water body [(10-12)]. For example, a high concentration of Cyanophyceae family members may indicate organic pollution in reservoirs; hence, certain phytoplankton species are crucial for assessing the quality of water bodies. Therefore, cataloguing phytoplankton species is essential. Understanding the relationship between physico-chemical properties and plankton populations is the primary objective of the current study.

MATERIALSAND METHODS

Ten station points were selected to study the distribution of various phytoplankton species in Kamuni Lake. The sample collection site and their latitude and longitude are shown in Table No.1, Map: 1 and Map: 2. The Deccan plateau is home to multiple lakes, many of which are named after themselves. This lake, commonly referred to as Shamshabad Lake, is one of these lakes and is crucial for maintaining the nearby natural ecosystems.

Table1: Latitude and longitudes of the Sample collection

Coordinates	Sample collection sites of Kamuni lake
17.254408N, 78.384140 E	1st
17.253097 N, 78.384902 E	2nd

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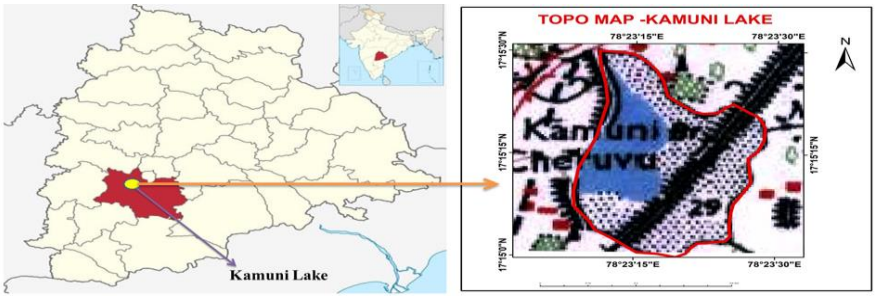
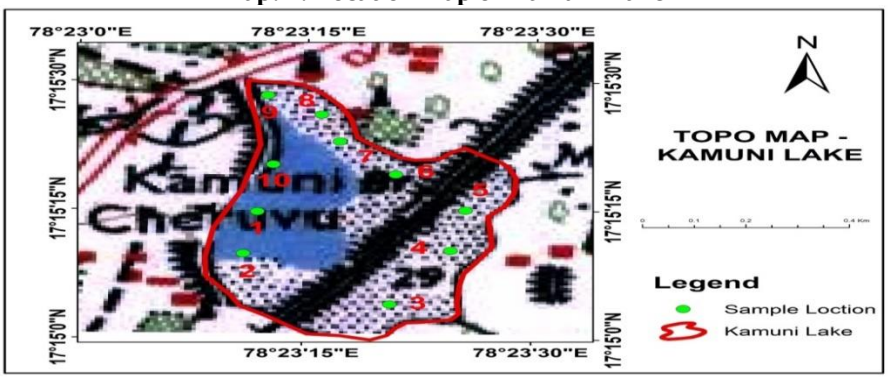
17.252431 N, 78.387305 E	3rd
17.253988 N, 78.388013 E	4th
17.255289 N, 78.388378 E	5th
17.256090 N, 78.387938 E	6th
17.257803 N, 78.386184 E	7th
17.258725 N, 78.385894 E	8th
17.259381 N, 78.384693 E	9th
17.256211 N, 78.384934 E	10th



Map: 1. Location map of Kamuni Lake



Map: 2.Sampling location Map by using software Arc-GIS, Version 10.1

One litre of surface water was collected from various water station points as depicted in study area map, and 2 to 3 ml of formaldehyde solution was added to each sample to ensure the complete settling of the organisms. The preserved samples were mixed uniformly by gentle inversion, and a drop of the sample was pipetted onto a glass slide for analysis. Ensuring that no air bubbles were trapped, the edges of the coverslip were sealed with transparent nail enamel to prevent evaporation during the examination process. Ten stations provided the algal samples, which were analysed qualitatively and quantitatively.

Using the drop method as outlined by the frequency of several algal species at each station was measured[13]. Carefully pipetted ten drops of the concentrated sample onto ten slides. Twenty high-power (15x45) microscope fields spaced evenly apart were inspected from each drop. In order to record the species composition, this led to the counting of 120 high-power microscope fields from each concentration. A uniform microscope field area was used to calculate the abundance of different species per ml. Using reputable sources like species were recognized[14-17].

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RESULT AND DISCUSSION

Four families of algae were identified in the current study: *Euglenophyceae, Bacillariophyceae, Cyanophyceae*, and *Chlorophyceae*. Members of the *Chlorophyceae* family dominated all stations and held the top spot. Members of the *Bacillariophyceae* ranked second, followed by members of the *Euglenophyceae* and *Cyanophyceae,* in that order.

Baciilariophyceae:

The *Bacillariophyceae* group is not static; rather, it changes with time, especially in distinct species that manifest themselves in various seasons[18]. As Table No. 2 illustrates, this group was dominant at every location throughout the Kamuni Lake investigation. but comes in second place behind members of the Chlorophyceae family. The primary group consists of the species *Gomphonema, Navicula, Cyclotella, Nitzschia,* and *Synedra*. *Cyclotella* species are known to be resilient to pollution.[19]

The species *Nitzschia* and *Gomphonema* exhibited significant variation and wide range in each site that was examined. These diatom species exhibit adaptability to a wide variety of ecological settings. The recent study discovered that diatoms come in a wide variety of species, with pinnate diatoms having higher species richness than centric diatoms. Table No. 2 showed the presence of *Bacillariophyceae* members as they were observed in Kamuni Lake.

Chlorophyceae:

Higher nutrient concentrations are thought to be responsible for the existence of *Chlorophyceae* in water bodies, according to Round [20-22]. The majority of *Chlorococcales* was found in the *Chlorophyceae* family. Over the course of the study, *Schizomeris* and *Pediastrum* were the most prevalent species. *Chlorophyceae* member variations are seen in Table No.3

Euglenophyceae:

Members of the *Euglenophyceae* family have been the subject of in-depth research by scientists[23,24]. Members of the *Euglenophyceae* family grow more readily in environments with higher chloride and ammonical nitrogen concentrations and lower phosphate concentrations. They made up a small portion of the phytoplankton in the ecosystems under study same trend was observed in present Kamuni Lake. This group includes species like *Phacus, Euglena*, and *Trachelomonas*, indicating the significant species variety found in Kamuni Lake water. Table No. 4 presented changes in various stations.

Cyanophyceae:

Physical elements like warm water have an impact on BGA growth [25]. Franklin proposed that the BGA serve as a broad marker of water eutrophication. They thrive in

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environments high in organic materials, such as shallow water bodies and contaminated rivers and lakes. They are highly diverse in terms of biodiversity and have a broad range of temperature tolerance. Three species were represented: *Spirulina*, and *Oscillatoria*. It was demonstrated that *Oscillatoria* dominated.

Bacillariophyceae and *Chlorophyceae* members also displayed rich diversity. Among diatoms, species such as *Gomphonema*, *Navicula*, and *Nitzschia* showed notable diversity and are considered good indicators of water quality. Within *Chlorophyceae*, species like *Ankistrodesmos*, *Scenedesmus*, and *Pediastrum* exhibited high diversity.

Cyanophyceae, on the other hand, showed lower diversity likely due to the eutrophication of water bodies. They tend to form blooms and impart a bluish-green colour to the water. Percentage distribution in phytoplankton *Bacilleriphyceae*, *Chlorophyceae*, *Cyanophyceae* and *Euglinophyceae* was shown in Figure No.1.

Table.No.2: Baciilariophyceae members distribution in Kamuni Lake, Shamshabad,Rangareddy, Telangana.

	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII	S-VIII	S-IX	S-X
Gomphonema parvulum	-	-	-	-	+	+	-	-	-	-
Gomphonema constructum	+	+	+	+	+	-	+	+	+	+
Pinnularia biceps	+	-	-	-	-	-	+	-	-	+
P.interrupta	-	-	+	-	-	-	+	+	-	+
Melosiragranulata	+	+	-	-	-	-	-	-	+	-
Achnanthesexigua	-	-	-	+	+	+	-	-	-	-
Synedra ulna	+	+	+	-	-	-	+	+	+	-
S. acus	-	-	-	+	-	-	+	+	+	-
Nitzschia acicularis	+	+	+	+	+	-	+	+	+	+
Ni. palea	+	+	+	+	+	+	+	+	+	+
Ni. acicularis	+	+	-	+	+	+	+	+	+	+
Ni. hungarica	+	+	+	+	-	+	+	-	+	+
Ni. Frustulum	+	+	+	+	+	+	+	+	+	+
Ni. Thermalis	+	-	+	-	+	+	+	+	-	+
Ni. Sublinearis	+	+	-	-	-	+	+	+	+	+
Ni.amphibia	+	+	-	+	+	+	+	+	-	+
Naviculapunctulata	+	+	+	-	-	-	-	-	-	-
Navicula capitatoradiata	-	-	-	+	+	+	-	-	-	-
N. rhynchocephala	-	-	+	+	+	+	+	-	-	-
N. bacillum	+	+	+	-	-	-	-	-	-	-
Cyclotella meneghiniana	+	+	+	+	+	-	-	+	+	+
C. bipunctata	-	-	-	-	+	+	+	+	-	-

S= Station

Table.No.3: Chlorophyceae members distribution in Kamuni Lake, Shamshabad,Rangareddy, Telangana.

	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII	S-VIII	S-IX	S-X
Closteridium	+	+	+	+	+	+	+	+	+	+
Pandorinamorum	+	-	-	+	+	+	+	+	-	-
Sphaerocystis schroeteri	+	-	-	-	-	-	+	-	-	+
Ankistridesmos	-	-	+	-	-	-	+	+	-	+
CrucigeniaTetrapedia	+	+	-	-	-	-	-	-	+	-
C. epiculata	-	-	-	+	+	+	-	-	-	-
C. crucifer	+	+	+	-	-	-	+	+	+	-
C. rectangularis	-	-	-	-	-	-	+	+	+	-
Scenedesmus dimorphus	-	-	+	+	+	-	-	-	-	-
S. Quadricauda	-	-	-	+	+	+	-	-	-	-
S. serratus	+	+	+	-	-	-	+	+	+	-
S . a r ma tu s	+	+	-	-	-	+	+	+	-	-
S. Quadricauda	-	-	-	-	+	+	-	-	-	-
S.muzzanensis	+	-	-	+	+	+	+	+	-	-
S.falcatus	+	-	-	-	-	-	+	-	-	+
Chlorococcum	+	+	+	+	+	+	+	+	-	+

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ActinastrumHantzschii	+	+	-	-	-	-	-	-	+	_
Eudorinaelegans	-	-	-	+	+	+	-	-	-	-
Eudrina degauss	+	+	+	-	-	-	+	+	+	-
Golenkinia	-	-	-	-	-	-	+	+	+	-
Pediasterium duplex	+	+	+	+	-	+	+	+	+	+
P. tetras	+	+	+	+	-	+	+	+	-	+
Peridiniumcinctum	-	+	+	+	+	-	+	+	-	+
Dictyosphaerium pulchellum wood	+	-	-	+	+	+	+	+	-	-
Di. ehrenbergianum	+	-	-	-	-	-	+	-	-	+

S= Station

Table.No.4: Cyanophyceae members distribution in Kamuni Lake, Shamshabad,Rangareddy, Telangana.

	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII	S-VIII	S-IX	S-X
Spirulina major	+	+	+	+	+	+	+	+	+	+
Microcystis aeruginosa	+	-	-	+	+	+	+	+	-	-
Oscillatoria	+	+	+	+	+	+	+	+	+	+
Gomphosphaeria	-	-	+	-	-	-	+	+	-	+
Anabaena	+	+	-	-	-	-	-	-	+	-
Arthospira	-	-	-	+	+	+	-	-	-	-

S= Station

Table.No.5: Euglenophyceae members distribution in Kamuni Lake, Shamshabad,Rangareddy, Telangana.

	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII	S-VIII	S-IX	S-X
Trachelomonaswoycickii	+	+	+	+	+	+	+	+	+	+
T. robusta	+	-	-	+	+	+	+	+	-	-
T. pulcherrima	+	-	-	-	-	-	+	-	-	+
T. hispida	-	-	+	-	-	-	+	+	-	+
Euglena proxima	+	+	+	+	+	+	+	+	+	+
E.oxyuris	-	-	-	+	+	+	-	-	-	-
E. tripteris		-	-	-	-	-	+	-	-	+
E. paramylum		-	+	-	-	-	+	+	-	+
Phacus.longicauda	+	+	+	+	+	+	+	+	+	+
P anomalous	+	-	-	+	+	+	+	+	-	-
p.acuminatus	+		-	-	-	-	-	-	+	-
P. helikoidis	-	-	-	+	+	+	+	-	-	
P. circumflexus	+	+	-	-	-	-	-	-	+	-
Lepocincils fusiformis	-	-	-	+	+	+	-	-	-	-

S= Station

Table.No.6: Distribution of different Phytoplankton, Genus and Species

Class of the phytoplankton	No. of Genus	No of Species
Chlorophyceae	15	25
Baciilariophyceae	8	22
Cyanophyceae	6	6
Euglenophyceae	4	13

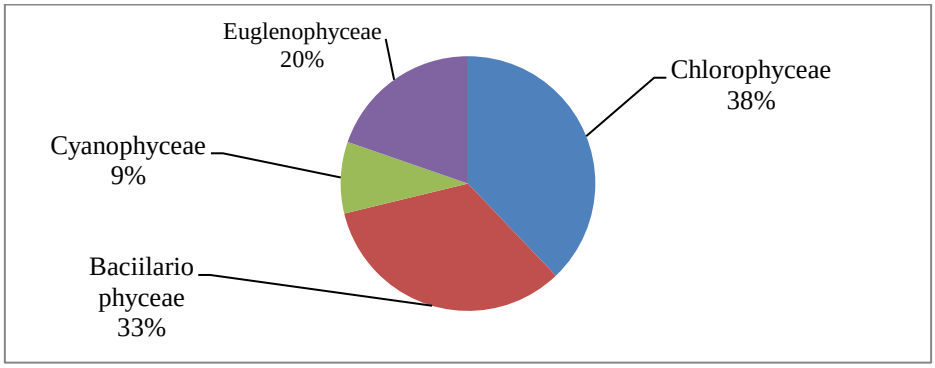

Figure: 1: Percentage distribution of different Phytoplankton's in Kamuni Lake.

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Among the phytoplankton species studied *Chlorophyceae* members contributing about 38% followed by *Bacillariophyceae (33%) Euglenophyceae(20%) and Cyanophyceae (9%)*. The higher number of *Chlorophyceae* members indicate the water of Kamuni Lake is occupied by photo synthetic algae which indicates healthy water condition.

Conclusion:

The main haven for aquatic biodiversity, including aquatic plants, animals, and other microbes, is found in wetland habitats. One of the key elements of aquatic ecosystems is phytoplankton. Lake water has a significant impact on the social ecology of the area where they are found. Anthropogenic activities, such as bathing, washing clothes, cleaning vehicles and animals, and disposing of solid waste, are some of the reasons endangering the lakes in locations where humans predominate. In turn, these activities cause the loss of aquatic biodiversity, particularly the diversity of plankton. The current study location is located in a semiarid zone, which is typically quite sensitive to weather conditions like high temperatures and little rainfall. The water bodies are in danger because of the high temperatures, reduced rainfall, and increased anthropogenic activity in the study area. Current research conducted to study phytoplankton diversity. 67 of the total number of species that were documented are from 4 distinct groups. Among the studied group *Chlorophyceae* dominated by 38% followed by *Bacillariophyceae (33%) Euglenophyceae(20%)* and *Cyanophyceae (9%).*

Table: No.7*: Bacillariphyceae* species

Phytoplakton Group	Species	Specimen Image
Baciilariophyceae	*Gomphonema parvulum*	
	Cyclotella meneghiniana	
	Nitzschia acicularis	
	Navicula cryptocephala	

Table:No. 8*: Cyanophyceae* species

Phytoplakton Group	Species	Specimen Image
Cyanophyceae	*Spirulina major*	

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	Anabaena	

Table:No.9*: Chlorophyceae* species

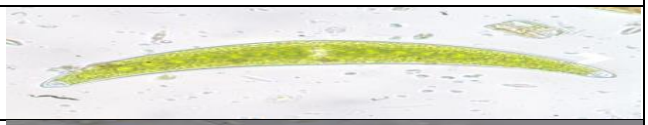
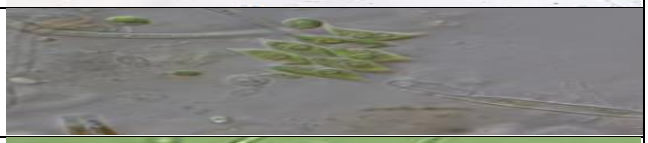
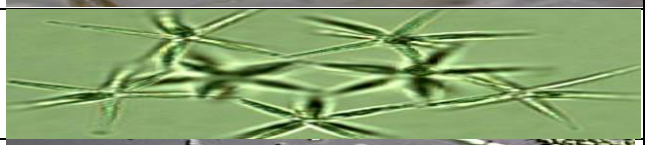
Phytoplakton Group	Species	Specimen Image
Chlorophyceae	*Closteridium*	
	Scenedesmus dimorphus	
	ActinastrumHantzschii	
	Pediasterium duplex	

Table: No.10*: Euglenophyceae* species

Phytoplakton Group	Species	Specimen Image
Euglenophyceae	*Euglena proxima*	
	Phacus.longicauda	
	Lepocincils fusiformis	

Acknowledgement:

The authors thanked the Department of Environmental Science, University College of Science, Osmania University, Hyderabad, Telangana for providing all necessary facilities.

ISSN PRINT 2319 1775 Online 2320 7876

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