



(RESEARCH ARTICLE)



## Phytoplankton Distribution and Algal indices of Mid Manair Dam in Rajanna Siricilla District, Telangana

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International Journal of Science and Research Archive, 2024, 12(02), 2141–2148

Publication history: Received on 08 July 2024; revised on 16 August 2024; accepted on 19 August 2024

Article DOI: <https://doi.org/10.30574/ijrsra.2024.12.2.1521>

### Abstract

Algae are an integral component of the food chain in aquatic ecosystems, playing a significant role in shaping the population dynamics of zooplankton and other aquatic animals. Algae, as photoautotrophs, have the ability to synthesize energy and serve as the primary food source for many tiny aquatic organisms. Lakes are vital water reservoirs that serve many functions. This study is specifically focused on the variety of algae. The current study was conducted from January 2021 to December 2022. The Mid Manair Dam serves as the primary water supply for the nearby villages, providing drinking water as well as supporting agricultural activities and fish farming. The current study aims to determine the variety of phytoplankton genera. The assessment of water's appropriateness for irrigation and drinking purposes relies significantly on the variety of phytoplankton. The water samples were kept in a solution of 4% formalin and examined using a binocular microscope to identify the presence of algae. There are primarily four distinct types of freshwater algae that have been documented in Mid Manair Dam. The organisms were classified as Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae the lake water is widely used for potable water and agricultural irrigation.

**Keywords:** Fresh water algae; Phytoplankton; Algal indices; Mid Manair Dam

### 1. Introduction

Phytoplankton represents the microscopic algal communities of water bodies and the pioneer of aquatic food chain. The planktonic studies are very useful tool for assessment of water quality and the productivity of any type of water body and also contribute to understanding of water bodies (Pawar et.al 2006). Algae occur in wide range of aquatic environments like lotic as well as lentic habitat. In India studies on river ecosystem have attracted the attention of quite a few investigations in last few decades, e.g. Roy (1955), Mathur (1990) Raghuvamshi *et.al* (2011). The maintenance of healthy aquatic ecosystem is depending on the biological diversity of the ecosystem and the abiotic properties of water (Harikrishnan, et al, 1999). Algae are a large and diverse group of simple and typically autotrophic organisms they are ranging from unicellular to multicellular forms. Algae constitute a major part of the food chain of the aquatic life. Algae show distinct distribution and diversity and major food producer of all aquatic environments. Whatever alters the algal growth and composition also affects all other organisms (palmer, 1969). Phytoplanktons are often considered powerful biological indicators of fresh water ecosystems (Bellinger and singee 2011). Biological indicators act as important measures of the state of an Ecosystem more so when combined with chemical data (Dixit et.al.1992). Planktonic algae are an integral part of lake food chains, nutrients cycles and oxygen production. Phytoplanktons take part in nutrient cycling via fixation, assimilation, and transfer through the food web, (Barasanthi and Gualtieri 2006). The proper balance of biological, physical and chemical properties of water in lake is an essential ingredient for successful production of aquatic resources. Water is one of the important sources, to sustain life and has long been suspected of being the source of much human illness. Source of surface water and ground water become increasingly contaminated due to increase the industrial and agricultural activity. The phytoplankton in a reservoir is

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an important biological indicator of the water quality (Patil, *et al.*, 2013). Phytoplankton, which includes blue-green algae, green algae, diatoms, desmids, euglenoids are important among aquatic flora. They are ecologically significant as they form the basic link in the food chain of all aquatic floras (Ravikumar, *et al.*, 2006).

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## 2. Materials and Methods

### 2.1. Collection and preservation

During present study, surface and ground samples were collected from different station of lake at monthly intervals in polythene cans and transported to laboratory for a period of one year. Phytoplankton samples were collected by using filtering water samples using plankton net (mesh size 105  $\mu\text{m}$ ) and preserved in 1000 ml plastic bottles by adding 5ml of formalin concentration. The collections were made early in the morning. Benthic and planktonic algae were collected separately and simultaneously along with water samples every month. The preserved samples were kept for 24 h undisturbed to allow the sedimentation of plankton suspended in the water. After 24 h, the supernatant was discarded carefully without disturbing the sediments and the final volume of concentrated sample was about 10ml. This concentrated material was used for species identification.

### 2.2. Counting and Identification

From the collected and concentrated filtrate 1ml of sample was taken, analysis of phytoplankton was done by putting one drop of fixed sample on the glass slide and studying it under microscope. This analysis was repeated for 10 times and computed. For determine the frequency of different species of algae at each station, the drop method of Pearsall *et al.*, (1946). Identification was done according to standard methods of (APHA 2005). Phytoplankton were examined and identified with the help of classified manuals (Desikachary, 1959; Anand, 1998; Krishnamurthy, 2000).

### 2.3. Study Area

The Mid Manair Dam is located on the Manair River in Manwada Village, Boinpally mandal, Rajanna Sircilla District, Telangana. Study area spread in three districts : Karimnagar , Rajanna Sircilla and Dharmapuri. It was built by the ruling Nizam. Situated in the Rajanna Sircilla District, near the little village of Narmala. The Nizam of Hyderabad state laid the cornerstone in 1943. The presence of backwater is mostly seen in the villages of Manwada, Lachapet, and Kollamaddi.. It was completed in 2018 and inaugurated by state government. It has the ability to irrigate 200,000 acres. The geographical coordinates are expressed in terms of latitude and longitude, with the specific values being 18.1613° N for latitude and 78.3240° E for longitude. The surface area is 15.3 square kilometres. The famous Kaleshwaram project involves the extraction and transportation of 2-3 tmcft of water to the Mid Manair Dam. When the dam reaches its full capacity, water is released into the Lower Manair Dam, a substantial reservoir located near Karimnagar city. The Lower Manair Dam has a total capacity of 24 trillion cubic feet. The reservoir has a gross capacity of 25.873 trillion cubic feet (Tmcft). The Left Bank Canal spans a distance of 22 km and is designed to provide irrigation for a total of 9,500 acres. The Kaleshwaram project is a 64 km long canal that is used to irrigate 90,500 acres of land. It supplies water from the Godavari river to the Mid Manair Reservoir and helps to stabilise the ayacut via the use of existing projects.

### 2.4. Data of Study Site

The District of Rajanna Sircilla is situated in the Telangana state of India. The district's administrative hub is located at Sircilla. The Districts of Nizamabad, Jagtial, Siddipet, Kamareddy, and Karimnagar are all close by. The district is 2,030.89 square kilometres (784.13 square miles) in size. The districts that border this one are Nizamabad District to the northwest, Siddipet District to the south, Kamareddy District to the west, Jagtial District to the north, and Karimnagar District to the northeast.

### 2.5. Sampling sites

Four sampling locations on the lake's north, east, west, and south shores were determined as almost equidistant. Data on phytoplankton studies and physicochemical characteristics can be acquired from four sample sites and are classified as follows:



**Figure 1** Overview of Mid Manair Dam

#### 2.5.1. Sampling site I

Sampling site I is situated near Rock hill. Clear water flows throughout the year except in rainy season. During the rainy season, the majority of the water inflow is accompanied with mud and sand. Water samples were collected in the morning at 8:00 am. These samples were then transferred to laboratory for further study.

#### 2.5.2. Sampling site II

Sample location II is close to paddy fields. Samples recovered from this site revealed a waterway used for agriculture to irrigate fields, as well as fishing. Because of human intervention, this location has become polluted. Water samples were taken from this location between 8:15 and 8:30 a.m.

#### 2.5.3. Sampling site III

Sluice (Thumu) is the third sampling site. A place with deep, clean water that is free of contaminants. Water samples are taken with the cooperation of local fishermen in the morning between 8:30 and 9 a.m.

#### 2.5.4. Sampling site IV

The fourth sampling site is close to the Manwada Pochamma temple. The site will become contaminated due to human activity and water overflows during the rainy season. Between 9:00 and 9:30 in the morning, samples were gathered.

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### 3. Results and Discussion

#### 3.1. Diversity of Phytoplankton at Mid Manair Dam During First Year Research Period

Abundance of some of the prominent phytoplankton species of Mid Manair Dam are *Cosmarium portianum*, *C. decoratum*, *C. depressum*, *Scenedesmus denticulatus*, *Oedogonium gigantium*, *Zygnema pectinatum*, *Spirogyra varians* and *S. parvispora* species were found to be dominant while, *Ulothrix cylindricum*, *Scenedesmus bijugatus*, *Cladophora glomerata*, *Volvox aureus*, *Pediastrum boryanum*, *Scenedesmus acutus*, *Pediastrum duplex* and *Scenedesmus dimorphus* were recorded as lowest species during the period of study. Maximum numbers of Chlorophyceae were recorded in the month of June and minimum in the month of September.

The major diatoms reported were *Navicula capitatoradiata*, *N. linearis*, *Nitzschia denticula* and *P. acrosphaeria*, whereas, *Eunotia camelus*, *Gomphonema abbreviatum*, *Gomphonema sphaerophorum*, *Gomphonema acuminatum*, *Synendra rumpens*, *N. cryptocephala*, *Pinnularia stomatophora*, *C. tumida* and *Amphora veneta* as minor species. Among the total Bacillariophyceae members observed maximum of 1416 were observed the month of May and minimum of 465 in August. Blue greens were *Oscillatoria acuta*, *Gloeotrichia natans*, *Oscillatoria obtuse*, *Phormidium ambiguum* and

*Oscillatoria hamelii* recorded as dominant, while, *Gloeocapsa nigrescens*, *Gloeotrichia ghosei*, *Hydrococcus rivularis* and *Tolyphothrix distorta* were recorded as least count. Total blue green were observed to be maximum, 668 in April and minimum, 171 in September. Euglenoids observed were *Euglena pascheri*, *Trachelomonas pulcherrima*, *T. acanthostoma* and *Phacus orbicularis* as dominant species, although, *Trachelomonas volvocina*, *Euglena polymorpha*, *E. Sanguinea*, *Trachelomonas granulate* and *Lepocinclis ovum* were recorded as lower abundance. Euglenoids were observed to be maximum, 125 in October and minimum, 46 in November. In this lake total numbers of phytoplankton individuals identified were Chlorophyceae 19796, followed by Bacillariophyceae 12364, Cyanophyceae 5769 and Euglenophyceae 866 during the period of study.(Table 1)

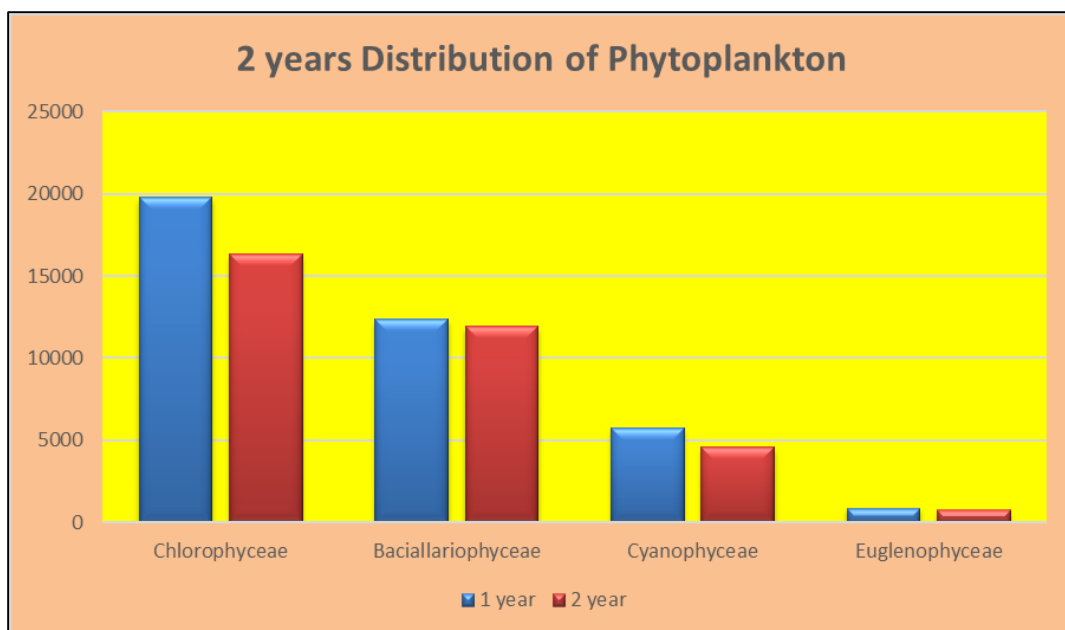
### 3.2. Diversity of Phytoplankton Second Year Research at Mid Manair Dam

Monthly assortment of the crucial phytoplanktons of Mid Manair Dam has been represented green algae *Cosmarium portianum*, *Chlorella vulgaris*, *Zygnema pectinatum*, *Chlamydomonas globosa* and *Chladophora oligoclona* were in peak, whereas, *Actinastrum gracillimum*, *Eudorina elegans*, *Oedogonium globosum*, *Pediastrum duplex*, *Scenedesmus acutoformis* and *Tetraedron bifercatum*, were found as smallest amount. Total green algae were observed to be maximum, 1905 in December and minimum, 804 November month. The dominant Bacillariophyceae members were *Navicula capitatoradiata*, *N. linearis*, *N. Cincta* and *N. rhynchocephala* whereas *Gomphonema sphaerophorum*, *G. acuminatum*, *Cyclotella aspera*, *Melosira granulate* and *Pinnularia abaujensis* were recorded as minimum abundance. Total number of diatoms was observed to be maximum, 1313 in January minimum, 645 in September.

The dominant Blue green algal members were *Microcystis aeruginosa*, *Nostoc spongeformae*, *Phormidium inumdatum*, *Nostoc spaericum* and *Oscillatoria obtusa*, while, *Lyngbya majuscule*, *Oscillatoria chalybea* and *Tolyphothrix distorta* were listed as slightest. Highest total of 782 were found in the month of January and lowest of 463 in November. Euglenophyceae recorded monthly wise were *Trachelomonas ocanthostoma*, *Phacus plueronectes* and *P. granulate* observed as minimum phytoplankton. Maximum of 223 number observed in the month of February and minimum of 23 in the month of August. In Mid Manair Dam total numbers of phytoplankton individuals observed were Chlorophyceae 16332, Bacillariophyceae 11920, Cyanophyceae 1571 and Euglenophyceae 747. ( Fig, table 1)

**Table 1** 2 years Phytoplankton Distribution in Mid Manair Dam

Year	Chlorophyceae	Bacillariophyceae	Cyanophyceae	Euglenophyceae
2021	19796	12364	5769	866
2022	11332	11920	4571	747



**Figure 2** Indicating Phytoplankton Distribution 2 years in research time at Mid Manair Dam

### 3.3. Phytoplankton Assemblage

The Phytoplankton diversity and population dynamics of two lakes were investigated during January 2021 to December 2022. The monthly fluctuations of phytoplankton have been observed that they follow any conventional rule, but some generalized trends with respect to some aspects have been observed. In all 130 different phytoplankton members belonging to 4 different families were recorded during the study period. It was found that 38.46% of the green algal flora, 31.53% of the Diatom flora, 29% of the Blue green algal flora and 7.69% of the Euglenoid flora in Mid Manair Dam.

#### 3.3.1. Chlorophyceae

The Chlorophyceae members are categorized as the first highest class among Phytoplankton group (Khenari 2010). The class Chlorophyceae mainly comprises of Orders Chlorococcales with 6 families 8 genera 20 species, Zygnematales with 2 families 4 genera 15 species, Volvocales with 1 family 3 genera 15 species, Cladophorales with 2 families 2 genera 3 species, Chlamydomonadales with 1 family 1 genus 3 species, Oedogoniales with 1 family 1 genus 2 species, Charales, Chaetophorales and Ulotrichales with 1 family 1 genus 1 species each. The present investigation shows that 50 species were identified in the Two Lakes. The Chlorophyceae population density was higher in the month of December with average number of taxa 2442 and lower in the month of September with 810 taxa. Green algae showed much more abundance than other phytoplanktons.

In Mid Manair Dam *Cosmarium portianum* *Oedogonium gigantium* and *Chlorella ellipsoidea* was observed as dominant.

#### 3.3.2. Bacillariophyceae

Bacillariophyceae was the second dominated class of phytoplankton in admiration of abundance and account of species. In this investigation a fairly great number of diatom genera (13 genera and 41 species) were reported from the study samples. The Bacillariophyceae consist of orders Pennales with 1 family, 2 genera and 6 species, Centrales with 5, families 12 genera and 35 species identified in the two sampling sites. The maximum number of diatoms found in December to June, the number decreases during the months of July to November. Bacillariophyceae abundance is mainly associated with certain physico-chemical parameters like silica, ammonia and Phosphate (Pearsall, 1930). In Mid Manair Dam *Navicula linearis*, *N. cincta* and *N. rhynchocephala* were observed as dominant over the rest.

#### 3.3.3. Cyanophyceae

Cyanophyceae was the third dominated class of phytoplankton in admirable of abundance and account of species. This group was regularly found in both samples during study period. The present work revealed prominent number of Cyanophyceae members (16 genera and 29 species) noticed throughout the period of study in two Lakes. Cyanophyceae consist of order Nostocales with 5 families, 11 genera and 20 species, order Chlorococcales with 1 family, 4 genera and 8 species, order Stigonematales consist 1 family, 1 genus and 1 species. In Mid Manair Dam *Gloeotrichia natans*, *G. nigrescens* and *Oscillatoria chalybea* were observed as dominant over the rest.

#### 3.3.4. Euglenophyceae

Euglenophyceae was the least dominated class of phytoplankton in admiration of abundance and account of species. This group was irregularly found in samples during the study period. In the present investigation least number of Euglenophyta (4 genera and 10 species) were reported from the study sample. The Euglenophyceae consist of order Euglenales with 1 family, 4 genera and 10 species were identified in the two sampling sites. The maximum number of Euglenophyta found in the months of January to March and September to November. The ecological distribution of Euglenophyta has been reported by Munawar (1970). In Lower Manair Dam *Trachelomonas acanthostoma* and *Phacus orbicularis* were observed as dominant, over the rest.

### 3.4. Nygaard's Indices

Nygaard's indices (1949) of various groups of Phytoplanktons - Cyanophyceae, Chlorophyceae, Bacillariophyceae, Euglenophyceae and Compound Quotient (CQ) are used to obtain a consequential assessment of the level of pollution in the water. In the present attempt, the Nygaard's phytoplankton compound index was calculated during the period of three years January 2021 to December 2022 and the varied values of Cyanophyceae Quotient, Chlorophyceae Quotient, Bacillariophyceae Quotient, Euglenophyceae Quotient and Compound Quotient were recorded.

**Table 2** Nygaard's algal indices

Index	Formula
Cyanophycean Quotient	Chorophyceae / Desmideae
Chlorophycean Quotient	Chlorococcales / Desmideae
Diatom Quotient	Centric diatoms / Pennate diatoms
Euglenophycean Quotient	Euglenophyceae / Cyanophyceae + Chlorococcales
Compound Quotient	Cyanophyceae + Chlorophyceae + Centric + diatoms + Euglenophyta / Desmideae

From the table it was evident that the trophic state indices in If the value is less than 1, the lake water status is accepted as oligotrophic, whereas if it is greater than 2, the lake is accepted to be Eutrophic. Mid Manair Dam was indicating oligotrophic status.(Table2,3)

**Table 3** Status of Nygaard's algal indices Mid Manair Dam

Group	Mid Manair Dam	
	2021	2022
Cyanophycean Quotient	0.93*	1.06
Chlorophycean Quotient	2.23	2.23
Diatom Quotient	0.04	0.03
Euglenophycean Quotient	0.03	0.04
Compound Quotient	5.27	5.41
Average	<b>1.89</b>	<b>1.75</b>
Status	<b>Oligotrophic</b>	<b>Oligotrophic</b>

### 3.4.1. Water Quality Index

Water quality index is a significant tool for getting an idea about the quality of water. The various methods are available for calculation of WQI, for the comparison of Physico chemical and biological parameters. *Diersing (2009)* stated that usually water quality means the physical, chemical and biological characteristics of water body. The present study based on large data of 14 parameters measured at two fresh water lakes every month over a two-year period. The WQI method was performed to assess the water quality of Lake under study. The water quality parameters were analyzed as per the standard method for guide manual.

**Table 4** WQI legend (House and Ellis,1987)

91-100%	Excellent water quality
71-90%	Good water quality
51-70%	Medium water quality
26-50%	fair water quality
0-25%	Poor water quality

**Table 5** WQ status of Mid Manair Dam

Lake / Year	Mid Manair Dam	WQ status
2021	76%	Good
2022	71%	Good

The final WQI In Mid Manair Dam is with Good Water Quality , value determined based on the annual average value of every sample site. (table 4,5 ).

#### 4. Conclusion

It would be obvious from present investigation that, the Chlorophyceae in the dominant members, Bacillariophyceae and Cyanophyceae are predominant members and few of Euglenophyceae in the Mid Manair Dam. The present study reveals all the algal species observed in the lake belongs to unpolluted water organisms. Phytoplankton plays an important role as biological indicators of aquatic ecosystems. Results indicated that the isolated phytoplankton were influenced by the human activities It indicates that the Mid Manair Dam at present free from pollution. Hence it can be safely used for different purposes such as drinking, agriculture, and for fisheries.

#### Compliance with ethical standards

##### *Disclosure of conflict of interest*

The author has no conflict of interest regarding the research, authorship or publication of this study.

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