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Algal diversity and water quality assessment in Lakaram Lake, Khammam, Telangana: A case study

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Abstract
This study aims to investigate the diversity and abundance of algal communities within the lakaram lake located in Khammam. Water samples were collected at four months intervals, and water quality parameters were measured for algal identification using microscopic techniques. 32 species were identified with different families of algae, with dominance of cyanophycean member of algae. The study will analyze the relationships between algal species composition, abundance, and environmental factors. The findings will contribute to a better understanding of the ecological health of the study site and provide valuable insights into the impact of environmental changes on algal communities.

Keywords: Lakaram, Khammam, Algae, water quality, ecosystem

Introduction

Algae play a vital role in aquatic ecosystems as,

Primary Producers: Algae are the foundation of aquatic food webs. Through photosynthesis, they convert sunlight into energy, forming the base of the food chain for various organisms like zooplankton, small fish, and ultimately larger predators.

Oxygen Production: Similar to plants, algae release oxygen as a byproduct of photosynthesis. This oxygen is essential for the survival of aquatic life, including fish and other organisms.

Food Source: Algae directly serve as a food source for many aquatic animals, providing essential nutrients and energy. Algae exhibit a remarkable diversity, encompassing a wide range of forms and sizes. Some of the major groups include:

Green Algae (Chlorophyta): Characterized by their green color due to the presence of chlorophyll a and b. They range from single-celled organisms to multicellular forms like sea lettuce.

Diatoms (Bacillariophyta): Known for their intricate, glass-like cell walls made of silica. They are a major component of phytoplankton in both freshwater and marine environments.

Blue-green Algae (Cyanobacteria): Prokaryotic organisms that are often classified as bacteria but exhibit many algal characteristics. They are significant contributors to primary production and can fix atmospheric nitrogen.

Algal identification plays a crucial role in monitoring water quality and ecosystem health

Bioindicators: Algal communities can serve as sensitive indicators of environmental change. Shifts in species composition, abundance, and diversity can signal changes in water quality, such as nutrient pollution, pollution fromindustrial or agricultural sources, and changes in temperature.

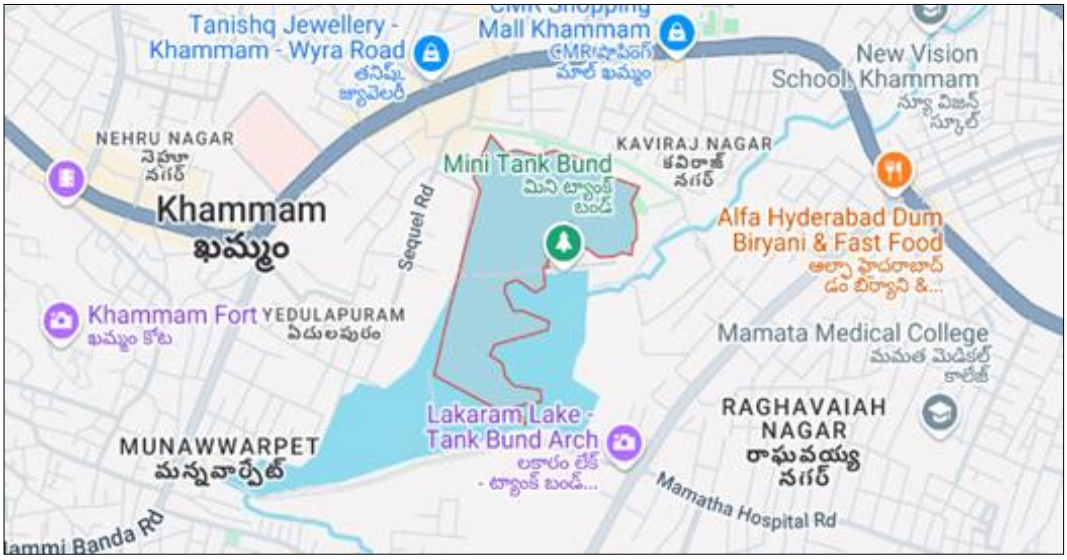
Early Warning System: The presence of certain algal species, particularly blooms of harmful algae (e.g., cyanobacteria), can indicate potential risks to human and aquatic health.

Assessing Ecosystem Health: Algal diversity and abundance provide valuable information about the overall health and functioning of aquatic ecosystems. A diverse algal community generally indicates a healthy and balanced ecosystem.

Materials and Methods

Sample collection (John D. Wehr, Richard G. Sheath., 2003) [4]

The desired water samples were collected from the location in the depth of 1 meter by using the sterilized plastic bottles at 3 different sides of the lake and immediately samples were brought to the laboratory for the identification of algae under the microscope. (John D. Wehr, Richard G. Sheath., 2003) [4].



a- Satellite map of Lakaram lake

b- Lakaram lake view

c- Collected water samples.

Fig 1

Algal identification (John *et al.*, 2002) [5].
The collected water samples were used for the identification of algae presented in the samples by using the microscope by using the key characters given by algal flora, online databases. Key morphological features used for identifying algal species by cell shape, size, pigmentation, presence of flagella, colonial organization. (John *et al*., 2002) [5].

Water Temperature (ºC): Water temperature ws recorded at sampling stations. Water temperature was measured at a depth of about 12 cm, with the help of hand-held mercury thermometer (ºC).

Hydrogen ion concentration (P^H): Electronic Method (IS:3025) (Standard Methods of APHA 1995). P^H was determined with the help of universal P^H paper and later was confirmed in the lab using hand held digital pH meter. This P^H system was previously calibrated with pH 4.0, 7.0, 9.2 buffers at laboratory temperature.

Dissolved Oxygen: Measured using by the Winkler method. the following equation to calculate the dissolved oxygen concentration

DO (mg/L) = (V x N x 8000) / mL sample
where: V = volume of sodium thiosulfate solution used (mL),
N = normality of sodium thiosulfate solution,
8000 = a conversion factor.

Nitrate (mg/l): Brucine method (APHA-1995) for Nitrate content of the water sample was determined by Brucine method. 10mlof the surface water sample was taken in test tube, to which 2ml of sodium chloride and 0.5ml of brucine sulphonic acid solution was added. A blank was also prepared in similar manner using 10ml distilled water. The test tubes were heated on water bath for 20 minutes. The optical density of the sample was measured at 410 nm using spectrophotometer.

Phosphate (mg/l): Stannous chloride method (APHA-1995) for Inorganic Phosphate content of the surface water sample was determined WOAR Journals Page 49 using stannous chloride method. 50ml of the water sample was taken in a conical flask, 2mlof ammonium molybdate and 5 drops of stannous chloride were added. A blank was also prepared in a similar manner using 50ml distilled water. The optical density of these samples was measured at 690 nm using spectrophotometer.

Turbidity: Turbidity is expressed in Nephelometric Turbidity Units (NTU) and was measured in the laboratory using Digital Nephelo-Turbidity meter. 5ml of hydrazine sulphate and 5 ml of hexamethylenetetramine was taken in 100 ml standard flask. The mixture was left a day, and after 24 hours it was made upto 100 ml. 10 ml of this solution was taken and diluted to 100 ml. Nephelometer was adjusted at 40 NTU using this standard. Water samples were Shaked before taking the readings in nephelometer. (Trivedy, R. K. and Goel, P. K., 1984) [10].

Results and Discussion

Algal abundance and diversity.
Maximum number of algal species with 14 number was found in winter season followed by rainy season as 10 and summer season as 8 in number. The diversity of species in Cyanophyceae and Bacillariophyceae was higher in number and hence the lakaram lake was polluted. Based on the present study it can be stated that the diversity of water algae is fairly rich in lakaram lake. This lake was mainly affected with surrounding waters were joining in this lake by canals, this may directly affect the natural growth and survival of algal species. The proper maintenance of this lake will help in ground water recharge and also will act as repository of water algae. The present study will help to enrich the knowledge on the diversity of algae of water lakes in Khammam.

Water quality parameters
Maximum temperature 26.5ºC shown in summer season, P^H 7.42 in rainy season, 25.7 NTU turbidity in summer, Dissolved oxygen 4.8 ppm in summer season, Nitrates 134 mg/l in winter season and Phosphates 148 mg/l in rainy season. The maximum values of different parameters were changed from season to season in all the diffe5ent types of parameters. All the values were decreased indicates the water quality was very low for the sustenance of different kinds of biodiversity.

Table 1. Diversity of algae presence in different seasons.

Family	Rainy Season	Winter Season	Summer Season
Cyanophyceae	10	14	8
Chlorophyceae	4	5	2
Bacillariophyceae	6	8	4
Euglenophyceae	2	5	3
Total	22	32	19

Table 2. Number of algal species identified.

Sl. No.	Class		Name of the algae
1.	Cyanophyceae	i	Spirulina gigantia
2.		ii	Nostoc calcicole
3.		iii	Anabena sphaerica
4.		iv	Microcystis auruginosa
5.		v	Lyngbya majuscule
6.		vi	Ocillatoria acuta
7.		vii	Scytonema subtile
8.		viii	Tolyphothrix distrota
9.		ix	Anacystis nidulans
10.		x	Gleocapsa atrata
11.		xi	Chroococcus

12.		xii	Hyfrococcus rivularis
13.		xiii	Rivularia
14.		xiv	Westiellopsis ramosa
15.	Chlorophyceae	i	Chara vulgaris
16.		ii	Cosmarium subtumidum
17.		iii	Chlorella vulgaris
18.		iv	Spirogyra longata
19.		v	Volvox aureus
20.	Bacillariophyceae	i	Cyclotella
21.		ii	Cymbella aspera
22.		iii	Gamphonema
23.		iv	Pinnularia borealis
24.		v	Ehrenberg
25.		vi	Fragillaria crotonensis
26.		vii	Nitzschia capitellata
27.		viii	Tabellaria flocculosa
28.	Euglenophyceae	i	Anisonema
29.		ii	Euglena polymorpha
30.		iii	Phacus orbicularis
31.		iv	Stauronensis anceps
32.		v	Lepocinclis

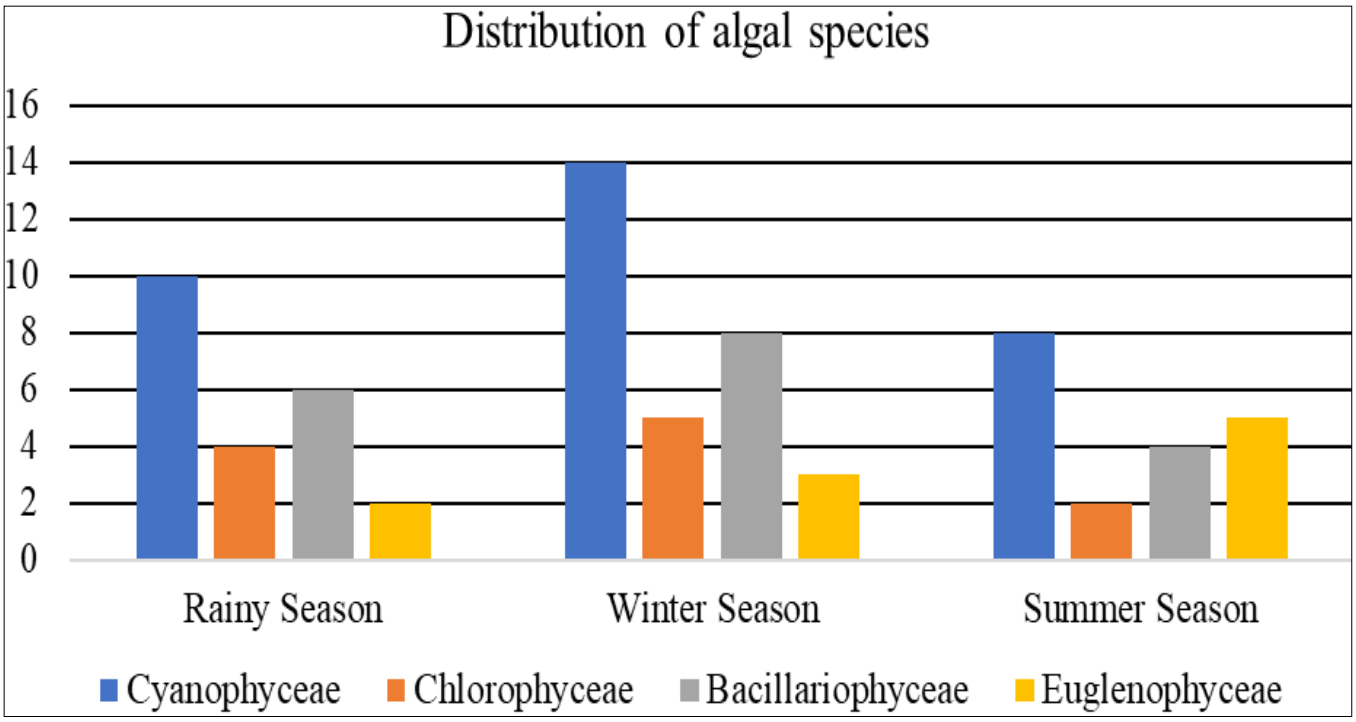


Fig 2: Distribution of algal species.

Table 2. Different values of water quality parameters.

Temperature (ºC)	P^{H}	Turbidity (NTU)	Dissolved oxygen (ppm)	Nitrate (mg/l)	Phosphates (mg/l)
Rainy Season					
25.2	7.42	24.5	4.3	126	148
Winter Season					
20.3	7.31	23.8	4.2	134	139
Summer Season					
26.5	7.18	25.7	4.8	117	121

Conclusion

The study shows that the algae abundance and diversity was affected by the lake different environmental conditions. The algae abundance and diversity were evaluated as an indicator of pollution. Calculating the diversity indices during the period may indicate a negative inference. According to the indices of lake has low dominance of species. From the Shannon wiener diversity index, it can be inferred that the water quality of the lake is moderately

polluted. The pollution is of autochthonic origin. From the study it is concluded that the lake within city Khammam needs more care in quality parameters to check pollution for a healthy environment of the area. Constant removal of the

pollutant and their debris can check this. Therefore, the lake has to be preserved for its intended use, a sustainable and aesthetic management planning is necessary for the conservation of this water body.

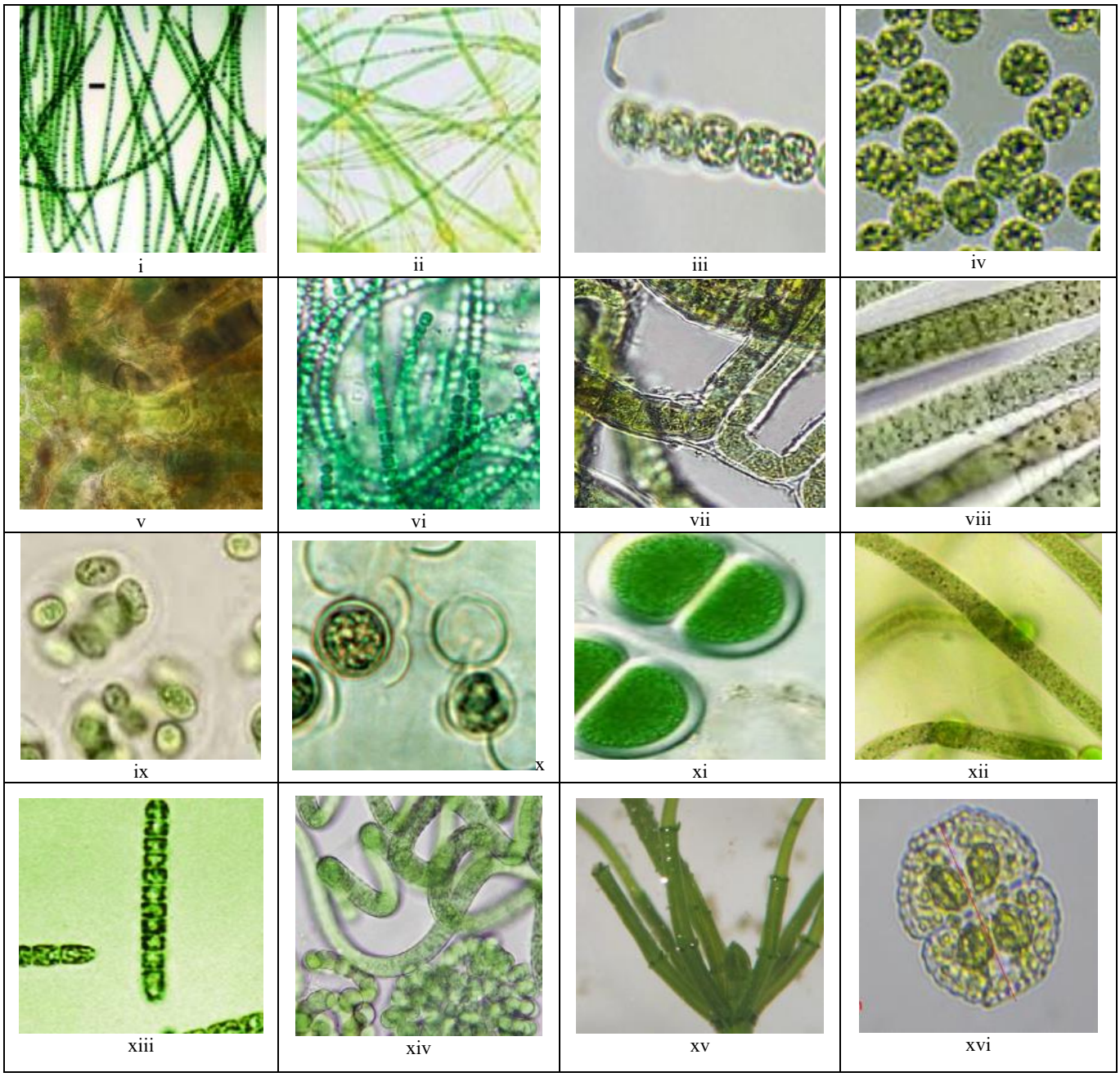
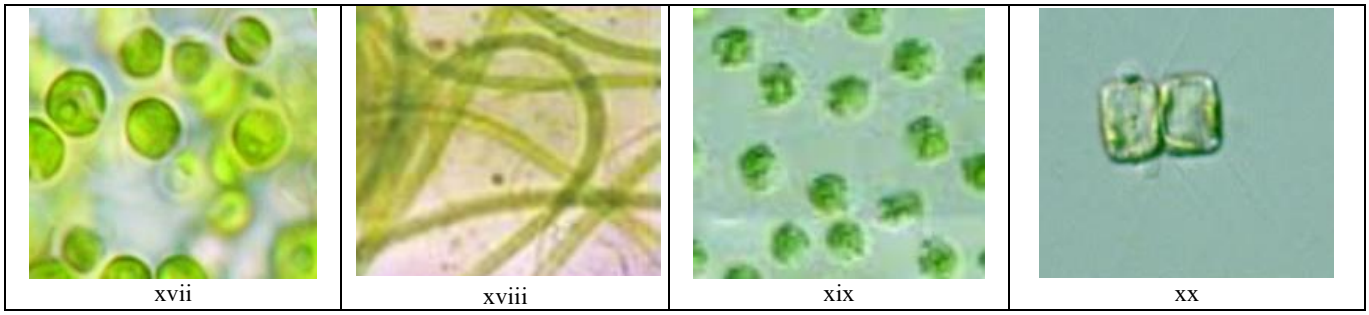


Fig 3: i-xvi: - Spirulina gigantia; Nostoc calcicole; Anabena sphaerica; Microcystis auruginosa; Lyngbya majuscule; Ocillatoria acuta; Scytonema subtile; Tolyphothrix distrota; Anacystis nidulans; Gleocapsa atrata; Chroococcus; Hydrococcus rivularis; Rivularia; Westiellopsis ramose; Trichodesmium; Chara vulgaris; Cosmarium subtumidum.



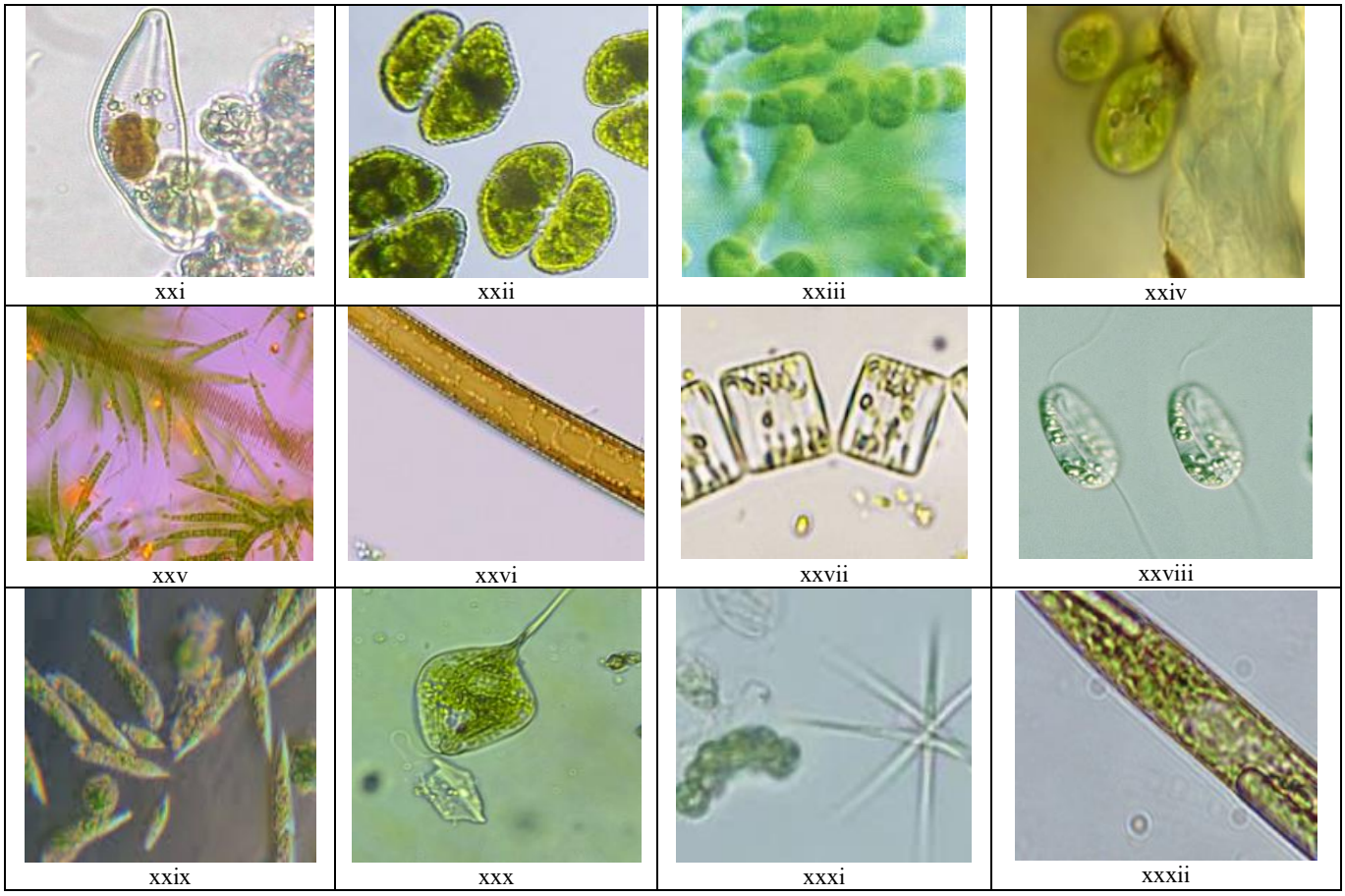


Figure 4: xvii-xxxii: -; Chlorella vulgaris; Spirogyra longata; Volvox aureus; Cyclotella; Cymbella aspera; Gamphonema; Pinnularia borealis; Ehrenberg; Fragillaria crotonensis; Nitzschia capitellata; Tabellaria flocculosa; Anisonema; Euglena polymorpha; Phacus orbicularis; Stauronensis anceps; Lepocinclis.

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