Journal of Animal Environment

(E-ISSN 2717-1396, ISSN 2717-1388)

Original Research Paper

The morphological study of genus Euglenoids from the Bharamasagara lake and Katral lake of Chitradurga district, Karnataka, India

Arpitha MP[1*], Parameswara Naik T[2].

Department of Applied Botany, Sahyadri Science College, Shivamogga, 577203, Karnataka, India.

Author for correspondence: arpithajanu7@gmail.com; maravanjiparameswara@gmail.com

Address For correspondence*

Arpitha M.P.

Department of Applied Botany,

Sahyadri Science College,

Shivamogga, Karnataka, India.

Email: arpithajanu7@gmail.com.

Abstract

The taxonomy and diversity of Euglenophyceae class members in Bharamasagara & Katral Lake Chitradurga district, Karnataka, India, are revealed in this study. Samples were gathered from four sampling locations over the course of two years, from January 2023 to December 2025. Fourteen euglenoid species from four genera were identified in the current study. *Euglena adhaerens, Euglena geniculata, Euglena granulata, Euglena polymorpha, Euglenaformis proxima, Euglena sanguinea, Euglena tuberculata, Lepocinclis acus, Lepocinclis globulus, Phacus nordstedtii, Phacus orbicularis, Phacus curvicauda, Trachelomonas superba var. duplex*, and *Trachelomonas subplanctonica*. Forever *Euglena polymorpha*, were more dominant at katral lake. For the first time, every taxon was recorded. Freshwater, brackish water, and marine environments are the monophyletic group of algae known as Euglenophyceae, which is made up of both pigmented and colorless, unicellular flagellates.

Key words Euglenophyta, Katral lake, Bharamasagara lake, Dominant.

1. Introduction

Lakes are essential to humanity because they provide water. However, ponds may have been created for a variety of purposes, such as domestic or agricultural use, transportation, defence, ritual or industrial use, social aggrandisement, swimming, fish farming, etc., or they may have been natural water sources that humans exploited at different times to meet different needs. (Rajagopal etal.2010)

The Phylum Euglenoids are free-living flagellated unicellular protists with both heterotrophic and Photoautotrophic characters. (Anindita Singha Roy and Ruma Pal 2016)

Euglenoids also comprise non-photosynthetic varieties and do not possess the light-sensitive structures typically linked to the flagellum. They demonstrate both phagotrophic and photoautotrophic nutritional strategies. (Vasanthakumar etal 2021)

A key to the subgenera, species, and varieties of euglenoids is included for easier identification of the taxa discussed below. Euglenoids have been differentiated based on the number, size, shape, and position of chloroplasts in the cell (axial or parietal), as well as the presence or absence of pyrenoid; paramylon grain features are occasionally correlated with the characteristics of chloroplasts. (Kim etal 1998) A few of them are heterotrophic, particularly phagocytic or saprophytic. These are distinguished by two anterior uneven flagella that are rooted in a canal known as “gullet” or “ampulla” and a unique cell wall made of spiral strips called a “ Pellicle” and surrounded by “Lorica”. (Gour Gopal Satpati etal 2017)

The Euglenophyceae class consists of phototrophic organisms from the Euglenida within the Excavata supergroup, commonly found in the plankton of marine, brackish, and freshwater habitats. This class includes free-living unicellular flagellates that are phototrophic, possessing one or more plastids of secondary origin that have three membranes and contain chlorophylls a and b;

***Corresponding Author:**

Received: 25th May, 2026; Revised: 6th June, 2026; Accepted: 8th June, 2026; Available Online: 29rd July, 2026

(DOI): 10.70102/AEJ.2026.18.2s.39

additionally, it contains colorless species that have lost their ability to photosynthesize as well as the associated photosensory structures related to cilia. (Bicudo CEdM and Menezes M 2016)

Aquatic environments are home to most of the taxonomic phyla that now exist. The most prevalent kind of tiny, unicellular organism in watery settings is phytoplankton. The Euglenophyceae family includes euglenoids. The majority of freshwater habitats are inhabited by these globally widespread animals; a limited number of these taxa live in brackish or marine biotopes, and a minor number of these creatures may be found in edaphons. (Yasmeen 2024)

They possess one, two, or three pantonematic-type flagella that originate from a front cell invagination. Paramylum, which is a type of polysaccharide, serves as the storage product. Euglenoid flagellates are commonly found in puddles, ditches, ponds, streams, lakes, and rivers, particularly in regions where animal waste or decaying organic material has polluted the water. (Yasmeen2024)

There have been various reports on Euglenophytes from India. (gonzalves & Joshi, 1943) (hosmani 1976) (Waghodekar & Patel 1991) (Sinha 2002) However all these works, were limited to the country ‘s north and west. There are very few records from coasts of eastern India. (habib & Pandey 1990) (Bhakta et al., 2010)

Thiruvananthapuram Museum Lake in India is the first place where Euglenaria clepsydroides has been found. Previously, reports of this species came from Poland. (Anila etal 2016)

In a Central Mexican eutrophic reservoir, higher species richness of euglenoids has been observed during the summer. (Gloria etal 2011)

This study aims to provide a floristic and taxonomic overview of the genus Euglena, focusing on its morphological characteristics. We present comprehensive descriptions and illustrations based on specimens collected from different water sources. (Kim etal 1998)

There is currently no published research on the ecology, distribution, morphological study and interaction between euglenoids and the physiochemical properties of the water bodies in the study area. Hence the floristic survey of the class euglenophyceae, its distribution pattern, taxonomical description in two lakes of Bharamasagara and Kathral lake at Chitradurga district, Karnataka.

.,

2. Materials and Methods

Study Area

Bharamasagara Lake: -

Bharamasagara Lake is situated in Karnataka Chitradurga (T) & (D). Built in the 18th century, Bicchugatti Bharamanna Nayaka Lake is located in the Krishna River Basin at latitude 14°22'34.0"N and longitude 76°11'53.7"E (Figure 1) Bharamasagara Lake primary uses include fishing, irrigation, and providing drinking water to the nearby 42 villages of Bharamasagara Hobli, Hissamudra, and Bevanalli. The reservoir has recently been refilled with water from the nearby Tungabhadra river via the Rajanahalli lift irrigation project.

Katral Lake:-

Katral Lake is one of a hotstop for bird watching with recording several bird species in the area located nearer to Chitradurga (T) & (D), Karnataka, and it Latitude is 14°16'55.7"N and Longitude is 76°11'53.7"E is Krishna River Basin (Figure 2) the main purpose is for irrigation and supply of drinking water to Biravara, Kalkunte & Goshala. The lake has been disturbed with the human interference.

Sample Collection and Analysis

Samples were collected in random sampling method in four different sampling sites used it collect the algae species from Jan 2023 to Dec 2024 in every month. The samples are collected at morning time 6am to 10 am. Samples were collected in polythene container. The collected samples were stored as 4% formaldehyde solution stored in bottles for further morphological studies. A light microscope (Olympus VANOX AHBT3) was used to examine the specimens under 1,000X. Additionally, the living materials were examined using an Olympus IX70 inverted microscope. A drawing tool was used to create the illustrations. The measurements of 50–100 cells were used to calculate the mean cell and organelle dimensions.

Phytoplankton samples were identified based on morphologically and taxonomic character such as Shape, Cell member, Pigmentation, Thallus Organization size colour pigmentation, Raphe, Straie, Centriole, Silica Sheath & Size, Choloroplast, Phytoplankton was done with the help of standard books and monographs (Prescott 1951) (Desikachary 1959) (Taylor 2007) (Fritsch 1935) etc

Fig 1: Map showing Bharamasagara lake of study area

Fig 2: Map showing katral lake of study area

3. Result and Discussion

Table:1 Algae Species found in Katral & Bharamasagara Lake

Sl No	Class	Name of phytoplankton	Katral lake	Bharamasagara lake
1	Euglenaidea	*Euglena adhaerens*	++	+
2		*Euglena geniculata*	++	+
3		*Euglena granulata*	++	++
4		*Euglena polymorpha*	+++	+
5		*Euglenaformis proxima*	+	+
6		*Euglena sanguinea*	+	_
7		*Euglena tuberculata*	+	+
8		*Lepocinclis acus*	_	+
9		*Lepocinclis globulus*	+	++
10		*Phacus nordstedtii*	++	+
11		*Phacus orbicularis*	+	+
12		*Phacus curvicauda*	+	_
13		*Trachelomonas superbavar. duplex*	++	++
14		*Trachelomonas subplanctonica*	+	+

(+++: Dominant); (++: common); (+: rare); (-: Not found).

Comparative distribution of Euglenophyceae species from Katral Lake and Bharamasagara Lake is displayed in Table 1 represented by 14 taxa of these organisms, belonging to major algal classes of Euglenaidea, were identified during the investigation. The distribution pattern showed substantial diversity of phytoplankton in freshwater ecosystems suggesting conducive environments for algal growth and development. Species of the Euglenaidea (e.g., *Euglena*, *Lepocinclis*, *Phacus*, *Trachelomonas*) also were present in both lakes. *Euglena polymorpha*, were more dominant at katral lake, otherwise *Euglena granulate*, *Trachelomonas superba var. duplex* are commen in both lakes *Euglena tuberculate*, *Phacus orbicularis* are rare at both the lake, *Lepocinclis acus* is not found in katral lake & *Euglena sanguinea*, *Phacus curvicauda* are not fount at Bharamasagara Lake. Euglenoids are frequently linked with nutrient rich biomes and accumulation of organic matter thus, they are localized and enriched in certain parts of the lakes. Comparative study showed Katral Lake to harbour some higher abundance.

A total of 14 species of the phylum Euglenophyta have been identified following standard classification. A detailed observation in light microscope was carried out for the dominant species for distinct cell wall morphology. taxonomic accounts of the identified taxa are as follows:

Taxonomic Classification
Phylum: Euglenozoa
Class: Euglenophyceae
Order: Euglenales
Family: Euglenaceae

Euglena adhaerens Matvienko (pl.1 fig a)
Konrad Wołowski *et al.* (2017), P. 1-11.
Cells are elongated, narrow type; blunt end anterior, tapering end posterior, discoid or plate like numerous small chloroplasts. Cell length = 80–86 µm, width = 7-8 µm
Place of collection: Katral lake & Bharamasagara lake

Euglena geniculata Dujardin 1841 (pl.1 fig b)
Gour Gopal Satpati and Ruma Pal. (2017), P. 105-122.
Konrad Wołowski *et al*. (2017), P. 1-11.
Cells fusiform, cylindrical, ovoid, central nucleus with 1 anterior & 1posterior, slightly damaged of 2 star shaped chloroplasts, ribbon like numerous chloroplasts with plastids, helical striations with periplast. Cell length = 50–80 µm, width = 10-21 µm.
Place of collection: Katral lake & Bharamasagara lake

Euglena granulate (Klebs) F. Schmitz 1884 (pl.1 fig c)
Gour Gopal Satpati and Ruma Pal. (2017), P. 105-122.
Konrad Wołowski et al. (2017), P. 1-11.
Cells fusiform, pyriform, elongated, blunt end tip narrow gradually towards posterior end, an aperture of flagellum originated by anterior end, diplopyrenoids of wavy like disc-shaped chloroplasts with paramylon caps. Cell length = 90–106 µm, width = 20- 30 µm.
Place of collection: Katral lake & Bharamasagara lake

Euglena polymorpha Dangeard (pl.1 fig d)
Anindita Singha Roy and Ruma Pal. (2016), P. 113-121
Prescott G.W (1982) pl. no. 85, fig. 21.
Pear-shaped, ovoid & sub-cylindrical cells, short gradually narrowed posterior side, tip is blunt, many chloroplasts with small ovoid grains of paramylon bodies. Cell length 80-90 µm, diameter= 20-28 µm.
Place of collection: Katral lake & Bharamasagara lake

Euglenaformis proxima (Dangeard) Bennett & Triemer 2014 (pl.1 fig e)
Leonardo H. Mendoza-Caebajal *et al.* (2023) P.1-28.
Gour Gopal Satpati and Ruma Pal. (2017) P. 105-122.
Prescott G.W. (1982) pl. no. 85, fig. 25
Cell fusiform, rounded-conical anterior end, acute tail-like extension & tapering posterior end, cell consists discoid numerous chloroplasts, within the cell arranged, randomly. Cell length= 49-53 µm and Width=10-16 µm.
Place of collection: Katral lake & Bharamasagara lake

Euglena sanguinea Ehrenberg (pl.1 fig f)
Jun tae kim *et al*. (1998) P.173-197
Prescott G.W (1982), P.832.
Cell cylindrical, ovoid, spindle shaped, green colour, rounded anterior end, blunt, short, towards of posterior end, cell consists single or numerous chloroplasts, finely pellicle, many ovoid shaped of several paramylon grains. Cell length= 66-106 µm and Width=26-54 µm.
Place of collection: Bharamasagara lake

Class: Euglenoidea
Order: Euglenida
Euglena tuberculata Swirenko (pl.1 fig g)
Anindita Singha Roy and Ruma Pal. (2016), P. 113-121.
Cell fusiform, green colour, middle of the cell is wide, short & narrow tail, rounded anterior end & conical posterior end, cell consists numerous plate like chloroplasts, paramylon grains is oval shaped. Cell length= 45-50 µm and Width=15-19 µm.
Place of collection: Katral lake & Bharamasagara lake

Order: Euglenales
Family: Phacaceae
Lepocinclis acus (O.F.Müller) Marin & Melkonian 2003 (pl.1 fig h)
Kouassi *et al*. (2013) P. 1176-1187.
Leonardo H. Mendoza-Caebajal *et al*. (2023) P.1-28.
Fusiform cells, spindle shaped elongate, slightly twisted & narrow anterior end, tapering point long incision hyaline posterior end, longitudinal striae numerous paramylons grains. Cell length= 100-121 µm and Width=15-21 µm.
Place of collection: Bharamasagara lake

Lepocinclis globulus perty (pl.1 fig i)
Kouassi *et al*. (2013) P. 1176-1187.
Oblong-elliptic to cells – elliptic, rounded broad anterior end, caudal bluntly pointed short, sharp narrow posterior end, discoid numerous chloroplasts, ring-shaped, lateral two paramylons grains. Cell length= 25-28 µm and Width=15-18 µm.
Place of collection: Katral lake & Bharamasagara lake

Phacus nordstedtii Lemmermann 1904 (pl.1 fig j)
Sylwia Kosmala *et al*. (2007), P. 1071–1082.
Napiform cell, green, broadly rounded anterior, narrow posterior, tail-like appendage straight pointed straight, spirally straited thin film, numerous chloroplasts. Cell length 56-59 µm, width 33-35 µm, tail length 17-19 µm
Place of collection: Katral lake & Bharamasagara lake

Phacus orbicularis Huebner 1886 (pl.1 fig k)
Sylwia Kosmala *et al*. (2007), P. 1071–1082.
Shadia Rahman *et al*. (2024), P.6-11.
Orbicular & circular cell with a short -tail, convex dorsal side, broadly rounded anterior end & short bent tail posterior end, striated pellicle. Cell length =46- 48 µm, width = 26-30 µm, tail length 2-12 µm.
Place of collection: Katral lake & Bharamasagara lake

Phacus curvicauda Swirenko 1915 (pl.1 fig l)
Shadia Rahman *et al.* (2024), P.6-11.
Ovoid cell, furrow like dorsiventral, slightly narrow, rounded anterior end, tail-piece short curved terminating & broad posterior end, numerous chloroplasts, short tail with blunt end with lightly curved caudas, paramylons bodies is two with circular disc. Cell length =35- 38 µm, width = 23-28 µm, tail length 1-2 µm.
Place of collection: Katral lake

Order: Euglenales
Family: Euglenaceae
Trachelomonas superba var. duplex Deflandre (pl.1 fig m)
Małgorzata Poniewozik *et al*. (2025), P.1-13.
Lorica broadly oval or ellipsoidal, surface covered with densely sharp spines, at the polar end slightly longer, numerous large pores on wall surface, without collar of apical pore. Lorica length= 32-34 µm and Width= 27-30 µm.
Place of collection: Katral lake & Bharamasagara lake

Trachelomonas subplanctonica Jiang & Pang (pl.1 fig n)
Xiaodie Jiang *et al*, (2022), P.1-12.
Lorica cylindrical or ellipsoid, collar cylindrical with toothed edge & perforation surface, haplopyronoid with 6-12 discoid chloroplasts, cylindrical collar apical pore, Lorica length= 22-30 µm and Width= 18-28 µm.

Place of collection: Katral lake & Bharamasagara lake.

Plate - 1

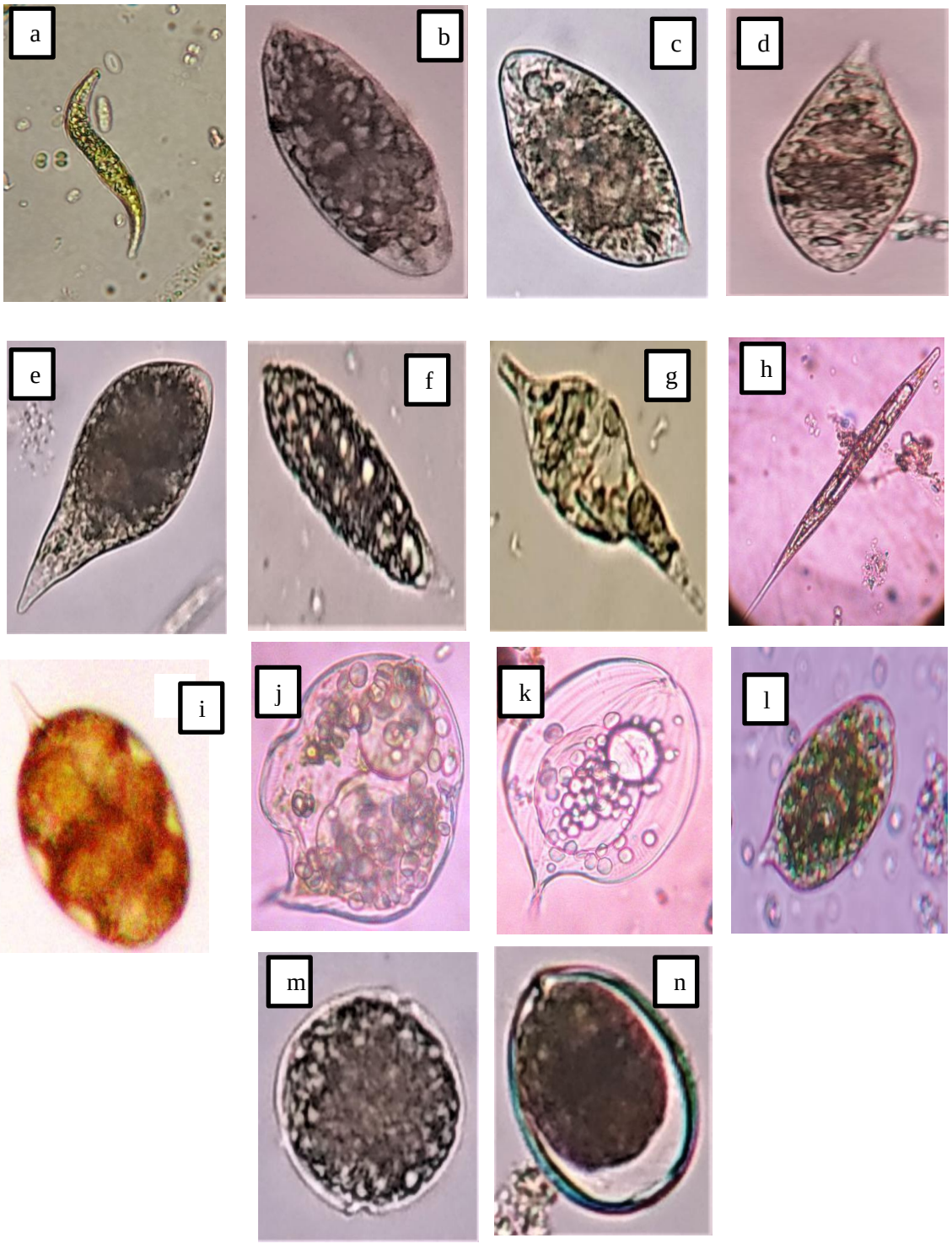

Fig a. *Euglena adhaerens*, Fig b. *Euglena geniculata*, Fig c. *Euglena granulata*, Fig d. *Euglena polymorpha*, Fig e. *Euglenaformis proxima* , F i g f. *Euglena sanguinea*, F i g g. *Euglena tuberculata*, Fig h. *Lepocinclis acus*, Fig i. *Lepocinclis globulus*, Fig j. *Phacus nordstedtii*, Fig k. *Phacus orbicularis* ,Fig l. *Phacus curvicauda*, Fig m. *Trachelomonas superba var. duplex*, Fig n. *Trachelomonas subplanctonica.*

4. Discussion

The study provides a comprehensive assessment of phytoplankton diversity in two freshwater lakes Katral and Bharamasagara by categorizing algae based on relative dominance and ecological indicators. Euglenophyceae are generally Plentiful in streams of waters rich in organic materials (Kalff J. 2000) Euglena is a dominant genus in contaminated waterways (Alam A, Khan A.A 1996) Many researchers have researched the ecological distribution of euglenoids (Munawar M 1970) (Singh U, Swarup DK 1979) Many scientists have explored, organic matter and albumonoid ammonia effect the growth and development of euglenophyceae.

(Sunder Singh 2015) (Murulidhar V.N 2015) Euglenoids directly influences nutrient stress or organic loading and classical indicators of pollution in eutropic waters (Palmer 1969) (Reynolds 2006). Further studies involving physicochemical profiling, seasonal variation analysis and long-term monitoring are essential to formulate sustainable management plans.

5. Conclusions

The current study of Euglenophyceae reveals that 4 major genera viz., *Euglena, Phacus, Lepocinclis, Trachelomonas* recorded in both the study areas. *Euglena polymorpha* is dominant and highest species richness at katral lake. Euglenoids are frequently linked with nutrient rich biomes and accumulation of organic matter thus, they are localized and enriched in certain parts of the lakes. That can be used as a good pollution indicator.

Conflicts of Interest: The authors declare no conflict of interest.

Funding: This research received no external funding.

Acknowledgement: The Authors are thankful to the department of Applied Botany, Sahyadri Science College, Shivamogga, Kuvempu University, Shankaragatta, for the Support Rendered during the Research Work.

Reference

1. Rajagopal, T., Thangamani, A., and Archunan, G. (2010), 'Comparison of physico-chemical parameters and phytoplankton species diversity of two perennial ponds in Sattur area, Tamil Nadu', *Journal of Environmental Biology* 31(5), 787-794.

2. Anindita Singha Roy., and Ruma Pal. (2016), 'Fresh Water Euglenophytes from East Kolkata Wetlands - A Ramsar Site', *Phytomorphology An International Journal of Plant Sciences* 66(3&4), 113-121.

3. Vasanthakumar, S., Bakthavachalam Babu, K., NandhiniJ, J., Hannah Sherine and Grace Mariam Philip. (2021), 'Diversity of Euglenophyceae from Kanniyakumari District, Tamil Nadu, India', *Indian Hydrobiology* 20(2), 303–316.

4. Jun Tae Kim., Sung Min Boo., and Bozena Zakrys. (1998), 'Floristic and Taxonomic Accounts of the Genus Euglena (Euglenophyceae) from Korean Fresh Waters', *Algae* 13(2), 173-197.

5. Gour Gopal Satpati., and Ruma Pal. (2017), 'Taxonomic diversity and SEM study of Euglenoids from Brackish Water Ecosystems of Indian Sundarbans Biosphere Reserve', *Phykos* 47 (1), 105-122.

6. Bicudo CEdM., and Menezes M. (2016), 'Phylogeny and Classification of

Euglenophyceae: A Brief Review', *Front. Ecol. Evol*. 4(17), 1-15.

7. Yasmeen., Kamalakar, p. (2024), 'Diversity of Euglenophyceae In Hussain Sagar Lake of Hyderabad',

National Journal of Environment and Scientific Research
6(5), 47-62.

8. Yasmeen., Kamalakar, p. (2024), 'Diversity and Distribution of Euglenophycea Members in Mir Alam Lake', *Journal of Emerging Technologies and Innovative Research* 11(7), 171-181.

9. Gonzalves, E.A., and Joshi D.B. (1943), 'The algal-flora of temporary waters around Bombay-l', *J. Univ. Bombay* 11, 121-128.

10. Hosmani, S.P. (1976), 'A new species of the genus phacus, phacusbharatii sp. Nov', *Phykos* 15, 29-30.

11. Waghodekar, V.H., & Patel, R.J. (1991), 'Euglenoids of Gujarat: genera Heteronema Dujardin and Anisonema (dujj.) Stein, *Phykos*, 30, 81-86.

12. Sinha, S. (2002), 'Industrial effluents and Organism inhabiting them. Pt. R.S. University Publications, Raipur, India, 174pp.

13. Habib, I., & Pandey, U.C. (1990), 'The Euglenineae from Nakatia River, Bareilly (U.P) India', *J. Ind. Bot. Soc.*, 69, 387-390.

14. Bhakta, S., Das, S.K., & Adhikary, S.P. (2010), 'Fresh Water Algae of Sikkim', *Journal of Indian Botanical Society* 89, 169-184.

15. Anila, P., Ajayan., Ajit Kumar K.G. (2016), 'New geographic distribution of Euglenaria clepsydroides (Euglenophyceae) from India', *Indian J Trop Biodiv*. 24(1), 100-102.

16. Gloria, G.S., Maria, G., Alfonso, L.V., Maria, B.M.G., Rafael, E.Q.Z., Visitacion, C. (2011), 'Trachelomonas (Euglenophyta) from a eutrophic reservoir in Central Mexico', *J Environ Biol* 32, 463-471.

17. Prescott, G.W. (1951), 'Algae of Western Great Lakes Area', Brown Publishers.

18. Desikachary, T.V. (1959), 'Cyanophyta. ICAR Monograph on Algae'.

19. Taylor, J.C., Harding, W. R and Archibald, C.G.M. (2007), 'A Methods Mannuals for the collection, Preparition, and analysis of diatom samples vol.TT281, Water Reseach Commission'

20. Fritsch. (1935), 'The Structure and Reproduction of Algae'. Vol. 1, Cambridge University press, London.

21. Konrad Wołowski., Abdullah Antar Saber., & Marco Cantonati. (2017), 'Euglenoids from The El Farafra Oasis (Western Desert, Egypt)', *Polish Botanical Journal* 62(2), 1-13.

22. Leonardo H., Mendoza-Carbajal., Elian Rojas-Baez., Jose Casasochoa., Maria Angela Pumacajia., Luz Morales., Angela Sulca., Dana Garcia., Nataly Galloso-Sanchez., Antuane Cordova., Josselyn Alvarez. (2023), 'Riqueza De Euglenophyta En La Laguna Yarinacocha (Pucallpa, Ucayali), Incluyendo Nuevos Registros Para El Perú', *Folia Amazonica* 32(2), 1-32.

23. Prescott, G.W. (1982), 'Algae of Western Great Lakes Area', William C. Brown Publishers.

24. Kouassi, B.A.T., Ouattara, A., Kouhété Philippe, D.A. (2013), 'Euglenozoa in Adzopé Reservoir, Côte D'Ivoire', *Turk J Bot* 37, 1176-1187.

25. Sylwia Kosmala., Magdalena Bereza., Rafał Milanowski., Jan Kwiatowski., And Bozena Zakrys. (2007), 'Morphological and Molecular Examination of Relationships and Epitype Establishment of *Phacus pleuronectes*, *Phacus orbicularis*, and *Phacus hamelii*' *J. Phycol* 43, 1071-1082.

26. Shadia Rahman., Sunil Kumar Choudhary., Braj Nandan Kumar. (2024), 'Taxonomical diversity of Genus *Phacus* (Dujardin, 1841) in different wetlands of Bhagalpur District, Bihar, India', *International Journal of Botany Studies* 9(5) 6-11.

27. Poniewozik, M., Yesayan, T., Zięba, E. *et al.* (2025), 'First record of euglenophytes of the genus *Trachelomonas* in mountain lakes of Lori Province in the Republic of Armenia', *Sci Rep* 15, 37496 https://doi.org/10.1038/s41598-025-21570-w

28. Jiang, X., Chen, X., Pang, W., Wang, Q. (2022), 'Phylogeny of *Trachelomonas* and *Strombomonas* (Euglenaceae) Based on Morphological and Molecular Data', *Diversity*, *14*(623) 1-12. https://doi.org/10.3390/ d14080623

29. Kalff J., (2000), 'Limnology prentice hall Uppers addle river', New Jersey.

30. Alam, A., Khan, A.A., (1996), 'Dynamics of plankton communities in four fresh water lentic ecosystems in relation to varying dominant biota', *Poll Res.* 15(3), 289-291.

31. Munawar, M. (1970), 'Limnological studies on fresh water ponds

of Hyderabad – India. I1. The biocenose - Distribution of unicellular and colonial phytoplankton in polluted and unpolluted environments, *Hydrobiologia.* 36(1), 105-128.

32. Singh, U., Swarup, DK. (1979), 'Limnological studies of Suraha lake the periodicity of phytoplankton', *J. Indian Bot Soc*, 58, 319-329.

33. Sunder Singh. (2015), 'Analysis of plankton diversity and density with physicochemical parameters of open pond in town Deeg (Bhratpur) Rajasthan, India', *Int Res J Biological Sci* 4(11), 61-69.

34. Murulidhar, V.N., Yogananda Murthy, V.N. (2015), 'Ecology, distribution and diversity of phytoplankton in Teetha wetland, Tumakuru district, Karnataka, India', *Int J Environ Pollun Res*, 3(3) 1-12.

35. Palmer, C.M. (1969), 'A composite rating of algae tolerating organic pollution', *Journal of phycology*, 5, 78-82.

36. Reynolds, C.S. (2006), 'The Ecology of Phytoplankton' Cambridge University Press.