PLANT SCIENCE TODAY
ISSN 2348-1900 (online)
Vol 11(4): 52-57
https://doi.org/10.14719/pst.3281

HORIZON
e-Publishing Group
HePG

RESEARCH ARTICLE

Seven new additions to euglenoid flora of India from petroleum hydrocarbon contaminated water bodies of Naga- Schuppen thrust belt

Bishmita Boruah* & Partha Pratim Baruah

Plant Ecology Laboratory, Department of Botany, Gauhati University, Jalukbari, Assam, 781 014, India

*Email: bishmitaboruah27@gmail.com

OPEN ACCESS

ARTICLE HISTORY

Received: 13 January 2024
Accepted: 01 June 2024

Available online
Version 1.0 : 04 September 2024
Version 2.0 : 01 October 2024

Additional information

Peer review: Publisher thanks Sectional Editor and the other anonymous reviewers for their contribution to the peer review of this work.

Reprints & permissions information is available at https://horizonepublishing.com/journals/index.php/PST/open_access_policy

Publisher's Note: Horizon e-Publishing Group remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Indexing: Plant Science Today, published by Horizon e-Publishing Group, is covered by Scopus, Web of Science, BIOSIS Previews, Clarivate Analytics, NAAS, UGC Care, etc
See https://horizonepublishing.com/journals/index.php/PST/indexing_abstracting

CITE THIS ARTICLE

Boruah B, Baruah P P. Seven new additions to euglenoid flora of India from petroleum hydrocarbon contaminated water bodies of Naga- Schuppen thrust belt. Plant Science Today. 2024; 11(4): 52-57. https://doi.org/10.14719/pst.3281

Abstract

Comprehensive explorations were conducted along the Naga- Schuppen thrust belt of Northeast India, a hydrocarbon province of Southeast Asia, during the years 2021-2023 which revealed altogether 7 new distributional records of freshwater Euglenophycean species for India. Out of the 7 identified taxa, *Phacus corculum, Menoidium tremulum, Trachelomonas crispa*, *Trachelomonas corniformis, Trachelomonas nadsonii* and *Trachelomonas rugulosa* var. *obliqua* are found to be newly reported algal species not only from India but from the entire Southeast Asia province. All the reported Euglenophyte flora belongs to 2 classes, 2 orders and 3 families. In addition, the systematic accounts of all these species are discussed in detail.

Keywords

New record; India; euglenophytes; diversity; hydrocarbon

Introduction

Photoautotrophic algae Euglenophytes are a group of flagellates that are cosmopolitan in nature and are commonly found free-swimmers. These are also often named as Euglenozoa or Euglenoids (1). Almost all the species in this incredibly varied group are unicellular and are capable of living in both fresh and saline water, which is abundant in organic material (2). Generally, higher water temperatures and long days of light during the summer season are found to be congenial for their luxuriant growth in both lotic and lentic water bodies (3). Further, a few members of Euglenophytes have been recently recognised as a tool for water quality monitoring (4).

Studies on algal research in India have documented around 7310 algal species belonging to 835 genera, organised under 11 classes, 95 orders and 255 families (5). Amongst them, the class Euglenophyceae, a remarkable microalgal group, is known to have 516 diverse taxa (384 species, 117 varieties and 15 forms) which include 509 Euglenoids reported from freshwater habitat (6).

Different groups of researchers worldwide, including those from India, have worked significantly on euglenophytes from different habitats (4, 7-25). In contrast, the primary source of knowledge regarding euglenoids reported from oil contaminated sites is scanty (26). Therefore, in this taxonomic investigation, an attempt has been made to explore freshwater Euglenophycean micro-algal diversity in some crude oil contaminated water bodies located in oil exploration sites, which are organically polluted due to

crude oil exploration since 1857 and subsequent leakage and seepage during transportation, refining etc.

Materials and Methods

Study area

Around 31 crude oil contaminated lentic water bodies of varied sizes located in and around Digboi, Jorajan and Makum oil fields under the Naga-Schuppen thrust belt (Fig. 1), a part of one of the significant hydrocarbon basins in India which houses many running and abandoned oil fields (27) were explored for euglenophytes from May 2021 to April 2023 for 2 years. The TOC (Total Oil Content) was beyond 36.56 g/L in those water bodies on an average throughout the studied year. The region enjoys a subtropical monsoon climate with a cold winter, wet spring and humid summer. The average annual rainfall is ± 1950 mm.

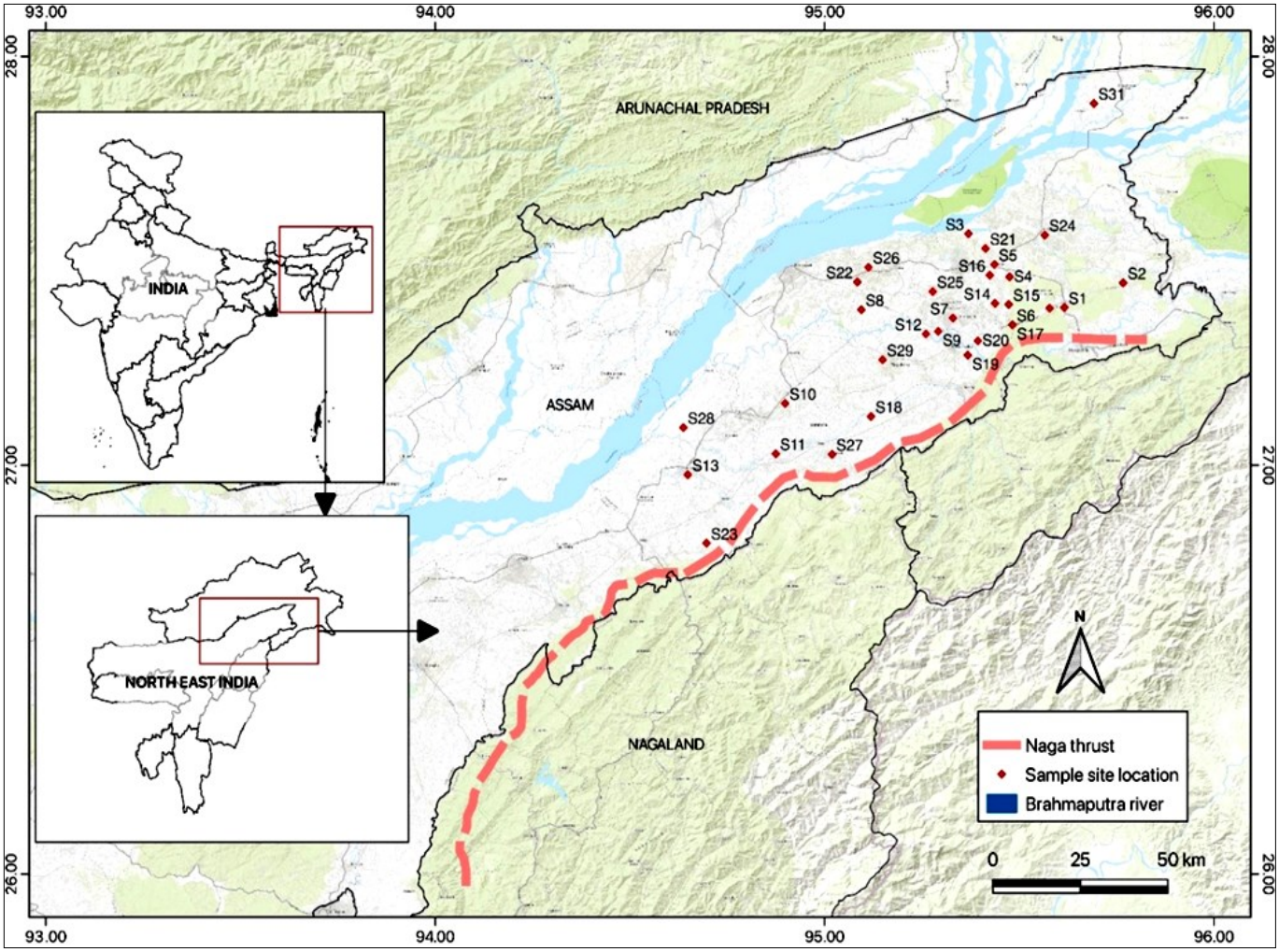


Fig. 1. Map of the study area with 31 locations of crude oil contaminated water bodies along Naga thrust.

Sample collection

To enumerate the Euglenophycean diversity in the study area, samples were collected by filtering water through a plankton net with a mesh size of 45 µm (28). Concentrated filtrates were then brought to the laboratory with proper labelling. The algal samples were preferably observed in fresh conditions under a Euromex Delphi X Observer series microscope with Image View software and photographs were clicked using a Euromex Digital camera (20 MP). For further observation, preservation was made in 4 % formaldehyde and Lugol's iodine solution when necessary. Identification was done based on their morphological features following standard taxonomic monographs, online databases and research publications. Taxa were updated using AlgaeBase (29) and then arranged following a previous report (30).

Results and Discussion

Altogether, seven Euglenoid species were revealed to occur in different hydrocarbon contaminated water bodies, which include 5 taxa under the genus *Trachelomonas* Ehrenberg, 1834 and one taxa each under *Phacus* Dujardin, 1841 and *Menoidium* Perty, 1852 respectively, during the present taxonomic survey. It is also to be noted that all 7 species were not identified and reported so far from India.

All the species of euglenoid taxa documented during this investigation are given with detailed morphological descriptions below in tabular form (Tables 1-3). Of these euglenoids, *Phacus corculum* (Fig. 2A), *Menoidium tremulum* (Fig. 2B), *Trachelomonas crispa* (Fig. 2C), *Trachelomonas corniformis* (Fig. 2D), *Trachelomonas nadsonii* (Fig. 2E) and *Trachelomonas rugulosa* var. *obliqua* (Fig. 2F) are found to be new additions to the algal flora not only of India but also to the entire Southeast Asia province.

Table 1. Morphological characteristics of species new to India under genus *Trachelomonas* with their comparison to already reported taxa

Species	Features	Information available on the taxa with source		Present study
		Source	Characters	
Trachelomonas crispa Balech 1944: 273, figs 90, 91, 201 (Fig. 2C)	Shape	(31)	Cylindrical, to ellipsoidal	Ellipsoidal, wall covered with minute sharp spines
	Length		36-40 µm	37.1-40.6 µm
	Width		16-18 µm	15-18 µm
	Colour		Brown	Brown to Dark yellow
	Collar		Low collar having a circle of short spines around the mouth	Low collar having a circle of short spines around the mouth
	Flagellum		No mention	Not seen
	Habitat		Moat, Ditch, Lake	Ditch, Wetland
	Habit		No mention	Free Floating
Trachelomonas corniformis Y.V.Roll 1925: 138, 147, pl. V [5]: fig. 3 (Fig. 2D)	Shape	(31)	Broad ovoid to ellipsoidal, densely punctate	Ovoid, wall densely punctate all over
	Length		33-38 µm	33.4-36.2 µm
	Width		24-28 µm	23-28.3 µm
	Colour		Dark brown	Dark brown
	Collar		Collar absent but encircled with short spines around the mouth	No collar and encircled with short spines around the mouth
	Flagellum		No mention	Not seen
	Habitat		Lake	Ponds, Ditch
	Habit		No mention	Plankton
Trachelomonas nadsonii Skv ortzov 1925: 78 (Fig. 2E)	Shape	(32)	Fusiform to spindle shaped with wavy margins and densely covered spines	Fusiform, Spherical with densely covered spines
	Length		65-69 µm	65-69.2 µm
	Width		19-20.1 µm	20-20.3 µm
	Colour		Brown	Brown
	Collar		Attenuated into a long neck like process with terminal spike	Attenuated into a long neck like process with terminal spike
	Flagellum		No mention	Not seen
	Habitat		Ponds, Lakes, Ditches	Ponds, Paddy field
	Habit		Plankton	Plankton
Trachelomonas rugulosa var. *obliqua* Bourrelly 1952: 185, pll. XXIII: figs 308, 309 (Fig. 2F)	Shape	(33)	Spherical, distinct spirally arranged ribs	Spindle shaped, densely covered with
	Length		14-21 µm	14.6-20 µm
	Width		20-22 µm	20-22.2 µm
	Colour		Dark yellow	Dark yellow
	Collar		Apical pore with a short collar directly inside lorica	With a short collar directly inside lorica
	Flagellum		Twice long as lorica	Twice long as lorica
	Habitat		Ponds, Puddles	Ponds, Paddy field
	Habit		No mention	Plankton
Trachelomonas hirta var. *duplex* Defflandre 1928: 664, fig. 6 (Fig. 2G)	Shape	(31)	Broad- ellipsoidal with round anterior and posterior end	Broad- ellipsoidal, walls covered with
	Length		18-22 µm	19-22.3 µm
	Width		14-15 µm	13-14 µm
	Colour		Yellowish	Yellowish
	Collar		Without collar	Without collar
	Flagellum		No mention	Not seen
	Habitat		Ditch, Pond, Moat	Ponds, Ditch
	Habit		No mention	Free Floating

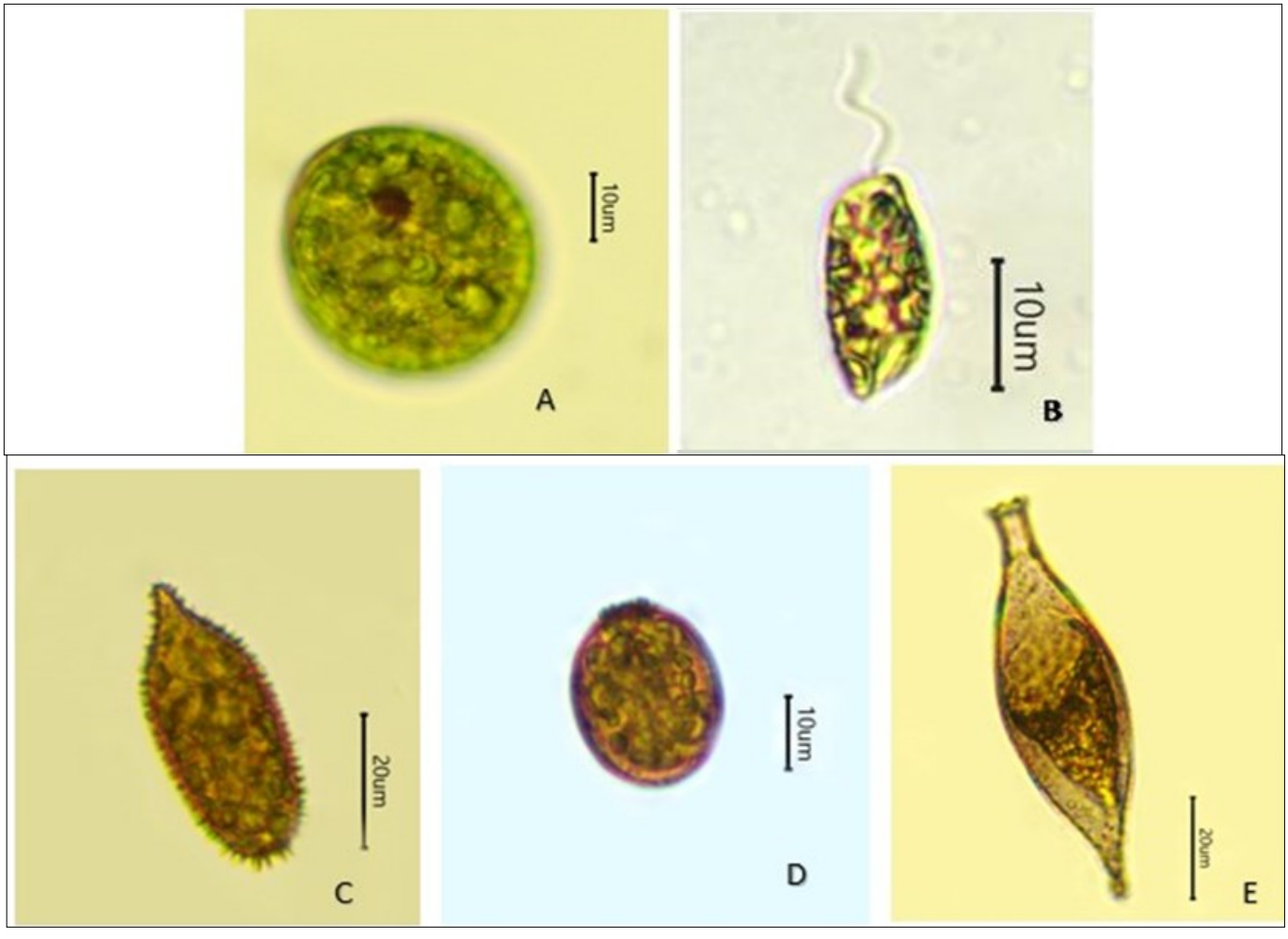
Table 2. Morphological characteristics of species new to India under genus *Phacus* with their comparison to already reported taxa.

Species	Features	Information available on the taxa with source		Present study
		Source	Characters	
Phacus corculum Pochmann 1942: 121, fig. 2 (Fig. 2A)	Shape	(33)	Heart shaped, cut in anterior end and	Heart shaped
	Length		17-20 µm	17.8-22 µm
	Width		12-13.6 µm	13.2-14 µm
	Paramylon bodies		1-2, disc shaped	2 disc-shaped
	Chloroplasts		Numerous	Numerous
	Habitat		Ponds, Ditch, Puddles	Ponds, Ditch
	Habit		No mention	Free floating

Table 3. Morphological characteristics of species new to India under genus *Menoidium* with their comparison to already reported taxa.

Taxa	Features	Information available on the taxa with source		Present study
		Source	Characters	
Menoidium tremulum Skvortzov 1924: 183, fig. A 9 (Fig. 2B)	Shape	(32)	Half-moon like bent,	Elongated, curved, with delicate striations
	Length		18 µm	15-20 µm
	Width		6 µm	8-10 µm
	Colour		Greenish	Greenish
	Collar		Anterior end of cell usually protruded	Protruded narrow neck not seen
	Flagellum		Flagellum long	One long emergent flagellum
	Paramylon bodies		Large	Large and small
	Habitat		Ponds, lakes, rivers	Ponds, Paddy field
	Habit		Plankton	Plankton

Systematic Account



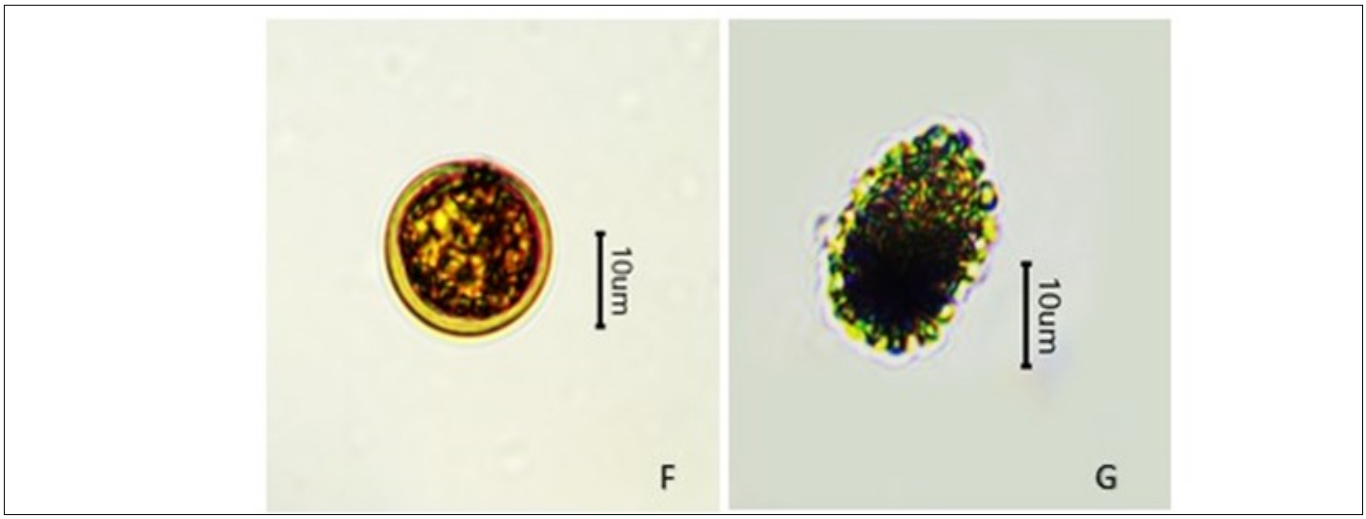


Fig. 2. Photomicrographs of Euglenoid species new to India. **A**. *Phacus corculum* Pochmann, **B**. *Menoidium tremulum* Skvortzov, **C**. *T rachelomonas crispa* Balech, **D**. *Trachelomonas corniformis* Y.V.Roll, **E**. *Trachelomonas nadsonii* Skvortzov, **F**. *Trachelomonas rugulosa* var. *obliqua* Bourrelly, **G**. *Trachelomonas hirta* var. *duplex* Deflandre.

Phylum: Euglenozoa

Class: Euglenophyceae

Order: Euglenales

Family: Euglenaceae

Genus: *Trachelomonas* (Ehrenberg, 1834)

Cells are solitary and free swimming, protoplast thin walled and naked and enclosed within a fragile lorica, lorica shapes varies from globose to ovoid, spindle, cylindric, pyriform or fusiform, anterior end with or without distinct collar, sometimes collar coarse, elongated neck-like, surrounding terminal flagellum pore, flagellum usually longer than body length, distinct cauda may be present at the posterior end, lorica wall smooth to rough, ornamented, dentate, punctate, granulate, scrobiculate, perforate, reticulate or spinose, spines thick or fine, blunt or sharp, distribution localized, sparse or dense, chloroplasts 2 to many, discoid to trough shaped, paramylon bodies round elongated or absent.

Family: Phacaceae

Genus: *Phacus* (Dujardin, 1841)

Cells are solitary and free swimming, almost flattened, pyriform, fusiform or orbicular, twisted sometimes, cells bear short or long, sharply pointed or blunt caudas at posterior ends, one flagellum at anterior end, pellicle ornamented with spiral or longitudinal striations, chloroplasts numerous in ovoid disc–band like, paramylon bodies circular plates or rings like, sometimes rods like, distinct stigma, some species may have eye spot.

Phylum: Euglenozoa

Class: Peranemea

Order: Natomonadida

Family: Astasiidae

Genus: *Menoidium* (Perty, 1852)

Cells are solitary, uniflagellate, compressed, curved, long fusiform in face view, narrow long thin, cylindric in side view, anterior ends narrowed into a quadrate and beak like apex, posterior ends gradually narrowed into a rounded end, periplast rigid, with longitudinal, parallel striae, cytoplasm granulate, with 2 or several, long rod like or ring like paramylon bodies.

Conclusion

The euglenoid species documented for the first time from India in the present endeavour could be a momentous contribution to the extensive record of the algal database of the state and the nation as well. As the recorded euglenoid species were from hydrocarbon contaminated water bodies, they are either resistant or adapted to grow in such harsh environment and hence, may be considered as a bio-monitoring tool in the future.

Acknowledgements

The authors are greatly thankful to MoEF and CC (Govt. of India) for providing grant to carry out the research work under AICOPTAX-Phytoplankton. They are also grateful to the Head, Department of Botany, Gauhati University for providing the facilities under UGC and DST, UGC- SAP, OIL and DST-FIST schemes.

Authors' contributions

BB: Conceptualization, Visualization, Investigation, Writing original draft. PPB: Supervision, Conceptualization, Writing- reviewing and editing.

Compliance with ethical standards

Conflict of interest: The authors declare that they have no conflict of interest that could have appeared to influence the work reported in this paper.

Ethical issues: None.

References

1. Satpati G, Pal R. Taxonomic diversity and SEM study of euglenoids from brackish water ecosystems of Indian Sundarbans Biosphere Reserve. Phykos. 2017;47:105-22.
2. Predojević D, Subakov-Simić G, Kovacević E, Papić P, Ćuk M, Kljajić Ž, Lazić M. Diversity of the Euglenophyta division in the Zasavica river, Serbia. Botanica Serbica. 2015.
3. Halder N, Sinha SN. New records of *Euglena acus* (OF Müll.) Ehr. and *Phacus acuminatus* (A. Stokes) Huber-Pestalozzi of Euglenineae from Hooghly district, West Bengal. JAIR. 2014;3:333-36.
4. Mohan B, Prabha D, Priyadarshinee S. New record of some *Phacus* species (Euglenophyceae) from Ukkadam lake, Coimbatore city, Tamil Nadu, India. Biology Bulletin. 2022;49(3):S98-S103. https://doi.org/10.1134/S1062359022150158
5. Savithra N, Malammanavar SG, Kumar AS, Palanisamy M. Six new additions to algal flora of India. Nelumbo. 2022;64(2). https://doi.org/10.20324/nelumbo/v64/2022/172549
6. Gupta RK. Algae of India, A checklist of Chlorophyceae, Xanthophyceae, Chrysophyceae and Euglenophyceae. Botanical Survey of India. 2012;2.
7. Conforti V. Morphological changes of Euglenophyta in response to organic enrichment. In: Phytoplankton and Trophic Gradients, Proceedings of the 10th Workshop of the International Association of Phytoplankton Taxonomy and Ecology (IAP); Granada:Spain. Netherlands: Springer. 1998;p. 277-85. https://doi.org/10.1007/978-94-017-2668-9_24
8. Alves-da-Silva SM, Hahn AT. Study of Euglenophyta in the Jacuí Delta state park, Rio Grande do Sul, Brazil. 1. *Euglena* Ehr., *Lepocinclis* Perty. Acta Botanica Brasilica. 2004;18:123-40. https://doi.org/10.1590/S0102-33062004000100011
9. Delgado JG, Sánchez L. Euglenophyta from lower basin of the Caura river, Venezuela. Acta Botánica Venezuelica. 2007;30:277-90.
10. Kosmala S, Milanowski R, Brzóska K, Pękala M, Kwiatowski J, Zakryś B. Phylogeny and systematics of the genus *Monomorphina* (Euglenaceae) based on morphological and molecular data. Journal of Phycology. 2007;43:171-85. https://doi.org/10.1111/j.1529-8817.2006.00298.x
11. Alves-da-Silva SM, Bicudo CEDM. *Cryptoglena*, *Monomorphina* and *Phacus* (Euglenophyceae) of a reservoir in the state of Rio Grande do Sul, Southern Brazil. Brazilian Journal of Botany. 2009;32:253-70. https://doi.org/10.1590/S0100-84042009000200006
12. Araujo GJM, Barbosa JEDL, Barbosa LG. Pigmented Euglenophytes in a natural and shallow lake in the semiarid region of Paraíba state, Brazil. Brazilian Journal of Botany. 2012;35:17-30. https://doi.org/10.1590/S1806-99592012000100004
13. Kouassi BAT, Ouattara A, Da KP. Euglenozoa occurring in Adzopé reservoir, Côte d'Ivoire. Turkish Journal of Botany. 2013;37:1176-87. https://doi.org/10.3906/bot-1201-11
14. Wołowski K, Poniewozik M, Walne PL. Pigmented euglenophytes of the genera *Euglena*, *Euglenaria*, *Lepocinclis*, *Phacus* and *Monomorphina* from the Southeastern united states. Polish Botanical Journal. 2013;58:659-85. https://doi.org/10.2478/pbj-2013-0071
15. Habib I, Pandey UC. The Euglenineae from Nakatia river, Bareilly (U.P.) India. J Ind Bot Soc. 1990;69:387- 90.
16. Shaji C, Patel RJ. Phytoplankton species diversity of Sabarmati river near Ahmedabad, Gujarat, as index of environmental changes. Ann Biol. 1991;7:15-20.
17. Anand N. Indian freshwater microalgae. Dehra Dun, India: Bishen Singh Mahendra Pal Singh. 1998; P. 50-53.
18. Ratha SK, Jena M, Adhikary SP. Euglenophytes from Orissa state, East coast of India. Algae. 2006;21:61-73. https://doi.org/10.4490/ALGAE.2006.21.1.061
19. Bhakta S, Das SK, Nayak M, Jena J, Panda PK, Sukla LB. Phycodiversity assessment of Bahuda river mouth areas of East coast of Odisha, India. Recent Res Sci Technol. 2011;2:80-89.
20. Ekhande AP. Monitoring water body: Seasonal variations in density and species richness of Euglenophyta of Yashwant lake, Toranmal (MS) India. Int J Sci Res Sci Tech. 2017;3:100-03.
21. Sharma BK, Hatimuria MK. Phytoplankton diversity of floodplain lakes of the Majuli river island of the Brahmaputra river basin, Assam, Northeast India. Int J Aquat Biol. 2017;5:295-309. https://doi.org/10.22034/ijab.v5i5.347
22. Patil JK, Kumawat DA. Genus *Trachelomonas* ehr. (Euglenophyta) from North Maharashtra, India. BIO-INFOLET, Q J Life Sci. 2020;17:646-53.
23. Kadam AD, Kishore G, Mishra DK, Arunachalam K. Microalgal diversity as an indicator of the state of the environment of water bodies of Doon valley in Western Himalaya, India. Ecol Indic. 2020;112:106077.https://doi.org/10.1016/j.ecolind.2020.106077
24. Dash SR, Pradhan B, Behera C, Nayak R, Jena M. Algal flora of Tampara lake, Chhatrapur, Odisha, India. J Indian Bot Soc. 2021;101:1-15. https://doi.org/10.5958/2455-7218.2021.00008.5
25. Mal J, Keshri JP. The genera *Phacus, Trachelomonas* and *Strombomonas* (Euglenophyta) in four districts of West Bengal, India. Nelumbo. 2022;64. https://doi.org/10.20324/nelumbo/v64/2022/169612
26. Duangjan K, Wołowski K, Peerapornpisal Y. New records of *Phacus* and *Monomorphina* taxa (Euglenophyta) for Thailand. Polish Bot J. 2014;5:235-47. https://doi.org/10.2478/pbj-2014-0039
27. Visvanath SN. A hundred years of oil: A narrative account of the search for oil in India. New Delhi: Vikas Publishing House. 1997.
28. Baruah PP, Boruah B, Nath S, Kalita H, Bhattacharjee S. Algal diversity in Deepor Beel of Assam: A Ramsar site of North East India. Nelumbo. 2020;62:221-52. https://doi.org/10.20324/nelumbo/v62/2020/153155
29. Guiry MD, Guiry GM. AlgaeBase. World-wide Electronic Publication; National University of Ireland. Galway, Ireland; 2020.
30. Ruggiero MA, Gordon DP, Orrell TM, Bailly N, Bourgoin T, Brusca RC *et al*. A higher-level classification of all living organisms. PloS one. 2015;10:4. https://doi.org/10.1371/journal.pone.0130114
31. Yamagishi T. Plankton algae of Southeast Asia. Bishen Singh Mahendra Pal Singh; 2010.
32. Ahmed ZU, Khondker M, Begum ZNT, Hassan MA, Kabir SMH, Ahmad M *et al*. Encyclopedia of flora and fauna of Bangladesh, Vol. 4. Algae, Charophyta- Rhodophyta (Achnanthaceae-Vaucheriaceae). Asiatic Society of Bangladesh: Dhaka. 2009;p. 543.
33. John DM, Whitton BA, Brook AJ. The freshwater algal flora of the British Isles: An identification guide to freshwater and terrestrial algae. Cambridge University Press; 2002.