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Identification of Phytoplankton Community in the Paravanar River Estuary Cuddalore Coast, South East Coast of India

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ABSTRACT

The research was carried out under the above research heading. Careful research was carried out on the types of micro algae, morphology, and characteristics in the Paravanar River located at the mouth of the coastal area of Cuddalore district. In this study, the Paravanar River was divided into two parts, and the above parameters were analysed, and the algae density and other metrological data were found to be higher in Part-1 and Part-2. They were also examined under microscopes and 114 species of Phytoplankton (microalgae) were identified during classification and classification. All of them are clearly mentioned in this research article.

Keywords: Estuary, Coastal, Density, micro algae, Phytoplankton, metrological, biodiversity.

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Introduction

In Tamil Nadu there are 34 rivers, including one west flowing river. All these 34 Rivers are grouped into 17 River basins for hydrological studies for water resources planning and managing activities. Paravanar is one of the 17 river basins of Tamil Nadu. This chapter looks at the hydrological endowment including groundwater potential, water resources demand for all sectors and the water balance of the basin. The water demand for domestic, irrigation, industries, livestock, power generation and other uses are governed by socio-economic and agricultural factors, including the present and future population size, income level, urbanization, market facilities, remunerative prices, cropping patterns, etc. An analysis of the water availability, water utilisation and allocation plan for different competing water uses and water balance form the core of a river basin plan. In Water Management Planning, in addition to mismatch problems between demands and supply, other important problems that hamper the safe water supply are waterlogging, salinity, pollution, environmental degradation, inefficient use of water, underutilisation of resources, seawater intrusion in coastal regions, natural calamities like floods and droughts, climate change etc. and health related problems. These problems are locally assessed at the basin level and possible solutions are evolved in the planning process for decision-making at higher levels.

Plankton is tiny organisms that drift with water currents. The term "plankton" was introduced by [1] and means "wanderer" in Greek. Phytoplankton is photosynthetic microscopic organisms found in the sunlit upper layers of oceans and freshwater bodies worldwide. They perform "primary production," creating organic compounds from dissolved carbon dioxide, which sustains aquatic food webs [2].

Phytoplankton obtain energy through photosynthesis and thus inhabit well-lit surface waters of seas, lakes, and other water bodies. They contribute to about half of the Earth's photosynthetic activity [3] and their energy fixation forms the foundation of most oceanic and many freshwater food webs. The impact of anthropogenic warming on global phytoplankton populations is an area of active research. Expected changes in water column stratification, temperature-dependent biological processes, and atmospheric nutrient supply are likely to affect future phytoplankton productivity [4]. Additionally, variations in zooplankton grazing rates, which influence phytoplankton mortality, may also play a significant role. Aquatic ecosystems are rich in biotic resources and play a crucial role in protein food security in India, with phytoplankton being a key component. Phytoplankton serves as essential food for the larval stages of crustaceans, fish, bivalves, and various zooplankton species [5]. Marine phytoplankton comprises a diverse community of floating microalgae, ranging in size from about 1 µm to a few millimetres. Based on size, phytoplankton are classified as macro-plankton (>1 mm), micro-plankton (5–60 µm), and ultra-plankton (<5 µm) [6-8]. As autotrophs and primary producers, phytoplankton initiate the aquatic food chain, supporting secondary producers (zooplankton) and tertiary consumers (shellfish, finfish, and others) either directly or indirectly. Phytoplankton also serve as indicators of water quality and natural regions, characterized by typical species or species groups [9]. They play a significant role in global biogeochemical cycles of carbon, nitrogen, phosphorus, silicon, and other elements. Phytoplankton blooms, including red tides, have notable ecological and economic impacts on aquatic environments. Therefore, phytoplankton analysis is essential for hydrobiological studies.

Understanding phytoplankton pigments is crucial in plankton research. Recently, photosynthetic pigments have been widely used as markers to identify algal groups and monitor changes in their vertical distribution, especially in oceanographic research, where algal groups respond sensitively to physical water changes [10]. Pigment analysis also aids in tracing food-chain relationships, zooplankton grazing, and detritus formation [11]. As primary producers, phytoplankton form the foundation of energy flow in aquatic ecosystems, with higher trophic level production ultimately dependent on photosynthetic primary production. This vital process is influenced by various physicochemical and biological factors. Measuring primary production is essential for evaluating fish production levels and potential fisheries. It also aids in classifying prawn and shrimp fields into highly productive (>1500 mg C m^2 day^{-1}), moderately productive (500–1500 mg C m^2 day^{-1}), and lowly productive (<500 mg C m^2 day^{-1}) areas [12]. The present study focuses on phytoplankton, emphasizing primary production, species composition, population density, and community structure.

Materials and Methods

Phytoplankton samples were collected monthly from two stations: Paravanar River Station I and Station II, over a two-year period from November 2024 to November 2025. Sampling was performed by towing a plankton net with a mouth diameter of 0.35 m, made of bolting silk (No. 30, mesh size 48 µm), for half an hour at a speed of one nautical mile per hour. After towing, plankton retained on the net gauze was washed into a bucket using water. The concentrated samples were then transferred to clean polythene containers preserved with 5% neutralized formalin for qualitative analysis. For quantitative analysis, the settling method described by references [8;12;7] was employed. Numerical plankton analysis was conducted using Utermöhl's inverted plankton microscope. Phytoplankton identification was carried out using a standard research microscope at 1000x magnification with phase-contrast illumination. Identification followed standard taxonomic references [14;2;9;13;1;15-16]. For convenience, the collected phytoplankton was classified into five major groups: Diatoms, Dinoflagellates, Blue-green algae, and others.

Results

MEROLOGICAL DATA 2024-2025

Table 1: Physicochemical parameters, biological parameters and phytoplankton for Paravanar River Estuary station-I.

Parameters	Ra.fa.	T	Salin.	pH	DO	NO_2	NO_3	NH_4	IP	SiO_3
Ra.fa.	1									
T	-0.226	1								
Salinity.	-0.878	0.491	1							
pH	-0.719	0.616	0.834							
DO	-0.374	0.694	0.471	0.603	1					
NO_2	0.566	-0.729	-0.626	-0.734	-0.950	1				
NO_3	0.428	-0.727	-0.494	-0.679	-0.934	0.973	1			
NH_4	0.614	-0.621	-0.626	-0.755	-0.79	0.965	0.948	1		
IP	0.523	-0.816	-0.617	-0.799	-0.891	0.957	0.947	0.910	1	
SiO_3	0.664	-0.6196	-0.693	-0.711	-0.921	0.955	0.906	0.922	0.899	1
Phaeo-Pig.	-0.029	-0.081	-0.102	0.217	0.378	-0.283	-0.299	-0.326	-0.241	-0.263
Pop. Den.	-0.384	0.654	0.516	0.567	0.860	-0.818	-0.779	-0.767	-0.744	-0.843

Table 2: Physico- chemical parameters, biological parameters and phytoplankton for Paravanar River Estuary station-II

Parameters	Ra.fa.	T	Salin.	pH	DO	NO_2	NO_3	NH_4	IP	SiO_3
Ra.fa.	1									
T	-0.274	1								
Salinity	-0.766	0.694	1							
pH	-0.808	0.593	0.970	1						
DO	-0.350	0.543	0.634	0.541	1					
NO_2	0.582	-0.858	-0.542	-0.724	-0.938	1				
NO_3	0.426	-0.872	-0.605	-0.638	-0.925	-0.962	1			
NH_4	0.616	-0.529	-0.729	-0.705	0.802	0.968	0.949	1		
IP	0.522	-0.715	-0.706	-0.642	0.849	0.930	0.945	0.910	1	
SiO_3	0.679	-0.564	-0.804	-0.738	-0.904	0.959	0.908	0.924	0.908	1

Species composition

At Station I, a total of 108 species of phytoplankton were recorded during 2024 and 2025. These comprised 15 species of Coscinodiscus, 6 species of Triceratiinae, 13 species of Chaetoceraceae, 5 species of Odontella, 4 species of Eucampiinae, 12 species of Solenoideae, 3 species of Euodiceae, 16 species of Naviculaceae, 9 species of Fragilariaceae, 4 species of Dinophysiales, 15 species of Peridiniales, 1 species of silicoflagellates, and 5 species of blue-green algae. At Station II, a total of 114 species of phytoplankton were recorded during the same period (2024–2025). These included 14 species of Coscinodisceae, 6 species of Triceratiinae, 13 species of Chaetoceraceae, 6 species of Odontella, 4 species of Eucampiinae, 12 species of Solenoideae, 3 species of Euodiceae, 18 species of Naviculaceae, 11 species of Fragilariaceae, 4 species of Dinophysiales, 17 species of Peridiniales, 1 species of silicoflagellates, and 5 species of blue-green algae (Table 3).

S.No.	Nameofthespecies	Station-I		Station-II	
		2024	2025	2024	2025
	Coscinodiscea				
1.	*Coscinodiscus granii*	+	+	+	+
2.	*C. radiatus*	+	+	+	+
3.	*C. gigas*	+	+	+	+
4.	*C. lineatus*	+	+	+	+
5.	*C. subtilis*	+	+	+	+
6.	*C. ecentricus*	+	+	-	-
7.	*C. thori*	+	+	+	+
8.	*C. centralis*	+	+	+	+
9.	*Planktoniellasol*	+	+	+	+
10.	*Skeletonemacostatum*	+	+	+	+
11.	*Thalassiosirasp.*	+	+	+	+
12.	*T subtilis*	+	+	+	+
13.	*T.ecentrica*	+	+	+	+
14.	*Lauderiasp.*	+	+	+	+
15.	*Cyclotellastriata*	+	+	+	+
	Tricertiinae				
16.	*Lithodesmiumundulatum*	+	+	+	+
17.	*Ditylumbrightwelli*	+	+	+	+
18.	*D. sol*	+	+	+	+
19.	*Triceratiumfavus*	+	+	+	+
20.	*T.reticulatum*	+	+	+	+
21.	*T.robertsianum*	+	+	+	+
	Chaetocercea				
22.	*Chaetocerosaffinis*	+	+	+	+
23.	*C. currivisetes*	+	+	+	+
24.	*C.compressum*	+	+	+	+
25.	*C. diversus*	+	+	+	+
26.	*C. debilis*	-	-	+	+
27.	*C. decipiens*	+	+	+	+
28.	*C. coarctatus*	+	+	+	+
29.	*C. lorenzianum*	+	+	-	-
30.	*C. messanensis*	+	+	+	+
31.	*C. peruvian*	+	+	+	+
32.	*C. indicus*	+	+	+	+
33.	*Bacteriastrumcomosum*	+	+	+	+
34.	*B. hyalinium*	+	+	+	+
35.	*B. delicatilum*	+	+	+	+
	Odontella				
36.	*Odontellaheteroceros*	+	+	+	+
37.	*O. biddulphia*	-	-	+	+
38.	*O. obtuse*	+	+	+	+
39.	*O.malleus*	+	+	+	+
40.	*O.sinensis*	+	+	+	+
41.	*O. mobiliensis*	+	+	+	+
	Eucampiinea				
42.	*Climocopiumfraunfeldium*	+	+	+	+
43.	*Eucampiazoodiaus*	+	+	+	+
44.	*E. carnuta*	+	+	+	+
45.	*Streptothaecaindicus*	+	+	+	+
	Solenoidea				
46.	*Rhizosoleniaalata*	+	+	+	+
47.	*R. cylindrica*	+	+	+	+
48.	*R. imbricata*	+	+	+	+
49.	*R. styliformis*	+	+	+	+
50.	*R. setigera*	+	+	+	+
51.	*R. hebetata*	+	+	-	
52.	*R. delicatula*	-	-	+	+
53.	*R. robusta*	+	+	+	+
54.	*Bacillariaparadoxa*	+	+	+	+
55.	*Leptocylindrusdanicus*	+	+	+	+
56.	*L. minimus*	+	+	+	+
57.	*Guinordiasp.*	+	+	+	+
58.	*G. striata*	+	+	+	+
	Euodiceae				
59.	*Hemidiscushardmannianus*	+	+	+	+
60.	*Hemiaulussinensis*	+	+	+	+
61.	*H. membranaeceus*	+	+	+	+
	Order:PennalesNaviculacea				
62.	*Pleurosigmasp.*	+	+	+	+
63.	*Pleurosigmaangulatum*	+	+	+	+
64.	*P.depressum*	+	+	+	+
65.	*P.normanii*	+	+	+	+
66.	*P.elongatum*	-	-	+	+
67.	*P.directum*	+	+	+	+
68.	*Gyrosigmasp.*	+	+	+	+
69.	*G. balticum*	+	+	+	+
70.	*Nitzschiasp.*	+	+	+	+
		+	+	+	+
71.	*Nitzschialongissima*				
72.	*N. seriata*	+	+	+	+
73.	*N. closterium*	+	+	+	+
74.	*N. granulata*	+	+	+	+
75.	*Naviculasp.*	+	+	+	+
76.	*N. henneydii*	+	+	+	+
77.	*N. granulate*	-	-	+	+
78.	*Diploneissp.*	+	+	+	+
79.	*Stephanophysispalmariana*	+	+	+	+
	Fragilariaceae				
80.	*Thalassionemanitzschioides*	+	+	+	+
81.	*Thalassiothrixfraunfeldii*	+	+	+	+
82.	*T.longissima*	-	-	+	+
83.	*Fragillariasp.*	+	+	+	+
84.	*F.intermedia*	-	-	+	+
85.	*F.oceanica*	+	+	+	+
86.	*Asterionellaglacialis*	+	+	+	+
87.	*Dichtyochasp.*	+	+	+	+
88.	*Pediastrum simplex*	+	+	+	+
89.	*Rhabdonemaarcuatum*	+	+	+	+
90.	*Diatomaanceps*	+	+	+	+
	DINOFLAGELLATES				
	Dinophysialeas				
91.	Dinophysis caudata	+	+	+	+
92.	D. punctata	+	+	+	+
93.	D. hastata	+	+	+	+
94.	Ornithocercussteinii	+	+	+	+
	Peridiniales				
95.	*Ceratium macroceros*	+	+	+	+
96.	*C. extensum*	+	+	+	+
97.	*C .breve*	+	+	+	+
98.	*C. furca*	+	+	+	+
99.	*C. trichoceros*	+	+	+	+
100.	*C. inflatum*	+	+	+	+
101.	*C.lineatum*	+	+	+	+
102.	*C. fusus*	+	+	+	+
103.	*C. tripos*	-	-	+	+
104.	*Protoperidiniumsp.*	+	+	+	+
105.	*Protoperidiniumoceanicum*	+	+	+	+
106.	*P. depressum*	+	+	+	+
107.	*P. venustrum*	+	+	+	+
108.	*P. obtusum*	+	+	+	+
109.	*Pyrophacussteinii*	+	+	+	+
110.	*P. striata*	-	-	+	+
111.	*Noctiluca sp.*	+	+	+	+
	Silicoflagellates				
112.	*Prorocentrummicans*	+	+	+	+
	Bluegreenalgae				
113.	*Trichodesmiumerythraea*	+	+	+	+
114.	*Oscillatoria limosa*	+	+	+	+
115.	*Spirulina sp.*	+	+	+	+
116.	*Lyngbya sp.*	+	+	+	+
117.	*Anabena sp.*	+	+	+	+
	Total	108	108	114	114

+ Present - Absent

Discussions

Phytoplankton is primarily found in the uppermost layers of water where light intensity is sufficient for photosynthesis. The amount of light reaching different water depths is influenced by several factors, including water absorption, light wavelength, water transparency, and surface reflection, reflection from suspended particles, latitude, and seasonal changes. When light hits the water surface, some of it is reflected, with the reflection amount depending on the angle of incidence. The photosynthetic rate of phytoplankton varies with light intensity, and different species exhibit distinct photosynthesis-light response curves, each having an optimal light intensity for maximum photosynthesis. The Light Extinction Coefficient (LEC), which indicates how light diminishes with depth, was observed to be highest in August and lowest in June at both study stations. The maximum LEC in August is attributed to high light intensity, clear water transparency, low turbidity, and light absorption by the water.

Conversely, the minimum LEC in June is due to increased water turbidity and warmer temperatures during the summer, which cause more light reflection and reduce light penetration.

Nutrients

Major nutrients required for phytoplankton growth are nitrogen (nitrate, nitrite, ammonia) and phosphorus (phosphate), primarily introduced through freshwater flow, sewage, and mixing of salt and fresh waters [17]. Nutrient availability often limits phytoplankton productivity. Nutrient concentrations are generally lower in surface waters compared to deeper layers due to uptake by phytoplankton. An inverse relationship was observed: as nutrient concentrations increased, phytoplankton density decreased, and vice versa, especially during summer when nutrients were rapidly utilized. Seasonal depletion of reactive silicate, nitrate, and phosphate during summer was linked to phytoplankton uptake, matching observations in other regions such as Plymouth [18-19]. Reactive silicate showed marked seasonal variation, with minimum levels during peak diatom abundance.

Species Composition

Dominant phytoplankton species included diatoms (Thalassiosirafraunfeldii, T. nitzschioides) and dinoflagellates (Ceratium trichoceros, Prorocentrum depressum). Highest species richness and abundance occurred in November, coinciding with elevated nutrient levels (NO_2, NO_3, TN, IP, TP, SiO_3). These dominant forms align with previous findings in various coastal and estuarine regions worldwide and across India [20-21].

Conclusion

In the Paravanar River estuary, a variety of environmental parameters, such as temperature, salinity, nutrient availability, light, and zooplankton grazing pressure, interact to affect phytoplankton productivity and community structure. Temporal fluctuations in phytoplankton growth rates, species composition, and chlorophyll concentrations are caused by seasonal cycles. The dynamics of the phytoplankton ecosystem in the examined estuary waters are shaped by the combined influence of various variables rather than by a single dominant element.

Slide 1: In the Cuddalore district, during the Paravanar River Estuary Sample Collection

Slide 2: Overview of the Cuddalore District's Paravanar River Estury on the East Coast

Slide 3: Overall Photography of All Phytoplankton specious

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				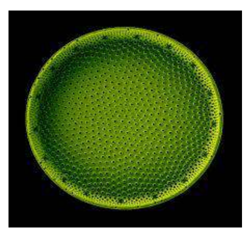

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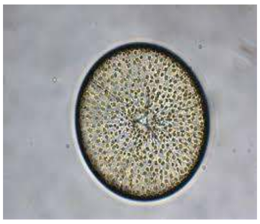		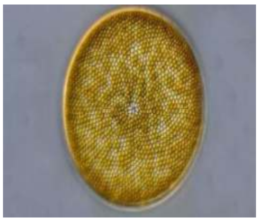	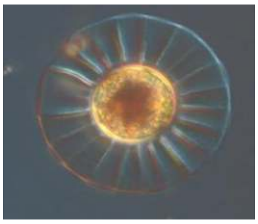	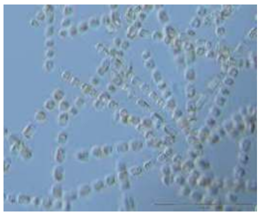
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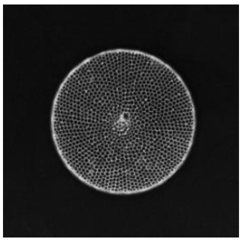	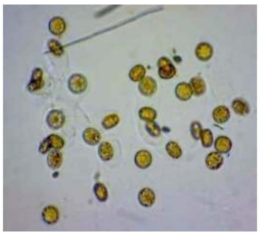		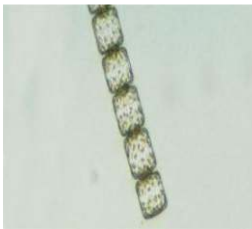	
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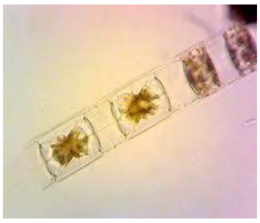	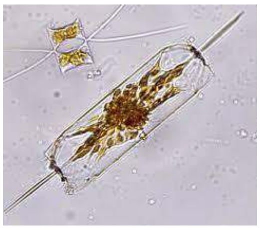			
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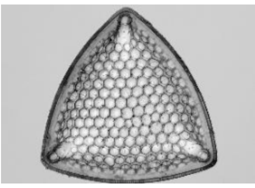
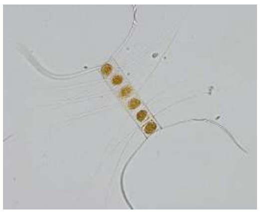
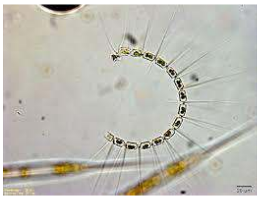
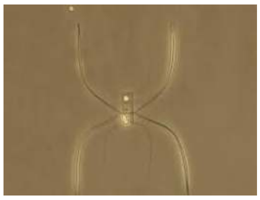
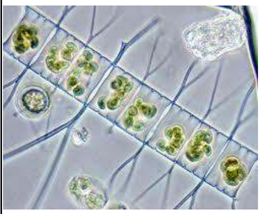
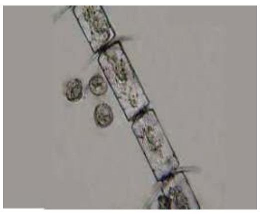
				
26.	27.	28.	29.	30.
				

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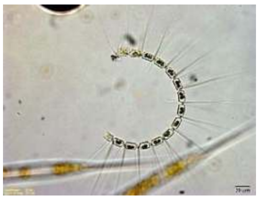	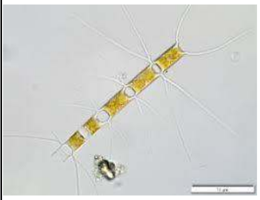	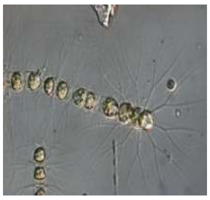	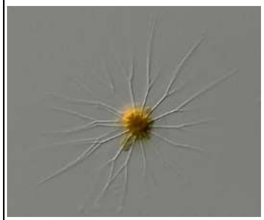	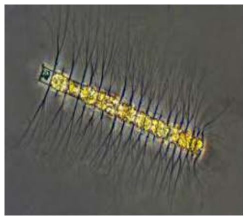
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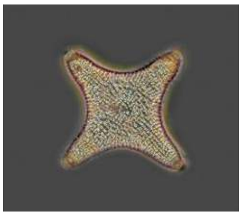	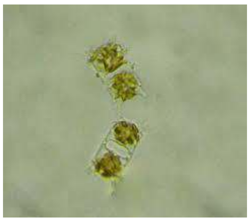			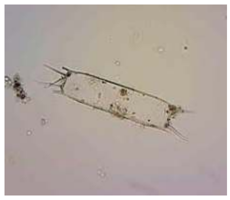
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		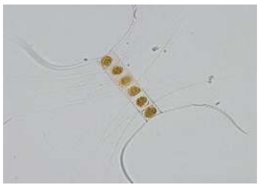	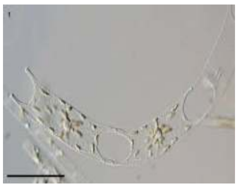	
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			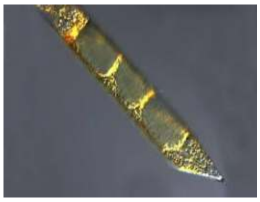	
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			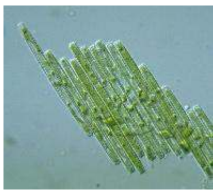	

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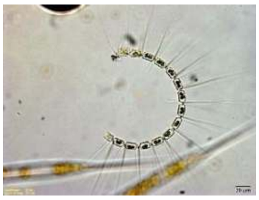	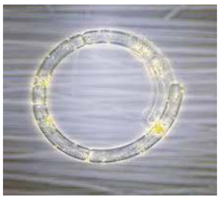		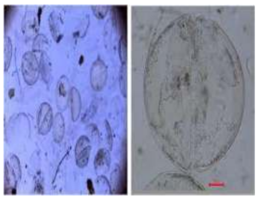	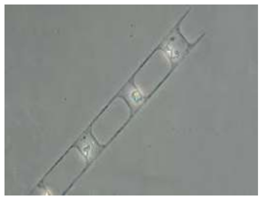
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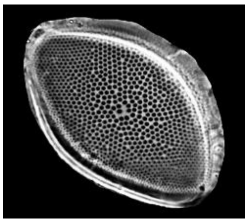				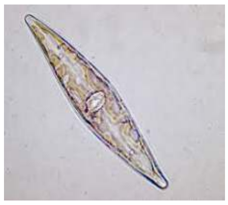
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	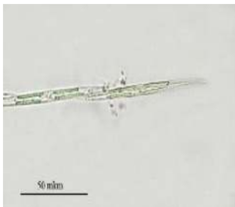			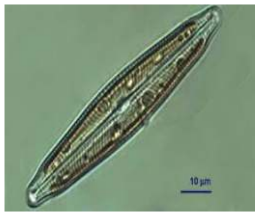
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			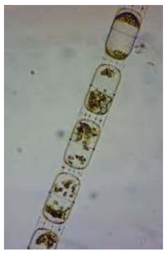	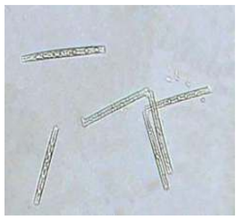

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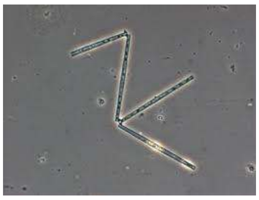	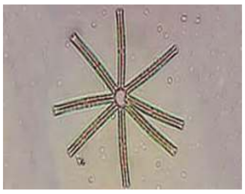			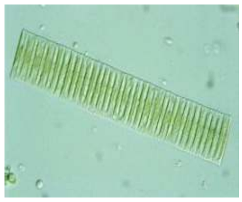
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	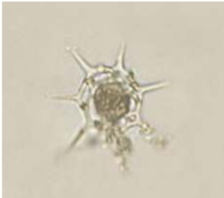	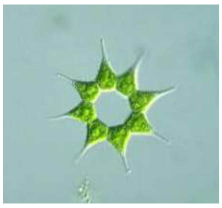	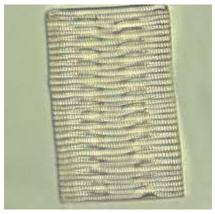	
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			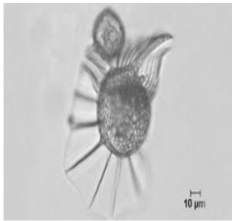	
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		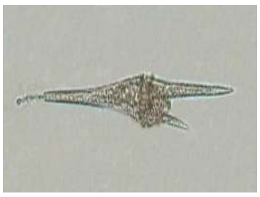		
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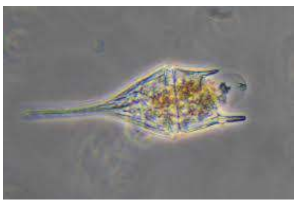	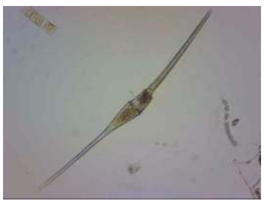	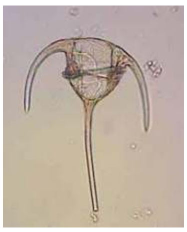		

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			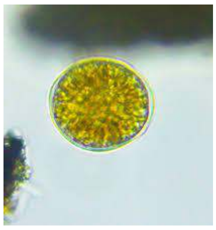	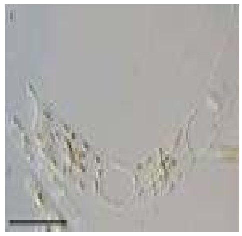
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			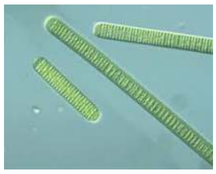	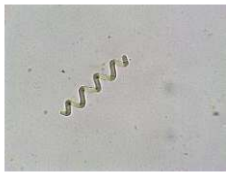
116.	117.			
				

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Conflict of interest
The authors affirm that this study has no conflicts of interest.

References

1. Anand, N., Mohan, E., Hopper, R. S. S., & Subramanian, T. D. (1986). Taxonomic studies on blue-green algae from certain marine environments. Seaweed Res. Util, 9(49), 56.
2. CUPP, E. (1943). Marine plankton diatoms of the wast coast of north America. Scripps Inst. Oceanogr., Univ. California Bull., 5, 1-238.
3. Pennak, R. W. (1946). The dynamics of fresh-water plankton populations. Ecological monographs, 16(4), 339-355.
4. Everitt, D. A., Wright, S. W., Volkman, J. K., Thomas, D. P., & Lindstrom, E. J. (1990). Phytoplankton community compositions in the western equatorial Pacific determined from chlorophyll and carotenoid pigment distributions. Deep Sea Research Part A. Oceanographic Research Papers, 37(6), 975-997.
5. Gopinathan, C. P., Nair, P. V., Pillai, V. K., Pillai, P. P., Vijayakumaran, M., & Balachandran, V. K. (1982). Environmental characteristics of the seasonal and perennial prawn culture fields in the estuarine system of Cochin. Proc Symp Coast Aquacult, 1: 368-382.
6. Ignatiades, L., Vassiliou, A., & Karydis, M. (1985). A comparison of phytoplankton biomass parameters and their interrelation with nutrients in Saronicos Gulf (Greece). Hydrobiologia, 128(3), 201-206.
7. Dai, J., Wu, S., Wu, X., Lv, X., Sivakumar, B., Wang, F., ... & Zhu, S. (2020). Impacts of a large river-to-lake water diversion project on lacustrine phytoplankton communities. Journal of Hydrology, 587, 124938.
8. Zhang, Y., Gao, W., Li, Y., Jiang, Y., Chen, X., Yao, Y., ... & Chen, Y. (2021). Characteristics of the phytoplankton community structure and water quality evaluation in autumn in the Huaihe River (China). International Journal of Environmental Research and Public Health, 18(22), 12092.
9. Prescott, G. W. (1954). How To Know The Freshwater Algae. (Ed. H. E. Jaques) WMC Brown Company Publishers. IOWA. 272.
10. Sampathkumar, P., & Ananthan, G. (2007). Phytoplankton. In: Coastal Biodiversity in Mangrove Ecosystems, UNU-INWEH-UNESCO-International Training Course Manual. 205-212.
11. S Kumar, C. S., & Perumal, P. (2012). Studies on phytoplankton characteristics in Ayyampattinam coast, India. Journal of Environmental Biology, 33(3), 585.
12. McKibben, S. M., Schollaert Uz, S., & Palacios, S. L. (2024). Testing a hyperspectral, bio-optical approach to identification of phytoplankton community composition in the Chesapeake Bay estuary. Earth and Space Science, 11(5), e2023EA003244.
13. Niu, Y., Shen, H., Chen, J., Xie, P., Yang, X., Tao, M., ... & Qi, M. (2011). Phytoplankton community succession shaping bacterioplankton community composition in Lake Taihu, China. Water research, 45(14), 4169-4182.
14. Kramer, S. J., Siegel, D. A., & Graff, J. R. (2020). Phytoplankton community composition determined from co-variability among phytoplankton pigments from the NAAMES field campaign. Frontiers in Marine Science, 7, 215.
15. Vernet, M., & Lorenzen, C. J. (1987). The presence of chlorophyll b and the estimation of phaeopigments in marine phytoplankton. Journal of plankton research, 9(2), 255-265.
16. Volkman, J. K., Jeffrey, S. W., Nichols, P. D., Rogers, G. I., & Garland, C. D. (1989). Fatty acid and lipid composition of 10 species of microalgae used in mariculture. Journal of experimental marine biology and ecology, 128(3), 219-240.

17. Qiao, L., Chang, Z., Li, J., Chen, Z., Yang, L., & Luo, Q. (2019). Phytoplankton community structure and diversity in the indoor industrial aquaculture system for Litopenaeus vannamei revealed by high-throughput sequencing and morphological identification. Aquaculture Research, 50(9), 2563-2576.
18. Roubeix, V., Danis, P. A., Feret, T., & Baudoin, J. M. (2016). Identification of ecological thresholds from variations in phytoplankton communities among lakes: contribution to the definition of environmental standards. Environmental monitoring and assessment, 188(4), 246.
19. Yang, R., Fan, X., Zhao, L., & Yang, K. (2023). Identification of major environmental factors driving phytoplankton community succession before and after the regime shift of Erhai Lake, China. Ecological Indicators, 146, 109875.
20. Huang, Y., Shen, Y., Zhang, S., Li, Y., Sun, Z., Feng, M., & Zhang, W. (2022). Characteristics of phytoplankton community structure and indication to water quality in the lake in agricultural areas. Frontiers in Environmental Science, 10, 833409.
21. Fragoso, G. M., Johnsen, G., Chauton, M. S., Cottier, F., & Ellingsen, I. (2021). Phytoplankton community succession and dynamics using optical approaches. Continental Shelf Research, 213, 104322.