

# Report on Phytoplankton from the In-front Pond of the University of Barishal, Bangladesh

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**Abstract:** A total of 34 taxa belongs to four different division i.e Chlorophyta, Chrysophyta, Cyanophyta and Euglenophyta have been worked out in this present investigation. The algal division Chlorophyta contains a plant body with unicellular, colonial, filamentous, membranous and tubular types, and cells are mostly unicellular as well as multinucleate (coenocytic). In Chrysophyta division, cells are solitary or united in colonies, flagellated or non-flagellated, and the colonies are definite in shape. The observed cells from Euglenophyta division were motile, unicellular, rarely colonial, lacking true cell wall, naked or loricate, with one to two or rarely four apical flagella. While working on these plankton samples, the authors observed a number of fascinating species that were challenging to identify. The report has no new records, thus all of the listed taxa were previously published in a series of articles by different authors and from different locations of Bangladesh. The phytoplankton list will help for further assessment of the water quality and overall biodiversity of the pond.

**Keywords:** Barishal University, Freshwater reservoir, Algae, Euglenophyta, Biodiversity.

The University of Barishal (BU) is located at Kornokathi of Barishal Sadar upazila, and adjacent to the Patuakhali-Dhaka highway. The location of the university is a part of south-central area, with many natural water resources, of Bangladesh. However, as a newly established university (Established at 2011), the ponds within its boundary are not very old enough to hold biodiversity rich profile (University Website). The university has three ponds, and among them the in-front one is largest and located at the right corner from the entrance to the university (Fig.1).

Tracking the water quality, pollution events, biodiversity of living organisms within a water reservoir

and regular monitoring are very important issues nowadays (1). To monitor or regular track of water quality of an aquatic ecosystem, it is crucial to measure its water physico-chemical properties and also the living organisms (2,3). Phytoplankton are the base for any aquatic ecosystem because of their photosynthetic capacity and their roles as primary producer. Moreover, they have been using as a bio-indicator to monitor water quality as a part of health of an aquatic ecosystem (4). Moreover, the authors also reported that the changes in aquatic ecosystem can affect the cell morphologies of freshwater phytoplankton by laboratory based assessment (5,6). No prior reports have been found on phytoplankton communities from the university ponds. Although several reports have been found from nearby water resources, but mostly the reports are on water quality assessment and hydroponic farming using potentiality (7–9). In case of Bangladesh, a series of publications was recently published on phytoplankton from various resources and locations, and the reports also covered the illustrations of many of the recorded taxa (10–13).

However, the authors previously reported the phytoplankton communities along with their diversity from the freshwater reservoirs from Barishal city area and nearby river (14,15). Now it is necessary to know the present status of phytoplankton profile of this pond as an first step to tack the health of aquatic ecosystem.

## MATERIALS AND METHOD

### Study Area and Season

The in-front BU pond was taken for counting phytoplankton species, and the details of the location mentioned in figure 1. The study was conducted at the Plant science laboratory at the University of Barishal, Bangladesh during November to December in 2021, winter season.



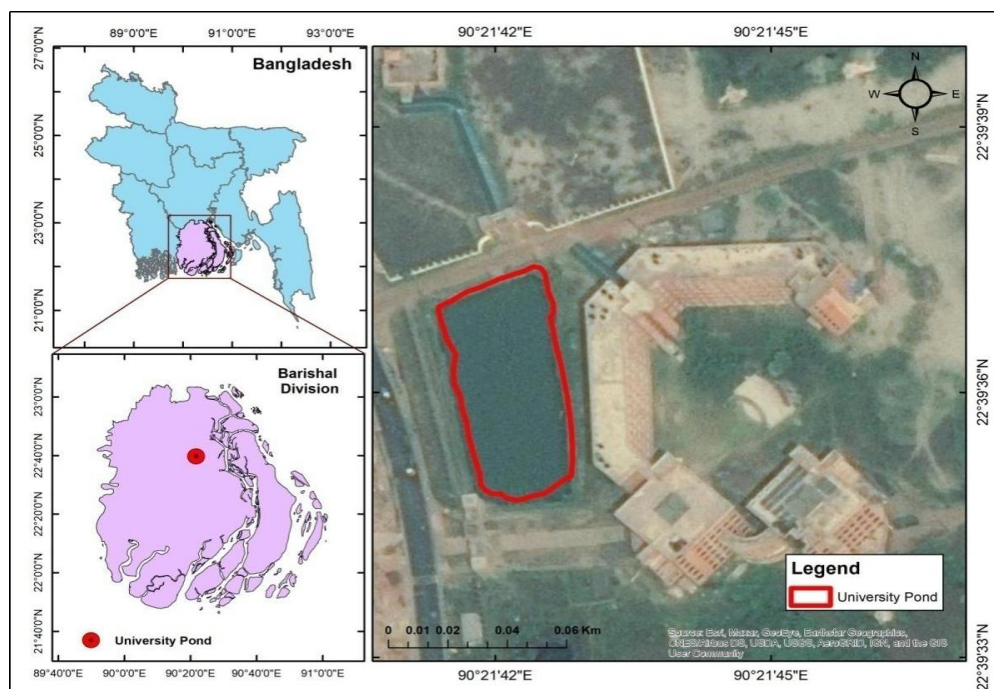
## Sampling Details

Water samples were collected through eight different point of the pond during morning 8.30 to 10.30 am, then the samples had been mixed properly. Water temperatures of these sampling locations were varied from 20-24°C and pH ranges from 6.9-7.9 in pH scale. Phytoplankton was collected by sedimentation technique with lugol's solution (5ml/1 L). At first around 400 ml of well mixed water sample taken into a transparent pyrex beaker and required amount of lugol's solution added into sample. The lugol's solution mixed with the sample carefully. The beakers closed with foil paper and kept in dark condition for 24

hours for sedimentation. Then overlaying water was removed from the upper layer and sediment layer was kept undisturbed for further study.

## Data Analysis

The microscopic study was performed with Olympus CH30 (Japan) and the photographs were taken by using a digital camera (Euromax) equipped with microscope. Finally, the number, cell size and shape were counted by using the recorded photograph on image processing program. Taxonomic identification and grouping was done according to authentic literatures (16–20).



**Fig.1.** Location of study area (Satellite View). Inset view indicates the position within Bangladesh

## RESULTS AND DISCUSSION

An illustrated account of species of together with their detailed description of taxonomic features is given and discussed. Photograph of the all listed taxa are presented in the following text (Fig.2-6).

**Division: Chlorophyta; Class: Chlorophyceae**  
**Order: Chlamydomonales**  
**Family: Chlamydomonadaceae**

*Carteria radiosia* Korshikov

The cells are spherical with thick and prominent wall, papilla present. Massive cup shaped, lobbed chloroplast, a

central large pyrenoid present. They are approximately 8-18  $\mu\text{m}$  long with 8-12  $\mu\text{m}$  broad. The species was reported from Pirojpur district, and the previously reported description is align with the current calculated results (21).

**Family: Chlorococcaceae**

*Tetraedron regulare* (Reinsch) Hansgirg

The shape of the cells are almost like tetragonal, pyramidal type with varying borders. Also like angle shape, and wall thickness present. Angles formed to form stout lobes with a single stout spine that are narrowly rounded. The previous report on cell diameter was 50  $\mu\text{m}$  broad by 50-60  $\mu\text{m}$  long (22).

**Order: Chlorellales ; Family Oocystaceae**

*Ankistrodesmus bernardi* Komárek

The species of *Ankistrodesmus* reported from Pirojpur district in Bangladesh. This is reported as colonial algae, a single colony of 2-8 cells bound together. This are characterized by narrow, elongated, thin, ends pointed. Length of cell may be 30  $\mu\text{m}$  and 0.8  $\mu\text{m}$  broad. Colony with many algal cells showed 40.67  $\mu\text{m}$ .

*Monoraphidium fontinale* Hindák

Cells are solitary with an extended spindle that is nearly straight to moderately curved, with pointed ends. The cell wall is smooth and hyaline also. Moreover, the observed chloroplast is close to the cell wall, but there is no pyrenoid as they reported. They are 20  $\mu\text{m}$  long and 5  $\mu\text{m}$  wide, that exactly match with the earlier report (21).

*Planktosphaeria gelatinosa* Smith

Cells are already reported as spherical in shaped and are encased in a large, colorless, homogeneous hyaline wrap in microscopy (23). They are solitary at first, but eventually form colonies observed by other previous report (23). Usually continuous in colony cells, and young cells have a single chloroplast that is cup-shaped. Chloroplasts in adult cells are polygonal, flattened, and parietal. Pyrenoid is a kind of pyrenoid. Cells with a diameter of 5.5 to 23  $\mu\text{m}$ .

**Order: Chlorococcales; Family: Coelastraceae***Actinastrum hantzschii* Lagerheim

Almost 4-9 oblong cells were organized in a colony. The cells has a massive central pyrenoid and they were 15-22  $\mu\text{m}$  long and 2-3  $\mu\text{m}$  wide in diameter. Their distribution reported in freshwater ecosystem is early winter mixing (May) through late spring, and this species was quantitatively significant in October. Also reported a central point in cells with extend outwards. A single pyrenoid and a single chloroplast ribbon as a signification identifying character is previously reported (24,25).

**Family: Hydrodictyaceae***Pediastrum simplex* Meyen Lemm

In average, 8-16-32 celled colonies are common. They present, with or without holes smooth or finely, punctuated cell walls. High regulation microscopy showed that inner cells have 5 or 6 sides, whereas peripheral cells have an expanded free wall that forms a single tapering horn-like projection with convexe borders according to microscopic observation. Cells are 6-15  $\mu\text{m}$  wide and 14-22  $\mu\text{m}$  long.

*Pedisastrum duplex* var. *Gracillimum* Meyen

According to literature the cells have smooth cell wall with tiny holes peripheral cells are quadrate, with the outer face expanded into two tapering, blunt-tipped processes, with the distance between processes of one cell being about half that of adjacent cells. Inner cells separated by lens shaped interstices. They form colony of 8-128 cells and a diameter of up to 182  $\mu\text{m}$  normally (22,24,26).

**Order: Sphaeropleales; Family: Scenedesmaceae***Coelastrum microporum* Naegeli

Eight or more tightly packed cells consist colonies with spherical shape. The cells linked with other cells showing a center inclusion that looked like a pyrenoid. In the spring bloom, the colonies had an average cross-sectional diameter of 19  $\times$  11  $\mu\text{m}$  and were the biomass dominants in September to November (24).

*Scenedesmus armatus* Smith

Individual cells looking oblong-ellipsoid shape. They have median incomplete longitudinal ridge, and also have terminal cells with a single, long, generally curved spine at each pole. The colony consist of 2-8 cells in a single, partially altering manner. The cells are 4  $\mu\text{m}$  wide and 12-13  $\mu\text{m}$  long. The similar data regarding this species also reported earlier (22).

*Scenedesmus regularis* Svir.

The taxon form colony, and 2-8 fusiform cells grouped in a single sequence in a colony. Articulate cells have dramatically tapered ends or apices. Cells possess smooth cell walls. The measured diameter was 2-11  $\mu\text{m}$  broad and 11.5-22  $\mu\text{m}$  long cells. Previous record are available of this species (22,26).

**Order: Desmidiiales; Family: Closteriaceae***Closterium archerianum* Anonym.

The counted cells are 126  $\mu\text{m}$  long with median diameter 11  $\mu\text{m}$ . It is strongly curved algae and lives as solitary. They don't form colony. In microscopic observation, their cell shape and size was variable sometimes. Previously from Bangladesh, it was reported from Gazipur and Chittagong district, but no report was found on the availability in Barishal University campus (28).

*Closterium pritchardianum* Archer

The majority of the cells are thin and narrower than usual. The taxon also lives in solitary and the cell diameter

counted as approximately 118-12 $\mu$ m. It is found in different habitat around the world; but in case of Bangladesh, it was reported from Maulvibazar district (29).

*Closterium ehrenbergii* Meneghini

It is one of the common desmid species in Bangladesh. Like other *Closterium* sp, this taxon don't form any colony. They are unicellular algae with bowed cells, slightly tumid in mid region and semi-cells not conspicuously conical. Cells are averagely 310  $\mu$ m long and 55  $\mu$ m broad. The species was found in Gazipur, Bandarban, Cox's Bazar and Maulvi Bazar (32).

*Closterium setaceum* Ehrenberg

The cells are looking like nearly straight, thin, and fusiform. It was earlier reported as about 30 times the length of the breadth as comparison. The report also said setae are inwardly curled towards apices and are distinctly and symmetrically enlarged in the mid area, tapering abruptly into long, straight setae (33). The authors observed poles are rounded narrowly and truncately. Approximately, 3 to 5 costae present on a wall. Cells are 305  $\mu$ m long on average.

*Closterium limneticum* Lemm.

Cells are solitary, green and morphologically almost similar with the other *Closterium* sp. The cells are crescent-shaped, and the measured diameter was 150  $\times$  7  $\mu$ m. The other identifying characters also aligned with the previous report (34).

*Closterium kuetzingii* Brebisson

Straight cells present a fusiform-lanceolate mid region. The dorsal and ventral borders of the cells were almost similar in convexness. The apical regions of cells were suddenly attenuated to form setaceous type. Apices appear as somewhat curvy, but the poles are rounded. The cell wall is generally brownish striated, with 7-10 stare in every ten cells with thickened inner walls. The authors observed 4-7 pyrenoids present in chloroplast of each cells.

**Order: Desmidiiales; Family: Desmidiaceae**

*Cosmarium auriculatum* Reinsch

Medium-sized, subcircular cells that are roughly as long as they are wide or somewhat wider than they are long. The sinus is moderately constricted and narrowly linear, yet it opens outward. Pyramidal-semicircular or truncate-pyramidal semicells with rounded basal angles and four tiny conical spines. The apex is rounded truncately.

Sparsely scorbiculate-punctate on the wall. Cells are 45-50  $\mu$ m long (29,32).

**Division: Chrysophyta; Class: Bacillariophyceae  
Order: Bacillariales; Family: Bacillariaceae**

*Nitzschia acicularis* (Kützing) W.Smith

The cells size and shape are variable. They form colony and also found as solitary in the surveyed pond. Valve spindle-shaped was long with tapering ends. Moreover, frustules were 65-75  $\times$  2-5  $\mu$ m in diameter. Striae Present and long up to 12  $\mu$ m.

**Order: Melosirales; Family: Melosiraceae**

*Melosira distans* (Ehrenb.) Kütz.

Cells are solitary, long straight. Drum-shaped cells are linked together to form a short chain. The diameter was unclear during the study, because of high variability in size and shape during counting.

*Melosira granulata* var *angustissima* (O. Müll.) Simonsen

The filament is straight. Cells are long and cylindrical, with a sulcus visible, but no apparent wall markings. Approximately, the cells were 5-8  $\mu$ m broad by 25-28  $\mu$ m long. There were no marginal teeth identified during microscopic observation.

**Order: Naviculales; Family: Naviculaceae**

*Navicula radiosa* Kützing

Valves were found symmetrically longitudinal and transversely with lanceolate apices. The blunt apices also observed by previous reports with 2-3 chromatophores. Cells were found same size and shape that also matched with previous records, which was 60  $\times$  7-8  $\mu$ m in diameter (36,37).

**Class: Conjugatophyceae; Order: Desmidiiales  
Family: Desmidiaceae**

*Staurastrum volans* West & G.S

Desmid present with two semi-cells, each with a short or long arm-like process. The patterns of their arrangement look like with an array of ridges or spines and orientated radially around the cell, divided by a deep midline constriction or isthmus that was also recorded previously (38). The calculated diameter of the cells are 21-25  $\mu$ m  $\times$  22-257 $\mu$ m in diameter.

**Order: Cymbellales; Family: Cymbellaceae**

*Cymbella turgidula* Grunow

The frustules were elliptic lanceolate shape, and significantly asymmetric appearance. The taxon also recorded with convex margin, ends more or less capitates along the cells (29,30). The cells are 38-40  $\mu\text{m}$  long with 12-15  $\mu\text{m}$  wide.

**Division: Euglenophyta; Class: Euglenophyceae**  
**Order: Euglenales; Family: Euglenaceae**

*Euglena oblonga* Lemm.

The species possessed spindle cells that are round, extended oval, or ellipsoidal and have a constricted anterior to closed end. The posterior end of maximum cells were abruptly narrowed and became blunt. Each cell measured as 72  $\mu\text{m}$  long and 20  $\mu\text{m}$  broad. It was recorded as thick and spirally looking periplast that was also striated (10).

*Euglena limnophila* Lemm.

The cells were bent and spindle-shaped with front constricted to a rounded end. The back of the cells were abruptly constricted to abrupt peak. The cells were 38  $\mu\text{m}$  long and 8  $\mu\text{m}$  broad in diameter (10).

*Euglena rostrifera* Johnson

The cells possessed anterior end narrowed to a blunt point and the posterior tapered to an abrupt long peak. They also forming a spindle or top shape. Cells were counted with a length of 100-105  $\mu\text{m}$  and a width of 23-25  $\mu\text{m}$ .

*Euglena spathirhyncha* Skuza

According to report, the cells featured an extended spindle, were extremely metabolic, and had a long neck-like anterior end that gradually narrowed to a sharply pointed posterior end, as well as a bulging mid area. The mid-

section is nicely sculpted during the metabolic period. Cells measure 53-120  $\mu\text{m}$  in length and 13-28  $\mu\text{m}$  in width. The flagellum is around 38 meters long, that matched with this survey result (10).

**Order: Euglenales; Family: Phacaceae**

*Lepocinclis sphagnophila*

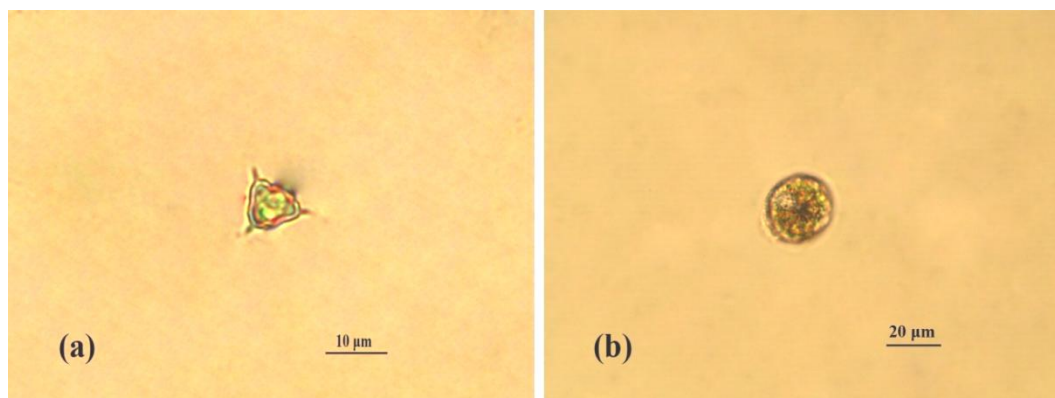
They live solitary, no colonial structure had not been found. The cells measure 18  $\mu\text{m}$  long and 10  $\mu\text{m}$  broad. Paramylon bodies were four, plate-like in appearance, with two on each side as earlier report. The cells were oval to fusiform in shape, with a blunt apex at the center and a gradual narrowing of the posterior end to a short pointed caudus (11).

*Lepocinclis playfairiana*

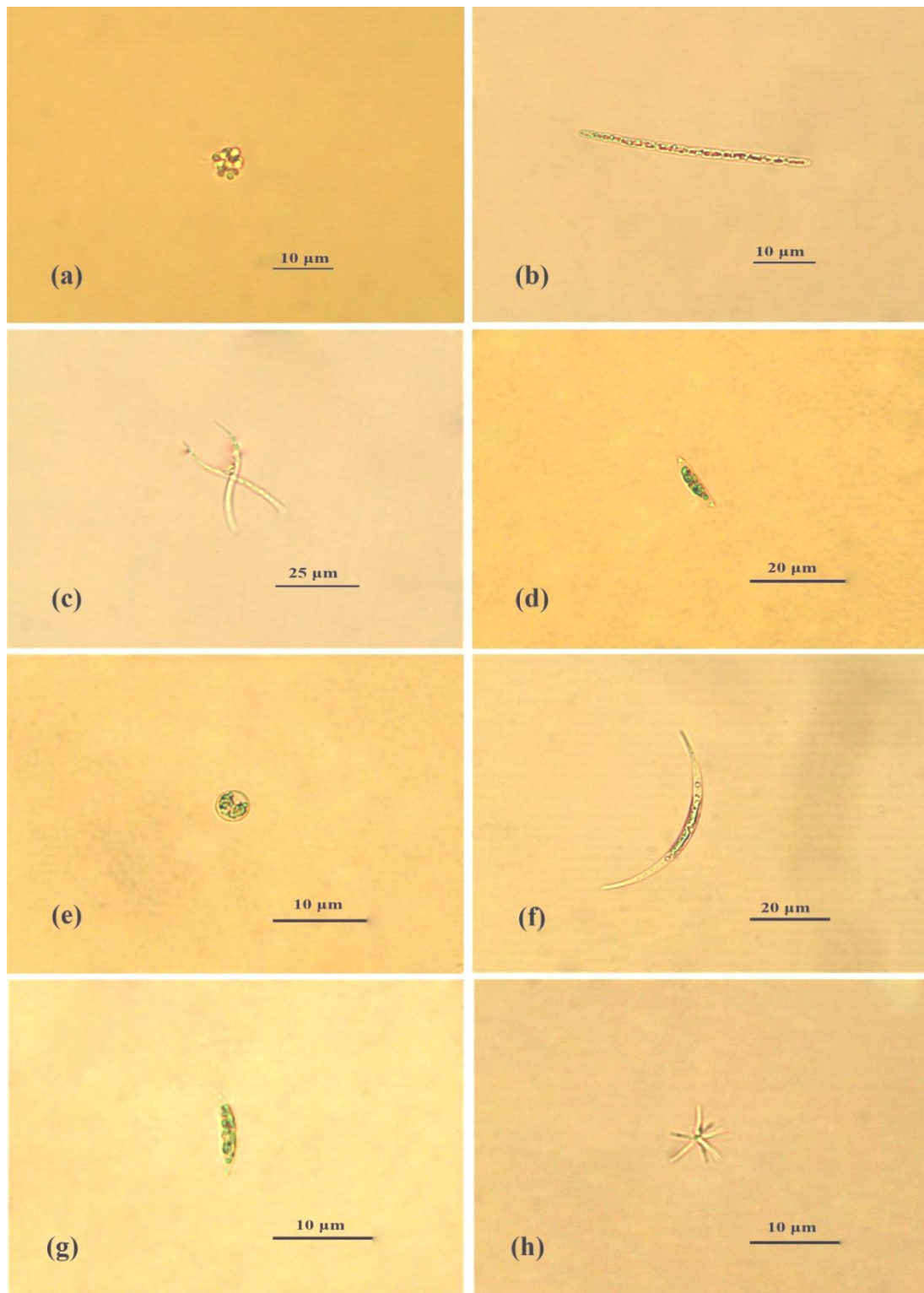
According to report, the cells are generally oval, with a short, constricted caudus and a strongly rounded front surface. Attachment of the gullet and flagellum is lateral to the apex, and the periplast is fine and smooth. Paramylon has two rings, either round or oval That was exactly same in this survey (39). The cells were 40  $\mu\text{m}$  long and 30  $\mu\text{m}$  broad.

*Lepocinclis ovum* var *butschii*

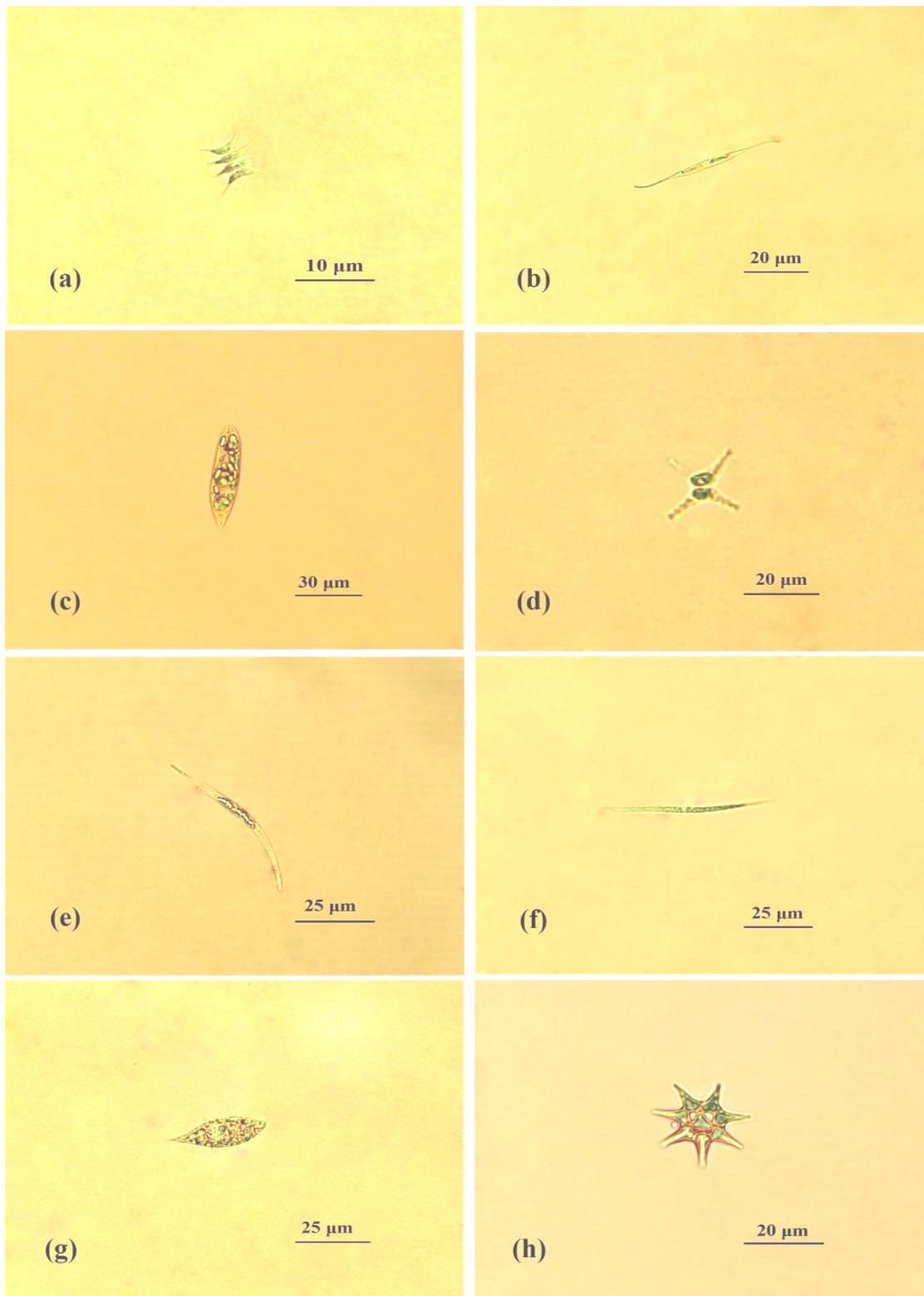
Cells were 30-35  $\mu\text{m}$  length and 18-20  $\mu\text{m}$  wide. Cells were solitary and no formation of colony observed. The body is oval, with a thin anterior end present. Moreover, a bi-lobed appearance was appeared. Discoid type chloroplast present.



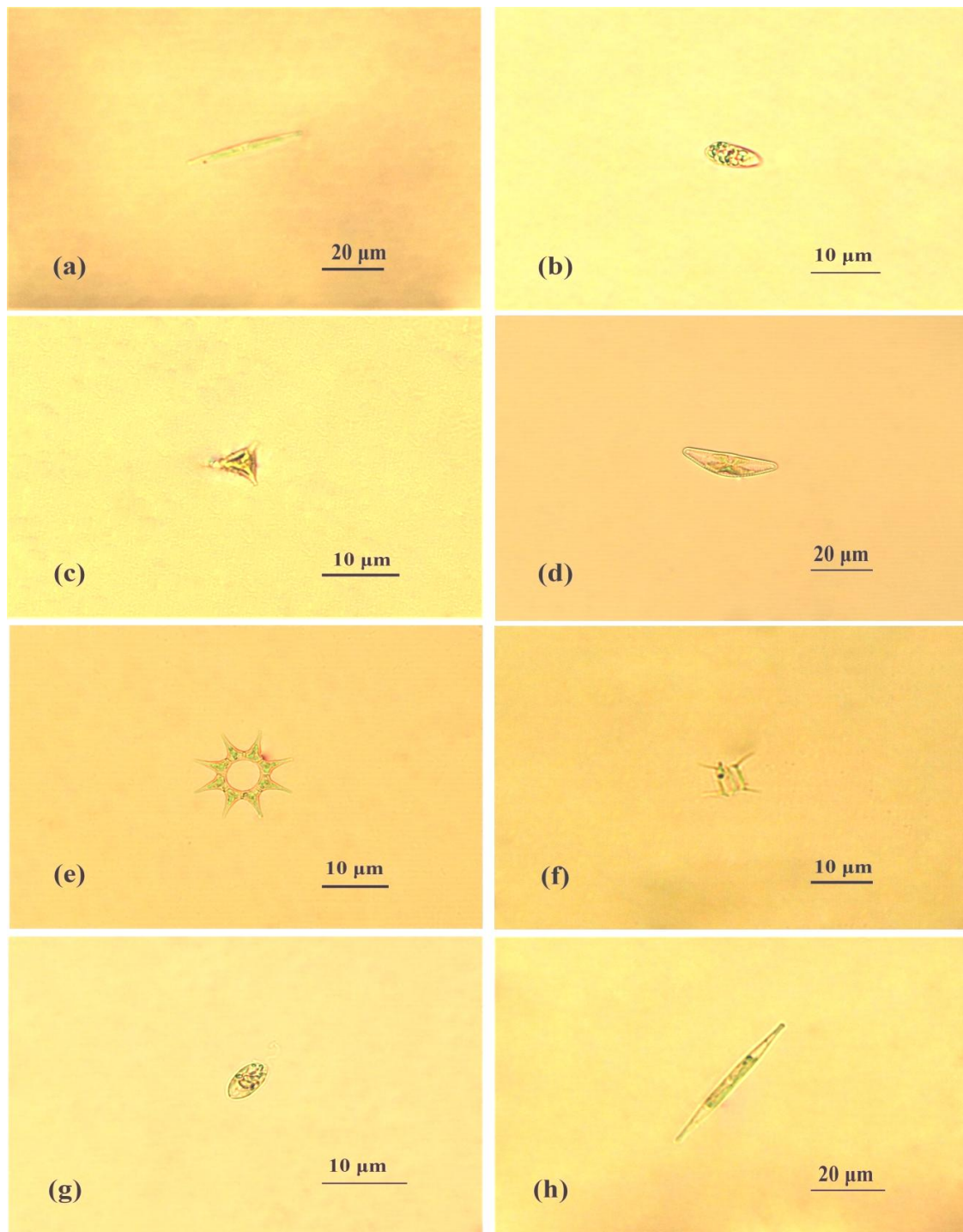
**Fig.2.** a) *Tetradron regulare*, b) *Planktosphaeria gelatinosa*.



**Fig.3.** a) *Coelastrum microporum*, b) *Anabaenopsis raciborskii*, c) *Ankistrodesmus barnardi*, d) *Closterium ehrenbergi*, e) *Carteria radiosa*, f) *Closterium archerianum* var. *archerianum*, g) *Closterium pritchardianum*, h) *Actinastrum hantschii*.

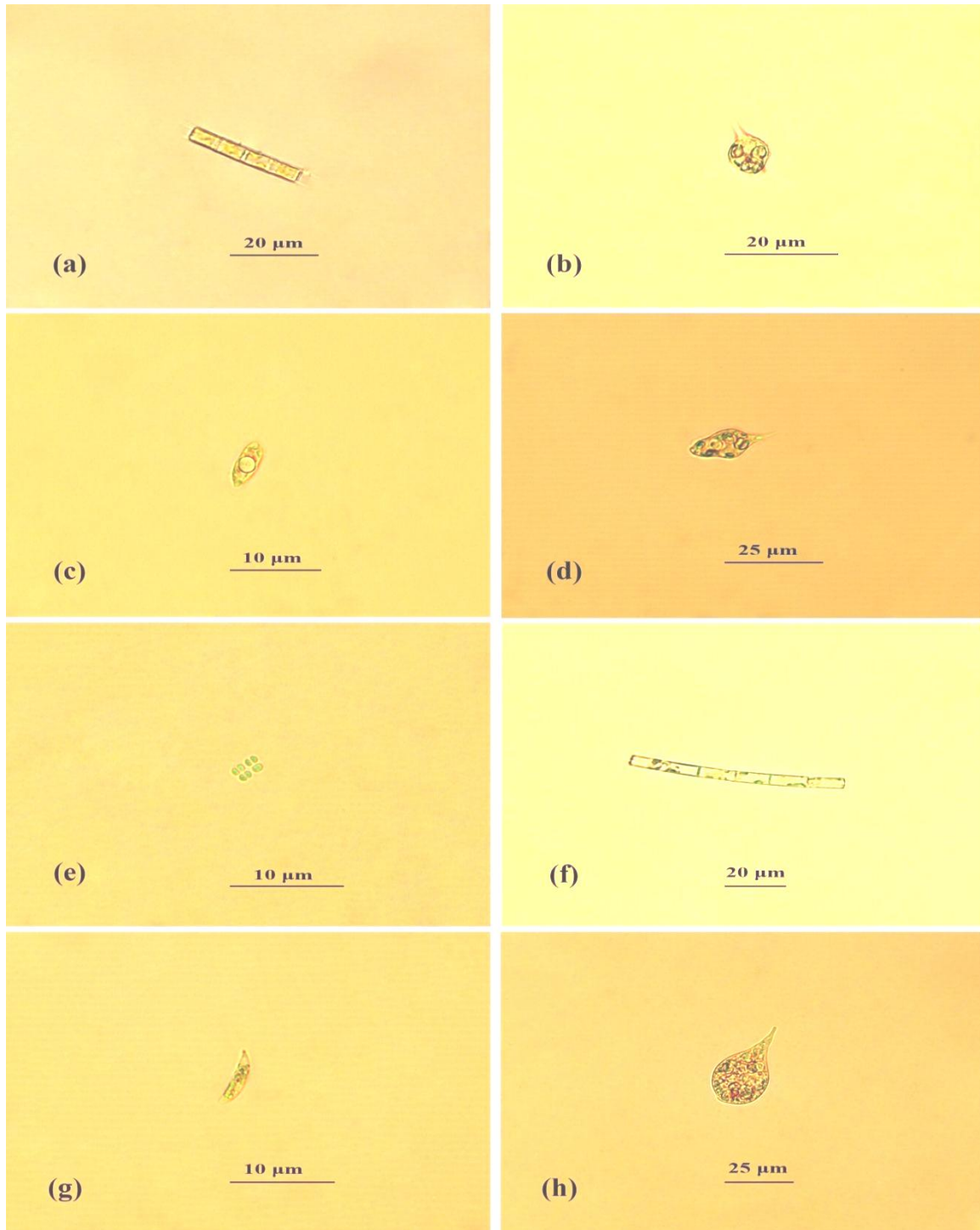


**Fig.4.** a) *Scenedesmus regularis*, b) *Closteriopsis longissimi*, c) *Euglena limnophila*, d) *staurodesmus volans*, e) *Closterium limneticum*, f) *Closterium kuetzingii*, g) *Euglena Oblonga*, h) *Pediatrum duplex var. gracillimum*.



**Fig.5.** a) *Navicula radiosa*, b) *Lepocinclis playfairiana*, c) *Euglena limnophila*, d) *Staurastrum longispinum*, e) *Padiastrum simplex*, f) *Scenedesmus armatus*, g) *Lepocinclis sphagnophia*, h) *Nitzschia acicularis* var. *closterioides*.





**Fig.6.** a) *Melosira distans*, b) *Euglena rostrifera*, c) *Lepocinclis ovum*, d) *Euglena spathirhyncha*, e) *Merismopedia glauca*, f) *Melosira granulata* var. *angustissima*, g) *Monoraphidium fontinale*, h) *Lepocinclis ovum* var. *butschii*.

**Division: Cyanophyta; Class: Cyanophyceae;  
Order: Nostocales; Family: Aphanizomenonaceae**

*Anabaenopsis raciborskii* Wolosz

The cells were filamentous short, solitary, free floating, mostly straight, sometimes slightly curved, never coiled, 40-135 µm long. Cylindrical cells were with or without cross-wall constriction in general. Cells are blue green in colour, sometimes reddish, granular, cell 2-5 µm wide.

**Family: Chroococcaceae**

*Merismopedia glauca* (Ehr.) Naegeli

The taxon form small to large colonies with 16-64-128 hemispherical cells. They sometimes would be larger, and colony 50-150 µm broad in this survey. The color was blue to deep blue green in cells. Shape was variable from rounded to oval, ellipsoidal and densely clustered sometimes under microscope.

The reported all taxa are previously reported (10,11,17,21-39). Some of them were confusing during identification due to their variable morphologies under microscope.

## CONCLUSION

In this study, the algal flora of Barishal University pond has been studied for the first time and the species recorded in this investigation are first time records for this campus. This present research gives more details about the algal variations of this area and will be useful in the upcoming period for limnological research for this pond.

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## CONFLICT OF INTEREST

This article has no conflict of interest.

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#### AUTHOR(S) CONTRIBUTION

Shaswati Chakraborty and Dipalok Karmaker performed this survey research and prepared the manuscript. Riyad Hossen plan the research, edited and corresponding the manuscript.

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