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FLORISTIC COMPOSITION OF PLANKTON IN SHITALAKHSYA RIVER, NARAYANGANJ, DHAKA

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Key words: Phytoplankton flora, River Shitalakhsya, Chlorophyta, Bacillariophyta, Euglenophyta

Abstract

Information of phytoplankton flora of polluted river ecosystems of Bangladesh are scanty. The present study was undertaken to explore the phytoplankton flora at Dakshin Rupshi Station of the river Shitalakhsya, Narayanganj, Dhaka. The study was carried out from May 2017 to March 2018 by collecting pelagic plankton samples bimonthly. A total of 53 species under 36 genera were identified, of which 51 species have been illustrated through photomicrographic images and listing. Two species of phytoplankton namely, *Pyrobotrys incurva* Arnoldi and *Phacus ranula* Pochmann were identified from the river water but could not be produced here. The recorded algal divisions of phytoplankton are Cyanophyta (6), Chlorophyta (19), Euglenophyta (13), Chrysophyta (13) and Pyrrhophyta (2). The standing crops presented by each division are: 463.5, 428.33, 199.67, 664.33 and 26.25×10^3 ind/l by Cyanophyta, Chlorophyta, Euglenophyta, Chrysophyta and Pyrrhophyta, respectively. The trend in contributing the number of species is Chlorophyta > Euglenophyta and Chrysophyta > Cyanophyta > Pyrrhophyta. For standing crop, the trend is Chrysophyta > Cyanophyta > Chlorophyta > Euglenophyta > Pyrrhophyta. Pollutant loading from the urban sources actually cuts the penetration of light into the upper part of the river water and thus creating a shrinking environment for the survival of phytoplankton. The present floristic study of phytoplankton of the River Shitalakhsya adds knowledge to the species composition and their systematic position which would be helpful for any further floristic study of phytoplankton on the river ecosystems of Bangladesh.

Introduction

In river ecosystems, species composition i.e., quality and quantity of phytoplankton determines the flora in free moving water. Though their hydraulic residence time in a flowing river is very short and unstable, they keep on synthesising carbohydrate in presence of sunlight utilising free CO_2 sources present in water. This process is vital for the pelagic grazing food chain as well as to serve as an indicator to the trophic state of

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any river[1]. The phytoplankton of river is also termed as potamoplankton[2] and in Limnology though a number of studies related to quantitative aspects of this specialized community has been worked out there exists a little information in its floristic composition. Whitton[1] and Reynolds[2] highlighted some generic occurrences of potamoplankton in some rivers but truly floristic composition of river phytoplankton has still been neglected.

Bangladesh is the country of rivers having a total length of 24,140 km[3]. Phytoplankton of rivers do play a great role in operating grazing food chain. But which kinds of phytoplankton do dominate our river ecosystem is mostly unanswered? Islam and Haroon[4] and Islam and Zaman[5] carried out the floristic work on the phytoplankton of the river Buriganga near Dhaka in mid-seventies. The river was little polluted then and the recorded number of coccoid, unicellular, colonial and filamentous cyanobacteria, diatoms, desmids and chlorococcoid algae from the planktonic flora of the river were rich. Not much significant research work had been carried out on the floristic composition of running water plankton in Bangladesh. Apart from this, Islam and Aziz[6] had carried out another floristic study on the Karnaphuli river estuary and recorded the occurrences of cyanobacterial flora, diatom, euglenoid, and chlorococcoid forms of plankton. Recently, some research works on potamoplankton biomass, primary productivity, and periodicity in relation to water quality of some peripheral rivers of Dhaka Metropolis had been carried out[7-11]. But still, the information on the floristic composition of phytoplankton in the water of the river Shitalakhsya, Narayanganj are scanty. The present study has therefore been undertaken to study the floristic composition of phytoplankton from a section of the river Shitalakhsya, Narayanganj.

Materials and Methods

Samples of phytoplankton from Dakhshin Rupshi Station of the river Shitalakhsya was collected bimonthly from May 2017 to March 2018. The collection was made following the sedimentation technique by using Lugol's iodine. Details of the sample collection procedure together with the morphometric features of the study side and seasonality of water quality data have been presented in Bhuiyan *et al.*[11]. After obtaining the phytoplankton concentrate via sedimentation, compound microscopy was carried out with the help of a microplankton counting chamber (Helber Microplankton Counting Chamber, Thoma Ruling, Hawksley Technology, UK) and a phase contrast compound microscope (Zeiss, Axio, Lab. A1, Germany) attached with photographic attachment (Zeiss Axiocam ERc 5s, Germany). Multicolored images of each phytoplankton species were shot at magnifications ranging from 200-400x. During microscopy, diameter of colony (col.), length and breadth of trichome (trich.), filament (fil.) and frustules (fr.), cell diameter (dia.) and length (l.) all were measured and recorded. With the help of all this data, each plankton individual was identified up to the species and/or higher taxonomic ranks by consulting various monographs, publications, and books on phytoplankton taxonomy(12-17). Helps from the national compendium, Encyclopedia of Flora and Fauna of Bangladesh were also taken for the identification of taxa(18-26). For the systematic arrangements of the collected species, the hierarchy presented by Bold and Wynne(27) was followed.

All the images of phytoplankton flora as recorded via microscopy from the samples collected from the study station of the river Shitalakhsya were presented in Figs. 1-51. Their list with some diagnostic features and the literatures used for the identification of each taxon has been tabulated in Table 1.

Results and Discussion

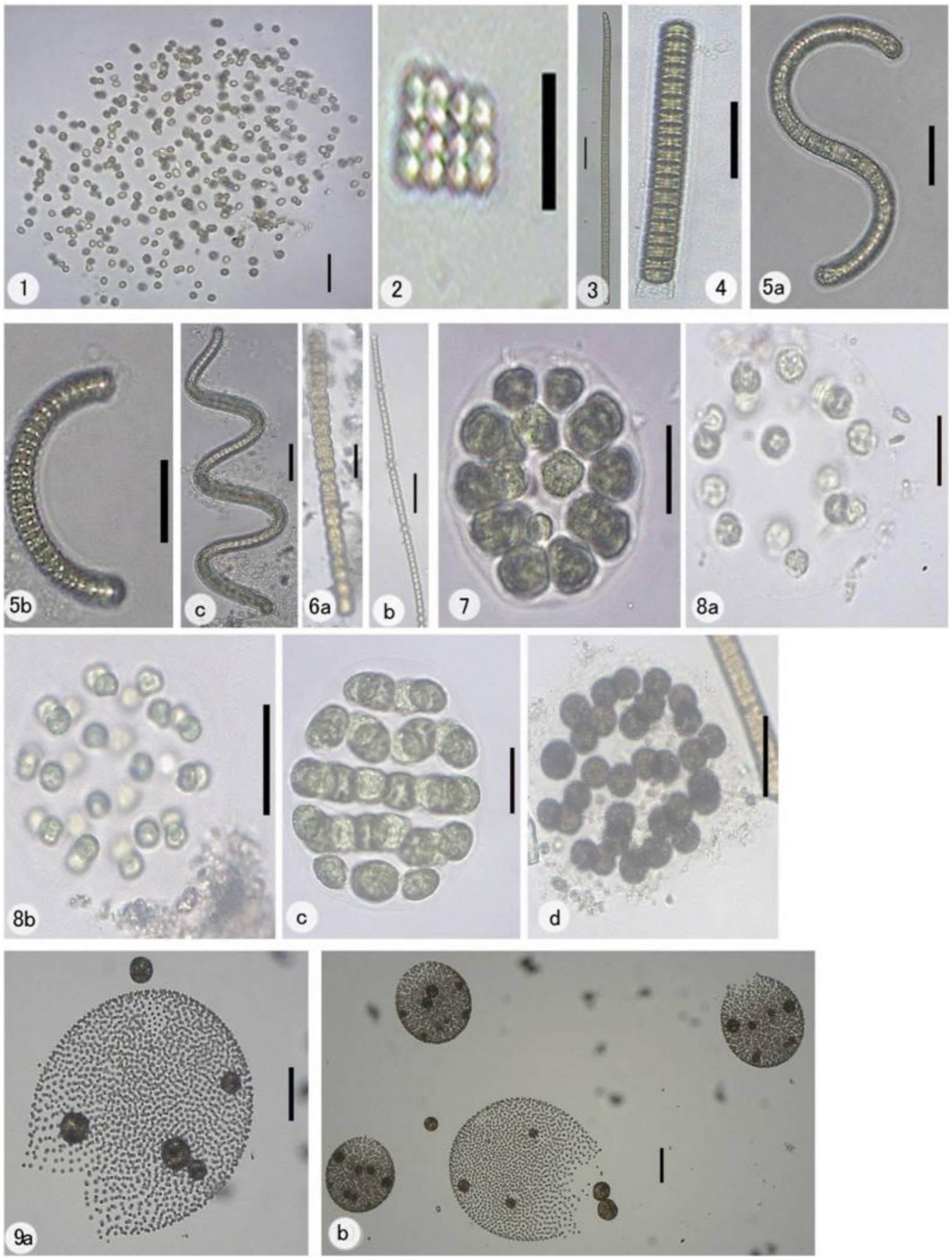
During the period of the investigation, a total of 24 phytoplankton samples were collected from the Shitalakhsya River. The recorded phytoplankton genera were 36 belonging to 5 algal Divisions. The total number of species recorded was 53, their division wise distribution is: Cyanophyta (6), Chlorophyta (19), Euglenophyta (13), Chrysophyta (13), and Dinophyta (2). The standing crops presented by each division are: 463.5, 428.33, 199.67, 664.33, and 26.25×10^3 ind/l by Cyanophyta, Chlorophyta, Euglenophyta, Chrysophyta, and Pyrrhophyta, respectively. A detail account of the population dynamics of the planktonic flora together with their relationships with water quality data have been presented in Bhuiyan *et al*.(11). Table 1 showed the list of 51 species of phytoplankton along with their morphometric features and literature sources of their identification. An illustrative account of the species has been provided in Figs. 1-51. Two species though recorded and identified from the river water but could not be produced here. Those species are: *Pyrobotrys incurva* Arnoldi and *Phacus ranula* Pochmann.

From the river Shitalakhsya, a record of 51 species in the community of phytoplankton is low. Islam and Zaman(5) obtained 194 species of phytoplankton from the river Buriganga near Dhaka Metropolis. Bhuiyan and Khondker(9) reported 30 species of phytoplankton from the River Buriganga and 22 species from the River Gomti of Cumilla. Urban sections of most of the rivers of Bangladesh have been getting heavy load with organic and metal pollutions over time. This has a severe consequence on floristic composition of phytoplankton of rivers. When the data of Islam and Zaman(5) and Bhuiyan and Khondker(9) on the Buriganga river are compared, a reduction of 84% in the species composition of planktonic flora has been observed over a period of 43 years span. Both the river Shitalakhysya and the river Buriganga are flowing through the heavily industrialized areas of Dhaka Metropolis and Narayanganj city and as a result have been exposed to strong pollution conditions. The phytoplankton species recorded for the Shitalakhsya and the Buriganga river are 51 and 30, respectively in the recent time (present study and Bhjuiyan and Khondker)(9). If 3-key water quality parameters are considered as the governing elements such as Secchi depth (Zs), Soluble reactive

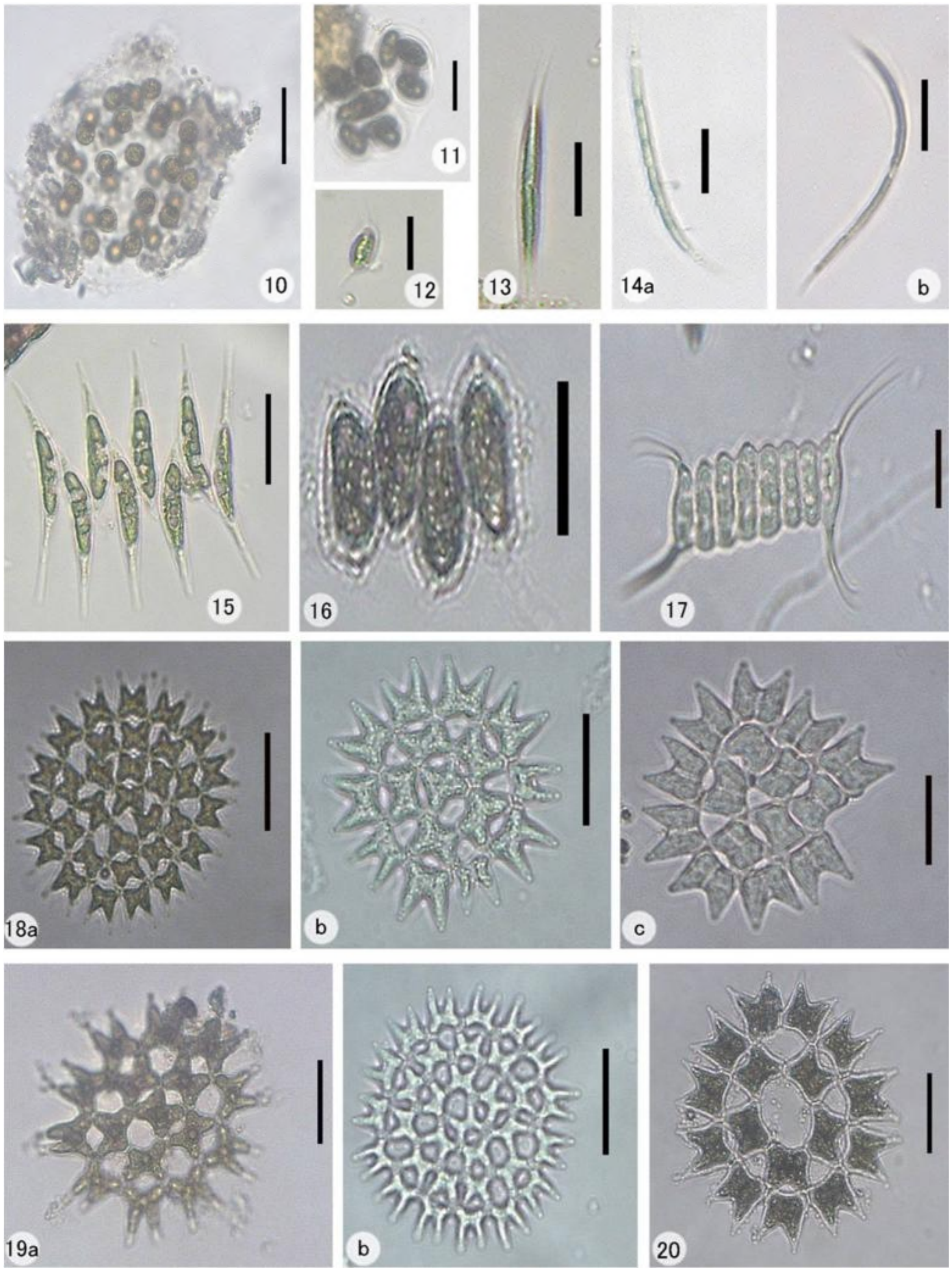
Table 1. Species list of phytoplankton from the River Shitalakhsya along with their diagnostic features and literature sources of identification.

Figs.	Species	Dimensions (µm)	References
1	*Aphanocapsa littoralis* Hansg.	col. dia. 276.8	Desikachary(27), p. 100, fig. 1
2	*Merismopedia glauca* (Ehrenb.) Naeg.	col. 15.0×10.0	Desikachary(27), p.151, fig. 5
3	*Oscillatoria formosa* Bory	trich. 301.5×12.5	Prescott(17), p. 878, fig. 10
4	*Oscillatoria subbrevis* Schmidle	trich. 125.2×15.0	Desikachary(27), p. 204, fig. 2
5a-c	*Arthrospira platensis* var. *non-constricta* (Banerji) comb. nov.	trich. 67.5 -182.5 × 10.0-17.0	Desikachary(27), p.194, fig. 1-2.
6a-b	*Anabaena fertilissima* Rao	fil. 197.5×15.0	Desikachary(27), p. 402, fig. 3
7	*Pandorina morum* (Müller) Bory	col. dia. 95	Islam(18), p. 696; Prescott(17), pl.1, fig. 63
8a-d	*Eudorina elegans* Ehrenberg	col. dia. 135 cell dia. 12.5	Ling & Tyler(12), p. 123, pl. 55, figs. 5, 6; Islam(18), p.695
9a,b	(a) *Volvox carteri* Stein (showing daughter colony inside mother colony), (b) *V. carteri* (daughter colonies released)	col. dia. 120	Islam and Zaman(5), p. 48, pl. 1, fig. 2
10	*Radiococcus wildmanii* (Schmidle) Schmidle	col. 102.5×122.5 cell 12.5	Begum(19), p.117
11	*Oocystis pusilla* Hansgirg	col. dia. 70 cell 17.5	Ling & Tyler(12), p. 101, pl. 45, fig. 4
12	*Diacanthos belenophorus* Koršikov		Begum(19), p.91
13	*Ankistrodesmus falcatus* (Corda) Ralfs	cell 80×5	Begum(19), p.588
14	*Monoraphidium mirabile* (W. & G.S. West) Pankow	cell 95×5	Ling & Tyler(12), p. 105, pl. 42, figs. 16,17
15	*Secenedesmus acuminatus* (Lager.) Chodat	col. 140.0×77.5	Ling & Tyler(12), p. 423, fig. 11
16	*S. denticulatus* Lagerheim	col. 42.5×32.5 cell 12.5	Ling & Tyler(12), p. 111, pl. 52, fig. 10
17	*S. quadricauda* (Turp.) de Breb.	col. 140×77.5 chaete 47.5 long	Begum(19), p.641
18	*P. duplex* Meyen	col. dia. 57.5×92.5	Ling & Tyler(12), p. 92, pl. 41, figs. 1,4; Prescott(17), pl.48, fig. 4
19	*Pediastrum duplex* var. *gracillimum* West & West	col. dia. 100-125 100	Ling & Tyler(12), p. 93, pl. 40, fig. 6
20	*P. duplex* var. *reticulatum* Lagerheim	100	Begum(19), p.515
21	*Pleurotaenium trabecula* (Ehr.) Naeg. var. *trabecula*	cell 215×10	Islam and Zaman(5), p. 51, pl. 4, fig. 48
22	*Cosmarium pardalis* Chon.	cell 62.5-77.5×30.0-57.5	Begum & Khondker(21), p.256
23	*C. paulii* Islam & Haroon	cell 87.5×60.0	Begum & Khondker(21), p.257
24	*Staurastrum saltans* Joshua var. *sumatranum* Scott and Prescott	cell 75×90	Nasima(25), p. 466
25	*Cyclotella comensis* Grunow in Van Heureck	dia. 12.5-17.5 striae 7.2/10 micron	Khondker & Bhuiyan(24), p. 192.

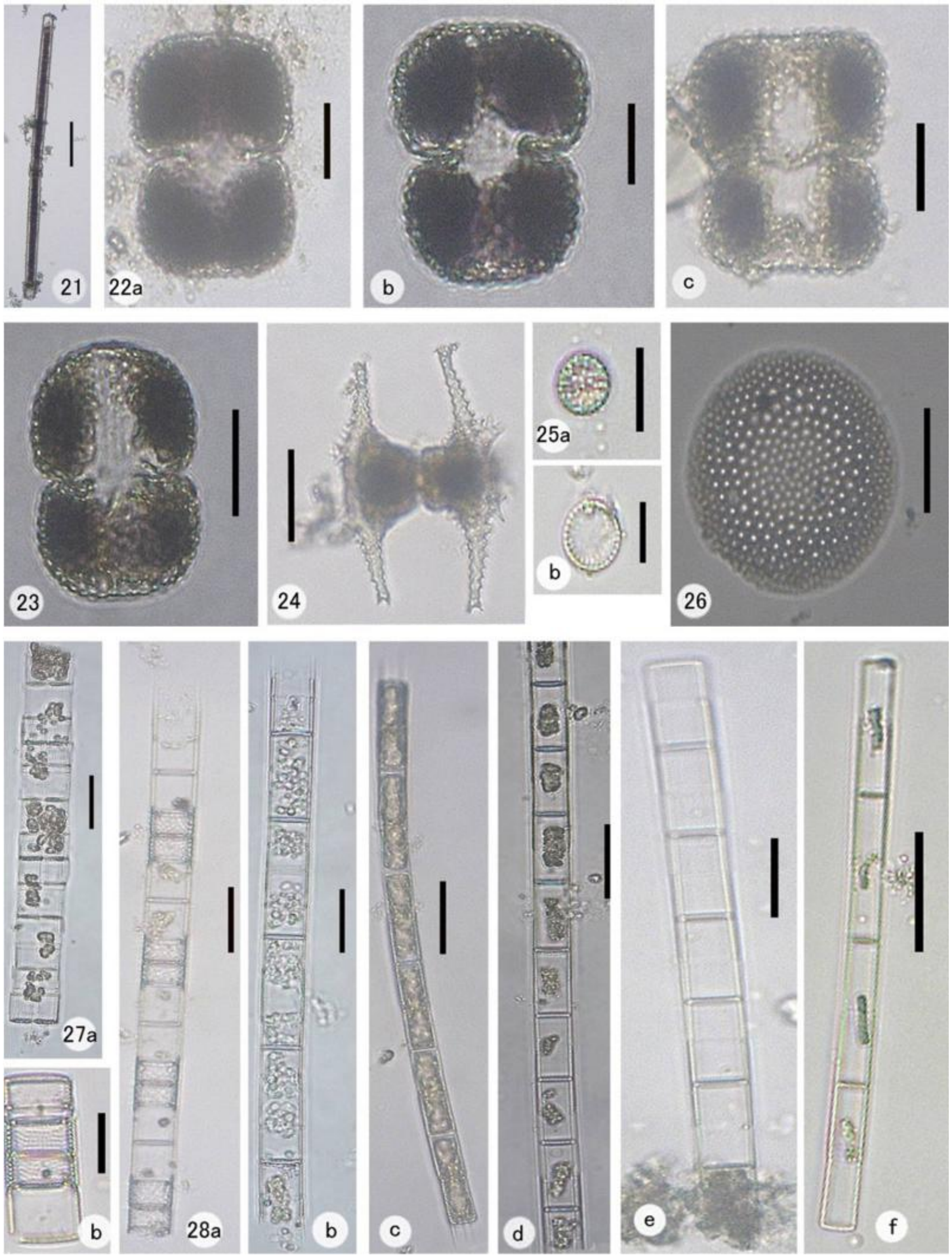
Figs.	Species	Dimensions (µm)	References
26	*Coscinodiscus excentricus* Ehr.	dia. 80	Begum[20], p. 61-62
27	*Melosira granulata* (Ehrenberg) Ralfs	chain 255×25 cell 22.4×25.0	Hustedt[16], p. 87, fig. 44
28	*Melosira granulata* var. *angustisima* Müller	chain 162.5-375.0×10.0-37.5	Hustedt[16], p. 88, fig. 45
29 32d	*Fragilaria virescens* Ralfs	chain 240×10	Germain[14], p. 68, pl. 22, fig. 1
30	*Fragilaria construens* (Ehrenberg) Grun.	chain 122.5×20.0	Hustedt[16], p. 141, fig. 135
31	*Fragilaria intermedia* (Grunow) Grunow	chain 92.5×27.5	Begum[20], p.103
32a-c, e-i	*Synedra ulna* (Nitz.) Ehrenberg	fr. 72.5-132.5×7.5-20 striae 7.2/10 micron	Begum[20], p.107
33	*Rhopalodia gibba* (Ehrenberg) O. Müll.	fr. 112.5×22.5	Hustedt[16], 390, fig. 739
34	*Gomphonema longiceps* var. *subclavata* Grun.	fr. 82.65×16.53	Hustedt[16], p. 375, fig. 705
35	*Gomphonema lanceolatum* Ehrenberg var. *insignis* (Gregory) Cleve	fr. 82.5-122.5×15.0-17.5	Hustedt[16], p. 374, fig. 701
36	*Nitzschia filiformis* (W. Stein) Hust.	fr. 71×5	Hustedt[16], p. 422, fig. 818c
37	*Surirella robusta* Ehrenberg var. *splendida* (Ehrenberg) van Heureck	fr. 162.5×62.5	Hustedt[16], p. 437-438, fig. 852
38	*Ceratium furca* (Ehrenberg) Claprède *et* Lachman	cell 217.5-305×35-62.5	Aziz[26], p. 406
39	*Peridinium gutwinski* Wolos.	cell 72.5×52.5	Ling & Tyler[12], p. 67, pl. 25, fig. 12
40	*Euglena acus* Ehrenberg	cell 177.5-187.5×15.0	H-P[15], 16, fig. 75c
41	*Euglena charkowiensis* Swirenko	cell 172.5×45.0	H-P[15], pl. 6, fig. 37d
42	*Euglena ehrenbergii* Klebs	cell 150-170×47.5-65.0	H-P[15], pl. 9, fig.15
43	*Euglena oblonga* Schmitz	cell 70×30	Khondker[22], p. 248
44	*Euglena spathirhyncha* Skuja	cell 157.5-182.5×12.530.0	Khondker[22], p. 256
46	*Euglena splendens* Dang	cell 45×35	Khondker[22], p. 258
46	*Lepocinclis salina* Fritsch	cell 55.0- 57.5×40.0-42.5	Khondker[22], p. 270
47	*Phacus acuminatus* var. *granulata* (Roll) Huber-Pest.	cell 55×40	Khondker[22], p. 275
48	*Phacus circumflexus* Poch.	cell 97.5.5×52.5	H-P[15], fig. 307a, Pl. L
49	*Phacus concavus* Hortobagyi	cell 135.0×52.5	Khondker[22], p. 281
50	*Phacus longicauda* (E.) Duj.	cell 170×62.5	H-P[15], fig. 299a, pl. XLIX
51	*Trachelomonas hispida* var. *coronata* Lemm. fa. *irregularis* Khondker	lorica 59×40	Khondker *et al.* [23]



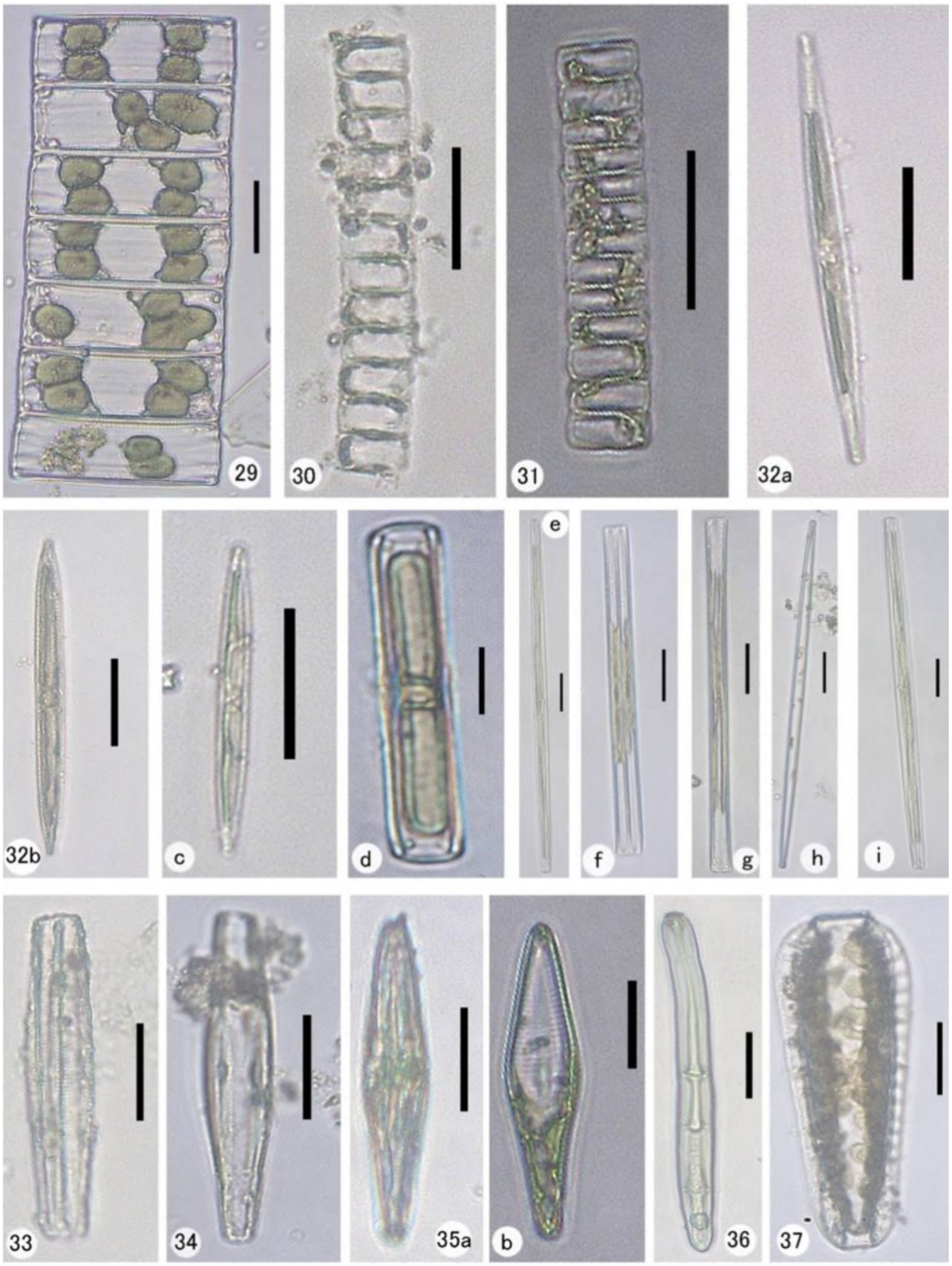
Figs 1-9. 1. *Aphanocapsa littoralis*. 2. *Merismopedia glauca*. 3. *Oscillatoria formosa*. 4. *O. subbrevis*. 5a-c. *Arthrospira platensis* var. *non-constricta*. 6a-b. *Anabaena fertilissima*. 7. *Pandorina morum*. 8a-d. *Eudorina elegans*. 9a-b. *Volvox carteri*. (Scales = 25 µm).



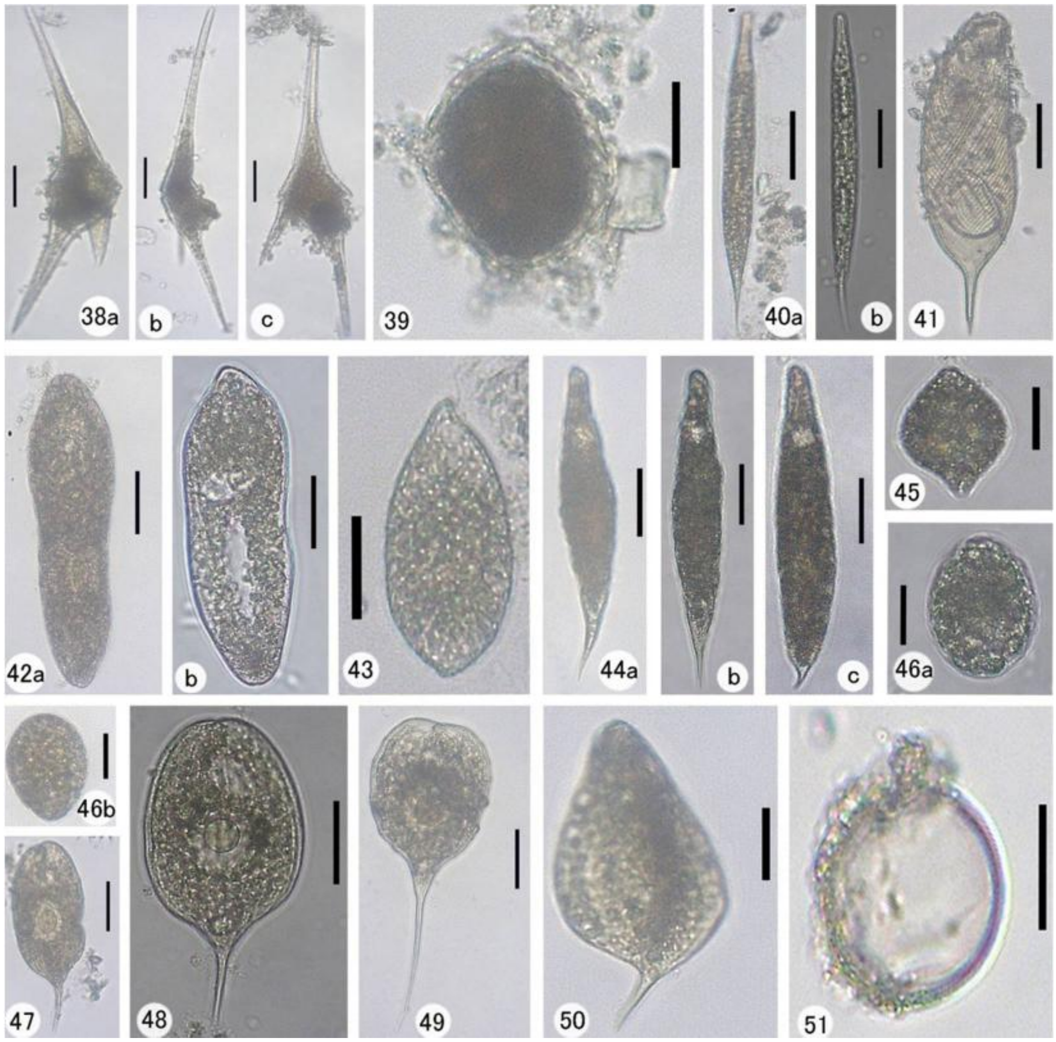
Figs 10-20. 10. *Radiococcus wildmanii*. 11. *Oocystis pusilla*. 12. *Diacanthos belenophorus*. 13. *Ankistrodesmus falcatus*. 14. *Monoraphidium mirabile*. 15. *Scenedesmus acuminatus*. 16. *S. denticulatus*. 17. *S. quadricauda*. 18a-c. *Pediastrum duplex*. 19a-b. *P. duplex* var. *gracillimum*. 20. *P. duplex* var. *reticulatum*. (Scales = 25 µm).



Figs 21-28. 21. *Pleurotaenium trabecula*. 22a-c. *Cosmarium pardalis*. 23. *C. paulii*. 24. *Staurastrum saltans* var. *sumatranum*. 25a-b. *Cyclotella comensis*. 26. *Coscinodiscus excentricus*. 27a-b. *Melosira granulata*. 28a-f. *M. granulata* var. *angustisima*. (Scales = 25 µm).



Figs 29-37. 29. 32d. *Fragilaria virescens*. 30. *F. construens*. 31. *F. intermedia*. 32a-c. e-i. *Synedra ulna*. 33. *Rhopalodia gibba*. 34. *Gomphonema longiceps* var. *subclavata*. 35a-b. *Gomphonema lanceolatum* var. *insignis*. 36. *Nitzschia filiformis*. 37. *Surirella robusta*. (Scales = 25 µm).



Figs 38-51. 38a-c. *Ceratium furca*. 39. *Peridinium gutwinski*. 40a-b. *Euglena acus*. 41. *E. charkowiensis*. 42a-b. *E. ehrenbergii*. 43. *E. oblonga*. 44a-c. *E. spathyrhyncha*. 45. *E. splendens*. 46a-b. *Lepocinclis salina*. 47. *Phacus acuminatus* var. *granulata*. 48. *P. circumflexus*. 49. *P. concavus*. 50. *P. longicauda*. 51. *Trachelomonas hispida* var. *coronata* fa. *irregularis*. (Scales = 25 µm).

phosphorus (SRP) and NO_3-N[9,11] then a big similarity can be observed in both the river Shitalakhsya and the river Buriganga (Zs, 0.48 m; SRP, 327 µg/l; NO_3-N, 550 µg/l; and Zs, 0.54 m; SRP, 493 µg/l and NO_3-N, 810 µg/l, respectively for the Shitalakhsya and the Buriganga). It clearly indicates that heavy organic load in the river water drastically cuts the light penetration (as observable with low Zs data). On the other hand, concentration of the key nutrients SRP and NO_3-N increases. In aquatic ecosystems, qualitative aspects of inhabiting species i.e., the number of species respond inversely to the nutrient conditions. It means higher the concentration of nutrients lower the number of species. So, there is a strong scientific basis for the record of relatively lower number of phytoplankton species in the river Shitalakhsya.

Considering the floristic composition of phytoplankton, as worked out in the present research, some species were found common in occurrences[5,8,9]. For example, *Volvox carteri*, *Eudorina elegans*, *Pandorina morum*, *Arthrospira platensis*, *Aphanocapsa littoralis*, *Pediastrum duplex*, *Scenedesmus acuminatus*, *Ankistrodesmus falcatus*, *Melosira granulata*, *Cyclotella comensis*, *Fragilaria intermedia*, *Synedra ulna*, *Euglena acus*, etc. are most common in occurrences. However, in some European river, species of *Stephanodiscus*, *Cyclotella*, *Melosira*, *Asterionella*, *Navicula*, *Chlamydomonas*, *Gonium*, *Chlorella*, *Pediastrum*, *Scenedesmus*, *Ankistrodesmus*, etc. are common[1-2].

In the present study it has been revealed that urban sections of some rivers in greater Dhaka area are supported by relatively low number of species of phytoplankton. And that the pollutant load, light limitation, increased concentrations of nitrogen and phosphorus can be responsible for the lower diversity of phytoplankton. Researches on qualitative study of river water inhabiting true plankton are rare in Bangladesh and we find the results of the present study as an addition to fill up the existing knowledge gaps. Species of phytoplankton from the river Shitalakhsya are listed along with their illustrative account with the help of photomicrography. So, it might become helpful to the limnologists for further evaluation of any floristic study of planktonic population of river ecosystems of Bangladesh.

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