RESEARCH

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Discovery

A preliminary taxonomic checklist of phytoplankton in the lower Meghna River-Estuary

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ABSTRACT

The study was conducted to uncover Phytoplankton occurrence and distribution in five sites (Sandwip, Hatiya, Bhola, Barishal, and Chandpur) of the Meghna river- estuary, Bangladesh. In the present investigate, a total of 51phytoplankton genera under 28 orders belonging 4 phylum's were identified; of which Chlorophyta (20 genera), Cyanobacteria (7 genera), Bacillariophyta (23 genera) and Ciliophora (1 genus). During the annual cycle Nitzschia was common genera at all five sites. *Nitzschia, Schrodella, Thalassiosira* and *Triceratium* were dominantat Sandwip; *Coscinodiscus, Navicula, Nitzschia, Schrodella* and *Triceratium* were prevalentat Hatiya; *Biddulphia, Cymbella, Nitzschia, Plurosigma, Thalassiosira* and *Triceratium* were common to Bhola; *Biddulphia, Cymbella, Nitzschia, Plurosigma, Thalassiosira,and Triceratium* were frequently recorded from Barishal and *Biddulphia, Nitzschia, Nostoc* and *Rhizosolenia* were predominant at Chandpur during the sampling seasons. During the monsoon *Nitzschia, Thalassiosira* and *Triceratium* were

common at all five sites whereas during the post-monsoon *Coscinodiscus, Nitzschia* and *Thalassiosira* were available in the study area.

Key words: Preliminary, pictorial Taxonomic, Checklist, Phytoplankton, Meghna River-Estuary

1. INTRODUCTION

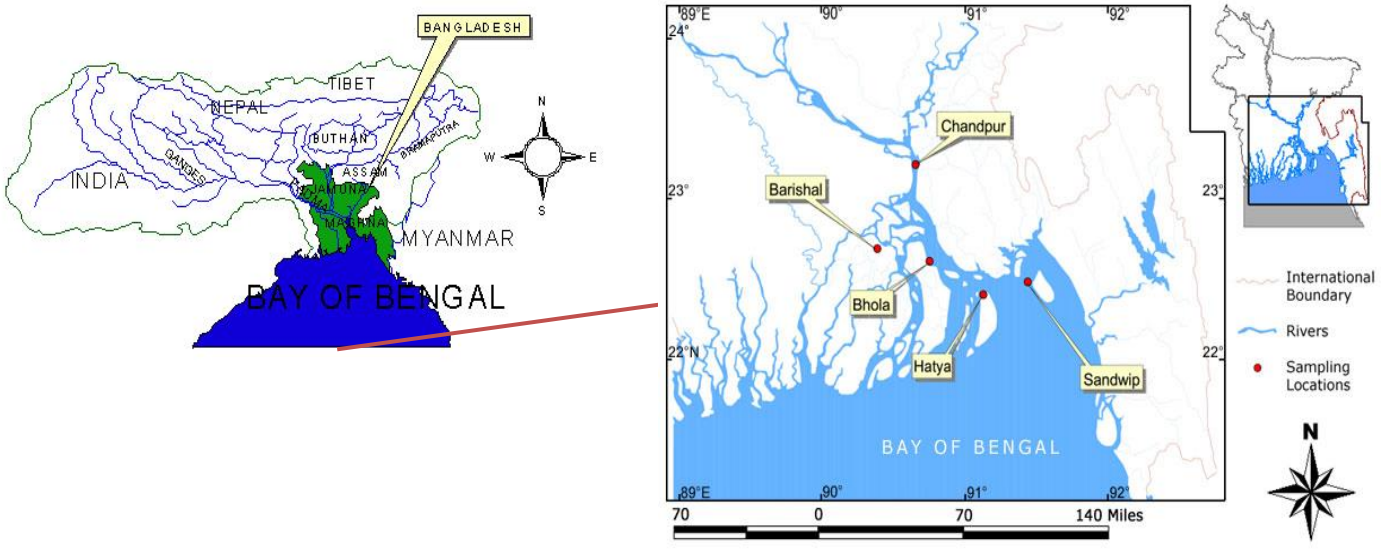
Phytoplankton, widely known as microalgae lying at the base of the food web and directly or indirectly support all aquatic life (Davies et al. 2016). Assemblages of phytoplankton generally occur in natural waters spatially and temporally (Hutchinson 1967; Holopainen et al. 2003). As highly efficient primary producers in the aquatic ecosystem, they are contributing in maintaining biodiversity and supporting fisheries (Field et al. 1998). Due to the high turnover rates and sensitivity to changes in environmental conditions, phytoplanktons are expedient indicators of changing ecological conditions, climate change, and deterioration in water quality (Poloczanska, et al. 2013; Beaugrand, 2009). For assessing the water quality they are used as important bio-indicators and in many cases, they are better than physico-chemical parameters (Round, 1985).

Beside positive aspects, some phytoplankton are harmful as they produce toxins which may be accumulated by filter feeding shellfish, causing irritation, serious illness or death to animals and humans. Phytoplanktons are known to respond sensitively to differences in chemical characteristics (Rosen, 1981; Arvolaetal., 1999). With the increased anthropogenic pollution they grow well in different nutritional levels of waters (Jarnefelt, 1952; Brettum, 1989). Although some research were conducted on phytoplankton of the Buriganga river (Islam and Haroon, 1975; Islam and Zaman, 1975), brackish water shrimp culture ponds (Islam and Khundker, 2003, 2004) and in pond (Begum and Hossain, 1993; Begum, 2008) but there are little or no research on the phytotoplankton of the Meghna river- estuary. For this shortage of information, the present research was carried out to study the phytoplankton taxonomy of the Meghna River- Estuary.

2. MATERIALS AND METHODS

Study Area

Study was conducted at Chandpur (23°13.768'N, 90°38.58'E), Barishal (22°41.962'N, 90°22.524'E), Bhola (22°37.153'N, 90°44.562'E), Hatiya (22°24.459'N, 91°07.013'E) and Sandwip (22°29.319'N, 91°25.668'E). Ganges is one of the most important rivers of the Indian subcontinent. The Ganges flows 2,510 km (1,560 mi) from the Himalayas of north central India southeast through Bangladesh and into the Bay of Bengal.



Map 1 Figure showing sampling sites in the Karnaphuli River

The main branch of the Ganges continues through Bangladesh, where for part of its course it is called the Padma River. The river gives rise to several distributaries that form a vast network of waterways and one of the world's largest, most fertile deltas. The main course of the river continues south and is joined by the Brahmaputra and then by the Meghna River (the name by which it is known thereafter) before entering the Bay of Bengal. At the bay the Meghna estuary measures 30 km (20 miles) wide. Average annual discharge of water of this river system is surpassed only by those of the Amazon and Congo rivers. Because the discharge includes large deposits of sediment, the delta continues to expand into the bay.

The area of this investigation ranged from the lower estuarine zone of the Meghna River (23˚13.768″N and 90˚38.58″E) at Chandpur to near shore coastal water (22˚29.319″N and 91˚25.668″) near Sandwip of Chittagong. Average depth of the estuary is about 5-6m and total length of the study area covering 5 selected stations was about 172 miles. Five selected sampling stations (Map 1) being located from upstream to downstream.

Collection

Phytoplankton samples were collected from sub-surface water of each sampling sites during monsoon and post monsoon seasons. One liter of sample was collected by a Kemmerer water sampler; collected samples were kept in plastic containers.

Preservation

40 ml of buffered formalin (also known as neutral formalin) were added with one litter sample, immediately after collection. The container was labeled and transferred to laboratory for further analysis.

Volume Reduction

In the laboratory the samples were transferred to measuring cylinders. The mouth was plugged and left over night. The phytoplankton settled, water from the top layer was removed and concentrated to 10 ml, and then concentrated samples were kept in marked vials for microscopic examination.

Enumeration

The concentrated samples were shaken to mix uniformly. 1 ml of sample was taken into a Sedgewick Rafter Counting cell (S-R cell), cover slip was placed with great care not to incorporate any air bubble. Then it was placed under microscope for identification and counting. Identification was done followingMizuno (1976); Yamazi (1972, 1974); Davis (1955); APHA (1975); Easter (1943); James (1943);Newell and Newell (1973, 1979); Islam and Aziz (1975); Islam and Aziz (1980); Haque (1983); Rahman (1997); Chowdhury (1998); Islam (2001); Sarode and Kamat (1948); Subrahmanyan (1946); Hendey (1964); Russel-Hunter (1970); Wickstead (1965); Suess (1982); Islam (1982). The records were kept in a note book and results were tabulated.

3. RESULTS AND DISCUSSION

In the present research, a total of 51 genera were identified under Chlorophyta (20 genera), Cyanobacteria (7 genera), Bacillariophyta (23 genera) and Ciliophora (1 genus) from the study area. *Nitzschia*and *Triceratium* was common genera at all five sites during the annual cycle (Table 1). *Schroederella*, *Spirogyra, Thalassiosira, Triceratium, Nitzschia, Nostoc, Rhizosolenia, Netrium, Navicula, Cyclotella, Coscinodiscus, Biddulphia and Chlorella* are common at Sanwdip and Hatiya sites.At Sandwip: *Nitzschia, Schrodella, Thalassiosira* and *Triceratium* were recorded as dominating species; *Coscinodiscus, Navicula, Nitzschia, Schrodella* and *Triceratium* were dominant species recorded from Hatiya (Table 1); *Coscinodiscus, Biddulphia, Chlorella, Aphanocapsa, Cyclotella, Cymbella, Melosira, Merismopedia, Nitzschia, Nostoc, Coelastrum*, *Rhizosolenia, Scenedesmus, Schroederella*, *Synedra, Thalassiosira, Triceratium* and *Volvox* were common as well as dominating at Bhola site; among them *Biddulphia, Cymbella, Nitzschia, Plurosigma, Thalassiosira* and *Triceratium* were dominating. *Biddulphia, Chlorella, Anabaena, Aphanocapsa, Coscinodiscus, Eucampia, Eunotia, Melosira, Detonula, Nitzschia, Nostoc, Navicula, Pleurotaenium, Thalassiosira, Rhizosolenia, Triceratium* and *Volvox* were common as well as dominating at Barishal and Chandpur sites (Table 1).

Table 1 Showing different phytoplankton genera (Cells/l) at different sites during monsoon and post-monsoon

Genera	Monsoon					Post-monsoon					Pre-monsoon				
(Cells/l)	St-1	St-2	St-3	St-4	St-5	St-1	St-2	St-3	St-4	St-5	St-1	St-2	St-3	St-4	St-5
Actinastrum										75				120	
Anabaena				300					450	675	24		24		

Aphanocapsa								255	75	1050			180	1095	
Diploneis														45	
Biddulphia		165	1155	555	2250	255		330	675	1800		165	60	345	555
Chlorella				180					585	1800	696		1260		
Chroococcus				120		77		375	300		108		228	45	
Climacosphenia										450					105
Closterium		30			375							30			
Coscinodiscus		75		120		825	600	2625	7500	14250	84	75	804	60	870
Actinoptychus								225	450				24	795	945
Cyclotella			375	300	225	255	255		1155					15	90
Cymbella			450					150		675	132		60	105	45
Detonula				5400	450			225	450				660	90	
Desmidium													48		
Ditylum						105	375								
Eucampia										2550					
Eudorina															210
Eunotia				570	750						468	390			30
Fragilaria					105				1155				120		30
Gloeocystis										2040			216		
Gomophonema				170											
Gymnozyga								270							
Melosira				6075	3150			3300	5250	4200	144		180	2550	
Merismopedia			600						45				48	60	
Micrasterias														15	
Microcystis													336		
Navicula		75		1800	900		210	300	750	1275	264	75	492	270	
Netrium						525								15	
Nitzschia	225	180	1425	720	1050	450	225	525	300	750	60	180	168	660	240
Nostoc					3300		825	435		5100	252		888	525	255
Oocystis													60		
Oscillatoria								75	180					360	30
Palmella													24		
Pediastrum								375							
Phormidium				75										330	
Planktosphaeria									120	150				15	
Pleurotaenium			43	105	1150										
Pleurosigma			23	60				75	60	1050	192		132		
Coelastrum												45			
Rhizosolenia		450		630	750			375		330	240	450	804	900	360
Scenedesmus				105	255			8250					252	240	
Schroederella	525	360	675	540		405	405	450	90		492	360		150	285
Spirogyra	1350						75		45	1950			132	105	
Surirella									30						60
Synedra			300		300				330				24		
Tetraedron													60	315	45
Thalassiosira	450		525	60	1125	75	300	600	120	675	60		144		
Tintinnopsis					2550										
Triceratium	1350	180	1050	3375	2850	1125	825	825	825		408	180	108	735	270
Volvox			675		525		375	180						240	960
Total	**3900**	**1515**	**7296**	**21260**	**22060**	**4097**	**4470**	**20220**	**20940**	**40845**	**3624**	**1950**	**7536**	**10200**	**5385**

Legend: ***St-1: Sandwip,*** ***St-2: Hatiya,*** ***St-3: Bhola,*** ***St-4: Barisal,*** ***St-5: Chandpur***

Taxonomic list of phytoplankton occurred in the study during the annual cycle (with reference to photograph in photo plate)

Phylum Chlorophyta

Class Trebouxiophyceae

Order Chlorellales

Family Chlorellaceae

Genus *Actinastrum* (Fig: 19-23, 31-33)

Genus *Chlorella* (Fig: 51)

Family Oocystaceae

Genus *Oocystis*

Genus *Oscillatoria*(Fig: 78)

Class Chlorophyceae

Order Chlamydomonadales

Family Volvocaceae

Genus *Eudorina* (Fig: 28)

Genus *Volvox*

Order Sphaeropleales

Family Radiococcaceae

Genus*Gloeocystis*

Family Hydrodictyaceae

Genus *Pediastrum* (Fig: 84, 86)

Family Schizochlamydaceae

Genus *Planktosphaeria* (Fig: 38)

Family Scenedesmaceae

Genus *Scenedesmus* (Fig: 17, 18, 66, and 80)

Genus *Coelastrum* (Fig: 27, 41)

Family Hydrodictyaceae

Genus*Tetraedron*

Order Chlamydomonadales

Family Palmellaceae

Genus*Palmella*

Class Conjugatophyceae (Zygnematophyceae)

Order Desmidiales

Family Closteriaceae

Genus *Closterium* (Fig: 14, 45)

Genus *Desmidium* (Fig: 71, 75)

Family Desmidiaceae

Genus *Gymnozyga*

Genus *Micrasterias* (Fig: 70, 88)

Genus *Pleurotaenium*

Family Mesotaeniaceae

Genus *Netrium* (Fig: 49)

Family Zygnemataceae

Genus *Spirogyra* (Fig: 47, 64, and 93)

Phylum Cyanobacteria

Class Cyanophyceae

Order Synechococcales

Family Merismopediaceae

Genus*Aphanocapsa* (Fig: 24, 35)

Genus*Merismopedia* (Fig: 39, 40)

Order Chroococcales

Family Chroococcaceae

Genus *Chroococcus* (Fig: 34, 42, 57, and 58)

Family Microcystaceae

Genus *Microcystis*

Order Nostocales

Family Nostocaceae

Genus *Nostoc* (Fig: 48, 53, 56, 79, and 89)

Family Nostocaceae

Genus *Anabaena* (Fig: 60, 92)

Order Oscillatoriales

Family Oscillatoriaceae

Genus *Phormidium*

Phylum Bacillariophyta

Class Coscinodiscophyceae

Order Coscinodiscales

Family Heliopeltaceae

Genus *Actinoptychus*

Class Mediophyceae

Order Biddulphiales

Family Biddulphiaceae

Genus*Biddulphia* (Fig: 25, 29, 36, and 55)

Genus *Eucampia*

Order Toxariales

Family Climacospheniaceae

Genus *Climacosphenia* (Fig: 67)

Order Stephanodiscales

Family Stephanodiscaceae

Genus *Cyclotella*

Order Thalassiosirales

Family Thalassiosiraceae

Genus *Detonula*

Order Lithodesmiales

Family Lithodesmiaceae

Genus *Ditylum* (Fig: 9)

Order Thalassiosirales

Family Skeletonemataceae

Genus *Schroederella*

Class Coscinodiscophyceae

Order Coscinodiscales

Family Coscinodiscaceae

Genus *Coscinodiscus* (Fig: 1-7, 68)

Order Melosirales

Family Melosiraceae

Genus *Melosira* (Fig: 44, 61)

Order Rhizosoleniales

Family Rhizosoleniaceae

Genus *Rhizosolenia* (Fig: 30, 54)

Order Triceratiales

Family Triceratiaceae

Genus*Triceratium*

Class Bacillariophyceae

Order Cymbellales

Family Cymbellaceae

Genus *Cymbella* (Fig: 10, 63)

Family *Gomphonemataceae*

Genus *Gomophonema*

Order Eunotiales

Family Eunotiaceae

Genus *Eunotia* (Fig: 50)

Order Fragilariales

Family Fragilariaceae

Genus *Fragilaria* (Fig: 62, 72, 81, 82, and 83)

Genus *Synedra* (Fig: 46, 76)

Order Naviculales

Family Naviculaceae

Genus *Navicula* (Fig: 8, 12, 73)

Family Pleurosigmataceae

Genus*Pleurosigma* (Fig: 37, 74, 47, and 87)

Family Diploneidaceae

Genus *Diploneis* (Fig: 13, 16)

Order Bacillariales

Family Bacillariaceae

Genus *Nitzschia* (Fig: 11, 15, 52, 59, 69, 85, and 93)

Order Surirellales

Family Surirellaceae

Genus *Surirella*

Order Thalassiosirales

Family Thalassiosiraceae

Genus *Thalassiosira* (Fig: 43)

Phylum Ciliophora

Class Spirotrichea

Order Tintinnida

Family Codonellidae

Genus*Tintinnopsis*

Photograph plate

Fig 1. Coscinodiscus

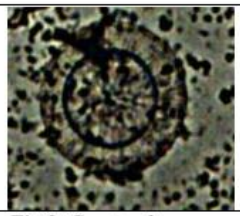


Fig 2. Coscinodiscus

Fig 3. Coscinodiscus

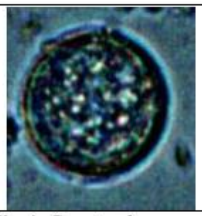


Fig 4. Coscinodiscus

Fig 5. Coscinodiscus

Fig 6. Coscinodiscus

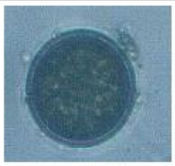


Fig 7. Coscinodiscus

Fig 8. Navicula

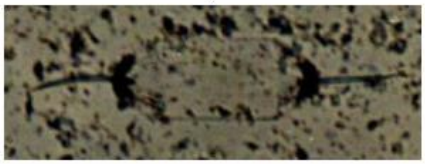


Fig 9. Ditylum

Fig 10. Cymbella

Fig 11. Nitzschia

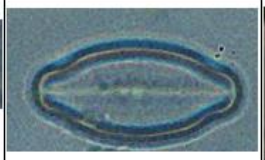


Fig 12. Navicula

Fig 13. Diploneis

Fig 14. Closterium

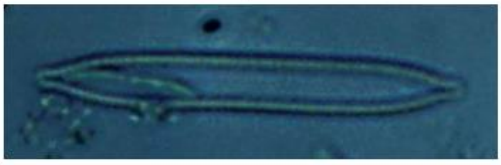


Fig 15. Nitzschia

Fig 16. Diploneis

Fig 17. Scenedesmus

Fig 18. Scenedesmus

Fig 19. Actinastrum

Fig 20. Actinastrum

Fig 21. Actinastrum

Fig 22. Actinastrum

Fig 23. Actinastrum

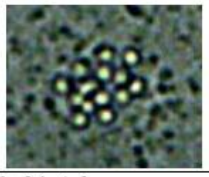


Fig 24. Aphanocapsa

Fig 25. Biddulphia

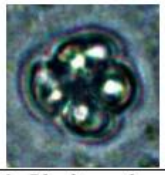


Fig 26. Planktoosphaea

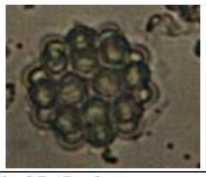


Fig 27. Coelastrum

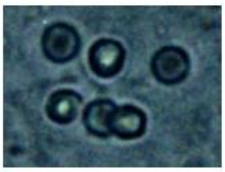


Fig 28. Eudorina

Fig 29. Biddulphia

Fig 30. Rhizosolenia

Fig 31. Actinastrum

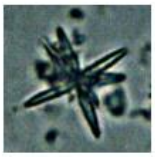


Fig 32. Actinastrum

Fig 33. Actinastrum

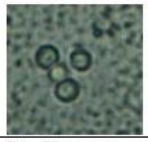


Fig 34. Chroococcus

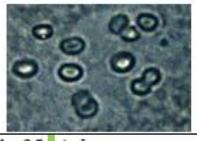


Fig 35. Aphanocapsa

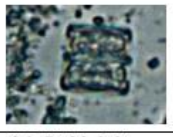


Fig 36. Biddulphia

Fig 37. Pleurosigma

Photograph plate

Fig 38. *Planktosphaeria*

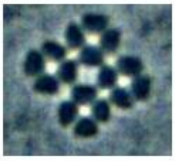


Fig 39. *Merismopedia*

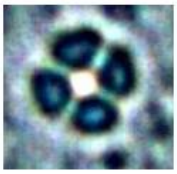


Fig 40. *Merismopedia*

Fig 41.Coelastrum

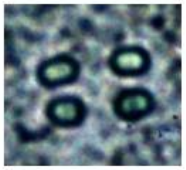


Fig 42. *Chroococcus*

Fig 43. . *Thalassiosira*

Fig 44. *Melosira*

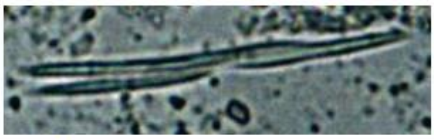


Fig 45. *Closterium*

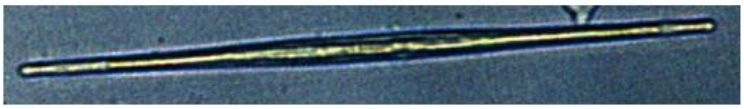


Fig 46. *Synedra*

Fig 47. . *Spirogyra*

Fig 48. *Nostoc*

Fig 49. *Netrium*

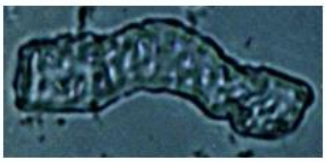


Fig 50. *Eunotia*

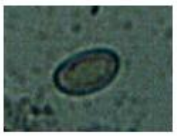


Fig 51. *Chlorella*

Fig 52. *Nitzschia*

Fig 53. *Nostoc*

Fig 54. *Rhizosolenia*

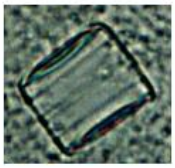


Fig 55. *Biddulphia*

Fig 56. *Nostoc*

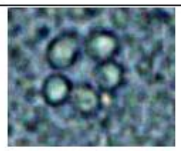


Fig 57. *Chroococcus*

Fig 58. *Chroococcus*

Fig 59. *Nitzschia*

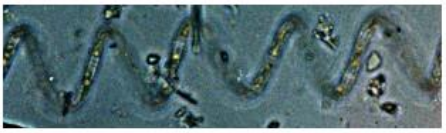


Fig 60. *Anabaena*

Fig 61. *Melosira*

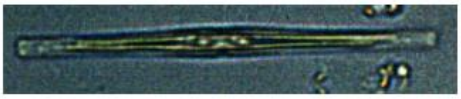


Fig 62. *Fragilaria*

Photograph plate

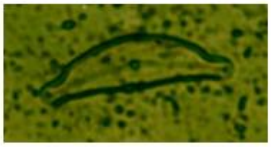


Fig 63 : *Cymbella*

Fig 64: *Spirogyra*

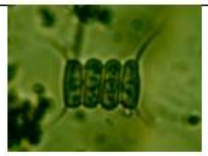


Fig 66:*Scenedesmus*

Fig 67: Climacosphenia

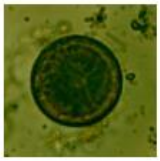


Fig 68:*Coscinodiscus*

Fig 69: *Nitzschia*

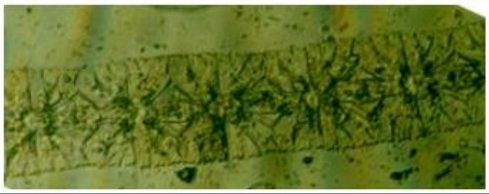


Fig 70:*Micrasterias*

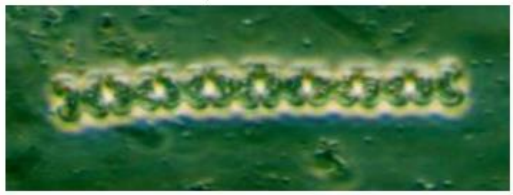


Fig 71:*Desmidium*

Fig 72: *Fragilaria*

Fig 73:*Navicula*

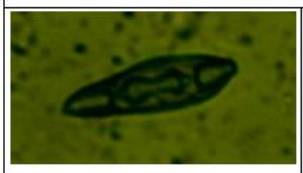


Fig 74: *Pleurosigma*

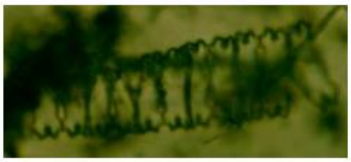


Fig 75: *Desmidium*

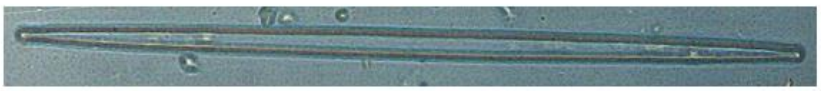


Fig 76: *Synedra*

Fig 77: *Pleurosigma*

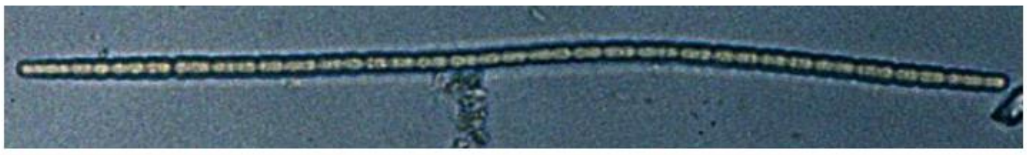


Fig 78:*Oscillatoria*

Photograph plate

Fig 79: *Nostoc*

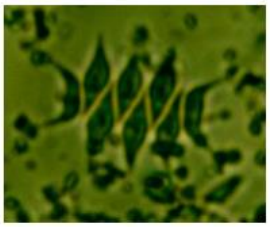


Fig 80: *Scenedesmus*

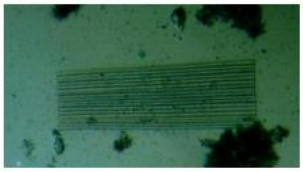


Fig 81: *Fragilaria*

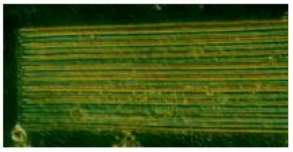


Fig 82:*Fragilaria*

Fig 83:*Fragilaria*

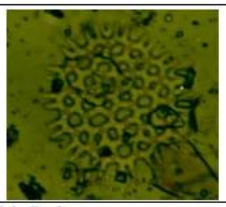


Fig 84: *Pediastrum*

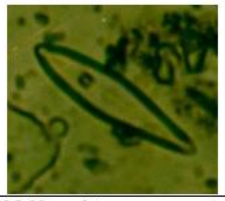


Fig 85:*Nitzschia*

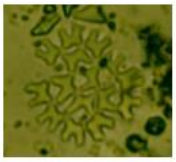


Fig 86: *Pediastrum*

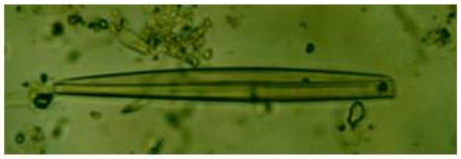


Fig 87: *Pleurosigma*

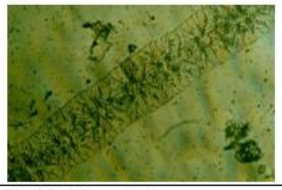


Fig 88: *Micrasterias*

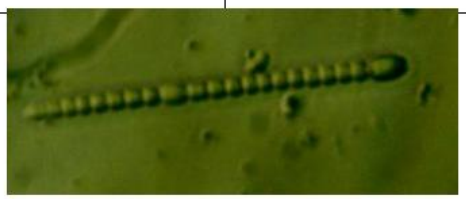


Fig 89: *Nostoc*

Fig 91: *Spirogyra*

Fig 92: *Anabaena*

Fig 93:*Nitzschia*

4. CONCLUSION

This taxonomic checklist with photographic plates will provide preliminary information and support as baseline for further study of phytoplankton in the northern Bay of Bengal and its estuaries.

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