

## NEW RECORDS OF PHYTOPLANKTON FOR BANGLADESH. 1. CYANOPHYCEAE

MONIRUZZAMAN KHONDKER<sup>\*</sup>, RAUF AHMED BHUIYAN, JENAT YEASMIN, MUNIRUL ALAM<sup>1</sup>,  
R. BRADLEY SACK<sup>2</sup>, ANWAR HUQ<sup>3</sup> AND RITA R. COLWELL<sup>2,3,4</sup>

*Department of Botany, University of Dhaka, Dhaka 1000, Bangladesh*

*Key words:* New records, Phytoplankton, Cyanophyceae, Bangladesh

### Abstract

The paper includes 16 taxa of blue-green algae (BGA) as new records for Bangladesh. These include two species from each of *Anabaena*, *Anabaenopsis*, *Merismopedia*, *Microcystis* and *Oscillatoria* and *Chroococcus dispersus*, *Gomphosphaeria lacustris*, *Pseudanabaena mucicola*, *Raphidiopsis indica*, *Aphanizomenon issatschenkoi* and *Cylindrospermopsis raciborskii* from some ponds belonging to Mathbaria of Pirojpur district and Bakerganj of Barisal district of Bangladesh.

### Introduction

In Bangladesh, studies carried out on blue-green algal flora remain limited to certain selected areas and habitats (Islam 1991). In a review, Islam (1991) mentioned the occurrence of 43 blue-green algal genera in Bangladesh of which 21 were recorded from the phytoplankton communities. Recently, blue-green algal flora of Madhabkunda waterfall and some areas of northern districts of Bangladesh have been reported by Aziz and Yasmin (1997) and Aziz and Tanbir (1999,2003). Blue-green algae, growing in some habitats such as freshwater-, brackishwater- and acidic-lagoons and jute retting and shrimp culture ponds of Bangladesh have been reported (Islam and Irfanullah 2000, 2001, 2003, 2005; Islam *et al.* 2002 and Islam and Khondker 2003). However, studies on blue-green algal flora from freshwater habitats of southern most parts of Bangladesh are meagre.

To study the "Seasonal distribution, abundance, identification and characterization of plankton", the present study was carried out in the cholera prone Mathbaria Upazila of Pirojpur district and Bakerganj Upazila of Barisal district of Bangladesh (Alam *et al.* 2006).

During the routine sampling of the phytoplankton in the study areas the authors collected a large number of phytoplankton samples which on investigation revealed the occurrence of many taxa not yet recorded for different groups of algae. The present paper deals with the systematics of 16 species of blue-green algae (Cyanophyceae) which are new records for Bangladesh.

### Materials and Methods

Samples of phytoplankton were collected from eight and six stations of Bakerganj (22°29'–22°41' N and 90°7'36''–90°29'5'' E) and Mathbaria (22°9'44''–22°23'46'' N and 89°49'32''–90°1'27'' E), respectively in between March 2004 and May 2006 (Table 1).

To collect concentrated sample of phytoplankton, a plankton net of 20 µm mesh size was used. Collected plankton were preserved in Lugol's solution. Phytoplankton population < 20 µm size fraction was collected via sedimentation technique (Wetzel and Likens 1979). At first 0.5 ml Lugol's solution was put onto the bottom of an empty and dried transparent Pyrex bottle (115 ml capacity) with the help of a pipette. Then the bottle was filled with well mixed sample water sieved through 20 µm plankton net. After closing the bottle with the stopper it was kept quiet for

<sup>\*</sup>Corresponding author. <sup>1</sup>International Center for Diarrhoeal Disease Research, Bangladesh, Dhaka, Bangladesh. <sup>2</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland. <sup>3</sup>Center of Marine Biotechnology, University of Maryland Biotechnology Institute, Baltimore, Maryland. <sup>4</sup>University of Maryland Institute for Advanced Computer Studies, College Park, Maryland, USA.

48 hours for the sedimentation of microplankton. Then the overlying water was withdrawn keeping the sedimented layer of plankton undisturbed. Finally, the volume of the slurry was measured and preserved in glass vials.

**Table 1. Description and some morphometric features of the sampling stations.**

Bakerganj			
Station number	Name of the station	A (m <sup>2</sup> )	Z <sub>max</sub> (m)
1	Bakerganj Helipad Government Pond	371	2.40
2	Bharpasha Mukherjee Bari Pond	139	1.53
3	Bharpasha Jame Mosque Pond	464	2.86
4	Thana Health Complex Mosque Pond	232	2.01
5	Tulatali River	-	~1.50
6	Harun Daku's Pond	371	3.50
7	Bara Aulia's Mazar Pond	371	2.02
8	Bairam Kha's Dighi	1,855	1.00
Mathbaria			
1	South Mithakhali Mridha Bari Pond	375	1.43
2	South Mithakhali Jotish Kanti Bepari Pond	250	1.18
3	South Mithakhali Jalal Mia's Pond	460	2.24
4	Mathbaria Bazar Primary School Pond	375	1.70
5	Mithapukur Mazumdar Bari (BRAC) Pond	920	1.85
6	North Mithakhali Ashraf Ali Baro Mia's Pond	900	3.03

A = area; Z<sub>max</sub> = maximum depth.

From each sample three successive preparations were made, each onto a Helber Bacteria Chamber (Thoma ruling single round cell, SV 400, Hawksley, England) for compound microscopy. The samples were viewed under a magnification ranging from 400-1000 × via a Nikon research microscope fitted with a photographic attachment (Nikon Optiphot, UFX-IIA, FX-35 WA, Japan). Interesting species encountered in the sample were photo-micrographed and cell/colony/filament size and their componental parts were measured. Later on, the species were identified with the help of published relevant literatures from home and abroad.

### Results and Discussion

In Bangladesh, studies carried out so far have reported 283 species of blue-green algae (Islam 1991, Aziz and Yasmin 1997, Aziz and Tanbir 1999, 2003, Islam and Irfanullah 2000, 2001, 2003, 2005; Islam *et al.* 2002, Islam and Khondker 2003). In an ongoing National Institute of Health (USA)-funded multidisciplinary-multiyear study carried out in two remote ecological niche adjacent to the Bay of Bengal, the authors have found 30 different blue-green algal taxa of which 16 have not been previously reported from Bangladesh. An illustrated account of these species are presented in this paper. For the systematic arrangement, Desikachary (1959) has been followed.

#### **Class: Cyanophyceae; Order: Chroococcales; Family: Chroococcaceae**

##### **1. *Microcystis holsatica* Lemm. (Fig. 1)**

(Desikachary 1959, p. 96; Ling and Tyler 2000, Pl. 3, Fig. 4, p. 20)

Colony irregular, some part of the colony seems to be spherical; clathrate, mucilage colourless, not so prominent; cells are very minute, spherical or sub-spherical, cells 1 µm diam.

Bakerganj, Station No. 3, 09. 08. 2004.

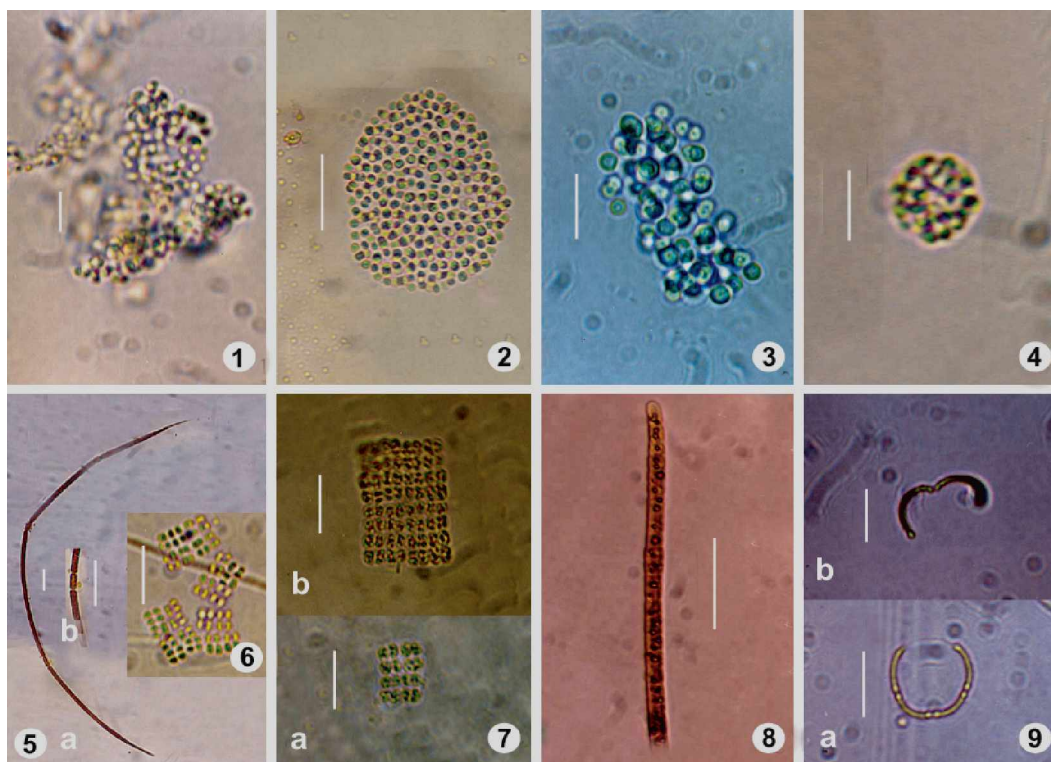
2. *M. incerta* Lemm.

(Fig. 2)

(Prescott 1982, Pl. 100, Figs. 1-3, p. 447; Ling and Tyler 2000, Pl. 4, Figs. 3-4, p. 13)

Colony spherical or sub-spherical, definite in shape; cells spherical, compactly arranged, 1.3 - 2.6  $\mu\text{m}$  diam., colony 63.5  $\times$  53.3  $\mu\text{m}$ , cell content light blue-green in colour; without gas vacuoles.

Bakerganj, Station No. 2, 29. 11. 2004.



Figs. 1-9: 1. *Microcystis holsatica*, 2. *M. incerta*, 3. *Chroococcus dispersus*, 4. *Gomphosphaeria lacustris*, 5a-b. *Aphanizomenon issatschenkoi*, 6. *Merismopedia punctata*, 7a-b. *M. trolleri*, 8. *Oscillatoria amphibia*, 9a-b. *Anabaenopsis elenkinii*.

3. *Chroococcus dispersus* (Keissl.) Lemm.

(Fig. 3)

(Prescott 1982, Pl. 100, Figs. 1-3, p. 447; Ling and Tyler 2000, Pl. 4, Figs. 3-4, p. 13)

Colony bright blue-green in colour, cells grouped together in the central portion of the colony forming small clusters, while those in the periphery shows a dispersal tendency, cells spherical, individual cell sheath not distinct, colony 36.6  $\mu\text{m}$  long, median diam. 14.4 - 16.0  $\mu\text{m}$ ; cells 3  $\mu\text{m}$  diam.

**Notes:** The present species fits well with *C. dispersus* in terms of colony shape, colour of the cell content and cell dimension (Ling and Tyler *l.c.*, Prescott *l.c.*). However, Starmach (1966) kept the taxa as synonym of *Gloeocapsa minor* (Kützing) Hollerbach f. *dispersa* (Keissler) Hollerbach.

Mathbaria, Station No. 6, 13. 09. 2004.

4. **Gomphosphaeria lacustris** Chodat (Fig. 4)

(Ling and Tyler 2000, Pl. 1, Figs. 7-8, p.17)

Colony spherical, smaller in size, hollow,  $8 \times 8 \mu\text{m}$ ; cells very minute, spherical, compactly arranged; 1.2 - 1.7  $\mu\text{m}$  diam., deep to light blue-green in colour.

**Notes:** The taxa fits well with the figure and cell dimension as presented by Ling and Tyler (*l.c.*). He mentioned that the colony dimension of the species may go up to 50  $\mu\text{m}$ . The arrangement of 4-8 cells in clusters in the colony as mentioned by Prescott (1982) for the species is not evident in the present material as well as in Ling and Tyler (*l.c.*). The present material fits to some extent with *G. lacustris* var. *compacta* Lemm. as by Prescott (*l.c.*) except the latter's oblong cells ( $1.5\text{-}2.0 \times 4\text{-}6 \mu\text{m}$ ).

Bakerganj, Station No. 3, 09. 08. 2004.

5. **Merismopedia punctata** Meyen (Fig. 6)

(Prescott 1982, Pl. 102, Fig. 10, p. 459)

Colony consisting of four individual rectangular plates each containing 32 cells; colour light blue-green; cells ovate, loosely arranged, cell content homogeneous, cells arranged in each sheet by mucilage, each plate of 32 cells measures  $9 \times 5 \mu\text{m}$ , individual cells *ca.*  $1.0 \times 1.5 \mu\text{m}$ .

Mathbaria, Station No. 1, 22. 06. 2004.

6. **Merismopedia trolleri** Bach. (Figs. 7a-b)

(Prescott 1982, Pl. 101, Fig. 5, p. 460)

Colony 8 - 64 celled, cells spherical to sub-spherical in shape, each cell with individual mucilage sheath embedded in a colonial envelope, cell contains many gas vacuoles, appearing brownish to purplish in colour. Colony  $8 \times 5 - 21 \times 14 \mu\text{m}$ , cells 2.3  $\mu\text{m}$  diam.

Mathbaria, Station No. 1, 19.07.2004; Station No. 6, 06. 09. 2004.

**Order: Oscillatoriales; Family: Oscillatoriaceae**

7. **Oscillatoria amphibia** Ag. *ex* Gomont (Fig. 8)

(Desikachary 1959, Pl. 37, Fig. 6, p. 229)

Trichome straight, slightly bent at the apex, pale-blue to brownish in colour, tip broadly rounded, not capitate, the whole trichome  $130 \times 3 \mu\text{m}$ , individual cells 5  $\mu\text{m}$  long and 3  $\mu\text{m}$  broad; two prominent granules at the septa.

Mathbaria, Station No. 1, 01. 02. 2005.

8. **O. pseudogeminata** G. Schmid (Figs. 16a-b)

(Desikachary 1959, Pl. 41, Fig. 10, p. 228)

Trichome straight, pale-blue green to light brownish in colour, cells usually longer than broad, some cells as long as broad, tip cell bluntly rounded, cell wall constricted at the joint of two cells, looks like a horizontal gap at the juncture, individual cells  $8 \times 3 \mu\text{m}$ , terminal cell  $4 - 8 \times 2 - 3 \mu\text{m}$ .

Bakerganj, Station No. 8, 29. 03. 2004; 12. 07. 2004.

**Order: Nostocales; Family: Nostocaceae**

9. **Anabaenopsis elenkinii** (?) Miller (Figs. 9a-b)

(Ling and Tyler 2000, Pl. 12, Fig. 9, p. 27)

Filament short, heterocyst present at both the ends of a filament, short filaments attach together at the point of heterocyst forming a ring like colony, ring diam. 12  $\mu\text{m}$ ; in the ring heterocysts appear in pairs, filament 1  $\mu\text{m}$  broad, light blue green in colour, partition wall of each cell not visible.

**Note:** The present specimen though looks like one of the figures presented in Ling and Tyler (*l.c.*) but much smaller in size.

Mathbaria, Station No. 6, 22. 11. 2004.

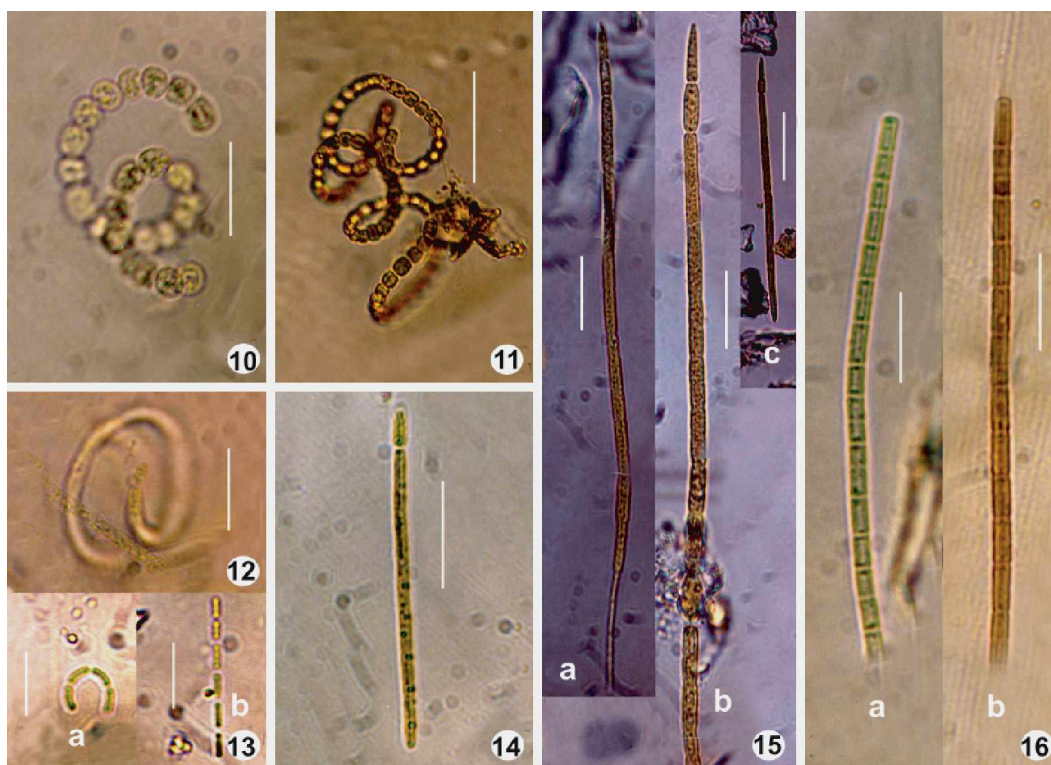
10. ***A. raciborskii*** Wolosz. fa. (Fig. 14)

(Desikachary 1959, Pl. 63, Fig. 6, p. 358)

Filament short, straight; heterocyst terminal; filament 48  $\mu\text{m}$  long without heterocyst, heterocyst  $7 \times 2 \mu\text{m}$ , pale blue-green in colour, gas vacuoles present in some cells, tip of the end cell rounded, vegetative cell  $5.7 \times 2.0 \mu\text{m}$ , heterocyst capsule like, end rounded.

**Note:** The present material differs from that of Desikachary (*l.c.*) by the presence of gas vacuoles in the filament and capsule like heterocyst with rounded pole.

Mathbaria, Station No. 2, 02. 08. 2004.



Figs. 10-16. 10. *Anabaena ballyganglii*, 11. *A. uttermöhl*, 12. *Cylindrospermopsis raciborskii*, 13a-b. *Pseudanabaena mucicola*, 14. *Anabaenopsis raciborskii* fa., 15a-c. *Raphidiopsis indica*, 16a-b. *Oscillatoria pseudogeminata*, (Bars = 10  $\mu\text{m}$ ).

11. ***Aphanizomenon issatschenkoi*** (Usacev) Proskina-Lavrenka (Fig. 5a-b)

(Ling and Tyler 2000, Pl. 13, Fig. 4, p. 27)

Trichome crescent-shaped, both ends gradually tapering to a hair like projection, heterocysts intercalary, 2 in number, whole trichome *ca.* 341.2  $\mu\text{m}$  long, vegetative cells  $5.2 \times 2 \mu\text{m}$ , heterocysts  $10.3 \times 3 \mu\text{m}$ .

Bakerganj, Station No. 2, 23. 01. 2006.

12. **Cylindrospermopsis raciborskii** (Woloszynska) Seenayya & Subba Raju (Fig. 12)  
(Ling and Tyler 2000, Pl. 12, Fig. 10, p. 28)  
Trichome straight or coiled, 3  $\mu\text{m}$  wide, heterocyst terminal, tip attenuated,  $3.4 \times 2.0 \mu\text{m}$ ; only coiled filaments were found in the sample.  
Bakerganj, Station No. 2, 15. 06. 2004.
13. **Anabaena ballyganglii** Banerjii (Fig. 10)  
(Desikachary 1959, Pl. 77, Fig. 4, p. 409)  
Trichome short, coiled, never straight, gap between one coil 10  $\mu\text{m}$ ; cells spherical, as long as broad or little wider than long (5.0  $\mu\text{m}$  wide and 4.5  $\mu\text{m}$  long); heterocyst circular 5.0  $\mu\text{m}$  diam.  
Bakerganj, Station No. 2, 15. 06. 2004.
14. **A. uttermöhlili** Geitler (Fig. 11)  
(Desikachary 1959, Pl. 74, Fig. 2, p. 415)  
Trichome solitary, long, irregularly coiled, spirals *ca.* 20  $\mu\text{m}$  broad, 10-13  $\mu\text{m}$  distant, vegetative cells  $5 \times 5 \mu\text{m}$ ; heterocyst  $6.3 \times 5.0 \mu\text{m}$ .  
Bakerganj, Station No. 8, 12. 07. 2004.
15. **Pseudanabaena mucicola** (Huber-Pest. and Naumann) Bourr. emend Chang (Fig. 13a-b)  
(Ling and Tyler 2000, Pl. 14, Fig. 2, p. 31)  
Trichome single, short, straight or curved; 4-6 cells in length, cells longer than broad, cell content homogeneous, light green in colour, whole trichome 22  $\mu\text{m}$  long, vegetative cells  $3 \times 1 \mu\text{m}$ .  
Mathbaria, Station No. 1, 16. 08. 2004.
16. **Raphidiopsis indica** Singh R.N. (Fig. 15a-c)  
(Desikachary 1959, Pl. 79, Fig. 5, p. 422)  
Trichome solitary, straight, long; tip cell lanceolate; akinete single large, ellipsoid, penultimate; whole trichome 155  $\mu\text{m}$  long; tip cell  $7-12 \times 2.5-3.0 \mu\text{m}$ , akinete  $9 \times 4 \mu\text{m}$ , median vegetative cells  $9 \times 3 \mu\text{m}$ .  
**Notes:** In one specimen posterior end of the trichome contained a hair-like projection (23  $\times$  1  $\mu\text{m}$ ) and in a second specimen an intercalary heterocyst-like organ ( $8 \times 5 \mu\text{m}$ ) was observed. Similar features have also been observed by Drouet (1951). According to him "In *Raphidiopsis* the trichome bears at one end a heterocyst; at the other end the cells are narrowed to a sharp point". Generally, *Raphidiopsis* is a non-heterocystous genus.  
Bakerganj, Station No. 4, 29. 11. 2004.

### Acknowledgements

The research as an integral part of the major multidisciplinary project entitled 'Epidemiology and Ecology of *Vibrio cholerae* in Bangladesh' was financed by the National Institute of Health research grant # 1R01A13912901 under the collaborative agreement between the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) and the Johns Hopkins Bloomberg School of Public Health. The authors gratefully acknowledge the NIH ecological surveillance team at ICDDR,B for kindly supporting this research.

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(Manuscript received on 25 October, 2006; revised on 11 November, 2006)