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NEW RECORDS OF PHYTOPLANKTON FOR BANGLADESH. 3. VOLVOCALES

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Abstract

This study presents 21 species of *Chlamydomonas*, four species of *Carteria*, two species of each of *Nephroselmis*, *Pyramidomonas* and *Scherffelia*, and *Collodictyon triciliatum*, *Polytoma minus*, *Tetrachloridium ? allorgei* and *Tetraselmis cordiformis*. These species have been reported from some ponds of Mathbaria of Pirojpur and Bakerganj of Barisal districts in Bangladesh.

Introduction

The members of the order Volvocales under the class Chlorophyceae show a common single character i.e., motility both in vegetative and reproductive phases of life. Their frequent occurrence in the samples of freshwater plankton is another common feature. Few of them e.g., *Chlamydomonas* sp., *Carteria* sp., *Heteromastix angulata*, *Pandorina morum*, *Volvox* sp., etc. form blooms and discolour water. The group is represented by 974 species worldwide (Huber-Pestalozzi 1961). In Bangladesh, the first research work on Volvocales dates back to 1966 when Professor A.K.M. Nurul Islam and one of his research students Momena Khatun studied the plankton of some polluted ponds of Dhaka city (Islam and Khatun 1966). In that study they reported nine species of Volvocales. Later, Islam (1974) reported three species of *Pleodorina* and four species of *Volvox* from Bangladesh. Including few more systematic works on Volvocales published later in Bangladesh, the total number of species reported are 38 (Islam and Khatun 1966, Islam 1974, Islam and Khondker 1993, 1994, 1997, Islam and Alfassane 2002).

In the present study, 35 species of Volvocales have been newly recorded for Bangladesh. The species were encountered in the plankton samples collected from different pond ecosystems of Mathbaria of Pirojpur district and Bakerganj of Barisal district between 2004 and 2006. New reports of phytoplankton for Bangladesh belonging to Cyanophyceae, Cryptophyceae, Xanthophyceae and Synurophyceae from the same study areas have been published elsewhere (Khondker *et al.* 2006, 2007).

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Materials and Methods

The species have been described by studying concentrated samples of plankton collected by a net and also by sedimentation technique. For the purpose water samples from 1-8 and 1-6 permanent stations of Bakerganj and Mathbaria, respectively have been used (Khondker *et al.* 2006). All the investigated water bodies were pond ecosystems except one river channel (Station No. 5, Bakerganj) and the sampling was carried out in between 2004 and 2006 (Khondker *et al*. 2006).

Taxonomic enumeration

In the present study, 35 species of unicellular Volvocales belonging to nine genera under three families were identified from the pelagic plankton communities of different ponds of Mathbaria and Bakerganj. An illustrated account of these species are presented in this paper. For the systematic arrangement, Huber-Pestalozzi (1961) has been followed.

Division: Chlorophyta; Class: Chlorophyceae; Order: Volvocales
Family: Polyblepharidaceae

1. **Pyramidomonas inconstans** Hodgett **(Fig. 34)**

(Huber-Pestalozzi 1961, 19, 2: 12c)

Cell shape strongly variable, elliptic-ovoid, posterior end rounded; periplast distinct, chromatophore occupying the whole cell, pyrenoid single, basal; cells 6 µm long and 5 µm broad; flagella 4, equal in length, 7 µm long.

Bakerganj, Station No. 6, 29.11.2004.

2. **Pyramidomonas montana** Geitler (**Figs. 36a-d**)

(Huber-Pestalozzi 1961, 18, 2: 9)

Cells elongate ovoid, posterior rounded, truncated square, gradually widened from posterior to anterior; chromatophore massive, two contractile vacuoles present at the top; cells 12-19 µm long and 8-11 µm broad; flagella 4, little more longer than the body length, 13-15 µm long.

Bakerganj, Station No. 6, 08.02.2005.

3. **Collodictyon triciliatum** Carter (**Figs. 23a-b**)

(Iyengar and Desikachary 1981, 181, Fig. 93)

Cells pale green in colour, broadly ovoid, anterior end wide and rounded, posterior end gradually narrowed to a blunt end; protoplast vacuolated; cells 18 µm long and 13 µm wide; flagella 4, long, inserted at the anterior end, about 1-1½ the size of the body length.

Mathbaria, Station No. 6, 22.06.2004.

4. **Tetrachloridium ? allorgei** (Bourr.) Huber-Pestalozzi (**Fig. 25**)

(Huber-Pestalozzi 1961, 31, 5: 23a)

Cells spindle or elongated pear shaped, posterior end rounded, anterior gradually narrowed to a blunt conical end; chromatophore large, parietal plate; cells 13 µm long and 6 µm broad; flagella 4, about 5 µm long.

Mathbaria, Station No. 1, 16.01.2004.

Family: Nephroselmidaceae

5. **Nephroselmis angulata** (Korsch.) Skuja (**Fig. 28**)

(Huber-Pestalozzi 1961, 58, 11: 49a)

Cells laterally depressed, subhexagonal, periplast distinct, firm. Chromatophore large, dark green in colour, completely occupied the cell except the area below the flagella. Cells 6 µm long and 4.5 µm broad; flagella 2, unequal in length, longer one 23 µm and shorter one 7 µm long.

Mathbaria, Station No. 1, 03.05.2004.

6. **Nephroselmis discoidea** Skuja (**Fig. 29**)

(Huber-Pestalozzi 1961, 59, 11: 50)

Cells strongly compressed laterally, to some extent discoid; cells 5 µm long 7 µm wide; flagella 2, unequal in length, longer one 13 µm long and shorter one 9 µm long. Periplast smooth, colourless; chromatophore bowl shaped with a basal pyrenoid, bright green.

Bakerganj, Station No. 6, 29.11.2004.

Family: Chlamydomonadaceae

7. **Polytoma minus** Pascher (**Fig. 33**)

(Huber-Pestalozzi 1961, 497, 104: 692)

Cells elongate ovoid, gradually narrowed towards apex, posterior end broadly rounded. Cells small, 6 µm long and 4 µm broad; flagella 2, long, about 12 µm long. Cell wall not distinct, delicate, without papilla, contractile vacuoles and small starch granules present.

Bakerganj, Station No. 3, 29.11.2004.

8. **Carteria globosa** Kors. (**Figs. 1a-c**)

(Huber-Pestalozzi 1961, 85, 16: 59)

Cells spherical, membrane hyaline and delicate, without papilla; chromatophore large, positioned somewhat in the middle of the cell, anterior portion of the chromatophore reaches closer towards cell wall from where flagella originates. Pyrenoid large, occupied in the basal region. Cells 13-19 µm long, 11-18 µm broad, protoplast 10-15 µm long and 9-14 µm broad; flagella 4, somewhat equal the body length or 1½ times than body length, 11-12 µm long.

Bakerganj, Station No. 4, 12.07.2004, 06.09.2004.

9. **Carteria huberi** Christen (**Fig. 2**)

(Huber-Pestalozzi 1961, 88, 17: 63)

Cells weakly ovoid to broadly ellipsoidal, posterior end widely rounded, also the anterior end widely rounded or slightly tapered. Cell membrane very thin, without papilla. Chromatophore sturdy, pyrenoid round. Cells 10 µm long and 8 µm broad. Flagella 4, somewhat equal to body length or slightly longer, 15 µm long.

Bakerganj, Station No. 8, 09.08.2004.

10. **Carteria peterhofiensis** Kiss. (**Fig. 3**)

(Huber-Pestalozzi 1961, 98, 20: 78A)

Cells ellipsoid-cylindric or ovoid cylindric; anterior widely rounded, extreme top somewhat flat, posterior end also rounded. Cell membrane strong, hyaline, smooth and prominent. Protoplast massive, moved away from the cell membrane, almost placed centrally. Cell 31 µm long and 17 µm broad, protoplast 22 µm long and 15 µm broad; flagella 4, originates from the terminal portion of the protoplast and then crosses the hyaline area further across cell membrane, flagella not always body length, 20 µm long.

Bakerganj, Station No. 8, 01.11.2004.

11. **Carteria radiosa** Korsch. (**Figs. 4a-d**)

(Iyengar and Desikachary 1981, 311, Fig. 178: 1)

Cells spherical, wall prominent and thick, papilla present, flagella arises surrounding papilla. Chloroplast cup shaped, massive, lobed, proceeding radially from a central large pyrenoid. Cells 8-18 µm long and 8-18 µm broad; flagella 4, 12-17 µm long.

Bakerganj, Station No. 8, 29.03.2004, 12.07.2004, 11.07.2005.

12. **Scherffelia deformis** Skuja (**Fig. 30**)

(Huber-Pestalozzi 1961, 133, 26:128a)

Cells pear shaped, posterior end broadly rounded, anterior end narrowly rounded, blunt. Chromatophore 2, light green, laterally placed. Cells 8 µm long and 7 µm broad; flagella 4, 5 µm long.

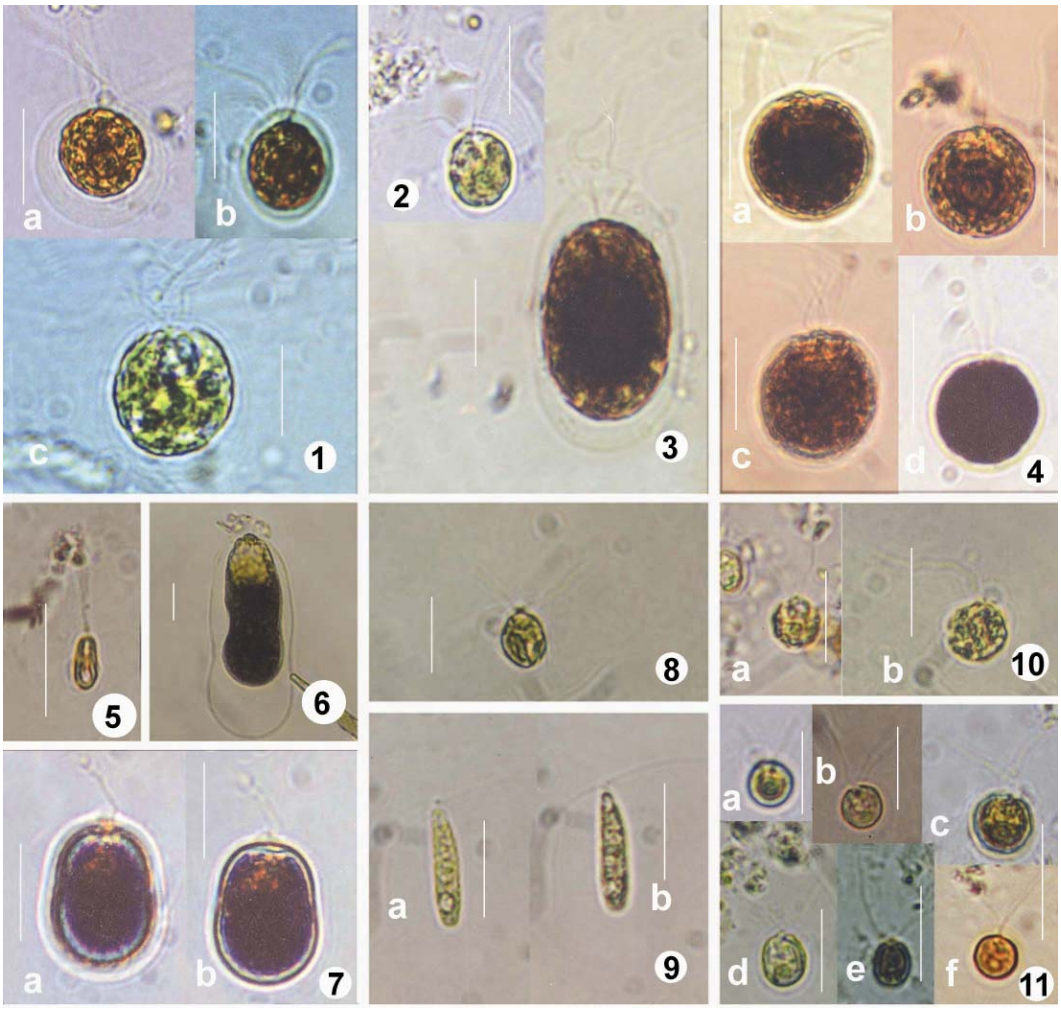
Mathbaria, Station No. 1, 30.01.2004.

13. **Scherffelia pelagica** Skuja **(Fig. 31)**

(Huber-Pestalozzi 1961, 132, 26: 126b)

Cells broadly ovate, posterior end slightly narrowed or rounded, membrane thin, colourless. Chromatophore parietal, light to yellow green without pyrenoid. Cells 8 µm long, 7 µm broad; flagella 4, about equal to body length.

Mathbaria, Station No. 6, 22.06.2004.



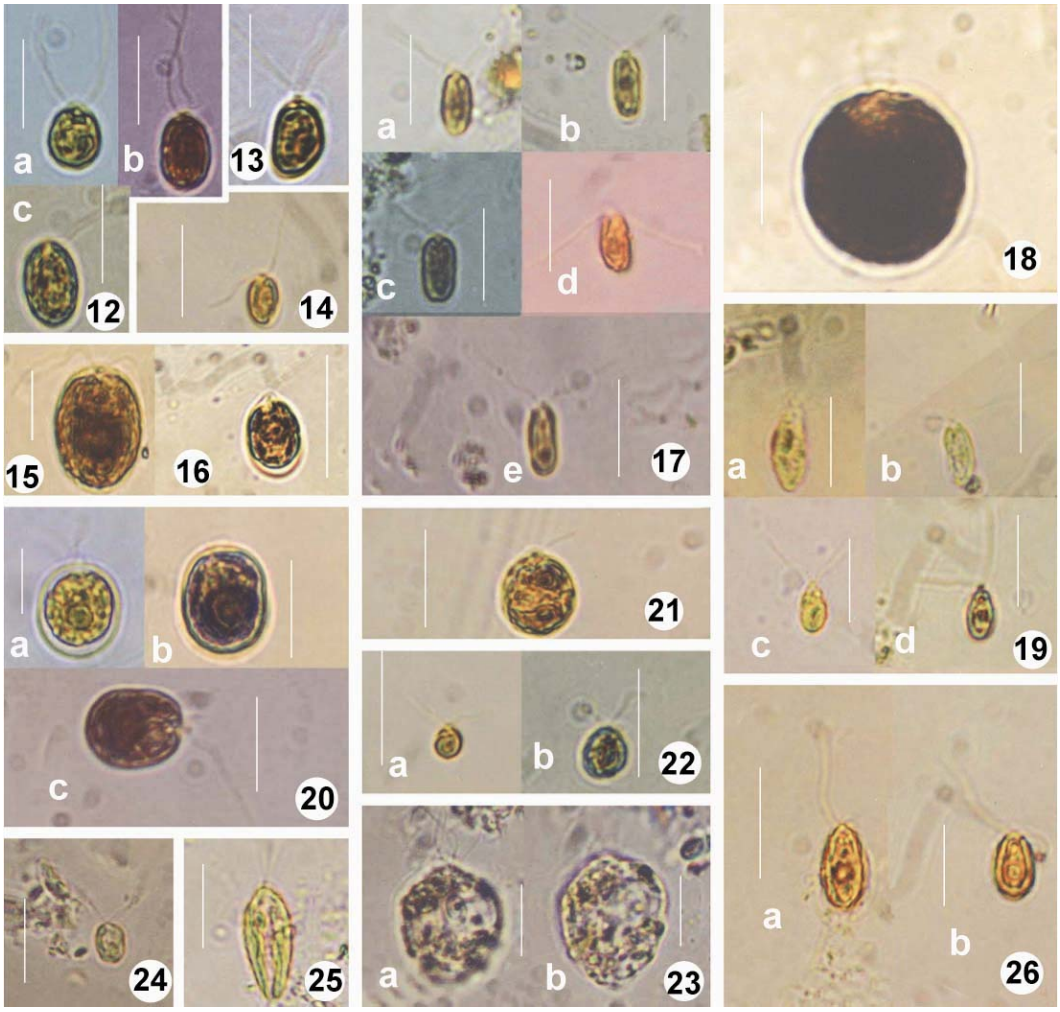
Figs. 1-11. 1a-c. *Carteria globosa*, 2. *C. huberi*, 3. *C. peterhofiensis*, 4 a-d. *C. radiosa*, 5. *Chlamydomonas acidophila*, 6. *Chla. opulenta*, 7. *Chla. angulosa*, 8. *Chla. botryopara*, 9a-b. *Chla. cylindrica*, 10a-b. *Chla. foveolarum*, 11a-f. *Chla. globosa*. (Bars =10 µm).

14. **Chlamydomonas acidophila** Nyg. **(Fig. 5)**

(Huber-Pestalozzi 1961, 361, 71: 440)

Cells relatively small, elongate ovoid, or elliptical or spindle shaped. Cell membrane delicate or fine, papilla absent. Chromatophore delicate, adjacent to the cell wall, central area blank, pyrenoid absent. Cells 6 µm long and 3 µm broad; flagella 2, 8-9 µm long.

Bakerganj, Station No. 6, R-10 (?).



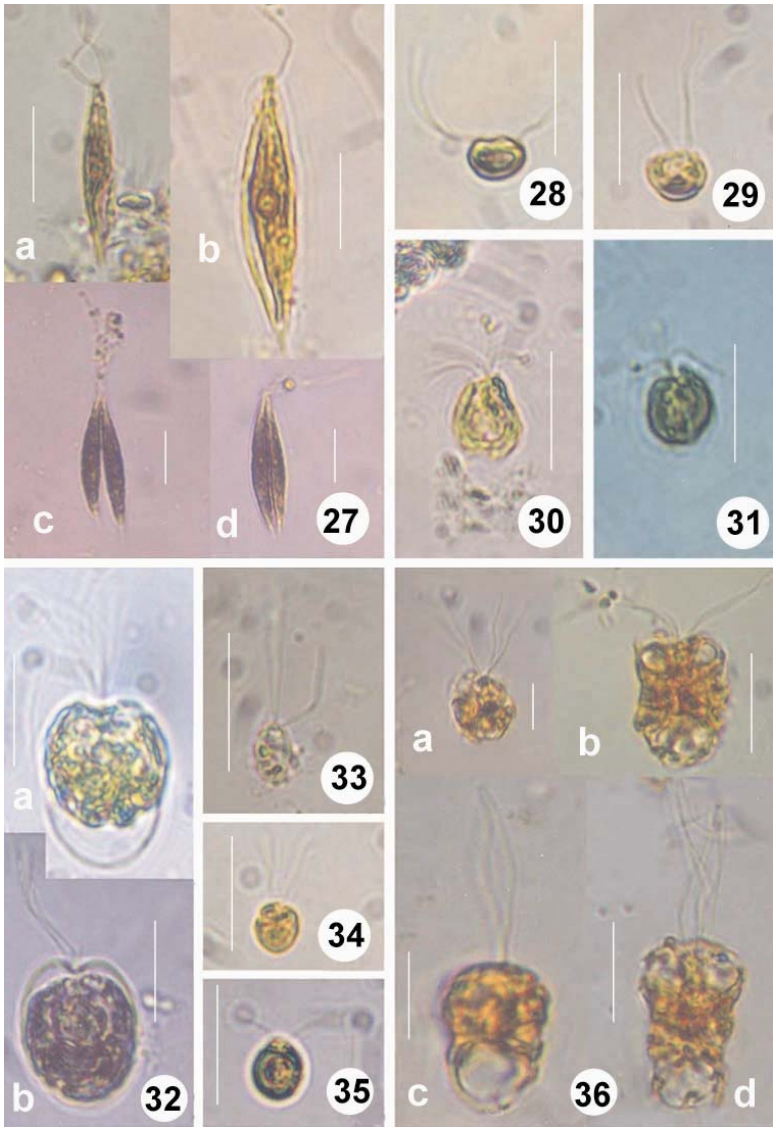
Figs. 12-26. 12a-c. *Chlamydomonas gloeopara*, 13. *Chla. indica*, 14. *Chla. inflata*, 15. *Chla. multitaeniata*, 16. *Chla. elliptica*, 17a-e. *Chla. cylindrus*, 18. *Chla. pertyi*, 19a-d. *Chla. planoconvexa*, 20a-c. *Chla. pulchra*, 21. *Chla. pulsatilla*, 22a-b, 24. *Chla. reinhardi* var. *minor*, 23a-b. *Collodictyon triciliatum*, 25. *Tetrachloridium* ? *allorgei*, 26a-b. *Chlamydomonas speciosa*. (Bars =10 µm).

15. **Chlamydomonas angulosa** Dill **(Fig. 7)**

(Huber-Pestalozzi 1961, 188, 36: 92b)

Cells broadly elliptic, anterior and posterior end widely rounded, membrane shining, strong, prominent, papilla wide. Cells 18 µm long and 13 µm broad; flagella 2, 8 µm long.

Bakerganj, Station No. 1, 29.11.2004.



Figs. 27-36. 27a-d. *Chlorogonium elongatum*, 28. *Nephroselmis angulata*, 29. *N. discoidea*, 30. *Scherffelia deformis*, 31. *S. pelagica*, 32a-b. *Tetraselmis cordiformis*, 33. *Polytoma minus*, 34. *Pyramidomonas inconstans*, 35. *Chlamydomonas iyengari*, 36a-d. *Pyramidomonas montana*. (Bars = 10 µm).

16. **Chlamydomonas botryopara** Rodhe *et* Skuja (**Fig. 8**)

(Huber-Pestalozzi 1961, 305, 62: 373)

Cells spherical ovoid and ellipsoidal, lightly asymmetric, in one side more convex. Flagella body length or 1½ longer than body length, papilla present. Cells 8 µm long and 5 µm broad; flagella 2, 8 µm long.

Mathbaria, Station No. 4, 30.08.2004.

17. **Chlamydomonas cylindrica** Chod. (**Figs. 9a-b**)

(Huber-Pestalozzi 1961, 223, 45: 245)

Cells cylindrical, 4 times longer than breadth, anterior and posterior ends rounded, sometimes from posterior towards anterior end gradually narrowed. Cell length fully occupied by a light green chromatophore. Cells 14 µm long and 3 µm broad; flagella 2, 11 µm long.

Mathbaria, Station No. 3, 31.07.2004.

18. **Chlamydomonas cylindrus** (Pasch.) Gerloff (**Figs. 17a-e**)

(Huber-Pestalozzi 1961, 313, 68: 385)

Cells cylindrical, sometimes weakly bent, about 3 times as long as broad, both posterior and anterior end rounded, cell membrane delicate, papilla present, sometimes it may be absent. Cells 8-9 µm long and 3-4 µm broad; flagella 2, about equal to body length, 5-10 µm long.

Mathbaria, Station No. 4, 30.08.2004.

19. **Chlamydomonas foveolarum** Skuja (**Figs. 10a-b**)

(Huber-Pestalozzi 1961, 293, 59: 342)

Cells somewhat spherical, membrane delicate, colourless, smooth, without terminal papilla. Chromatophore thin, light green. Cells 7-8 µm in diameter; flagella 2, delicate, about double the body size, here 12 µm long,

Mathbaria, Station Nos. 3 & 6; 16.08.2004, 30.08.2004.

20. **Chlamydomonas globosa** Snow (**Figs. 11a-f**)

(Huber-Pestalozzi 1961, 157, 37: 132)

Cells mostly spherical, sometimes weakly ellipsoidal, small, cell membrane prominent, anterior papilla absent. Cells 5-9 µm in diameter; flagella 2, longer than body length, 5-12 µm long.

Bakerganj, Station Nos. 3 & 4, 12.07.2004, 29.11.2004; Mathbaria, Station Nos. 4 & 5, 16.08.2004, 13.09.2004.

21. **Chlamydomonas gloeopara** Rodhe *et* Skuja (**Figs. 12a-c**)

(Huber-Pestalozzi 1961, 276, 56: 330)

Cells broadly elliptic, both the anterior and posterior ends rounded. Cell membrane delicate, anterior papilla may be absent, if present weakly developed. Chromatophore cup-shaped, pyrenoid lateral. Cells 8-10 µm long, 6-7 µm broad; flagella 2, prominent, about equal to body length or little longer, 9-15 µm long.

Bakerganj, Station Nos. 1 & 2, 06.09.2004, 04.10.2004, 29.11.2004.

22. **Chlamydomonas indica** Mitra (**Fig. 13**)

(Huber-Pestalozzi 1961, 423, 89: 554; Iyengar and Desikachary 1981, 287, Fig. 162)

Cells ellipsoid to oval, posterior end rounded but not uniformly, posterior sub-laterally depressed, papilla present, prominent. Chloroplast thin, occupied cell fully. Cells 10 µm long and 6 µm broad; flagella 2, emerging from the margin of the papilla, 10 µm long.

Bakerganj, Station No. 6, 09.08.2004.

23. **Chlamydomonas inflata** Skv. (**Fig. 14**)

(Huber-Pestalozzi 1961, 430, 90: 569)

Cells elliptical or ovoid, membrane very thin, nucleus in the middle. Cell 6 µm long, 4 µm broad; flagella 2, 8 µm long.

Mathbaria, Station No. 6, 19.07.2004.

24. **Chlamydomonas iyengari** Mitra (**Fig. 35**)

(Iyengar and Desikachary 1981, 274, 154: 1)

Cells spherical to somewhat oblong, wall thin, posterior end broadly rounded, anterior end gradually narrowed to a truncate transparent papilla. Cell 7 µm long, 5 µm broad; flagella 2, 6 µm long.

Mathbaria, Station No. 1, 30.08.2004.

25. **Chlamydomonas multitaeniata** Kors. (**Fig. 15**)

(Iyengar and Desikachary 1981, 272, 149: 2)

Cells ellipsoid to ellipsoid-cylindric, anterior and posterior poles rounded, papilla prominent, chloroplast large, striated, with a rounded central pyrenoid. Cell 18 µm long and 13 µm broad; flagella 2, not more than body length, 12 µm long.

Bakerganj, Station No. 8, 12.07.2004.

26. **Chlamydomonas opulenta** Pasch. (**Fig. 6**)

(Huber-Pestalozzi 1961, 333, 68: 406)

Cells elongated pear, anterior end smoothly rounded, both the lateral walls of the cell as well as protoplast depressed, then gradually tapered to an almost narrowed but blunt end; cell wall delicate, transparent but prominent. Chloroplast massive, drawn quite a distance from the posterior end towards the inner half of the cell. Cell 71 µm long and 28 µm broad; protoplast 51 µm long and 18 µm broad; flagella not found.

Mathbaria, Station No. 4, 30.08.2004.

27. **Chlamydomonas elliptica** Korsch. (**Fig. 16**)

(Huber-Pestalozzi 1961, 270, 54: 317)

Cells ellipsoidal, both sides rounded, membrane delicate, papilla thick, sharp. Chromatophore massive with a large pyrenoid. Cell 15 µm long and 9 µm broad; flagella 2, half of the body length.

Mathbaria, Station No. 3, 16.08.2004.

28. **Chlamydomonas pertyi** Gor. (**Fig. 18**)

(Huber-Pestalozzi 1961, 155, 27: 129)

Cells spherical, both sides rounded, membrane thin, hyaline, double layered. Chromatophore massive. Cells 22 µm long and 21 µm broad, body wall somewhat warty; flagella not found.

Mathbaria, Station No. 1, 03.05.2004.

29. **Chlamydomonas planoconvexa** Lund (**Figs. 19a-d**)

(Huber-Pestalozzi 1961, 318, 65: 387F; Iyengar and Desikachary 1981, 292, 165: 8-9)

Cells elliptic or lanceolate, dorsiventral, symmetrical in one view, both anterior and posterior ends rounded or pointed, anterior somewhat narrower, papilla small, laterally placed. Cells 6-10 µm long and 3-4 µm broad; flagella 2, as long as body length, 8-13 µm long.

Bakerganj, Station No. 2, 15.06.2004; Mathbaria, Station No. 6, 22.06.2004.

30. **Chlamydomonas pulchra** Skv. (**Figs. 20a-c**)

(Huber-Pestalozzi 1961, 233, 46: 264)

Cells broadly elliptic, cell membrane firm, papilla absent. Pyrenoid single, large, round, placed almost in the middle. Cells 12-13 µm long and 10-11 µm broad; flagella not found.

Bakerganj, Station Nos. 1 & 4, 12.07.2004, 13.06.2005; Mathbaria, Station No. 5, 16.08.2004.

31. **Chlamydomonas pulsatilla** Woll. (**Fig. 21**)

(Huber-Pestalozzi 1961, 156, 27: 131)

Cells broad, elliptic-ovoid, posterior widely rounded, membrane often firm. Cells 10 µm long and 9 µm broad; flagella 2, closer to body length, 6 µm long.

Bakerganj, Station No. 1, 01.11.2004.

32. **Chlamydomonas reinhardi** Dang. var. **minor** Nygaard (**Figs. 22a-b, 24**)

(Huber-Pestalozzi 1961, 164, 29: 144A)

Cells spherical to short-ellipsoidal, smaller in size, anterior and posterior ends broadly rounded or slightly narrowed, membrane delicate, no true-papillae but plasma-papilla present. Cells 4-6 µm long and 3-5 µm broad; flagella 2, 5 µm long.

Bakerganj, Station No. 2, 02.06.2004; Mathbaria, Station No. 6, 19.07.2004.

33. **Chlamydomonas speciosa** Korsch. (**Figs. 26a-b**)

(Huber-Pestalozzi 1961, 230, 46: 259a)

Cells elliptical to elongate ovoid, both the anterior and posterior ends blunt or the posterior may be broadly rounded, membrane delicate but easily visible, anterior portion not very sharply narrowed. Cells 8-10 µm long and 5 µm broad; flagella 2, about equal to body length or little shorter, 10 µm long.

Bakerganj, Station No. 1, 12.07.2004.

34. **Chlorogonium elongatum** Dang. (**Figs. 27a-d**)

(Huber-Pestalozzi 1961, 470, 97: 645m)

Cells elongated, spindle form, shape highly variable, 9-15 times as long as broad, posterior end pointed, sharp, hyaline; chromatophore large, free at the posterior end, pyrenoid single, large. Cells 28-38 µm long and 3-5 µm broad; flagella 2, somewhat equal to half of the body length, 7-15 µm long.

Bakerganj, Station Nos. 1 & 6, 12.07.2004, 27.01.2005.

35. **Tetraselmis cordiformis** (Carter) Stein (**Figs. 32a-b**)

(Dillard 1989, 23, 4: 1)

Cells cordiform, anteriorly broadened and moderately compressed, anterior end posses a small depression, papilla absent; chloroplast a massive cup, pyrenoid single. Cells 16-17 µm long and 12-14 µm braod; flagella 4, 10-12 µm long.

Bakerganj, Station No. 8, 09.08.2004, 29.11.2004.

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