Bangladesh J. Plant Taxon. **13**(2): 111-129, 2006 (December)

HYDROBIOLOGICAL STUDIES WITHIN THE TEA GARDENS AT SRIMANGAL, BANGLADESH. VI. DESMIDS (*XANTHIDIUM*, *ARTHRODESMUS*, *STAURODESMUS* AND *STAURASTRUM*)

A.K.M. NURUL ISLAM AND HASEEB MD. IRFANULLAH[1]

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

Key words: Acidic habitats, Species diversity, Conservation, Phytoplankton, New records

Abstract

In this last instalment of the series, 78 desmid taxa belonging to four genera, namely *Xanthidium* (8 taxa), *Arthrodesmus* (3 taxa), *Staurodesmus* (11 taxa) and *Staurastrum* (56 taxa) have been recorded from different aquatic habitats located within the tea gardens at Srimangal, Maulvi Bazar. Of these, nine are described as new records for Bangladesh. An overall assessment of the algal flora of the study area reveals desmids as the single largest group consisting of 230 taxa out of 421 recorded algal taxa. The paper comments on the conservation potentials of the studied aquatic habitats as monitoring tools of land use pattern like tea-gardening.

Introduction

In a series of hydrobiological papers, Islam and Irfanullah have recently described the aquatic macrophytes (Islam and Irfanullah 2000) and the major proportion of the algal flora (Islam and Irfanullah 2005a, b, c, 2006) of some selected habitats within the tea gardens at Srimangal, Maulvi Bazar District. The present paper is the concluding instalment of this series dealing with four desmid genera, namely, *Xanthidium, Arthrodesmus, Staurodesmus* and *Staurastrum*, from these aquatic habitats.

Materials and Methods

The studied water bodies (described in Islam and Irfanullah 2000), namely, Baraoora Lake, the Burburia River, ditches and paddy fields were mainly acidic (Islam and Irfanullah 2005a). A total of 120 algal samples were collected in different seasons of 1996 and 1997: winter (9 January 1996 and 6 January 1997), spring (18 March 1997), rainy season (20 July 1997) and autumn (20 October 1997). The methods of sample collection, preservation and subsequent examination were described by Islam and Irfanullah (2005a).

Taxonomic enumeration

This study revealed 78 desmid taxa belonging to four genera, of which nine are new records for Bangladesh. The new records are marked with asterisks. Eighteen desmid taxa belonging to the mentioned four genera have already been reported from this area by the

[1]Corresponding author. Present address: The World Conservation Union (IUCN), Bangladesh Country Office, House 11, Road 138, Gulshan 1, Dhaka-1212, Bangladesh. E-mail: hmirfanullah@yahoo.co.uk

same authors as new records for Bangladesh (Islam and Irfanullah 1998, 1999), thus are not marked in this account. Remaining other taxa are briefly described along with their spatial and temporal occurrence, and abundance.

Class: Chlorophyceae; Order: Zygnematales; Family: Desmidiaceae
Genus: Xanthidium Ehrenberg

1. **X. acanthophorum** Nordst. (Pl. **1**, Fig. **4**)
(Islam 1970, 928, 14: 4)
L. csp. 59.4 µm, L. ssp. 44.5 µm, W. csp. 46 µm, W. ssp. 37.8 µm, I. 12 µm. Lake (autumn 1997) and river (spring 1997); rare.

2. **X. burkillii** W. & W. fa. (Pl. **1**, Fig. **5**)
L. csp. 74.2-78.3 µm, L. ssp. 52.6-54 µm, W. csp. 87.7; W. ssp. 59.4-61.4 µm. I. 23 µm. Differs from Islam and Haroon (1980, 582, 16: 232) in the ornamentations at front view. Lake; winter 1996; few.

3. **X. hastiferum** Turner var. **javanicum** (Nordst.) Turner
(Islam and Irfanullah 1999, 103, 3: 31)
Lake; autumn 1997; rare.

4. **X. hastiferum** var. **javanicum** fa. **planum** Turner
(Islam and Irfanullah 1999, 103, 3: 30)
Lake; autumn 1997; few.

5. **X. spinosum** (Josh.) W. & W. fa. (Pl. **1**, Fig. **2**)
L. ssp. 50 µm, W. ssp. 48.6 µm, W. csp. 54 µm, I. 25.6 µm. Ten pairs of spine not regularly arranged as described by Islam and Haroon (1980, 584, 16: 226-227). Lake (winter 1996 and spring 1997; few) and river (winter 1997; rare).

6. **X. spinosum** (Josh.) W. & W. var. (Pl. **1**, Fig. **3**)
L. 47.2 µm, W. ssp. 44.5 µm, W. csp. 48.6 µm, I. 24.3 µm. Small spines are irregularly, sparsely distributed all over the cell surface. River; spring 1997; rare.

7. **X. urniforme** (W. & W.) Scott & Croasdale (Pl. **1**, Fig. **1**)
(Islam and Haroon 1980, 586, 13: 177)
L. csp. 44.5 µm, L. ssp. 41.8 µm, W. csp. 41.8-44.5 µm, W. ssp. 39 µm, t. csp. 25.6 µm, t. ssp. 23 µm, I. 17.5 µm. Paddy field and river; autumn 1997; few to rare.

8. **Xanthidium** sp. (Pl. **1**, Fig. **6**)
L. csp. 61 µm, L. ssp. 47 µm, depth 23.5-24.7 µm. River; spring 1997; rare.

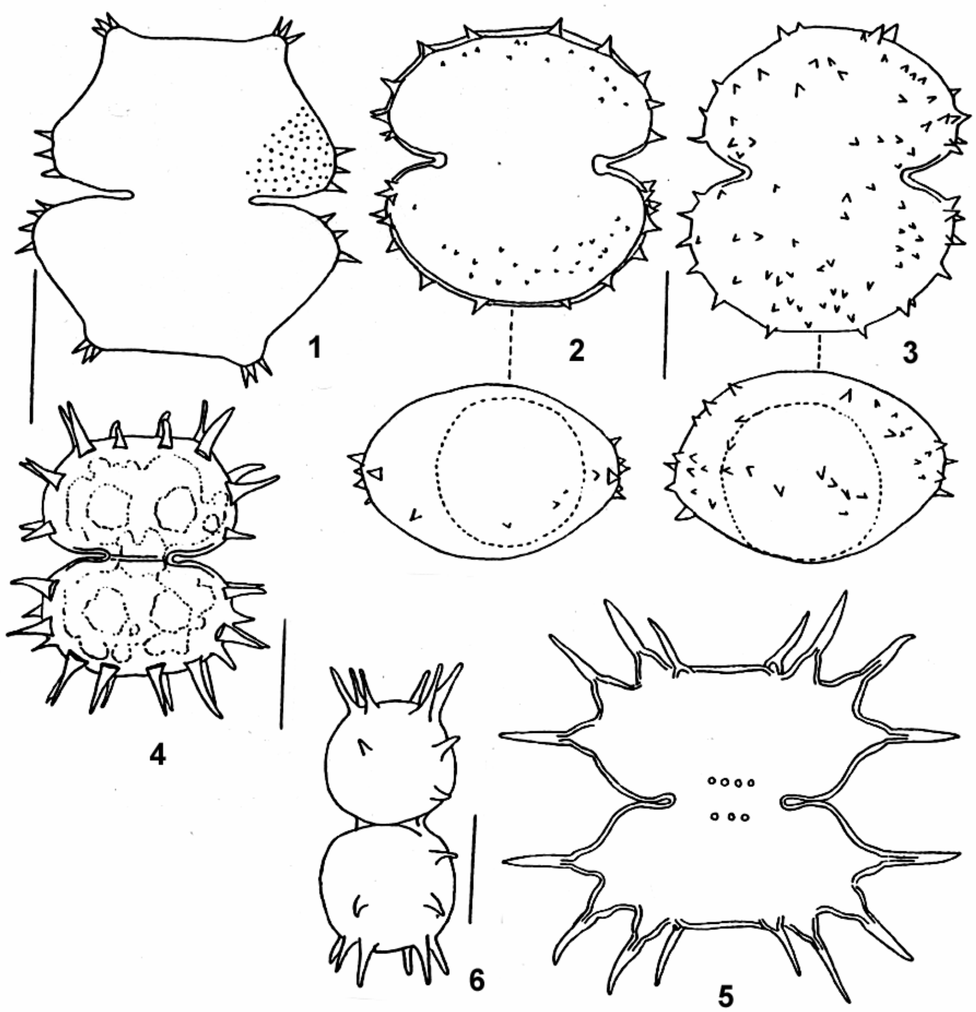

Plate 1 (Figs. 1-6)
1. *Xanthidium urniforme*, 2. *X. spinosum* fa., 3. *X. spinosum* var., 4. *X. acanthophorum*, 5. *X. burkillii* fa., 6. *Xanthidium* sp. [Scales = 20 µm]

Genus: Arthrodesmus Ehrenberg

9. **A. asperies** Scott & Croasdale fa.
(Islam and Irfanullah 1999, 95, 2: 17-18)
Lake; winter 1996; few.

10. ***A. curvatus** Turner var. **latus** Scott & Prescott (Pl. **2**, Fig. **8**)
(Scott and Prescott 1961, 76, 33: 1-3)
L. 36.4 µm, W. csp. 70.2-73 µm, W. ssp. 39-41.8 µm, I. 13.5 µm. Lake; winter 1996; common.

11. **A. curvatus** Turner fa. (Pl. **2**, Fig. **7**)

L. 36.4 µm, W. csp. 64.8-66 µm, W. ssp. 35-37.8 µm, I. 8 µm. Our form differs from Hirano (1972, 142, 7: 3) in narrow isthmus and angular sides. Side's angles are comparable with Corasdale and Scott's *Staurodesmus indentatus* (W. & W.) Teil. (1976, 542, 12: 1). Lake; winter 1996; few.

Genus: Staurodesmus Teiling

12. **Std. dejectus** (Bréb.) Teil. var. **dejectus** fa.
(Islam and Irfanullah 1999, 96, 4: 45-46)
Lake; winter 1996; rare.

13. **Std. dickiei** (Ralfs) Lillier var. **circularis** (Turner) Croasdale
(Islam and Irfanullah 1999, 96, 4: 39-40)
Lake; autumn 1997; common.

14. **Std. dickiei** var. **circularis** fa.
(Islam and Irfanullah 1999, 97, 4: 41-42)
Lake; winter 1996 and 1997; rare to common.

15. **Std. dickiei** var. **maximus** (W. West) Thom.
(Islam and Irfanullah 1999, 97, 4: 37-38)
Lake; winter 1996; common.

16. **Std. hebridarus** (W. & W.) Förster var. **hebridarus**
(Islam and Irfanullah 1999, 98, 4: 43-44)
Lake; winter 1997; few.

17. **Std. megacanthus** (Lund.) Thunk. (Pl. **2**; Fig. **12**)
(Ling and Tyler 1986, 53, 26: 5-7)

L. 46 µm, W. csp. 58.8-68.2 µm, W. ssp. 44.7-50.5 µm, I. 11.8 µm. Lake; winter 1996; few.

18. **Std. pachyrhynchus** (Nordst.) Teiling
(Islam and Irfanullah 1998, 94, 2: 16)
Lake; winter 1997; few.

19. **Std. unicornis** (Turner) Thomasson var. **ceylanicum** W. & W. fa.
(Islam and Irfanullah 1999, 98, 3: 32-33)
Lake; autumn 1997; few.

20. **Std. unicornis** (Turner) Thomass. var. **gracilis** (Iyenger & Vimala Bai) Teil.
(Croasdale and Scott 1976, 543, 14: 3) (Pl. **2**, Fig. **10**)

L. 30.3 µm, W. csp. 34.3-36.4 µm, W. ssp. 25.6-28.3 µm, I. 7.4 µm. Lake; winter 1996; few.

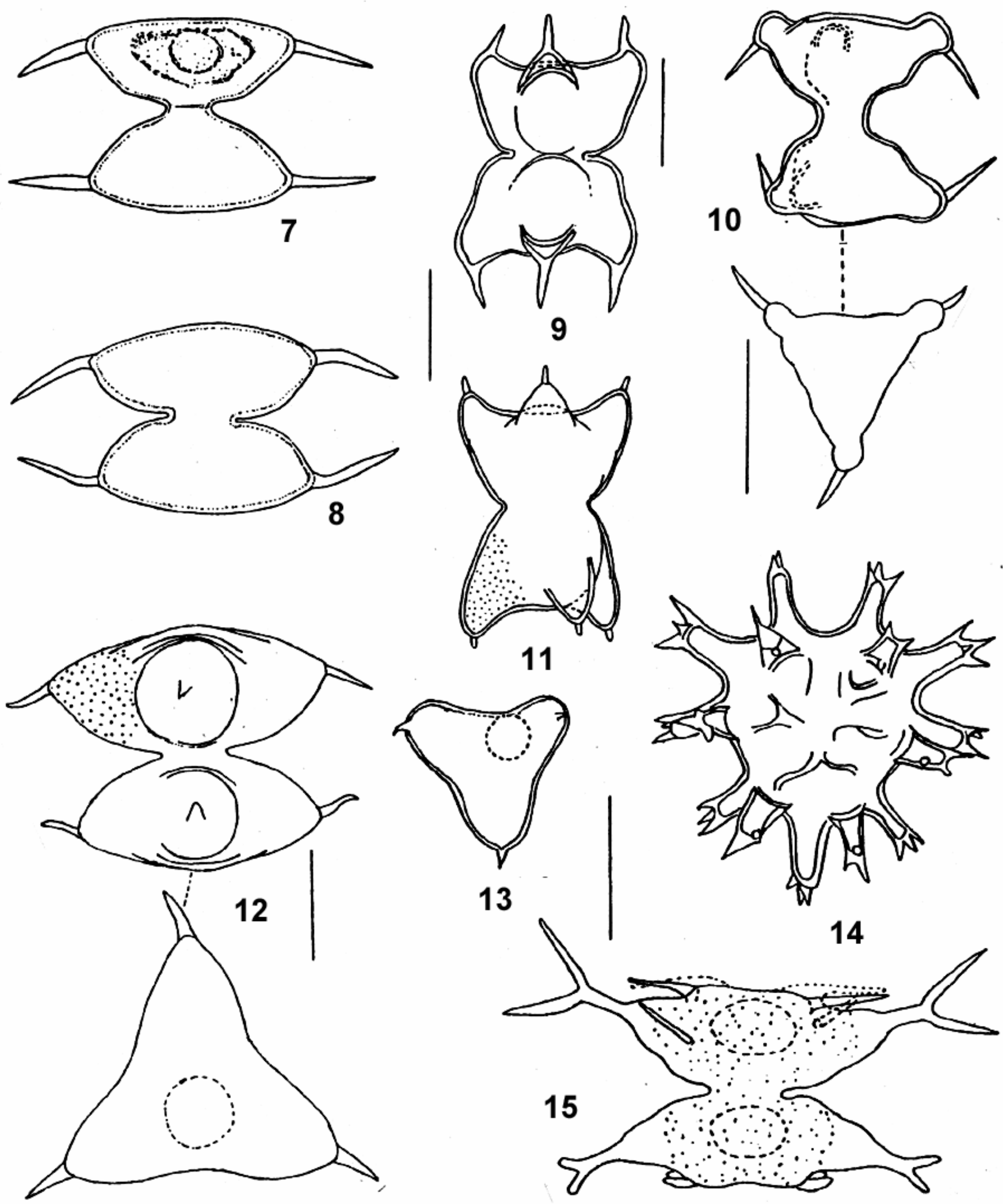

Plate 2 (Figs. 7-15)

7. *Arthrodesmus curvatus* fa., 8. *A. curvatus* var. *latus*, 9 & 11. *Staurastrum leptodermum* var. *ikapoae*, 10. *Staurodesmus unicornis* var. *gracilis*, 12. *Std. megacanthus*, 13. *Staurastrum* sp., 14. *St. leptacanthum* var. *brachyurum*, 15. *St. freemanii* fa. [Scales = 20 µm]

21. **Staurodesmus** sp. (Pl. **3**, Fig. **26**)

L. 27.5 µm, W. 22.5-25 µm, I. 11.7 µm. Granules are concentrically arranged on each arm as well as on the poles. Shape is similar to *Std. pachyrhynchus* (Nordst.) Teiling (Islam and Irfanullah 1998, 94, 2: 16). Lake; winter 1997; very rare.

22. **Staurodesmus** sp. (Pl. **7**, Fig. **70**)

L. 27.5 µm, W. csp. 25.8-27.5 µm, I. 7.5 µm. Lake; winter 1997; rare.

Genus: Staurastrum Meyen

23. **St. alternans** Bréb.

(Islam and Irfanullah 1999, 94, 2: 11-13)

Lake; autumn 1997; rare.

24. **St. alternans** Bréb. fa. (Pl. **4**, Fig. **37**)

L. 27 µm, W. 25 µm, I. 8.5 µm. River; spring 1997; rare.

25. **St. bifidum** (Ehr.) Bréb. (Pl. **7**, Figs. **59** & **60**)

(Ling and Tyler 1986, 38, 28: 17 & 18)

L. 43.2 µm, W. csp. 63.4-68.8 µm, W. ssp. 40.5-43.2 µm, I. 14-16 µm, cell wall punctuate, divergent processes on each arm tip. Ours are larger than Ling and Tyler's specimens. Lake; winter 1996; common.

26. **St. bifidum** (Ehr.) Bréb. fa. (Pl. **3**, Fig. **28**)

L. 32.4-37.8 µm, W. csp. 32.4-46 µm, W. ssp. 28.3-32 µm, I. 13.5-14.8 µm; smooth wall, flat poles. The distance between the level of spines and the level of isthmus is twice as much the distance between the level of spines and the level of the pole of a semicell. Lake (winter 1997, common) and river (spring 1997, few).

27. **St. brevispinum** Bréb. fa. (Pl. **7**, Fig. **68**)

L. 25 µm, W. csp. 29-30 µm, W. ssp. 26.7-28 µm, I. 5.8 µm. Semi-cells broader and length-wise compressed compare with Hirano's (1959a, 289, 38: 7) material. Lake; winter 1996; rare.

28. **St.** ? **cerastes** Lund. (Pl. **6**, Fig. **48**)

(Hirano 1959b, 371, 50: 1)

L. 37.8 µm, W. cpr. 50.5 µm, I. 7.4 µm, t. 9.4 µm. Lake; autumn 1997; rare.

29. **St. ceylanicum** W. & W.

Paddy field; autumn 1997; few.

30. **St. coarctatum** Bréb. var. **subcurtum** Nordst. (Pl. **3**, Fig. **27**)

(Islam and Irfanullah 1999, 96, 2: 15 & 16)

Lake; winter 1996; few.

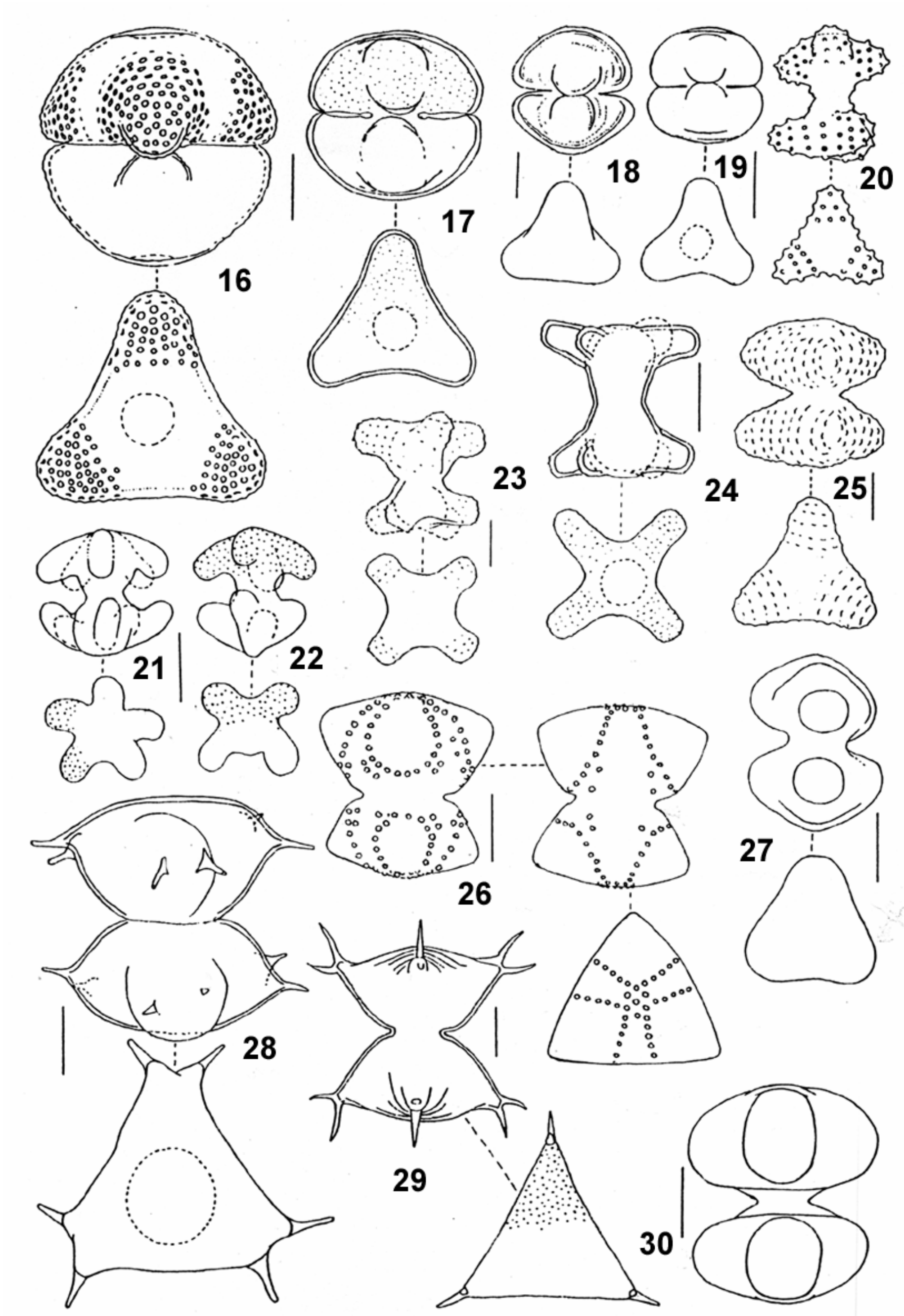

Plate 3 (Figs. 16-30)

16-18. *Staurastrum orbiculare* var. *depressum*, 19. *St. retusum* var. *boreale,* 20. *St. disputatum* var. *sinense* fa., 21 & 22. *Staurastrum* sp., 23. *St. disputatum* var. *sinense*, 24. *St. disputatum* var. *extensum*, 25. *St. punctulatum*, 26. *Staurodesmus* sp., 27. *Staurastrum coarctatum* var. *subcurtum* (after Islam and Irfanullah, 1999), 28. *St. bifidum* fa., 29. *St. ensiferum*, 30. *Staurastrum* sp. [Scales = 10 µm]

31. ***St.** ? **crenulatum** (Näg.) Delp. (Pl. **6**, Fig. **53**)
(Scott and Prescott 1961, 88, 59: 10)
L. 25 µm, W. csp. 37.5 µm, W. ssp. 30.8 µm, I. 8 µm. Lake; winter 1997; few.

32. ***St.** ? **cyclacanthum** W. & W. (Pl. **6**, Fig. **54**)
W. csp. 48.6-52.6 µm, W. ssp. 40.5-43.2 µm, I. 8 µm. Top view is similar to *St. cyclacanthum* var. *armigerum* of Scott and Prescott (1961, 89, 57: 1-3). Lake; winter 1996; rare.

33. **St. disputatum** W. & W. var. **extensum** (Borge) W. & W. (Pl. **3**, Fig. **24**)
(Islam and Haroon 1980, 588, 17: 238 & 239)
L. 24.3 µm, W. 27.7 µm, I. 8 µm. River; spring 1997; few.

34. **St. disputatum** W. & W. var. **sinense** (Lütkm.) W. & W. (Pl. **3**, Fig. **23**)
(Skuja 1949, 157, 36: 1 & 2)
L. cpr. 27 µm, W. cpr. 27-28.3 µm. I. 10.8 µm. Lake (winter 1996) and river (spring 1997); few.

35. **St. disputatum** var. **sinense** fa. (Pl. **3**, Fig. **20**)
L. 20.2 µm, W. 17.5 µm, I. 5.4 µm. Comparable with Hirano (1959b, 298, 39: 3). Paddy field; autumn 1997; rare.

36. **St. ensiferum** Turner (Pl. **3**, Fig. **29**)
(Turner 1892, 109, 14: 22; Ling and Tyler 1986, 40, 39: 23-26)
L. ssp. 48.6 µm, W. csp. 46-48 µm, W. ssp. 35 µm, I. 9.4 µm. River; spring 1997; few.

37. **St. forficulatum** Lund. (Pl. **4**, Fig. **34**)
(Islam and Haroon 1980, 588, 21: 328 & 329)
L. csp. 27 µm, L. ssp. 23 µm, W. csp. 23 µm, W. ssp. 20.2 µm, I. 12 µm. Paddy field; autumn 1997; common.

38. **St. freemanii** W. & W.
(Islam and Irfanullah 1998, 94, 2: 17)
Lake; autumn 1997; rare.

39. **St. freemanii** W. & W. fa. (Pl. **2**, Fig. **15**)
L. 28.3 µm, W. cpr. 70.2 µm, W. spr. 37.8 µm, I. 9.4 µm, t. spr. 17.5 µm, t. cpr. 36.4 µm. Granulated cell wall; two additional spines alternately located on each semicell. Paddy field; autumn 1997; rare.

40. **St. gemelliparum** Nordst. (Pl. **4**, Fig. **35**)
(Islam and Haroon 1980, 588, 20: 324 & 325)
L. csp. 25.6 µm, L. ssp. 20.2 µm, W. csp. 24.3 µm, W. ssp. 16.2 µm, I. 8 µm. Young cell (?). Lake; winter 1997; rare.

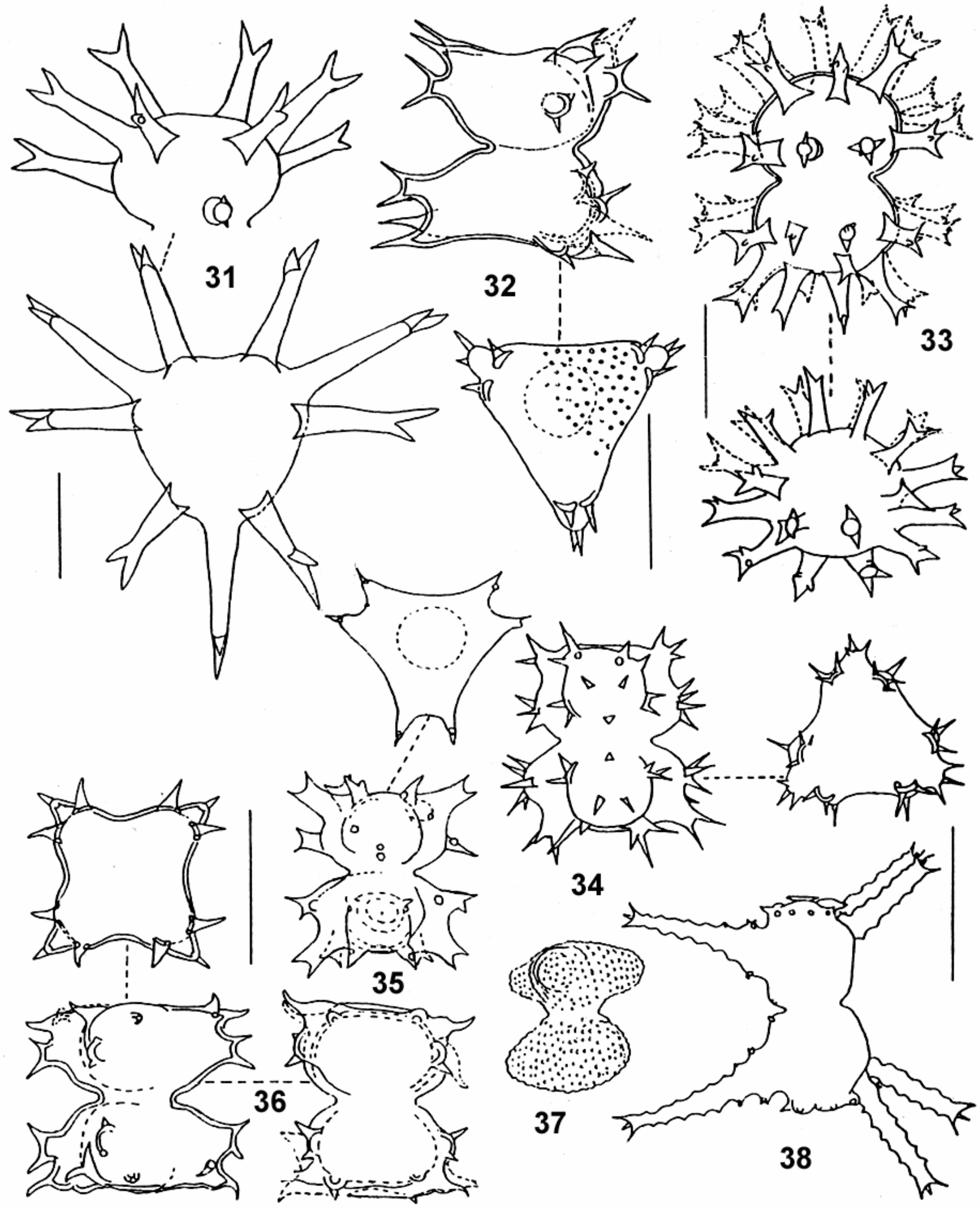

Plate 4 (Figs. 31-38)

31. *Staurastrum tohopekaligense*, 32 & 36. *St. quadrangulare* var. *contectum*, 33. *St. leptacanthum* var., 34. *St. forficulatum*, 35. *St. gemelliparum*, 37. *St. alternans* fa., 38. *St. pseudosebaldi* var. *planctonicum*. [Scales = 20 µm]

41. ***St. glabrum** (Ehr.) Ralfs var. **glabrum** (Pl. **7**, Fig. **69**)
(Scott *et al.* 1965, 53, 11: 154)

L. 25-29.7 µm, W. cpr. 39-46 µm, W. spr. 29.7-37.8 µm, I. 6-6.7 µm. Also comparable with Turner's (1892, 17: 12) *St. curvirostrum* Turner. Lake; winter 1996; few.

42. **St. gladiosum** Turner (Pl. **7**, Fig. **63**)
(Ling and Tyler 1986, 41, 32: 24 & 25)

L. csp. 37.8 µm, L. ssp. 30.3 µm, W. csp. 41 µm, W. ssp. 27 µm, I. 8.8 µm. Paddy field; autumn 1997; rare.

43. **St. javanicum** (Nordst.) Turner var. **apiculiferum** (Turner) Krieger
(Islam and Irfanullah 1998, 94, 2: 18-20)
Lake; winter 1996; very rare.

44. **St. laceratum** Turner fa. (Pl. **6**, Fig. **56**)

W. csp. 54-58.7 µm, I. 14.8 µm. Differs from Islam and Haroon (1980, 590, 8: 125 & 126) in arms having 3 terminal spines and 3-4 dorsal spines instead of 2 on both cases. Lake; winter 1996; rare.

45. **St. leptacanthum** Nordst. var. **leptacanthum**
(Islam and Irfanullah 1999, 96, 2: 14)
Paddy field; autumn 1997; rare.

46. **St. leptacanthum** Nordst. var. **brachyurum** Scott and Grönbl. (Pl. **2**, Fig. **14**)
(Islam and Haroon 1980, 590, 21: 347 & 348)

W. spr. 31 µm, W. cpr. 45.9 µm. Six arms in the upper ring and nine arms in the lower ring. River; spring 1997; rare.

47. **St. leptacanthum** Nordst. var. (Pl. **4**, Fig. **33**)

L. cpr. 59.4 µm, L. spr. 50 µm, W. cpr. 48.6 µm, W. spr. 27 µm, I. 14.8 µm. Bears larger number of arms: the lower ring has 12 and the upper one has 8 arms. River; spring 1997; few.

48. **St. leptocladum** Nordst. var. **cornutum** Wille (Pl. **6**, Fig. **47**)
(Islam and Haroon 1980, 590, 17: 243)
L. 37.8 µm, W. cpr. 85 µm, W. spr. 12 µm, I. 9.4 µm. Lake; winter 1996; common.

49. **St. leptodermum** Lund. var. **ikapoae** (Schmidle) W. & W. (Pl. **2**, Figs. **9** & **11**)
(Grönblad *et al.* 1958, 41, 20: 73 ; Hirano 1972, 149, 6: 8)

Broad form (Fig. 9): L. csp. 54-56.7 µm, L. ssp. 40.5-41.8 µm, W. ssp. 33.7-35 µm, I. 13.5 µm, t. csp. 24.3-21.6 µm. Lake; winter 1996; few. Elongated form (Fig. 11): L. csp. 50 µm, L. ssp. 45 µm, L. pole-pole 31 µm, W. 32.4 µm, I. 13.5 µm. Lake; winter 1997; rare. However, Förster (1964, 33: 14-15) named the elongated form *St. ikapoae* Schm. var. *elongatum* (Grönblad & Scott) Förster.

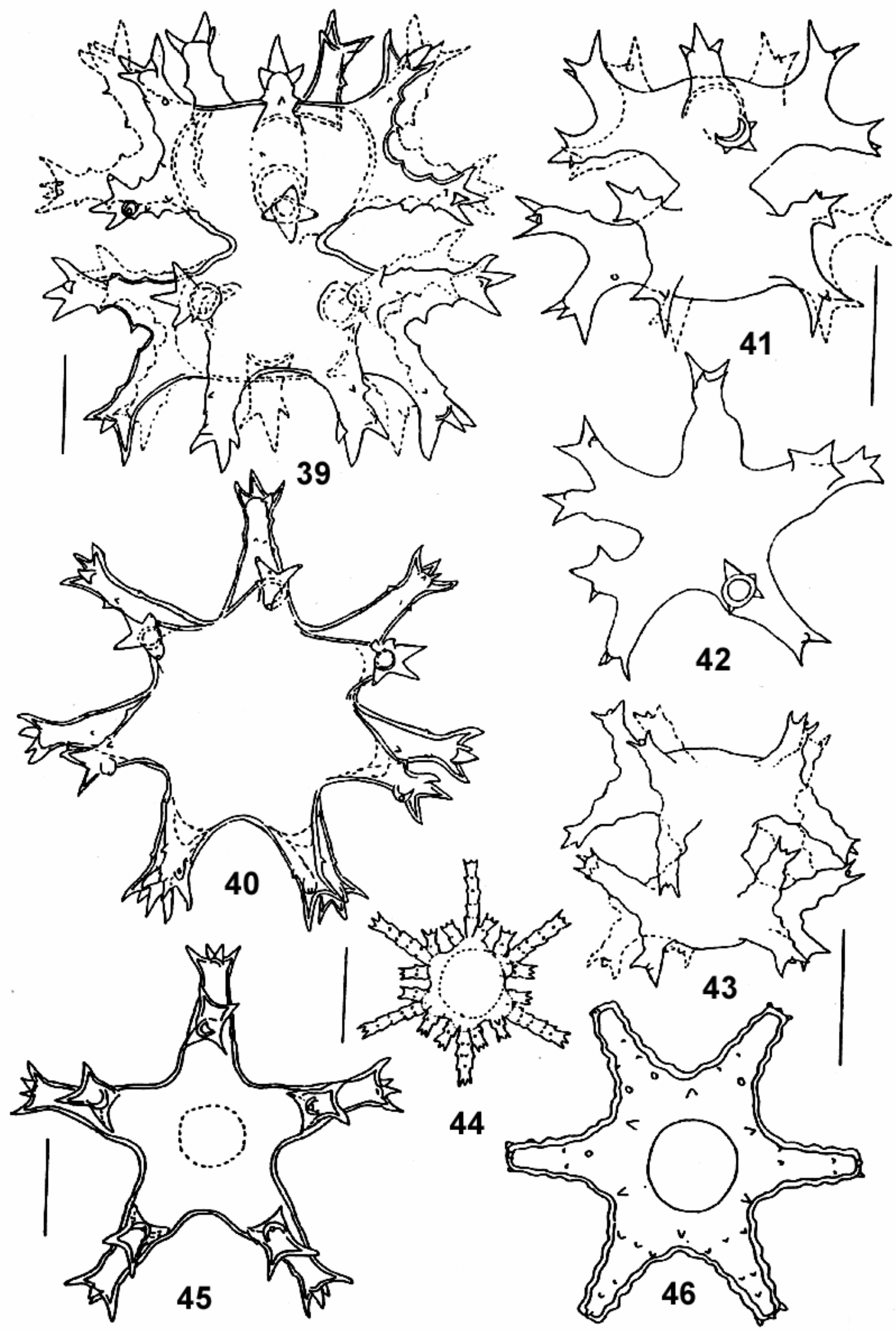

Plate 5 (Figs. 39-46)
39 & 40. *Staurastrum sexangulare* var. *asperum*, 41 & 42. *St. sexangulare* fa., 43. *St. sexangulare* ? var. *bidentatum*, 44. *St.* ? *pinnatum*, 45. *St. sexangulare* var. *subglabrum*, 46. *St. pinnatum* ? var. *subpinnatum*. [Scale = 20 μm]

50. **St. longibrachiatum** (Borge) Gutw. (Pl. **6**, Fig. **50**)
(Ling and Tyler 1986, 42, 31: 24-26)
L. 36.4 µm, W. csp. 64.8-74.2 µm, W. ssp. 60.7-70.2 µm, I. 9.4 µm. Lake; winter 1996 and autumn 1997; few.

51. ***St.** ? **mucronatus** (Ralfs) Croasdale (Pl. **7**, Fig. **62**)
(Förster 1969, 71, 30: 16)
L. 27 µm, W. csp. 35 µm, W. ssp. 25.6-27 µm; each arm is terminated with a small spine directed outward parallel to the flat cell pole. Lake; winter 1997; few.

52. **St. orbiculare** (Ehr.) Ralfs var. **depressum** Roy & Biss. (Pl. **3**, Figs. **16-18**)
(Scott and Prescott 1961, 100, 52: 12; Scott *et al.* 1965, 56, 12: 170; Islam and Haroon 1980, 590, 8: 129 & 130, 17: 253 & 254)
L. 27-38.5 µm, W. 24.3-37.8 µm, I. 6.7-10.8 µm. Pitted cell wall. Lake (winter 1996 and autumn 1997; few to common) and river (spring 1997; few).

53. **St. orbiculare** var. **ralfsii** W. & W.
(Islam and Irfanullah 1998, 95, 2: 14)
Lake; winter 1996; rare.

54. ***St.** ? **peristephes** Scott and Prescott (Pl. **6**, Fig. **55**)
L. 47.2 µm, W. cpr. 56.7 µm, I. 12 µm. The top view is similar to Scott and Prescott's material (1961, 100, 59: 5), but the front view of our specimen was not sufficient to confirm other details. Lake; autumn 1997; common.

55. ***St. perundulatum** Grönbl. (Pl. **7**, Fig. **65**)
(Scott and Prescott 1961, 101, 52: 9; Förster 1969, 90, 36: 7 & 8)
L. 11.5 µm, W. cpr. 34.4 µm, W. spr. 10 µm, I. 6 µm. Lake; autumn 1997; rare.

56. **St. pinnatum** Turner ? var. **subpinnatum** (Sch.) W. & W.
(Islam and Haroon 1980, 590, 20: 320 & 321) (Pl. **5**, Fig. **46**, Pl. **7**, Fig. **66**)
W. 51.6–57.4 µm, I. 14 µm. Lake; winter 1996 (few) and autumn 1997 (rare).

57. **St.** ? **pinnatum** Turner (Pl. **5**, Fig. **44**)
(Islam and Haroon 1980, 590, 19: 290 & 291)
W. cpr. 48.2 µm, W. spr. 18.5 µm, I. 13.5-14 µm. Lake; autumn 1997; rare.

58. ***St. pseudosebaldi** Wille var. **planctonicum** Teil. (Pl. **4**, Fig. **38**)
(Förster 1974, 181, 28: 4)
L. 30.4 µm, W. cpr. 46-52.6 µm, W. spr. 12.2-14.8 µm, I. 8 µm, t. 12.8 µm. Lake; autumn 1997; rare.

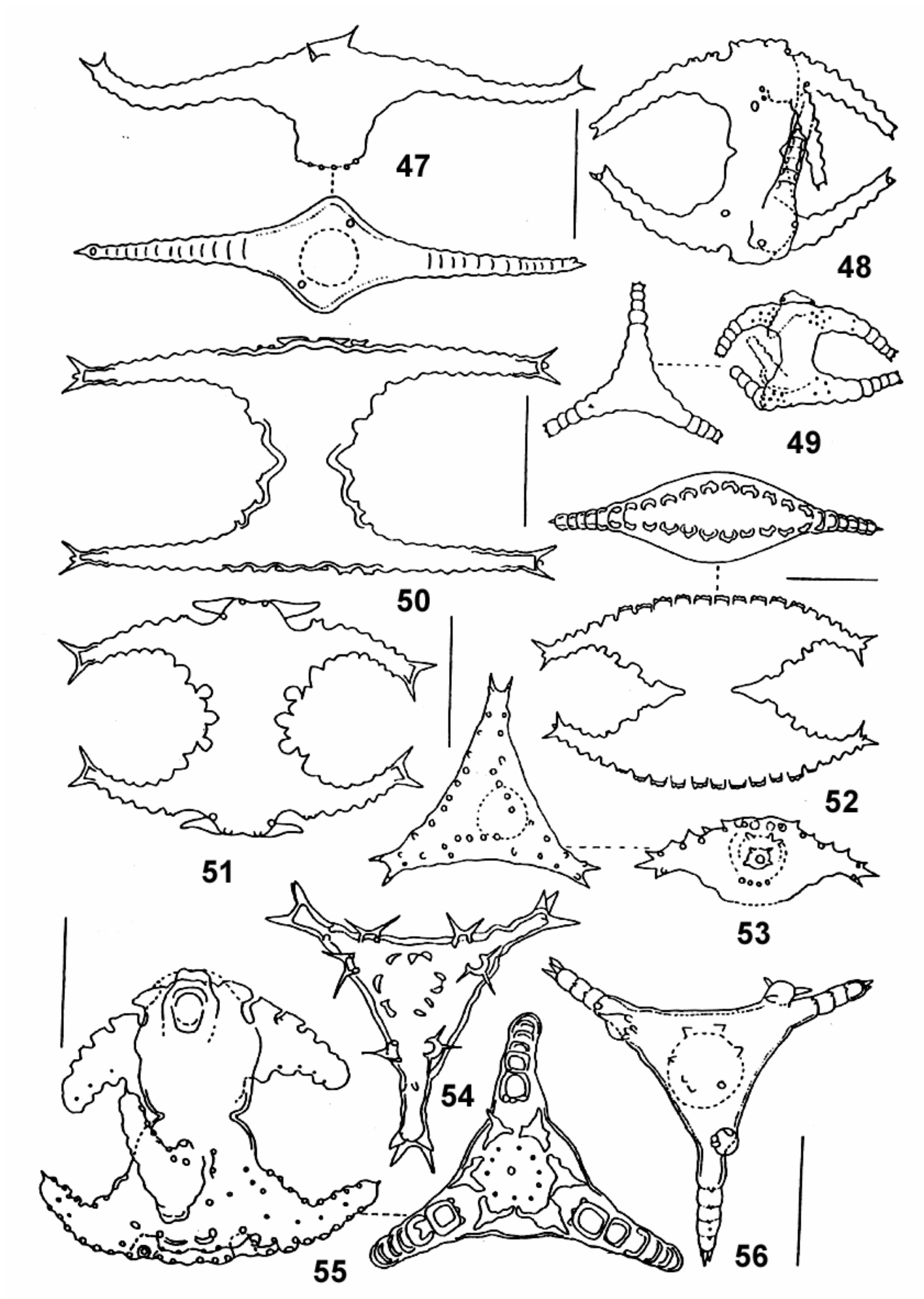

Plate 6 (Figs. 47-56)

47. *St. leptocladum* var. *cornutum*, 48. *St.* ? *cerastes*, 49. *Staurastrum* sp., 50. *St. longibrachiatum*, 51. *St. subsuecicum*, 52. *St. sonthalianum*, 53. *St.? crenulatum*, 54. *St.* ? *cyclacanthum*, 55. *St.* ? *peristephes*, 56. *St. laceratum* fa. [Scales = 20 μm]

59. **St. punctulatum** Bréb. in Ralfs (Pl. **3**, Fig. **25**)
(Scott and Prescott 1961, 104, 52: 14)
L. 27-28.3 µm, W. 31 µm, I. 9.4 µm. River; spring 1997; few.

60. **St. quadrangulare** Bréb. var. **contectum** (Turner) Grönbl. (Pl. **4**, Figs. **32** & **36**)
(Islam and Haroon 1980, 592, 21: 330 & 331)
L. csp. 33.7 µm, L. ssp. 27 µm, W. csp. 33-40.5 µm, W. ssp. 23 µm, I. 10-11.5 µm. Lake; winter 1996; few.

61. **St. retusum** Turner var. **boreale** W. & W. (Pl. **3**, Fig. **19**)
(Ling and Tyler 1986, 44, 29: 21 & 22)
L. 17.5 µm, W. 16.7 µm, I. 5.8. Lake; winter 1996; common.

62. **St. sexangulare** Lund. var. **asperum** Playf. (Pl. **5**, Figs. **39** & **40**)
(Scott and Prescott 1961, 107, 45: 1-3; Islam 1970, 931, 17: 18)
L. cpr. 89 µm, L. spr. 56.7 µm, W. cpr. 94.5 µm, W. spr. 43.2 µm, I. 19 µm, t. cpr. 81 µm, t. spr. 35 µm. River; spring 1997; few.

63. **St. sexangulare** Lund. ? var. **bidentatum** Gutw. (Pl. **5**, Fig. **43**)
(Scott and Prescott 1961, 107, 45: 4 & 5)
L. spr. 31 µm, W. cpr. 47.2 µm, I. 9.4 µm. Smaller than typical. Lake; autumn 1997; rare.

64. **St. sexangulare** Lund. ? var. **subglabrum** W. & W. (Pl. **5**, Fig. **45**)
(Scott and Prescott 1961, 107, 46: 1 & 2)
W. csp. 75.6-81 µm. Lake; winter 1996; rare.

65. **St. sexangulare** Lund. fa. (Pl. **5**, Figs. **41** & **42**)
L. spr. 35.8 µm, W. cpr. 52.6-60 µm, I. 11.5 µm. Smaller cell with 5 pairs of processes. Close to *St. sexangulare* var. *subglabrum* W. & W. (Scott and Prescott 1961, 107, 46: 1 & 2; Ling and Tyler 1986, 46, 34: 13 & 14). Lake; autumn 1997; rare.

66. **St. sonthalianum** Turner (Pl. **6**, Fig. **52**)
(Turner 1892, 14: 27)
L. 40.5 µm, W. cpr. 70.2-73 µm, I. 10.2 µm. Lake; winter 1996; rare.

67. **St. subgracillimum** W. & W. ? var. **tortum** Scott and Grönbl. (Pl. **7**, Fig. **61**)
(Ling and Tyler 1986, 46, 32: 10-12)
W. csp. 37-43.5 µm. I. 4.5 µm. Lake; autumn 1997; rare.

68. ***St. subsuecicum** Scott & Prescott (Pl. **6**, Fig. **51**)
(Scott and Prescott 1961, 110, 52: 3)
L. 33.7, W. cpr. 51.3-54 µm, I. 8 µm. Paddy field; autumn 1997; few.

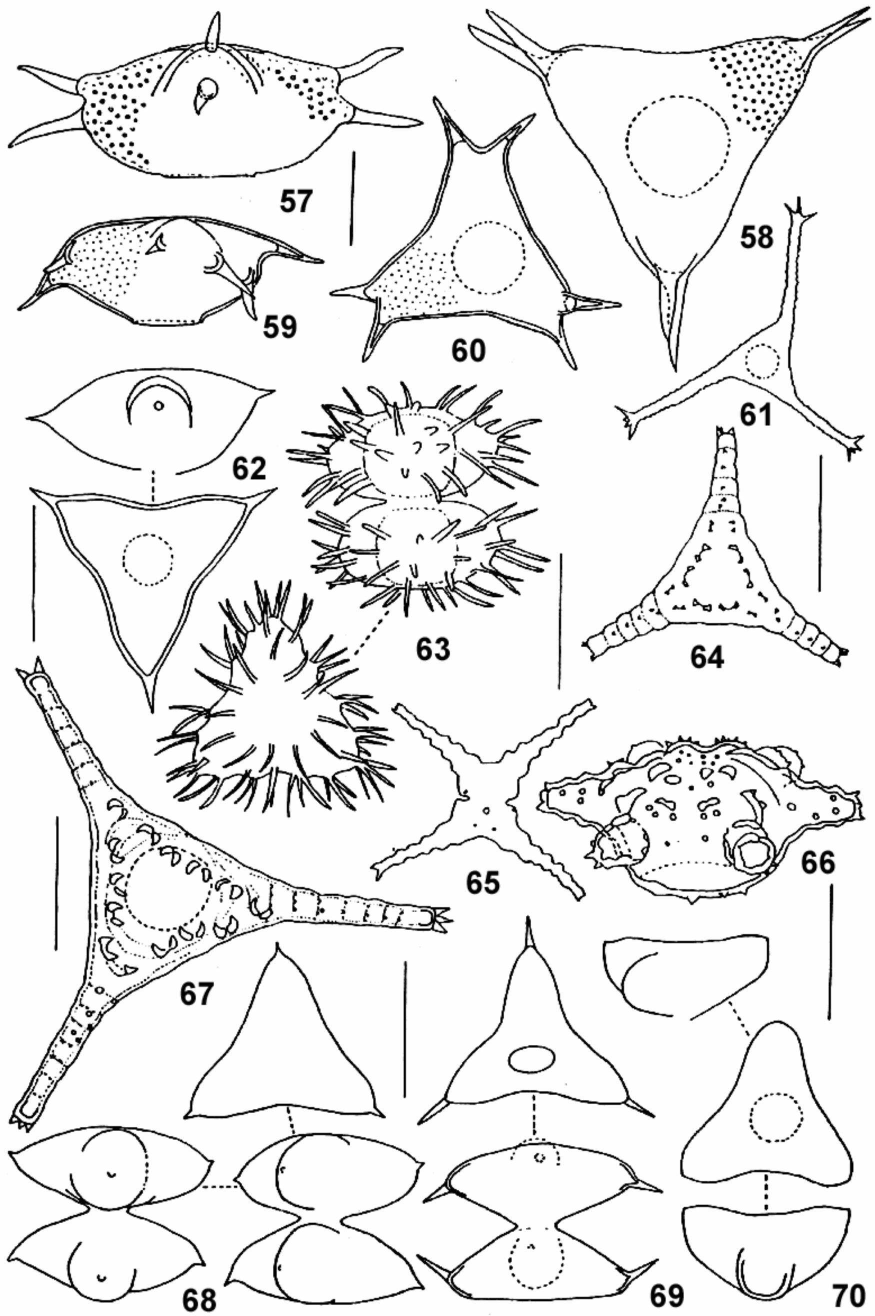

Plate 7 (Figs. 57-70)

57 & 58. *Staurastrum wildemanii*, 59 & 60. *St. bifidum,* 61. *St. subgracillimum* ? var. *tortum*, 62. *St. ? mucronatus*, 63. *St. gladiosum*, 64. *Staurastrum* sp., 65. *St. perundulatum*, 66. *St. pinnatum* ? var. *subpinnatum*, 67. *Staurastrum* sp., 68. *St. brevispinum* fa., 69. *St. glabrum* var. *glabrum*, 70. *Staurodesmus* sp. [Scales = 20 µm]

69. **St. tohopekaligense** Wolle (Pl. **4**, Fig. **31**)
(Islam and Haroon 1980, 592, 17: 236 & 237)
L. cpr. 70.2 µm, L. spr. 40.5 µm, W. cpr. 67.5-77 µm, W. spr. 31-32.4 µm, I. 17.5 µm. Lake; winter 1996; common.

70. **St. tohopekaligense** fa. **minus** (Turner) Scott & Prescott
(Islam and Irfanullah 1999, 96, 3: 35 & 36)
Lake; winter 1996; few.

71. **St. wildemanii** Gutw. (Pl. **7**, Figs. **57** & **58**)
(Ling and Tyler 1986, 48, 28: 5 & 6, 11 & 12)
L. 54 µm, W. csp. 85 µm, W. ssp. 54 µm, I. 20.2 µm. Spines are shorter than Ling and Tyler's (1986) two-spined forms. Lake; winter 1996; few.

72. **St. zahlbruckneri** Luetk.
(Islam and Irfanullah 1998, 95, 2: 15)
Lake; winter 1997; rare.

73. **Staurastrum** sp. (Pl. **2**, Fig. **13**)
W. 22.7 µm, I. 6.25 µm. Lake; winter 1997; rare.

74. **Staurastrum** sp. (Pl. **3**, Figs. **21** & **22**)
L. 18.3-19.2 µm, W. 18.3-19.2 µm, I. 5.4-5.8 µm. Four or five droopy processes, punctuate cell wall. Processes of *St. paulense* var. *ornatum* Krieger as shown by Förster (1964, 425, 29: 8) are not long enough like our material, but show droopiness. Lake; autumn 1997; common.

75. **Staurastrum** sp. (Pl. **3**, Fig. **30**)
L. 35 µm, W. 28.3-31 µm, I. 8 µm. Lake; autumn 1997; few.

76. **Staurastrum** sp. (Pl. **6**, Fig. **49**)
L. 18.3 µm, W. 26.7 µm, I. 5 µm. Lake; autumn 1997; rare.

77. **Staurastrum** sp. (Pl. **7**, Fig. **64**)
W. cpr. 39.5 µm. Top view similar to *St. manfeldtii* Delp. (Hirano 1959b, 368, 48: 1). Lake; winter 1996; few.

78. **Staurastrum** sp. (Pl. **7**, Fig. **67**)
W. cpr. 64.8–67.5 µm, I. 12 µm. Lake; winter 1996; rare.

The study area as a whole was extraordinary in terms of algal species richness (Table 1). Desmid diversity was remarkable, as expected in acidic waters, species number occupying more than half of the total species number. Most of the algal taxa (>50%) were microplankton (size 20-200 µm) followed by nannoplankton (size <20 µm) and epiphytes (around 40 taxa each).

Habitat-wise, Baraoora Lake had more taxa (mean number about 75) than the Burburia River (mean number around 30). The lake showed highest number of species in winter (>140 taxa), whereas the river showed maximum in spring (>75 taxa). The lowest species number (around 40 taxa) in spring was quite unusual for a lentic water-body like Baraoora Lake. The river was highly dynamic in rainy season explaining the lowest species richness in monsoon (<10 taxa).

Table 1. Relative abundance of different algal classes recorded from the aquatic habitats within the tea gardens at Srimangal, based on Islam and Irfanullah (2005 a, b, c, 2006 and the present paper).

Algal Classes	No. of genera	No. of species	No. of taxa	Relative abundance by taxa (%)
Cyanophyceae	17	28	28	6.7
Euglenophyceae	5	33	37	8.8
Chloromonadophyceae	1	1	1	0.2
Chlorophyceae (excluding desmids)	42	76	83	19.7
Chlorophyceae (desmids only)	25	182	230	54.6
Charophyceae	2	3	3	0.7
Xanthophyceae	8	11	11	2.6
Chrysophyceae	4	4	4	1.0
Bacillariophyceae	17	20	20	4.8
Dinophyceae	2	2	2	0.5
Rhodophyceae	1	2	2	0.5
Total	124	362	421	100

Discussion

Conservation of algal communities lies with their habitat conservation. But it is difficult to peruse the stakeholders for conservation without direct and immediate benefits, which is often monetary. In many cases it is hard to prove the direct benefits of ‘a species’. In case of microscopic organisms, like algae, it is even tougher. If we argue that saving a species is essential for maintaining ecological integrity, many species will lose their importance as they might not be crucial in maintaining the functioning of their native ecosystems (Lawton 1991).

But we believe that habitats like Baraoora Lake are important just because of the species diversity they possess. It is just like a living laboratory for aquatic biologists. Deepening this habitat and trying something financially profitable, like aquaculture, should not be encouraged (Of course, given the acidic pH, fish-culture might not be practical, anyway). Instead we should leave these habitats in their present state without any major interventions. Because of high species diversity, these can be used as ‘natural tools’ for monitoring the ecological quality of the tea gardens as a whole. Islam and Irfanullah (2005a) also emphasised on more systematic sampling and quantitative estimation of species abundance to get a clearer and detailed picture of the algal flora of these interesting habitats.

Institute like the Bangladesh Tea Research Institute (BTRI) can take initiatives to run simple analyses of water chemistry and plankton community on a regular basis and share the information with the tea garden owners. This will assist the latter to assess the ecological impacts of current tea cultivation practices (e.g. nutrient-holding capacity of the soil, major changes in the soil chemistry, effects of chemical residues, etc.). Correlating the tea garden soil chemistry with lake water chemistry and biology will also help them to trace the viability of tea garden ecosystems. Baraoora Lake could be one of the first sites for the ecological monitoring of catchment-lake connectivity in Bangladesh. A full limnological investigation in these habitats will strengthen the justification of these habitats becoming monitoring tools.

Acknowledgements

The authors are grateful to Mr. A.F.M. Badrul Alam, the then Director, Bangladesh Tea Research Institute (BTRI), Srimangal, Maulvibazar for providing the logistic, laboratory and other support during this study and also to all his colleagues who extended their help in the laboratory and in supplying necessary information. Thanks are also due to James Finley & Co. for the permission to sample its aquatic habitats. Prof. Moniruzzaman Khondker, Department of Botany, University of Dhaka helped in reconfirming the new records.

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(Manuscript received on 21 October 2006; revised on 15 November 2006)