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Desmids from Bees-hazaar Lake, Chitwan, Nepal

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Abstract
A total 36 taxa belonging to 7 genera of desmids have been described and illustrated from Bees-hazaar lake of which 11 taxa are recorded for the first time for Nepal. This is a preliminary work on the desmids from this lake.

***Key words*:** Algae, Bees-hazaar Lake, Desmids, Nepal.

Introduction

Bees-hazaar lake (Latitude 27°37'04.6"N, Longitude 84°26'11.3"E; altitude 286 m amsl; area ca 100 ha) is an oxbow lake (Ramsar site) situated in Tikauli-3, Gitanagar VDC, Chitwan, surrounded by Barandabhar Corridor Forest, an extension of the buffor zone of Chitwan National Park. The lake is connected with other six ponds, ghols and swamps towards its south-east end whereas it forms many finger-like projections towards the north. The rich in total nitrogen and orthophosphate and low in transparency level ranked the lake as hypereutrophic category.

The work on desmids of Nepal has been carried out by Hirano (1955, 1963, 1969, 1984), Förster (1965), Kusel-fetzmann (1969), Hickel (1973), Ichimura and Kasai (1982), Shrestha and Manandhar (1983), Nakanishi (1986), Bando *et al.* (1989), Habib and Chaturvedi (1995, 1997), Rai (2007), and Rai and Misra (2008). The literature revealed that the desmids flora of Nepal has not been explored so far extensively and further more, the terai plain is least studied. Here, an attempt has been made to study the desmids from Bees-hazaar Lake.

In this paper, taxonomy and morphology of 36 taxa of desmids belonging to 7 genera (*Closterium* 4, *Pleurotaenium* 1, *Euastrum* 5, *Micrasterias* 5, *Cosmarium* 16, *Arthrodesmus* 1, *Staurastrum* 4) has been described and illustrated. Out of these, 11 taxa *viz.*, *Euastrum elegans* (Bréb.) Kütz., *Micrasterias mahabuleshwarensis* Hobs. var. *surculifera* Legerh., *M. tropica* Nordst., var. *polonica* Eichl. et Gutw. f. *evoluta* Scott et Prescott, *Cosmarium bioculatum* Bréb., *C. contractum* Kirchn. var. *pachydermum* Scott et Prescott, *C. cymatopleurum* Nordst. var. *subtropicum* Islam, *C. punctulatum* Bréb. var. *subpunctulatum* (Nordst.) Borges, *C. striolatum* Näg., *Arthrodesmus convergens* Ehr. var. *curtus* Turn., *Staurastrum* cf *bifidum* Bréb. in Ralfs, and *St. javanicum* (Nordst.) Turn. var. *apiculiferum* (Turn.) Krieg. have been reported for the first time for Nepal. All the reports are new for the lake as no work has been done hitherto.

Materials and methods

Algal samples were collected from five

different sites of Bees-hazaar lake during the period of June to September, 2007. All the samples were taken by squeezing out the roots of *Eichhornia crassipes*, *Pistia stratiotes* and submerged aquatic macrophytes. Samples were tagged and labeled then preserved in 4% formaldehyde solution on the spot. Morpho-taxonomy of the desmids was studied in the Laboratory of Department of Botany, P.G. Campus by screening and camera-lucida drawings. Identification was done on the basis of illustration and dimension of the relevant literature and monographs mentioned below each taxon's name in the text.

Explanation of symbols and abbreviations
L: Cell length
W: Cell diameter
MW: Median diameter
AW: Apical diameter
PW: Polar diameter
I: Isthmus diameter
CN: Sample number
D: Collection date

Taxonomic descriptions

1. ***Closterium acerosum*** (Schr.) Ehr. ex Ralfs (Pl. 1, Fig. 17)

Scott, A.M. and G.W. Prescott 1961, P. 9, Pl. 3, Fig.1
L 474 µm, MW 42 µm, AW 4.5-6 µm; CN BH-18; D 27.8.2007
Distribution: Pangka, 4600 m; Longponga, 4650 m; Dudhpokhari, 4750 m (Watanabe, 1982); Mahendranagar (Habib and Chaturvedi, 1995; 1997); Koshi Tappu, 206 m (Rai and Misra, 2008)

2. ***Closterium dianae*** Ehr. ex Ralfs var. ***dianae*** (Pl. 1, Fig. 14)

Flint, E.A. and D.B. Williamson 1998, P. 75, Pl. 2, Fig. 7
L 203 µm, MW 17 µm, AW 2-3 µm; CN BH-4; D 25.6.2007
Distribution: Begnas lake, 960 m; Hetauda, 500 m (Watanabe, 1982); Koshi Tappu, 206 m (Rai and Misra, 2008)

3. ***Closterium ehrenbergii*** Menegh. ex Ralfs (Pl. 1, Fig. 15)

Nurul Islam, A.K.M. 1970, P. 910, Pl. 6, Fig. 14
L 374 µm, MW 64 µm, AW 8-10 µm; CN BH-5; D 25.6.2007
Distribution: Mugling, 500 m; Hetauda, 500 m (Watanabe, 1982); Baudha, Pashupatinath, Bansbari in Kathmandu; Dulari in Jhapa; Itahari; Birganj (Ichimura and Kasai, 1982); Chabahil in Kathmandu (Bando *et al.*, 1989); Mahendranagar (Habib and Chaturvedi, 1997); Koshi Tappu, 206 m (Rai and Misra, 2008)

4. ***Closterium rostratum*** Ehr. ex Ralfs (Pl. 1, Fig. 18)

Kouwets, F.A.C. 1987, P. 207, Pl. 5, Figs. 4-5
L 295 µm, MW 17 µm, AW 3-4 µm; CN BH- 13; D 24.7.2007
Distribution: Dole, 4100 m, Solu; Hetauda, 500 m (Watanabe, 1982); Mahendranagar (Habib and Chaturvedi, 1997)

5. ***Pleurotaenium baculoides*** (Roy et Biss.) Playf. (Pl. 1, Fig. 19)

Scott, A.M. and G.W. Prescott 1961, P. 14, Pl. 3, Fig. 5
L 370 µm, MW 30 µm, AW 18-20 µm, I 20 µm; CN BH-21; D 25.9.2007
Distribution: Taudaha, 1350 m, Kathmandu (Bando *et al.*, 1989)

6. ***Euastrum ansatum*** Ralfs var. ***dideltiforme*** Ducell. (Pl. 2, Fig. 9)

Nurul Islam, A.K.M. 1970, P. 916, Pl. 16, Fig. 6
L 85.8 µm, W 45 µm, PW 21 µm, I 11.6 µm; CN BH-10; D 25.6.2007
Distribution: Mewa valley (Hirano, 1984); Maipokhari lake, 2150 m, Ilam (Rai, 2008)

7. ***Euastrum bidentatum*** Näg. (Pl. 2, Fig. 14)
Capdevielle, P. and A. Coute' 1980, P. 880, Pl. 2, Fig. 20
L 48 µm, W 30.5 µm, PW 18 µm, I 10 µm; CN BH-10; D 25.6.2007
Distribution: Pheriche, 4200 m, Khumbu (Förster, 1965 as var. *speciosum*); Koshi Tappu, 206 m (Rai and Misra, 2008)

8. ***Euastrum elegans*** (Bréb.) Kütz. (Pl. 1, Fig. 3)
Kouwets, F.A.C. 1987, P. 215, Pl. 8, Figs. 7-8
L 36 µm, W 24 µm, PW 16 µm, I 6 µm; CN BH-8; D 25.6.2007
Distribution: New record for Nepal.

9. ***Euastrum platycerum*** Reinsch (Pl. 1, Fig. 10)
Scott, A.M. and G.W. Prescott 1961, P. 33, Pl. 60, Fig. 4
L 41 µm, W 35 µm, PW 12.5 µm, I 10 µm; CN BH-17; D 27.8.2007
Distribution: Koshi Tappu, 206 m (Rai and Misra, 2008)

10. ***Euastrum spinulosum*** DelP. (Pl. 1, Fig. 8)
Scott, A.M. and G.W. Prescott 1961, P. 40, Pl. 10, Fig. 3
L 45 µm, W 36 µm, PW 15 µm, I 11 µm; CN BH-13; D 24.7.2007
Distribution: Koshi Tappu, 206 m (Rai and Misra, 2008)

11. ***Micrasterias foliacea*** Bail. (Pl. 1, Fig. 13)
Scott, A.M. and G.W. Prescott 1961, P. 46, Pl. 20, Fig. 4
L 70 µm, W 75 µm, I 17 µm; CN BH-1; D 25.6.2007
Distribution: Koshi Tappu, 206 m (Rai and Misra, 2008)

12. ***Micrasterias mahabuleshwarensis*** Hobs. var. ***surculifera*** Lagerh. (Pl. 2, Fig. 6)
Scott, A.M. and G.W. Prescott 1961, P. 50, Pl. 16, Figs. 1-2
L 154 µm, W 134 µm, I 24 µm; CN BH-19; D 27.8.2007
Distribution: New record for Nepal.

13. ***Micrasterias pinnatifida*** (Kütz.) Ralfs (Pl. 2, Fig. 8)
Nurul Islam, A.K.M. 1970, P. 920, Pl. 10, Figs. 3-7
L 54 µm, W 62 µm, I 10 µm; CN BH-11; D 24.7.2007
Distribution: Luitel Bhanjyang, 770 m, Gorkha (Hirano 1955); Koshi Tappa, 206 m (Rai and Misra, 2008)

14. ***Micrasterias radians*** Turn. (Pl. 2, Fig. 7)
Scott, A.M. and G.W. Prescott 1961, P. 51, Pl. 23, Fig. 1
L 125 µm, W 115 µm, I 21 µm; CN BH-6; D 25.6.2007
Distribution: Tahachal, 1300 m, Kathmandu (Hirano, 1955)

15. ***Micrasterias tropica*** Nordst. var. ***polonica*** Eichl. et Gutw. f. ***evoluta*** Scott et Prescott (Pl. 2, Fig. 5)
Scott, A.M. and G.W. Prescott 1961, P. 53, Pl. 16, Fig. 7
L 133 µm, W 103 µm, I 17.5 µm; CN BH-19; D 27.8.2007

Distribution: New record for Nepal.

16. ***Cosmarium bioculatum*** Bréb. (Pl. 1, Fig. 4)
Bharati, S.G. and G.R. Hegde 1982, P. 736, Pl. 11, Fig. 12
L 19 µm, W 19 µm, I 5 µm; CN BH-1; D 25.6.2007
Distribution: New record for Nepal.

17. ***Cosmarium contractum*** Kirchn. var. ***pachydermum*** Scott et Prescott (Pl. 1, Fig. 2)
Scott, A.M. and G.W. Prescott 1961, P. 56, Pl. 27, Fig. 6
L 34 µm, W 27 µm, I 6 µm; CN BH-12; D 24.7.2007
Distribution: New record for Nepal.

18. ***Cosmarium cymatopleurum*** Nordst. var. ***subtropicum*** Islam (Pl. 1, Fig. 5)
Nurul Islam, A.K.M. 1970, P. 923, Pl. 11, Fig. 11
L 42 µm, W 29µm, I 8.5 µm; CN BH-8; D 25.6.2007
Distribution: New record for Nepal.

19. ***Cosmarium granatum*** Bréb. (Pl. 1, Fig. 7)
Tiffany, L.H. and M.E. Britton 1952, P. 186, Pl. 51, Fig. 565
L 33 µm, W 24 µm, I 6 µm; CN BH-12; D 24.7.2007
Distribution: Luitel Bhanjyang, 770 m, Gorkha; Pisang, 3100 m, Manang; Tukucha Moor, 2600 m, Mustang (Hirano, 1955; 1963); Mahendranagar (Habib and Chaturvedi, 1997)

20. ***Cosmarium impressulum*** Elfv. f. ***minus*** Turn. (Pl. 1, Fig. 9)
Bharati, S.G. and G.R. Hegde 1982, P. 742, Pl. 11, Fig. 3
L 24 µm, W 16.5 µm, I 4 µm; CN BH-19; D 27.8.2007
Distribution: Pheriche, 4200 m, Khumbu (Förster, 1965)

21. ***Cosmarium javanicum*** Nordst. (Pl. 1, Fig. 6)
Nurul Islam, A.K.M. and A.K. Yusuf Haroon 1980, P. 576, Pl. 11, Figs. 156-157; Pl. 13, Fig. 179
L 155 µm, W 70 µm, I 32.5 µm; CN BH-1; D 25.6.2007
Distribution: Luitel Bhanjyang, 770 m, Gorkha (Hirano, 1955); Taudaha, 1350 m, Kathmandu (Bando *et al.* 1989); Mahendranagar (Habib and Chaturvedi, 1995); Koshi Tappu, 206 m (Rai and Misra, 2008)

22. ***Cosmarium lundellii*** DelP. var. ***circulare*** (Reinsch) Krieg. (Pl. 2, Fig. 4)
Bharati, S.G. and G.R. Hegde 1982, P. 744, Pl. 1, Fig. 2
L 55 µm, W 42 µm, I 16 µm; CN BH-13; D 24.7.2007
Remark: Present specimen has small dimension than the type.
Distribution: Mewa valley (Hirano, 1984); Mahendranagar (Habib and Chaturvedi, 1997)

23. ***Cosmarium lundellii*** DelP. var. ***ellipticum*** West et West f. ***minus*** Prescott (Pl. 1, Fig. 11)
Bharati, S.G. and G.R. Hegde 1982, P. 744, Pl. 1, Fig. 6
L 43 µm, W 39 µm, I 15 µm; CN BH-12; D 27.7.2007
Distribution: Koshi Tappu, 206 m (Rai and Misra, 2008)

24. ***Cosmarium maculatiforme*** Schm. (Pl. 2, Fig. 12)

Nurul Islam, A.K.M. 1970, P. 924, Pl. 14, Fig. 1
L 113 µm, W 62 µm, I 40 µm; CN BH-18; D 27.8.2007
Distribution: Luitel Bhanjyang, 770 m, Gorkha (Hirano, 1955 as var. *maior*)

25. ***Cosmarium margaritatum*** (Lund.) Roy et Biss. var. ***sublatum*** (Nordst.) Krieg. (Pl. 2, Fig. 10)
Scott, A.M. and G.W. Prescott 1961, P. 63, Pl. 29, Fig. 4
L 70 µm, W 64 µm, I 21 µm; CN BH-23; D 25.9.2007
Distribution: Ankhu Khola, 630 m, Gorkha (Hirano, 1955)

26. ***Cosmarium obsoletum*** (Hantz.) Reinsch (Pl. 2, Fig. 2)
Kouwets, F.A.C. 1987, P. 226, Pl. 11, Fig. 15
L 51 µm, W 55 µm, I 24 µm; CN BH-18; D 27.8.2007
Distribution: Luitel Bhanjyang, 770 m, Gorkha (Hirano, 1955); Koshi Tappu, 206 m (Rai and Misra, 2008)

27. ***Cosmarium punctulatum*** Bréb. var. ***subpunctulatum*** (Nordst.) Borges (Pl. 2, Fig. 3)
Scott, A.M. and G.W. Prescott 1961, P. 67, Pl. 31, Fig. 8
L 28 µm, W 25 µm, I 9 µm; CN BH-7; D 25.6.2007
Distribution: New record for Nepal.

28. ***Cosmarium quadratum*** Ralfs ex Ralfs var. ***willei*** (Schm.) Krieg. et Gerl. (Pl. 2, Fig. 13)
Kouwets, F.A.C. 1987, P. 231, Pl. 11, Figs. 8-10
L 78 µm, W 44 µm, I 18 µm; CN BH-14; D 24.7.2007
Distribution: Karyolung, 4300-4400 m, Khumbu (Förster, 1965)

29. ***Cosmarium regnellii*** Wille Fa. (Pl. 1, Fig. 1)
Prasad, B.N. and P.K. Misra 1992, P. 180, Pl. 21, Fig. 25
L 11.5 µm, W 10 µm, I 2.7 µm; CN BH-19; D 27.8.2007
Distribution: Pheriche, 4200 m, Khumbu (Förster, 1965); Taudaha, 1350 m, Kathmandu (Bando *et al.*, 1989); Rara lake, 3030 m, Mugu (Watanabe, 1995)

30. ***Cosmarium striolatum*** Näg. (Pl. 2, Fig. 11)
Bharati, S.G. and G.R. Hegde 1982, P. 752, Pl. 10, Fig. 4
L 108 µm, W 63 µm, I 51 µm; CN BH-4; D 25.6.2007
Distribution: New record for Nepal.

31. ***Cosmarium sublateriundatum*** West et West (Pl. 2, Fig.1)
Nurul Islam, A.K.M. and A.K. Yusuf Haroon 1980, P. 580, Pl. 22, Figs. 263-264
L 41 µm, W 39 µm, I 13 µm; CN BH-22; D 25.9.2007
Distribution: Tukucha Moor, 2600 m, Mustang (Hirano, 1955); Pashupatinath, 1300 m (Bando *et al.*, 1989)

32. ***Arthrodesmus convergens*** Ehr. var. ***curtus*** Turn. (Pl. 1, Fig. 12)
Scott, A.M. and G.W. Prescott 1961, P. 74, Pl. 34, Fig. 5
L 57 µm, W 84 µm (with spines), I 20 µm; CN BH-1; D 25.6.2007
Distribution: New record for Nepal.

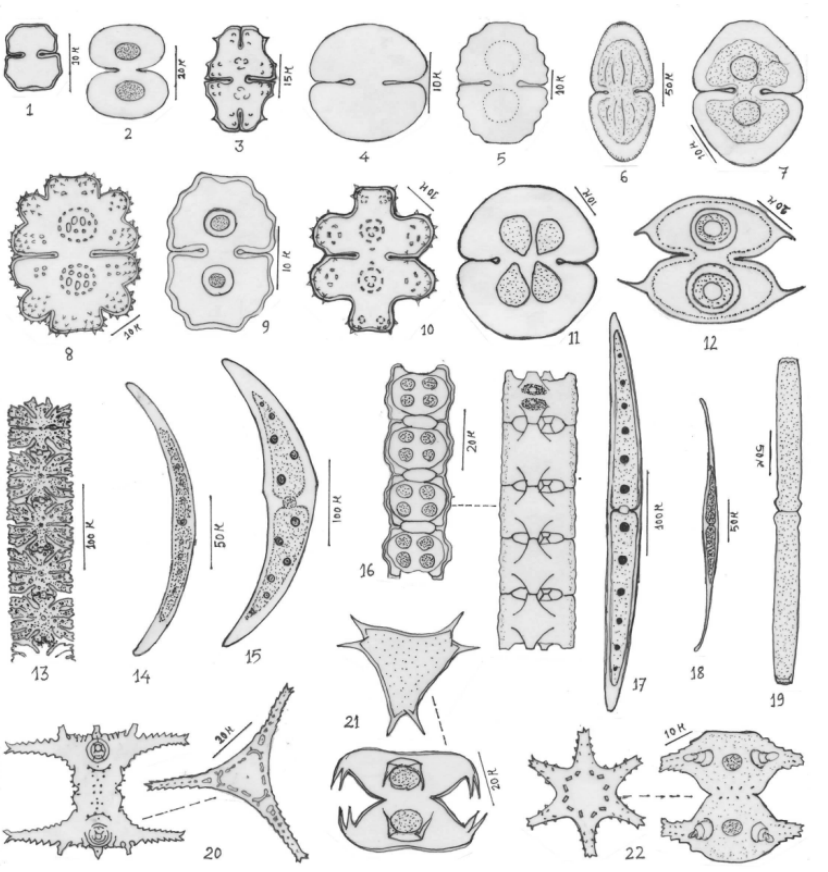

Plate 1

Fig.1 *Cosmarium regnellii* Wille Fa., **Fig. 2** *C. contractum* Kirchn. var. *pachydermum* Scott et Prescott, **Fig. 3** *Euastrum elegans* (Bréb.) Kütz., **Fig. 4** *Cosmarium bioculatum* Bréb., **Fig. 5** *C. cymatopleurum* Nordst. var. *subtropicum* Islam, **Fig. 6** *C. javanicum* Nordst., **Fig. 7** *C. granatum* Bréb., **Fig. 8** *Euastrum spinulosum* DelP., **Fig. 9** *Cosmarium impressulum* Elfv. f. *minus* Tum., **Fig. 10** *Euastrum platycerum* Reinsch, **Fig. 11** *Cosmarium lundellii* DelP. var. *ellipticum* West et West f. *minus* Prescott, **Fig. 12** *Arthrodesmus convergens* Ehr. var. *curtus* Turn., **Fig. 13** *Micrasterias foliacea* Bail., **Fig. 14** *Closterium dianae* Ehr. ex Ralfs var. *Diana,* **Fig. 15** *Cl. ehrenbergii* Menegh. ex Ralfs, **Fig. 16** *Desmidium baileyi* (Ralfs) Nordst. var. *baileyi* f. *tetragonum* Nordst., **Fig. 17** *Closterium acerosum* (Schr.) Ehr. ex Ralfs, **Fig. 18** *Cl. rostratum* Ehr. ex Ralfs, **Fig. 19** *Pleurotaenium baculoides* (Roy et Biss.) Playf., **Fig. 20** *Staurastrum javanicum* (Nordst.) Turn. var. *apiculiferum* (Turn.) Krieg., **Fig. 21** *St. cf bifidum* Bréb. in Ralfs, **Fig. 22** *St. sexcostatum* Bréb. ex Ralfs var. *productum* (W. West) G.S. West.

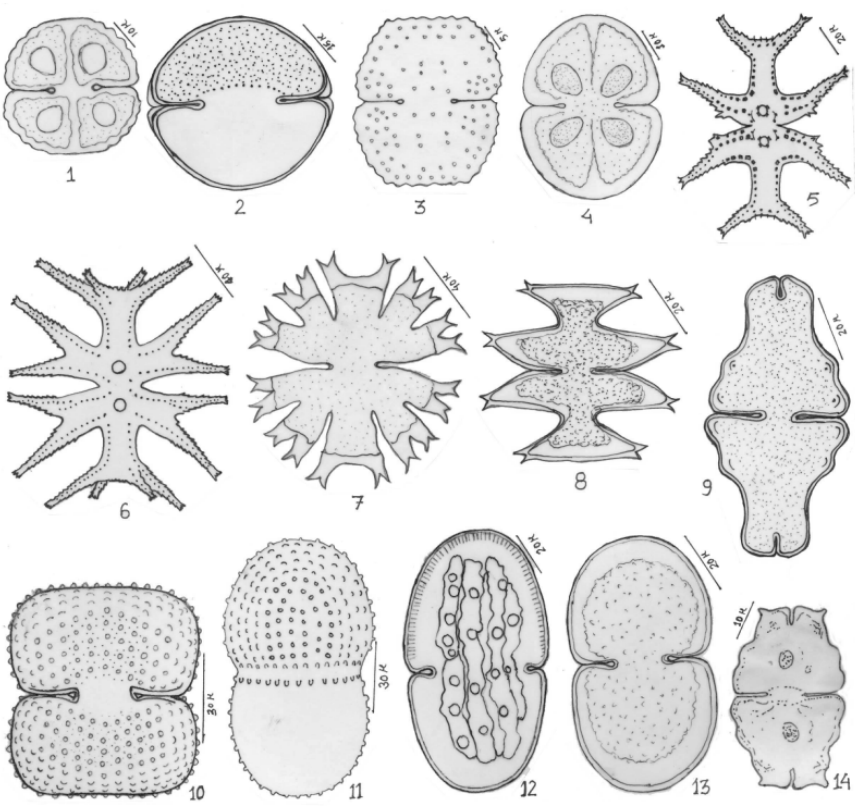

Plate 2

Fig.1 *Cosmarium sublateriundatum* West et West, **Fig. 2** *C. obsoletum* (Hantz.) Reinsch, **Fig. 3** *C. punctulatum* Bréb. var. *subpunctulatum* (Nordst.) Borges, **Fig. 4** *C. lundellii* DelP. var. *circulare* (Reinsch) Krieg, **Fig. 5** *Micrasterias tropica* Nordst. var. *polonica* Eichl. et Gutw. f. *evoluta* Scott et Prescott, **Fig. 6** *M. mahabuleshwarensis* Hobs. var. surculifera Lageth, **Fig. 7** *M. radians* Turn, **Fig. 8** *M. pinnatifida* (Kütz.) Ralfs, **Fig. 9** *Euastrum ansatum* Ralfs var. *dideltiforme* Ducell, **Fig. 10** *Cosmarium margaritatum* (Lund.) Roy et Biss. var. *sublatum* (Nordst.) Krieg, **Fig. 11** *C. striolatum* Näg, **Fig. 12** *C. maculatiforme* Schm, **Fig. 13** *C. quadratum* Ralfs ex Ralfs var. *willei* (Schm.) Krieg. et Gerl, **Fig. 14** *Euastrum bidentatum* Näg.

33. Remark: ***Staurastrum*** cf ***bifidum*** Bréb. in Ralfs (Pl. 1, Fig. 21)

Scott, A.M. and G.W. Prescott 1961, P. 86, Pl. 54, Fig. 5

L 37 µm, W 54 µm (with spines), I 16 µm; CN BH-23; D 25.9.2007

Present specimen has more or less similar dimension with the type but spines are

abruptly bent and outer surface distinctly concave.
Distribution: New record for Nepal.

34. ***Staurastrum javanicum*** (Nordst.) Turn. var. ***apiculiferum*** (Turn.) Krieg. (Pl. 1, Fig. 20)
Scott, A.M. and G.W. Prescott 1961, P. 97, Pl. 44, Fig. 6
L 51 µm, W 70 µm, I 14 µm; CN BH-15; D 24.7.2007
Distribution: New record for Nepal.

35. ***Staurastrum sexcostatum*** Bréb. ex Ralfs var. ***productum*** (W. West) G.S. West (Pl. 1, Fig. 22)
Kouwets, F.A.C. 1987, P. 251, Pl. 19, Fig. 7
L 42 µm, W 45 µm, I 14 µm; CN BH-1; D 25.6.2007
Distribution: Luitel Bhanjyang, 770 m, Gorkha (Hirano, 1955); Koshi Tappu, 206 m (Rai and Misra, 2008)

36. ***Desmidium baileyi*** (Ralfs) Nordst. var. ***baileyi*** f. ***tetragonum*** Nordst. (Pl. 1, Fig. 16)
Nurul Islam, A.K.M. and H.M. Irfanullah 1999, P. 120, Pl. 1, Fig. 1
L 17 µm, W 24 µm, I 23 µm; CN BH-1; D 25.6.2007
Distribution: Koshi Tappu, 206 m (Rai and Misra, 2008)

Conclusion

Present investigation shows that the desmids flora of Bees-hazaar lake is rich and diverse. Among the genera, *Cosmarium* has the maximum taxa representing by 16 out of 36 whereas *Pleurotaenium* and *Arthrodesmus* have monotypes. Here, one specimen (*Staurastrum* cf *bifidum*) we have has similar dimensions and morphology of spines with *Staurastrum bifidum* described by Scott and Prescott (1961) but it has distinctly concave outer surface as in *Staurodesmus triangularis* (Lagerh.) Teil. described by Kouwets (1987) and abruptly bent down spines. Therefore, it needs further study to be confirmed. For a complete documentation of the specimens, regular seasonal explorations of the lake will be essential.

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