

## THE DESMID FLORA OF SOME HIGH MOUNTAIN LAKES OF THE TURKISH EASTERN BLACK SEA REGION

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### Abstract

A floristik study of desmids which were found in the epipellic and epilithic habitats of the 7 high mountain lakes, all situated in the Eastern Black Sea region of Turkey, is presented. A total of 55 desmid taxa of 12 genera belonging to 3 families were identified. Ten taxa are new records for the Turkey's desmid flora.

### Introduction

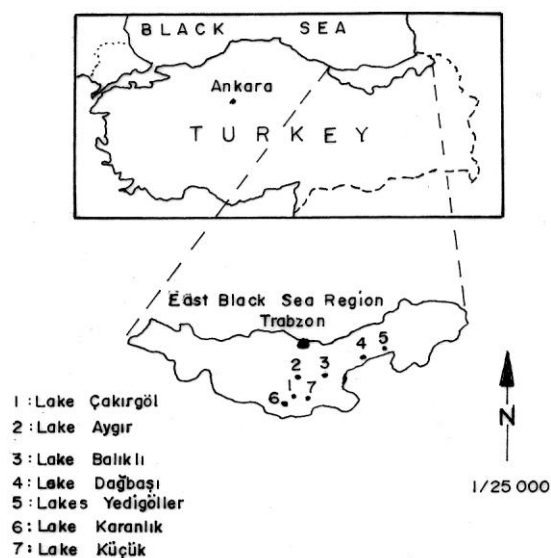
Among aquatic microorganisms, desmids (Chlorophyta, Zygnematophyceae) lend themselves particularly well for the assessment of water quality and nature conservation value, not only because of their specific ecological demands but also for their species-specific regional distribution patterns are well-known compared to those of many other group of microorganisms (Coesel, 2003). Most floristic-ecological studies on European desmids have been carried out in oligo-mesotrophic moorland pools, fens and bogs, known to be an optimal habitat for these algae, nevertheless the new records in alkaline habitats reveal their occurrence in Hungary (Feher, 2003). High mountain areas, with relatively high precipitation, potentially offer suitable desmid habitats. Desmids were published from European high mountain lakes, too (Lenzenweger, 2003). There are a number of high mountain lakes in the Eastern Black Sea Region of Turkey. Desmid investigations started in 1996 and since then 22 species have been added to the list of Turkey desmids (Şahin, 1998, 2000, 2002). Therefore it was decided to carry out a more focussed investigation of the desmid flora of high mountain lakes in the Eastern Black Sea Region of Turkey.

### Materials and Methods

The studied lakes are located on the Çakırgöl, Haldizen, Kızılkaya and Zigana mountains in the Eastern Black Sea region of Turkey as shown in the Map. The climate of the region is temperate, with cool summers and mild winters (seasonal average temperature 15.5, precipitation 80.5 mm). Terrestrial vegetation is composed of trees, shrubs and herbs, including *Picea orientalis*, *Fagus orientalis*, *Ranunculus caucasicus*, *Pinus silvestris*, *Rhododendron* sp. (Anon., 1999).

Collections were made during snow-free periods from June to September in 1996-2003. The number of sampling stations per watercourse depended on the size of the lakes. Samples were taken on a monthly basis and were collected from stations of 20-30 cm depth, 50-100 cm offshore. Vascular plants were absent at all stations. In total, 100 samples of epipellic and epilithic algae were collected and processed. Epipellic samples were collected by drawing a glass tube across the surface of the sediment and epilithic samples at random (Round, 1953). All samples were fixed in 4% formalin. Desmids were examined using temporary slide preparations. Taxonomic identifications were made according to Bourrelly

& Couté (1982), Coesel (1982,1983,1985,1991,1994,1997), Forster (1982), Lenzenweger (1996,1997,1999,2003), Lind & Brook (1980), Ruzicka (1977,1981), West & West (1905, 1908). The systematic classification of desmids was made according to Christiansen (1994). Photographs were taken with an Olympus BH-2 microscope. On each sampling date, the water temperature and pH were measured using a mercury thermometer and WTW Digi 88 model pH meter, respectively. The dissolved oxygen concentration was measured by the Winkler method (Yaramaz, 1988).



Samples were deposited at the Biology Laboratory, Karadeniz Technical University, Trabzon.

All dimensions are given in micrometers and the following abbreviations are used: L=Cell length, W=cell width, I=Breadth of isthmus.

## Results

**Environmental conditions:** Hydrological characteristics of the lakes are given in Tabal1. For all lakes, the bottom is slightly muddy with pebbles. The Yedigöller Lakes (No:5) consist of seven small and large lakes. All waters were slightly acidic and circumneutral (pH 6.5-7.5) and dissolved oxygen was between 8.1 and 12.2 mg/l<sup>-1</sup>. The temperature was between 4 and 16.5°C, except small lakes (25°C) of the Yedigöller Lakes (No:5) (Table 1).

**Systematic enumeration and descriptions:** A total of 55 desmid taxa of 12 genera belonging to 3 families were identified from epipelagic and epilithic samples. Of all genera, *Cosmarium* was predominant with 20 taxa, followed by *Euastrum* with 11 taxa, *Closterium* with 10 taxa. Other genera encountered included *Cylindrocapsa* (1), *Netrium* (1), *Roya* (1), *Penium* (1), *Spondylium* (1), *Actinotaenium* (2), *Pleurotaenium* (1), *Staurastrum* (3) and *Micrasterias* (3). Three genera belonged to saccoderm desmids while 9 to placoderm

desmids. According to Palamar-Mordvinceva (1982) the best characterization of desmid flora is by enumerating species richness of the different genera (Table 2). Of the most diverse lake, the lake No.5 (Yedigöller Lakes) with 28 taxa species of 10 genera and the poorest one was No.1 (Çakır Lake) with only 3 species belonging to 3 genera.

**Table 1. Hydrological characteristics of the lakes.**

| Lakes                   | 1                    | 2                    | 3                    | 4                            | 5                            | 6                            | 7                            |
|-------------------------|----------------------|----------------------|----------------------|------------------------------|------------------------------|------------------------------|------------------------------|
| Location                | 40°-41'N<br>39°-40'E | 50°-52'N<br>36°-38'E | 50°-52'N<br>36°-38'E | 40° 37'30''N<br>40° 45'00''E | 40° 52'32''N<br>40° 37'30''E | 40° 44'30''N<br>39° 42'00''E | 40° 44'30''N<br>39° 42'00''E |
| Depth(m)                | 15                   | 8                    | 8                    | 10                           | 0.2-8                        | 6                            | 5                            |
| Elevation (ma.s.l.)     | 2533                 | 2700                 | 2600                 | 2721                         | 3100-3142                    | 2800                         | 2800                         |
| T (°C)                  | 4-15                 | 4.5-16.5             | 4.5-16.5             | 11-16                        | 9-25                         | 10.5                         | 10.5                         |
| PH                      | 7.1-7.2              | 7.0-7.1              | 7.0-7.1              | 7.1-7.2                      | 6.9-7.5                      | 6.7                          | 6.5                          |
| DO(mg/l <sup>-1</sup> ) | 9.5-12               | 9.5-12               | 9.5-12               | 9.5-11                       | 8.1-11.2                     | 9.5-12.2                     | 9.5-12.2                     |

1:Çakır Lake, 2:Aygır Lake, 3:Balıklı Lake, 4:Dağbaşı Lake, 5:Yedigöller Lakes, 6:Karanlık Lake, 7:Küçük Lake.

**Table 2. The occurrence of species from the investigated lakes according to genera.**

| Lake No               | 1        | 2        | 3         | 4         | 5         | 6         | 7         |
|-----------------------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| <i>Cylindrocystis</i> |          |          |           | 1         | 1         |           |           |
| <i>Netrium</i>        |          |          |           |           | 1         |           |           |
| <i>Roya</i>           |          |          |           |           | 1         |           |           |
| <i>Penium</i>         | 1        |          | 1         |           | 1         | 1         |           |
| <i>Closterium</i>     |          |          | 3         | 1         | 5         | 6         | 5         |
| <i>Spondylosium</i>   |          |          | 1         |           |           |           |           |
| <i>Actinotaenium</i>  |          |          |           | 1         | 1         | 1         | 1         |
| <i>Pleurotaenium</i>  |          | 1        | 1         | 1         | 1         |           |           |
| <i>Cosmarium</i>      | 1        | 1        | 3         | 5         | 13        | 2         | 6         |
| <i>Staurastrum</i>    | 1        | 1        | 2         | 2         | 2         | 3         | 2         |
| <i>Euastrum</i>       |          | 3        | 3         | 2         | 2         | 1         | 3         |
| <i>Micrasterias</i>   |          | 2        | 1         |           |           |           |           |
| <b>Total</b>          | <b>3</b> | <b>8</b> | <b>15</b> | <b>13</b> | <b>28</b> | <b>14</b> | <b>17</b> |

Following is a list of species recorded. Those marded with an asterisd are new records.

**Familia: Mesotaeniaceae**

**Genus *Cylindrocystis* Meneghini 1838**

*Cylindrocystis brebissonii* (Ralfs) De Bary (Fig. 1:1)

L:108.3 µ, W:60 µ.

Habitat:Epipelic, epilithic

Lake:4,5.

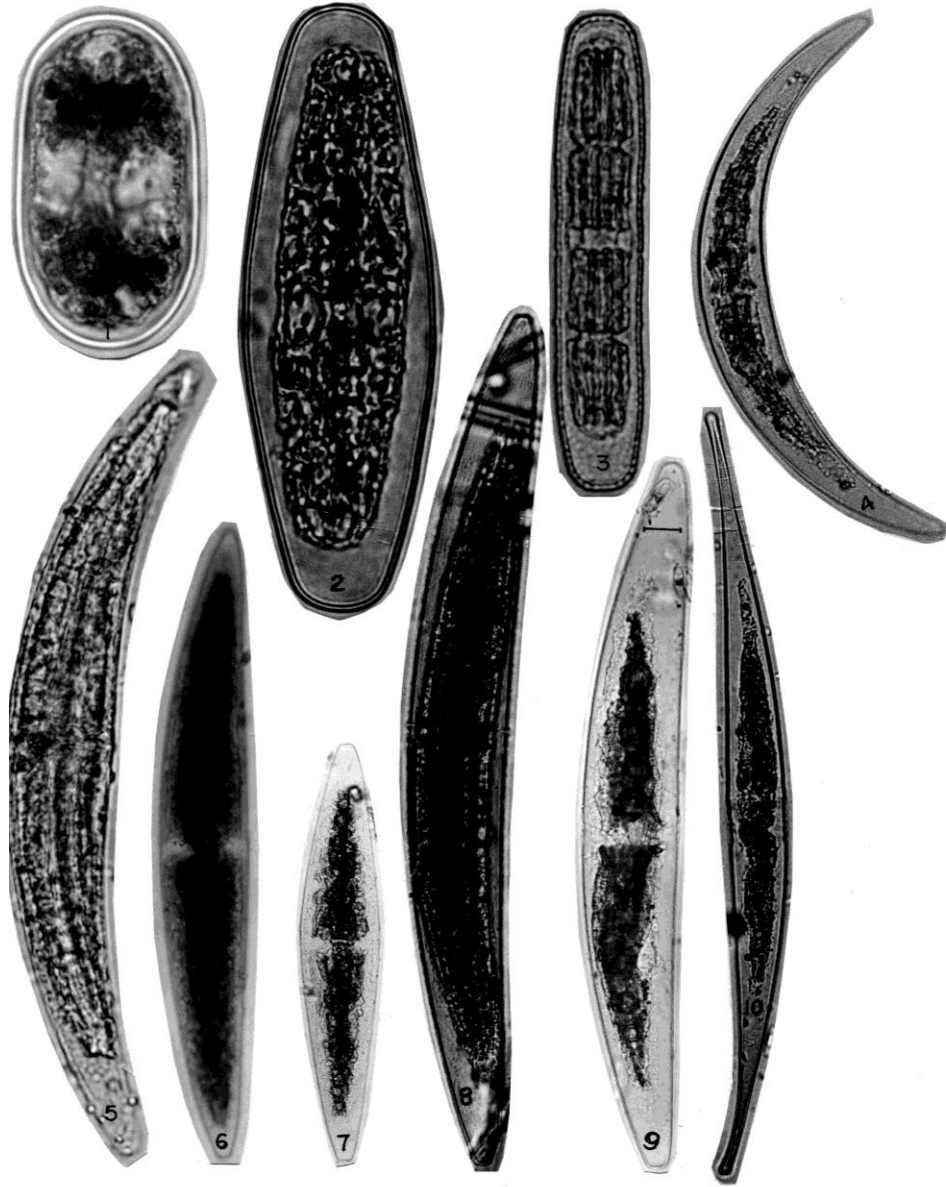


Fig. 1. 1- *Cylindrocyclis brebissonii* (Ralfs) De Bary, 2-*Netrium digitus* Itzigs. & Rothe, 3-*Penium margaritaceum* (Ehrenb.) ex Bréb., 4-*Closterium diana* Ehrenb. ex Ralfs, 5-*Cl. littorale* Gay., 6-*Cl. lunula* (O. F. Müll.) Nitzsch ex Ralfs, 7-*Cl. lunula* var. *biconvexum* Schmidle, 8-*Cl. pritchardianum* Archer, 9-*Cl. pseudolunula* Borge, 10-*Cl. rostratum* Ehrenb. ex Ralfs (Scale bar – 10  $\mu$ ).

**Genus *Netrium* (Izigs. & Rothe) emend. Lütke 1902**

*Netrium digitus* (Bréb.) Itzigs. & Rothe (Fig. 1:2)

L:172  $\mu$ , W:53  $\mu$ .

Habitat:Epipellic.

Lake:5.

**Genus *Roya* West & G.S. West 1920**

*Roya obtusa* (Bréb.) W. & G.S. West

L:22  $\mu$ , W:6.5  $\mu$

Habitat:Epilithic.

Lake:5.

**Familia: *Peniaceae*****Genus *Penium* Brébisson ex Ralfs 1848**

*Penium margaritaceum* (Ehrenb.) ex Bréb. (Fig. 1:3)

L:253.8  $\mu$ , W:25.6  $\mu$ .

Habitat:Epipellic, epilithic.

Lake:1,3,5,6.

**Genus *Closterium* Nitzsch ex Ralfs 1848**

*Closterium acerosum* (Schrank) Ehrenb. ex Ralfs

L:200  $\mu$ , W:21  $\mu$ .

Habitat:Epipellic.

Lake:6.

*Closterium diana* Ehrenb. ex Ralfs (Fig. 1:4)

L:163-223  $\mu$ , W:27-33  $\mu$ .

Habitat: Epipellic.

Lake: 5,6,7.

*Closterium littorale* Gay. (Fig. 1:5)

L:178.3  $\mu$ , W:26.6  $\mu$

Habitat:Epipellic.

Lake:3,4.

*Closterium lunula* (O. F. Müll.) Nitzsch ex Ralfs ( Fig. 1:6)

L:357  $\mu$ , W:53  $\mu$ .

Habitat: Epipellic.

Lake: 5,6,7.

(\*)*Closterium lunula* var. *biconvexum* Schmidle (Fig. 1:7)

(Syn.:*C. lunula* (Müll.) Nitzsch ex Ralfs f. *biconvexum* (Schmidle) Kosinskaja

Ruzička 1977, p. 147, pl. 16, figs. 5,6.

Cell 540  $\mu$  L, 110  $\mu$  W, about 5 times longer than wide, somewhat abruptly attenuated to the truncate apices, ventral margin convex, prominently swollen at the midregion; cell wall colorless.

Habitat:Epipelic, epilithic.

Lake:6,7.

Distribution:England, Europe, United States.

*Closterium pritchardianum* Archer (Fig. 1:8)

L:372  $\mu$ , W:44  $\mu$ .

Habitat: Epipelic, epilithic.

Lake:5,6.

*Closterium pseudolunula* Borge (Fig. 1:9)

L:367  $\mu$ , W:47  $\mu$ .

Habitat: Epipelic.

Lake:5,6,7.

*Closterium ralfsii* Bréb. ex Bréb.

L:250  $\mu$ , W:40  $\mu$ .

Habitat:Epipelic.

Lake:3.

*Closterium rostratum* Ehrenb. ex Ralfs (Fig. 1:10)

L:330  $\mu$ , W:25  $\mu$ .

Habitat: Epipelic, epilithic.

Lake:5,7.

*Closterium striolatum* Ehrenb. ex Ralfs

L:200  $\mu$ , W:25  $\mu$ .

Habitat:Epipelic.

Lake:3.

#### **Genus *Spondylosium* Brébisson 1844**

*Spondylosium planum* (Wolle) W. & G. S. West ( Fig. 2:1)

L:10  $\mu$ , W:12.5  $\mu$ , I:5  $\mu$ .

Habitat:Epilithic.

Lake:3.

#### **Genus *Actinotaenium* Teiling 1954**

*Actinotaenium cruciferum* (De Bary) Teiling (Fig. 2:2)

L:21  $\mu$ , W:10  $\mu$ .

Habitat:Epipelic.

Lake:4.

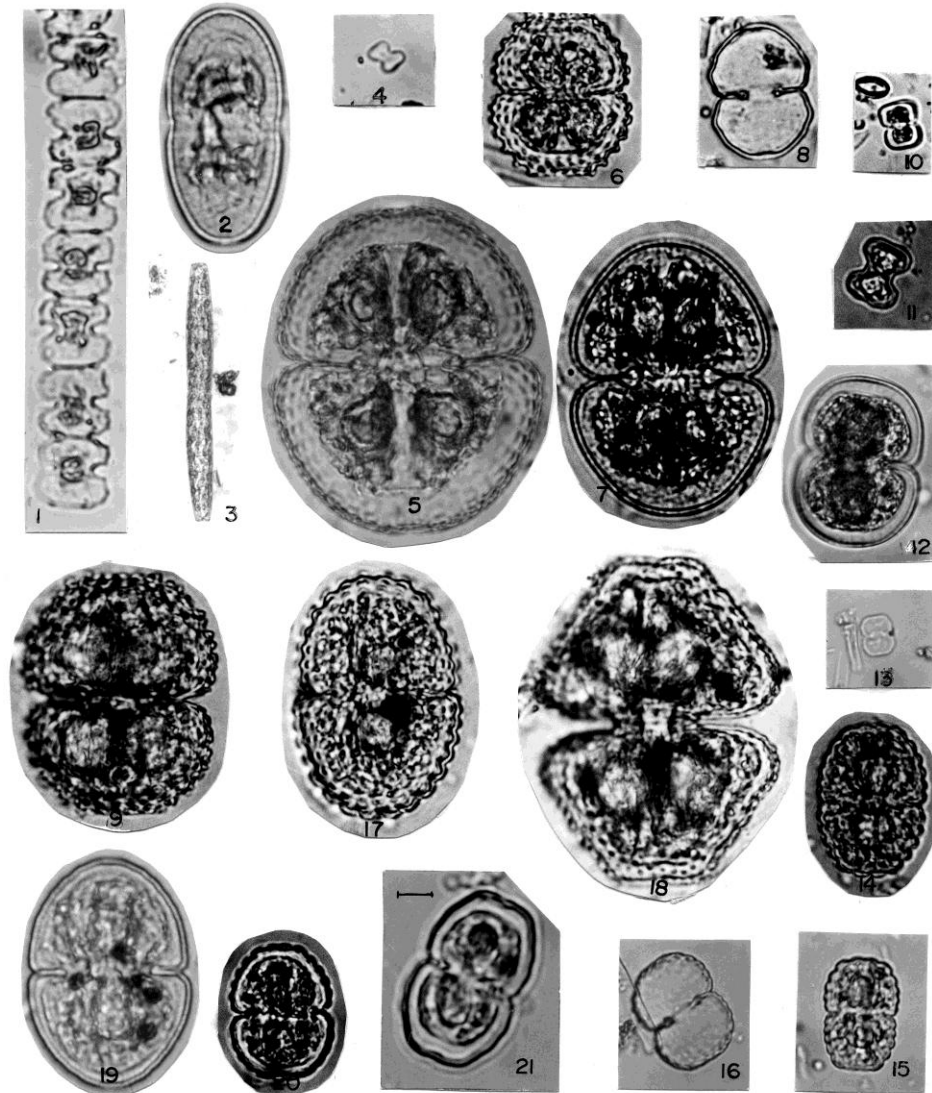


Fig. 2. 1- *Spondylosium planum*(Wolle) W. & G.S. West, 2- *Actinotaenium cruciferum* (De Bary) Teiling, 3- *Pleurotaenium trabecula* (Ehrenb.) Nägeli, 4- *Cosmarium asphaerosporum* var. *strigosum* Nords. in Wittr. et Nordst., 5- *C. botrytis* Meneg. ex Ralfs, 6- *C. costatum* Nordst., 7- *C. galeritum* Nordst., 8- *C. leave* Rabenh., 9- *C. malinvernianum* (Racib.) Schmidle var. *badense* Schmidle, 10- *C. norimbergense* Reinsch, 11- *C. novae-semiliae* Wille, 12- *C. rectangulare* Grun., 13- *C. regnelli* Wille, 14- *C. speciosum* P. Lundell, 15- *C. speciosum* var. *simplex* Nordst., 16- *C. subcostatum* Nordst. in Nordst. et Wittr., 17- *C. subspeciosum* Nordst. var. *validus* Nordst., 18- *C. turpinii* Gutw., 19- *C. variolatum* P. Lundell, 20- *C. vexatum* W. West, 21- *Cosmarium* sp. (Scale bar- 10  $\mu$ ).

*Actinotaenium cucurbita* (Bréb.) Teiling

L:32 µ, W:15 µ.

Habitat:Epipellic.

Lake:5,6,7.

**Genus *Pleurotaenium* Nägeli 1848**

*Pleurotaenium trabecula* (Ehrenb.) Nägeli (Fig. 2:3)

Habitat:Epipellic, epilithic.

Lake:2,3,4,5.

**Familia: *Desmidiaceae***

**Genus *Cosmarium* Corda ex Ralfs 1848**

(\*)*Cosmarium asphaerosporum* var. *strigosum* Nordst. in Wittr. et Nordst. (Fig. 2:4)

Lenzenweger 1999, p. 37, pl. 50, fig. 32.

West and West 1905, p. 164, pl. 60, figs. 26,27.

Cell 10 µ L, 7.5-8 µ W, 2.5-3 µ I. Cells with a narrower isthmus and consequently with a deeper sinus, apices flatter.

Habitat: Epipellic.

Lake:7.

Distribution: Austria, England, Sweden, United States

*Cosmarium blyttii* Wille

L:28.8 µ, W:24 µ.

Habitat:Epipellic, epilithic.

Lake:3,4.

*Cosmarium botrytis* Menegh. ex Ralfs (Fig. 2:5)

L:76.6 µ, W:71.6 µ, I:25 µ.

Habitat:Epipellic, epilithic.

Lake:3,4,5,7.

*Cosmarium costatum* Nordst. (Fig. 2:6)

L:45 µ, W:38 µ, I:11-12 µ.

Habitat:Epilithic.

Lake:5.

*Cosmarium galeritum* Nordst. (Fig. 2:7)

L:81 µ, W:60 µ, I:21 µ.

Habitat:Epilithic.

Lake:5.

*Cosmarium leave* Rabenh. (Fig. 2:8)

L:38 µ, W:28 µ, I:8 µ.

Habitat:Epipellic, epilithic.

Lake:4,5.

(\*)*Cosmarium malinvernianum* (Racib.) Schmidle var. *badense* Schmidle (Fig. 2:9)  
(Syn.: *Cosmarium margaritifera* Menegh. ex Ralfs var. *badense* (Schmidle) Coesel.)

Lenzenweger 1999, p. 137, pl. 62, figs. 11,12.

Cell 1.23 times longer than wide, 68  $\mu$  L., 55  $\mu$  W., 17  $\mu$  I; median constriction very deep, sinus narrowly linear, apex slightly dilated; semicell pyramidal-truncate, cell wall granulate throughout, with 9 granules. Apex without marginal granules.

Habitat:Epipellic.

Lake:5.

Distribution:Austria,

*Cosmarium norimbergense* Reinsch (Fig. 2:10)

L:15  $\mu$ , W:12  $\mu$ , I:3  $\mu$ .

Habitat:Epilithic.

Lake:5.

*Cosmarium novae-semillae* Wille (Fig. 2:11)

L:20  $\mu$ , W:17  $\mu$ , I:3  $\mu$ .

Habitat:Epipellic.

Lake:5.

(\*)*Cosmarium rectangulare* Grun. (Fig. 2:12)

(Syn.: *Cosmarium gotlandicum* Wittr.)

Coesel 1991, p. 51, pl. 4, figs. 13-15.

Lenzenweger 1999, p. 64, pl. 49, fig. 9.

Cell about 1.36 times longer than wide, 50  $\mu$  L, 36.6  $\mu$  W, 11.6  $\mu$  I; median constriction deep, sinus narrow, apex dilated; semicells subhexagonal-reniform apex truncate and straight.

Habitat:Epipellic.

Lake:7.

Distribution:United States.

*Cosmarium regnellii* Wille (Fig. 2:13)

L:12.5  $\mu$ , W:10  $\mu$ , I:2.5  $\mu$ .

Habitat:Epipellic.

Lake:7.

*Cosmarium speciosum* P. Lundell (Fig. 2:14)

L:45  $\mu$ , W:31  $\mu$ , I:10  $\mu$ .

Habitat:Epilithic.

Lake:5.

(\*)*Cosmarium speciosum* var. *simplex* Nordst. (Fig. 2:15)

Lenzenweger 1999, p. 148, pl. 64, fig. 15.

Cell 1.5 times longer than wide, 28.8-33  $\mu$  L, 17.6-22  $\mu$  W, 5-11.2  $\mu$  I; median constriction moderately deep, sinus narrowly linear, apex slightly dilated; semicells are

more attenuated toward the apex, marginal crenations entire with the basal, vertical series of granules very indistinct.

Habitat:Epipelic.

Lake:7.

Distribution:Austria, England.

*Cosmarium subcostatum* Nordst. in Nordst. & Wittr. (Fig. 2:16)

L:30-33  $\mu$ , W:25-28  $\mu$ , I:8  $\mu$ .

Habitat:Epipelic, epilithic.

Lake:1,2,3,4,5,6,

*Cosmarium subspeciosum* Nordst. var. *validus* Nordst. (Fig. 2:17)

L:70  $\mu$ , W:48  $\mu$ , I:13  $\mu$ .

Habitat:Epilithic.

Lake:5.

*Cosmarium turpinii* Gutw. (Fig. 2:18)

L:93  $\mu$ , W:70  $\mu$ , I:23  $\mu$ .

Habitat:Epipelic.

Lake:5.

*Cosmarium variolatum* P. Lundell (Fig. 2:19)

L:27  $\mu$ , W:19  $\mu$ , I:5  $\mu$ .

Habitat:Epipelic.

Lake:4.

*Cosmarium vexatum* W. West (Fig. 2:20)

L:40  $\mu$ , W:30  $\mu$ , I:6-7  $\mu$ .

Habitat:Epipelic.

Lake:5,6.

*Cosmarium* sp.1 (Fig. 2:21)

L:50  $\mu$ , W:32  $\mu$ , I:8  $\mu$ .

Habitat:Epipelic.

Lake:5.

*Cosmarium* sp.2

L:32-35  $\mu$ , W:27-30  $\mu$ , I:8  $\mu$ .

Habitat:Epipelic.

Lake:7.

### Genus *Staurastrum* Meyen 1829 ex Ralfs 1848

*Staurastrum dispar* Bréb. (Fig. 3:1)

L:36.6  $\mu$ , W:40  $\mu$ , I:15  $\mu$ .

Habitat:Epipelic, epilithic.

Lake:5,6,7.

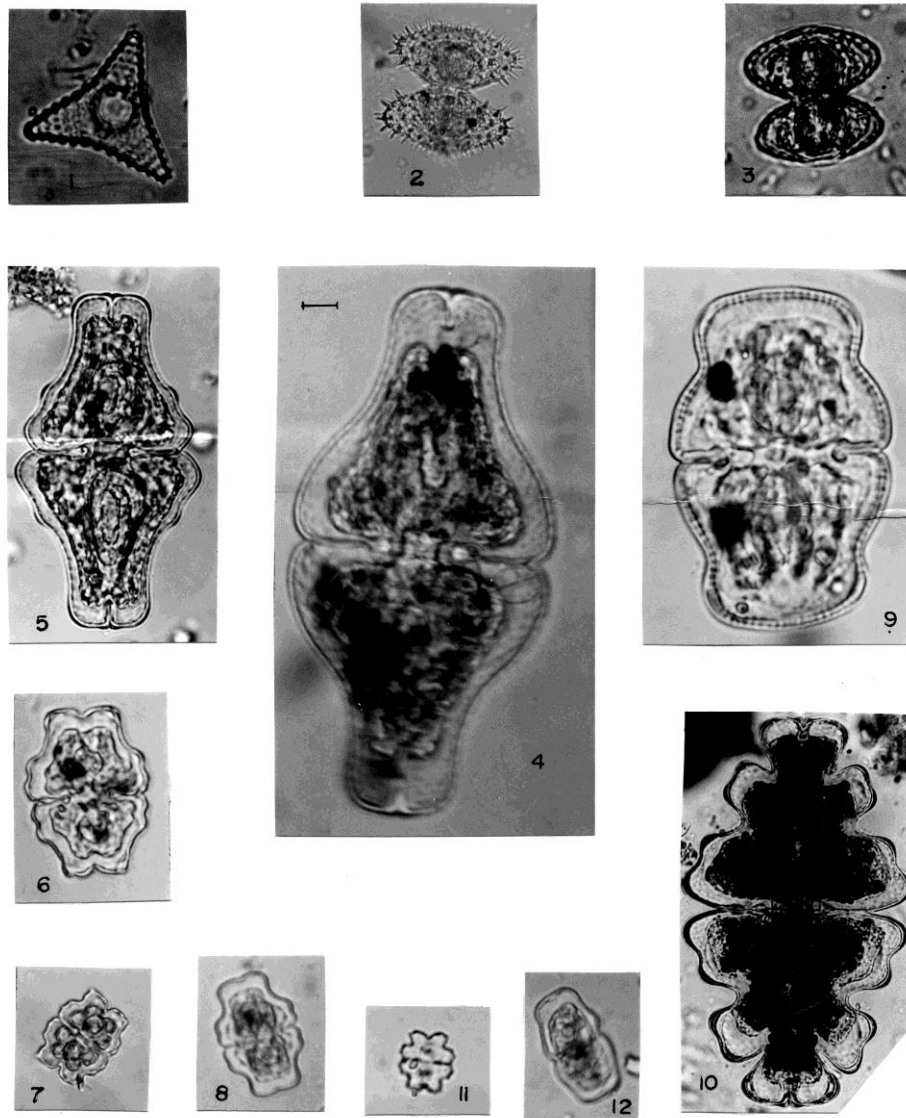


Fig. 3. 1- *Staurastrum dispar* Bréb., 2- *S. pilosum* (Näg.) Archer, 3- *S. punctulatum* Bréb., 4- *Euastrum ansatum* Ralfs, 5- *E. ansatum* var. *pixidatum* Delp., 6- *E. binale* var. *gutwinskii* (Schmidle) Homfeld, 7- *E. denticulatum* Gay., 8- *E. luetkemuellerei* var. *carniolicum* (Lütkem.) Willi Krieg., 9- *E. luetkemuellerei* var. *floridanum* Scott & Grönblad, 10- *E. oblongum* (Grev.) Ralfs, 11- *E. pseudotuddalense* Messik., 12- *E. sublobatum* var. *subdissimile* W. & G.S. West (Scale bar- 10  $\mu$ ).

*Staurostrum pilosum* (Näg.) Archer (Fig. 3:2)

L:42.5 µ, W:37.5 µ.

Habitat:Epipelic, epilithic.

Lake:3,4,6.

*Staurostrum punctulatum* Bréb. ex Ralfs (Fig. 3:3)

L:40 µ, W:36.6 µ, I:8 µ.

Habitat:Epipelic, epilithic.

Lake:1,2,3,4,5,6,7.

**Genus *Euastrum* Ehrenberg ex Ralfs 1848***Euastrum ansatum* Ralfs (Fig. 3:4)

L:63.5-77µ, W:31.7-40 µ, I:10.5-17 µ.

Habitat:Epipelic.

Lake:3,4,7.

**(\*)***Euastrum ansatum* var. *pixidatum* Delp. (Fig. 3:5)

Ruzička 1981, p. 396, pl. 60, fig. 6-9.

Cell 98 µ L., 55 µ W, 20 µ I, median incision shallow and closed; sinus deep and narrow. Cell wall punctate. There is an inflation on each side.

Habitat:Epipelic.

Lake:7.

Distribution:Germany.

*Euastrum binale* var. *gutwinskii* (Schmidle) Homfeld (Fig. 3:6)

L:20 µ, W:14 µ, I:4.7 µ.

Habitat:Epipelic.

Lake:4.

**(\*)***Euastrum denticulatum* Gay. (Fig. 3:7)(Syn.: *Euastrum binale* var. *β* Ralfs*E. binale* b. *denticulatum* Kirchn.*E. amoenum* Gay.*Helierella Kirchneri* Kuntze)

West and West 1905, p. 56, pl. 39, figs. 1-4.

Cells 1.15 times longer than wide, 30 µ L., 26 µ W., 8 µ I, very deeply constricted, sinus narrowly linear with a dilated extremity; semicells subpyramidal, basal angles rounded, furnished with a number of granules, upper part of lateral margins concave, apical part of semicell protracted, broadly rectangular, upper angles furnished with an acute granule, apex truncate with a slight median notch; semicells with a granulated central protuberance, and a number of granules within the basal angles and the apex.

Habitat:Epipelic.

Lake:7.

Distribution: East and Central Africa, Austria, Australia, Azores, Brazil, Central China, Ceylon, England, Finland, France, Germany, Iceland, Java, Madagascar, New Zealand, North Russia, Norway, Siam, Singapore, United States, West Indies.

*Euastrum luetkemuellerei* var. *carniolicum* (Lütkem.) Willi Krieg. (Fig. 3:8)

L:31.6  $\mu$ , W:21.6  $\mu$ , I:3.3  $\mu$ .

Habitat:Epipellic.

Lake:4.

*Euastrum luetkemuellerei* var. *floridanum* Scott & Grönblad (Fig. 3:9)

L:32-35.6  $\mu$ , W:20.5-23.5  $\mu$ , I:4.5-6  $\mu$ .

Habitat:Epipellic.

Lake:4.

*Euastrum oblongum* (Grev.) Ralfs (Fig. 3:10)

L:172.5  $\mu$ , W:75  $\mu$ , I:27.5  $\mu$ .

Habitat:Epipellic.

Lake:2,3,5,6,7.

(\*)*Euastrum pseudotuddalense* Messik. (Fig. 3:11)

Lenzenweger 1996, p. 88, pl. 11, fig. 10.

Cell from 1.14 to 1.20 times longer than wide, 18-20  $\mu$  L., 15-17.5  $\mu$  W, 5-7.5  $\mu$  I. Semicell trapezoid with three lobes. Basal lobe truncated bearing 2 marginal granules. Apical lobe trapezoid with concav sides. Apical incision obtuse-angled with 1-1 granules on each side. The incision between the basal lobes and the apical lobe acute angled. Sinus deep and narrow. In the middle of the semicells with a large granule.

Habitat:Epipellic.

Lake:7.

Distribution:Austria.

(\*)*Euastrum sublobatum* var. *subdissimile* W. & G. S. West (Fig. 3:12)

West and West 1905, p. 74, pl. 40, fig. 20.

Cell 40  $\mu$  L., 22  $\mu$ , 2  $\mu$  I, cells with a broader isthmus; semicells with larger basal angles, the retuse portion of the lateral margin being nearer the apex; apex widely convex and retuse-emarginate in the middle.

Habitat:Epipellic.

Lake:2,3.

Distribution:England.

*Euastrum verrucosum* Ehrenb. ex Ralfs var. *alatum* Wolle (Fig. 4:1)

L:140  $\mu$ , W:128  $\mu$ , I:50  $\mu$ .

Habitat:Epipellic.

Lake:5.

*Euastrum verrucosum* Ehrenb. ex. Ralfs var. *rhomboideum* P. Lundell (Fig. 4:2)

L:110-120  $\mu$ , W:100-105  $\mu$ .

Habitat:Epipellic.

Lake:2.

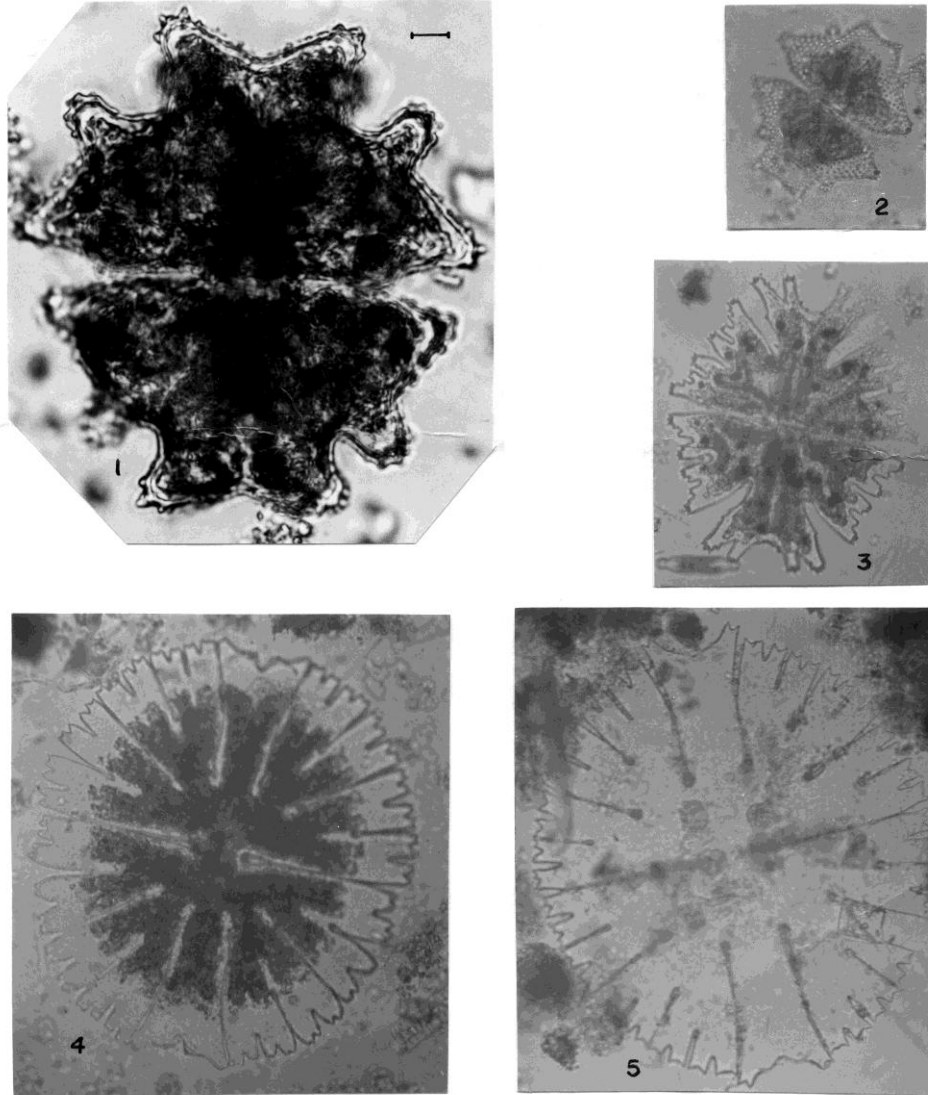


Fig. 4.1- *E. verrucosum* Ehrenb. ex Ralfs var. *alatum* Wolle, 2- *E. verrucosum* Ehrenb. ex Ralfs var. *rhomboideum* P. Lundell, 3- *Micrasterias americana* (Ehrenb.) Ralfs, 4- *M. denticulata* Bréb. ex Ralfs, 5- *M. rotata* (Grev.) Ralfs (Scale bar- 10  $\mu$ ).

#### Genus *Micrasterias* Agardh ex Ralfs 1848

*Micrasterias americana* (Ehrenb.) Ralfs (Fig. 4:3)

L:175  $\mu$ , W:150  $\mu$ .

Habitat:Epipelagic.

Lake:2.

*Micrasterias denticulata* Bréb. ex Ralfs (Fig. 4:4)

L:245-260  $\mu$ , W:220-235  $\mu$ .

Habitat:Epipellic.

Lake:2.

*Micrasterias rotata* (Grev.) Ralfs (Fig. 4:5)

L:280  $\mu$ , W:250  $\mu$ .

Habitat:Epipellic.

Lake:2,3.

### Discussion

A total of 55 desmid taxa belonging to 12 genera and 3 families were identified. The species of families Desmidiaceae and Peniaceae predominated. They comprised of 67.27 % and 27.28 % of all recorded taxa respectively. The species of Mesotaeniaceae (5.45 %) make up an insignificant part of all taxa. The genus *Cosmarium* has the highest species richness- 36.4 % of all desmid taxa. Two other species-rich genera are *Euastrum* (20 %) and *Closterium* (18.2 %). The second group of genera, each comprising about 5.45 % of all taxa, consist of *Staurastrum* and *Micrasterias*. The genus *Actinotaenium* comprises 3.63 % of all taxa. The genera that have the lowest number of species are *Cylindrocycitis*, *Netrium*, *Roya*, *Penium*, *Spondylosium* and *Pleurotaenium*.

The desmid flora of the high mountain lakes of the Turkish Eastern Black Sea Region is characterized by a high proportion of alpine (94.55%) floral elements (Lenzenweger, 2003). The remaining species (5.45%) are elements of arctic-alpine flora such as *Cosmarium costatum*, *C. galeritum* and *C. speciosum* (Coesel, 1996). *Closterium rostratum* and *Micrasterias americana* were on the red list in the Netherlands (Coesel, 1998). *Closterium lunula* var. *biconvexum*, *Cosmarium asphaerosporum* var. *strigosum*, *C. malinvernianum* var. *badense*, *C. rectangulare*, *C. speciosum* var. *simplex*, *Euastrum ansatum* var. *pixidatum*, *E. denticulatum*, *E. pseudotuddalense* and *E. sublobatum* var. *subdissimile* are new record for Turkey (Şahin, 2005), and were found in the lakes 5, 7 and 2, respectively.

All waters were slightly acidic and circumneutral (pH 6.5-7.5) and the dissolved oxygen values varied between 8.1 and 12.2 mg/l<sup>-1</sup>. It is suggested that further studies on the chemical nature and characteristics of the lake be carried out in order to have a better understanding of the ecology of desmids.

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