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A preliminary checklist of desmids of Turkey

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Abstract – The desmid flora in Turkey has been investigated over different periods. The first study was undertaken in 1966, then there was a period of silence until 1980. Since then, there have been many studies undertaken, mostly were focused on lakes and rivers. A total of 165 taxa of 15 genera belonging to 3 families have been identified. Of all genera, *Cosmarium* dominated with 73 taxa, followed by *Closterium* with 46 taxa, *Staurastrum* with 19 taxa, and *Euastrum* 10 taxa. Other genera encountered were: *Cylindrocystis* (1), *Netrium* (1), *Roya* (1), *Penium* (3), *Gonatozygon* (1), *Desmidium* (1), *Spondylosium* (1), *Actinotaenium* (2), *Pleurotaenium* (2), *Xanthidium* (1) and *Micrasterias* (3). Three of the genera belong to saccoderm desmids while 12 are placoderm desmids. Regarding the species distribution in the investigated areas, rare species comprised 95.1% of the total number of taxa. *Closterium acerosum*, *C. acutum*, *C. littorale*, *C. lunula*, *C. parvulum*, *Cosmarium botrytis*, *C. formosulum* and *C. granatum* were the most frequently encountered taxa in the desmid flora of Turkey. The highest species diversity was found in localities with pH 6.8-7.5.

Freshwater green algae / Desmids / Floristics / Ecology / Checklist / Turkey

Résumé – **Liste préliminaire des desmidiées de Turquie.** La flore desmidiale de Turquie a été étudiée à diverses périodes. Une première étude a été entreprise en 1966, mais plus rien juqu'à 1980. Depuis lors, de nombreuses recherches ont été effectuées, principalement dans des lacs et des cours d'eau. En tout, 165 taxons, appartenant à 15 genres et 3 familles, ont été identifiés. *Cosmarium*, avec 73 taxons est le genre le mieux représenté, suivi par *Closterium* (46 taxons), *Staurastrum* (19 taxons) et *Euastrum* (10 taxons). Les autres genres observés sont : *Cylindrocystis* (1), *Netrium* (1), *Roya* (1), *Penium* (3), *Gonatozygon* (1), *Desmidium* (1), *Spondylosium* (1), *Actinotaenium* (2), *Pleurotaenium* (2), *Xanthidium* (1) et *Micrasterias* (3). Trois de ces genres appartiennent aux desmidiées saccodermes, les 12 autres aux desmidiées placodermes. Du point de vue de la répartition des espèces dans les localités étudiées, 95,1 % des taxons peuvent être considérés comme rares. *Closterium acerosum*, *C. acutum*, *C. littorale*, *C. lunula*, *C. parvulum*, *Cosmarium botrytis*, *C. formosulum* et *C. granatum* sont les taxons les plus fréquemment rencontrés parmi les desmidiées de Turquie. La plus grande diversité spécifique a été observée dans des localités à pH variant de 6,8 à 7,5.

Algues vertes d'eau douce / Desmidiées / Liste floristique / Ecologie / Turquie

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INTRODUCTION

Among numerous desmid papers from European countries there is relatively little information on Turkish desmids. The reasons for this are many, including: a shortage of limnologists, few large water bodies, deficiencies in the selection of study sites and sampling methods, and the limited availability of specialized literature. The first reports concerning desmids were published by Güner (1966, 1969). He described *Closterium moniliferum*, *Cosmarium botrytis* and *C. ornatum*. The first specialized taxonomic studies on desmids of Turkey were published by Öztürk *et al*. (1995a, 1995c). They described two new taxa: *Closterium kuetzingii* var. *kuetzingii* and *Pleurotaenium trabecula*. Şahin (1998b, 2000a, 2002a) made the most substantial contribution to the Turkish desmid flora. He investigated desmids found mainly in high mountain lakes and rivers.

Turkey is rather unique among the Southern European countries in that it still contains rich wetland areas. The country has 906.118 ha lakes, 18.000 ha dam lakes and a water network 145.000 km long (Ertan & Morkoyunlu, 1998). A number of lakes, pools and rivers situated in high mountain areas offer good conditions for the development of a rich desmid flora because they are largely ecologically intact and remote from the industrial and agricultural centres of the Turkey. Recent desmid investigations started in 1998 and, since then, 23 species have been added to the list of Turkey desmids. In this paper the main taxonomic and ecological features of the Turkey desmid flora are described briefly.

MATERIALS AND METHODS

For the present paper all known literature sources (published papers, manuscripts and proceedings) concerning Turkey desmids were examined. The taxa identified by the author were collected between 1996 and 2001 in the high mountain lakes of the North East Blacksea region of Turkey. The number of sampling stations per watercourse depended on the size of the lakes. The samples were taken on a monthly basis, and collected from stations of 20-30 cm depth, 50-100 cm offshore. Vascular plants were absent at all stations in the lakes. 308 epipelic and epilithic samples were collected and processed. Epipelic samples were collected by drawing a glass tube across the surface of the sediment, epilithic samples were collected at random (Round, 1953; Sladeckova, 1962). All samples were fixed in 4% formaldehyde. Samples were examined in temporary slides and under the Nikon light microscope (magnification × 400 and × 1000). Photographs were taken with an Olympus BH-2 microscope.Taxonomic identifications were made according to Bourrelly & Couté (1982), Compère (1977), Dillard (1990, 1991a, 1991b, 1993), Förster (1982), Gontcharov (1998), Lenzenweger (1996, 1997, 1999, 2003), Lind & Brook (1980), Ling and Tyler (1986) and Scott & Prescott (1961). The systematic classification of desmids was made according to Christiansen (1994). Occurrence of species is indicated according to the following scale: rare (R) – species recorded in 10% of investigated sites; frequent (F) – species recorded in 10-50% of investigated sites; common (C) – species recorded in 50% of investigated sites.

RESULTS AND DISCUSSION

A total of 165 desmid taxa are reported in this paper. They represent 15 genera, 124 species, 37 varieties and 4 formae. Three of the genera belong to saccoderm desmids while 12 are placoderm desmids. The taxonomic inventory is shown in Table 1.

Taxonomic composition

The taxonomic composition of the Turkish desmid flora is given in Tab. 1. As expected, species of families *Desmidiaceae* and *Peniaceae* dominate. They comprise, respectively, 67.8% and 30.3% of all recorded taxa. Species of *Mesotaeniaceae* (1.8%) make up an insignificant portion of the flora. According to Palamar-Mordvinceva (1982), the best characterization of the desmid flora in different geographic regions is made by enumerating species richness in the different genera. The desmid flora of Turkey shows great similarity with the desmid flora of countries like Austria (Lenzenweger, 2003), France (Kouwets, 1999), Lithuania (Kostkeviciene *et al*., 2003), Netherlands (Coesel, 1998) and Sweden (Engels, 2002). The genus *Cosmarium* has the highest species richness – 44.2% of all desmid taxa. Two other species-rich genera, *Closterium* and *Staurastrum*, have comparable percentages in the above-mentioned countries. But in the Turkish flora the percentages of *Closterium* (27.9%) is much greater than *Staurastrum* (11.5%). To sum up, the above-mentioned three genera comprise 83.6% of all desmid taxa. The next genus is *Euastrum*, comprising 6.0% of all desmid taxa. The genera that have the lowest number of species are *Penium*, *Micrasterias,*

Table 1. Taxonomic constitution of the Turkey desmid flora.

Taxa	*Species number*	*Species number %*
Mesotaeniaceae	**3**	**1.8**
Cylindrocystis	1	0.6
Netrium	1	0.6
Roya	1	0.6
Peniaceae	**50**	**30.3**
Penium	3	1.8
Gonatozygon	1	0.6
Closterium	46	27.9
Desmidiaceae	**112**	**67.8**
Desmidium	1	0.6
Spondylosium	1	0.6
Actinotaenium	2	1.2
Pleurotaenium	2	1.2
Cosmarium	73	44.2
Staurastrum	19	11.5
Xanthidium	1	0.6
Euastrum	10	6.0
Micrasterias	3	1.8
Total	**165**	**100**

Actinotaenium, Pleurotaenium, Xanthidium, Gonatozygon, *Desmidium, Spondylosium, Cylindrocystis, Roya and Netrium*, each of these comprising 1.8–0.6% of all taxa.

Biogeographical characteristics

The desmid flora of Turkey is characterized by a high proportion of cosmopolitan (73.1%) and boreal (21.5%) elements (Coesel, 1998; Kadiri, 2001; Kostkeviciene *et al*., 2003; Lenzenweger, 2003). In total they comprise about 94.6% of all taxa. Also, there are some (3.0%) elements of warm temperate and tropical region floras; *Cosmarium abbreviatum*, *C. incavatum*, *C. mansagense*, *Staurastrum brachiatum* and *S. crenulatum* (Kadiri, 2001; Kostkeviciene *et al*., 2003; Scott & Prescott, 1961; Suxena & Venkareswarlu, 1968), these species have been recorded from different regions of Turkey (Albay & Aykulu, 1994a,b; Balık & Şipal-Gezerler, 1999; Cirik-Altındağ, 1984; Gezerler-Şipal *et al*., 1999; Obalı *et al*., 2002; Özesmi, 1987; Şahin, 2001). The remaining species (2.4 %) are elements of arctic-alpine and boreal-arctic flora: *Cosmarium costatum*, *C. galeritum*, *C. speciosum* and *Penium polymorphum* (Coesel, 1996; Kostkeviciene *et al*., 2003). These species have been found in the high mountain lakes of the East Black Sea region in Turkey (Şahin, 2001, 2002a,b).

Species distribution

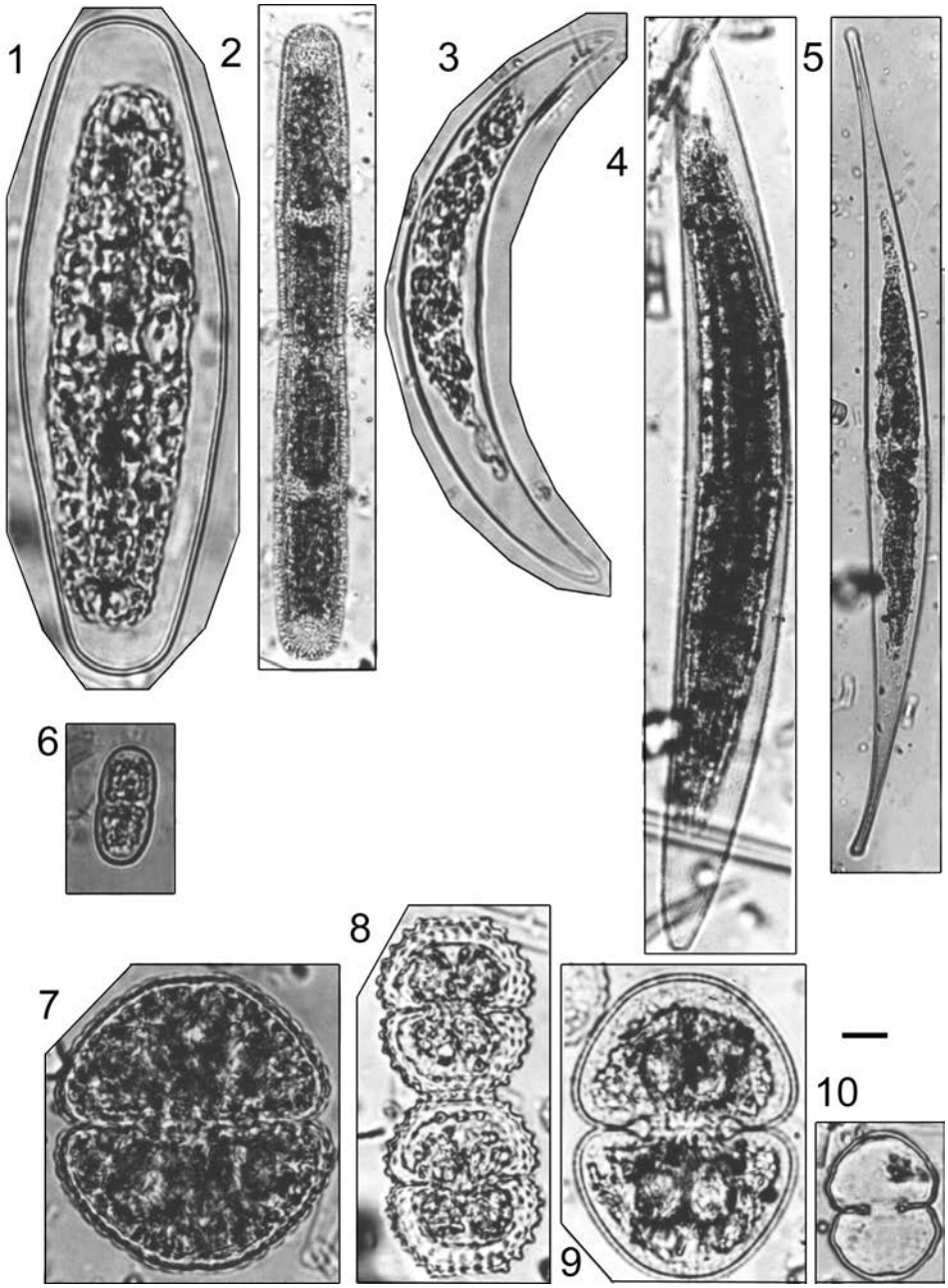
Rare species comprise 95.2% of all taxa (Tab. 2). A possible explanation for this could be that the Turkish desmid flora has been inadequately investigated or that certain habitats are not fully represented (Tab. 2). Olrik (2003) found a similar tendency for pelagic desmids in 17 Danish lakes. Unfortunately, except for pH, there are not enough data on the environmental conditions of the investigated habitats to establish correlations with presence or absence of given species. Frequently encountered species make up only 4.8% of all taxa. Coesel (1998) pointed out that *Closterium attenuatum*, *C. closterioides*, *C. ralfsii*, *C. rostratum*, *Cosmarium blyttii*, *C. margaritatum*, *C. monomazum*, *Micrasterias americana*, *Penium cylindrus*, *Staurastrum brachiatum*, *S. furcatum*, *S. polytrichum* and *S. westitum* were on the red list in the Netherlands. These species were found to be rare in Turkey as well.

Species distribution related to pH

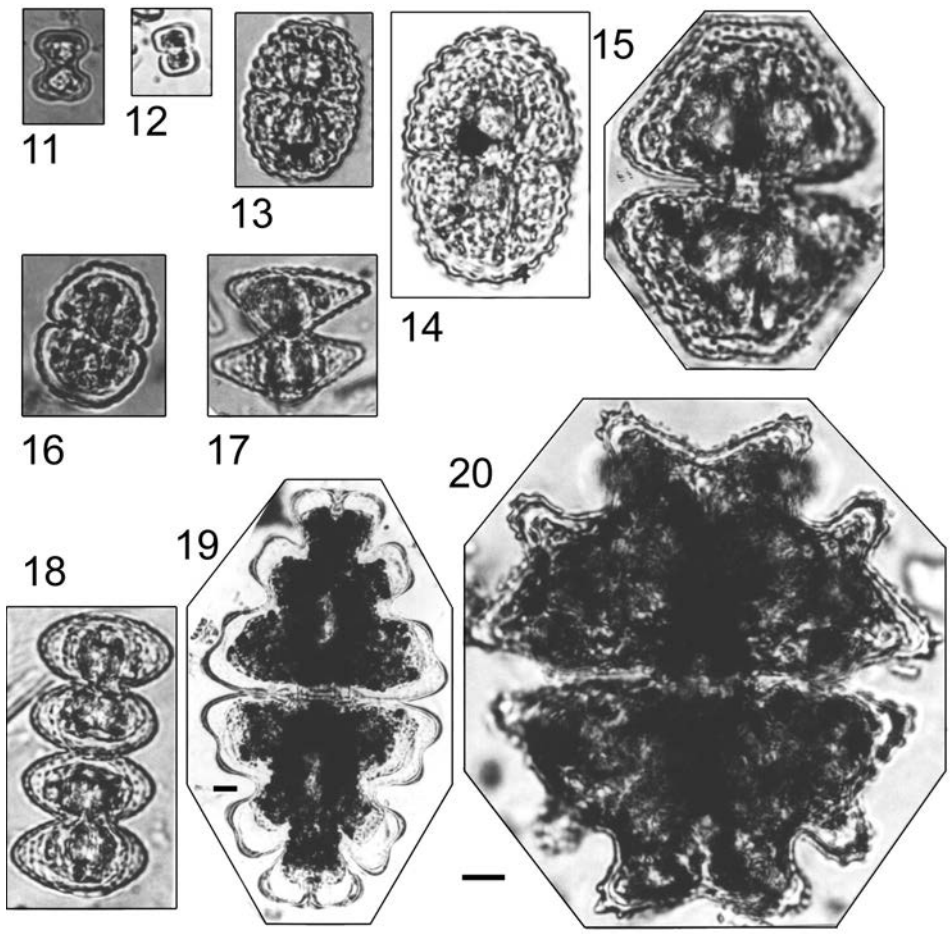
Many authors have mentioned the alkalinity of water as one of the main factors affecting the occurence of desmid species (Tomaszewicz, 1994; Růžička, 1977, 1981; Brook, 1981; Lenzenweger, 1996, 1997). Desmids prefer mainly acidic and pH-circumneutral waters. Another factor that seems to be important in species distribution is the concentration of nutrients. Desmids prefer habitats with a low or moderate concentration of biogens (Coesel, 1983). Unfortunately, in our studies we only have pH data, which ranged from 6.8 to 9.5 in the habitats investigated. The highest species numbers (66) have been found in habitats with pH 6.8-7.5. A relatively high number of desmid species (17) was recorded from alkaline habitats. In the sites studied, pH fluctuated from 7.5-8.0 up to 8.1-9.5. The remaining species (18) seemed to be indifferent to water pH and were recorded in quite a wide range of pH values, from 6.8-9.5, albeit in different abundance. The species (4) of the genera *Penium* and *Xanthidium* – according to the literature (Kostkeviciene *et al*., 2003) characterized as inhabitants of acidic water, were found in pH-circumneutral and alkaline waters in Turkey.

Table 2. Species list of desmids in Turkey.

Taxa	*Literature **	*Habitat*	*D*	*pH*
Familia *Mesotaeniaceae*				
Genus *Cylindrocyctis* Meneghini 1838				
C. brebissonii (Ralfs) De Bary	48, 78	2	R	6.9, 7.0, 7.1
Genus *Netrium* (Itzigs. & Rothe) emend. Lütkem. 1902				
N. digitus (Bréb.) Itzigs. & Rothe	77, 78	2	R	6.9, 7.0, 7.1, 7.5
Genus *Roya* W. &. G. S. West 1920				
R. obtusa (Bréb.) W. &. G. S. West	78	2	R	6.9, 7.0
Familia *Peniaceae*				
Genus *Penium* Brébisson ex Ralfs 1848				
P. cylindrus (Ehrenb.) ex Bréb.	14, 63	2, 3	R	
Syn.:*Disphinctium cylindrus* (Ehrenb.) Nägeli				
P. margaritaceum (Ehrenb.) ex Bréb.	69, 72, 75, 77, 78	1, 2, 3	R	6.9, 7.0, 7.1, 7.5
P. polymorphum (Perty) Perty	76	2	R	7.0, 7.1
Genus *Gonatozygon* De Bary 1856				
G. monotaenium De Bary	30	1	R	
Syn.:*G. ralfsii* De Bary				
Genus *Closterium* Nitzsch ex Ralfs 1848				
C. acerosum (Schrank) Ehrenb. ex Ralfs	18, 22, 24, 35, 37, 41, 43, 60, 70, 82, 85, 89, 90, 91, 94	1, 2, 3, 4	F	7.2, 7.3, 7.9, 8.1, 8.3, 8.8, 9.1
C. aciculare T. West	1, 16, 21, 29, 37,	1, 2, 3	R	7.9, 8.0
Syn.:*C. subpronum* W. & G. S. West	42, 46, 64, 68, 69			
C. acutum Bréb	3, 4, 18, 23, 24, 26, 32, 40, 41, 45, 46, 47, 55, 68, 69, 85, 86, 93	1, 2, 3, 4	F	8.4, 8.9
C. acutum var. *linea* (Perty) W. & G.S. West	26	1	R	8.4, 8.5
Syn.:*C. linea* Perty				
C. acutum var. *tenuis* Nords.	26	1	R	8.3, 8.4
C. acutum var. *variabile* (Lemmerm.) Willi Krieg.	14, 19, 26, 27, 39, 47, 85	1, 4	R	7.2, 8.8, 9.1
Syn.:*C. pseudospirotaenium* Lemmerm.				
C. attenuatum Ralfs	1, 31	1, 2	R	
C. closterioides (Ralfs) Louis & Peeters	22	2, 3, 4	R	7.7, 8.0
Syn.:*Penium closterioides* Ralfs, *P. libellula* (Focke) Nordst., *C. libellula* Focke.				
C. dianae Ehrenb. ex Ralfs	1, 2, 16, 31, 42, 45, 63, 77, 78, 93	1, 2, 4	R	6.9, 7.4, 7.5, 8.8
C. dianae var. *pseudodianae* (Roy) Willi Krieg.	86	4	R	
Syn.:*C. pseudodianae* Roy et Biss.				
C. ehrenbergii Menegh. ex Ralfs	23, 45, 60, 63, 69	2, 4	R	
C. gracile Ralfs	18	1	R	7.0, 7.3
C. incurvum Bréb	23	1	R	7.5, 8.0
Syn.:*C.venus* Kütz. ex Ralfs var. *incurvum* (Bréb.) Willi Krieg.				
C. kuetzingii Bréb.	16, 17, 23, 62, 67	1	R	7.3, 8.0
C. leibleinii Kütz. ex Ralfs	68	2	R	7.9, 8.1
C. leibleinii Kütz. ex Ralfs var. *boergeseni* (Schmidle) Skv.	23, 69	4	R	
C. libellula Focke var. *interrupta* W. West	69	4	R	
C. limneticum Lemmerm.	47, 87	1	R	7.7, 8.0



Figs 1-10: **1**. *Netrium digitus* (Bréb) Itzigs. & Rothe. **2.** *Penium margaritaceum* Bréb. **3**. *Closterium dianae* Ralfs. **4**. *Cl. pritchardianum* W. Archer. **5.** *Cl. rostratum* Ralfs. **6**. *Actinotaenium cucurbita* (Bréb) Teilling. **7**. *Cosmarium botrytis* Ralfs. **8**. *C. costatum* Nordst. **9**. *C. galeritum* Nordst. **10**. *C. laeve* Rabenh. (Scale bar = 10μ).



Figs 11-20: **11**. *Cosmarium novae-semliae* Wille. **12**. *C. norimbergense* Reinsch. **13**. *C. speciosum* P.Lundell. **14**. *C. subspeciosum* var. *validus* Nordst. 15. *C. turpinii* Bréb. **16**. *C. vexatum* West. **17**. *Staurastrum dispar* Bréb. **18**. *S. punctulatum* Bréb. **19**. *Euastrum oblongum* Ralfs. **20**. *E. verrucosum* Ehr. ex. Ralfs var. *alatum* Wolle (Scale bar = 10μ).

Table 2. Species list of desmids in Turkey *(following)*.

Taxa	*Literature* *	*Habitat*	*D*	*pH*
C. lineatum Ehrenb. ex Ralfs	58	1	R	
C. littorale Gay.	25, 44, 56, 59, 68, 70, 73, 75, 76, 79, 80	1, 2, 3, 4	F	7.0, 7.2, 7.9, 8.1
C. littorale var. *crassum* W. West	69, 80	4	R	
C. lunula (O.F. Müll.) Nitzsch ex Ralfs	4, 7, 8, 9, 32, 47, 50, 52, 79, 87, 88, 94	1, 2, 3	F	6.0, 7.7, 7.9, 8.4, 8.9, 9.0, 9.5
C. lunula var. *intermedium* Gutwinski	78	2, 3	R	6.9, 7.5
C. lunula var. *massartii* (Wildeman) Willi Krieg.	78, 79	1	R	6.9, 7.0, 7.1
C. macilentum Bréb. var. *japonicum* (Suringar) Willi Krieg.	26	1	R	
C. moniliferum (Bory) Ehrenb. ex Ralfs	22, 24, 49, 59, 63, 80, 86	1, 3, 4	R	7.0, 7.3, 8.0, 8.3
C. moniliferum (Bory) Ehrenb. ex Ralfs var. *concavum* Klebs	37	2, 3	R	7.3
C. navicula Bréb.	63	1	R	7.2, 8.5
C. nordstedtii Chodat var. *polystichum* (Nygaard) Ruzicka Syn.:*C. polystictum* var. *nordstedtii* (Chodat) Willi Krieg.	44, 46	1	R	
C. obtusum Bréb.	48	3	R	
C. parvulum Nägeli	3, 8, 9, 10, 11, 14, 23, 26, 27, 29, 50, 51, 53, 60, 65, 66, 76, 79, 83, 87, 94	1, 2, 3, 4	F	6.6, 7.0, 7.1, 7.7, 8.5, 9.0
C. parvulum var. *maius* (Schmidle) Willi Krieg.	23, 60	2, 3	R	7.0, 7.2
C. praelongum Bréb.	23, 65	1	R	
C. pritchardianum Archer	20, 44, 45, 70, 77	1, 2, 3, 4	R	6.9, 7.0, 7.5
C. pronum Bréb.	70	2	R	
C. pseudolunula Borge	22	1	R	7.3
C. ralfsii Bréb. ex Bréb.	75	1	R	7.0, 7.1
C. ralfsii Bréb. ex Bréb var. *hybridum* Rabenh.	15, 16	1	R	
C. rostratum Ehrenb. ex Ralfs	47, 69, 77, 78	1, 3, 4	R	6.9, 7.5
C. setaceum Ehrenb. ex Ralfs	15, 16	1	R	7.3
C. setaceum var. *vittatum* Grönblad	30	1	R	7.7
C. striolatum Ehrenb. ex Ralfs	78	2	R	6.9, 7.0, 7.1, 7.2
C. strigosum Bréb.	40, 41, 43, 91	1, 2, 3	R	7.3, 8.3
C. tumidulum Gay	37	2, 3	R	
C. tumidum Johnson	56	2, 3	R	
C. venus Kütz. ex Ralfs	18, 60	1	R	
Familia *Desmidiaceae*				
Genus *Desmidium* C. A. Agardh 1824	63	2	R	
D. swartzii (C. A. Agardh.) C. A. Agardh ex Ralfs				
Genus *Spondylosium* Brebisson 1844				
S. planum (Wolle) W. & G. S. West	71, 75	2, 3	R	7.0, 7.1
Genus *Actinotaenium* Teiling 1954				
A. cruciferum (De Bary) Teiling Syn.:*Dysphinetium cruciferum* (De Bary) Hansg.	77, 78	2	R	6.9, 7.5
A. cucurbita (Bréb) Teiling Syn.:*Cosmarium cucurbita* Bréb.	74, 76	2, 3	R	6.9

Table 2. Species list of desmids in Turkey *(following)*.

Taxa	*Literature **	*Habitat*	*D*	*pH*
Genus *Pleurotaenium* Nägeli 1848				
P. minutum (Ralfs) Delponte	75	3	R	7.0
Syn.:*Docidium minutum* Ralfs, *Penium ralfsii* De Bary, *P. minutum* (Ralfs) Cleve				
P. trabecula (Ehrenb.) Nägeli	64, 76, 76, 78	1, 2, 3	R	7.0, 7.1, 7.2
Genus *Cosmarium* Corda ex Ralfs 1848				
C. abbreviatum Racib.	26, 65	1	R	
C. bioculatum Bréb.	14, 26, 31, 32, 47, 55, 78, 87, 88	1, 2, 3	R	6.9, 7.5, 7.7, 8.4, 8.9, 9.0
C. bioculatum var. *depressum* (Schaarschm) Schmidle	42, 45, 46	1, 2, 4	R	
C. bireme Nordst.	21	1	R	
C. biretum Bréb. in Ralfs	5, 6	1	R	
C. blyttii Wille	56, 70, 75, 76	2, 3	R	7.0, 7.1, 7.2
C. blyttii var. *hoffii* Börges.	78	2, 3	R	6.9, 7.5
C. botrytis Menegh. ex Ralfs	14, 16, 20, 22, 23, 25, 27, 33, 42, 45, 49, 56, 57, 60, 63, 69, 70, 75, 76, 77, 78, 79, 86	1, 2, 3, 4	F	6.9, 7.0, 7.1, 7.5
C. constrictum Delponte	85	1	R	7.2, 9.1
C. contractum Kirchn.	21	1	R	6.8, 7.2, 8.8, 9.1
Syn.:*C. contractum* f. *jakobsenii* (Roy) W. & G. S. West, *C. contractum* var. *rotundatum* Borge				
C. costatum Nordst.	77	3	R	6.9, 7.5
C. dentiferum Corda ex Nordst.	24, 75	2, 3, 4	R	7.0, 7.1
C. depressum (Nägeli) P. Lundell	18, 24, 39, 41, 85	1, 2, 3, 4	R	6.8, 7.7, 8.8, 9.1
C. depressum var. *planctonicum* Reverdin	42	1	R	7.7
Syn.:*C. subtumidum* Nordst. var. *minus* Ström.				
C. exiguum W. & G. S. West	91	2	R	
C. exiguum var. *subrectangulum* W. & G. S. West	78	3	R	6.9, 7.5
C. formosulum Hoff. in Nordst.	18, 19, 23, 40, 41, 42, 43, 45, 46, 47, 54, 55, 60, 65, 66, 82, 84, 85, 89, 90, 91, 92	1, 2, 3, 4	F	6.8, 7.9, 8.0, 8.1, 8.5, 9.1, 9.5
C. formosulum var. *nathorstii* (Boldt) W. & G. S. West	26, 57	1	R	
C. galeritum Nordst.	77	3	R	6.9, 7.5
C. granatum Bréb. in Ralfs	1, 14, 16, 17, 26, 34, 36, 40, 42, 43, 45, 60, 61, 62, 63, 86, 87, 89, 91	1, 2, 3, 4	F	7.3, 7.7, 8.3 ,9.0
C. hornavanense Gutw.	23	2	R	
C. humile (Gay.) Nordst. in De Toni	2, 42, 45	1, 2	R	
C. impressulum Elfving	42	1	R	
Syn.:*C. meneghinii* Bréb. f. *latiuscula* Jacbs.				
C. impressulum var. *suborthogonum* (Racib.) W. & G.S. West	26	1	R	
C. incavatum Turner	63	2, 4	R	
C. laeve Rabenh.	21, 42, 45, 48, 76, 77, 78, 79	1, 2, 3, 4	R	6.9, 7.0, 7.1, 7.5
Syn.:*C. leiodermum* Gay., *C. laeve* var. *septentrionale* Wille				

Table 2. Species list of desmids in Turkey *(following)*.

Taxa	*Literature* *	*Habitat*	*D*	*pH*
C. laeve var. *octangulare* (Wille) W. & G. S. West	26	1	R	7.0, 7.1
Syn.:*C. laeve* var. *undulatum* Schmidle				
C. laeve var. *rectangulare* (Wille) W. & G. S. West	29	1	R	7.0, 7.1
C. laeve var. *westii* Willi Krieg. & Gerloff	23	1	R	7.0, 7.1
C. mansangense W. & G. S. West	76	2	R	7.0, 7.1
C. margaritatum (P. Lundell) Roy et Bisset	7, 9, 12, 50, 51, 53	1, 2, 3, 4	R	
C. margaritiferum (Turpin) Ralfs	23, 78	2	R	6.9, 7.5
C. medioscrobiculatum W. & G. S. West.	69	4	R	
C. meneghinii Bréb.	42, 45, 46, 55, 60	1, 2, 4	R	
Syn.:*C. meneghinii* a. *genuinum* Kirchn				
C. moniliforme (Turpin) ex Ralfs	14	1, 2, 3, 4	R	
C. monomazum P. Lundell	16	2	R	
C. nitidulum De Not.	60	2	R	
C. norimbergense Reinsch	77	3	R	6.9, 7.5
Syn.:*C. exiguum* Archer var. *norimbergense* (Reinsch) f. *minor* (Reinsch) Lütkem.				
C. novae-semliae Wille	77	2	R	6.9, 7.5
C. obtusatum (Schmidle) Schmidle	1, 2, 13, 14, 16, 86, 93, 94	1, 2, 3, 4	R	7.4, 7.9, 8.1, 8.8
C. ornatum Ralfs ex Ralfs	49	1	R	
C. orthopunctulatum Schmidle	26	1	R	
C. phaseolus Bréb. ex Ralfs	87	1	R	7.7, 7.8, 8.0, 9.0
C. phaseolus var. *phaseolus* f. *minus* (Bold) Willi Krieg.& Gerloff	45, 46, 55	1, 2, 3, 4	R	7.8
C. phaseolus var. *minutum* Willi Krieg.	26	1	R	7.7
C. praemorsum Bréb.	32, 88	3	R	8.4, 8.9
C. pseudoholmii Borge	75	3	R	7.0, 7.1
C. pseudorectangulare Grönblad	24, 26, 27, 28, 31, 37	1, 2, 3, 4	R	
C. pseudoretusum Ducell.	31	1	R	
C. punctulatum Bréb.	42, 45, 75	1, 2, 3	R	7.0, 7.1
C. punctulatum var. *subpunctulatum* (Nordst.) Börges.	70	3, 4	R	7.0, 7.1
Syn.:*C. subpunctulatum* Nordst. f. *bornholmense* Börges.				
C. pyramidatum Bréb. in Ralfs	63	2	R	7.0, 7.1
Syn.:*C. pyramidatum* subsp. *abnorme* Lütkem.				
C. regnelli Wille	42, 57	1	R	7.7
C. regnelli Wille var. *chondrophorum* Skuja f. *minus* Grönblad	21	2	R	
C. regnelli Wille var. *minimum* Eichler & Gutw.	42, 45	1, 2	R	7.7
C. reniforme (Ralfs) Archer	13, 36, 42, 57, 86, 94	1, 2, 4	R	
C. sexnotatum Gutw. var. *tristriatum* (Lütkem.) Schmidle	26	1	R	
Syn. :*C. blytii* Wille f. *tristriatum* Lütkem., *C. sexnotatum* var. *tristriatum* f. *rotundata* Schmidle				
C. skujae Willi Krieg.	26	1	R	
C. speciosum P. Lundell	77, 78	3	R	6.9, 7.5
C. subcostatum Nordst. in Nordst. & Wittr.	26, 38, 70, 76	1, 2	R	7.0, 7.1
C. subcostatum f. *minus* (W. & G.S.West) Förster	27, 72, 75, 76, 78	1, 2, 3	R	7.0, 7.1
C. subimpressulum Borge	42	1	R	

Table 2. Species list of desmids in Turkey *(following)*.

Taxa	*Literature **	*Habitat*	*D*	*pH*
C. suborthogonum Racib	84	2	R	
C. subspeciosum Nordst.	50	1, 2	R	6.9, 7.5
C. subspeciosum var. *validus* Nordst.	31, 77, 78	1, 2	R	6.9, 7.5
C. transitorium (Heimerl) Ducell. Syn.:*C. pachydermum* P.Lundell f. *transitoria* Heimerl, *C. pachydermum* P. Lundell	78	2, 3	R	6.9, 7.5
C. trilobulatum Reinsch	42, 46	1	R	
C. turpinii Bréb.	77	2	R	6.9, 7.5
C. turpinii var. *podolicum* Gutw.	78	2	R	6.9, 7.5
C. variolatum P. Lundell Syn.:*C. pseudopyramidatum* Lund. var. *variolatum* (Lund.) Wittr.	74, 76	2, 3	R	7.0, 7.1
C. vexatum W. West	22, 23, 25, 48, 77, 78, 79	2, 3	R	6.9, 7.5
C. wembarense Schmidle	34	4	R	
C. wittrockii P. Lundell	42	1	R	
Genus *Staurastrum* Meyen ex Ralfs 1848				
S. brachiatum Ralfs	62	1	R	
S. brachioprominens Börgesen	26, 28	1	R	
S. chaetoceras (Schröder) G. M. Smith	19	1	R	
S. crenulatum (Nägeli) Delponte	38	1	R	6.9
S. crenulatum (Nägeli) Delponte. var. *britannicum* Messik	26, 27, 28, 31, 57	1	R	
S. cyclacanthum W. &. G. S. West	2, 16, 26, 29, 57	1	R	
S. dispar Bréb. Syn.:*S. hexacerum* (Ehrenb.) Wittr.	77, 78	3	R	6.9, 7.5
S. furcatum (Ehrenb.) Bréb. Syn.:*S. spinosum* Reinsch	62	1	R	
S. gracile Ralfs ex Ralfs	16, 18, 40, 41, 42, 47, 85, 87	1, 2, 3	R	6.8, 7.7, 7.9, 8.0, 8.8, 9.0, 9.1
S. hexacerum Wittr.	42, 45	1, 2	R	
S. margaritaceum (Ehrenb.) Menegh. ex Ralfs	42	1	R	
S. muticum (Bréb.) Ralfs	31	1	R	
S. paradoxum Ralfs	24	1, 3, 4	R	
S. pilosum (Nägeli) Archer	71, 75, 76	2, 3, 4	R	7.0, 7.1, 7.2
S. polymorphum Bréb. in Ralfs	62	1	R	
S. polytrichum (Perty) Rabenh. Syn.:*S. senticosum* Delp.	75	1, 2, 3	R	6.9, 7.0, 7.1
S. punctulatum Bréb. ex Ralfs	26, 42, 72, 75, 76, 77, 78	1, 2, 3	R	6.9, 7.5
S. sexangulare var. *subglabrum* W. &. G. S. West	30	1	R	
S.vestitum Ralfs	50, 51, 53	1, 3, 4	R	
Genus *Xanthidium* Ehrenberg ex Ralfs 1848				
X. ornatum Börges.	29	1	R	7.8
Genus *Euastrum* Ehrenberg ex Ralfs 1848				
E. ansatum Ralfs Syn.:*E. ansatum* var. *emargiantum* Hansg.	75	1, 2	R	7.0, 7.1
E. binale var. *gutwinskii* (Schmidle) Homfeld	74, 76	2, 3	R	7.0, 7.2
E. insulare (Wittr.) Roy	1, 2, 42, 45, 86, 93	1, 2, 4	R	
E. luetkemuelleri var. *carniolicum* (Lütkem.) Willi Krieg. Syn. :*E. crassangulatum* Börges var. *carniolicum* Lütkem.	74, 76	2, 3	R	7.0, 7.2

Table 2. Species list of desmids in Turkey *(following)*.

Taxa	*Literature* *	*Habitat*	*D*	*pH*
E. luetkemuelleri var. *floridanum* Scott & Groenblad	74, 76	2, 3	R	7.0, 7.2
E. obesum Joshua	74, 76	2, 3	R	6.9, 7.0, 7.1, 7.2
E. oblongum (Grev.) Ralfs	71, 75, 77, 78	2, 3	R	6.9, 7.0, 7.1, 7.5
E. pinnatum Ralfs	75	3	R	7.0, 7.1
E. verrucosum Ehrenb. ex. Ralfs var. *alatum* Wolle	77, 78	2	R	6.9, 7.5
E. verrucosum Ehrenb. ex. Ralfs var. *rhomboideum* P. Lundell Syn.:*E. verrucosum* var. *pterygoideum* (Hub.-Pest.) Willi Krieg.	71, 75	3	R	7.0, 7.1
Genus *Micrasterias* Agardh ex Ralfs 1848				
M. americana (Ehrenb.) Ralfs	71, 75	2, 3	R	7.0, 7.1
M. denticulata Bréb. ex Ralfs	71, 75	2, 3	R	7.0, 7.1
M. rotata (Grev.) Ralfs	71, 75	2, 3	R	7.0, 7.1

1: Phytoplankton, 2: Epipelic, 3: Epilithic, 4: Epiphytic.

D: Species distribution classes.

R: Rare, F: Frequent, C: Common.

Syn: Synonym.

* The numbers in the literature column refer to the numbers in parentheses after the references in the References list.

Habitats

Desmid species were mainly encountered in one or more of the following habitats: benthic (epipelic, epilithic and epiphytic) and pelagic zones of lakes and rivers. Most of the species (about 67.7 % of all species) were collected in the littoral zone of lakes and rivers where genera *Actinotaenium*, *Closterium, Cosmarium*, *Euastrum* and *Micrasterias* dominate. A minor part of the desmid species found (32.3%) was sampled in the pelagic zone of lakes and rivers where planktonic species of *Closterium*, *Cosmarium* and *Staurastrum* were found. It should be noted that more than half of all species dealt with were found in the littoral habitats investigated.

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