

New Records for the Freshwater Algae of Turkey

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Abstract: Algae samples were collected from important dam lakes and running waters of the Lower Euphrates Basin. Eighteen new records of Turkish freshwater algae were identified. Among these new records, 5 belong to Cyanophyta, 10 to Chlorophyta, 1 to Xanthophyta, and 2 to Bacillariophyta.

Key Words: Algae, new record, freshwater, South-East Anatolian region

Türkiye Tatlısu Algleri İçin Yeni Kayıtlar

Özet: Alg örneklemeleri, Aşağı Fırat Havzası içerisindeki baraj göllerinden ve nehir sistemlerinden yapılmıştır. Türkiye tatlısu algleri için on sekiz yeni kayıt verilmiştir. Bunlar içerisinde beşi Cyanophyta, Onu Chlorophyta, biri Xanthophyta ve ikisi Bacillariophyta bölümlerine aittir.

Anahtar Sözcükler: Alg, yeni kayıt, tatlısu, Güneydoğu Anadolu Bölgesi

Introduction

Research on freshwaters in Turkey has mostly concerned classification of habitats, identification of floral composition, and seasonal succession of population density in aquatic ecosystems. Within the South-East Anatolian Project (GAP), dams, hydro-electric systems, agricultural, and irrigation infrastructures have been built on the Fırat (Euphrates) and Dicle (Tigris) rivers. This situation can lead to serious ecological variation. Although to date there have been no records pertaining to the algal flora of this region, it is important to know and follow its biological diversity (Gönüloğlu & Öztürk, 1996; Aysel, 2005).

Algae of the region were collected from 21 sampling stations during the present study. These stations included stagnant (4 dam reservoirs) and running waters (the Euphrates and its tributaries). A map of the area and sampling stations are shown in Figure 1.

Materials and Methods

Samples were collected between November 2001 and August 2003. Plankton samples were taken using plankton nets of 30 and 55 µm, and epipelagic samples were collected from sediments using a glass rod 0.5-0.8 cm in diameter. Epiphytic and epilithic samples were

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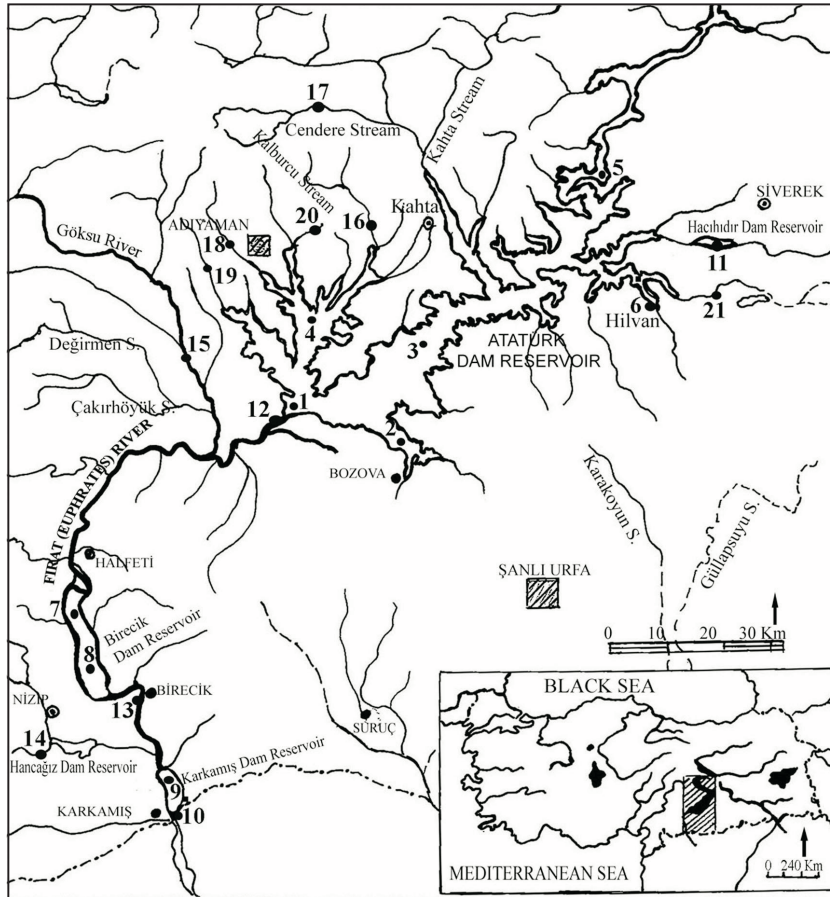


Figure 1. Sampling station locations.

obtained by scratching the surfaces of submerged plants and stones, respectively. Epipellic algae were made to undergo phototaxis. All samples were fixed in 4% formaldehyde, and organisms were identified on temporary and permanent slides. Photographs were taken with a Nikon research microscope and are shown in Figures 2-7.

Taxonomic identification was carried out according to Komarek and Anagnostidis (1999), Prescott (1975), and Huber-Pestalozzi (1938) for Cyanophyta, Wehr and Sheath (2003), Prescott (1975), Bourrelly (1972), Huber-Pestalozzi (1982), and Korshikov (1987) for Chlorophyta, Wehr and Sheath (2003) and John et al. (2002) for Xanthophyta, and Krammer and Lange-Bertalot (1999a, 1999b) for Bacillariophyta. Water temperature, pH, conductivity, salinity, and dissolved O₂ were measured in situ with YSI equipment.

Results and Discussion

In total, 364 algal taxa were identified in the Lower Euphrates Basin, 18 of which are new records for the Turkish freshwater algal flora.

Phylum: Cyanophyta (Cyanobacteria)

Class: Cyanophyceae

Order: Chroococcales

Family: Entophysalidaceae

Subfamily: Entophysalidoideae

Genus: *Entophysalis* Kützing 1843

1. **Species:** *Entophysalis deusta* (Meneghini) F.E.Drouet & W.A.Daily 1948

(Figure 2a-b) (Komarek & Anagnostidis, 1999).

Basionym: *Cochochloris deusta* Meneghini 1841

Synonym: *Gloeocapsa deusta* (Meneghini) Kützing 1849

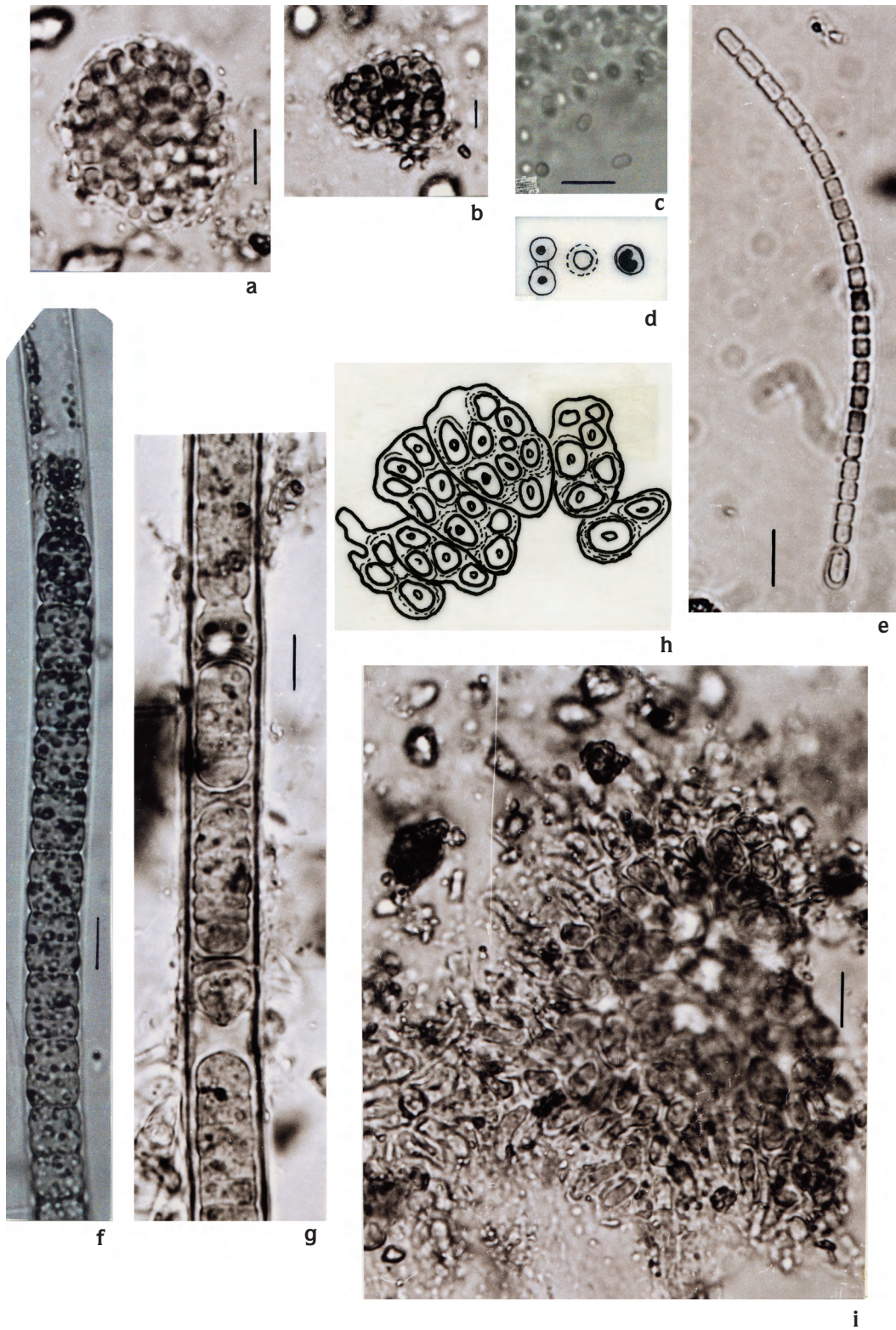


Figure 2. a-b: *Entophysalis deusta*; c-d: *Synechocystis salina*; e: *Anabaenopsis raciborskii*; f-g: *Scytonema crispum*; h-i: *Stigonema mesentericum* (Scale 10 µm).

Description: Colonies with lamellate, not very wide, yellow-brown. Cells less spherical and elongate, 3-6 µm in diameter.

Found at station 11 in epiphyton.

Family: Merismopediaceae

Subfamily: Merismopedioideae

Genus: *Synechocystis* Sauvageau 1892

2. Species: *Synechocystis salina* Wislouch 1924 (Figure 2) (Komarek & Anagnostidis, 1999).

Synonyms: *Synechocystis aquatilis* var. *minor* Geitler 1935

S. aquatilis f. *salina* (Wislouch) Komarek 1976

Description: Cells spherical, solitary or paired, pale blue-green, with homogeneous contents, 2.5-4 µm in diameter.

Found at station 11 in epilithon.

Order: Nostocales

Family: Nostocaceae

Genus: *Anabaenopsis* Woloszyńska 1923

3. Species: *Anabaenopsis raciborskii* Woloszyńska 1912 (Figure 2) (Huber-Pestalozzi, 1938).

Description: Trichome short and coiled, with a heterocyst at end, elongate, 2.5-3 µm in diameter, 5.5 µm long. Cells blue-green, slightly cylindrical, 2.5 µm in diameter, 3.5-5 µm long.

Found at station 6 in epipelon.

Family: Scytonemataceae

Genus: *Scytonema* C.Agardh ex Bornet & Flahault 1887

4. Species: *Scytonema crispum* (C.Agardh) Bornet 1889 (Figure 2) (Prescott, 1975).

Basionym: *Oscillatoria crispa* C.Agardh 1817

Synonyms: *Lyngbya crispa* (C.Agardh) C.Agardh 1824

Lyngbya cincinnata Kützing 1843

Scytonema cincinnatum (Kützing) Thuret 1875

Description: Filaments straight, seldom branched, 12.5-17.5 µm in diameter. Cells short and disc-like; 11.25-12 µm, 4.5-6.25 µm long, contents granular.

Found at station 6 in plankton, epiphyton.

Family: Stigonemataceae

Genus: *Stigonema* C.Agardh ex Bornet et Flahault 1886

5. Species: *Stigonema mesentericum* Geitler 1925 (Figure 2) (Prescott, 1975).

Description: A gelatinous, cushion-like mass composed of filaments, with short irregularly developed branches on which a series of globose or ovate cells are arranged in a definite order. Cells 6-8 µm in diameter, sheath close, thick and lamellate, enclosing a small groups of cells, which form irregular lobes from the main axis.

Found at station 6 in plankton.

Phylum: Chlorophyta

Class: Ulvophyceae

Order: Ulotrichales

Family: Ulotrichaceae

Genus: *Hormidiella* M.O.P. Iyengar et S.Kanthamma 1940

6. Species: *Hormidiella parvula* Iyengar & Kanthamma 1940 (Figure 3) (Bourrelly, 1972).

Description: Cells 5-6 µm in diameter, 6.25-7 µm long. Chloroplast parietal with 1 pyrenoid.

Found at station 20 in epiphyton.

Class: Chlorophyceae

Order: Chaetophorales

Family: Chaetophoraceae

Genus: *Cloniophora* Tiffany 1936

7. Species: *Cloniophora spicata* (Schmidle) Islam 1961 (Figure 3) (Bourrelly, 1972).

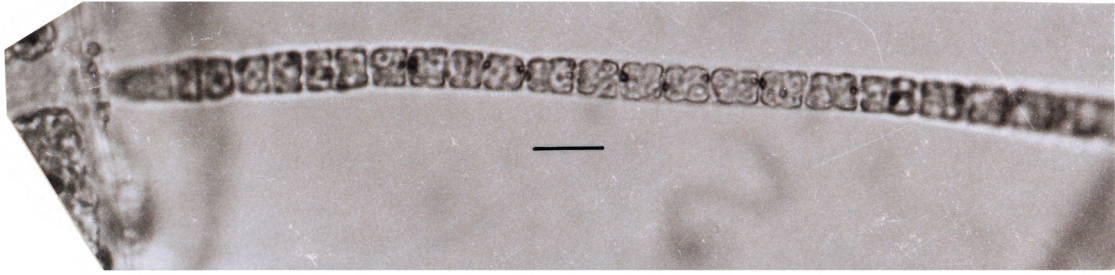
Basionym: *Stigeoclonium spicatum* Schmidle

Description: Filaments branched on both sides. Chloroplast is a parietal plate with 1 or more pyrenoids. Cells approximately 17 µm in diameter, 12.5-20 µm long.

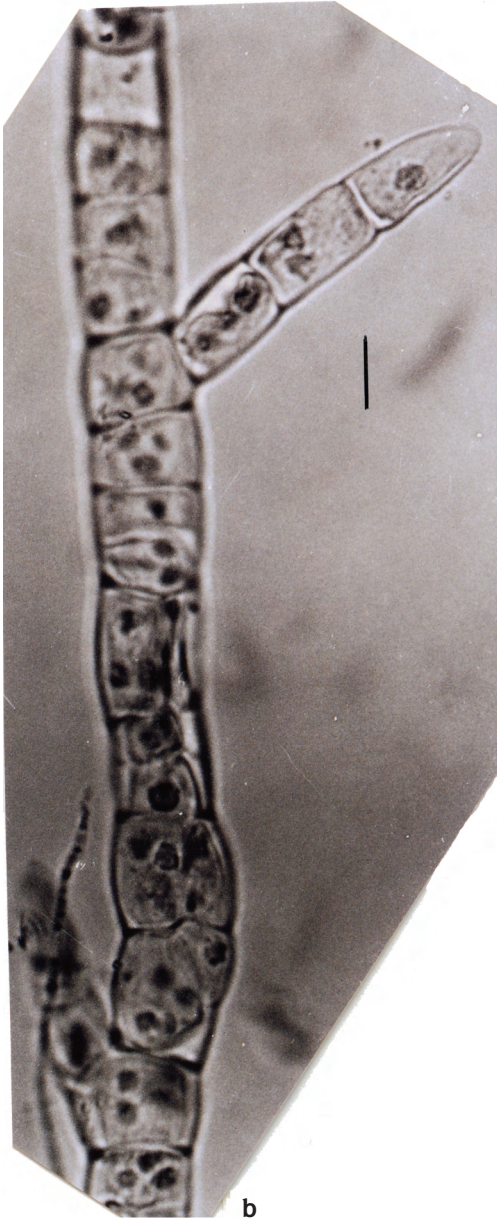
Found at stations 1 and 19 in epipelon and at station 9 in epiphyton.

Genus: *Chlorotylum* Kützing 1843

8. Species: *Chlorotylum cataractarum* Kützing 1843 (Figures 3-4) (Bourrelly, 1972).



a



b



c

Figure 3. a: *Hormidiella parvula*; b: *Cloniophora spicata*; c: *Chlorotylum cataractarum* (Scale 10 μ m).

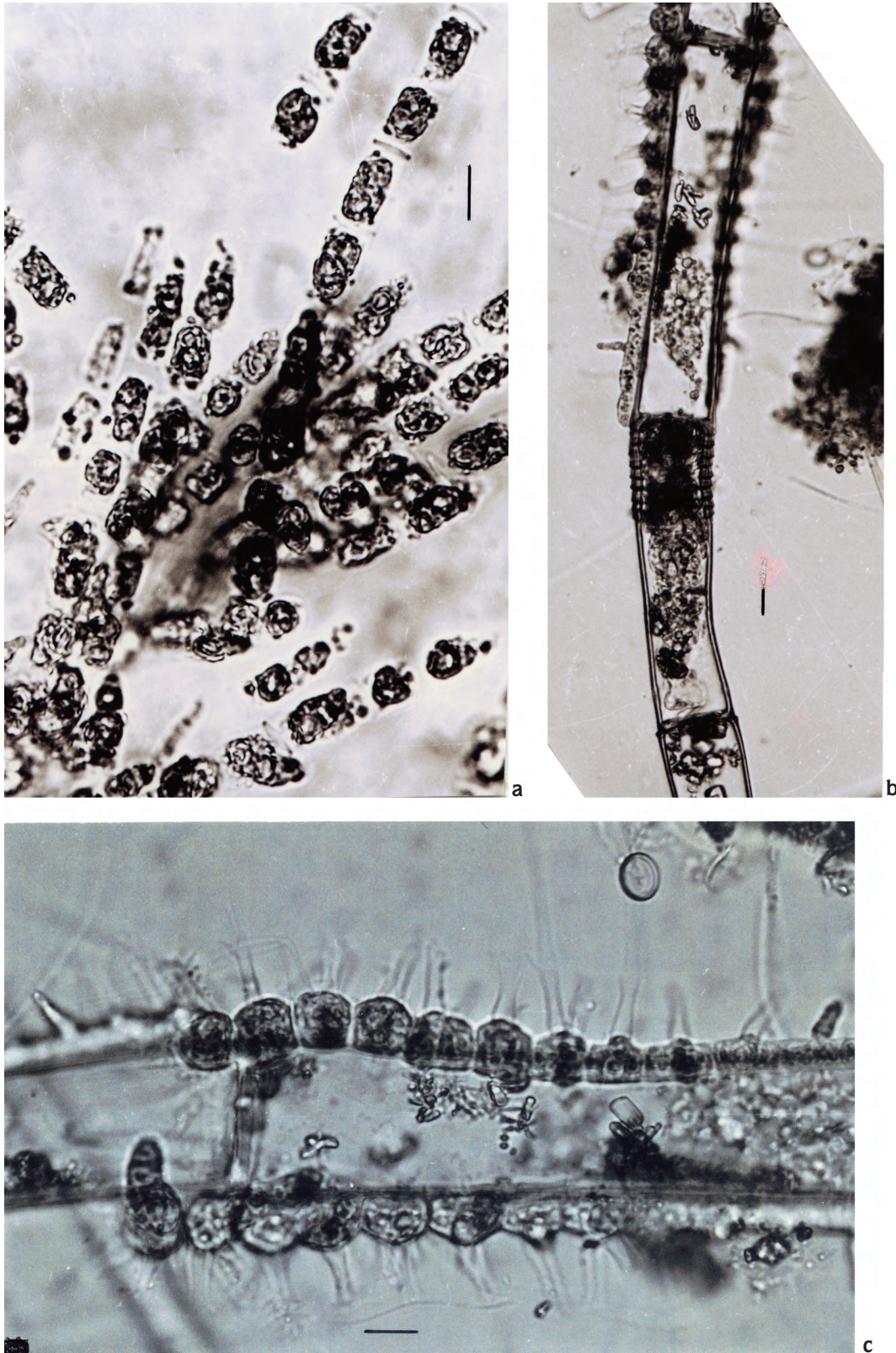


Figure 4. a: *Chlorotylum cataractarum*; b-c: *Chaetosphaeridium pringsheimii* (Scale 10 μm).

Description: Thallus irregularly branched, branches usually unilateral and whorled. Apex of branches tapered. On branches, some vegetative cells empty and transparent. Cells approximately 10 µm in diameter and 17.5-20 µm long.

Found at station 14 in epiphyton.

Order: Coleochaetales

Family: Coleochaetaceae

Genus: *Chaetosphaeridium* Klebahn 1892

9. Species: *Chaetosphaeridium pringsheimii* Klebahn 1892 (Figure 4) (Bourrelly, 1972).

Description: Unicellular, cells gregarious and globulose with gelatinose tube sheaths present, epiphyte, in linear series on *Oedogonium* spp. Cells 12.5 µm in diameter and setae 12.5-30 µm long.

Found at station 10 in plankton and at station 6 in epiphyton.

Order: Oedogoniales

Family: Oedogoniaceae

Genus: *Oedogonium* Link 1820

10. Species: *Oedogonium sociale* Wittrock 1882 (Figure 5) (Prescott, 1975).

Description: Vegetative cells cylindrical, 8.5-9 µm in diameter, 45 µm long. Oogonia solitary, subglobose, opening by a median pore, 35 µm in diameter, 33 µm long. Oospores ellipsoid-globose, nearly filling the oogonia, wall smooth.

Found at station 6 in epiphyton.

Order: Chlorococcales

Family: Oocystaceae

Genus: *Palmellochaete* Korshikov

11. Species: *Palmellochaete tenerrima* Korshikov (Figure 5) (Korshikov, 1987; Wehr & Sheath, 2003).

Description: Cells 5 µm in diameter, up to 37.5 µm long. Cells bear 2 or 8 long tapering spines. Cells have 2-4 chloroplasts each with 1 pyrenoid. Colony consisting of 8 spherical cells within a mucilage envelope containing fragments of parental cell walls.

Found at station 2 in plankton.

Family: Endosphaeraceae

Genus: *Kentrosphaera* A.Borzi 1883

12. Species: *Kentrosphaera gloeophila* (Bohlin) Brunnthaler 1915 (Figure 5) (Prescott, 1975).

Description: Cells broadly ovate, with knob-like thickenings of the lamellate wall. Cell walls initially thin, homogeneous, and colourless, becoming irregularly thick, stratified and yellowish or brownish with age; often with 1 to several local thickenings that may develop into extensive protrusions. When development is complete the external lamellate is observed as a half capsule. Cells 12.5-18 µm in diameter, 15-25 µm long. Chloroplast primarily parietal, consisting of 1 to several plate-like segments with 1 or 2 pyrenoids, later axial, very massive, with extensions flattened at the wall to form irregularly shaped processes.

Found at station 5 in plankton.

Class: Zygnematophyceae

Order: Zygnematales

Family: Zygnemataceae

Genus: *Mougeotia* (C.Agardh) Wittrock 1872

13. Species: *Mougeotia punctata* Wittrock 1867 (Figure 5) (Prescott, 1975).

Description: Vegetative cells long and cylindrical, 8.75-10 µm in diameter, approximately 90 µm (up to 112.5 µm) long. Chloroplast is a broad plate with 5-7 pyrenoids.

Found at stations 6, 8, and 10 in plankton, at stations 3, 5, 6, 9, and 18 in epipelon, at stations 1, 6, and 7 in epiphyton, and at stations 6, 8, and 10 in epilithon.

Genus: *Zygnema* C.Agardh 1817

14. Species: *Zygnema stellinum* (Vaucher) C.Agardh 1824 (Figure 6) (Prescott, 1975).

Basionym: *Conjugata stellinum* Vaucher

Synonyms: *Zygnema stelligera* Hardy

Zygnema stellinum var. *compressum* Gayral

Description: Filaments green, vegetative cells 39-40 µm in diameter, 50-60 µm long. Cell walls thick with mucilage. Zygosporangia formed in one of the gametangia; broadly ovate or oblong, median layer brown; 32-34 µm in diameter, 36-40 µm long.

Found at station 12 in epiphyton.

Order: Desmidiaceae

Family: Closteriaceae

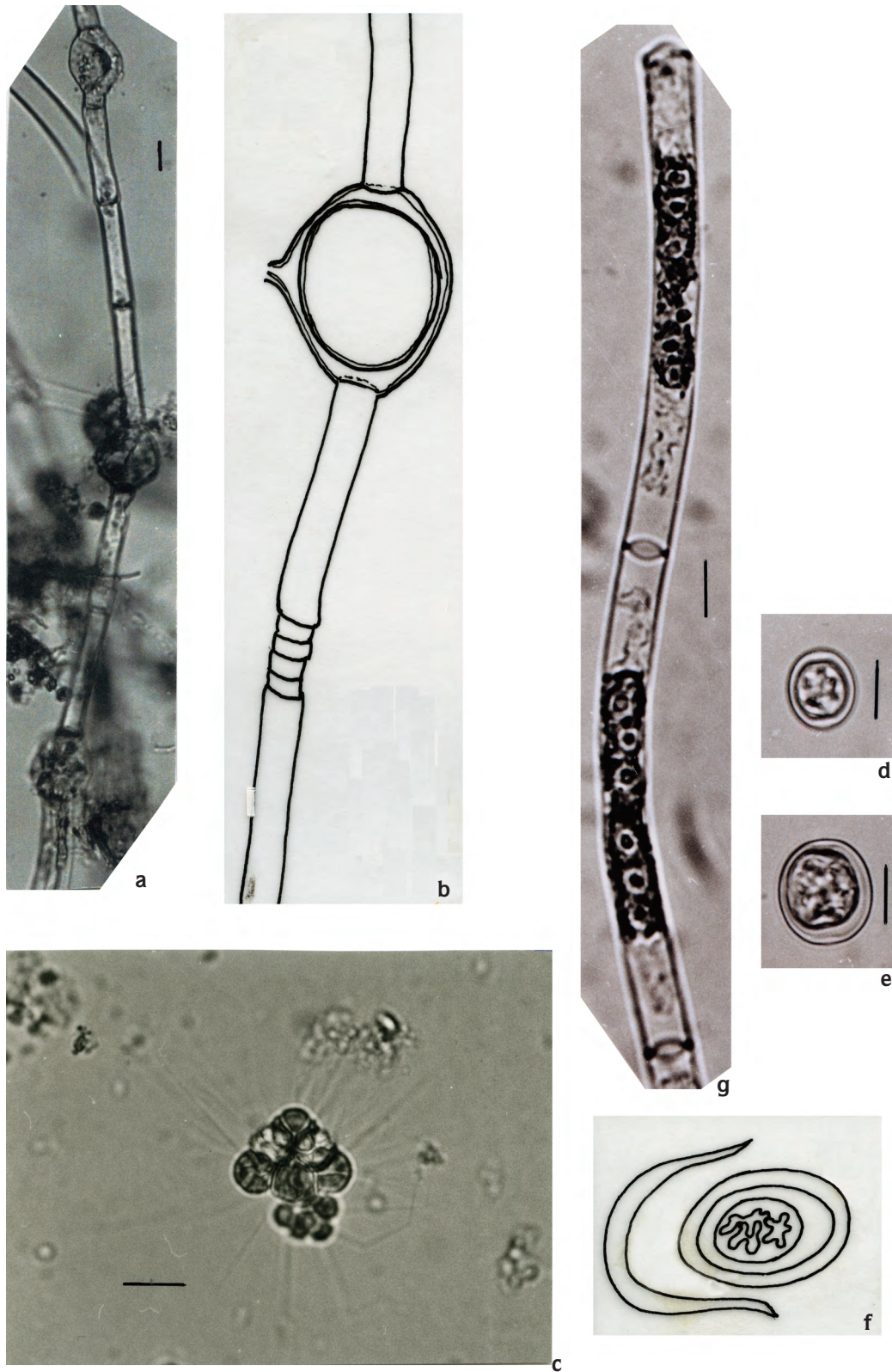
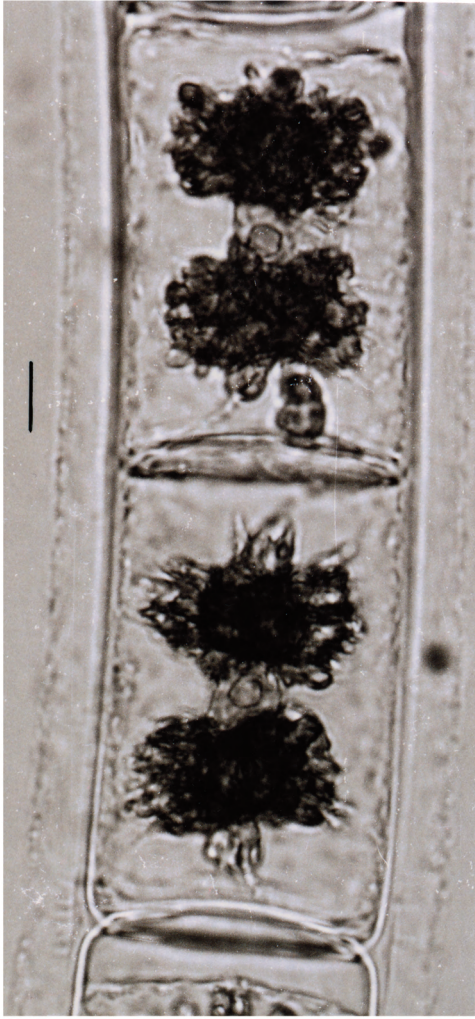
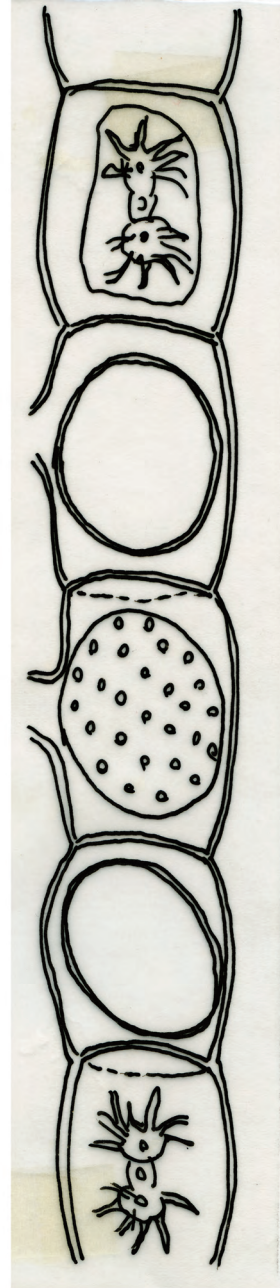


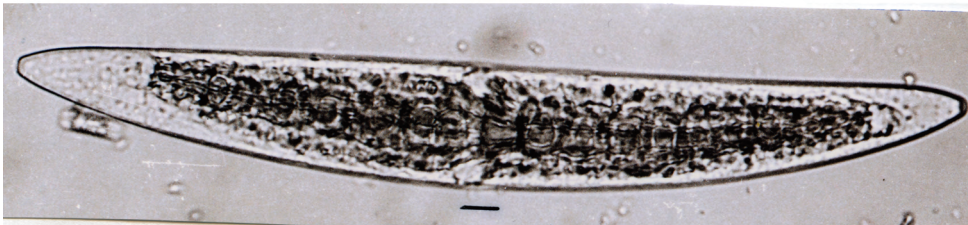
Figure 5. a-b: *Oedogonium sociale*; c: *Palmellochaete tenerrima*; d-f: *Kentrosphaera gloeophila*; g: *Mougeotia punctata* (Scale 10 μ m).



a



b



c

Figure 6. a-b: *Zygema stellinum*; c: *Closterium tumidum* var. *nylandicum* (Scale 10 μ m).

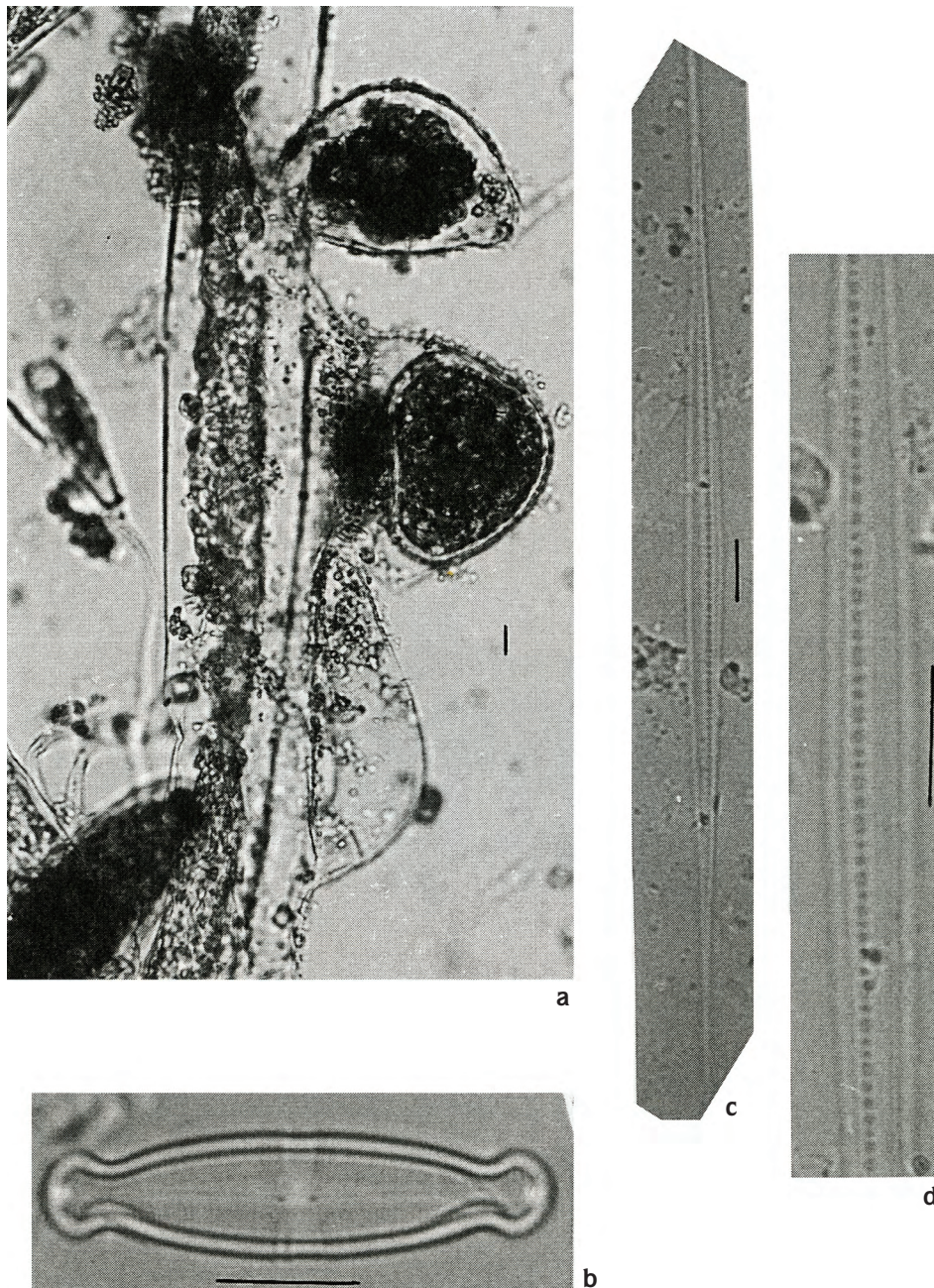


Figure 7. a: *Vaucheria fontinalis*; b: *Caloneis macedonica*; c-d: *Nitzschia behrei* (Scale 10 μm).

Genus: *Closterium* Nitzsch ex Ralfs 1848

15. Species: *Closterium tumidum* var. *nylandicum* Grönblad 1921 (Figure 6) (Huber-Pestalozzi, 1982).

Description: Cells 12.5 μm in diameter, 146 μm long, apices acutely pointed. Chloroplast broad with 5-10 axial pyrenoids.

Found at station 18 in epilithon.

Phylum: Xanthophyta

Class: Xanthophyceae

Order: Vaucheriales

Family: Vaucheriaceae

Genus: *Vaucheria* A.P. de Candolle 1801

16. Species: *Vaucheria fontinalis* (Linnaeus) T. A. Christensen 1868 (Figure 7) (John et al., 2002; Wehr & Sheath, 2003).

Basionym: *Conferva fontinalis* Linnaeus 1753

Synonyms: *Ectosperma clavata* Vaucher 1803

Vaucheria clavata (Vaucher) A.P. de Candolle 1805

Vaucheria ornithocephala C.Agardh 1817

Vaucheria polysperma Hassal 1843

Description: Filaments 50-55 µm wide. Antheridia 28 × 80 µm, slightly club-shaped, bent horizontally parallel to filament. Oogonia 58-64 × 70-80 µm. Two oogonia with oospores next to an empty antheridium. Oospore spherical, almost filling oogonium at its widest point, but not at ends. Ovoid with relatively thin wall, 3-layered.

Found at station 9 in plankton.

Phylum: Bacillariophyta

Class: Bacillariophyceae

Order: Pennales

Family: Naviculaceae

Genus: *Caloneis* Cleve 1894

17. Species: *Caloneis macedonica* Hustedt 1945 (Figure 7) (Krammer & Lange-Bertalot, 1999a).

Description: Valves linear-lanceolate with weakly convex sides, broadly capitate, 38 µm long, 8 µm wide. Raphe straight with somewhat lateral deflected central pores. Axial area slender, central area with a wide transverse fascia reaching the valve margins. Striae 19-22/10 µm, radial at the middle, transapical striae delicate, slightly convergent on the ends.

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Found at station 13 in epipelon.

Family: Bacillariaceae

Genus: *Nitzschia* Hassall 1845

18. Species: *Nitzschia behrei* Hustedt 1959 (Figure 7) (Krammer & Lange-Bertalot, 1999b).

Description: Frustules 190-200 µm long, 6 µm wide. Valves narrow lanceolate with long, capitately rounded ends at the apices. Fibulae conspicuously large, 6/10 µm, towards apical axis, 15/10 µm and 38-40 striae in 10 µm.

Found at station 15 in plankton.

Generally, eutrophic species are found in Turkish freshwaters; however, Tortum Lake (Altuner & Aykulu, 1987), Aygır and Balıklıgöl lakes (Şahin, 2000), and Yedigöller (Şahin, 2002) are oligotrophic, while Hazar Lake is in a state of transition from oligotrophic to mesotrophic (Şen, 1988). The dam reservoirs are reported to be more mesotrophic in character.

The surface temperature of the running waters and dam reservoirs recorded in the region varied between 17 and 27 °C (average: 22.1 °C), pH was 7.4-8.4 (average: 8.0), and dissolved O₂ was 6.7-11.0 mg l⁻¹ in dam reservoirs and 6.6-10.0 mg l⁻¹ in running waters. Among the changing physical and chemical properties, temperature and nutrients had the greatest effect on algal growth. The identified species were generally observed to be wide-spread and sometimes rare in mesotrophic and eutrophic Europe and American waters (John et al., 2002; Wehr & Sheath, 2003).

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