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A Study on Algae in Devegeçidi Dam Lake

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Abstract: This research was carried out between 1995 and 1996 in Devegeçidi Dam Lake and a total of 112 taxa belonging to 5 divisions were identified, with 29 species belonging to *Cyanophyta*, 5 to *Euglenophyta*, 45 to *Chlorophyta*, 5 to *Pyrrhophyta* and 28 to *Bacillariophyta*. *Microcystis aeruginosa* Kütz. from the *Cyanophyta* was the most abundant and widespread species in phytoplankton. This was followed by *Aphanizomenon floss - aquae* (L.) Ralfs and *Aulacoseira granulata* (Ehr.) Simonsen as the second most abundant and widespread organisms. *Pediastrum dublex* Meyen, *P. simplex* var. *duodenarium* (Bailey) Rabenhorst and *Ceratium hirundinella* (O.F.Muell.) Duj. species were widely distributed and sometimes observed in abundance. The morphometric structure of Devegeçidi Dam Lake, its physical and chemical properties, algal composition and the high abundance of some species in certain months show the mesotrophic characteristics of this lake. Temperature and phosphorus inflow were noted as the main factors causing an increase in eutrophication.

Key Words: Phytoplankton, Algae, Devegeçidi Dam Lake.

Devegeçidi Baraj Gölü Algleri Üzerine Bir Araştırma

Özet: Devegeçidi Baraj Gölü'nde 1995 – 1996 yıllarında yapılan araştırmalar sonucu *Cyanophyta* (29), *Euglenophyta* (5), *Chlorophyta* (45), *Pyrrhophyta* (5), *Bacillariophyta* (28), bölümlerine ait toplam 112 takson teşhis edilmiştir. *Cyanophyta* grubu alglerinden *Microcystis aeruginosa* Kütz. fitoplanktonda yaygın ve dominant, *Aphanizomenon floss - aquae* (L.) Ralfs, *Aulacoseira granulata* (Ehr.) Simonsen ise ikinci derecede en bol ve yaygın organizmalardır. *Pediastrum dublex* Meyen, *P. simplex* var. *duodenarium* (Bailey) Rabenhorst, *Ceratium hirundinella* (O.F.Muell.) Duj. türleri yaygın ve arasıra bol olarak gözlenmişlerdir. Devegeçidi Baraj Gölü, morfolometrik yapı, suyun fiziksel ve kimyasal özellikleri, algal kompozisyonu ve bazı türlerin belirli aylardaki çoğalmaları ile mezotrofik karakterlidir. Sıcaklığa ve fosfor girdisine bağlı olarak ötrofikasyonun arttığı gözlenmiştir.

Anahtar Sözcükler: Fitoplankton, Alg, Devegeçidi Baraj Gölü.

Introduction

Devegeçidi Dam Lake is located within the South-East Anatolian Project (GAP) region. As there are no previous publications on the algal composition of this region, the results and evaluations reached in this study will contribute to any future studies that are carried out there.

It is expected that when the dam systems are completed there will be a transition from the observed drought to a humid and mild climate in the region. This will bring important changes to the flora and fauna of the

region. In this study, phytoplankton species compositions and of organismal abundance percentages, and the physical and chemical properties of the dam system were examined.

Devegeçidi Dam Lake is located 20 km north-west of Diyarbakır. The lake is 32.8 m deep and its active volume is 211.86 hm³. The surroundings of the dam lake are used for agricultural purposes (especially for cotton production). In dry seasons, the water level sometimes falls below 5 m.

Materials and Methods

Stations were selected from 3 different points in an area suitable for field work and with convenient transportation.

1st Station: The reservoir and the deepest region.

2nd Station: Güleçoba and Esentepe, between settlement areas. Although the region enjoys absolute protected area status, sewage and other wastes are dumped into the dam lake.

3rd Station: This station is near the Boyalitaş region, and the arm of the dam is also known as Baykan.

The study area and experimental stations are shown in Figure 1.

This study was performed between April 1995 and December 1996, although no samples were taken in January, February, March of May 1996 due to bad weather conditions. Monthly samples were collected horizontally and vertically (\cong 250 m long and 1 m deep) from these stations using a Hydro Bioss Kiel plankton net (55 μ m mesh size). Water samples were also taken with 1L plastic bottles from the surface. The water samples were fixed with 4% formaldehyde. Taxonomic identifications were performed and photographs of some

species were taken using a Nikon research microscope according to the relevant sources (Huber & Pestalozzi, 1938, 1950; Bourrely, 1972; Prescott, 1975; Huber & Pestalozzi, 1982; Korshikov, 1987; Krammer & Lange-Bertalot, 1991/a-b; Krammer & Lange-Bertalot, 1999/a-b;) and the approximate density of species (Table 2) was recorded (Odum, 1971).

$\text{CO}_3^{=}$ and HCO_3^- values were determined by titration, temperature and oxygen by a YSI-O₂-meter, pH and mV with an NEL 890 pH meter and ammonium and ammonia values with a HACH practical test kit. These parameters were measured in situ. For the other analyses a HACH model spectrophotometer was used. In addition, State Hydraulic Works (DSİ.) reports covering 1992–1994 were used for comparative results (inorganic-N/PO₄-P ratio).

Results

The physical and chemical parameters of Devegeçidi Dam Lake are presented in Table 1. The average parametric values of the 3 stations were measured monthly.

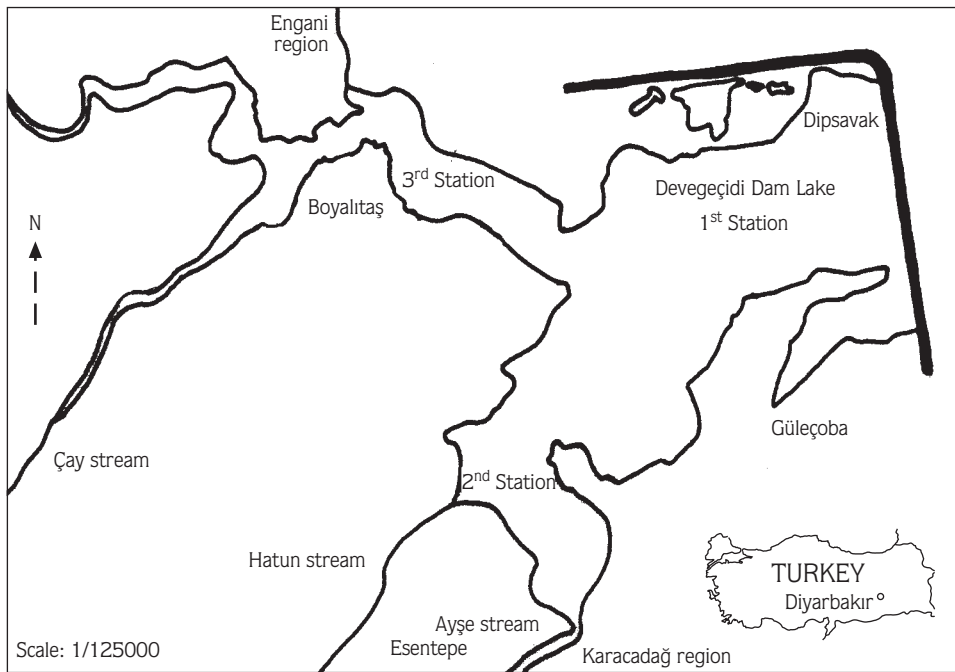


Figure 1. Experimental stations in Devegeçidi Dam Lake.

Table 1. The physical and chemical parameters of Devegeçidi Dam Lake.

YEARS	1995												1996											
	April	May	June	July	August	September	October	November	December	Average	April	May	June	July	August	September	October	November	December	Average				
MONTHS PARAMETERS																								
Temperature (°C)	19	24	27	28	25	21	17	7	3	19	13	25	26	24	22	14	13	10	18					
Oxygen (ppm)	x	x	x	6.5	5.8	6.9	8.2	10.2	9.4	7.83	11.8	8.8	6.0	7	8.2	8.8	10.2	10	8.9 ± 0.05					
pH	8.3	8.54	8.59	8.44	8.29	8.19	8.27	8.18	7.85	8.29	8.17	8.40	8.23	8.2	8.04	8.05	8.09	7.76	8.11					
mV	-78	-88	-62	-81	-68	-71	-69	-63	-37	-69 ± 0.45	-56	-78	-50	-65	-43	-25	-39	-20	-47					
Nitrite (mg l ⁻¹)	7	1	3	1	1	1	2	6	3	2.7	5	1	0	1	1	2	2	3	1.9 ± 0.03					
Nitrate (mg l ⁻¹)	2.6	0.4	0.3	0.6	0.8	0.5	0.5	0.8	0.8	0.8 ± 0.01	1.0	0.7	0.5	0.2	0.2	0.4	0.5	0.7	0.5 ± 0.02					
Ammonia (mg l ⁻¹)	0.6	0.32	2.58	0.68	0.24	0.44	0.32	0.6	0.48	0.69	0.32	0.52	0.88	1.05	1.12	1.12	0.56	0.36	0.74					
Ammonium (mg l ⁻¹)	0.65	0.34	2.75	0.73	0.26	0.47	0.34	0.65	0.52	0.74	0.33	0.56	0.47	0.37	0.60	0.60	0.60	0.39	0.49					
Hardness (Alım)	8	8	8	7	8	9	10	11	10	8.8 ± 0.03	9	9	8	8	8	8	9	10	8.6 ± 0.02					
Turbidity (NTU)	19	11	11	23	13	11	9	6	6	12 ± 0.11	18	14	12	17	10	14	9	8	12.8 ± 0.05					
Sulphate (mg l ⁻¹)	x	31	31	32	x	30	29	30	31	31 ± 0.5	23	24	24	25	25	29	27	27	26 ± 0.5					
Carbonate (mg l ⁻¹)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Orthocarbonate (mg l ⁻¹)	x	0.16	0.17	0.18	0.17	0.22	0.19	0.25	0.23	0.19	0.23	0.23	0.19	0.20	0.19	0.18	0.18	0.20	0.20					
Total chlorine (mg l ⁻¹)	x	x	0.08	0.13	0.05	0.03	0.05	0.03	0.02	0.05	0.02	0.08	0.07	0.09	0.06	0.06	0.05	0.6	0.06					
Orthophosphate (mg l ⁻¹)	x	x	x	x	x	x	x	0.8	0.7	0.75	0.09	1.36	1.3	1.65	1.0	1.16	0.96	1.0	1.1 ± 0.04					
CaCO ₃ -Ca (mg l ⁻¹)	x	x	x	x	x	x	x	191	152	171.5	149	x	122	138	144	149	136	159	142					
Mg (mg l ⁻¹)	x	x	x	x	x	x	x	47	38	42.5	37	x	30	34	36	37	34	39	35 ± 0.28					
CaCO ₃ -Ca (mg l ⁻¹)	x	x	x	x	x	x	x	170	116	143	143	x	90	127	132	132	118	143	126 ± 0.42					
Ca (mg l ⁻¹)	x	x	x	x	x	x	x	67	46	56.5	56	x	35	51	53	53	47	57	50 ± 0.28					

x: not determined

According to Sonaer (Jeffries & Mills, 1990), there is an important relationship between pH, carbonate and bicarbonate levels in a medium. If pH is ≥ 8 , it is carbonate, but if pH is ≤ 8 , then there is bicarbonate alkalinity. Only a few orthocarbonate measurements (0.15 mg l^{-1} in the 1st station in May and July, in the 3rd station in October 1995, and 0.28 mg l^{-1} in the 3rd station in November 1995) were made in the dam lake.

A total of 112 taxa belonging to 5 divisions were identified, with 29 species belonging to *Cyanophyta*, 5 to *Euglenophyta*, 45 to *Chlorophyta*, 5 to *Pyrrhophyta* and 28 to *Bacillariophyta* in Devegeçidi Dam Lake. The approximate density and frequency of species identified in the lake are presented in Table 2.

Discussion

Bacillariophyta species are generally widespread and dominant in Turkey (Ünal, 1985; Altuner & Aykulu, 1987; Obalı & Elmacı, 1992; Altuner & Gürbüz, 1994; Temel, 1997; Elmacı & Obalı, 1998; Şahin, 1998; Akbulut & Akbulut, 2000) with the exception of lakes such as Mogan (Obalı, 1984) and Manisa-Marmara (Cirik-Altındağ 1982,1984), which have eutrophic characteristics. *Chlorophyta* and *Cyanophyta* are sometimes noted as dominant. In Devegeçidi Dam Lake, *Cyanophyta* was recorded as widespread and as the most abundant organism.

Navicula pupula Kütz. (Figure 6c) and *Amphora ovalis* Kütz., which grow faster in alkaline waters (Cirik & Cirik, 1991), were observed to be rare and few in number. In addition, *Fragilaria ulna* (Nitzsch) Lange-Bertalot, *Navicula cryptocephala* Kütz. and *Surirella ovalis* de Breb., known to inhabit water bodies affected by household and industrial wastes (Cirik & Cirik, 1991), were rare, and only a few *F. ulna* and *S. ovalis* specimens were encountered in Devegeçidi Dam Lake (especially at the 2nd station). Although the dam lake is alkaline and is rich in organic and inorganic wastes, these species were almost unnoticeable. This condition between interspecies could be allelopathic.

When there is excess growth of blue-green algae in a lake, the growth of diatoms is inhibited. This is a characteristic of eutrophic lakes (Temel, 1996). Between summer (especially June and July) and autumn, *Microcystis aeruginosa* Kütz. (Figures 2a,b),

Aphanizomenon floss-aquae (L.) Ralfs (Figure 3a) and sometimes *Anabaena spiroides* Kleb. (Figure 2f) belonging to the *Cyanophyceae* were found to be widespread and abundant in phytoplankton in the lake. In addition, except for *Aulacoseira granulata* (Ehr.) Simonsen (Figure 5f), the abundance of diatom species was low.

F. ulna, *A. granulata* var. *angustissima* Muller (Figure 5g) (Cox, 1996), *A. floss-aquae*, *A. spiroides* and *M. aeruginosa* from the *Cyanophyceae* are the characteristic species in eutrophic waters (Cirik & Cirik, 1991).

M. aeruginosa, found in the phytoplankton of Devegeçidi Dam Lake and which often caused algal blooms in the lake, was also found in Suat Uğurlu Dam Lake (Yazıcı & Gönüloğlu, 1994), Akşehir Lake (Elmacı & Obalı, 1998), Kurtboğazı Dam Lake (Aykulu & Obalı, 1981), Mogan Lake (Obalı, 1984), Karamık Lake (Gönüloğlu & Obalı, 1986) and the Bafra Balık Lakes (Gönüloğlu & Çomak, 1992) and frequently showed excessive growth. It was observed that 18-22 °C was the optimum temperature range for the growth of *M. aeruginosa* (Lund, 1965). In some seasons Devegeçidi Dam Lake possesses this optimum temperature range (Table 1). *Ceratium hirundinella* (O.F.Muell.) Duj. (Figure 5e), *Pediastrum Boryanum* (Turp.) Meneghini and *Staurastrum* sp. as mesotrophic species and the centric diatoms *Cyclotella* sp. (especially *Cyclotella ocellata* Pantocsek (Figure 5i) are also known to be transitional from oligotrophic to eutrophic species (Round, 1956). *A. granulata* was dominant among centric diatoms. Species of *Cyclotella* were rare and very few in number in Devegeçidi Dam Lake. This situation showed that the lake has mesotrophic characteristics and that it is changing into a eutrophic lake. *A. granulata* thrives best in a low nitrogen medium because it prefers waters which have a low nitrate/phosphate ratio for growth. In terms of orthophosphate values (0.4 mg l^{-1} in the 2nd station in April and October 1996 and 2.6 mg l^{-1} in the 3rd station in October 1996), Devegeçidi Dam Lake is in the 3rd class of water quality regulations (Türkiye Çevre Vakfı Yayını, 1992). In some months, as a result of increases in the amount of phosphate, the water acquires the properties of the 4th class (very polluted). In terms of the values for nitrite-N, the water is in the 4th class. According to the OECD, in situations where ratio of the total amount of nitrogen divided by the total amount of phosphate is

Table 2. The approximate density and frequency of species identified in Devegeçidi Dam Lake.

MONTHS	April 95			May 95			June 95			July 95			August 95			September 95			October 95			November 95			December 95		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III			
SPECIES																											
CYANOPHYTA																											
<i>Chroococcales</i>																											
<i>Chroococcus dispersus</i> (Keissl.) Lemm.																											
<i>Chroococcus minor</i> (Kütz.) Naeg.	A																										
<i>Chroococcus minutus</i> (Kütz.) Naeg.																											
<i>Chroococcus turgidus</i> (Kütz.) Naeg.																											
<i>Aphanocapsa elachista</i> West & West																											
<i>Aphanocapsa endophytica</i> G.M.Smith																											
<i>Aphanocapsa Crevillei</i> (Hass.) Raben.																											
<i>Microcystis aeruginosa</i> Kütz. (Figure 2a,b)	A																										
<i>Microcystis marginata</i> (Men.) Kg.																											
<i>Merismopedia elegans</i> A.Braun																											
<i>Holopedia geminata</i> Lagerh. (Figure 2c)																											
<i>Holopedia irregularis</i> Lagerh.																											
<i>Aphanothece nidulans</i> var. <i>endophytica</i> West & West																											
<i>Coelaesphaerium Naegelianum</i> Unger																											
<i>Composphaeria aponina</i> Kütz.																											
<i>Composphaeria lacustris</i> Chodat																											
Hormogonales																											
<i>Spirulina major</i> Kütz. (Figure 2d)																											
<i>Oscillatoria formosa</i> Bory																											
<i>Oscillatoria limnetica</i> Lemm.																											
<i>Oscillatoria minima</i> Cicklhorn																											
<i>Phormidium mucicola</i> Naum. & Huber - Pestalozzi																											
<i>Phormidium tenue</i> (Menegh.) Gomont																											
<i>Lyngbya</i> sp.																											
<i>Anabaena aequalis</i> Borge																											
<i>Anabaena affinis</i> Lemm. (Figure 2e)																											
<i>Anabaena cylindrica</i> Lemm.																											
<i>Anabaena spiroides</i> Kleb. (Figure 2f)																											
<i>Aphanizomenon floss-aquae</i> (L.) Ralfs (Figure 3a)																											
<i>Geotrichia</i> sp.																											
EUGLENOPHYTA																											
<i>Euglenales</i>																											
<i>Euglena charchowiensis</i> Swir. (Figure 3b)																											
<i>Euglena spiroides</i> Lemm.																											
<i>Euglena spirogyra</i> Ehr.																											
<i>Phacus longicauda</i> (Ehr.) Duj.																											
<i>Phacus orbicularis</i> Huebner (Figure 3c)																											
CHLOROPHYTA																											
<i>Volvocales</i>																											
<i>Pandorina monum</i> (Muell.) Bory																											

A: Rare 10-20% B: Occasional 21-40% C: Frequent 41-60% D: Codominant 61-80% E: Dominant 81-100%

Table 2. The approximate density and frequency of species identified in Devegeçidi Dam Lake (continued).

MONTHS	April 95			May 95			June 95			July 95			August 95			September 95			October 95			November 95			December 95		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III			
SPECIES																											
<i>Eudorina elegans</i> Ehr. (Figure 3d)	A																										
Oedogoniales																											
<i>Oedogonium</i> sp.	A																										
Chaetophorales																											
<i>Chaetopeltis orbicularis</i> Berthold																											
Chlorococcales																											
<i>Colerinkia radiata</i> (Chod.) Wille	A																										
<i>Macrochloris dissecta</i> (Korsh.) Meneg.	A																										
<i>Palmellogystis planctonica</i> Korsh. (Figure 3e)	A																										
<i>Pediastrum Boryanum</i> (Turp.) Meneghini	B																										
<i>Pediastrum dublex</i> Meyen	A																										
<i>Pediastrum dublex</i> var. <i>clathratum</i> (A.Braun)	B																										
<i>Lagerheim</i> (Figure 3f)	C																										
<i>Pediastrum dublex</i> var. <i>cohaerens</i> (Bohlin)	A																										
<i>Pediastrum simplex</i> (Meyen) Lemm. (Figure 3g)	A																										
<i>Pediastrum simplex</i> var. <i>duodenarium</i> (Bailey) Raben. (Figure 4a)	B																										
<i>Coelastrum microporum</i> Naeg. (Figure 4b)	B																										
<i>Dictyosphaerium Ehrenbergianum</i> Naegeli	C																										
<i>Dictyosphaerium pulchellum</i> Wood (Figure 4c)	B																										
<i>Oocystis Borgei</i> Snow	A																										
<i>Oocystis solitaria</i> Wittrock	A																										
<i>Lagerheimia</i> sp.																											
<i>Ankistrodesmus falcatus</i> (Corda) Raife	A																										
<i>Ankistrodesmus longissimus</i> (Lemm.) Wille (Figure 4d)	A																										
<i>Ankistrodesmus longissimus</i> var. <i>acicularis</i> (Chod.) Brunnth	A																										
<i>Dactylococcopsis acicularis</i> Lemmermann	B																										
<i>Dactylococcopsis irregularis</i> G.M.Smith	C																										
<i>Selenastrum Bibralianum</i> Reinsch	A																										
<i>Kirchneriella elongata</i> G.M.Smith																											
<i>Kirchneriella lunaris</i> (Kirch.) Moebius	A																										
<i>Coenococcus planktonicus</i> Korsh. (Figure 4e)	A																										
<i>Tetraedron caudatum</i> var. <i>longispinum</i> Lemm.	A																										
<i>Tetraedron minimum</i> (A.Braun) Hensgrig	A																										
<i>Hyaloraphidium arcuatum</i> Korsh.	A																										
<i>Hyaloraphidium contortum</i> Pasch. et Korsh.	A																										
<i>Hyaloraphidium molinae</i> Korsh.	A																										
<i>Hyaloraphidium rectum</i> Korsh.	A																										
<i>Scenedesmus acuminatus</i> (Lagerh.) Chod.	A																										
<i>Scenedesmus arcuatus</i> var. <i>platydiscus</i> G.M.Smith (Figure 4f)	A																										
<i>Scenedesmus bijuga</i> (Turp.) Lagerheim	A																										
<i>Scenedesmus quadricauda</i> (Turp.) de Breb & Coodey (Figure 4g)	A																										
<i>Scenedesmus quadricauda</i> var. <i>longispina</i> (Chod.) G.M.Smith	A																										
<i>Scenedesmus quadricauda</i> var. <i>Westi</i> G.M.Smith	A																										
<i>Crucigenia Lauterbornii</i> Schmidle	A																										

A: Rare 10-20% B: Occasional 21-40% C: Frequent 41-60% D: Codominant 61-80% E: Dominant 81-100%

Table 2. The approximate density and frequency identified in Devegeçidi Dam Lake (continued).

MONTHS	April 95			May 95			June 95			July 95			August 95			September 95			October 95			November 95			December 95		
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III			
SPECIES	A																										
Desmidiatales																											
<i>Cosmarium reniforme</i> (Ralfs) Archer (Figure 5a)																											
<i>Cosmarium witrockii</i> Lundell																											
<i>Staurastrum pungens</i> Breb. (Figure 5b)																											
<i>S. seabaldi</i> var. <i>ornatum</i> fo. <i>elongata</i> Kriegl. et Bourr. (Figure 5c)																											
PYRRHOPHYTA																											
Peridinales																											
<i>Glennodinium</i> sp.																											
<i>Peridinium cinctum</i> (Muell.) Ehr.																											
<i>Peridinium cinctum</i> var. <i>tuberosum</i> (Meunier) Lindemann (Figure 5d)																											
<i>Peridinium Willei</i> Huitfeldt – Kaas																											
<i>Ceratium hirundinella</i> (O.F. Muell.) Duj. (Figure 5e)																											
BACILLARIOPHYTA																											
Centrales																											
<i>Melosira varians</i> C.A. Agardh																											
<i>Aulacoseira granulata</i> (Ehr.) Simonsen (Figure 5f)																											
<i>Aulacoseira granulata</i> var. <i>angustissima</i> Muller (Figure 5g)																											
<i>Aulacoseira ambigua</i> (Grun.) Simonsen (Figure 5h)																											
<i>Cyclotella meneghiniana</i> Kütz.																											
<i>Cyclotella ocellata</i> Pantocsek (Figure 5i)																											
<i>Stephanodiscus rotula</i> (Kütz.) Hendey (Figure 5j)																											
<i>Cyrtostephanos dubius</i> (Fricke) Round (Figure 6a)																											
<i>Thalassiosira weissflogii</i> (Grunow) Fryxell and Hasle																											
Pennales																											
<i>Navicula bacillum</i> Ehr. (Figure 6b)																											
<i>Navicula pupula</i> Kütz. (Figure 6c)																											
<i>Cymbella cymbiformis</i> Agardh																											
<i>Cymbella aequalis</i> W. Smith																											
<i>Cymbella ventricosa</i> Kütz. (Figure 6d)																											
<i>Gyrosigma acuminatum</i> (Kütz.) Rabh. (Figure 6e)																											
<i>Amphora ovalis</i> Kütz.																											
<i>Nitzschia sigmoidea</i> (Ehr.) W. Smith																											
<i>Nitzschia gracilis</i> Hantzsch																											
<i>Nitzschia acicularis</i> W. Smith																											
<i>Nitzschia closterium</i> (Ehr.) W. Smith																											
<i>Cymatopleura solea</i> (de Breb.) W. Smith																											
<i>Cymatopleura elliptica</i> (de Breb.) W. Smith (Figure 6f)																											
<i>Surirella ovalis</i> de Breb.																											
<i>Surirella robusta</i> var. <i>splendida</i> (Ehr.) Van Heurck (Figure 6g)																											
<i>Surirella tenera</i> Gregory																											
<i>Fragilaria ulna</i> (Nitzsch) Lange-Bertalot																											
<i>Fragilaria ulna</i> var. <i>acus</i> (Nitzsch) Lange-Bertalot																											
<i>Fragilaria ulna</i> var. <i>angustissima</i> (Nitzsch) Lange-Bertalot																											

A: Rare 10-20% B: Occasional 21-40% C: Frequent 41-60% D: Codominant 61-80% E: Dominant 81-100%

Table 2. The approximate density and frequency of species identified in Devegeçidi Dam Lake (continued).

MONTHS	April 96	June 96	July 96	August 96	September 96	October 96	November 96	December 96	Frequency %
STATIONS	I II III	I II III	I II III	I II III	I II III	I II III	I II III	I II III	
SPECIES									
CYANOPHYTA									
Chroococcales									
<i>Chroococcus dispersus</i> (Keisli.) Lemm.				E				A	41
<i>Chroococcus minor</i> (Kütz.) Naeg.									18
<i>Chroococcus minutus</i> (Kütz.) Naeg.	A	E	D						59
<i>Chroococcus turgidus</i> (Kütz.) Naeg.									6
<i>Aphanocapsa elachista</i> West. & West.									6
<i>Aphanocapsa endophytica</i> G.M.Smith									6
<i>Aphanocapsa Grevillei</i> (Hass.) Raben.									18
<i>Microcystis aeruginosa</i> Kütz.	A E	E	E E	E E	E E	E E	B	A	100
<i>Microcystis marginata</i> (Men.) Kg.	A	A						A	12
<i>Merismopedia elegans</i> A.Braun									12
<i>Holopedia geminata</i> Lagerh.	A								6
<i>Holopedia irregularis</i> Lagerh.									12
<i>Aphanothece nidulans</i> var. <i>endophytica</i> West. & West									6
<i>Ceolaspheerium Naegalianum</i> Unger	A								18
<i>Gomphosphaeria aponina</i> Kütz.			A				A		29
<i>Gomphosphaeria lacustris</i> Chodat									6
Hormogonales									
<i>Spirulina major</i> Kütz.				A					6
<i>Oscillatoria formosa</i> Bory				A				A	12
<i>Oscillatoria limnetica</i> Lemm.			A	A				A	65
<i>Oscillatoria minima</i> Cickithorn									18
<i>Phormidium mucicola</i> Naum. & Huber-Pestalozzi									35
<i>Phormidium tenue</i> (Menegh.) Gomont								C	6
<i>Lynghya</i> sp.									12
<i>Anabaena aequalis</i> Borge									12
<i>Anabaena affinis</i> Lemm.		A		A					24
<i>Anabaena cylindrica</i> Lemm.									6
<i>Anabaena spiroides</i> Kleb.					A	A	C	A	35
<i>Aphanizomenon floss-aquae</i> (L.) Palfs	A	D	A	C	A	C	A	A	94
<i>Gleotrichia</i> sp.									6
EUGLENOPHYTA									
Euglenales									
<i>Euglena charchowiensis</i> Swir.					A				12
<i>Euglena spiroides</i> Lemm.									6
<i>Euglena spirogyra</i> Ehr.									24
<i>Phacus longicauda</i> (Ehr.) Duj.		A	A	A	A				35
<i>Phacus orbicularis</i> Huebner	A								6

A: Rare 10-20% B: Occasional 21-40% C: Frequent 41-60% D: Codominant 61-80% E: Dominant 81-100%

Table 2. The approximate density and frequency of species identified in Devegeçidi Dam Lake (continued).

MONTHS	April 96			June 96			July 96			August 96			September 96			October 96			November 96			December 96			Frequency %	
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III		
STATIONS																										
SPECIES																										
CHLOROPHYTA																										
Volvocales																										
<i>Pandorina morum</i> (Muel.) Bory	A																								12	
<i>Eudorina elegans</i> Ehr.								A																		18
Oedogoniales																										
<i>Oedogonium</i> sp.																										6
Chaetophorales																										
<i>Chaetopeltis orbicularis</i> Berthold	A																									6
Chlorococcales																										
<i>Colenkinia radiata</i> (Chod.) Wille																										6
<i>Macrochloris dissecta</i> (Korsch.) Meneg.																										6
<i>Palmelloccystis planctonica</i> Korsch.																										6
<i>Pediastrum Boryanum</i> (Turp.) Meneghini																										41
<i>Pediastrum dublex</i> Meyen				B	A	A	C	A	A	C	B	B	B	C	A											65
<i>Pediastrum dublex</i> var. <i>clathratum</i> (A. Braun) Lagerheim				C	A	A	A	A	A	A	A	A	A	A												59
<i>Pediastrum dublex</i> var. <i>cohaerens</i> (Bohlin)				C																						18
<i>Pediastrum simplex</i> (Meyen) Lemm.				C	C	C	C	C	C	D	C	B	C	C	A											76
<i>Pediastrum simplex</i> var. <i>duodenarium</i> (Bailey) Raben.				A																						41
<i>Ceblastrum microporum</i> Naeg.				A																						47
<i>Dictyosphaerium Ehrenbergianum</i> Naegeli																										6
<i>Dictyosphaerium pulchellum</i> Wood																										24
<i>Oocystis Borgesi</i> Snow																										12
<i>Oocystis solitaria</i> Wittrock																										6
<i>Lagerheimia</i> sp.																										6
<i>Ankistrodesmus falcatus</i> (Corda) Rafts																										12
<i>Ankistrodesmus longissimus</i> (Lemm.) Wille				A				A	A	A	A	A	A	A												47
<i>Ankistrodesmus longissimus</i> var. <i>actularis</i> (Chod.) Brunth																										6
<i>Dactylococopsis acicularis</i> Lemmermann				A																						18
<i>Dactylococopsis irregularis</i> G.M. Smith																										6
<i>Selenastrum Bibralianum</i> Reinsch																										6
<i>Kirchneriella elongata</i> G.M. Smith																										12
<i>Kirchneriella lunaris</i> (Kirch.) Moebius																										6
<i>Ceococcus planktonicus</i> Korsch.																										6
<i>Tetraedron caudatum</i> var. <i>longispinum</i> Lemm.																										6
<i>Tetraedron minimum</i> (A. Braun) Hansgirg				A				A	A	A	A	A	A	A												59
<i>Hyaloraphidium arcuatum</i> Korsch.																										35
<i>Hyaloraphidium contortum</i> Pasch. et Korsch.				A																						18
<i>Hyaloraphidium moirae</i> Korsch.																										6
<i>Hyaloraphidium rectum</i> Korsch.																										6
<i>Scenedesmus acuminatus</i> (Lagerh.) Chod.																										18
<i>Scenedesmus arcuatus</i> var. <i>platydiscus</i> G.M. Smith				A																						6
<i>Scenedesmus bijuga</i> (Turp.) Lagerheim								A	A	A	A	A	A	A												18
<i>Scenedesmus quadricauda</i> (Turp.) de Breb in de Breb & Godley								A	A	A	A	A	A	A												65
<i>Scenedesmus quadricauda</i> var. <i>longispina</i> (Chod.) G.M. Smith																										12
<i>Scenedesmus quadricauda</i> var. <i>Westii</i> G.M. Smith								A																		6

A: Rare 10-20% B: Occasional 21-40% C: Frequent 41-60% D: Codominant 61-80% E: Dominant 81-100%

Table 2. The approximate density and frequency of species identified in Devegeçidi Dam Lake (continued).

MONTHS	April 96		June 96		July 96		August 96		September 96		October 96		November 96		December 96		Frequency %
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III		
SPECIES																	
<i>Crucigenia Lauterbornii</i> Schmidle																	6
Desmidiatales																	
<i>Cosmarium reniforme</i> (Ralfs) Archer	A			A	A	A	A	A	A	A	A						6
<i>Cosmarium witrockii</i> Lundell	A			A	A	A	A	A	A	A	A						53
<i>Staurastrum pungens</i> Breb.																	88
<i>S. sebaldi</i> var. <i>ornatum</i> fo. <i>elongata</i> Krieg. et Bourr.	A																6
PYRRHOPHYTA																	
Peridinales																	
<i>Glennodinium</i> sp.																	6
<i>Peridinium cinctum</i> (Muell.) Ehr.				A	A	A			B	B	A						29
<i>Peridinium cinctum</i> var. <i>tuberosum</i> (Meunier) Lindemann	A	B		A	A	A	A	A	A	A	A						65
<i>Peridinium Willei</i> Huitfeldt – Kaas	C																47
<i>Ceratium hirundinella</i> (O.F.Muell.) Duj.					A	A	B	B	B	B	B	A			B		65
BACILLARIOPHYTA																	
Centrales																	
<i>Melosira varians</i> C.A.Agardh																	12
<i>Aulacoseira granulata</i> (Ehr.) Simonsen	A			B	D	B	A	C	E	E	C	D			A		82
<i>Aulacoseira granulata</i> var. <i>angustissima</i> Müller			A		C			D							A		41
<i>Aulacoseira ambigua</i> (Grun.) Simonsen				B	A	B		C	C	C	C						35
<i>Cyclotella meneghiniana</i> Kütz.	A																24
<i>Cyclotella ocellata</i> Pantocsek																	12
<i>Stephanodiscus rotula</i> (Kütz.) Hendey																	6
<i>Cyclotella dubius</i> (Fricke) Round	B																12
<i>Thalassiosira weissflogii</i> (Grunow) Fryxell and Hasle	B	A															12
Pennales																	
<i>Navicula bacillum</i> Ehr.																	6
<i>Navicula pupula</i> Kütz.										A							6
<i>Cymbella cymbiformis</i> Agardh																	6
<i>Cymbella aequalis</i> W.Smith																	6
<i>Cymbella ventricosa</i> Kütz.																	6
<i>Gyrosigma acuminatum</i> (Kütz.) Rabh.																A	18
<i>Amphora ovalis</i> Kütz.																A	6
<i>Nitzschia sigmaidea</i> (Ehr.) W.Smith																	6
<i>Nitzschia gracilis</i> Hantzsch	A																6
<i>Nitzschia acicularis</i> W.Smith																	24
<i>Nitzschia closterium</i> (Ehr.) W.Smith	B	A	C	B	A	B		A	A	A	A						53
<i>Cymatopleura solea</i> (de Breb.) W.Smith																	12
<i>Cymatopleura elliptica</i> (de Breb.) W.Smith																	6
<i>Surirella ovalis</i> de Breb.																	6
<i>Surirella robusta</i> var. <i>splendida</i> (Ehr.) Van Heurck																	6
<i>Surirella tenera</i> Gregory																	6
<i>Fragilaria ulna</i> (Nitzsch) Lange-Bertalot	A	A															24
<i>Fragilaria ulna</i> var. <i>acuta</i> (Nitzsch) Lange-Bertalot	A	A															35
<i>Fragilaria ulna</i> var. <i>angustissima</i> (Nitzsch) Lange-Bertalot	A																35

A: Rare 10-20% B: Occasional 21-40% C: Frequent 41-60% D: Codominant 61-80% E: Dominant 81-100%

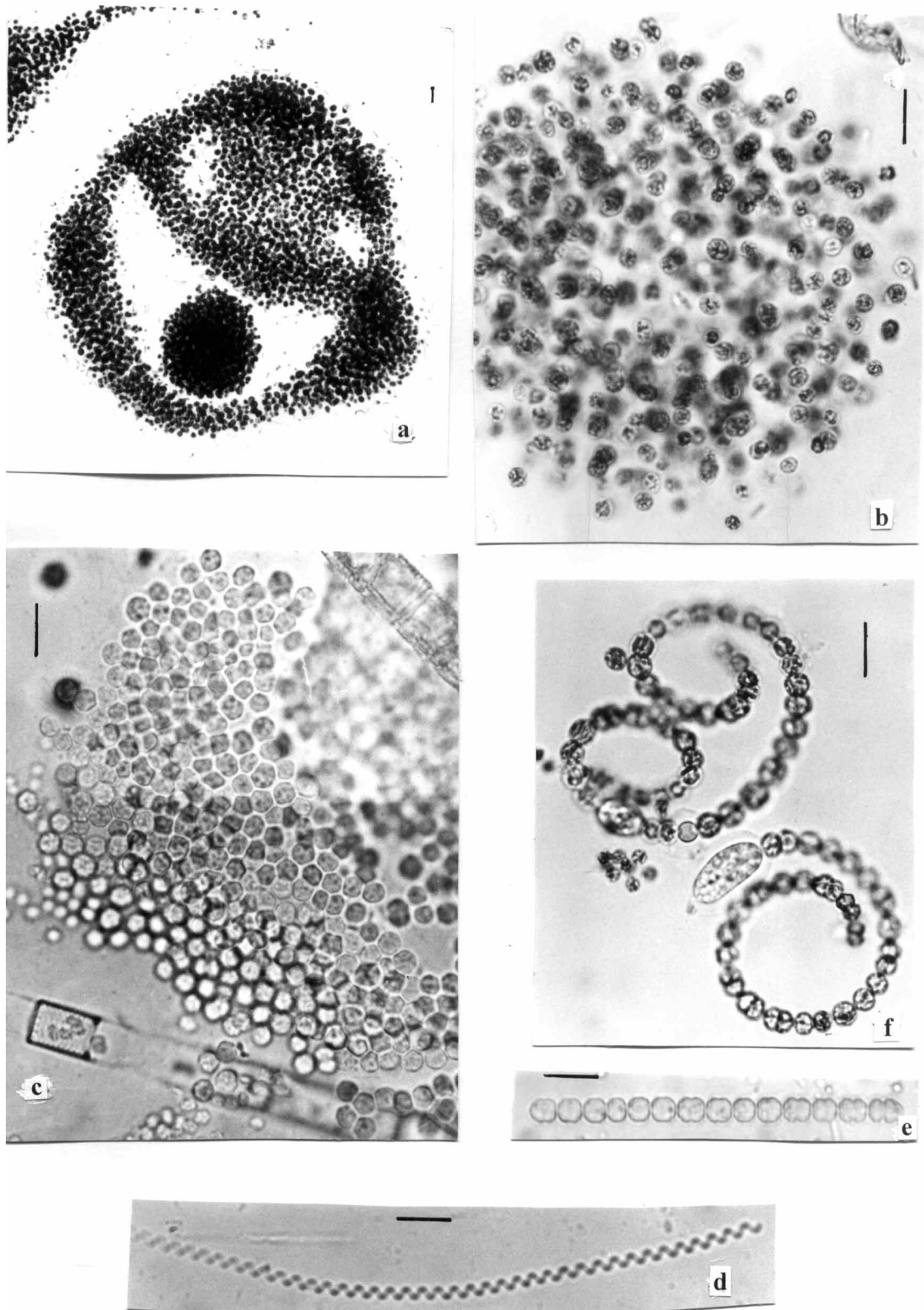


Figure 2. a,b. *Microcystis aeruginosa*, c. *Holopedia geminata*, d. *Spirulina major* e. *Anabaena affinis*, f. *A. spiroides* (Scale 10 μ m).

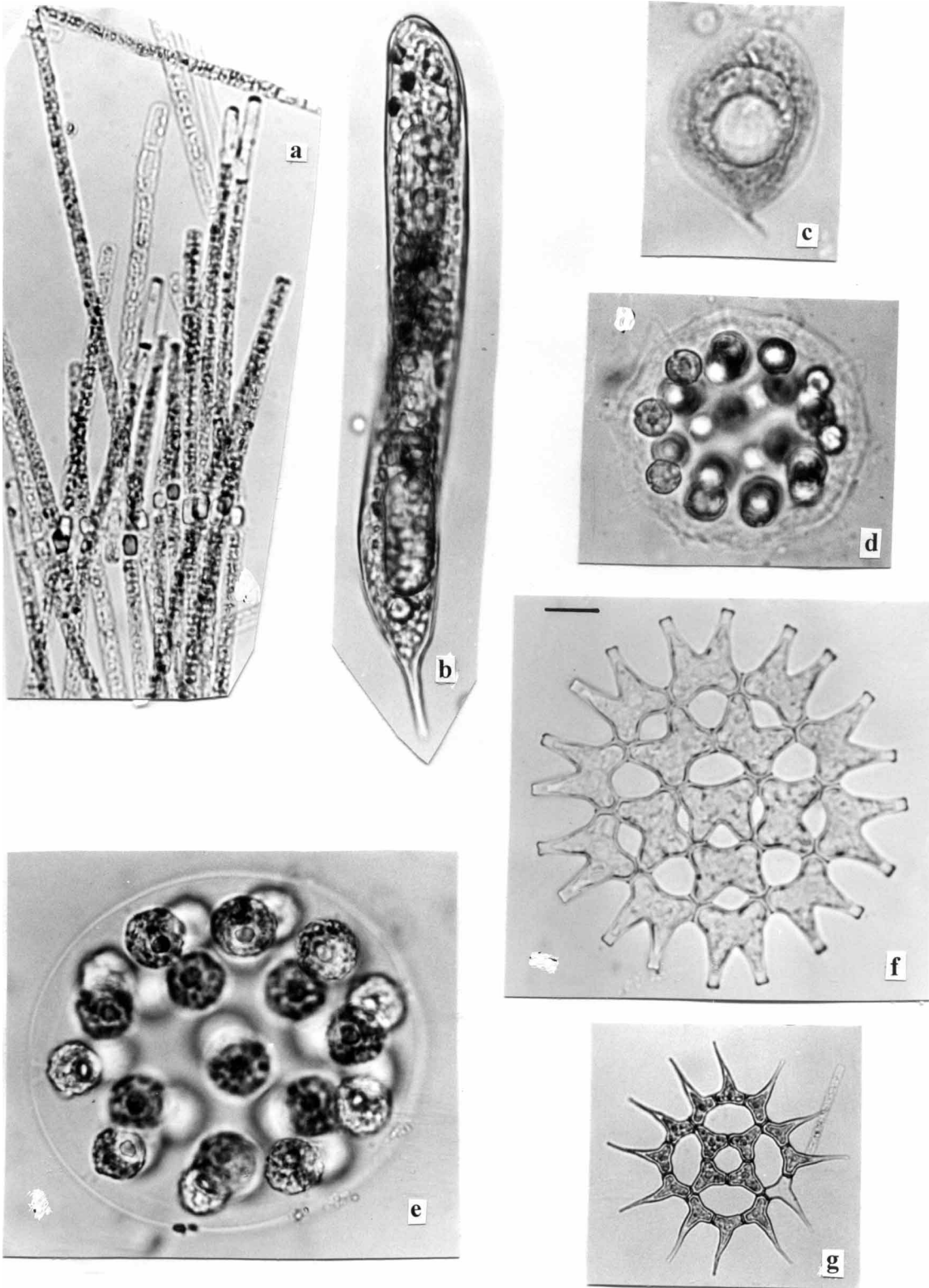


Figure 3. a. *Aphanizomenon floss-aquae*, b. *Euglena charchowiensis*, c. *Phacus orbicularis*, d. *Eudorina elegans*, e. *Palmellocystis planctonica*, f. *Pediatrum dublex* var. *clathratum*, g. *P. simplex* (Scale 10 μ m).

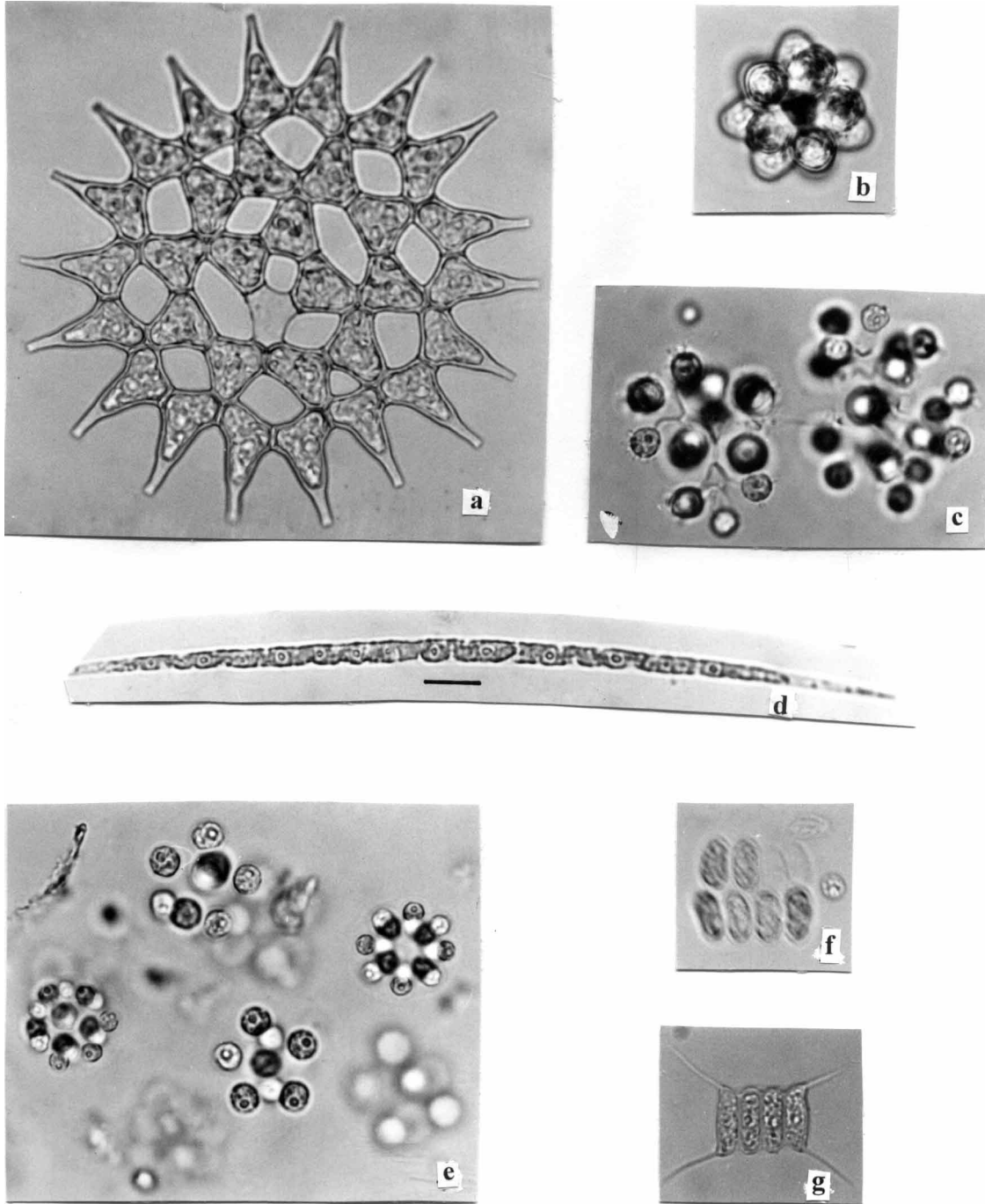


Figure 4. a. *Pediatrulum simplex* var. *duodenarium*, b. *Coelastrum microporum*, c. *Dictyosphaerium pulchellum*, d. *Ankistrodesmus longissimus*, e. *Coenococcus planktonicus*, f. *Scenedesmus arcuatus* var. *platydisca*, g. *S. quadricauda* (Scale 10 μm).

greater than 15, it is accepted that nitrogen is not the limiting factor. In calculations of the inorganic-N/PO₄-P

ratio near the 1st station, the average and probable percentage values were 25.34 and 16.67, respectively.

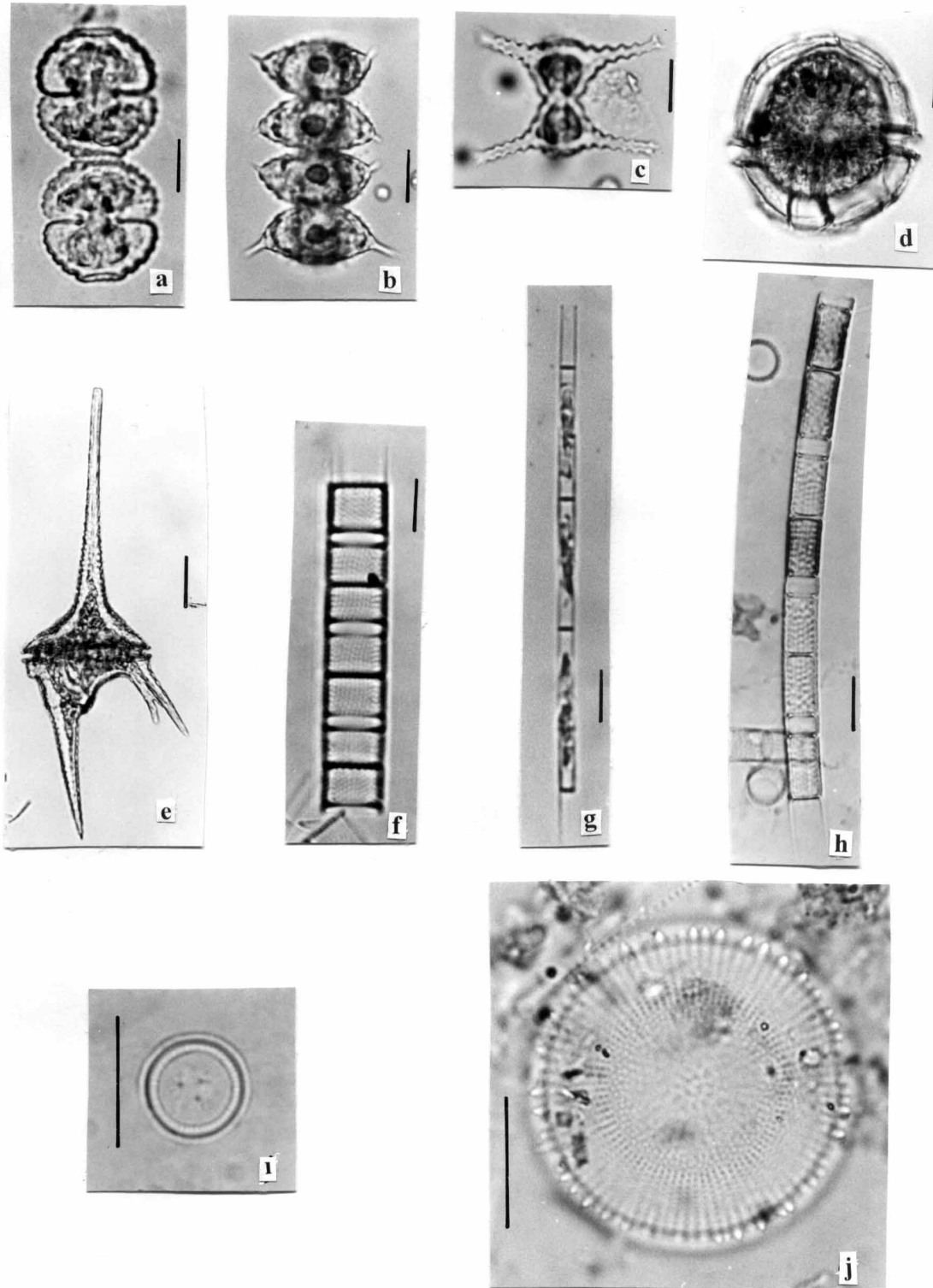


Figure 5. a. *Cosmarium reniforme*, b. *Staurastrum pungens*, c. *S. sebaldi* var. *ornatum* fo. *elongata*, d. *Peridinium cinctum* var. *tuberosum*, e. *Ceratium hirundinella*, f. *Aulacoseira granulata*, g. *A. granulata* var. *angustissima*, h. *A. ambigua*, i. *Cyclotella ocellata*, j. *Stephanodiscus rotula* (Scale 10 μ m).

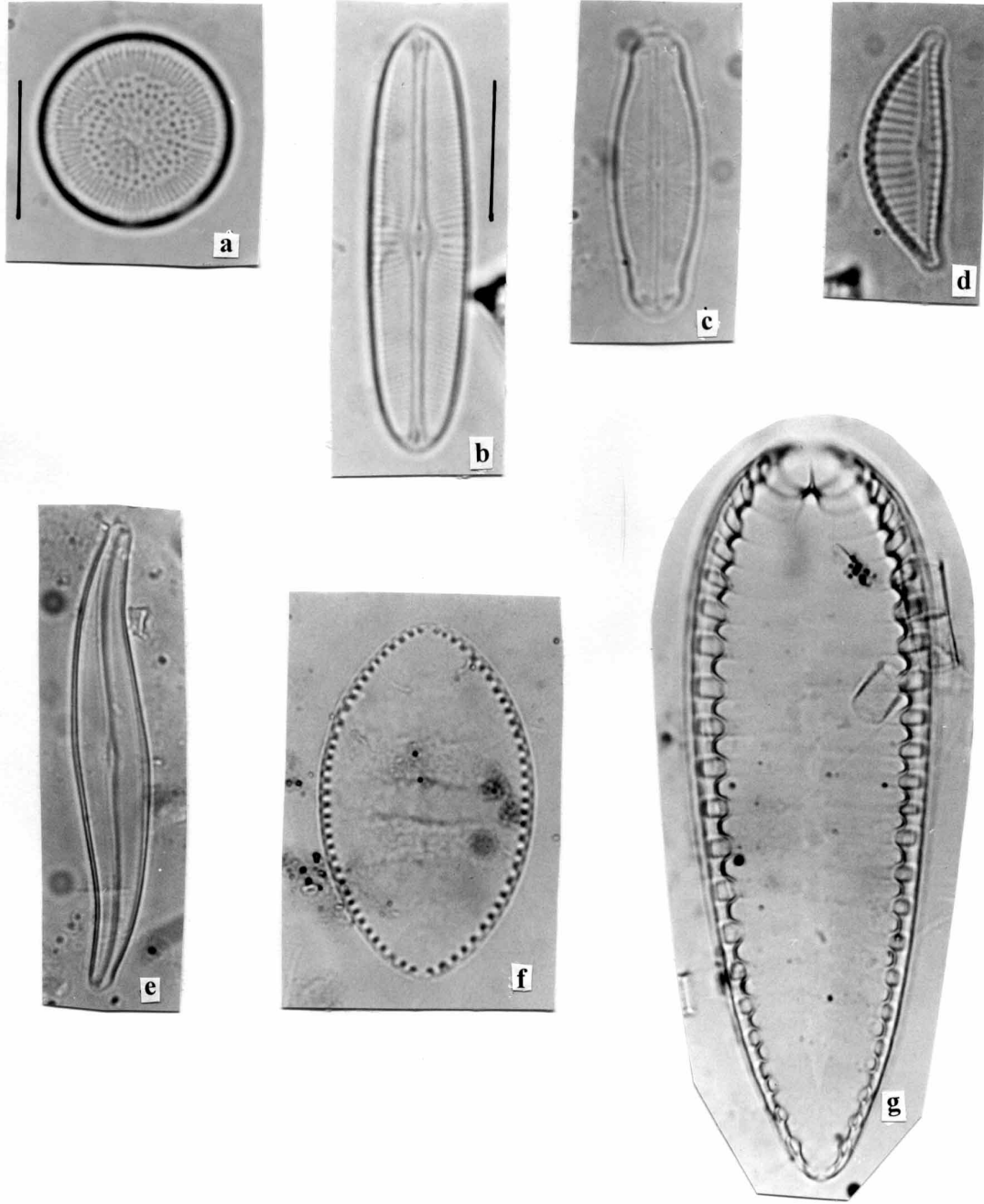


Figure 6. a. *Cyclostephanos dubius*, b. *Navicula bacillum*, c. *N. pupula*, d. *Cymbella ventricosa*, e. *Gyrosigma acuminatum*, f. *Cymatopleura elliptica*, h. *Surirella robusta* var. *splendida* (Scale 10 µm).

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