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Research Article

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, morfometrik 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 hm^3. 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 (≅ 250 m long and 1 m deep) from these stations using a Hydro Bioss Kiel plankton net (55 µm 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).

$CO_3^{=}$ and HCO_3^{-} values were determined by titration, temperature and oxygen by a YSİ-O_2-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/PO_4-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.

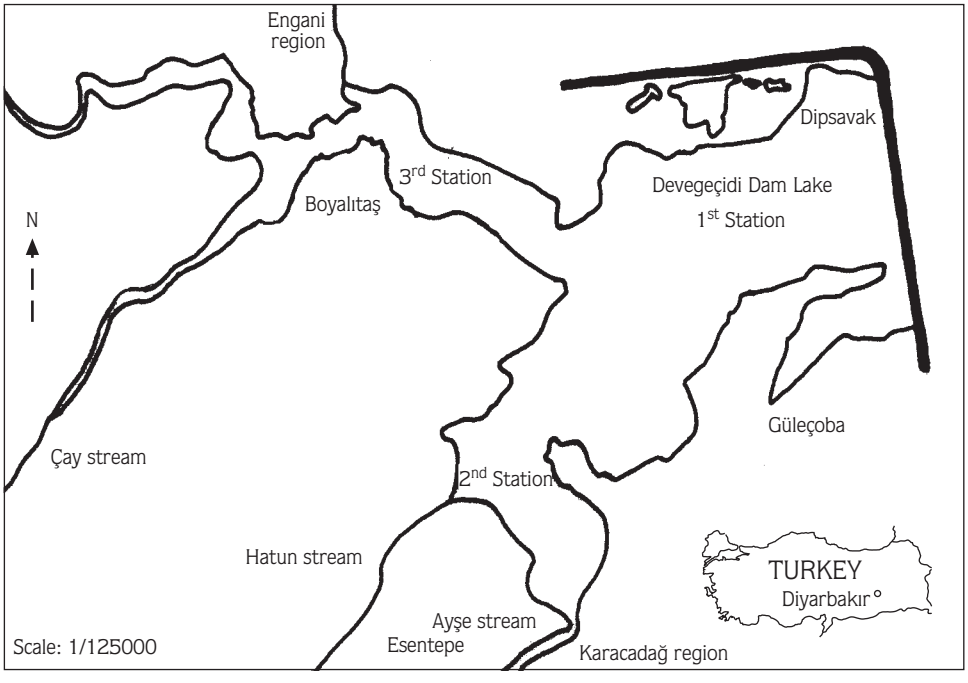

Figure 1. Experimental stations in Devegeçidi Dam Lake.

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

YEARS	1995										1996								
MONTHS PARAMETERS	April	May	June	July	August	September	October	November	December	Average	April	June	July	August	September	October	November	December	Average
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 (Alm)	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 & Gönülol, 1994), Akşehir Lake (Elmacı & Obalı, 1998), Kurtboğazı Dam Lake (Aykulu & Obalı, 1981), Mogan Lake (Obalı, 1984), Karamık Lake (Gönülol & Obalı, 1986) and the Bafra Balık Lakes (Gönülol & 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 5ı) 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		
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	I	II	III
SPECIES																											
CYANOPHYTA																											
Chroococcales																											
Chroococcus dispersus (Keissl.) Lemm.					C				B	C	D			C			B										
Chroococcus minor (Kütz.) Naeg.		A			A																	A					
Chroococcus minutus (Kütz.) Naeg.							C		C	C	C		C	A	B	B	C						B		A		
Chroococcus turgidus (Kütz.) Naeg.					C																						
Aphanocapsa elachista West & West															A												
Aphanocapsa endophytica G.M.Smith																								A			
Aphanocapsa Grevillei (Hass.) Raben.								A			C			B													
Microcystis aeruginosa Kütz. (Figure 2a,b)		A			C	C	D	E	D	B	E		D	D	C	C	D		D		D	D	C	C	C		
Microcystis marginata (Men.) Kg.																											
Merismopedia elegans A.Braun																									A		
Holopedia geminata Lagerh. (Figure 2c)																											
Holopedia irregularis Lagerh.																A	A		C								
Aphanothece nidulans var. *endophytica* West & West											A																
Coelasphaerium Naegalianum Unger							A									A											
Gomphosphaeria aponina Kütz.																	A		A			A					
Gomphosphaeria lacustris Chodat			A																								
Hormogonales																											
Spirulina major Kütz. (Figure 2d)																											
Oscillatoria formosa Bory																											
Oscillatoria limnetica Lemm.		A			A		A	A		A	A		A			A	A				A		A				
Oscillatoria minima Gicklhorn											A								B					A			
Phormidium mucicola Naum. & Huber - Pestalozzi							B			A			C	B	B	C	C		C		B		B	B			
Phormidium tenue (Menegh.) Gomont																											
Lyngbya sp.							A			A																	
Anabaena aequalis Borge		A								A																	
Anabaena affinis Lemm. (Figure 2e)										A					A												
Anabaena cylindrica Lemm.								A																			
Anabaena spiroides Kleb. (Figure 2f)			A											C		B	C										
Aphanizomenon floss – aquae (L.) Ralfs (Figure 3a)		C		A				B	C	E	C		B	C	B	B	B		B		B		A	A	A		
Gleotrichia sp.									A																		
EUGLENOPHYTA																											
Euglenales																											
Euglena charchowiensis Swir. (Figure 3b)																			A								
Euglena spiroides Lemm.																A											
Euglena spirogyra Ehr.					A						A								A			A					
Phacus longicauda (Ehr.) Duj.									A										A								
Phacus orbicularis Huebner (Figure 3c)																											
CHLOROPHYTA																											
Volvocales																											
Pandorina morum (Muell.) Bory														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 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		
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	I	II	III
SPECIES						A																					
Eudorina elegans Ehr. (Figure 3d)														A									A				
Oedogoniales																											
Oedogonium sp.					A																						
Chaetophorales																											
Chaetopeltis orbicularis Berthold																											
Chlorococcales																											
Golenkinia radiata (Chod.) Wille																											
Macrochloris dissecta (Korsh.) Meneg.					A																						
Palmellocystis planctonica Korsh. (Figure 3e)			A																								
Pediastrum Boryanum (Turp.) Meneghini			B		A	B																					
Pediastrum dublex Meyen			B		A	B											B			A			A		B		
Pediastrum dublex var. *clathratum* (A.Braun)																											
Lagerheim (Figure 3f)		A			C		B	B	A	B	C										A						
Pediastrum dublex var. *cohaerens* (Bohlin)		A																									
Pediastrum simplex (Meyen) Lemm. (Figure 3g)										A			A				B				A		A	B			
Pediastrum simplex var. *duodenarium* (Bailey) Raben.																											
(Figure 4a)					B		C	C	B	B	C		B	B	A	B	C		C				B				
Coelastrum microporum Naeg. (Figure 4b)					B				A										A								
Dictyosphaerium Ehrenbergianum Naegeli																	A										
Dictyosphaerium pulchellum Wood (Figure 4c)		B															A							B			
Oocystis Borgei Snow			A			A																					
Oocystis solitaria Wittrock						A																					
Lagerheima sp.																											
Ankistrodesmus falcatus (Corda) Ralfs									A																		
Ankistrodesmus longissimus (Lemm.) Wille (Figure 4d)					A												A							B			
Ankistrodesmus longissimus var. *acicularis* (Chod.) Brunnth																											
Dactylococcopsis acicularis Lemmermann																B	C				A						
Dactylococcopsis irregularis G.M.Smith																			C								
Selenastrum Bibraianum Reinsch										A																	
Kirchneriella elongata G.M.Smith																											
Kirchneriella lunaris (Kirch.) Moebius																											
Coenococcus planktonicus Korsh. (Figure 4e)																											
Tetraedron caudatum var. *longispinum* Lemm.																								A			
Tetraedron minumum (A.Braun) Hansgirg							A	A	A				A	A		A					A				A		
Hyaloraphidium arcuatum Korsh.		B			A											A			A				A				
Hyaloraphidium contortum Pasch. et Korsh.																											
Hyaloraphidium moinae Korsh.										A			A			A											
Hyaloraphidium rectum Korsh.																	A										
Scenedesmus acuminatus (Lagerh.) Chod.		A																									
Scenedesmus arcuatus var. *platydisca* G.M.Smith (Figure 4f)																											
Scenedesmus bijuga (Turp.) Lagerheim			A		A	A																					
Scenedesmus quadricauda (Turp.) de Breb in de Breb & Godey (Figure 4g)				A				A	A		A							A	A		A		A				
Scenedesmus quadricauda var. *longispina* (Chod.) G.M.Smith						A																					
Scenedesmus quadricauda var. Westii G.M.Smith																											
Crucigenia Lauterbornii 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 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		
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	I	II	III
SPECIES						A																					
Desmidiales																											
Cosmarium reniforme (Ralfs) Archer (Figure 5a)																					A						
Cosmarium witrockii Lundell		A														A	A					A					
Staurastrum pungens Breb. (Figure 5b)					A				A		A		A		A	A		A	A			A			A		
S. sebaldi var. *ornatum* fo. *elongata* Krieg. et Bourr. (Figure 5c)																											
PYRRHOPHYTA																											
Peridiniales																											
Glenodinium sp.																			A								
Peridinium cinctum (Muell.) Ehr.																								C			
Peridinium cinctum var. *tuberosum* (Meuiner) Lindemann (Figure 5d)									A	A	A	A			A	A	A		B				A		C		
Peridinium Willei Huitfeld – Kaas		A			A		A	B	C	B	C		B	B	A	A	B		C		A						
Ceratium hirundinella (O.F.Muell.) Duj. (Figure 5e)					A	A	A	C	A	A	B		B	B	A	A	A										
BACILLARIOPHYTA																											
Centrales																											
Melosira varians C.A.Agardh					A														B								
Aulacoseira granulata (Ehr.) Simonsen (Figure 5f)					A	B					A		B	A	A	A	C		D		C			A			
Aulacoseira granulata var. *angustissima* Muller (Figure5g)													B	C	A	A	B		B								
Aulacoseira ambigua (Grun.) Simonsen (Figure 5h)																			B								
Cyclotella meneghiniana Kütz.		D			A												A										
Cyclotella ocellata Pantocsek (Figure 5ı)													C		B												
Stephanodiscus rotula (Kütz.) Hendey (Figure 5j)																											
Cyclostephanos dubius (Fricke) Round (Figure 6a)																	A										
Thalassiosira weissflogii (Grunow) Fryxell and Hasle		C																									
Pennales																											
Navicula bacillum Ehr. (Figure 6b)		A																									
Navicula pupula Kütz. (Figure 6c)																											
Cymbella cymbiformis Agardh					A																						
Cymbella aequalis W.Smith																								B			
Cymbella ventricosa Kütz. (Figure 6d)					A																						
Gyrosigma acuminatum (Kütz.) Rabh. (Figure 6e)																											
Amphora ovalis Kütz.																									A		
Nitzschia sigmoidea (Ehr.) W.Smith																	A										
Nitzschia gracilis Hantzsch																											
Nitzschia acicularis W.Smith																	A										
Nitzschia closterium (Ehr.) W.Smith		B									A						A										
Cymatopleura solea (de Breb.) W.Smith																											
Cymatopleura elliptica (de Breb.) W.Smith (Figure 6f)																											
Surirella ovalis de Breb.																											
Surirella robusta var. *splendida* (Ehr.) Van Heurck (Figure 6g)																				A							
Surirella tenera Gregory																											
Fragilaria ulna (Nitzsch) Lange-Bertalot		A							A	A																	
Fragilaria ulna var. *acus* (Nitzsch) Lange-Bertalot			A					A		B	A		A														
Fragilaria ulna var. *angustissima* (Nitzsch) Lange-Bertalot		A						B		B	C		B				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 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																									
Chroococcus dispersus (Keissl.) Lemm.												E										A			41
Chroococcus minor (Kütz.) Naeg.																									18
Chroococcus minutus (Kütz.) Naeg.	A				E			D				E													59
Chroococcus turgidus (Kütz.) Naeg.																									6
Aphanocapsa elachista West & West																									6
Aphanocapsa endophytica G.M.Smith																									6
Aphanocapsa Grevillei (Hass.) Raben.																									18
*Microcystis aeruginos*a Kütz.	A	E			E		E	E		C		E	E	E	E	E				B		A			100
Microcystis marginata (Men.) Kg.	A						A																		12
Merismopedia elegans A.Braun																						A			12
Holopedia geminata Lagerh.		A																							6
Holopedia irregularis Lagerh.																									12
Aphanothece nidulans var. *endophytica* West & West																									6
Coelasphaerium Naegalianum Unger		A																							18
Gomphosphaeria aponina Kütz.								A											A						29
Gomphosphaeria lacustris Chodat																									6
Hormogonales																									
Spirulina major Kütz.												A													6
Oscillatoria formosa Bory												A										A			12
Oscillatoria limnetica Lemm.							A			A		A										A			65
Oscillatoria minima Gicklhorn																									18
Phormidium mucicola Naum. & Huber-Pestalozzi																									35
Phormidium tenue (Menegh.) Gomont																						C			6
Lyngbya sp.																									12
Anabaena aequalis Borge																									12
Anabaena affinis Lemm.					A							A													24
Anabaena cylindrica Lemm.																									6
Anabaena spiroides Kleb.								A					A	A	C	A									35
Aphanizomenon floss – aquae (L.) Ralfs	A	D	A		C		A		C				A		C	B			A			A			94
Gleotrichia sp.																									6
EUGLENOPHYTA																									
Euglenales																									
Euglena charchowiensis Swir.													A		A										12
Euglena spiroides Lemm.																									6
*Euglena spirogyr*a Ehr.																									24
Phacus longicauda (Ehr.) Duj.					A			A				A	A		A										35
Phacus orbicularis 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 %
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																									
CHLOROPHYTA																									
Volvocales																									
Pandorina morum (Muell.) Bory		A																							12
Eudorina elegans Ehr.								A																	18
Oedogoniales																									
Oedogonium sp.																									6
Chaetophorales																									
Chaetopeltis orbicularis Berthold		A																							6
Chlorococcales																									
Golenkinia radiata (Chod.).Wille																A									6
Macrochloris dissecta (Korsh.) Meneg.																									6
Palmellocystis planctonica Korsh.																									6
Pediastrum Boryanum (Turp.) Meneghini					B			A				C	B										A		41
Pediastrum dublex Meyen					C			A	C		A			B			C			A					65
Pediastrum dublex var. *clathratum* (A.Braun) Lagerheim		A			C			A				A			A										59
Pediastrum dublex var. *cohaerens* (Bohlin)												A											A		18
Pediastrum simplex (Meyen) Lemm.		A			C			C	C			C	D	C	B		C			A			A		76
Pediastrum simplex var. *duodenarium* (Bailey) Raben.																									41
Coelastrum microporum Naeg.					A							A	A				A			A					47
Dictyosphaerium Ehrenbergianum Naegeli																									6
Dictyosphaerium pulchellum Wood													A												24
Oocystis Borgei Snow																									12
Oocystis solitaria Wittrock																									6
Lagerheima sp.																							A		6
Ankistrodesmus falcatus (Corda) Ralfs													A	A											12
Ankistrodesmus longissimus (Lemm.) Wille			A					A			A		A	A						B					47
Ankistrodesmus longissimus var. *acicularis* (Chod.) Brunnth																							B		6
Dactylococcopsis acicularis Lemmermann			A																						18
Dactylococcopsis irregularis G.M.Smith																									6
Selenastrum Bibraianum Reinsch																									6
Kirchneriella elongata G.M.Smith								A																	12
Kirchneriella lunaris (Kirch.) Moebius					A																				6
Coenococcus planktonicus Korsh.					A																				6
Tetraedron caudatum var. *longispinum* Lemm.																									6
Tetraedron minumum (A.Braun) Hansgirg		A			A			A				A	A												59
Hyaloraphidium arcuatum Korsh.	A																								35
Hyaloraphidium contortum Pasch. et Korsh.	A							A																	12
Hyaloraphidium moinae Korsh.																									18
Hyaloraphidium rectum Korsh.																									6
Scenedesmus acuminatus (Lagerh.) Chod.												A				A									18
Scenedesmus arcuatus var. *platydisca* G.M.Smith					A																				6
Scenedesmus bijuga (Turp.) Lagerheim								A																	18
Scenedesmus quadricauda (Turp.) de Breb in de Breb & Godey						A		A	A				A	A	A						A			A	65
Scenedesmus quadricauda var. *longispina* (Chod.) G.M.Smith																								A	12
Scenedesmus quadricauda var. *Westii* 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 %
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																									
Crucigenia Lauterbornii Schmidle																									6
Desmidiales																									
Cosmarium reniforme (Ralfs) Archer																									6
Cosmarium witrockii Lundell	A				A			A		A			A			A									53
Staurastrum pungens Breb.	A				A		A	A		A		A	A		A	A			A						88
S. sebaldi var. *ornatum* fo. *elongata* Krieg. et Bourr.		A																							6
PYRRHOPHYTA																									
Peridiniales																									
Glenodinium sp.																									6
Peridinium cinctum (Muell.) Ehr.					A		A	A					B			A									29
Peridinium cinctum var. *tuberosum* (Meuiner) Lindemann	A	B					A					A	A	A	A				A						65
Peridinium Willei Huitfeld – Kaas		C																							47
Ceratium hirundinella (O.F.Muell.) Duj.							A	A		B		B	B	B	B	A			A			B			65
BACILLARIOPHYTA																									
Centrales																									
Melosira varians C.A.Agardh																									12
Aulacoseira granulata (Ehr.) Simonsen		A			B		D	B		A		C	E	E	C	D			A			A			82
Aulacoseira granulata var. *angustissima* Müller			A				C					D										A			41
Aulacoseira ambigua (Grun.) Simonsen					B		A	B				C	C	C		C									35
Cyclotella meneghiniana Kütz.		A																							24
Cyclotella ocellata Pantocsek	A																								12
Stephanodiscus rotula (Kütz) Hendey			A																						6
Cyclostephanos dubius (Fricke) Round	B																								12
Thalassiosira weissflogii (Grunow) Fryxell and Hasle	B	A																							12
Pennales																									
Navicula bacillum Ehr.																									6
Navicula pupula Kütz														A											6
Cymbella cymbiformis Agardh																									6
Cymbella aequalis W.Smith																									6
Cymbella ventricosa Kütz.																									6
Gyrosigma acuminatum (Kütz.) Rabh.																						A			6
Amphora ovalis Kütz.												A										A			18
Nitzschia sigmoidea (Ehr.) W.Smith																									6
Nitzschia gracilis Hantzsch	A																								6
Nitzschia acicularis W.Smith		A					A					A													24
Nitzschia closterium (Ehr.) W.Smith	B	A	C		B		A	B				A	A		A	A									53
Cymatopleura solea (de Breb.) W.Smith										A		A										A			12
Cymatopleura elliptica (de Breb.) W.Smith												A													6
Surirella ovalis de Breb.												A													6
Surirella robusta var. *splendida* (Ehr.) Van Heurck																									6
Surirella tenera Gregory												A													6
Fragilaria ulna (Nitzsch) Lange-Bertalot	A		A																						24
Fragilaria ulna var. *acus* (Nitzsch) Lange-Bertalot	A	A					A																		35
Fragilaria ulna var. *angustissima* (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%

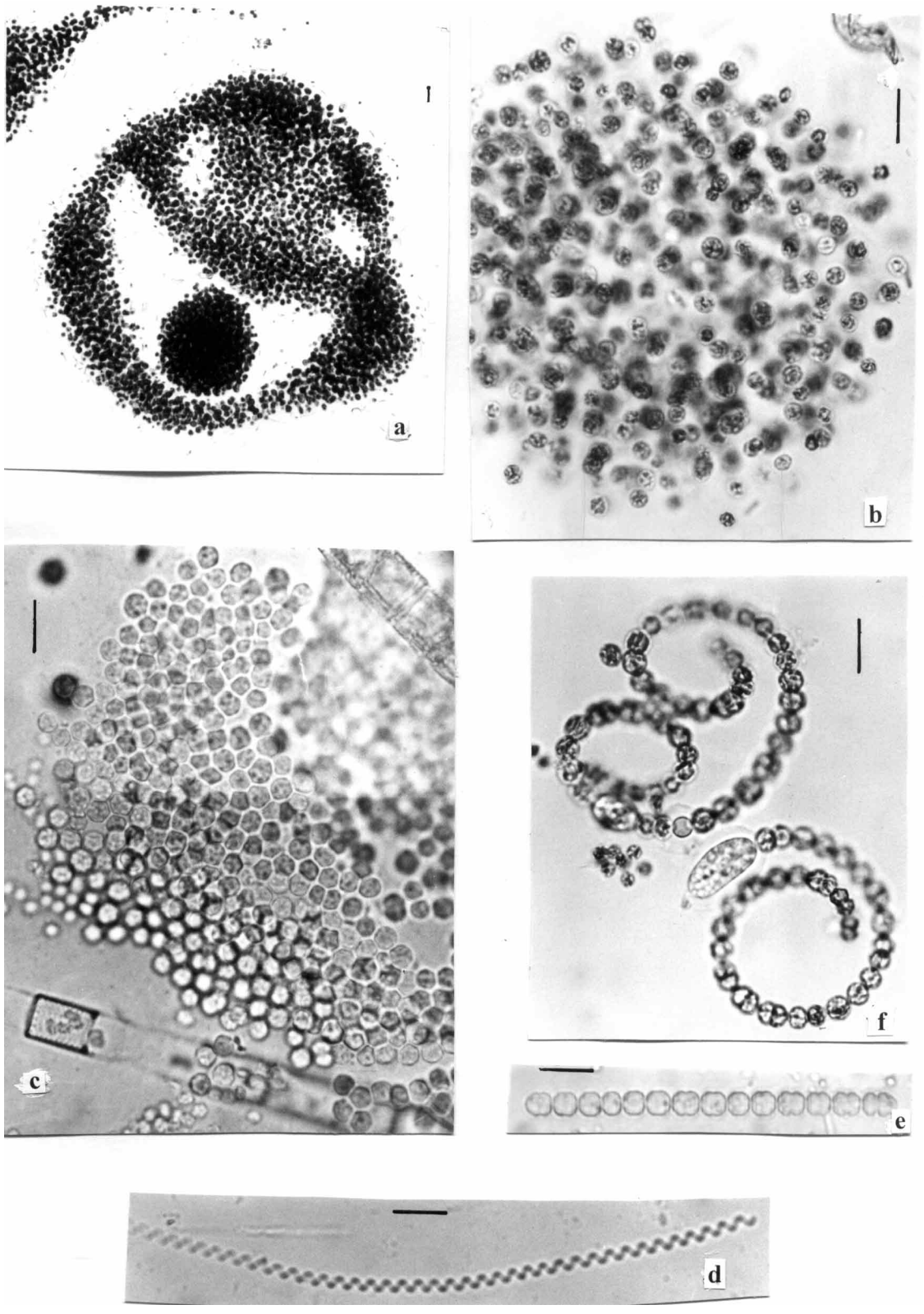

Figure 2. a,b. *Microcystis aeruginosa*, c. *Holopedia geminata*, d. *Spirulina major* e. *Anabaena affinis*, f. *A. spiroides* (Scale 10 µm).

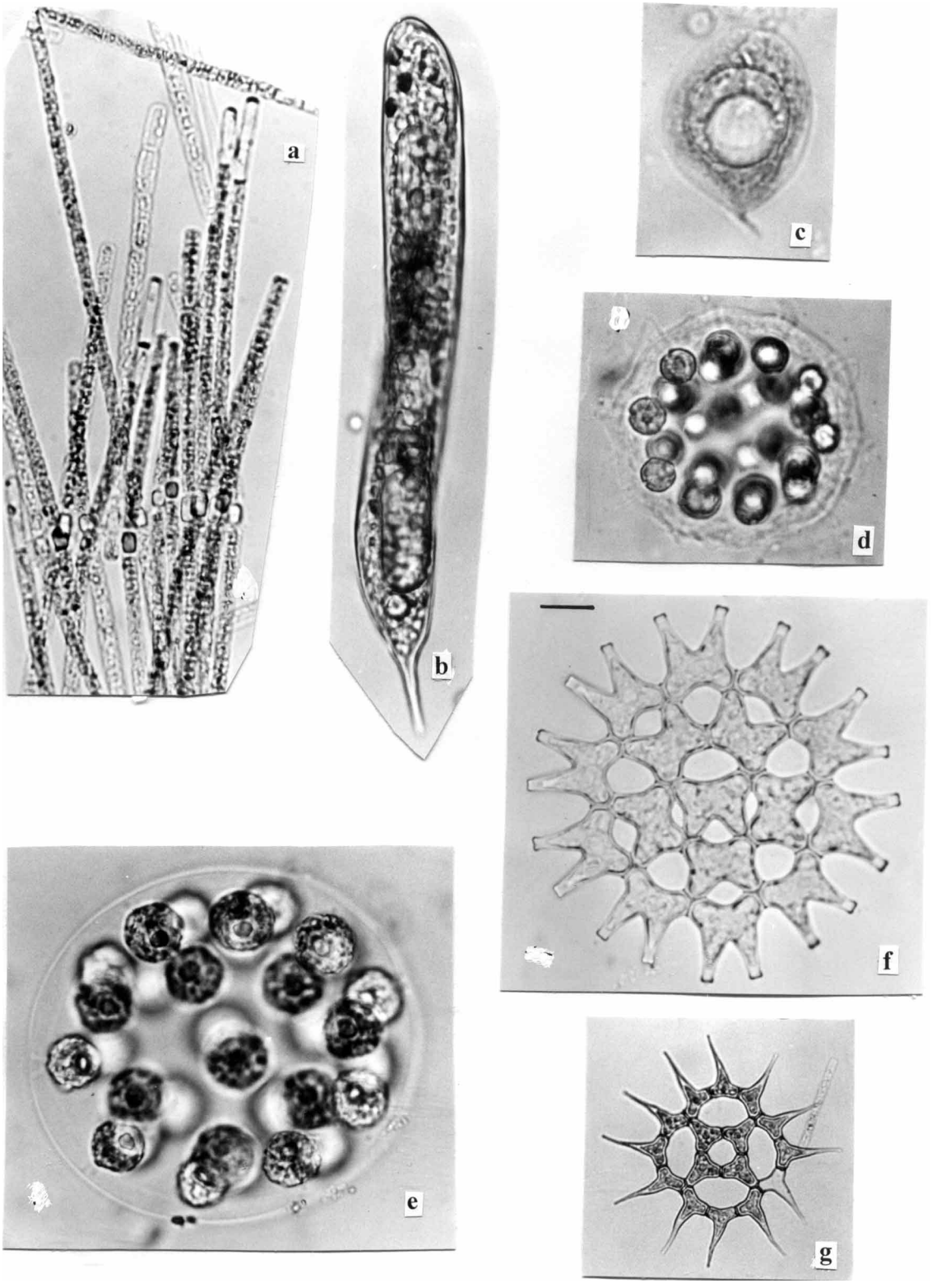

Figure 3. a. *Aphanizomenon floss–aquae*, b. *Euglena charchowiensis*, c. *Phacus orbicularis*, d. *Eudorina elegans*, e. *Palmellocystis planctonica*, f. *Pediastrum dublex* var. *clathratum*, g. *P. simplex* (Scale 10 µm).

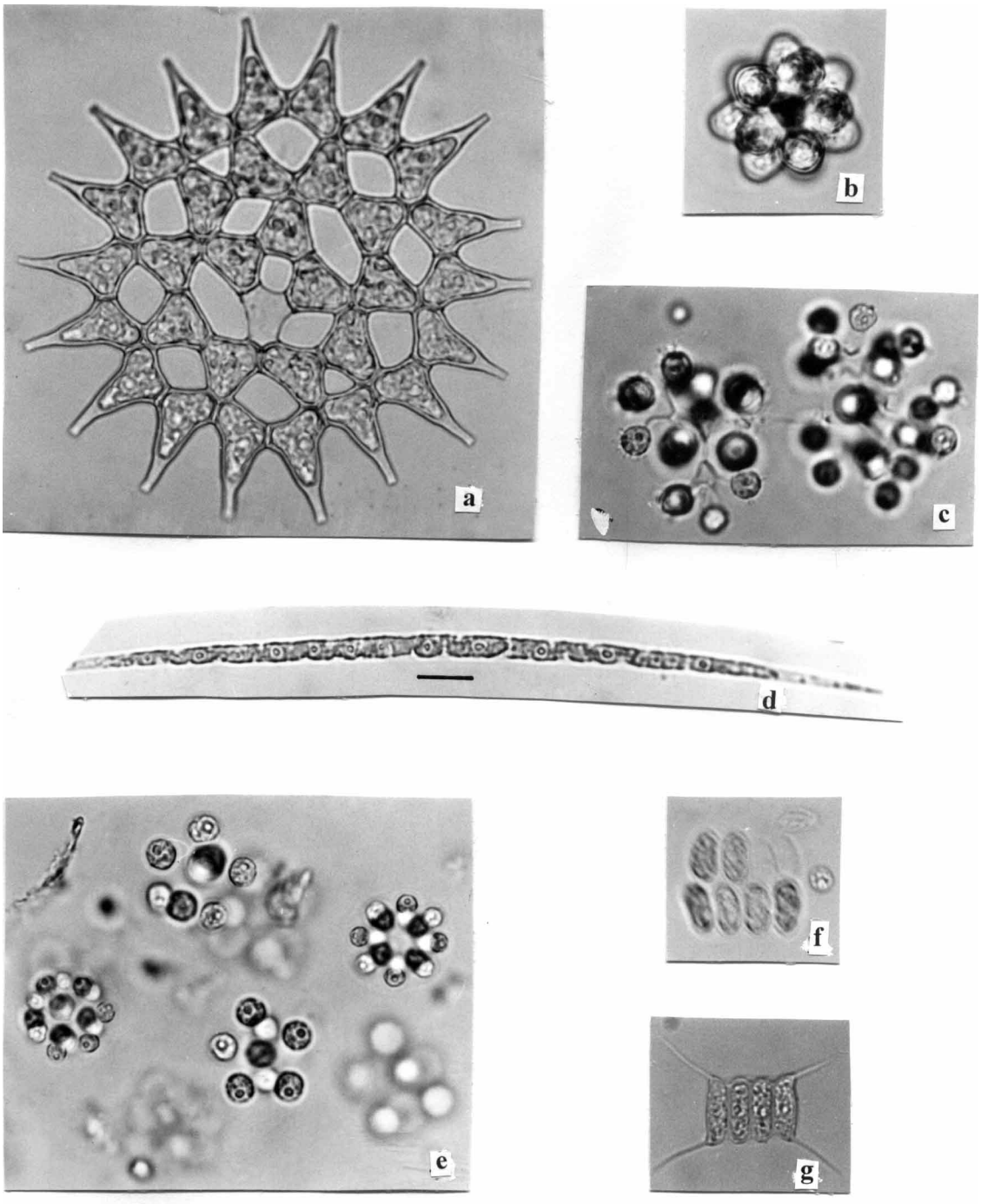

Figure 4. a. *Pediastrum simplex* var. *duodenarium*, b. *Coelastrum microporum*, c. *Dictyosphaerium pulchellum*, d. *Ankistrodesmus longissimus*, e. *Coenococcus planktonicus*, f. *Scenedesmus arcuatus* var. *platydisca*, g. *S. quadricauda* (Scale 10 µm).

greater than 15, it is accepted that nitrogen is not the limiting factor. In calculations of the inorganic-N/PO_4-P ratio near the 1st station, the average and probable percentage values were 25.34 and 16.67, respectively.

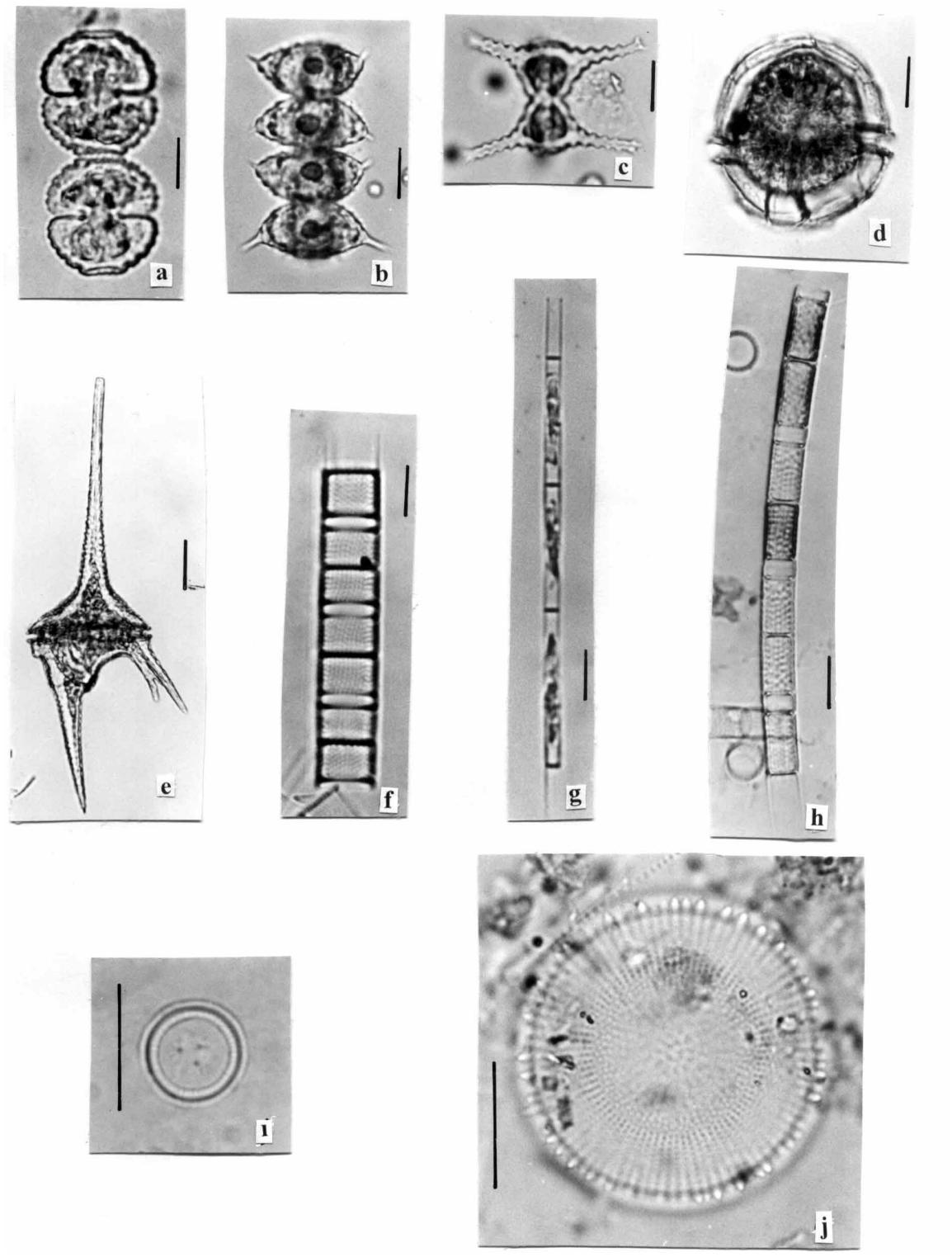

Figure 5. a. *Cosmarium reniforme*, b. *Staurastrum pungens*, c. *S. sebaldi* var. *ornatum* fo. *elongata*, d. *Peridinium cinctum* var. *tuberosum*, e. *Ceratium hirundinella*, f. Aulacoseira granulata, g. *A. granulata* var. *angustissima*, h. *A. ambigua*, i. *Cyclotella ocellata*, j. *Stephanodiscus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

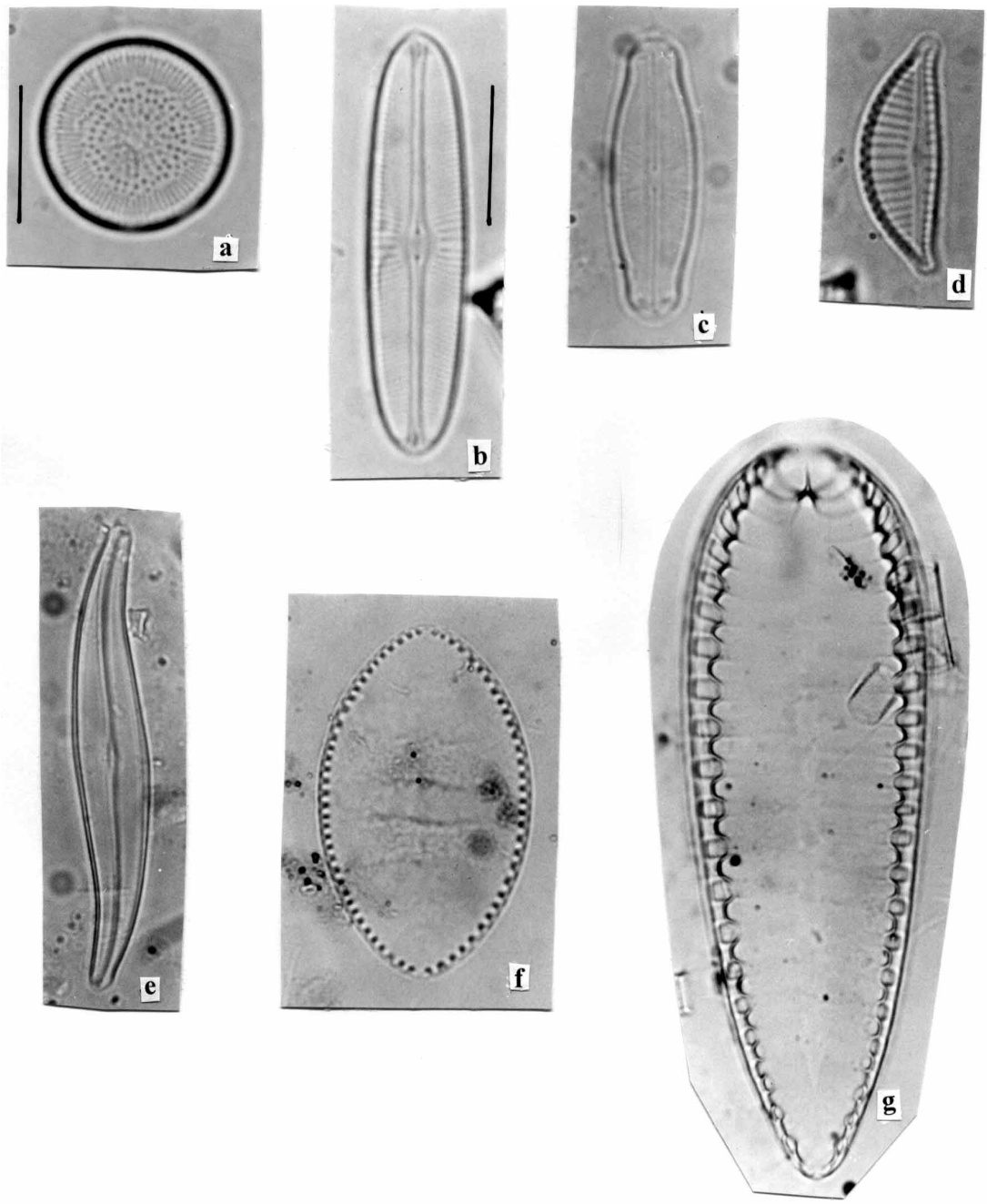

Figure 6. a. *Cyclostephanos dubius*, b. *Navicula bacillum*, c. *N. pupula*, d. *Cymbella ventricosa*, e. *Gyrosigma acuminatum*, f. *Cymatopleura elliptica*, h. *Surirella robusta* var. *splendida* (Scale 10 µm).

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