Turkish Journal of Fisheries and Aquatic Sciences 2: 121-128 (2002)

A Study on the Seasonal Variation of the Phytoplankton of Lake Cernek (Samsun-Turkey)

Beyhan İşbakan Taş[1,*], Arif Gönülol[1], Erol Taş[2]
[1] Ondokuz Mayıs University, Science and Arts Faculty, Department of Biology, Kurupelit, Samsun, Turkey
[2] Abant İzzet Baysal University, Education Faculty, Department of Science Education, Gölköy, Bolu, Turkey

* Corresponding Author: Tel: +90. 462. 341 50 23; Fax: -
E-mail: beyhantas@mynet.com

Received 24 April 2002
Accepted 16 September 2002

Abstract

Seasonal variations of the pytoplankton of Lake Cernek were studied between January 1996 and June 1997. *Cyclotella ocellata* and *Nitzschia acicularis*, members of Bacillariophyta produced bloom during the spring and autumn in the phytoplankton. Chlorophyta division were occurred to be the most widespread and dominant algal group in the phytoplankton. *Monoraphidium caribeum*, *M. irregulare*, *Scenedesmus quadricauda*, *Oocystis borgei* and *Pediastrum boryanum* have been the most abundant species present during the blooming in spring and autumn months. Cyanophyta members (*Microcystis aeruginosa*, *Anabaena affinis* and *A. spiroides*) produced bloom during the summer. In addition, *Euglena gracilis*, E. *polymorpha* (Euglenophyta) were generally present in the phytoplankton. *Cryptophyta* division was represented by *Cryptomonas ovata* and Dinophyta division *Gymnodinium* sp. was both of which increased in January. Xanthophyta division was represented by *Characiopsis cylindrica* and while it was very dense in March 1996, it was found very few in the other months.

There were no an important differences from side species contents, seasonal variations and the total amount of present groups found in the surface and in 1 meter depth of stations

Key Words: Algae, Phytoplankton, Seasonal Variation, Lake Cernek

Introduction

Lake Cernek is a type of lagoon. The lake that are close and connected to the sea are called lagoon. Lagoons are important because of many economical and ecological reasons. Lagoons have very high productive biological properties due to nitrogen and phosphate compounds coming from the rivers. Therefore these are the suitable places for many kinds of fish species. They constitute a natural habitat. In addition to fishes that have a high economical value, birds, mammals and many species of insect are rich in lagoon especially in the ones surrounded by aquatic areas. The type of lagoons that gets the water from rivers contributes environmental health too. Because the sediment fall down when the river water slow down in the aquatic areas and in the lagoon before it reaches the sea. By this way, it serves as an erosion control mechanism too. Artificial materials found in sediments are eliminated in the process of high production and decomposition in lagoon. For this reason, lagoons ease the control of environmental pollution.

There is needed many studies research in order to increase the water products obtained from inland water. It is also necessary to determine the feeding capacity, ecological conditions of this lakes and what kind of fishes can breed in the water. For this purposes, the taxonomy, density and seasonal variations and the ecological, physical and chemical factors affecting this variations of the phytoplankton that constitutes the first ring of the food chain should be determined.

The floristic composition, and the amount of chloropyl-a in the phytoplankton of Kurtboğazı Dam Lake were increased in the firt study done in Turkey (Aykulu and Obalı, 1981). In subsequent years, the phytoplankton and seasonal variation in Karamık Lake (Gönülol and Obalı, 1986), Hafik Lake (Kılınç and Dere, 1988), Bafa Lake (Cirik *et al.*, 1989), Eğirdir Lake (Conk and Cirik, 1991), Trabzon Çaykara Uzun Lake (Şahin, 1993) have been studied.

The algae present in the phytoplankton of Lake Cernek that is apart of lagoon series of Bafra Balık Lakes, has been investigated in a previous article (İşbakan *et al.*, 1998). This investigation aims to examinate the seasonal variations in the phytoplankton of Lake Cernek. The study is expected to contribute the researchs in fishery.

Kızılırmak Delta is in the central part of the Black Sea Region. It is a triangular delta which lies pointing towards to the sea between Samsun and Sinop. There are lagoons that are separated by shore cordons from the sea in the delta especially on its east sides. The Lake called "Bafra Fish Lakes" covers Liman Lake, Cernek Lake, Gıcı Lake, Tatlı Lake, Balık Lake and Uzun Lake by starting from the north side (Figure 1).

Lake Cernek is in the boundary of Doğanca town, which is apart of Bafra city in Samsun province. It is 20 km away from Bafra located on the east side of Kızılırmak River and Bafra city. The area of the lake, which is one of largest Lakes in Bafra plain is 589 hectares. There are many drainage canals connected to the lake.

The sewerage system of Bafra city reaches to the lakes by means of these drainage canals especially the Badut canal.

The pastures around the lake are the feeding zones for approximately 10,000 cattles and water buffalos since the vicinity of Cernek Lake is under the protection it shelters many species of birds.

Material and Methods

Three stations were chosen to examine the seasonal variation of the phytoplankton in Lake Cernek. The station 1 (St. 1) was located near the northwest edge of the lake. The station 2 (St. 2) was in the middle of the lake. And station 3 (St. 3) was located 250 meter away from the southeast edge of the lake (Figure 1). The depth averaged from 1.5 to 1.6 meter in all three stations. But, the water level in winter can reach up to 2-3 meter high around the St. 3. The bottom of the lake consist grey coloured mud, sand and rotten crops.

Samples were collected monthly from the selected stations from the surface (0-20 cm) and 1m depth with 2 litre capacity Hydro-Bios water samplers to determine the density of the algae in the lake. The water samples transferred to the research laboratory were shaken to ensure the homogeneity of the organisms. Three series of water samples of 10 ml from each bottle were put in measurement cylinders. To fix and to paint the organisms, one or two drops of lugol solution (IKI) were added into these measurement cylinders. After waiting, at least 12 hours, the water samples were drained by means of a thin, U shaped, glass pipe until a 2 ml of water remained in the measurement cylinders. The remaining water was shaken again to ensure the homogeneity of the distribution. Then, these water samples were poured in the counting tubes made specifically for this purpose. After waiting the organisms precipitate in the counting tubes, the counting was made with inverted plankton microscope (Lund *et al.*, 1958). In the evaluations, the average of three countings from each station was used.

Results

The phytoplankton represented in Lake Cernek has been demonstrated in previous article (İşbakan *et al.*, 1998). Table 1 shows the repetition rate of the algae forming the phytoplankton.

Seasonal Variation of Phytoplankton

The seasonal variation of the phytoplankton on the lake surface and in1m depth have been almost similar except some numerical changes (Figure 2). During the investigation, some species have been dominant on the surface and in 1 m. depth in the stations. It was found suitable to investigate the seasonal variation of the plankton by dividing the periods as spring, summer, autumn and winter.

Spring Months:

1996 March - 1996 May: Thirty eight percent of the total 22,118 organisms on the surface of the St. 1 were *Cyclotella ocellata* and 27% *Scenedesmus quadricauca* in March. While a decrease in the total amount of organisms was observed in the St. 2 in February, *C. ocellata* and *S. quadricauda* were again the dominant organisms. In April, *S. quadricauda* become the dominant organism by forming 12-32% of the total organisms in all stations. In addition, in the St. 2, 24% of 7,500 org./cm^3 was *Ulothrix subtilissima*, in the St. 3, 18% of 10,217 org./cm^3 was

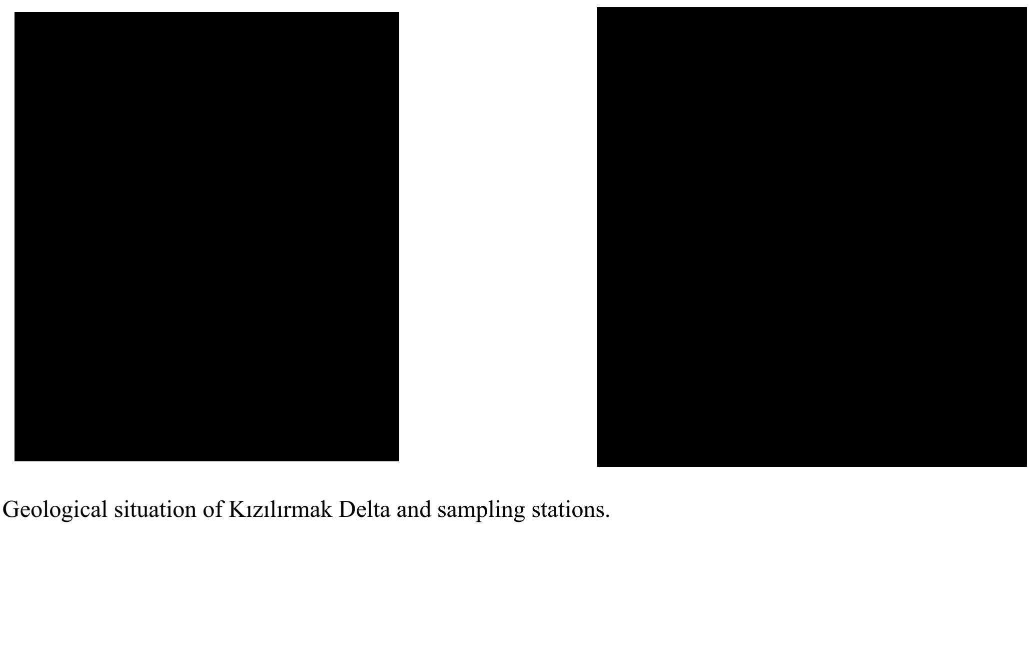

Figure 1. Geological situation of Kızılırmak Delta and sampling stations.

Table 1. The frequency ratio of some algae composing phytoplankton in all stations (The percentage of samples in wich organisms were found to the total number of samples). 80-100% Constantly present, 60-80% Largely present, 40-60% Generally present, 20-40% Sometimes present, 1-20% Seldom present.

		Sampling stations	Station 1		Station 2		Station 3	
			Surface	1 m	Surface	1 m	Surface	1 m
	Organisms	Sampling Number	18	18	18	18	18	18
BACILLARIOPHYTA	Centrales	*Cyclotella ocellata*	83	77	66	77	83	83
		Cyclotella meneghiniana	27	38	38	44	38	38
	Pennales	*Cocconeis placentula*	50	38	44	17	44	38
		Navicula cryptocephela	66	66	44	66	50	44
		Nitzschia acicularis	94	94	89	89	94	89
		Rhoicosphenia curvata	33	27	17	11	27	17
CHLOROPHYTA	Chlorococcales	*Chlorella* spp.	44	22	22	33	44	22
		Crucigenia quadrata	77	72	72	77	83	83
		Monoraphidium spp.	77	77	83	66	72	83
		Oocystis borgei	72	66	72	72	77	77
		Pediastrum boryanum	94	89	83	89	89	89
		Pediastrum tetras	22	33	22	22	38	44
		Scenedesmus dimorphus	77	83	89	72	77	83
		Scenedesmus quadricauda	100	100	100	100	100	100
		Scenedesmus minutum	61	44	22	33	38	44
		Tetraedron minimum	83	77	61	77	56	61
	Desmidiales	*Closterium acutum*	22	27	17	11	11	22
		Cosmarium spp.	50	61	50	56	61	50
CRYPTOPHYTA		*Cryptomonas ovata*	72	66	83	72	77	77
CYANOPHYTA	Chroococcales	*Chroococcus* spp.	72	66	83	83	72	72
		Gomphosphaeria lacustris	11	17	22	22	27	22
		Merismopedia tenuissima	33	17	27	22	27	17
		Microcystis aeruginosa	56	33	27	38	38	38
	Nostacales	*Anabaena* spp.	38	44	33	33	44	38
		Oscillatoria spp.	38	50	38	44	38	44
EUGLENOPHYTA		*Euglena* spp.	83	77	72	89	77	89
		Phacus acuminatus	33	44	27	38	11	27
		Trachelomonas spp.	33	33	17	33	38	22

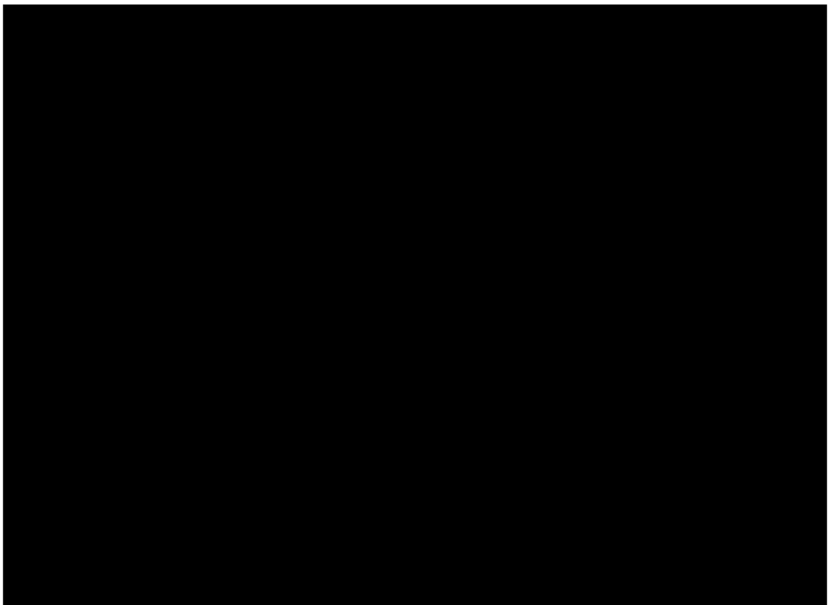

Figure 2. The seasonal variations of total organisms/cm^3 in the sampling stations.

Gomphosphaeria lacustris and 15% *Oocystis borgei*. In all stations, 7% of the total organisms was *Nitzschia acicularis*. In the St. 3 that showed an increase both on the surface and 1 m depth, *S. quadricauda* was again dominant. *O. borgei* which is another of Chlorococcales members was dominant organism in the first and second St. In the St. 1, *Schroderia indica*, *N. acicularis*, *Euglena polymorpha* and *Cocconeis placentula* become subdominant organisms by forming 12%, 10%, 6% and of 3,891 org/cm^3, respectively. In this month; *Cladophora glomerata* formed communities on the surface of the lake by blooming extensively.

1997 March - 1997 May: As in the previous years, the total number of organisms decreased in March (7,000-10,000 org./cm^3), a slight increase in April and decline again in May.

In all stations, *S. quadricauda* was dominant in March and *Nitzschia acicularis* in April. *Cryptomonas ovata* become the subdominant by forming 31% of the total 13058 org/cm^3 in the St. 2. In May *Monoraphidium caribeum* was dominant by forming 17% of the total organisms in the first and St. 2. In the St. 3, of the total 9,199 org./cm^3, were 28% *N. acicularis*, 14% *S. quadricauda* and 13% *C. ovata.*

Navicula cryptocephala, Closterium acutum, Crucigenia quadrata, Oocystis crassa, O. submarina, Scenedesmus dimorphus, S. intermedius, Selenastrum minutum, Chroococcus dispersus, C. minutus, Euglena acus, E. gracilis, Characiopsis cylindrica were the species observed in a few number in the phytoplankton in spring months.

Summer Months:

1996 June - 1996 August: While there was a slight increase in the number of total organisms on the surface of the St. 1 and St. 3, a slight decline was observed in the total number of organisms 1 m. depth of the St. 2 and St.3 in June. In this month 51% of the total of 8,519 org./cm^3 in the St. 3 was *Nodularia spumigea*. In July and August *Anabaena affinis, A. spiroides* and *Microcystis aeruginosa* were the ones that made extensive blooming.

1997 June: In all the stations *Anabaena affinis* and *A. spiroides* were the dominant organisms that made extensive blooming. In this month, *Oscillatoria limnetica* was subdominant organism. The species shown in a few number in summer months were as follows: *Cyclotella ocellata, Nitzschia acicularis*, *Cosmarium bioculatum*, *C. formosulum*, *C. phaseolus*, *Monoraphidium setiforme*, *Oocystis borgei, Scenedesmus acuminatus, S. dimorphus* and *S. quadricauda, Chroococcus limneticus, Cryptomonas ovata* and *Euglena gracilis*.

Autumn Months

1996 September - 1996 November: In September, the total number of organisms was found low in all stations. In October, there was increasing in the total number of organisms. On the other hand, while there was an increase in the total number of organisms on the surface of the St. 1 and both surface and 1 m. depth of the St. 2 and St. 3, there was a slight decrease in 1 m. depth of the station one in November. In September, the highest values in a total of 5,940 org./cm^3 were 34% *Cyclotella ocellata* and 17% *Trachelomonas hexangulata* in the St. 1. While the same organisms were dominant in the St. 2, *Oscillatoria limnetica* became dominant making up 21% of the total of 7,439 org./cm^3 in the St. 3. On the other hand, *Oscillatoria limnetica* was dominant organism in all the stations in November.

Cyclotella meneghiniana, Nitzschia acicularis, Chlorella vulgaris, Cosmarium bioculatum, Monoraphidium caribeum, M. irregulare, M. setiforme, Pediastrum boryanum, P. tetras, Scenedesmus quadricauda, Cryptomonas ovata, Anabaena affinis, Chroococcus dispersus, C. limneticus, Euglena gracilis were the species observed in a few number in the phytoplankton in autumn months.

Winter Months:

1996 January-1996 February: The total amount of organisms has changed between 1979 and 22587 org/cm^3 in January. In this month, the dominant organism was *Cryptomonas ovata* making up 75% of the total organisms in all station. In February, while there was a slight increase in the surface of the St. 2, there was a decrease both on the surface and in 1 m depth in the other stations. In all stations, the dominant species was *Scenedesmus quadricauda* making up 57-74% of the total organisms.

1996 December - 1997 February: After an increasing in the total amount of organisms in December in 1996, there was a fluctuation by decreasing in January and again increasing in February in 1997. In December, the highest value in the St. 1 was 53,569 org./cm^3 of which 42% was *Cryptomonas ovata* and 31% *Monoraphidium caribeum*. These organisms were observed in almost the same amounts in the other stations too. While the dominant organism was again *Cryptomonas ovata* in the January of 1997, the number of *Monoraphidium caribeum* showed a slight decline while there was no *Cryptomonas ovata* in February 1997, but *Monoraphidium* species was found in high percentages (65-75%) that make it the dominant organism in all stations. In this month, the subdominant organism was *Closterium acutum* in all stations.

In the winter months; *Nitzschia acicularis, Crucigenia quadrata*, *Oocystis borgei, Scenedesmus dimorphus, S. intermedius, Selenastrum minitum*, *Tedraedron minimum*, *Chroococus dispersus, C. limneticus*, and *Euglena gracilis* were the species observed in a few numbers.

The seasonal variation of some algal groups in the phytoplankton is shown at Figure 2-5.

Discussion

Chlorococcales - Pennales type phytoplankton that Chlorophyta and Bacillariophyta divisions were sometimes dominant in Lake Cernek.

The dominant algal group in the phytoplankton is Chlorophyta division which constitute to 46% of the total taxa. Chlorococcales members which have 32 taxa were dominant in winter months. The most abundant species belonging to this order are *Monoraphidium caribeum*, *M. irregulare*, *Scenedesmus quadricauda*, *Oocystis borgei* and *Pediastrum boryanum* during spring and summer blooms. Chlorococcales members are the dominant organisms in eutrophic waters (Jarnefeld, 1952; Hutchinson, 1967). *Scenedesmus, Oocystis* and *Pediastrum* species were dominant in Manisa-Marmara Lake (Cirik-Altındağ, 1984), Kurtboğazı Dam Lake, Çubuk-I Dam Lake and Mogan Lake (Aykulu *et al.*, 1983), Karamık Lake (Gönülol and Obalı, 1986), Hafik Lake (Kılınç and Dere, 1988) which were the eutrophic lake of Turkey.

It has been pointed that *Monoraphidium* species were dominant in oligotrophic and mesotrophic lakes (Legnerova, 1965). However, it has also been pointed that the members of *Monoraphidium* genus which is very similar to *Ankistrodesmus* genus, may be occur on temperature climate zone with Chlorococcales members. *Sphaerocystis schroeteri* belonging to Tetrasporales was reached to high numbers in certain months in eutrophic Bafra Fish Lakes (Gönülol and Çomak, 1993 a,b). *Chlamydomonas globosa* and *Phacotus lenticularis* belonging to Volvocales were found low numbers. Volvocales members were usually found in shallow and productive lakes (Hutchinson, 1967). Volvocales members were found in Bafra Fish Lakes (Gönülol and Çomak, 1993 a,b) and Kurtboğazı Dam Lake (Aykulu and Obalı, 1981) dominantly and Suat Uğurlu Dam (Yazıcı and Gönülol, 1994) subdominantly, however they were not found in Mogan (Obalı, 1984) and Hafik Lake (Kılınç and Dere, 1988). Desmidiales members were found rarely. The members of this order were usually seen in the characteristic algal communities of oligotrophic lakes (Hutchinson, 1967). Desmidiales members were widely found in eutrophic and mesotrophic lakes of Turkey (Cirik-Altındağ, 1984; Obalı, 1984; Gönülol and Obalı, 1986). It has been

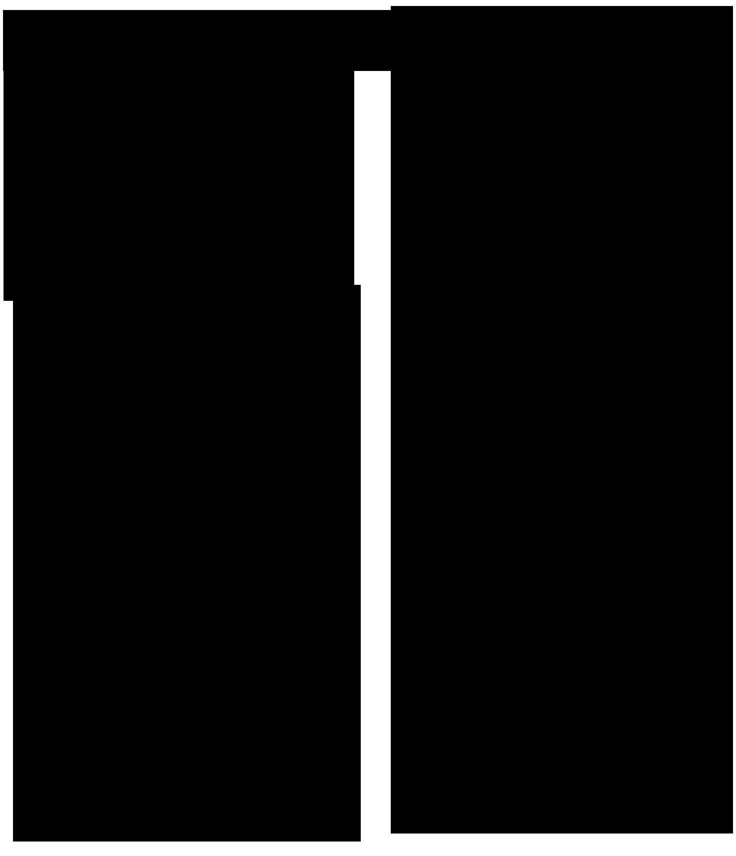

Figure 3. The seasonal variations of total Bacillariophyta, *Cyclotella ocellata* and *Nitzschia acicularis* in all sampling stations.

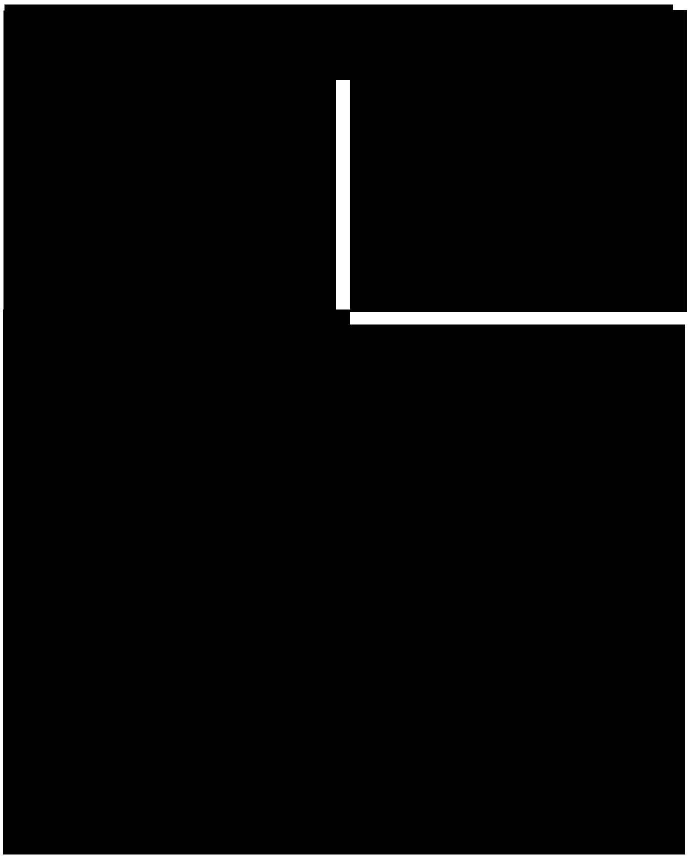

Figure 4. The seasonal variations of total Chlorophyta, *Scenedesmus quadricauda* and *Pediastrum boryanum* at the sampling stations.

Figure 5. The seasonal variations of total Cyanophyta and total Euglenophyta at the sampling stations.

concluded that oligotrophic genus may be found widely in eutrophic phytoplankton (Aykulu *et al.*, 1983; Gönülol and Obalı, 1986).

Bacillariophyta division was important second degree in Lake Cernek *Cyclotella ocellata* belonging to Centrales order was dominant in spring and autumn blooms. This species was found widely in eutrophic Mogan Lake (Obalı, 1984) and Karamık Lake (Gönülol and Obalı, 1986). One of the members of Pennales order, *Nitzchia acicularis* was found in all stations and each sampling period. The population density of this species increased during spring and autumn. *Cyclotella* species that occurred usually in oligotrophic lakes and other diatoms well growed on littoral sediments were the natural members of eutrophic lakes. The main reason of this event in shallow nature of eutrophic lakes was the high abundance of aquatic plants and dominance of diatoms depending on waves (Gönülol and Çomak, 1992a; 1992b).

Cryptomonas ovata which belongs to Cryptophyta was reached to the highest population density in January. The members of this species were researched during winter, summer and the end of spring months. This species was reached to the high population density during the winter months in Çubuk-I (Gönülol and Aykulu, 1984), Kurtboğazı (Aykulu and Obalı, 1981) and Suat Uğurlu (Yazıcı and Gönülol, 1994) Dam Lakes, and *Cryptomonas ovata* was not found in Bafra Fish Lakes (Gönülol and Çomak, 1990).

The population density of *Microcystis aeruginosa* belonging to Chroococcales and *Anabaena affinis*, *A. spiroides* belonging to Nostocales highly increased during July and August. A similar situation was observed for *Oscillatoria limnetica* belonging to Nostocales and additionally this species was reached to highest numbers in autumn. It has been concluded that Cyanophyta members were reached to highest numbers in the lakes of Europe, Northern America and Anatolia (Prescott, 1973; Huber-Pestalozzi, 1983). *Microcystis aeruginosa* were observed in highest numbers in Kurtboğazı Dam Lake, Mogan, Karamık and Bafra Fish Lakes, however it was observed in low numbers in Suat Uğurlu Dam Lake (Yazıcı and Gönülol, 1994).

Euglena gracilis and *E. polymorpha* belonging to Euglenales were usually found, but these two species was not observed blooming. *E. acus* was found in low numbers in phytoplankton. Another species *Trachelomonas hexangulata* belonging to Euglenales was rarely found except an unimportant increasing in autumn.

Xanthophyta division were represented by *Characiopsis cylindrica*. The individuals of this species increased in March 1996, however it was found in low numbers except March.

Seasonal variations in phytoplankton composition were usually similar to each other in the studied sampling stations. However, it was not reached to the previous year's number as to the number of algae due to environmental factors which effective on the growth of algae. For example, it has been observed a decrease in the number of algae during February, March and April belonging to 1997 as compared to 1996. Additionally, mean precipitations in March 1996 was 117.3 mm. However, in April the number of organism was decreased due to alleviation. In April 1997 precipitation was 112.3 mm and the number of organism decreased in May 1997. On the other hand, the number of sunny days and frozen days in February, March and April was lower than that of 1996. It has been stated environmental factors were effective on the growth of algae (Aykulu and Obalı, 1981; Aykulu *et al.*, 1983; Gönülol and Aykulu, 1984; Gönülol, 1985).

Compound indice value in Lake Cernek was found as 12.4. Lake Cernek was classified as extremely eutrophic lake (Nygaard, 1949; Rawson, 1956; Hutchinson, 1967). However, all researches said that phytoplankton indices should be used carefully. They were indicated that other parameters should have taken into account additionally (Aykulu *et al.*, 1983).

It is concluded that the morphometric structure of Lake Cernek was a eutrophic lake due to blooming of some species in certain months and seasonal changes of the species.

References

Anonymous. 1997. Meteorolojik Değerler, Meteoroloji İstasyon Müdürlüğü, Bafra, Samsun.

Aykulu, G. and Obalı, O. 1981. Phytoplanton Biomass in the Kurtboğazı Dam Lake,Commun. Fac. Sci. Univ. Ank., Ser. C-2, 24: 29-44.

Aykulu, G., Obalı, O. and Gönülol, A. 1983. Ankara Çevresindeki Bazı Göllerde Fitoplanktonun Yayılışı, Doğa Bilim Dergisi, Temel Bilim., 7: 277-288

Cirik-Altındağ, S. 1984. Manisa-Marmara Gölü Fitoplanktonu III- Chlorophyta, Doğa Bilim Dergisi, (A2), 8 (1): 1-8.

Cirik, S., Metin, C. and Cirik, Ş. 1989. Bafa Gölü Planktonik Algleri ve Mevsimsel Değişimleri, Çevre Sempozyumu, 604-613.

Conk, M. and Cirik, S. 1991. Eğirdir Gölü Fitoplanktonu Üzerinde Bir Araştırma, Göller Bölgesi Tatlı Su Kaynaklarının Korunması ve Çevre Sorunları Sempozyumu, Haziran 1991, Isparta, 393-411.

Gönülol, A., Aykulu, G. 1984. Çubuk-I Baraj Gölü Algleri Üzerinde Araştırmalar Fitoplanktonun Kompozisyonu ve Yoğunluğunun Mevsimsel Değişimi, Doğa Bilim Dergisi, Az. 8 (3): 330-342.

Gönülol, A. and Obalı, O. 1986. Phytoplanton of the Karamık Lake, Afyon, Turkey, Commun, Fac. Sci. Univ. Ank., Ser. C-4, 105-128.

Gönülol, A. and Çomak, Ö. 1990. Bafra Balık Gölleri (Balık Gölü, Uzun Göl) Fitoplanktonun Araştırılması Samsun, X. Ulusal Biyoloji Kongresi, 18-20 Temmuz 1990, Gönülol, A. and Çomak, Ö. 1992a. Bafra Balık Gölleri (Balık Gölü, Uzun Göl) Fitoplanktonu Üzerinde Floristik Araştırmalar I- Cyanophyta, Doğa- Tr. J. of Botany, 16: 223-245.

Gönülol, A. and Çomak, Ö. 1992b. Bafra Balık Gölleri (Balık Gölü, Uzun Göl) Fitoplanktonu Üzerinde Floristik Araştırmalar IV- Bacillorophyta, Dinophyta, Xanhtophyta, OMÜ Fen Dergisi, 4 (1): 1-19.

Gönülol, A. and Çomak, Ö. 1993a. Bafra Balık Gölleri (Balık Gölü, Uzun Göl) Fitoplanktonu Üzerinde Floristik Araştırmalar II. Euglenophyta, Doğa, Tr, J. of Botany, 17: 163-169.

Gönülol, A. and Çomak, Ö. 1993b. Bafra Balık Gölleri (Balık Gölü, Uzun Göl) Fitoplanktonu Üzerinde Floristik Araştırmalar III. Chlorophyta, Doğa, Tr, J. of Botany, 17: 227-236.

Huber-Pestalozzi, G. 1983. Das Phytoplankton des Susswassers, 7. Teil, 1. Halfre, E. Schweizerbatrh'sche Verlagsbuchhandlung (Naegele U.Obermiller), Stuttgart.

Hutchinson, G. E. 1967. A Treatise On Limnology Vol: II. Introduction to Lake Biology and The Limnoplankton, John Wiley and Sons. Inc., Newyork, London, Sydney, 115 pp.

İşbakan, B., Gönülol, A. and Obalı, O. 1998. Cernek Gölü (Bafra-Samsun) Fitoplanktonu, XIV. Ulusal Biyoloji Kongresi, 7-10 Eylül 1998, Samsun.

Jarnefeld. H. 1952. Plankton Als Indikator Der Trophiegruppen Seen, Suomal, Tiedeakad, Tom, Anlls, Acad, Sci. Feen, Ser. A, IV Biol, 18: 29-394.

Kılınç, S. and Dere, Ş. 1988. Hafik Gölü (Sivas) Fitoplanktonunun Mevsimsel Değişiminin İncelenmesi, IX. Ulusal Biyoloji Kongresi, 21-23 Eylül 1988, Sivas.

Legnerova, J. 1965. The Genera Ankistrodesmus Corda and Raphidium Kützing and their Position In the Family Ankistrodesmusmaceae, Preslia 37: 1-8.

Lund, J.W.G., Kipling, C.D. and E Le Cren. 1958. The Inverted Microscope Method of Estimating Algal Numbers and Statistical Basis of Estimations by Countung, Hydrobiol. 11: 143-170.

Nygaard, G. 1949. Hydrobiological Studies In Some Ponds and Lakes, Part II:the Quotient Hypothesis and Some Organisms, Kgl. Danske, Vidensk, Setsk. Biol. Skrifter, 7(1): 1-293.

Obalı, O. 1984. Mogan Gölü Fitoplantonunun Mevsimsel Değişimi, Doğa Bilim Dergisi, A2, 8 (1): 91-104.

Prescott, G. W. 1973. Algae of the Western Great Lakes Area, M. C. Brown. Comp. Pub., Dubuque, Iowo, 977pp.

Rawson, D.S. 1956. Algal Indicators of Trophic Lake Types. Limnol. and Ceanog.Vol. 1 (1): 18-25.

Şahin, B. 1993. Trabzon - Uzungöl'ün Algleri Üzerinde Bir Araştırma, Doktora Tezi, KTÜ Fen Bil. Ens., Fen Bil. Eğt. Anabilim Dalı, Trabzon.

Yazıcı, N., Gönülol, A. 1994. Suat Uğurlu Baraj Gölü (Çarşamba-Samsun-Türkiye) Fitoplanktonu Üzerinde Floristik ve Ekolojik Bir Araştırma, E.Ü. Su Ürünleri Dergisi, 11: (42-43) 71-93.