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Relationship Between Some Photosynthetic Pigments and Total Algae Numbers in Lake Ömerli, Istanbul, Turkey

Mustafa Temel

Istanbul University, Faculty of .Fisheries, Ordu Cad. No:200, Laleli, Istanbul, Turkey
E mail: temelm@istanbul.edu.tr

Özet: ***Ömerli Gölü (İstanbul, Türkiye)'nde bazı fotosentetik pigmentler ve toplam alg sayıları arasındaki ilişki.*** Ömerli gölünde toplam alg sayıları ve fotosentetik pigmentler arasındaki ilişkiler incelenmiştir. Alg grupları Bacillariophyta, Chlorophyta, Cyanobacteria, Euglenophyta ve Cryptophyta 'dan oluşmuştur. Toplam alg sayıları 1.2.3. ve 4. istasyonlarda sırasıyla 10960, 4944, 5039 ve 5129 org.ml^{-1} dır. Cyanobacteria grubundan *Anabaena affinis* Kasım 2002 tarihinde aşırı çoğalmıştır. Klorofil a,b,c ve total karotenoid değerleri sırasıyla 5.59-42.39, 2.64-9.41, 14.14-26.55 mg.m^{-3} ve 0-2.06 MSPU.m^{-3} arasında değişmiştir. Genelde klorofil a, toplam karotenoid ve toplam alg sayıları arasında pozitif bir korelasyon vardır.

Anahtar Kelimeler: Algal pigmentler, Toplam alg sayıları, Ömerli gölü.

Abstract: Relationship between some photosynthetic pigments and total algae numbers were examined in Lake Ömerli. Algal groups were composed of Bacillariophyta, Chlorophyta, Cyanobacteria, Euglenophyta and Cryptophyta. Total algae numbers were 10960, 4944, 5039 and 5129 ind.ml^{-1} at stations 1, 2, 3 and 4, respectively. *Anabaena affinis* from Cyanobacteria increased in November 2002 at station 1 (5472 ind.ml^{-1}). Chlorophyll a, b, c pigments and total carotenoid values were changes 5.59-42.39, 2.64-9.41, 14.14-26.55 mg.m^{-3} and 0-2.06 MSPU.m^{-3}. Generally, there is a positive correlation between chlorophyll a , total carotenoid and total algae numbers.

Key Words: Algal pigments, Total algae numbers, Ömerli lake.

Introduction

In Marmara region, drinking water source of the area, the Ömerli dam is under pollution danger. In recent years, lake surround has especially investigated for its hidrologic and sociologic points and attention was attracted to the pollution problem (İlze et al., 2004). There is no given study about biological structure of this lake.

As known, chlorophyll a is a photosynthetic pigment present in all species of algae, including eukaryothic (algae) and prokaryotic organisms (Cyanobacteria) and thus it is a reliable and commonly used proxy for total phytoplankton biomass (Pepe et al., 2001).

Chl-a concentration and/or phytoplankton biomass are, therefore, important parameters, widely used in limnological studies and proposed by European Union (EU) legislation to classify lake-water quality.

The use of chl-a concentration as an estimate of algal biomass has several advantages: it is technically simpler and less time consuming. However, chl-a concentration depends on a number of factors, namely: the dominance of different algae groups in the phytoplankton (Pyrina and Jelizarova 1971, 1975); chlorophyll content changes during the ontogenesis of the individual algal cells and also during the development of the whole population (Hallegraeff 1976); chlorophyll concentration suffers great diurnal variation (Lorenzen 1963, Glooschenko and Blanton 1977, Komarkova and Javornick 1977); and variability in chlorophyll concentration has been associated with nutrient concentration (Steele and Baird 1965, Nicholls 1976).

The aim of present paper was to determine the correlations between chlorophyll a, b, c, total carotenoid (especially chl-a) and total algae numbers.

Material and Methods

Phytoplankton samples were collected at four stations between the dates, November, 2002 and July, 2003. The four designated stations; 1-Emirli, 2-Kurtdogmus, 3-Ballıca, 4-Esenceli (Figure 1).

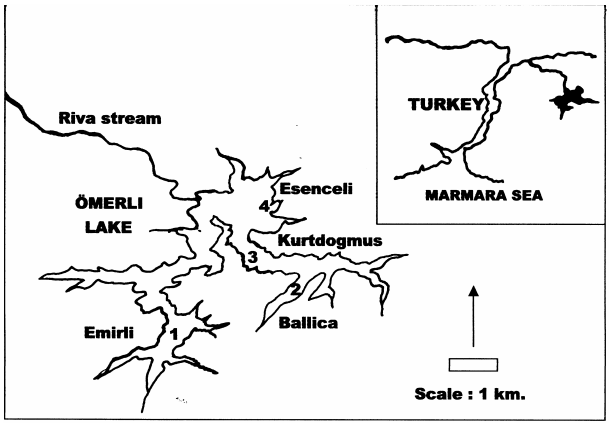

Figure 1. Ömerli Lake and sampling stations

The samples were fixed with Lugol's solution and counted following the standard Utermohl technique (Utermohl 1958). The following variables were measured in the field: dissolved oxygen, (Winkler method, APHA 1989), pH (Orion pH meter), temperature (thermometer), total hardness (titration method), nitrate and phosphate (spectrophotometric, APHA 1989). A definite amount of sub-sampler of lake water was filtered insitu through GF/C fiberglass and membrane filters for the determination of pigments and dissolved nutrients, respectively. All samples were preserved, transported and stored according to standard procedures (Boyd & Tucker 1992). In the laboratory, chlorophyll-a was determined via extraction with 90% acetone by spectrophotometric method using Schimadzu UV.1601 model UV-visible spectrophotometer. Calculations followed the equation recommended in Parson & Strickland (1963). The algae numbers were determined by counting the algal cells in sedimentation chambers using a Zeiss Winkel inverted microscope (magnification X10 and X40). Collected samples were evaluated as explained in the literature (Nauwerck 1963, Vollenwider 1969, Lund et al., 1958, Utermohl 1931) and the algae species were determined (Cleve-Euler 1951, Huber-Pestalozzi 1942, Hustedt 1930, Lind and Brook 1980, Patrick and Reimer 1975, Prescott 1961, Krammer and Lange-Bertalot 1991, Tiffany 1971).

Results

Some physico-chemical parameter values of Ömerli Lake water measured (Figure 2,3,4,5 and table 1).

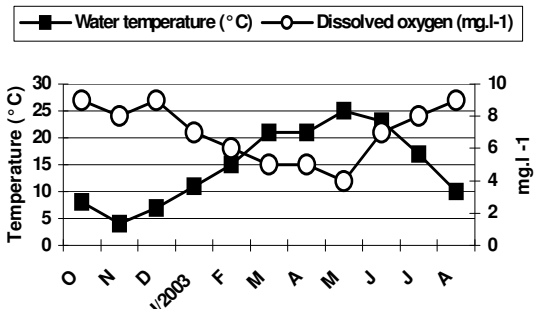

Figure 2. Seasonal changes of water temperature and dissolved oxygen values of Ömerli Lake water.

The seasonal mean temperature of water varied from 3,5-25 °C, with maximum values in summer (25°C) (Fig.2). The seasonal mean values of dissolved oxygen varied from 3,51 to 9,05 mg.l^{-1}. The station overall means on the contrary, were all around 6,98 mg.l^{-1}. (Fig.2). The seasonal mean values of pH varied from 7,46 to 8,83.(Fig.3).

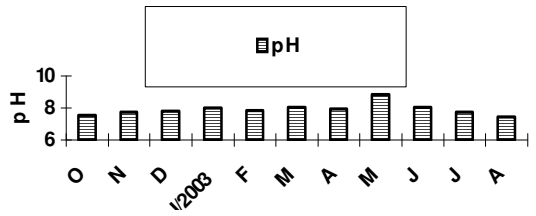

Figure 3. Seasonal changes of p H values of Ömerli Lake water.

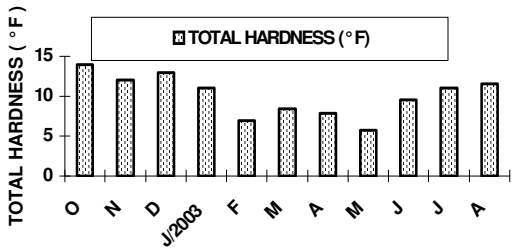

Figure 4. Seasonal changes of total hardness values of Ömerli Lake water.

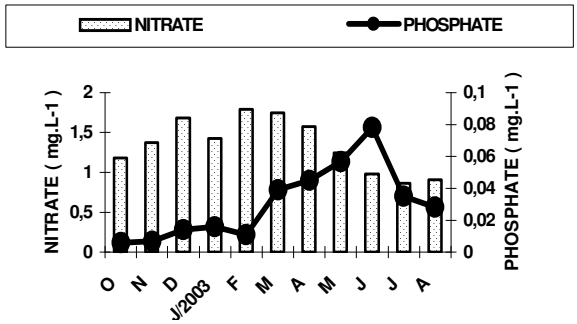

Figure 5. Seasonal changes of nitrate and phosphate values of Ömerli Lake water.

The seasonal mean total hardness of water varied from 5,7 - 14° F.(Fig.4). The overall mean nitrate values varied between 0,86 -1,79 mg.l^{-1} , with higher values in February and lower values in July (Fig.5). The overall mean phosphate values varied between 0,006 -0,058 mg.l^{-1} , with higher values in June and lower values in October (Fig.5).

In this lake, phytoplankton community is composed of groups; Bacillariophyta, Chlorophyta, Cyanobacteria, Crptophyta and Euglenophyta.

All the stations, in spring and in summer Bacillariophyta and Chlorophyta, in fall and in winter Cyanobacteria and in spring Cryptophyta showed increasing in quantity (Figure 6, 7, 8, 9).

Seasonal changes of measured total algae numbers and chlorophyll a,b,c, total carotenoid values of Ömerli lake given in figure 10, 11, 12, 13.

Table 1. The average, minimum and maximum values of some of the physico-chemical parameters in lake water.

	Water Temp.(°C)	Dissolved Oxygen (mg.l^{-1})	p H	Total Hardness (°F)	Nitrate (mg.l^{-1})	Phosphate (mg.l^{-1})
Min.	3,5	3,51	7,46	5,7	0,86	0,006
Max.	25	9,05	8,83	14	1,79	0,058
Mean.	14,59	6,98	7,91	10,09	1,34	0,029

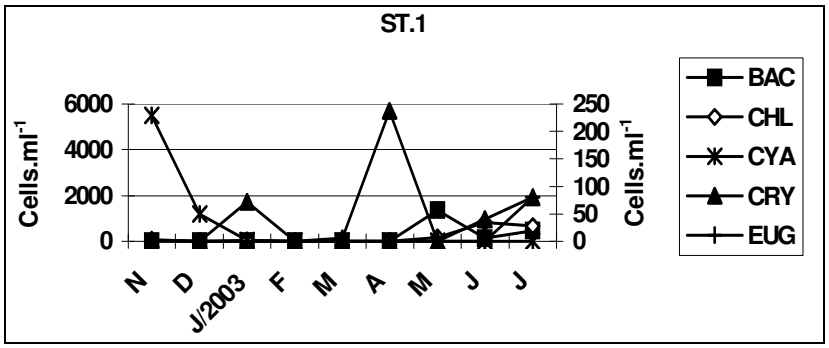

Figure 6. Seasonal changes of algal groups at station 1.

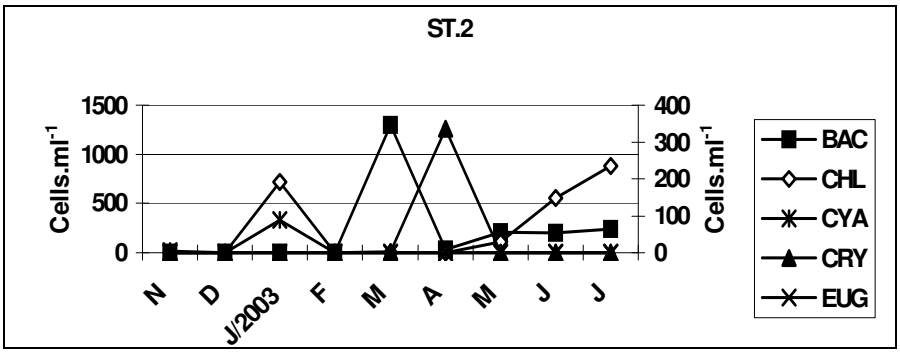

Figure 7. Seasonal changes of algal groups at station 2.

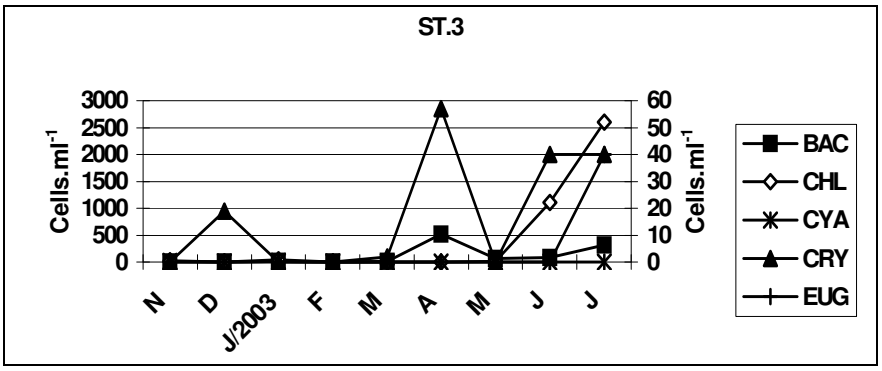

Figure 8. Seasonal changes of algal groups at station 3.

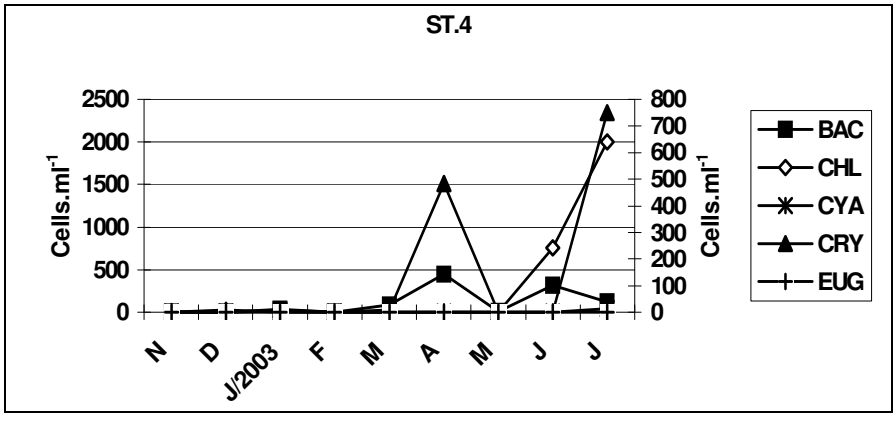

Figure 9. Seasonal changes of algal groups at station 4.

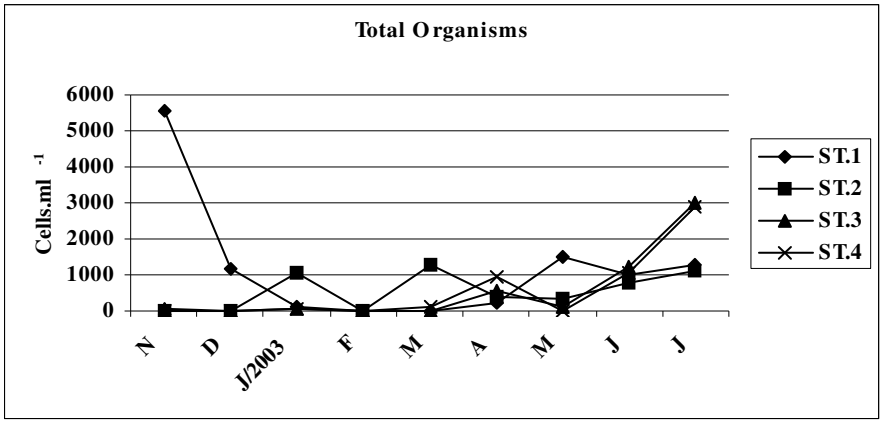

Figure 10. Seasonal changes of total algae numbers.

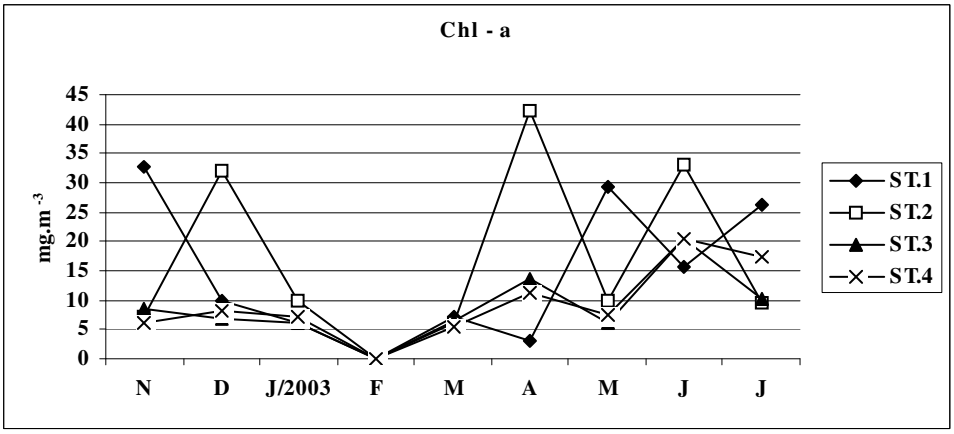

Figure 11. Seasonal changes of measured chlorophyll a values.

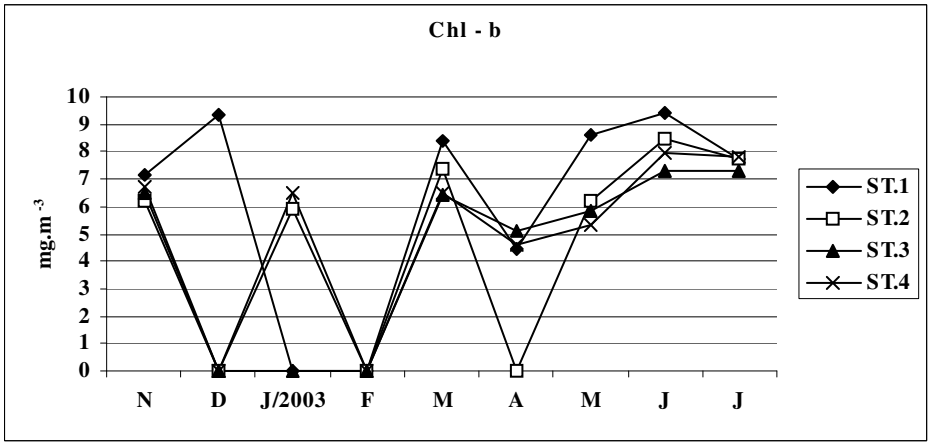

Figure 12. Seasonal changes of measured chlorophyll b values.

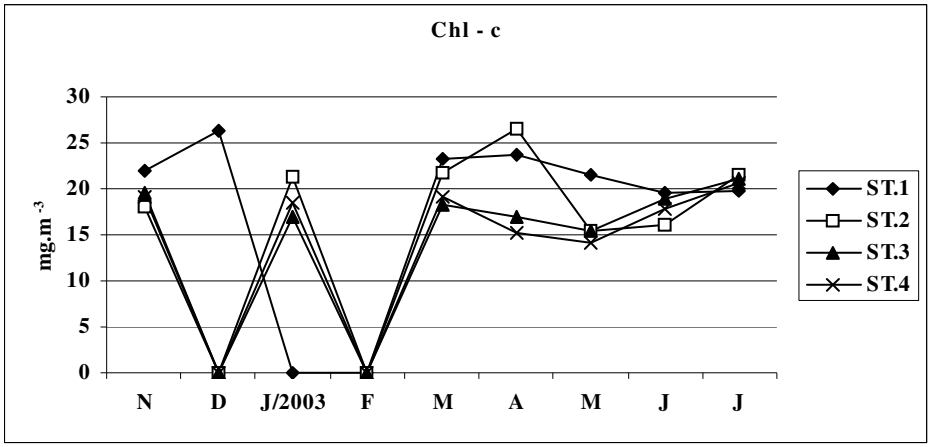

Figure 13. Seasonal changes of measured chlorophyll c values.

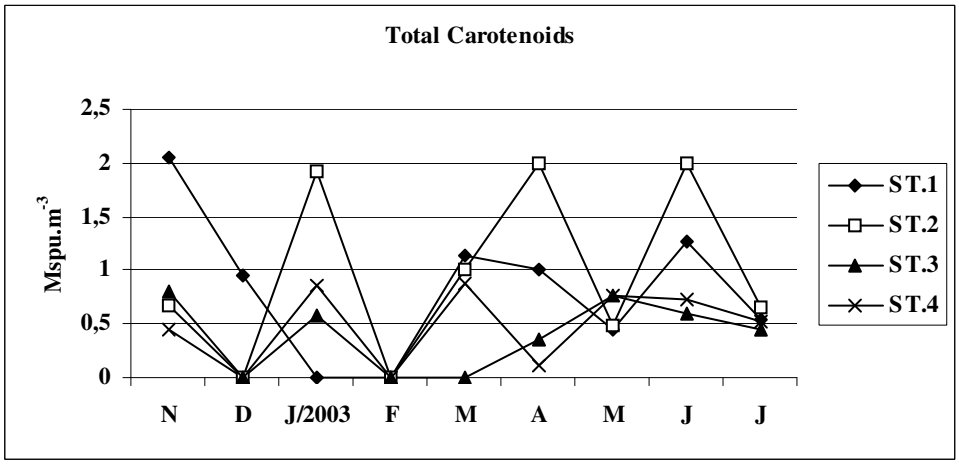

Figure 14. Seasonal changes of measured total carotenoid values.

When seasonal changes in numbers of the total organisms are investigated, decreasing was recorded in winter months; especially February and March, in spite of increasing was recorded in fall, spring and summer (Figure 10).

Chl-a occurs in all algae groups and can be accompanied, or not, by other chlorophylls. In the Cyanophyceae (blue green algae), Xanthophyceae and some red algae (Rhodophyceae) chl-a occurs unaccompanied by other chlorophylls; in other red algae it is accompanied by small quantities of chl-d; in the Bacillariophyceae, Dinophyceae and Phaeophyceae it is always found with chl-c, and Chlorophyceae (green algae) have chl-b and chl-a (Bold and Wynne 1985).

Figure 10 and figure 11 show the relationship between chlorophyll a and the total organisms. Based on these data, during the winter period the amounts of chlorophyll a and of the total organisms were low, but during the spring and summer periods, both values were very high. In eutrophic lakes, the total of phytoplanktonic organisms and the concentration of chlorophyll a increase during April and May. The second highest increase begins from July and continues until the middle of November. During the winter, a low concentration is generally observed.

In spring chlorophyll a, In summer chlorphyll b and c from photosynthetic pigments were determined in high quantities (Fig. 11, 12, 13).

The overall mean total carotenoid values varied between 0 – 2,06 Mspu.m^{-3} , with higher values in fall and summer and lower values in winter (Fig.14).

The results of the investigation of the correlation between total organisms and chlorophyll a at 1st and 2nd stations is weak+. There is a negative correlation between total organisms and chlorophyll a at the other stations.

Discussion

Low phosphorus value of investigated chemical values which seems to be limiting factor in Ömerli Dam Lake. Because of that, if devices aren't taken into account, the lake will be against these problems after a while, although eutrophication and pollution have not been effective values, yet. To prevent this situation, nutrient input has to be monitored and required devices have to be considered.

As the conclusion, when the Ömerli dam's phytoplankton composition and some physico-chemical parameters are investigated, its water is hard, a little alkali, nutrient rich and its algal flora is composed of algae groups which are common in our country lakes. In spite of phytoplanktonic species are not much in number, increasing in quantity with the season which is close to spring and summer shows that there is a tendency towards to eutrophication. That phenomen accelerates because of indented coastline about 100 kilometers and settlements around the lake.

When physico-chemical properties and algae composition of Ömerli lake are investigated, lake is a mesotrophic, alkali and hard water reserve with its high chlorophyll and nutritient values, also with being poor at number of species but relatively rich at species quantity.

Algal flora is composed of five divisions (Bacillariophyta, Chlorophyta, Cyanobacteria, Euglenophyta and Cryptophyta). Bacilariophyta is dominant to these groups with species number and with its quantity.

The levels of chlorophyll a has been determined in only a few studies in lakes Marmara region. The values of chlorophyll a determined in these studies are as follows: 0.26-11.7 ppb in Sapanca Lake (Tugrul et al., 1989), 0.116-9.519 mg m^{-3} in Sapanca Lake (Temel 1992), 0.4-2 mg m^{-3} in Kamil Abduş Lake (Morkoç et al., 1993), 0.05-4.55 mg m^{-3} in Büyükçekmece Lake (Temel 2002), 0.976-6.28 mg m^{-3} in Poyrazlar Lake and 4.83-65.6 mg m^{-3} in Taşkısı Lake (Temel and Yardımcı 2004), 6.29-29.87 mg m^{-3} in Terkos Lake (Temel 2005).

When seasonal changes of chlorophyll values are investigated, chlorophyll a and chlorophyll c occured high values according to chlorophyll b. That shows us the diatoms are dominant group in the phytoplankton community.

A positive correlation between total algae numbers and chlorophyll a was found based on seasonal changes. The correlation coefficient for the first station was 0.771, that of the second station 0.721. These results are statistically significant and there is a positive correlation between the two parameters. However, there is a negative relationship between chl-a and the total number of organisms (for stations 3 and 4.). The total number of algae and chlorophyll a values exhibited significant the correlation between the different stations.

At the same time, there are positive correlation between total Chlorophyta members and chl-a and chl-b values.

In this study, the relationship between the two parameters were examined. Generally, It seems that the relationships between these variables are parallel to the literature. An investigation of the seasonal succession of phytoplanktonic organisms and their correlation with chlorophyll abased on seasonal studies at different localities would increase knowledge of wetlands in Turkey (Akbulut 2003).

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