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Research Note

The Relationship Between Phytoplanktonic Organisms and Chlorophyll *a* in Sultan Sazlığı

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Abstract: This study examines the variations and relationship between phytoplanktonic organisms and chlorophyll *a* in Sultan Sazlığı marshes. During the sampling period, the density of phytoplankton and the value of chlorophyll *a* were examined, and it was found that the correlation between them was high. Given the variations between these two parameters in accordance with the seasons, the relationships with other studies are also discussed.

Key Words: Phytoplankton, Chlorophyll *a*, Sultan Sazlığı

Sultan Sazlığı'ndaki Fitoplanktonik Organizmalar ve Klorofil *a* Arasındaki İlişki

Özet: Sultan Sazlığındaki fitoplanktonik organizmalar ve klorofil *a* arasındaki ilişki incelenmiştir. Örnekleme tarihlerindeki fitoplankton yoğunluğu ve klorofil a değerleri belirlenerek aralarındaki korelasyon ilişkisinin yüksek olduğu bulunmuştur. Bu iki parametrenin mevsimlere göre değişimleri de göz önüne alınarak diğer çalışmalarla olan ilişkileri yorumlanmıştır.

Anahtar Sözcükler: Fitoplankton, Klorofil *a*, Sultan Sazlığı

Introduction

The concentration of chlorophyll *a* is used to determine the trophic level, the quality of water, and the vertical and horizontal distribution of phytoplanktonic samples (Vöros & Padisäk, 1991). Chlorophyll *a* exists in all algal groups, and the total algal density in plankton is only known indirectly (Round, 1981). Another method of determining the algal biomass is to count the individuals in unit volume (Vöros & Padisäk, 1991). The biomass of phytoplankton is frequently measured by counting the algal cells. The aims of this study are to determine the chlorophyll *a* variations in Sultan Sazlığı (a marshland) and also the relationship between chlorophyll *a* and phtoplanktonic cell density.

Study Area

Sultan Sazlığı stands on a flat area of 14,000 ha and is surrounded by the districts of Develi, Yahyalı and Yeşilhisar. The marshes are 1170 m above sea level and the co-ordinates are 38°20′N long 25°17′E. Its northern side is surrounded by Erciyes Mountain (3916 m) and its southern side by Aladağlar (approximately 3500 m). The eastern and western parts of the study area are surrounded by ranges that are the extensions of these two mountains. In its northern and southern parts there are freshwater marshes (salinity does not exceed1‰). Between them, there is a salty water area called Yay Lake. In the north-eastern part of Sultan Sazlığı there is Çöl Lake, which is dry for most of the year and has a high salinity level (15-20‰).

Materials and Methods

In order to analyse the planktonic algae in Sultan Sazlığı, samples were taken from three stations between August 1993 and October 1994 (Figure 1). Of these stations, two were in Sultan Sazlığı and the other in the southern area of Yay Lake. Those stations in Sultan Sazlığı represent a freshwater ecosystem and the third a brackish water ecosystem. The former stations were approximately 1.5-2 m deep and were surrounded by *Phragmites australis* (Cav.) Trin. ex Steud. They were

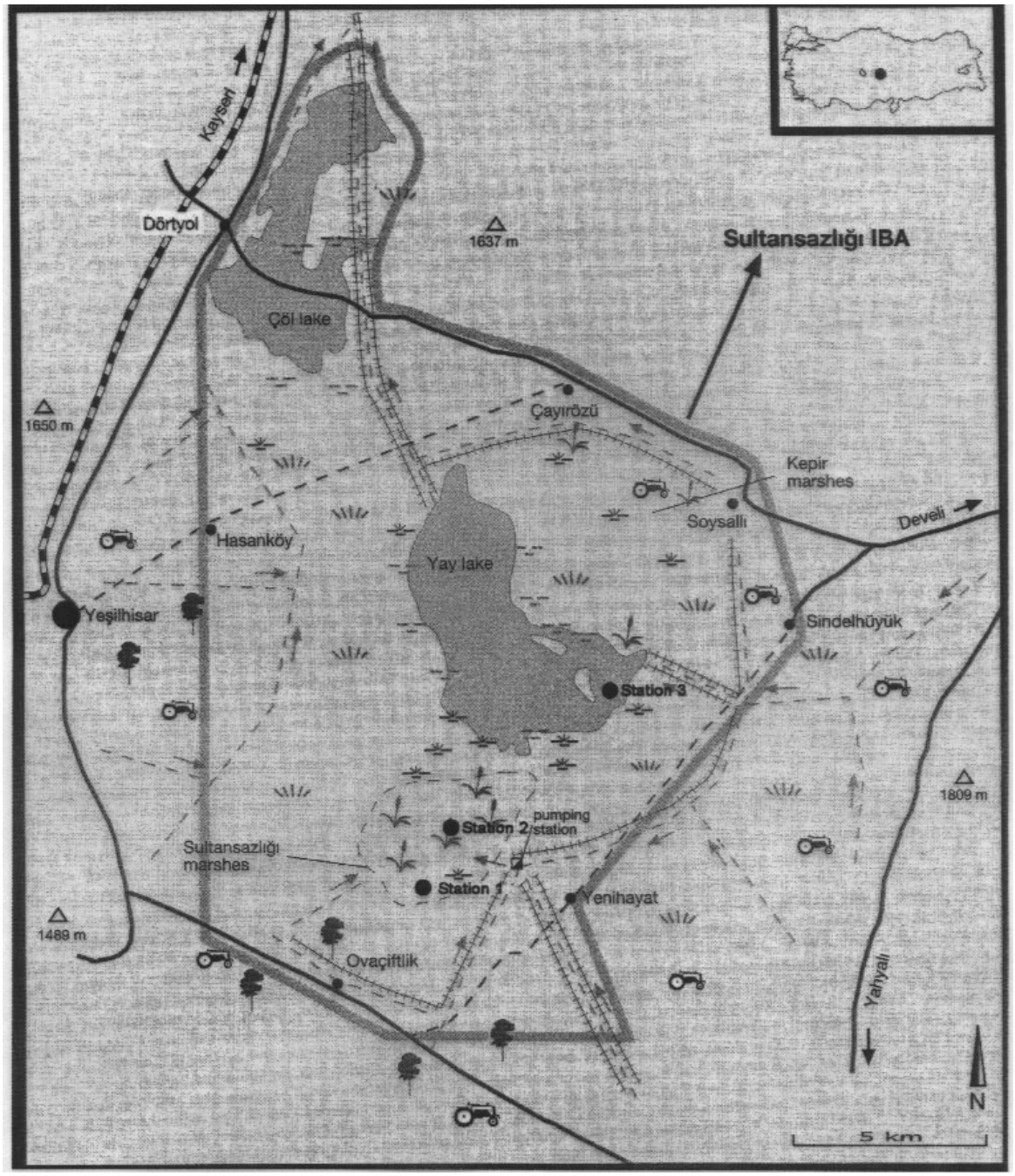

Figure 1. Study area and sampling stations (Magnin & Yarar, 1997).

very rich in deep water macrophytes. The latter station was 0.3-1 m deep and macrophyte development was less than in the other two stations.

To estimate the value of chlorophyll *a* in the lakes, a water sample of 0.5 l was filtered using cellulose acetate filter paper (0.4 µm), and the concentration of chlorophyll *a* was calculated using the methanol method (Youngman, 1978).

For the determination of the amount of phytoplankton in specific volumes, a closed water pot 0.5 l in volume was used to obtain samples from 30 cm depth. An inverted microscope (Olympus brand) was used

in counting the phytoplankton samples (Lund et al., 1958).

Statical analysis (regression) was performed with SPSS 9.0.

Results and Discussion

Figures 2-4 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 (Marshall & Peters, 1989). This applied to the changing profile in Sultan Sazlığı.

The levels of chlorophyll *a* has been determined in only a few studies, and such studies were mostly carned out in lakes around Ankara. The values of chlorophyll *a* determined in these studies are as follows: 17.33-262.27 µg/l in Manyas Lake, 0.23-17 µg/l in Mogan Lake, 0.17-50 µg/l in Kurtboğazı Dam Lake and 5-47 µg/l in Çubuk I Dam Lake (Akbulut & Akbulut, 2000; Obalı, 1984; Aykulu & Obalı, 1981; Aykulu & Gönülol, 1984). Demir et al. (1999a, 1999b) have also studied chlorophyll *a* in Kurtboğazı Dam Lake and Çamlıdere Dam Lake. Atay & Bakan (1992) found the value of chlorophyll *a* in Mogan Lake to be between 1.52 and 15.96 µg/l. Akbulut & Yıldız (2001) found the value in the same lake to be between 1.94 and 68 µg/l. The studies carried out by the state Hydraulic Works (DSİ) in Keban Dam Lake in the eutrophic category established it at between 3 and 45.09 µg/l (Soyupak et al., 1994). Chlorophyll *a* has also been found in some of the fish ponds (Atay & Demir, 1998; Şen et al., 1997).

In Sultan Sazlığı, chlorophyll *a* was recorded at between 1.22 and 33.04 µg/l. Wetzel (1983) states that the level of chlorophyll *a* in oligotrophic lakes is 0.33-3 µg/l, in mesotrophic lakes 2-15 µg/l and in eutrophic lakes 10-500 µg/l. While comparing the data with the results of the previous studies, it was observed that the concentration of chlorophyll *a* and the total biomass of Sultan Sazlığı indicate that it shares common characteristics with other eutrophic lakes. Mogan Lake and Sultan Sazlığı in particular have similar levels of chlorophyll *a* and of total organisms. This result was explained by their similar physical, chemical and biological structures. In both lakes, dense macrophytes limit the development of phytoplanktonic organisms. Macrophytes share food with phytoplanktonic organisms and also reduce the transition of light. The level of chlorophyll *a* and the total number of organisms in Sultan Sazlığı deviates somewhat from the values of eutrophic lakes as given by Wetzel (1983). This is explained by the fact that both deep and surface water macrophytes are widely distributed.

The total number of organisms recorded in the biomass was between 351.19 and 18159.14 cells/ml. Analysis of the relationship between the levels indicated that they began to rise in spring as a result of the increase in temperature. They continued to increase during the summer period and started decreasing at the beginning of autumn. *Fragilaria ulna* (Nitzsch) Lange-Bert. from

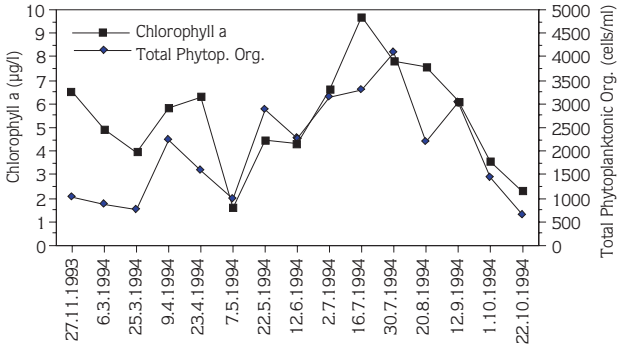

Figure 2. Relationships between chlorophyll *a* and total phytoplanktonic organisms at Station 1.

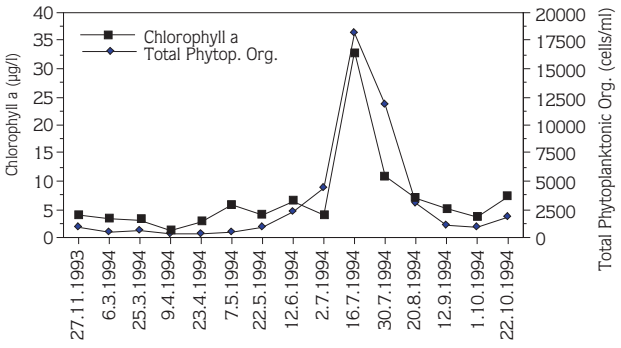

Figure 3. Relationships between chlorophyll *a* and total phytoplanktonic organisms at Station 2.

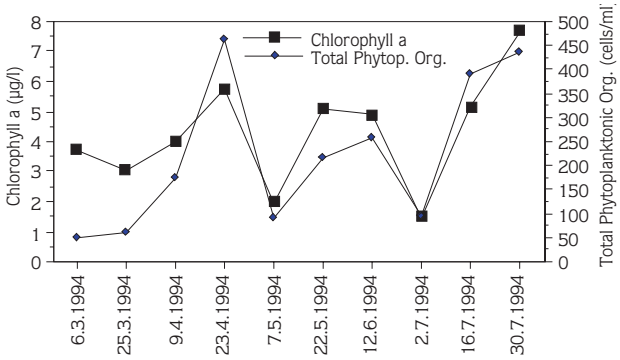

Figure 4. Relationships between chlorophyll *a* and total phytoplanktonic organisms at Station 3.

Bacillariophyceae showed a rapid increase in July, 1994. Similarly, Moore (1979) stated that the number of organisms belonging to *Bacillariophyceae* increases in relation to temperature increase. It was also observed that *Cryptomonas* Hansg. spp. also showed a rapid increase at the same station in August, 1994.

A positive correlation between phytoplanktonic organisms and chlorophyll *a* was found based on seasonal changes. The correlation coefficient for the first station was 0.678, that of the second station 0.914 and for the third station 0.846. These results are statistically significant, and there is a positive correlation between the two parameters. However, there is a negative relationship between light transition and the total number of organisms (for stations 1, 2 and 3, r^2 values were 0.41, 0.37 and 0.19, respectively) and chlorophyll *a* (for stations 1, 2 and 3, r^2 values were 0.29, 0.38 and 0.29, respectively). An increase in algal biomass (particularly during the summer) caused a decrease in light transition. This was recorded at the lowest levels during the summer, while the increase in the algae was at the highest level. Therefore, negative correlations between total organisms, chlorophyll *a* and light transition are expected results. In addition, the low relationship between these parameters at Sultan Sazlığı is consistent with the literature.

Counting is one of the commonly used methods of obtaining information about the total biomass of algae. The determination of chlorophyll *a* in algae is also used for this purpose. In this study, both methods were used and a positive relationship was established. The total number of phytoplanktonic organisms and chlorophyll *a* values did not exhibit significant variations in the different stations.

Conclusion

Although the positive relationship between total phytoplanktonic organisms and chlorophyll *a* is known, there are ongoing studies of this subject at different localities all over the world. In this study, the relationship between the two parameters was statistically significant at each of the three stations of Sultan Sazlığı. 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 *a* based on seasonal studies at different localities would increase knowledge of wetlands in Turkey.

References

Akbulut A & Akbulut (Emir) N (2000). Planktonic Organisms of Manyas Lake. *Hacettepe Üniv Fen ve Müh Bil Der Series A: Biology and Chemistry* 29: 9-22.

Akbulut A & Yıldız K (2001). Mogan Gölü'nün (Ankara) Bacillariophyta Dışındaki Planktonik Algleri ve Dağılımları. *Gazi Üniv Fen Bil Enst Der* 14(3): 723-739.

Atay D & Bakan AN (1992). Mogan Gölü'nün İlk Ürünü ve İlk Ürüne Göre Balık Ürününün Tahmin Edilmesi Üzerine Bir Araştırma. *Akdeniz Üniv Su Ürünleri Mühen Der* 3(1): 1-26.

Atay D & Demir N (1998). The Effects of Chicken Manure on the Phytoplankton Primary Production in Carp Ponds. *Acta Hydrobiol* 40: 215-225.

Aykulu G & Gönülol A (1984). Çubuk I Baraj Gölü Algleri Üzerine Araştırmalar I. Fitoplankton Kompozisyonu ve Yoğunluğunun Mevsimsel Değişimi. *Doğa Bilim Der* 8: 330-342.

Aykulu G & Obalı O (1981). Phytoplankton Biomass in Kurtboğazı Dam Lake. *Comm. de la Fac Sci d'Ank Series C* 2: 29-45.

Demir N, Çamdeviren H & Keskin S (1999a). A Path Analysis of Some Water Quality Parameters in Kurtboğazı and Çamlıdere Reservoirs Turkey In: Anonim. *Uluslararası Hayvancılık '99 Kongresi Bildirileri:* 666-671.

Demir N & Çamdeviren H, Keskin S (1999b). Prediction of Chlorophyll *a* in Kurtboğazı and Çamlıdere Reservoirs. *Tarım Bilim Der* 5(1): 66-70.

Lund JWG, Kipling C & Gren ED (1958). The Inverted Microscope Method of Estimating Algal Numbers and the Statistical Basis of Estimations by Counting. *Hydrobiologia* 11: 113-170.

Marshall GT & Peters RH (1989). General patterns in the seasonal development of chlorophyll *a* for temperate lakes. *Limnol Oceanogr* 34(4): 856-867.

Magnin G & Yarar M (1997). *Important Bird Areas in Turkey*. İstanbul: The Society for the Protection of Nature.

Moore J (1979). Seasonal Succession of Phytoplankton in a Large Subarctic River. *Hydrobiologia* 67: 107-112.

Obalı O (1984). Mogan Gölü Fitoplanktonunun Mevsimsel Değişimi. *Doğa Bilim Der* 8(1): 91-104.

Round F E (1981). *The Ecology of Algae*. Cambridge: Cambridge Univ. Press.

Soyupak S, Akbay N, Yücel N, Çilesiz FA & Kaya A (1994). Keban Baraj Gölü'nün Palu-Elazığ Arasında Kalan Kısmında Ötrofikasyon Problemi. *Su Kalite Kontrol Der* 4(1): 29-36.

Şen B, Özrenk F & Alp MT (1997). Bir Balık Üretim Tesisindeki Havuzlarda Klorofil a Miktarı'nın Değişimleri Üzerine Bir Araştırma In: Anonim. *IX Ulusal Su Ürünleri Sempozyumu Bildirileri* Isparta: 365-373.

Vörös L & Padisäk (1991) Phytoplankton biomass and chlorophyll-a in some shallow lakes in central Europe. *Hydrobiologia* 215: 111-119.

Wetzel RG (1983). *Limnology*. Michigan: Michigan State University.

Youngman RE (1978). *Measurement of Chlorophyll-a*. Tech Rep TR-82 New York: Water Research Center.