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Annual and Seasonal Variation of Nutrients and Pigment Content in Uzunçayir Dam Lake, Turkey (Eastern Anatolia)

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ABSTRACT

Our aim is to assess nutrient status and pigment content of Uzunçayır Dam Lake during period from May of 2013 to April of 2014. We sampled at different depths (0, 2.5, 5, 7.5 and 10 m) from nine stations selected and investigated chlorophyll concentrations and carotenoid content in samples. The concentrations of chlorophyll were high in the spring and autumn that the values ranged from surface 19.06 to deeper parts 97.15 µg L-1. The highest value was determined as 13.14 µg L-1.Based on our data, Uzunçayır Dam Lake can be classified as oligotrophic.

Introduction

Chlorophyll a (Chl a) known as the predominant chlorophyll in photosynthetic organisms plays a central role in the photochemical energy conversion of the majority of photosynthesizing organisms while Chl c participates effectively in photosynthesis as an accessory pigment, similar in its functional activity to the Chl b of higher plants [1]. Chlorophyll a (Chl a) is widely utilized as a measure of phytoplankton biomass. It has been associated with many factors in the former researches [2-3]. Concerning lotic system, e.g. in rivers and their associated waters, Chl a concentration was usually detected to be influenced more strongly by water-flow than by nutrients [4]. Additionally, Chl a concentration may vary with catchment area, water depth, or other physical factors.

Tunceli, located in the eastern Anatolia region of Turkey, has rich water resources. The most important of which are Munzur and Pülümür Rivers. Uzunçayır Dam, which was built on these rivers, was chosen as the study area. Even though it has a major role in the aquatic ecosystem, the patterns of phytoplankton variation in these river ecosystems involving Lake Uzunçayır and its tributaries are not yet well known. The long-term dataset that includes phytoplankton chlorophyll a and physical-chemical monitoring could provide an important basis for ecologically significant comparisons.

This research was conducted to determine the relationships between chlorophyll a and nutrients concentrations in the Uzunçayır Dam Lake for identify important and effective nutrients on Chl concentrations. Because of Chl identified as a major photosynthetic pigment in a lot of phytoplankton and a trophy index in aquatic ecosystems and the other hand the chlorophyll a concentration in the phytoplankton cells changes with nutrients and environmental factors so know about the effective factors on chlorophyll concentrations is very important for ecosystem management [5].

In the present study, we determined the seasonal distribution of phytoplankton chlorophyll pigments (Chl a, b and c) and carotenoid content at sampling points (surface and depth) we selected from Uzunçayır Dam Lake.

Experimental

determined on Uzunçayır Dam Lake during period from May of 2013 to April of 2014. Sampling points on Uzunçayır Dam Lake selected were 39o 04ı 93.81ıı N-39o52ı 38.04ıı E (Figure 1).

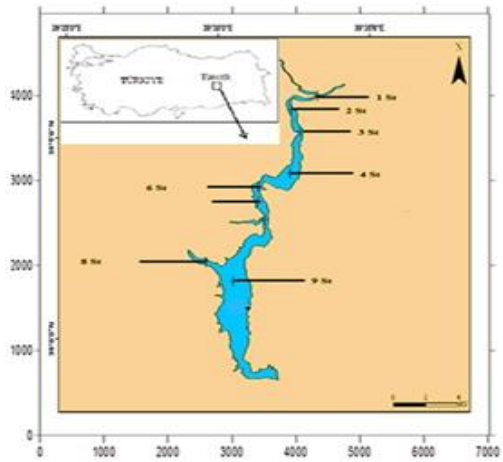

Figure 1. The location of stations on Uzunçayır Dam Lake.

Sampling points are as follows:

-Five station from the area affected by the city (from 1th to 5th stations),

-One station from the discharge point of the city (6th station),

-Three station from the beginning, the middle and the end of the Uzunçayır Dam Lake (from 7th to 8th stations)

-One station near the village to (9th station)

Water samples taken from each depth by using a Nansen bottle were transferred to the laboratory for further examination.

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The samples were filtered by using 0.45 mm membrane filters. Then extracted in acetone solution (90%), and protected from any light.

Phytoplankton chlorophyll pigments (Chl a, b and c) and carotenoid content were determined according to a standard protocol with a spectrophotometer (Carry 60 UVD Model) [6]. The nitrogen forms (NH_4-N, NO_2-N, and NO_3-N) and phosphate (PO_4) were analyzed by the method of Strickland and Parsons [6]. Graphs were drawn by using the software package Surfer 8.0.

Statistical analysis was performed using the software package Statgraphics 18.0. Results were expressed as means ± Standard Deviation. Differences among the treatments were tested by one-way ANOVA. Duncan test was used for all post-

Results

Phytoplankton chlorophyll pigments (Chl a, b and c) and carotenoid content

In surface, Chl a was high in the spring and autumn (Figure 2). The highest Chl a value was 85.39 µg L^{-1} in September at 5 meters (6th station). The highest Chl b was 100 µg L^{-1} in 2.5 m at 8th station (Figure 3). The highest Chl c was 97.15 µg L^{-1} at 2.5, 5 and 7.5 m in May (Figure 4).

The vertical distribution of carotenoid is given in Figure 5. Carotenoid content was not detected at 5, 7.5 and 10 meters in depth. The concentration of carotenoid was higher in the summer season (June, July and August). The highest value was determined as 13.14 µg L-1 in 5 m (P< 0. 05).

Discussion

Phytoplankton Chl a and phosphate concentration are used as a marker of biomass and trophic levels. Oligotrophic lakes are characterized by low phosphate concentrations (< 10 µg L^{-1}) and primary productivity (Chl < 2.6 µg L^{-1}) [7-8]. In this study, the mean Chlorophyll values and phosphate content were 0.43 µg L-^{1} and 0.25 µg L^{-1}, respectively. Based on our data, Uzunçayır Dam Lake can be classified as oligotrophic.

Physical, chemical and biological processes in lakes are influenced by environmental conditions. Scientists have long recognized the ecological relationship between various water quality parameters (e.g. dissolved oxygen, temperature) and

phytoplankton chlorophyll a. Phytoplankton chlorophyll a is a useful indicator to determine seasonal variation, which has long been recognized as phytoplankton biomass [9] and also has great importance for developing ecosystem models. As documented in previous studies, concentrations of phytoplankton chlorophyll pigments, especially phytoplankton chlorophyll a, reached maximum levels with phytoplankton productivity because of phytoplankton biomass during early spring (i.e. March and May) and pigment concentration rapidly reduced toward winter [10]. [10] reported that phytoplankton chlorophyll a increased in spring and decreased during autumn in the lakes of the United Kingdom (UK). [11] determined the lowest phytoplankton chlorophyll a concentration during the late autumn, early winter and early spring in Mogan Lake, Turkey. In accordance with previous studies, the highest chlorophyll content was in spring (4th, 8th and 9th station in the rainy season) while lowest concentration was in the late autumn, winter and early summer.

Carotenoids concentration depends on light and nutrients intensity for phytoplanktonic organisms. While the concentration of carotenoids was found higher because of nutrient load in surface water, nitrous and phosphorus, compounds affect sediment concentration in the deep-water matrix in selected stations. In our study, it was reported as important data, (which fed with a flow in 7.5 m of Uzunçayır Dam Lake). Determination of the temporal-spatial distribution of the euphotic depths of Lake Taihu, China, combined with knowledge of the temporal-spatial distribution of phytoplankton, photosynthetically available radiation at the water's surface, and water surface temperatures, can be used to estimated primary productivity of the whole lake and furthermore, the nutrients consumed by phytoplankton [12].

In conclusion, we observed variability in primer productivity on a spatial and temporal scale during the study. In addition, the determination of the relationship between chlorophylls and nutrients is vitally important for developing ecosystems and it is only possible by means of monitoring programs. This research may be helpful for future investigations to understand and evaluate changes in the structure of Uzunçayir Dam Lake ecosystem.

Conclusions

In conclusion, we observed variability in primer productivity on a spatial and temporal scale during the study. In addition, the determination of the relationship between chlorophylls and nutrients is vitally important for developing ecosystems and it is only possible by means of monitoring programs. This research may be helpful for future investigations to understand and evaluate changes in the structure of Uzunçayir Dam Lake ecosystem.

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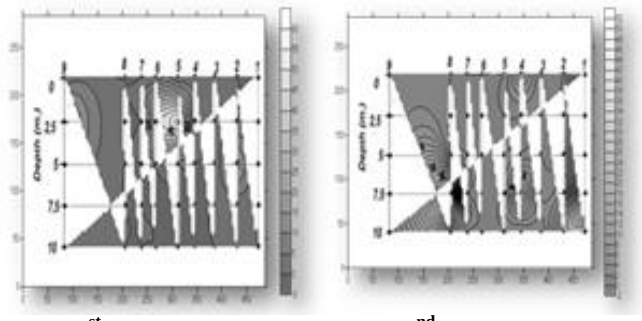

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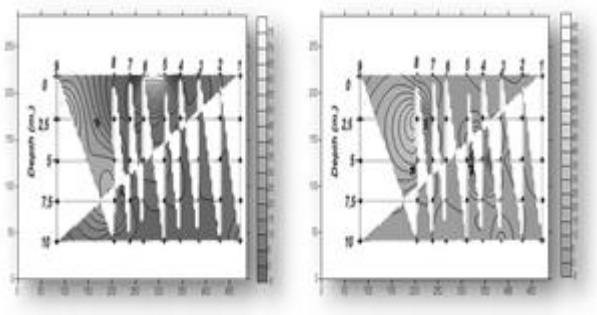

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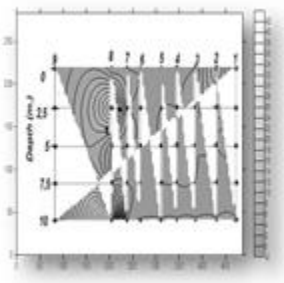
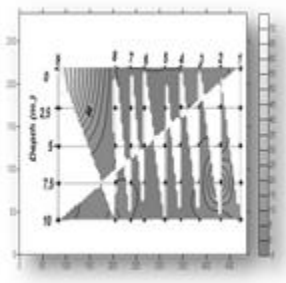

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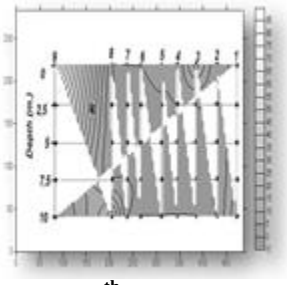

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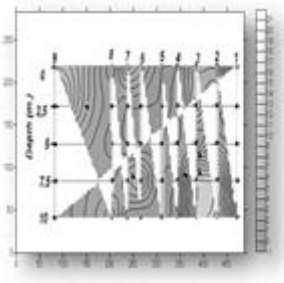
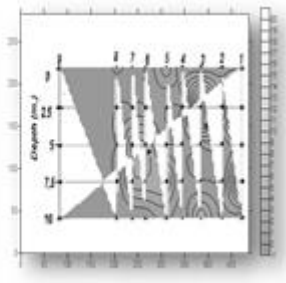
Fig. 2. Chlorophyll a concentrations (µg L^{-1}) according to stations of Uzunçayır Dam Lake.

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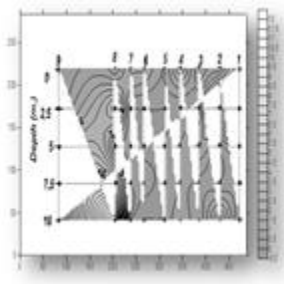
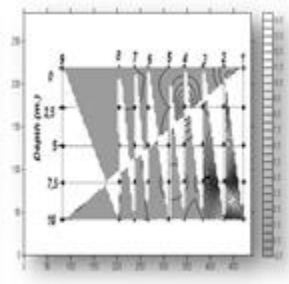

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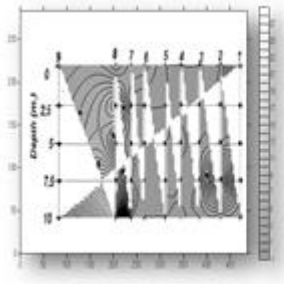
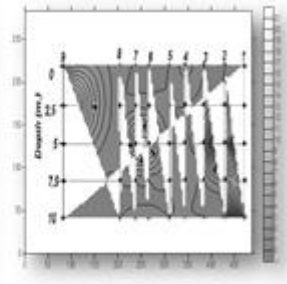

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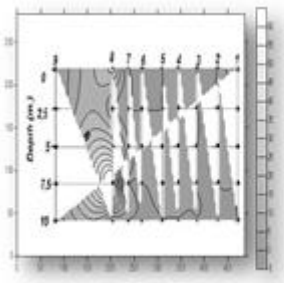
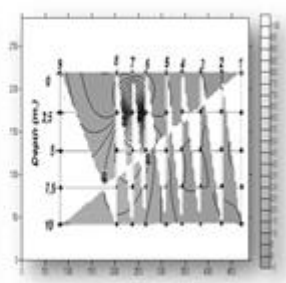

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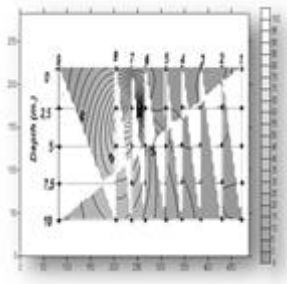

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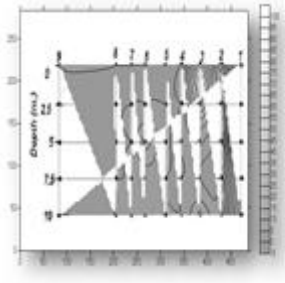
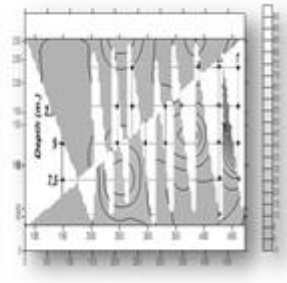
Figure 3. Chlorophyll b contenrations (µg L^{-1}) according to stations of Uzunçayır Dam Lake.

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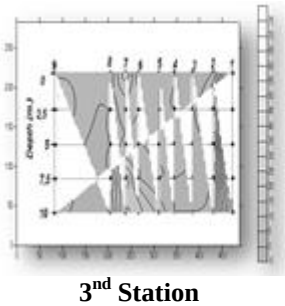
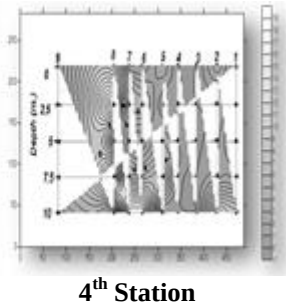

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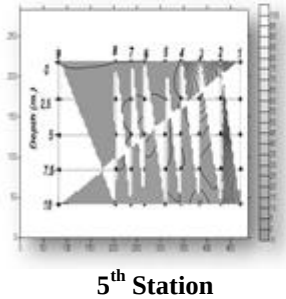
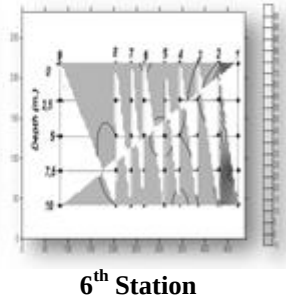

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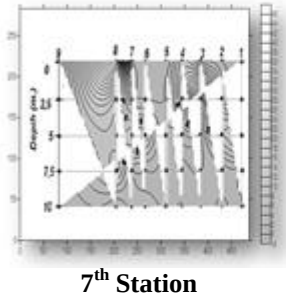
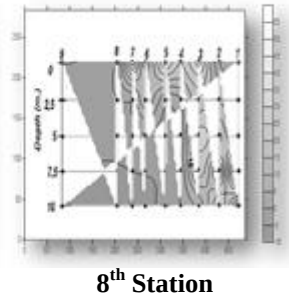

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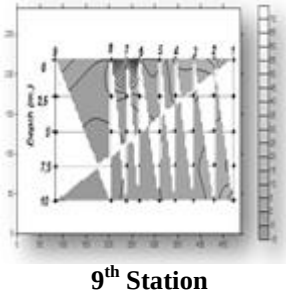

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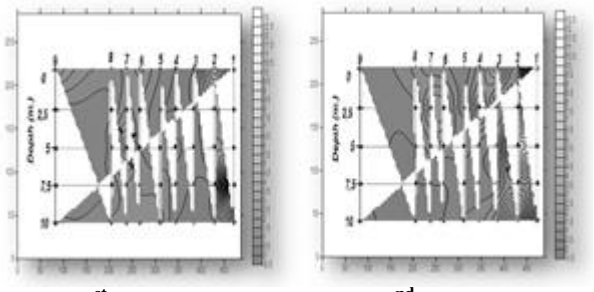
Figure 4. Chlorophyll c (µg L^{-1}) concentrations according to stations of Uzunçayır Dam Lake.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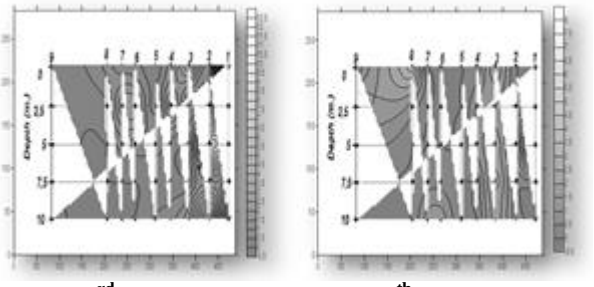
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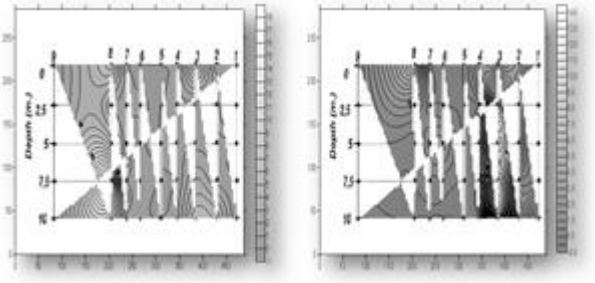
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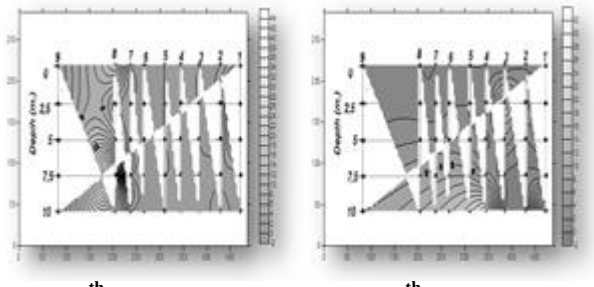
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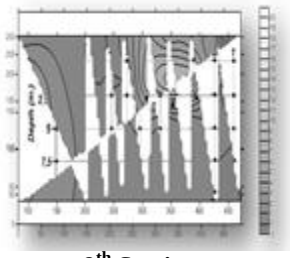
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Figure 5.Carotenoid content according to stations of Uzunçayır Dam Lake.

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