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The Determination Trophic Status of Ucpinar Dam Lake (Usak, Turkey)

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Abstract: Trophic status of Ucpinar Dam Lake (Usak), some parameters of water quality, phytoplankton and zooplankton (which are in this pond) are the first and the second food chain also benthic samples seasonally were studied quantitatively and qualitatively during June 2005 to April 2006. From 10 genera (phytoplankton) determined; 5 genera belong to Cyanophyta, 3 to Chlorophyta, 1 to Euglenophyta and 1 to Bacillaropyhta. From 30 species identified (zooplankton), 26 species are from Rotifera, 2 species from Cladocera, 2 species from Copepoda. A total of 3 families from zoobenthic were determined. Average water quality parameters of Ucpinar Pond were measured as follows; water temperature was 15,1°C, pH 7.84, dissolved oxygen 7.87 mg L^{-1}, Secchidisc depth 32.16 cm and electrical conductivity 754.08 μS cm^{-1}. As a result, the obtained physical, chemical and biological parameter as well as the dominant zooplankton and phytoplankton species shows that Ucpinar Dam Lake is eutrophic.

Key words: Phytoplankton, Ucipnar Dam Lake, water quality, zoobenthic, zooplankton

INTRODUCTION

Aquatic ecosystems have been contaminated more with the increase in human population and their needs. In parallel with the technological progress, as a result of increasing industrial, domestic and agricultural wastes and discharge of some of these wastes into water systems, excessive phosphorus and nitrogen accumulation occurs, which results in eutrophication problem. Physical, chemical and biological methods are used to measure the level of pollution in water. Physical and chemical methods are used to determine the existing conditions, while biological observations show the effects of the pollutant on the environment and the species. There is no study on trophic manner in Ucpinar Dam Lake (UDL). The aim of this study is to determine the trophic level of UDL.

MATERIALS AND METHODS

Ucpinar Dam Lake is located in Usak province of Turkey, 76 km to the city center, 6 km northeast of Takmak village of Esme district. It is a dam reservoir built above Çiftlik creek for irrigation purposes in 1992. Common carp (*Cyprinus carpio*) was inoculated to the dam, which has a lake area of 1388 km^2.

Measurement of water quality parameters: The pH of the water was determined using a portable WTW pH meter, the dissolved oxygen was determined using YSI 51 model oxygen meter, the electrical conductivity was determined using WTW conductivimeter and water temperature was determined by making comparisons from pH meter, oxygen meter and conductivimeter. Water permeability was measured in centimeters using the secchi disc having a diameter of 20 cm.

Collection of plankton specimens: Plankton specimens were collected from the selected 3 stations (Fig. 1) of the lake reservoir using Hydro-Bios Kiel brand Hensen type plankton net made of nylon fabric having a net ring diameter of 25 cm and 55 μ mesh size. The planktons were collected using the plankton net

Fig. 1: Stations and Ucpinar Dam Lake map

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horizontally and vertically. The specimens were preserved in 4% formaldehyde (Wetzel and Likens, 1990). In identification of zooplankton specimens, we followed studies of Kolisko (1974), Koste (1978), Segers (1995) and Smirnov (1996).

Collection of benthos (Zoobenthic) specimens: Zoobenthic specimens were collected using Ekman Birge (15×15 cm) from each station twice and were fixed in the field with 4% formaldehyde after being sieved through the successive sieves having a mesh size ranging between 210 and 3600 μ (0.21 and 3.6 mm). After the dividing into groups under binocular, the samples were preserved in 70% alcohol. The specimens were subject to qualitative and quantitative analysis according to the method proposed by Lagler (1956). Chironomidae larvae were identified according to Sahin (1991), Zhadin (1965) and Macan (1977).

RESULTS AND DISCUSSION

This study was carried out between July 2005 and April 2006 to determine the trophic level of UDL, some water quality parameters and biological parameters (phytoplankton, zooplankton and zoobenthic organisms). The average water temperature measured during the study in UDL was 15.16°C. The highest water temperature was found to be 28.0°C at 3rd station in the summer (2005), while the lowest water temperature was found to be 3.6°C at 3rd station in the winter season (2006) (Fig. 2). The temperature is one of the restricting factors in the presence and the distribution of the zooplanktonic organisms (Mikschi, 1989). The average dissolved oxygen content measured in UDL was 7.87 mg L^{-1}. The highest dissolved oxygen content was found to be 10.6 mg L^{-1} in the summer term (2005) at the 1st station, while the lowest dissolved oxygen content was found to be 2.5 mg L^{-1} in spring term (2006) at the 2nd station (Fig. 3). The minimum dissolved oxygen value of the water for the maintenance of the aquatic life in aerobic conditions in the freshwater ecosystems should not be <5.0 mg L^{-1} (Gülle, 1999). The average dissolved oxygen content of UDL was not found to be a life-restricting factor. The average pH value in UDL was measured as 7.84. The highest pH value was measured as 9.2 at the 3rd station in summer season (2005), while the lowest pH value was measured as 6.0 at the 3rd station in winter season (2006) (Fig. 4). According to average pH value, UDL has an alkali character. *Brachionus angularis, Brachionus calyciflorus* species in UDL are the common cosmopolitan species of waters having alkali characteristics (Koste, 1978). In the measurements made in UDL, average Secchi disc value was found to be 32.16 cm. The maximum Secchi Disc

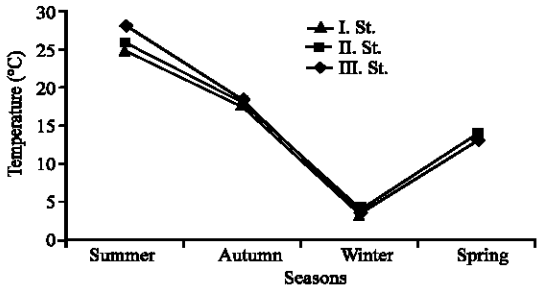

Fig. 2: Seasonal temperature (°C) changes in UDL

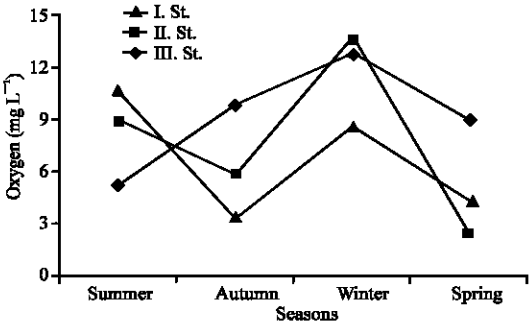

Fig. 3: Seasonal dissolved oxygen (mg L^{-1}) changes in UDL

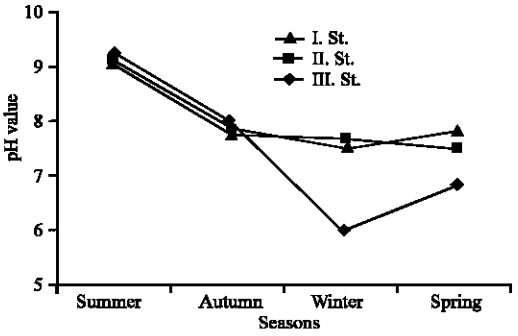

Fig. 4: Seasonal pH changes in UDL

value was measured as 39.0 cm in the 1st station in summer season, while minimum value was measured as 24.0 cm in the 3rd station in winter season (Fig. 5). According to the OECD limit value for trophic classification system, the lakes having Secchi Disc values of 0.8-1.5 m are called eutrophic lakes; the lakes having Secchi Disc value of 1.4-2.4 m are called mesotrophic and the lakes having a Secchi Disc value of 3.6-5.9 m are called oligotrophic (Ryding and Rast, 1989). According to these values, UDL has hypertrophic lake characteristics according to average Secchi Disc values. The average Electrical Conductivity (EC) measured in UDL was 754.08 μS cm^{-1}, the highest value was found to

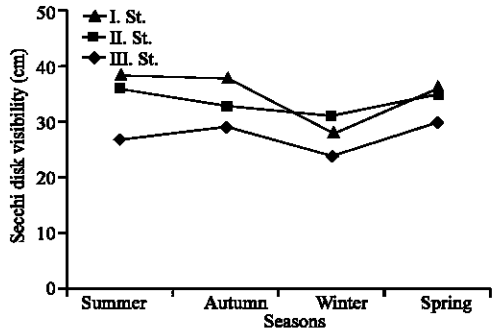

Fig. 5: Seasonal Seechi disk visibility (cm) changes in UDL

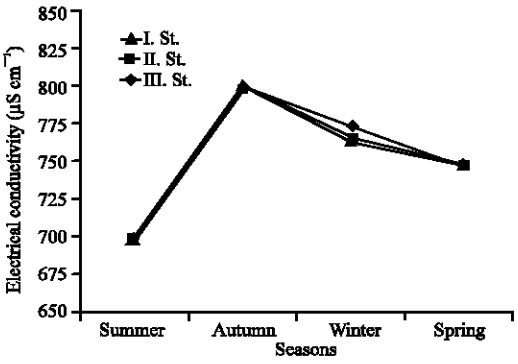

Fig. 6: Seasonal electrical conductivity (µS cm^{-1}) changes in UDL

be 800 µS cm^{-1} in autumn season (2005), while the lowest was found to be 700 µS cm^{-1} in summer season (2005) (Fig. 6). Considering maximum 500 µS cm^{-1} EC value for aquaculture, it was found that average electrical value measured in UDL was higher than the average electrical conductivity value.

Phytoplanktonic, zooplanktonic and zoobenthic species in Ucpinar Dam Lake: A total of 10 genera were identified from phytoplanktons, 5 genera belonging to Cyanophyta, 3 genera belonging to Chlorophyta, one genusbelonging to Euglenophyta, one genus belonging to Bacillariophyta. From zooplankton, a total of 30 species were identified, 26 genera belonging to Monogonantha of Rotifera, 3 genera belonging to Cladocera, 2 species belonging to Copepoda. A total of three families from zoobenthos were identified; one family belonging to Arthropoda and two families to Mollusca.

In the analysis in UDL, 10 genera belonging to phytoplanktonic organisms were identified. When the average annual phytoplankton divisions were considered, 95.3% Cyanophyta, 4.2% Chlorophyta, 0.42% Bacillariophyta and 0.08% Euglenophyta were identified.

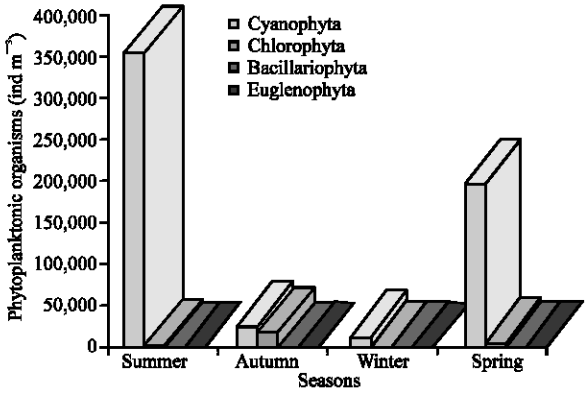

Fig. 7: Seasonal changes of phytoplanktonic organisms (ind m^{-3}) in UDL

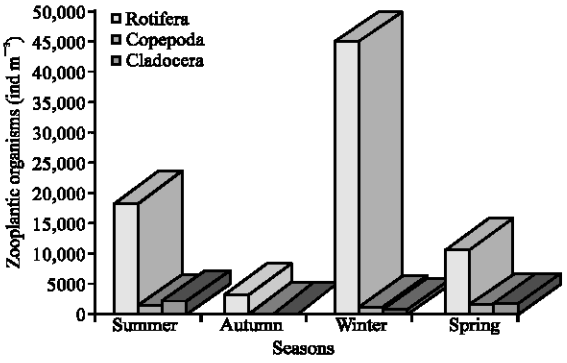

Fig. 8: Seasonal changes of zooplanktonic organisms (ind m^{-3}) in UDL

Cyanophyta was found to be the most dominant group in the reservoir. The dominant phytoplankton genera of the pond were found to be *Microcystis*, *Anabaena*, *Oscillatoria*, *Spirulina*, *Aphanizemenon*, *Actinastrum*, *Euglena* and *Navicula*. In considering the identified genera, *Microcystis*, *Anabaena* and *Oscillatoria* were defined as the indicators of the eutrophic lakes (Wetzel, 1983; Ryding and Rast, 1989; Reynolds *et al*., 2002).

The genus *Anabaena* is the most dominant genus with a dominance percentage of 55.12% in Cyanophyta group. It was reported that this genus caused excessive algae increase in semi-hard water in summer months and that *Aphanizomenon* caused excessive algae increase in lakes in cases of excessive nitrogen (Atici and Obali, 1999) (Fig. 7).

A total of 30 genera were identified among zooplankton organisms; 26 genera from Rotifera, 2 genera from Cladocera and 2 genera from Copepoda. The zooplankton of UDL was found to be 91.24% Rotifera, 4.78% Cladocera and 3.98% Copepoda (Fig. 8). Rotifera constituted the most dominant group in the reservoir. The

species belonging to *Brachionus* genus in the Rotifera group (*Brachionus angularis*, *Brachionus calyciflorus*) constituted the most dominant species of the reservoir. It is known that the species belonging to *Brachionus* genus are indicator species of eutrophic waters (Blancher, 1984; Gannon and Stemberger, 1978; Sharma, 1983; Pejler, 1983). Furthermore, *Filinia longiseta*, *Keratella quadrata*, *Asplanhna sieboldi*, *Polyarthra vulgaris* and *P. dolichoptera* species were also evaluated as dominant species.

Brachionus species are related to eutrophic waters, and *Trichocerca* species to oligotrophic waters. A trophic index coefficient was formed according to the number of *Brachionus* species/the number of *Trichocerca* species (QB/T). According to this coefficient value, the reservoir has oligotrophic characteristics when QB/T is lower than the reservoir has mesotrophic characteristics when QB/T is between 1 and 2 and the reservoir has eutrophic characteristics when (QB/T) is >2 (Sladecek, 1983).

In the studies carried out in UDL, 7 *Brachionus* species (*Brachionus angularis*, *Brachionus budapestiensis*, *Brachionus quadridentatus, Brachionus calyciflorus, Brachionus leydigi*, *Brachionus urceolaris*, and *Brachionus plicatilis*) and 2 *Trichocerca* species (*Trichocerca similis* and *Trichocerca pusilla*) were identified. According to this rate, the lake has eutrophic character with a value of QB/T = 3.5.

Moina micrura is the dominant genus of the Cladocera, which ranks the second with 4.78% in Ucpinar dam reservoir. The species of the Cladocera, in which ranks the third with 3.98% was identified as *Cyclops* sp. While calanoid Copepoda was generally observed to adapt to the oligotrophic conditions in optimum levels, Cladocera and cyclopoid Copepoda were reported to be good adapters to eutrophic waters (Gannon and Stemberger, 1978). The fact that there are abundant amounts of Cladocera and cyclopoid Copepoda in UDL supports that the reservoir has eutrophic characteristic. *Brachionus angularis* is the most dominant genus with 70.13% domination. The high level of trophyis can be explained with the fact that the ecosystem is different. The zooplankton abundance in hypertrophic lakes, the fact that dominant species are higher in number is characterized by the high percentage of Rotifera. Rotifera react to environmental differentiation faster than Cladocera and Copepoda and they can be used as sensitive indicators of the changes in the quality of water (May and Hare, 2005). In the hypertrophic water masses, the lifecycle of the dominant genera is short and young members are dominant in the population because adult members are subject to predation by fish (Kubar *et al*., 2005). Many studies reported that the structure of the zooplankton gives an idea about the trophic condition of the lake and the trophication level. There is a close link between the zooplankton structure and trophic structure of the water and this aspect is the most important characteristic in the general characteristics of aquatic ecosystems (Tallberg *et al*., 1999; Rogozin, 2000). In addition, such factors as excessive algae formation and pollution also affect the zooplankton abundance and varieties (Sarma *et al*., 2005).

When the zoobenthic groups in the lake were analyzed for determining the trophic condition of UDL, it was observed that the reservoir contained 56% Diptera, 25% Planobidae and 19% Sphaeridae was 1. Generally, as the substantiality level of the reservoir increased, it was the density of the macrofaunal groups such as Chironomidae, Gastropoda were reported to increase (Svensson *et al*., 1999). In this study, high content of Chironomidae and Gastropoda supports this finding. The members belonging to a specific group become dominant in the benthic structure. This is an indication of eutrophication in the lakes. Moreover, it was reported that the Chironomidae are dominant in eutrophic lakes (Ryding and Rast, 1989).

CONCLUSION

UDL contains the dominant genera (phytoplankton, zooplankton and zoobenthos). These are the indicators of eutrophic lakes in terms of both its water quality values and the groups of species. It was determined that UDL is a eutrophic lake in terms of trophic level. Euthrophication in the reservoir can be caused both by the environmental pollution and fluctuations in the water level resulting from the usage of water of the reservoir for irrigation purposes. In order to save the reservoir, it needs managing its trophic level.

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