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Investigation of Some Physical and Chemical Parameters of Water in the Lake Isykli in Denizli, Turkey

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ABSTRACT

Water sampled from Lake Isykli in Denizli region during the four seasons was analyzed for chemical and physical properties. Recoveries were nearly quantitative for all the elements studied (>90 %) for Cr, Pb, Cu, Cd, Ni and Fe. The results were within the acceptable limits of pollution according to EU and Turkish Standards except organic matter, phosphate, ammonia nitrogen and nitrite.

Key Words: Water; Heavy metals; Isykli lake; Turkey

INTRODUCTION

The accurate determinations of trace element concentrations and other physical and chemical parameters of lake waters are important for controlling their pollution. The wetlands are one of the most productive ecosystems in the world and they include natural or artificial; permanent or temporary water (Tuzen, 2002). The wetlands are defined as fluent fresh, acrid or salty waters and the include all depth which are not over 6 m in receding periods of flood-tide; as well as the swamps, pods and reed beds. This definition is made under the internationally accepted Ramsar Agreement of 1971 (Anonymous, 1995). In addition, they are very important economically in fishing, agriculture, husbandry, reed production, ecological tourism and educational and scientific researches (Anonymous, 2000a). Numerous pre-concentration techniques have been extensively developed for this purpose (Yamini & Tamadon, 1999). The most frequently employed pre-concentration procedure in water analysis is complexation with ammonium.

There are many industrial plants on the lake discharging their waste into the lake as main sources of pollution. The most important problem in protecting wetlands is pollution. This pollution can be physical, chemical or biological and it is caused by the water of poor quality as agricultural, home or industrial waste. Physical pollution can be determined by the parameters such as colour, turbidity, light permeability, water temperature and electrical conductivity (EC); whereas, chemical pollution is determined by values which are derived from pH, dissolved oxygen (DO), biological oxygen value (BOD), chemical oxygen value (COD), total hardness, total acidity and nourishment volume. Bacteriological parameters which show biological pollution are the values that are derived from fecal coliform and total coliform (Anonymous, 1996). Water plants are the basic components of a wetland ecosystem. They produce oxygen, provide protection for living organism in water and ensure the perpetual effects of sediment in the bottom and because they are the first of the food chain in water, they are indispensable for life in such mediums (Anonymous, 2001). The Directory of the State Hydraulic Works of XXI Region reports that since 1988 an immensely large population of aquatic plants has emerged in Lake Isykli obstructing the fishing; also the mud in the bottom has been killing the fish and lobster especially in summer periods and that the problems in irrigation due to clogging in the grates of regulator has been increasing here (Anonymous, 2000b).

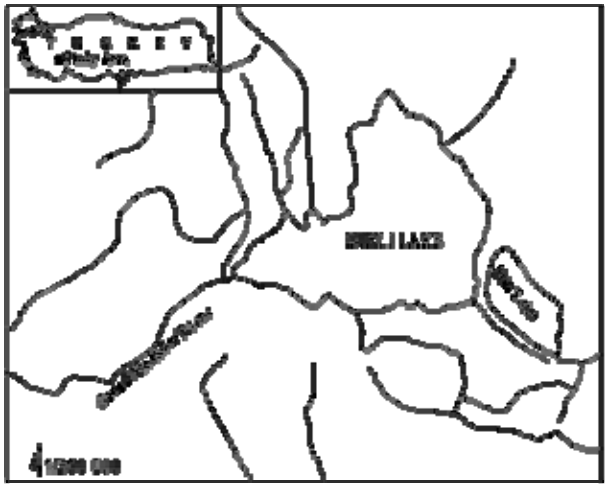
The aim of this project was to determine the spatial and temporal pattern in the community structure of biota richness with particular emphasis on the relationships between structure of community and the physical and chemical environment.

MATERIALS AND METHODS

The water samples were taken periodically from different parts of Lake Isykli between November 2000 and October 2001. The Isykli Lake in Denizli is a tectonic rooted lake which is situated in the southern part of Civril Meadow in sediment domain that is surrounded by Burgaz Mount in the noth; Akdag in the east, Bozdag in the south, basically on the western Taurus Mountains. During rainy seasons, the lake expands itself with flood and destroys settlement and farming areas in the neighbourhood and in order to prevent floods the lake was circumscribed by a dike in the dike is performed by a west, south and east, which was built between the years 1939-1963. In terms of geographical location, lake is situated in 38° 15 north, 29° 50 east. This lake is fed by Isykli springs, Kufi stream and

Meander, stream that run through Dinar also Hamam and Karadirek streams that come from Sandıklı and other rivers which spring from Akdag. At the same time, Isykli Lake is one of the most important sources of Great Meander and the lake itself is surrounded by large farming areas (Fig. 1).

Fig. 1. Map of the study area (Isykli Lake)



During the one year study period, water samples which were taken from Isıklı Lake, Kufi stream, Meander stream, Isykli regulator and Irgıllı regulator in monthly period and which were preserved in glass bottles in 4°C, are brought to laboratory and the measurement of water quality parameters were performed according to suitable methods. Temperature, pH, conductivity, and dissolved oxygen of the samples were measured in the field using portable instruments. The samples were filtered through a 0.45μm Millipore membrane (Whatman). The samples were kept in the refrigerator at 4°C until analysis (Tuncay, 1994; Egemen & Sunlu, 1999).

RESULTS

Comparison of the measured parameters and the metal concentration with the water quality index shows that the water quality of Isykli Lake can be accepted as first grade irrigated water. The minimum and maximum values of the analytical results are given in Table I. While the values of pH, total dissolved solids, hardness, calcium, magnesium, chloride, sulfate, sodium, potassium and nitrate agreed with the standards, those of organic matter, phosphate, ammonia nitrogen and nitrite were observed to exceed the standards. Biodegradable organic matter such as contributed by industries or domestic pet excreta and mixed with lake water may cause a depletion of dissolved oxygen reserves as a main reason for fish mortality observed. The use of fertilizers in agriculture and detergents including phosphate are supposed to increase phosphate concentration. The exceeding amounts of the ammonia nitrogen and nitrite are thought to be mainly a result of the fertilizers and sewerage wastes.

Table I. Seasonal mean parameters and the classes of the water quality in Lake Isykli

Parameters	Unit	Spring	Summer	Autumn	Winter
Temperature	°C	10±20	22±29	10±23	2±12
pH		78±3	8±9.2	7±8.6	7±12.2
Electric conductivity (EC)	mS/cm	280±470	330±570	352±560	220±313
Standing solid substance	mgL^{-1}	5±85	90±150	70±200	20±170
Dissolved oxygen(DO)	mgL^{-1}	8±4	6.5±10.2	5.9±12.3	8.9±12.2
Biologic oxygen value (BOD)	mgL^{-1}	4±85.5	2.5±4.8	3.9±4.6	3.5±5.0
Chemical oxygen value (COD)	mgL^{-1}	20±60	20±68	20±36	20±80
Permeability of light	cm	90±170	40±180	10±45	55±130
Turbidity	JTU	5±10	5	5±10	102±00
Colour	Pt-Co	5	5	5	5
Total hardness	Fr	17±24	17±26	20±25	20±28
Total acidity	$mgCaCO_3/L$	6±62	11±58	10±76	10±106
Alkalinite (bicarbonate)	$mgCaCO_3/L$	160±864	760±900	762-912	234±835
Alkalinite (carbonate)	$mgCaCO_3/L$	20±45	24±48	36±74	25±45
Free carbondioxide	$mgCaCO_3/L$	0.12±0.47	0.23±1.16	0.2±1.52	0.2±2.3
(NH_3-N)	mgL^{-1}	0±0.14	0±0.43	0±0.40	0±0.40
(NO_2-N)	mgL^{-1}	0.001±0.01	0±0.02	0±0.03	0±001
(NO_3-N)	mgL^{-1}	0±2.7	0.50±2.38	0.75±3.2	0.12±1.41
Sulfate (SO_4)	mgL^{-1}	21.6±50	8.8±46	19.2±129	30±54
Organic substance	mgL^{-1}	3.2±6	2.1±4.8	0.4±4.8	3.1±3.3
Calcium	mgL^{-1}	23±±50.1	20±52.1	30.1±60.1	30±56
Magnesium	mgL^{-1}	18.2±36.5	10±34	25±41	26±31.6
Chloride	mgL^{-1}	10±28	5.68±42.5	16±28.4	14±28
Chlorophylla-a	mgL^{-1}	1.2±8.8	1.9±3.6	0.5±1.5	0.5±2.4
Iron	$\mu g/L^{-1}$	< 0.3			
Chromium	$\mu g/L^{-1}$	< 0.005			
Copper	$\mu g/L^{-1}$	< 0.02			
Lead	$\mu g/L^{-1}$	< 0.005			
Cadmium	$\mu g/L^{-1}$	< 0.005			
Nickel	$\mu g/L^{-1}$	< 0.02			
Fecal coliform	EMS/100mL	15-50	10-650	30-500	20-250
Total coliform	EMS/100mL	100-3100	100-18000	700-2000	50-1500

DISCUSSION

Several studies have attempted to address issue of water quality and have been based on the assumption that lake front properties, like other markets goods, consist of a mix of characteristics; some characteristics, because of their nature or quality, have higher value than others (Michaels *et al*., 1996). If studies suggest that good water quality is reflected in property values, it follows that the protection of good water quality should become a community priority. Excessive loading of phosphorus and nitrogen rich sediment from shore land development leads to poor water quality, nuisance plant growth and habitat degradation (Panuska, 1994). The concentration levels of some trace metal ions in the water samples investigated were below the detection limit of AAS analysis and have to be determined after pre-concentration by liquid-liquid extraction. The metal concentrations were found to be lower than the values of Turkish Standards (Turkish Standards, 1989). Water sampled from River Yeşilırmak in Tokat region during the four seasons has been analyzed. Recoveries were nearly quantitative for all the elements studied (≥95 %) with detection limits of 41, 15, 48, 24, 32 and 35 μg/L for Pb, Cd, Fe, Cu, Mn and Zn, respectively. The results were within the acceptable limits of pollution according to EU (Tuzen, 2002). In a different study, the biological richness was

defined as accurate as possible and macroinvertebrates and physicochemical parameters were used to determine the water quality (Duran, 2003).

The parameters which are effective in development of water plants, are water depth, water temperature, pH, chlorophyll-a account, light permeability, standing solid substance volume, organic substance volume and nourishment volume (Pieterse & Murphy, 1990). With regard to the effects of water depth and light permeability parameters on plant growth, ıt can be observed that light permeability is limited by the increase of water depth and light permeability increases by the reduction of water depth. This is a case dependent on other factors like solid substances which stand in water though. Maximum depth of lake in 2001 was measured as 7 m; whereas, minimum depth was 2.5 m. Light permeability was mostly measured in spring and summer times and it was observed that plant growth was intensive in those periods. There was a positive relationship between chlorophyll-a concentration and light permeability. It was found that chlorophyll-a value (2001) increases with an increase in light permeability. Standing solid substance volumes affect the light permeability of water negatively. This negative effect causes a reduction in plant growth. As a result, standing solid substances measured in 2001 are less than the values which would have a negative effect on plant growth. Water temperature also has some positive and negative effects on plant growth. The most suitable water temperature for plant growth is 20-35°C. However, temperatures over 30°C cause regression in plant growth and decay in plants. pH has direct or indirect effects on photosynthetic events and growth of water plants. In water with low pH, solution dissociation of iron phosphate decreases; whereas, in water with high pH. Similarly, high pH, solution dissociation of iron phosphate decreases whereas in water with high pH causes more carbonate and bicarbonate in water. Regarding to pH data in 2001, it was found that high pH values don't have any negative effect on plant growth. Since organic substance volume correspond all the structural and functional requirements of water plants and animals, it is a crucial parameter for water ecology. If the water temperatures exceed the normal value in water which has so much organic substance, it causes lack of oxygen. Organic substance in water can vary according to water quality and ecological particulars. Regarding to organic substance measured in 2001, it was observed that organic substance volume is higher in spring and summer times than other seasons. Also the fact that the identified species volume was higher in those seasons than autumn and winter proves this observation. Nourishments are necessary for photosynthesis and plant growth. Total hardness or alkalinity is used in classification of lake waters according to nourishments. So, regarding to carbonate values measured in lake water in 2001; it can be said that lake has an average wealth in terms of nourishment in spring, summer and winter; and in autumn it was rich in terms of nourishment. In measurements performed in lake water in 2001, a significant alteration wasn't observed in phosphate, nitrite and ammonia nitrogen intensity. Phosphate, nitrite and ammonia nitrogen level is too low in that period. The decrease in nitrate which is one of the nourishments in lake waters depends on the seasonal alteration in lake size. It is still questionable that how much the nitrate volume in water effects the plant growth. Plants can provide the necessary nitrate also from lake sediment. When the physical and chemical parameter values of lake are investigated, it was observed that lake water does not have any risky parameter for living species in lake. If studies suggest that good water quality is reflected in property values, it follows that the protection of good water quality should become a community priority.

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