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Evaluation Of Water Quality Of Karacalar Dam (Ulaş-Sivas) By Using Physico-Chemical Methods

Ekrem MUTLU[a] Banu KUTLU[b] Telat YANIK[c] Tuğba DEMİR[d]

[a]Kastamonu University, Faculty of Fisheries, Kastamonu, Turkey
(ekrem-mutlu@hotmail.com)
[b]Tunceli University, Faculty of Fisheries, Tunceli, Turkey
(kutlubanu@gmail.com)
[c]Faculty of Fisheries, Atatürk University, Erzurum, Turkey
(telatyanik@yahoo.com)
[d]Hafik Kamer Örnek Vocational High School, Cumhuriyet University, Hafik-Sivas, Turkey
(tugbilim@hotmail.com)
[e]

ekrem-mutlu@hotmail.com

ABSTRACT

Located in Upper-Kızılırmak plateau, Karacalar Dam Lake is located within borders of Karacalar and Yapalı villages of Ulaş district of Sivas city, and the water resource of the barrage is Karacalar Brook. Karacalar Barrage Lake has 1353 m altitude, 4.40 km^2 lake surface, 49 hm^3 lake volume, and it is very important role in watering the agricultural lands of Ulaş district. In this study, it has been aimed to determine the water quality characteristics of Karacalar Barrage Lake (Ulaş- Sivas) via physico-chemical methods, and to determine its class according to Water Pollution and Control Regulation and Drinking Water Standards Regulation).

This study has been started in March 2011, and it has lasted for 1 year. The water samples have been collected monthly from 3 stations representing the whole of the lake. Among the water quality parameters, dissolved oxygen (D.O.), saltiness, pH, temperature, electrical conductivity (E.C.), suspended solid matters (SSM), chemical oxygen demand (COD) biological oxygen demand (BOD), total alkalinity, total hardness, total ammoniac azote, nitrite, nitrate, phosphate, sulfate, sulfide, sodium, magnesium, calcium, ferrous, lead, copper and cadmium levels have been investigated in water samples. As a result of performed study, the monthly and seasonal water quality changes in Karacalar Barrage Lake has been determined, and it has been investigated it the lake is suitable for aquaculture activities.

Keywords: Water Quality, Karacalar Dam Lake, Ulaş, Sivas

INTRODUCTION

As well as water is one of the basic elements of life, its own is a life environment. Because it is an essential pre-condition of life, water's existence in life environments and its quality have great importance(Akın and Akın, 2007).¾ of surface of the earth is covered with water, and it leads us to think that there is water abundance on earth, but the amount of drinkable water is approximately 0.74%. Waterpotential is about 3690 $m^3$with a part of 1735 m^3 (50%) drinkable per capita indicating water shortage in Turkey considering World average value of 5000 m^3 .

The limitedness of our country's fresh water resources which we can use gradually increases the pressure of pollution on those resources. The reasons of that are rapid population growth, industrial development, deficiencies in infrastructure as a result of excessive urbanization, increasing agricultural and stockbreeding activities, climate changes, domestic waste waters, and unplanned regulation efforts.

As lakes show characteristic of continuous receivers, they are affected from environmental pollution at primary degree. The pollutants arising from domestic, industrial and agricultural activities mix into rivers firstly, and then they arrive at lakes and seas through the rivers (Taş, 2006).

As they receive drainage waters of large land parts, there is a continuous exchange between the lake and the land covering the lake. The surficial and underground waters enter into and exit from lakes. With these flows, they bring many physical, chemical and biological compounds, organic matters, residues, and other matters with them. The rate of this flow may vary depending on lake's geographical structure, climate, and seasonal conditions (Ünlü et al., 2008). The type of rocks in drainage region of any lake is the most important factor determining the inorganic compound of the lake water. Especially in lakes having no water outflow, the increasing pollution potential due to accommodation of heavy metals, agricultural pesticide and fertilizer residues indicates how important the protection of lake is because they constitute the most pollution-sensitive water group among surficial waters (Çakmak and Demir, 1997).

The obvious change in agricultural activities in Sivas city in last 30 years is one of the human-originated factors affecting derogation of water-soil resources. As important environmental problems, opening lands for agriculture, saltiness of soil, dense fertilizer utilization, erosion, and decrease of organic matter and herbal diversity became threats on water resources (Mutlu et al., 2013). That's why; it is very important to evaluate the monthly changes of physio-chemical parameters of lakes being used as fresh water resources in region, and to determine that changing parameters affect the water quality.

The aim of this study. Between Mart 2011 and February 2012, 3 points have been determined as representatives (sampling stations) of whole lake for monthly investigations for 1 year. Through analyzing the samples taken from sampling stations, it has been aimed to determine the actual water quality characteristics of Karacalar Barrage being one of the lakes constituting the most pollution-sensitive water resources, to reveal the pollution problems, to determine the compliance with lives of creatures, and to classify the lake's water according to Surface Water Quality Management Regulation's (SWQMR) Inland Surface Water Classification criteria.

MATERIAL and METHOD

Research Field

Located in Upper-Kızılırmak plateau, KaracalarDam Lake is located within borders of Karacalar and Yapalı villages of Ulaş district of Sivas city, and the water resource of the barrage is Karacalar Brook. Karacalar Barrage Lake has 1353 m altitude, 4.40 km^2 lake surface, 49 hm^3 lake volume and 6.3m of mean depth, and there are large and flat agricultural lands around the lake. Besides playing an important role in watering agricultural lands in Ulaş district, the barrage lake is also used for sportive fishing activities. While determining the sampling stations on the lake, 3 points have been chosen to homogenously represent the lake water characteristics. 1st station is located at eastern point of the lake (the entrance point of Karacalar Brook), 2nd point is located at northeastern point of the lake (where Yapalı village is located), and 3rd station is located at the middle of the lake.

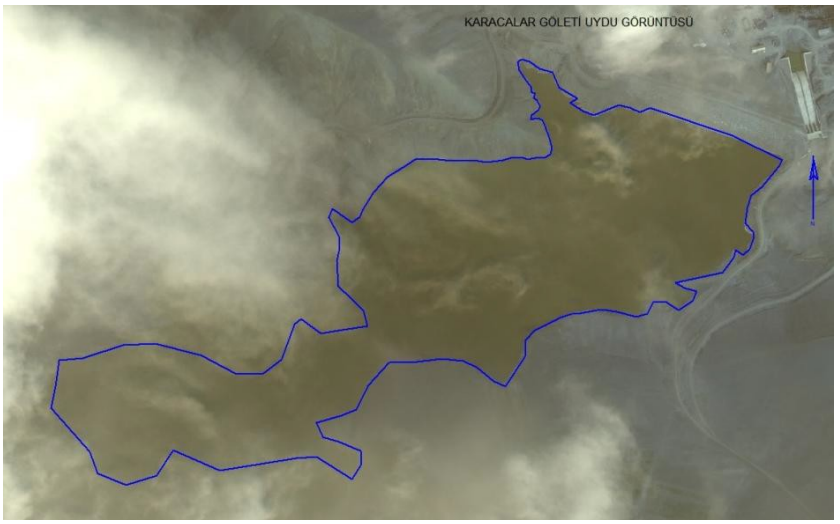

Figure 1. The location of Karacalar Dam Lake

Water Analysis

In this study started in March 2011, samples used in analyses of some chemical and physical parameters constituting the water quality has been collected monthly from 3 sampling stations during 12 months. Sampling process continued until February 2012. The cleaning and maintenance of all of the equipment, land-type measurement tools, and glass sampling containers to be used in sampling have been executed 1 day before the sampling. Sampling tubes have been immersed into acidic solution, and then dried in drying oven after being washed wit pure water. The sampling tubes to be used in water sampling have been flushed and immersed into 15 cm below water surface for taking water sample.

The obtained water samples have been taken to the laboratory within max. 2 hours for analysis. Temperature, pH, dissolved oxygen, saltiness and electrical conductivity parameters have been measured in-place via land-type measurement devices. Dissolves oxygen and temperature were measured via YSI brand 52 model oxygen meter, pH measurement was conducted with Orion brand 420A model pH-meter, the electrical conductance (µs/cm) and salinity (ppt) were measured by using YSI brand 30/50 FT model conductance-meter.

Among other parameters determining water quality; total alkalinity, total hardness, ammoniac, nitrite, nitrate, ammonium azote, phosphate, sulfite, sulfate chloride, sodium, potassium, suspended solid matter (SSM), chemical oxygen demand (COD), calcium, magnesium, ferrous, lead, copper and cadmium analyses of water samples were conducted in Cumhuriyet University Hafik Kamer Örnek Vocational High School Laboratory in same day.

Titration with sulfuric acid (for total alkalinity) and titration with EDTA (for total hardness) were executed. The results were presented in mg/L $CaCO_3$ unit. Chemical oxygen level was calculated through titration with ferrous ammonium sulfate based on determination of amount of oxygen being used while lysing the natural and organic pollutant load by using powerful chemical oxidants. The analyses of ammoniac, nitrite (NO_2), nitrate (NO_3), ammonium nitrogen (NH_4^+), phosphate, sulfate , sulfite, chloride, sodium, potassium, calcium, and magnesium were conducted with CECİL CE4003 brand spectrophotometer by using Merk photometric test kits according to standard procedures. The analyses of lead copper, ferrous and cadmium water samples were conducted with PERKIN ELMER brand ELMER ANALIST 800 Atomic Absorption Spectrometer in laboratory. The analysis of Suspended Solid Matter (SSM) was conducted by filtering the water through Whatman brand 42 Nr0.45 NM membrane filters, and then keeping filter papers at 103°C for 24 hours and calculating the weight difference.

Monthly mean values, standard deviations and graphics of each of parameters were calculated by using Office Excel 2007 which is a part of Microsoft Office Professional Edition 2007.

FINDINGS

Water temperatures showed significant annual and monthly variances among measurement stations on the lake. The lowest value in February 2012 was measured as 7.2 ^{0}C in 1st station, while the highest water temperature was measured in September 2011 as 25.1^{0}C in 2nd station. The annual average temperature of lake was recorded as 15.03^{0}C.

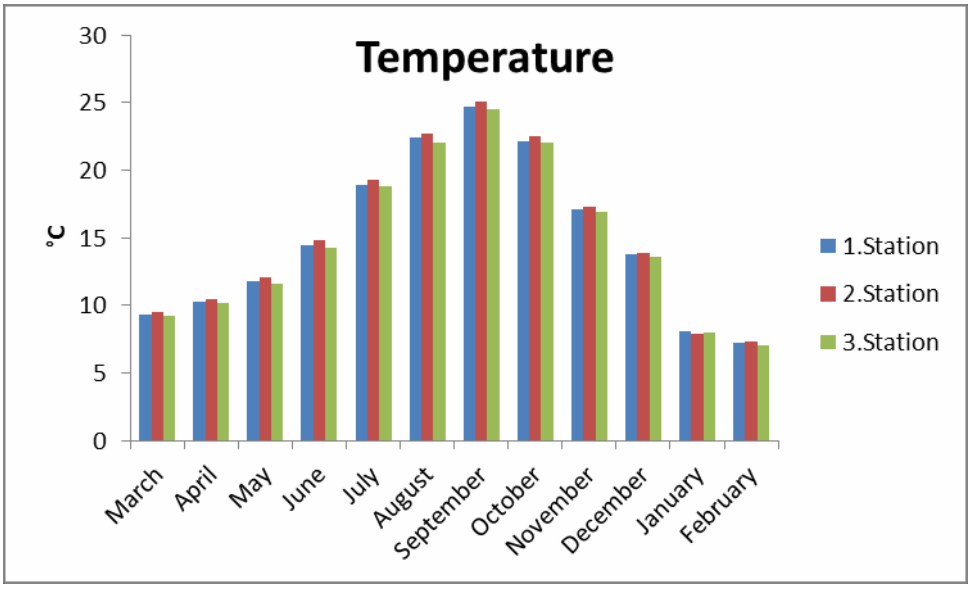

Figure 3.1. Monthly mean temperature values of the stations(0C)

The pH value showing the acidic and basic situation of waters has showed that Karacalar Dam Lake is mildly basic. During this study, the lowest pH value was measured as 8.18 in February 2012 in 3rd station and the highest pH value was measured as 8.45 in September 2011 in 2nd station, and the annual mean pH value of the lake has been found to be 7.96. Also the annual mean value was found to be 8.33.

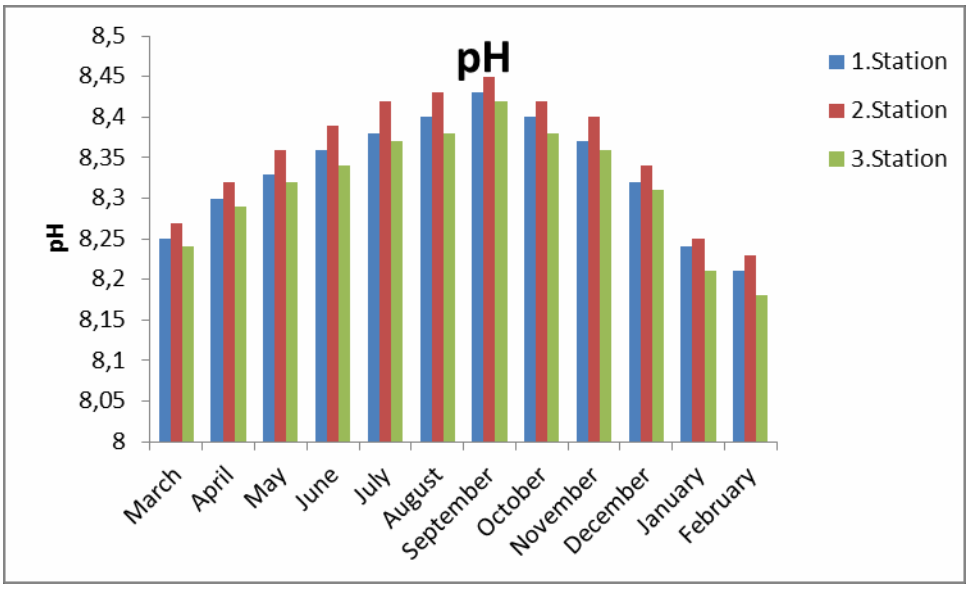

Figure 3.2. Monthly mean pH values of the stations

During study, the dissolved oxygen amount showed variance between stations, months and seasons. The lowest value was 8.42 mg/L (September 2012, 2nd station) and the highest value was 13.60 mg/L (May 2012, 3rd station), and the annual average of all of the measurement stations in lake was 11.22 mg/L.

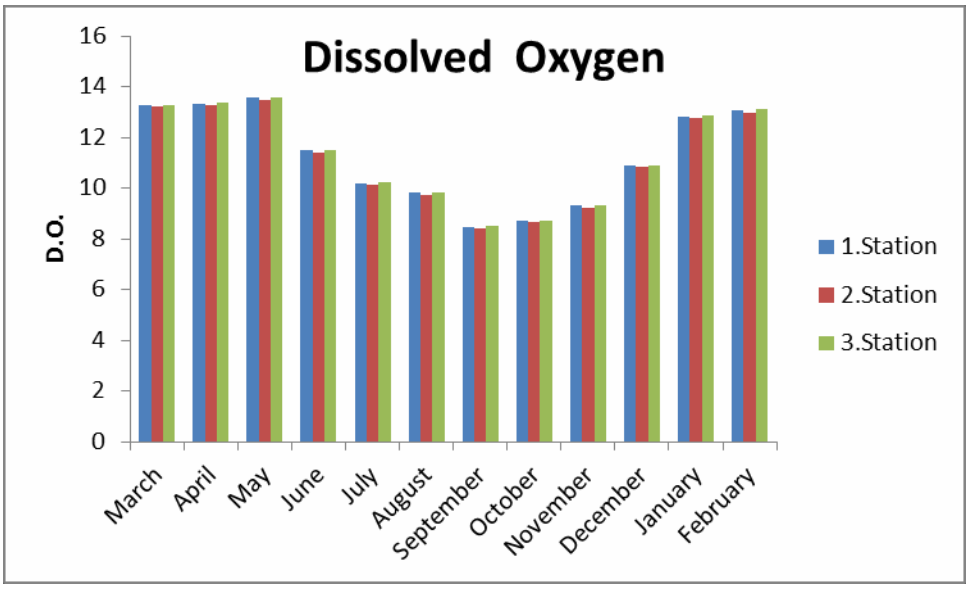

Figure 3.3 Monthly mean dissolved oxygen amounts of the stations (DO) mg/L

In Karacalar Dam Lake, the chemical oxygen demand (COD) has been found to be at its lowest level in all of 3 stations in February, while it has shown increase since February. Its peak value has been detected in 2nd station in September 2011 as 5.38 mg/L. The lowest COD amount in the lake has been determined in 3rd station in February 2012 as 2.42 mg/L, while the annual average of all of sampling stations is 3.28 mg/L.

In Karacalar Dam Lake, the biological oxygen demand (BOD) has similarly shown increase since February until September in all 3 stations, and it has peaked in 2nd station in September 2011 as 2.7 mg/L. The lowest BOD value of the barrage lake has been found to be 0.6 mg/L in 3rd station in February 2012, while the annual mean value has been found to be 1.44 mg/L.

The Suspended Solid Matter (SSM) amounts of lake showed significant changes between stations, months and seasons. The highest value was observed as 1.98 mg/L (September 2011, 2ndstation), and lowest level was 0.17 mg/L (February 2012, 3rdstation). The annual mean value was 0.82 mg/L.

The salinity of Karacalar Dam Lake has reached its maximum in all of the stations in September when water temperature was at highest and the dissolved oxygen amount was at minimum. The highest value has been measured as 0.11 ppt in September 2011 in 2ndstation, while the mean salinity of the lake has been found to be 0.06 ppt.

The Electrical Conductivity (EC) of Karacalar Dam Lake has showed significant variance among seasons, stations and months. The electrical conductivity (E.C.) has showed increase in summer months and decrease in winter months. The lowest value was measured in February 2012 in 3rdstation as 115.82 µs/cm while the highest value has been determined in September 2012 in 2ndstation as 170.88 µs/cm. The annual average electrical conductivity of Karacalar Dam Lake was146.55µs/cm.

In Karacalar Dam Lake; nitrite (NO_2), nitrate (NO_3) and ammonium azote (NH_4) values have been determined to be very low in winter during the study period.

The nitrite (NO_2) value of the lake has shown increase in summer months while it decreases in winter months. The highest nitrite value has been observed in July 2011 in 2nd station as 0.0013 mg/L, while the lowest value has been observed in February 2012 in 3rd station as 0.0001 mg/L. The annual mean value of all stations is 0.0004 mg/L.

Nitrate (NO_3) and ammonium azote (NH_4) values have increased in all stations from February to September. The lowest nitrate value has been observed in February 2012 in 3rd station as 0.09 mg/L, while the highest value has been observed in September 2011 in 2nd station as 2.13 mg/L, and the average of all of sampling stations was 1.14 mg/L. The ammonium azote (NH_4) value of the lake has reached its peak value in September 2011 in 2nd station as 0.0032 mg/L, while the lowest value has been observed in February 2012 in 3rd station as 0.0002 mg/L.

The total alkalinity and total hardness values in Karacalar Dam Lake shows parallelism during this study, and the results have been found to be close to each other. While total hardness and total alkalinity values of the lake showed decreases in winter, they increased in spring months.

The lowest total alkalinity and total hardness values have been detected in 3rd station in February 2012, it has been determined that they have peaked in 2nd station in June 2011. The total alkalinity and total hardness values measured in 3 stations on the lake showed increase from February to June. The highest total alkalinity value has been observed in 2nd station in June 2011 as 234.66 mg/L $CaCO_3$,while the lowest value has been detected in 3rd station as 205.88 mg/L, and the annual mean value among 3 stations was 222.46 mg/L $CaCO_3$.

In Karacalar Dam Lake, the sulfate (SO_4) value has shown variance between stations, months and seasons. The lowest sulfate value in the lake has been detected in 3rd station in February 2012 as 11.00 mg/L, while the highest value has been determined in 2nd station in September 2011 as 14.66 mg/L and the annual mean value among measurement stations was 12.44 mg/L.

The sulfide value of the barrage lake showed increase in all 3 stations from February to September, and it has peaked in 2nd station in September 2011 as 2.48 mg/L, while its lowest value has been detected in February as 0.64 mg/L. The sulfide (SO_3) value of the lake showed significant variance among months and seasons. The seasonal mean sulfide (SO_3) values of the lake are 0.83 mg/L for spring, 1.80 mg/L for summer, 2.24 mg/L for autumn, and 0.82 mg/L for winter.

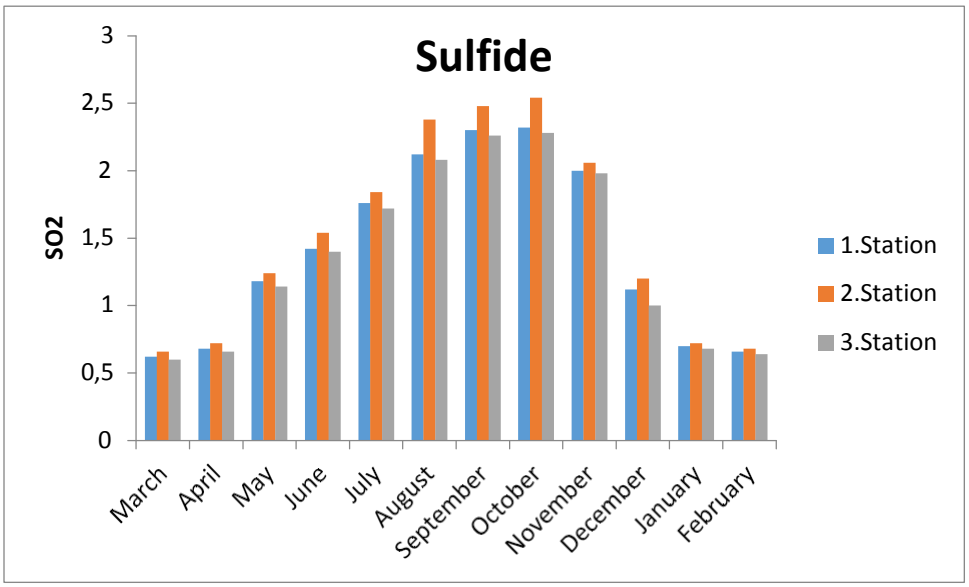

Figure 3.4 Monthly mean sulfide (SO_3) mg/L values

In Karacalar Dam Lake, the magnesium (Mg) and calcium (Ca^{++}) values have shown parallelism. While magnesium and calcium values of the lake peaked in all of the stations in June, they reached their minimum levels in February. The highest magnesium (Mg) value has been detected in 2nd station in June 2011 as 28.11 mg/L, while the lowest value has been found in 3rd station in February 2012 as 19.54 mg/L and the annual mean value has been found to be 23.27 mg/L. The lowest calcium (Ca^{++}) value has been detected in 3rd station in February 2012 as 22.28 mg/L, while the highest value has been determined in 2nd station in June 2011 as 30.14 mg/L, and the annual mean value has been found to be 26.16 mg/L.

The chloride values in Dam Lake showed significant variance between stations, months and seasons. It has increased during summer, and decreased during winter. The highest value has been observed in September 2011 as 20.08 mg/L in 2ndstation, while the lowest value has been recorded in February 2012 as 9.20 mg/L in 3rd station.

In Karacalar Dam Lake, the lowest phosphate value has been detected in 1st and 3rd stations in February 2012 as 0.001 mg/L, while it has peaked in May 2011 in 2nd station as 0.017 mg/L. The phosphate (PO_4) value of the lake has increased continuously in all stations from February to May.

In Karacalar Dam Lake; the sodium (Na) and potassium (K) values have shown parallelism. In measurement in May, it has been determined that they have peaked in all 3 stations. The highest sodium (Na) value has been detected in May 2011 in 2nd station as 73.12 mg/L, while the lowest value has been detected in December 2011as 44.30 mg/L, and annual mean value has been found to be 57.57 mg/L.

The lowest potassium (K) value has been determined in 3rd station in February 2012 as 3.75 mg/L, while it has peaked in May 2011 in 2nd station with value of 7.83 mg/L, and the annual mean value among the stations has been found to be 5.81 mg/L.

The lead(Pb) and cadmium (Cd) values of Karacalar Dam Lake have peaked in September 2011 in 2nd station as 0.006 mg/L for lead and 0.007 mg/L for cadmium.

The level of copper (Cu) in the lake has been found to be lower than measurable limits in all of 3 stations in January and February, while it has peaked in September 2011 in 2nd station with value of 0.009 mg/L.

Karacalar Dam Lake's ferrous (Fe) level has been found to be lower than measurable limit during measurements in winter months (in all of 3 stations). The highest ferrous (Fe) level of the lake has been determined in May 2011 in 2nd station as 0.009 mg/L.

RESULTS and DISCUSSION

Located within the borders of Ulaş district of Sivas city, Karacalar Dam Lake is a barrage lake which has been established over Karacalar Brook in Upper Kızılırmak plateau. The lake is fed with waters from Karacalar brook and the precipitation and snow waters mixing into the lake.

The seasonal mean values of water quality parameters from 3 sampling stations where the monthly measurements of Karacalar Dam Lake have been carried out for 1 year are given in Table 1.

Table1: Seasonal Values of Water Quality Parameters of Karacalar Dam Lake, and Standard Deviations

Water Quality Parameters	Spring	Summer	Autumn	Winter
pH	8.2978	8.3856	8.4033	8.254444444
Temperature	10.5	18.6222	21.3556	9.644444444
Salinity (‰)	0.0489	0.08	0.086666667	0.04
Electrical Conductivity	141.484	161.7822	160.56	122.4144444
Suspended solids(mg/L)	0.2844	1.1056	1.504444444	0.402222222
Chemical Oxygen Demand(mg/L)	2.5278	3.6789	4.387777778	2.582222222
Dissolved Oxygen (mg/L)	8.8233	1.1056	1.504444444	0.402222222
Biological Oxygen Demand (mg/L)	1.0778	1.8444	1.9	0.966666667
Nitrite (NO_2)(mg/L)	0.0004	0.0008	0.0005	0.000266667
Nitrate (NO_3)(mg/L)	0.9367	1.9167	1.535333333	0.225555556
Ammonium (NH_4)(mg/L)	0.0012	0.0024	0.002677778	0.000544444
Total Alkalinity($CaCO_3$)(mg/L)	223.3711	227.9578	222.8911111	215.6444444
Total Hardness ($CaCO_3$)(mg)	220.5178	226.5389	221.0155556	212.5155556
Sodium (Na)(mg/L)	64.2178	64.1811	57.65	44.25111111
Potassium (K)(mg/L)	6.2478	6.7111	6.513333333	3.813333333
Chloride (Cl)(mg/L)	9.9689	13.9844	15.15111111	9.576666667
Phosphate (PO_4)(mg/L)	0.0087	0.0058	0.005	0.002333333
Magnesium (mg) (mg/L)	23.4711	25.2956	24.04888889	20.28111111

Calcium (Ca)(mg/L)	26.7356	27.9378	26.12444444	23.86888889
Iron (Fe)(mg/L)	0.0046	0.004222222	0.002222222	0.000222222
Sulfide (mg/L)	0.8333	1.806666667	2.246666667	0.822222222
Sulfate (SO_4)(mg/L)	1.7844	3.322222222	3.384444444	1.302222222
Lead (Pb)n(mg/L)	0.0026	0.005111111	0.003444444	0.000444444
Copper (Cu)(mg/L)	0.0031	0.006555556	0.006	0.000555556
Cadmium(mg/L)	0.0006	0.003333333	0.004111111	0.000222222

The water temperature is the most important factor affecting the biologic activities of aquatic creatures and fishes. The changes in water temperature arise from seasonal temperature changes (MUTLU et al., 2013b). Karacalar Dam Lake is located in continental climate region. It has been observed that the water temperature differences between monthly measurements of 3 stations during 12 months were not at the level affecting the aquatic life in the barrage lake negatively. According to Surficial Water Quality Management Regulation (SWQMR), the water quality of the lake is 1st class.

Being the indicator of hydrogen ion concentration in waters, pH is an important factor from the aspect of chemical and biological systems in natural waters. Water's pH changes depending on temperature, saltiness, and alkalinity (PULATSU and TOPÇU, 2012). The highest pH value in the barrage lake has been determined as 8.45 in September 2012, and the average of monthly measurements during the year has been calculated to be 8.33. The barrage lake has mildly basic structure, and showed variance between 1st and 2nd class according to SWQMR criteria.

In aquatic ecosystem, the type and level of biological activity depend on the amount of dissolved oxygen in medium (Havser,1996). For aquatic life in fresh waters, the minimum amount of dissolved oxygen is 5 mg/L (ATAY and PULATSU,2000). The lowest dissolved oxygen amount in our study has been detected in September 2011 in 2nd station as 8.42 mg/L, and the lake's water is 1st class according to SWQMR in terms of dissolved oxygen content.

Chemical Oxygen Demand (COD) is a very important parameter for determining the pollution level of water and waste waters (MUTLU et al; 2013c). The concentration of chemical oxygen requirement in waters more than 25 mg/l indicates the pollution, while the values more than 50 mg/l indicated the severe pollution and possible toxicity for aquatic animals (Güler, 1997).The highest COD value of KaracalarDam Lake has been determined in September 2011 in 2nd station as 5.38 mg/L. Accordingly,the barrage lake takes place in 1st class in terms of COD according to SWQMR.

Being the indicator of organic pollution in waters where aquacultural activities are performed, biological oxygen demand (BOD) is defined as the required oxygen amount for dissolving organic matters in medium by bacteria under anaerobic conditions (PULATSU and TOPÇU,2012). It is required BOD value of the water to be lower than 3.0 mg/L in salmoniformes breeding and 6.0 mg/L in cypriniformes breeding (ATAY and PULATSU,2000).

The highest BOD level in KaracalarDam Lake has been determined in September 2011 in 2nd station as 2.7 mg/L, while the average of the lake is 1.44 mg/L. It has been determined that the lake is suitable for salmoniformes and cypriniformes farming, and the lake takes place in 1st class in terms of BOD value according to SWQMR criteria.

Suspended Solid Matters (SSM) are the solid matters bigger than 0.45 micron existing in water in dissolved form (PULATSU and TOPÇU,2012). The maximum permissible SSM level in aquaculture is 10 mg/l. (NTENGUE, 2006). The highest SSM amount in the lake has been determined in 2nd station in September 2011 as 1.98 mg/L. It has been determined that the lake is 1st class in terms of SSM level according to SWQMR, and the lake is suitable for aquaculture.

Saltiness is the representation of salts dissolved in 1 L of water in terms of gram, and it doesn't have unit (YANIK et al., 2001). Saltiness is in a close relationship with temperature and electrical conductivity (EC) (MUTLU et al., 2013a). Considering the temperature and electrical conductivity values measured in the lake, it has been observed that saltiness has decreased in winter months, and it has increased in summer months when the temperature and vaporization have been high.

Electrical Conductivity (E.C) value is an important parameter in aquacultural activities. The acceptable EC value for aquatic creatures is 250-500 µs/cm, while the upper limit is 2000 µs/cm (MUTLU,2013). The highest EC value in Dam Lake has been determined in September 2011 in 2nd station as 170.88 µs/cm, and this value is suitable for aquacultural activities. The lake is in 1st class according to SWQMR criteria.

Basically, the azote resources mixing into surficial waters are natural, domestic, industrial and agricultural ones (MUTLU et al.,2013a). The azote derivatives of nitrite (NO_2), nitrate (NO_3), and ammonium azote (NH_4) have important effects on water pollution, and they are the 2nd important factor limiting the production, following the dissolved oxygen. The amounts of azote compounds of nitrite, nitrate, and ammonium azote in our study have been determined in very low levels in the lake, and the lake is in 1st quality according to SWQMR criteria in terms of those parameters.

In fish farming, the total alkalinity and total hardness values are desired to be within 20-300 mg/L $CaCO_3$range, and to be similar with or close to each other (PULATSU and TOPÇU,2012). In our study, the total alkalinity and total hardness values have been found to be close to each other, and the highest total alkalinity and total hardness values have been determined in June 2011 in 2nd station as 234.66 mg/L $CaCO_3$ and 233.60, respectively. It has been determined that Karacalar Dam Lake shows hard water characteristic, and it is suitable for aquacultural activities.

The mean of sulfate in water is high hardness, high sodium salt, and high acidity. Sulfate (SO_4) value in natural waters varies between 5 and 100, the concentration of sulfate in waters higher than 250 mg/L indicates the severe pollution (MUTLU,2013). The highest sulfate value in the lake has been determined in September 2011 in 2nd station as 14.66 mg/L. The lake is suitable for aquaculture, and it is in 1st class according to SWQMR criteria.

Sulfide (SO_3) compounds are important water pollutants due to taste, smell and toxicity problems they create. The concentration of sulfite in water higher than 10 mg/L creates danger (Xiao-Sun et.al,2008). In our study, the highest sulfite (SO_3) level in the lake has been determined in September 2011 in 2nd station as 2.48 mg/L, and it has been concluded that the lake is suitable for aquacultural activities.

Magnesium (Mg) is one of the ions constituting the hardness of the water. As it is involved in composition of chlorophyll, the magnesium ion is very important for plants with chlorophyll, and it arranges the phosphor mechanism in algae and plants. The magnesium limit in fresh waters is 50 mg/L(TAŞ,2011). The highest magnesium value in the lake has been detected in June 2011 in 2nd station as 30.14 mg/L. It has been determined that the lake is suitable for aquacultural activities from the aspect of magnesium content.

Being an important mineral for all creatures, calcium (Ca^{++}) is one of the elements existing in waters at highest concentrations. Calcium (Ca^{++}) concentrations in waters with normal hardness are within 5-60 mg/L range. As well as 80-100 mg/L concentration can be acceptable in mildly hard waters, the highest recommended value for $Ca^{++}$is 75 mg/L(TAŞ,2006). The highest concentration of Ca^{++}in our study has been determined in June 2011 in 2nd station as 30.14 mg/L, and this level has been considered to be within normal limits for a lake having mildly hard characteristic.

The chloride ions, indicators of healthy water, can exist in natural waters up to the concentration of 30 mg/L (TAŞ,2011). In our study on the lake, the highest concentration of chloride has been detected in September 2011 in 2nd station as 20.08 mg/L, and this value is within normal limits.

Phosphor in natural waters is a key metabolic nutritive element of multidimensional, complex and biochemical balances (MUTLU,2013). According to Nisbet and Verneaux (1970), the productivity in waters containing 0.15-0.30 mg/L phosphate is very high, but when this concentration exceeds the level of 0.30 mg/L, the water will be accepted to be polluted. In our study, the highest phosphate concentration has been detected in May 2011 in 2nd station as 0.017 mg/L. It has been determined that the lake is suitable for aquacultural activities and it is 1st class according to SWQMR criteria.

Sodium (Na) exists mostly in NaCl form in waters, and it is an important element for development of phytoplankton and herbal organisms in aquatic environment (BOYD, 1990). Sodium salt concentration in natural waters varies between 2 and 100 mg/L, and the concentration higher than 100 mg/L may cause pollution (TEPE,2006). The highest NA value in this study has been detected in May 2011 in 2nd station as 73.12 mg/L.

Under the light of this value, it can be understood that Karacalar Dam Lake is in 1st class according to SWQMR criteria in terms of Na concentration, and the lake is suitable for aquacultural activities.

Potassium (K) is one of the inorganic salts giving the taste of water, and it varies between 1 and 10 mg/L in natural waters (TEPE et al.,2006). In study on Karacalar Dam Lake, the highest potassium level has been determined in May 2011 in 2nd station as 7.83 mg/L. It can be understood that this level is not dangerous for aquacultural activities.

During 1 year-long measurements in Karacalar Dam Lake, while the lead (Pb), cadmium (Cd), copper (Cu) and ferrous (Fe) showed decreases in winter months in all of stations and increases in some months, they have never exceeded the level which can be harmful for aquacultural activities. That's why; the barrage lake shows 1st class water characteristic according to SWQMR criteria in terms of lead (Pb), cadmium (Cd), copper (Cu) and ferrous (Fe) elements.

As a result; besides being a hotspot for daily picnickers and amateur fishermen, Karacalar Dam Lake located within the borders of Ulaş District of Sivas city is very important for the region because it provides the water for most of agricultural lands in Ulaş district. From the aspect of actual situation of the lake, no negative finding has been observed in terms of water quality, and it has been concluded that the lake is suitable for aquacultural activities. According to the criteria of Classification of Intra-Continental Water Resources of Surficial Water Quality Management Regulation, the Karacalar Dam Lake's class varies between 1st and 2nd classes in terms of investigated water quality parameters. For protecting the actual situation of the lake, and for sustainability of the natural ecologic balance consisting of natural fish stocks and other aquatic creatures, it is obvious that taking the required legal measures as soon as possible is necessary for the environment around the lake.

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