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Assessment of Physico-chemical Water Quality of Birecik Dam, Şanlıurfa, West East Region, Turkey

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A B S T R A C T

In year 2013, onsite seasonal measurements have been carried out in 4 different points of Birecik Reservoir, and water samples have been taken from surface and different depths. Physical and chemical parameters have been investigated in taken water samples. The result of analysis were obtained in the following range pH (6.98-9), temperature (9.9-26 °C), electrical conductivity (275-373 µs/cm), sodium (19.93-22.06 mg/L), potassium (1.-2.2 mg/L), chloride/11.68-21.4, hardness (179-210 mg/L), calcium (41.66-52.9 mg/L), magnesium ((17-18.35 mg/L), sulphate (27.92-43.48 mg/L), dissolved oxygen (7.92-8.83 mg/L), chemical oxygen (0.25-8.70 mg/L), nitrate (0.62-2.48 mg/L), nitrate (0.001-0.008), ammonium (0.01-0.07), phosphate (0.001-0.031 mg/L). The samples were compared with standard values recommended by world health (WHO). The study finalize that Birecik reservoir which was declared to be a threat to the water quality should be arrested at denitrification and nutrient control to halt the degradation of the water.

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Birecik Baraj Gölü, Şanlıurfa, Güney Doğu Bölgesi Su Kalitesinin Mevsimsel Olarak İncelenmesi

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Ö Z E T

2013 yılında Birecik Baraj Gölü'n de dört farklı noktada mevsimsel olarak yerinde ölçümler yapılmış, yüzey ve farklı derinliklerden su örnekleri alınmıştır. Alınan su örneklerinde fiziksel ve kimyasal parametreler incelenmiştir. Mevsimsel değişimler araştırılarak atık suların ve diğer kaynakların baraj gölü sahasına etkisi araştırılmıştır. Bu çalışmada elde edilen parametrelere ait veriler Su Kirliliği Kontrol Yönetmeliği'nde bildirilen kıta içi su kalite standartlarına göre değerlendirildiğinde, genel olarak Birecik Baraj Gölü sularının I. sınıf yani yüksek kaliteli su sınıfında yer aldığı sonucuna varılmıştır. Su Kirliliği Kontrol Yönetmeliğinde I. sınıfa dahil olan suların yalnız dezenfeksiyon ile içme suyu temini, rekreasyonel amaçlar, alabalık üretimi, hayvan üretimi, çiftlik ihtiyacı ve diğer amaçlar için uygun olduğu bulunmuştur.

Introduction

Water quality affects the composition, productivity, abundance of the species and physiological conditions of the aquatic species. Reservoirs are essentially affected by the environmental pollutions as they are a constant receiving environment. This pollution does not only adversely affect the living creatures in it but also this negative effect reach to humans through the food chain. Water is severely deteriorated degraded (Williamson et al., 2008).

Mankind have been building dams for thousands of years with aims to prevent floods, to benefit from hydroelectric, to procure drinking water, to procure industrial water, to procure irrigation water and to utilize water recreationally. Fresh water is the major worry in terms of water quantity and quality (Shinde et al., 2011). Especially since 1950s, as the pollution increased and the economies enlarged, increasing numbers of barrages started to be constructed by private or public sector. In order to satisfy energy and water requirements, at least 45.000 large barrages have been constructed to date (Anonymous, 2012a). Advancing technology, rapidly increasing population, global climate change, and domestic, industrial and agricultural pollution resources create a great pressure on the lakes. The widest ecologic problem among them is the human-originated eutrophication. Occurring as a result of excessive entrance of nitrogen and phosphor, the lake eutrophication leads water quality to worsen, and biodiversity to significantly decrease (Kristensen and Hansen, 1994; Dodson et al., 2000). As a result of newly established reservoirs or watering activities, certain changes in environmental factors such as ecosystem and climate and consequently in planta and animals are expected. As a result of these changes, either some of the plant and animal species may disappear or their population may significantly change. In response to these changes, the fresh water, fauna and flora in new reservoir regions may have a great potential. For this reason, the natural resources must be continuously observed, and the monitoring activities must be executed in order to make required precautions. Determination of the physical and chemical parameters is importance for this reason. The main criteria determining the pollution in aquatic environments are physiochemical and biological factors. The creatures living any water are of great importance in terms of biological diversity, food chain, water quality, and biological purity of the water. In recent years, the studies examining the physiochemical properties of the reservoirs have significantly increased in number (Alaş, 1998).

In parallel with Water Framework Directive (WFD) accepted by European Union, studies are carried out in Europe in order to ecologically improve the aquatic systems and other systems in relation with them (WFD, 2000). And in Turkey, the Water Pollution Control Regulation (WPCR) has brought comprehensive regulations on according to Turkish legislation (Water Pollution Control Regulation WPCR) Official Gazette (1988) water quality management. In this regulation, the improvement of the water quality in direction of the country's necessities and the protection of the quality of water sources within the frame of ecosystem principle are aimed, and the quality classification of drinking and tap waters, underground waters and surface waters has been done. Most of the Turkey's fresh water basins are not under protection, and they are recipients of domestic, industrial and agricultural pollutants.

In this research, it was aimed to determine the water quality of the reservoir, to put forth the problems related to the pollution and to contribute in fishing industry by determining some physical and chemical parameters in different depths and water surface in the Birecik Reservoir.

Material and Method

Established on the Fırat River within the border of Şanlıurfa city, the construction of Birecik Barrage has finished in 2000. Its volume at normal water code is 1220 hm^3, lake surface area is 56.25 km^2, and it has been constructed for watering and energy purposes. At 4 determined points on Birecik Reservoir, the onsite measurements have been executed in seasonal basis (Figure 1).

Temperature, pH, dissolved oxygen, % oxygen saturation, electrical conductivity, and secchi disk depths were measured onsite. 500 ml of the taken water samples were filtered through nitrocellulose membrane filter, and then the analyses were started. The total hardness and total alkalinity of filtered part were determined through titrimetric method, while ammoniac, nitrite, nitrate, reactive phosphor, sulfate, chloride, fluoride, sodium, magnesium, and calcium were determined through ion chromatography method (APHA, 1995). Total nitrogen and total phosphor were determined with Nova 60 spectrophotometer device via kits.

The normality test of each parameter has been executed through Shapiro–Wilk method. The difference between monthly changes and depths at sampling points for each of examined parameter was compared via one-way ANOVA. The significance in normally distributed series ($p<0.05$) was determined via Student t-test, while that of non-normally distributed series was determined via Wilcoxon test. For multi-variable correlation analysis, non-parametric Pearson correlation method was utilized. For statistical analysis of the data, the JMP 7.0 software was used.

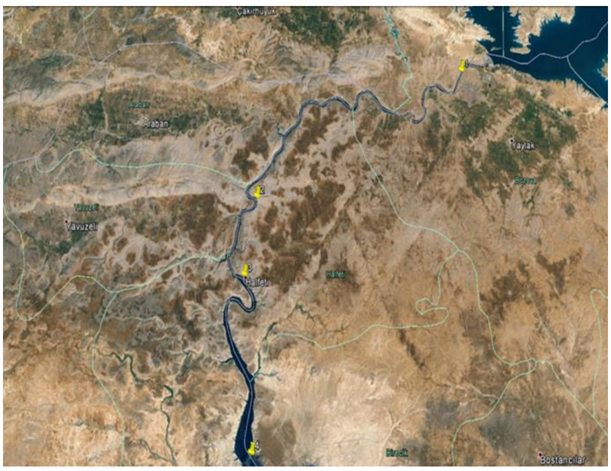

Figure 1 Birecik Baraj Lake station

Result

The annual average temperature in the sampling points in Birecik Reservoir was found to be 15.9±5.4°C in the surface water (Table 1). The difference between the seasonal changes of the temperature was found to be significant ($P<0.05$) and the difference between the depths was found to be insignificant ($p=0.719$).

pH was determined to be 8.11±0.75 in the surface water. pH values in the sampling points in the reservoir were as follows: 6.98-9.00 in the surface, 7.25-9.20 in 5 m depth, 7.11-9.10 in 10 m depth and 7.11-9.10 in 20 m depth (Table 1). Electrical conductivity was found to be averagely 339±38 µS/cm in the surface water. Electrical conductivity in the sampling points in the reservoir was as follows: 269-384 µS/cm in the surface, 272-375 µS/cm in 5 m depth, 272-373 µS/cm in 10 m depth and 275-374 µS/cm in 20 m depth (Table 1). When the measured values were analyzed, electrical conductivity between depths produced similar results. Dissolved oxygen in the surface water was determined to be averagely 8.49±0.29 mg/L. Dissolved oxygen in the sampling points in the reservoir was as follows: 7.92-8.33 mg/L in the surface (average saturation %86), 7.99-8.55 mg/L in 5 m depth (average saturation %78±9), 7.03-8.87 mg/L in 10 m depth (average saturation %78±9) and 7.38-8.70 mg/l in 20 m depth (average saturation %74±10) (Table 1).

Total hardness was found to be averagely 191±7 mg $CaCO_3$/L in the surface water. Total hardness in the sampling points in the reservoir was as follows: 174-207 mg $CaCO_3$/L in the surface, 179-210 mg $CaCO_3$/L in 5 m depth, 189-206 mg $CaCO_3$/L in 10 m depth and 186-207 mg $CaCO_3$/L in 20 m depth (Table 1). Sodium was found to be averagely 20.96±0.71 mg Na^+/L in the surface water. Sodium in the sampling points in the reservoir was as follows: 19.93-22.06 mg Na^+/L in the surface, 19.94-21.81 mg Na^+/L in 5 m depth, 20.11-22 mg Na^+/L in 10 m depth and 20.08-23.04 mg Na^+/L in 20 m depth (Table 1). The difference between the seasonal changes of the sodium was found to be significant ($P<0.05$) and the difference between the depths was found to be insignificant (P=0,998). Potassium was found to be averagely 2.05±0.10 mg K^+/L in the surface water. Potassium in the sampling points in the reservoir was as follows: 1.90-2.22 mg K^+/L in the surface, 1.84-2.28 mg K^+/L in 5 m depth, 1.94-2.18 mg K^+/L in 10 m depth and 1.89-2.80 mg K^+/L in 20 m depth (Table 1).

Calcium was found to be averagely 47.24±2.62mg Ca^{+2}/L in the surface water (Table 1). Magnesium was found to be averagely 17.66±0.40 mg Mg^{+2}/L in the surface water. Magnesium in the sampling points in the reservoir was as follows: 17.05-18.35 mg Mg^{+2}/L in the surface, 17.08-18.47 mg Mg^{+2}/L in 5 m depth, 17.25-18.23 mg Mg^{+2}/L in 10 m depth and 16.52-18.25 mg Mg^{+2}/L in 20 m depth (Table 1). Sulphate was found to be averagely 38.30±4.07 mg SO_4^{-2}/L in the surface water. Sulphate in the sampling points in the reservoir was as follows: 27.92-43.48 mg SO_4^{-2}/L in the surface, 33.22-43.96 mg SO_4^{-2}/L in 5 m depth, 32.26-43.21 mg SO_4^{-2}/L in 10 m depth and 35.07-43.74 mg SO_4^{-2}/L in 20 m depth (Table 1). Chemical oxygen Need was found to be averagely 3.39±2.02 mg O_2/L in the surface water. CON in the sampling points in the reservoir was as follows: 0.20-8.70 mg O_2/L in the surface, 0.70-5.30 mg O_2/L in 5 m depth, 0.40-8.70 mg O_2/L in 10 m depth and 1-6 mg O_2/L in 20 m depth (Table 1). It was determined that the secchi disk depth in the Birecik Reservoir was 2.90 m in the station 2, 3.00 m in the station 3 and 4.35 m in the station 4.

Orthophosphate was found to be averagely 0.008±0.008 mg PO_4^{-3}-P/L in the surface water (Table1). Total phosphor was found to be averagely 0.023±0.015 mg P/L in the surface water. Total phosphor in the sampling points in the reservoir was as follows: 0.01-0.07 mg P/L in the surface, 0.01-0.05 mg P/L in 5 m depth, 0.01-0.1 mg P/L in 10 m depth and 0.01-0.06 mg P/L in 20 m depth (Table 1). Ammonium was found to be averagely 0.013±0.015 mg NH_3-N/L in the surface water. Ammonium in the sampling points in the reservoir was as follows: 0.001-0.049 mg NH_3-N/L in the surface, 0.001-0.045 mg NH_3-N/L in 5 m depth, 0.001-0.032 mg NH_3-N/L in 10 m depth and 0.001-0.051 mg NH_3-N/L in 20 m depth (Table 1). Nitrite was found to be averagely 0.008±0.008 mg NO_2--N/L in the surface water. Nitrite in the sampling points in the reservoir was as follows: 0.001-0008 mg NO_2--N/L in the surface, 0.001-0.030 mg NO_2^--N/L in 5 m depth, 0.001-0.023 mg NO_2^--N/L in 10 m depth and 0.001-0.034 mg NO_2^--N/L in 20 m depth (Table 1). Nitrate was found to be averagely 1.754±0.478 mg NO_3^--N/L in the surface water. Nitrate in the sampling points in the reservoir was as follows: 0.629-2.488 mg NO_3^--N/L in the surface, 1.173-2.473 mg NO_3^--N/L in 5 m depth, 1.233-2.521 mg NO_3^--N/L in 10 m depth and 1.365-2.626 mg NO3--N/L in 20 m depth (Table 1). Total nitrogen was found to be averagely 1.953±0.526 mg N/L in the surface water. Total nitrogen in the sampling points in the reservoir was as follows: 0.713-2.758 mg N/L in the surface, 1.329-2.737 mg N/L in 5 m depth, 1.379-2.792 mg N/L in 10 m depth and 1.560-2.913 mg N/L in 20 m depth (Table 1).

Discussion

As a result of 12-month study, through the values of water quality parameters, the water quality classes of Birecik Reservoir were determined by utilizing the tables titled "Quality Criteria by the Classes of Intracontinental Water Resources" and "Limit Values for Eutrophication Control of Lakes, Ponds, Marshes, and Reservoirs" in Water Quality Control Regulation (Dirican, 2008).

The water temperature of the Birecik Reservoir has varied between 9.90 and 26ºC. From the aspect of temperature, there is not any thermal pollution, but it only changes seasonally. In terms of mean water temperature, the water of Birecik Reservoir is I. Class. According to the Water Pollution Control Regulation, the waters having I. class temperature are suitable for trout breeding.

In studies carried out in our country, since the soil and rock structure is generally limy, the measured pH values indicate the slightly alkali character of our lakes (Anonymous, 2004). pH value needs to be in between 6.5-8,5 for not jeopardizing the living creatures and for being used with water product cultivation in an aquatic ecosystem (Arrignon, 1976; Dauba, 1981). The diffusion of CO_2, which is used by algae cells for photosynthesis, becomes easier and faster in pH 8-10 range, hence the photosynthesis rates of the algae also increases (Bozniak and Kennedy, 1968). Within pH 7-9 range, CO_2 exists in water in form of HCO_3-, and in form of CO_3 when pH is higher than 9.5 (Goldman and Horne, 1983; Gökmen, 2007). pH must be known from the aspects of ensuring both of biologic life and chemical balance, and it must be able to be controlled. pH is an important indicator of corrosive or precipitation inclination of the water (Şengül and Müezzinoğlu, 2008). In primary production, since the carbondioxide that is used by algae changes the carbonate balance, the pH value of the medium increased (Tüfekçi et al., 2003). According to the data obtained from Birecik Reservoir, the stations show slightly basic character, and water quality is I. class. Since the Birecik Reservoir has slightly basic character, it can be concluded that it is fertile, and also it provides suitable environment for aquatic creatures.

Electrical conductivity varies depending on geological structure and precipitation level, but it is not affected from nutrient salts in the water (Temponeras et al. 2000). Conductivity rises in parallel with the increases in temperature and saltiness (Şen, 2003). As the pollution in the water increases, the electrical conductivity value exceeds the level of 1000 µS/cm. The electrical conductivity value measured in Birecik Reservoir is less than this level the water quality is I. class. The electrical conductivity value that is acceptable for aquatic creatures is 250-500 µS/cm. Hence, Birecik Reservoir has suitable electrical conductivity values for aquatic creatures.

Table 1 The average values of physico- chemical parameters of Birecik Reservoir

Dept (m)	Temperature (°C)				pH				Electrical conductivity (µS/cm)				Dissolved O_2 (mg/L)			
	min	max	Ave	ss	min	max	ave	ss	min	max	ave	ss	min	max	ave	ss
0	9.90	26.00	15.97	5.46	6.98	9.00	8.11	0.75	269	384	339	38	7.92	8.83	8.49	0.29
5	10.40	22.90	15.23	4.44	7.25	9.20	8.16	0.81	272	375	340	37	7.99	9.44	8.34	0.38
10	10.40	18.50	13.29	2.38	7.11	9.10	8.03	0.82	272	373	330	36	7.03	8.87	8.13	0.49
20	10.30	17.70	12.83	2.22	7.11	9.10	8.05	0.83	275	374	327	34	5.30	9.30	7.60	1.17
	Oxygen Saturation (%)				Total Hardenesss (mg $CaCO_3$/L)				Sodium (mg/L)				Potassium (mg/L)			
	min	max	ave	ss	min	max	ave	ss	min	max	ave	ss	min	max	ave	ss
0	74.30	99.30	85.75	8.07	174	207	191	7	19.93	22.06	20.96	0.71	1.90	2.22	2.05	0.10
5	54.40	92.40	78.84	9.97	179	210	194	7	19.94	21.81	21.02	0.72	1.84	2.28	2.01	0.13
10	60.30	90.30	78.05	9.73	189	206	197	5	20.11	22.00	21.14	0.66	1.94	2.18	2.02	0.08
20	50.30	85.40	74.78	10.61	186	207	196	6	20.08	23.04	21.13	0.90	1.89	2.80	2.13	0.25
	Calcium (mg/L)				Magnesium (mg/L)				Chlorides (mg/L)				Sulphate (mg/L)			
	min	max	ave	ss	min	max	ave	ss	min	max	ave	ss	min	max	ave	ss
0	41.66	52.91	47.24	2.62	17.05	18.35	17.66	0.40	11.68	21.14	17.76	2.47	27.92	43.48	38.30	4.07
5	42.99	53.74	48.55	2.55	17.08	18.47	17.69	0.44	14.76	20.53	18.22	1.64	33.22	43.96	39.74	3.07
10	45.93	52.51	49.38	1.70	17.25	18.23	17.79	0.33	13.74	20.08	17.46	2.07	32.26	43.21	38.45	3.67
20	46.63	52.72	49.22	1.66	16.52	18.25	17.65	0.59	15.47	21.87	18.19	1.88	35.07	43.74	39.56	2.92
	Nitrite (mg/L)				Nitrate (mg/L)				Ammonium (mg/l)				Total Phosphor (mg/L)			
	min	max	ave	ss	min	max	ave	ss	min	max	ave	ss	min	max	ave	ss
0	0.001	0.019	0.008	0.008	0.629	2.488	1.754	0.478	0.001	0.049	0.013	0.015	0.713	2.758	1.953	0.526
5	0.001	0.030	0.005	0.008	1.173	2.473	1.984	0.402	0.001	0.045	0.015	0.014	1.329	2.737	2.204	0.444
10	0.001	0.023	0.007	0.008	1.233	2.521	2.010	0.399	0.001	0.032	0.012	0.010	1.379	2.792	2.232	0.437
20	0.001	0.034	0.010	0.010	1.365	2.626	2.056	0.362	0.001	0.051	0.017	0.017	1.560	2.913	2.292	0.395
	Dissolved Phosphate (mg/l)				Total Phosphate Phosphorus (mg/l)				Chlorophyll a (mg/)				Chemical Oxygen Demand (mg/l)			
	min	max	ave	ss	min	max	ave	ss	min	max	ave	ss	min	max	ave	ss
0	0.001	0.031	0.008	0.008	0.010	0.070	0.023	0.015	0.51	14.97	5.57	4.33	0.2	8.7	3.4	2.0
5	0.002	0.025	0.008	0.007	0.010	0.050	0.027	0.014	0.75	11.51	3.37	3.88	0.7	5.3	2.7	1.5
10	0.001	0.050	0.011	0.014	0.010	0.100	0.023	0.026	0.25	5.83	2.17	1.73	0.4	8.7	3.3	2.3
20	0.001	0.028	0.007	0.009	0.010	0.060	0.029	0.013	0.76	15.12	4.43	4.75	1.0	6.0	3.5	1.7

	C[1]	T°C	O_2	T[2]	TP	TN	Chl	KOI	Na	NH_4	P	Mg	Ca	Cl	$N0_2$	$N0_3$	$P0_4$	$S0_4$
ph	0.42	0.21	0.03	0.02	0.15	0.26	0.03	0.14	0.18	0.21	0.04	0.29	0.12	0.09	0.02	0.25	0.04	0.11
C[1]		0.29	0.16	0.29	0.39	0.11	0.08	0.12	0.65	0.02	0.43	0.70	0.10	0.42	0.38	0.12	0.19	0.38
T°C			0.02	0.08	0.26	0.09	0.06	0.31	0.00	0.00	0.26	0.00	0.08	0.28	0.16	0.09	0.11	0.24
O_2				0.31	0.21	0.08	0.11	0.27	0.30	0.16	0.12	0.24	0.29	0.10	0.33	0.07	0.04	0.17
T[2]					0.03	0.61	0.23	0.16	0.40	0.07	0.15	0.53	0.94	0.33	0.03	0.61	0.07	0.42
TP						0.05	0.09	0.03	0.32	0.00	0.26	0.22	0.04	0.23	0.02	0.06	0.05	0.25
TN							0.16	0.06	0.11	0.14	0.09	0.11	0.76	0.49	0.12	1.00	0.18	0.57
Chl								0.02	0.12	0.29	0.08	0.08	0.19	0.08	0.20	0.16	0.06	0.09
KOI									0.11	0.15	0.10	0.09	0.21	0.09	0.12	0.06	0.38	0.13
Na										0.10	0.61	0.86	0.20	0.47	0.28	0.10	0.04	0.46
NH_4											0.23	0.12	0.07	0.03	0.26	0.11	0.15	0.02
P												0.62	0.03	0.21	0.36	0.10	0.13	0.17
Mg													0.27	0.30	0.29	0.12	0.12	0.29
Ca														0.29	0.04	0.76	0.16	0.40
Cl															0.08	0.47	0.07	0.98
NO_2																0.13	0.16	0.06
NO_3																	0.18	0.59
PO_4																		0.11

[1]C: Conductivity, [2]T: T. Hardness

Accordingly we can state that Birecik Reservoir is suitable for aquatic life in terms of dissolved oxygen amount. According to the Water Pollution Control Regulation, if the amount of dissolved oxygen in any water is 8 mg/L, then this water is I. class high-quality water, if it is 6 mg/L, then this water is II. Class mildly polluted water, and if it is less than 3 mg/L, then the water is IV. Class severely polluted water. According to WPCR, Birecik Reservoir has I. and II. Class (Table 1). The average values of physico- chemical parameters of Birecik Reservoir water quality. When the amount of dissolved oxygen in any water decreases under a certain level, then the fish start to die due to drowning. This happens firstly with trout fish since their dissolved oxygen needs are higher. The amount of dissolved oxygen needed in trout breeding is 6– 7 mg/L (Egemen and Sunlu, 1999). Since the level of dissolved oxygen measured in Birecik Reservoir is higher than 6–7 mg/L, it can be said that it is suitable for trout breeding. When classified according to $CaCO_3$ equivalent in mg/L unit, total hardness values can be defined as soft between 0 and 50, mild between 50 and 100, mildly hard between 100 and 150, medium hard between 150 and 250, hard between 250 and 350, and severely hard 350 (Egemen and Sunlu, 1999). Accordingly, it has been determined that the water of Birecik Reservoir is “mildly hard water” class.

The calcium is the most abundant alkali mineral existing in seas and fresh waters, and it is very important biologically since it constructs the core of many creatures’ skeleton. Calcium increases the development and growth of flora and fauna in lakes. In fresh waters, all the creatures are in metabolic relationship with calcium. The high density of calcium increasing the growth rate of algae and high plants is also effective on distribution of other organisms. Calcium is especially important for Mollusca’s shell and for skeleton structure of the vertebrates, especially the fish (Bremond and Vuichard, 1973; Nisbet and Verneaux, 1970). The calcium values measured in all of the stations on Birecik Reservoir varies between 41.66–53.74 mg/L at both of surface and various depths. The calcium level in fertile waters is 25 mg/L (Cirik and Cirik, 1999). Accordingly, it can be concluded that the water of Birecik Reservoir is under risk, even slightly, from the aspect of fertility in terms of calcium.Normally, calcium exists in fresh waters at higher concentration than magnesium does (Barlas et al., 1995). As seen in Birecik Reservoir (Table 1), calcium values were found to be higher than magnesium values (Boyd, 1992; Boyd et al.1998).

COD is one of the most used collective parameters in environmental pollution. In chemical oxidation, regardless of presence biologically decaying or the speed of decaying, all of the organic matters are oxidized. In oxidation medium, the carbonic organic materials transform into CO_2 and H_2O, while nitrogenous organic compounds transform into NH_3 (Samsunlu 1999).

According to WPCR, the water of Birecik Reservoir is in I. Class water class according to the ammonium levels measured at surface and various depths.

The important of sulfate ion in natural waters is diversified. There should be sulfate in medium in natural waters in order for biological productivity to increase. In adequate level of sulfate in medium prevents the phytoplankton development, and decreases the growth rate of the plants. Hence, the biological productivity decreases. Moreover, in anaerobic mediums, the sulfate ion is degraded to sulfuric hydrogen, while being used by sulfide bacteria in chemosynthetic events. According to WPCR, the water of Birecik Reservoir is in I. and II. Class water class in terms of nitrite values measured in surface waters.

Nitrate is a form of nitrogen mineral that is widely seen in waters rich in terms of oxygen, and it is an important factor that can limit or increase the growth. Pollution of the waters by nitrate occurs due to excessive use of nitrogenous fertilizers in agricultural lands, oxidation of the ammoniac arising due to decay of protein that animal and herbal wastes contain, discharging the domestic and industrial waste waters without refining, uncontrolled removal or storage of animal wastes (Aslan et al., 2003).According to WPCR, if the nitrate concentration in water is 5 mg/L, then the water is I. Class; if it is 10 mg/L, then the water is II. 0Class mildly polluted water; if it is 20 mg/L, then the water is III. Class polluted water; and if it is higher than 20mg/L, then the water is IV. Class severely polluted water. The nitrate values measured at all the stations on Birecik Reservoir varied between 0.629-2.626 mg/L at both of surface and various depths (Table 1). According to WPCR, the water of Birecik Reservoir is I. Class high-quality water in terms of nitrate values. According to trophic situation classification made by OECD (1982), the oligotrophic lakes contain <0.008 mg P/L as total phosphor and <0.661 mg N/L as total nitrogen, while mesotrophic lakes contain <0.027 mg P/L and <0.763 mg N/L, eutrophic lakes contain <0.084 mg P/L and <1.874 mg N/L. But Nürnberg (1996) has stated these limits as <0.010 mg P/L and <0.250 mg N/L for oligotrophic lakes, as 0.010-0.030 mg P/L and 0.350-0.650 mg N/L for mesotrophic lakes, as 0.031-0.100 gm P/L and 0.651-1.200 mg N/L for eutrophic lakes. In WPCR, the table for trophic classification of lakes, ponds, and reservoirs states these limits as ≤10 μg P/L for total phosphor, as ≤350 μg N/L for total nitrogen, and <3.5 μg/L for chlorophyll a for oligotrophic lakes, as 10>TP≥30 μg P/L, 350>TN≥650 μg N/L and 3.5-9.0 μg/L for chlorophyll a for mesotrophic lakes, and 30>TP≥100 μg P/L, 650>TN≥1200 μg N/L and 9.1-25.0 μg/L for chlorophyll a for eutrophic lakes. Birecik Reservoir was defined as mesotrophic in terms of chlorophyll a content. The range of total nitrogen in surface and depths was 0.713-2.792 mg N/L, while the mean value was 2.17 mg N/L. Hence, Birecik Reservoir was defined as eutrophic in terms of total nitrogen content. Phosphor is one of the multidirectional elements that are keys for some complex chemical balances. Phosphor exists in waters in various phosphate types. Dissolved reactive phosphate (orthophosphate) is the only phosphate compound that can be utilized by many plants and microorganisms.

This study has revealed that preventive or rehabilitative precautions must be taken as soon as possible in Birecik Reservoir, which has high-quality water in general, in order to protect the fresh water ecosystems, to ensure the rational usage and sustainable development, and especially to decrease the nitrogen load and to control the amount and qualification of pollutants mixing into the reservoir.

Nitrite is a mid-product of nitrogen cycle. As well as nitrates, also nitrites contribute to plankton development. Moreover, Nisbet and Verneaux (1970) assert that the pollution begins if the concentration of NO_2 in water exceeds 1 mg/l. The concentration of NO_2 in natural waters is generally low. But in locations where the organic pollution is high and oxygen concentration is low, it may reach at high concentrations. According to the limit values in trophy classification system, the lakes in 0.8–1.5 m range are eutrophic, those in 1.4–2.4 m range are mesotrophic, and those in 3.6–5.9 m are oligotrophic (Ryding and Rast, 1989). Accordingly, it is concluded that Birecik Reservoir is in “Mesotrophic Lake” class.

Ammonium ion is not significantly toxic for organisms living within the water. But by transforming into ammoniac depending on high pH and temperature, ammonium may become toxic for fish life and other creatures in aquatic environment (Ünlü et al., 2008). In clean and oxygen-rich waters, the concentration of ammonium compounds is very low.

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