Determination of The Nemrut Crater Lake Turkey Water Quality

Dr. Edip Avsar, Bitlis Eren University
edipavsar@hotmail.com

ABSTRACT

Nemrut Crater Lake is Turkey's largest the world's second largest crater lake. It lies within the borders of Bitlis Province to the west of the Van Lake basin. The average depth is 100m. Since 2013 Ramsar Wetland has been declared and taken under protection. The announcement of a geopark area is on the agenda. The most important source of feed is snow and spring water. The lake level is almost constant and the precipitation and evaporation balance have been established. For this reason, water quality is not changed much, but due to its volcanic nature it is thought to have a unique water quality. The aim of the study is to monitor and determine the specific water quality of Nemrut Crater Lake. For this purpose, 2 samples were taken from 5 points in June and August in 2018 and the water quality was examined and evaluated. It was found that the pH of the water was almost 8.5, it included Arsenic and Boron and the TOC level was very low.

Keywords: Nemrut Cater Lake, Water Quality, Heavy Metals.

INTRODUCTION

Nemrut Crater lake is located in Bitlis Turkey is the biggest crater lake of Turkey and second in the World. The altitude of this lake is 2250 m (Kuluöztürk and Dogru (2015)). The most important source of feed is snow and spring water. The lake water level is almost constant and the precipitation and evaporation balance have been established. For this reason, water quality is not changed much, but due to its volcanic nature it is thought to have a unique water quality (Url1; Url 2).

Water quality monitoring and long term limnologic analysis were being carried out all over the World for crater lakes The main purpose of this investigations are determining the unique water quality and monitoring the variations in water quality in long term (Larson (1996); Larson et al. (2007); Wondimu et al. (2008); Gunkel et al. (2008)).

Figure 1: Nemrut crater lake (Url 3)

The aim of the study is to monitor and determine the specific water quality of Nemrut Crater Lake. According to literature there are very limited study about the Nemrut Crater Lake but non of them dealed with the water quality. One study evaluate the natural radioactivy levels of the lake and it was determiend that the deepest side of the lake radioactivity was increased [1]. Another study investigates the water resource potential of the lake. According to this study 1 meter decrease for water level of the lake equals to rougly 350000 peoples annually water consuption or irrigation requirement of approximately 400 ha agricultural land (Kurttaş and Tezcan (2018)).

For determining the water quality, 2 samples were taken from 5 points in June and August in 2018 and the water quality was examined and evaluated. This is only preliminarly study and covers only the surface water.

MATERIAL AND METODS

Within the scope of the study, sampling and analysis study wetr conducted on 2 different dates in 2018 summer season. According to sampling study plan, samples were taken from 5 different points on the lake surface below the 50 cm depth from the surface. The coordinates of the sampling points are given in the Table 1.

Table 1: Coordinates of sampling points

Sampling Points	Coordinate
1	38.635885; 42.229324
2	38.634553; 42.214738
3	38.621815; 42.218419
4	38.619977; 42.208019
5	38.607486; 42.229267

Location of the lake and sampling points were given in Figure 2.

Figure 2: Location of the lake and sampling points

Devices used in the measurement, measured parameters and measurement methods are given in the Table 2 Numunelerde bakılan parametreler.

Table 2: Measured parameters, devices and methods used in the study

Parameter	Device	Method
TOC (Total organic carbon)	Teledyn Tecmar Torch TOC/TN Analyzer	Standard Methods 5310-B
TN (Total nitrogen)		Standard Methods 4500N-B
pH/temperature	Hach Hq40d Multimeter	USEPA Electrode Method 8156
Conductivity		USEPA Direct Measurement Method 8160
ORP (Oxidation reduxtion potential)		Direct Measurement Method 10228
Dissolved O_2		10360 Direct Measurement, LDO Probe (EPA)
NO_3^--N (Nitrate)	WTW Photolab 7600 UV Vis Spektrophotometer	Standard Methods 4500 NO_3^-- B
Alkalinity	-	Standard Methods 2320-B
Tubidity	WTW Turb 355 IR	ISO 7027 – DIN/EN 27 027
Metals	ICP MS	EPA 200.8 metodu

RESULTS

Water quality parameter results were given in Table 3. Results evaluated According to limit values given in Turkish Surface Water Quality Regulation (Official Gazette date and number 30.11.2012; 28483). According to results, except the O_2 and conductivty water quality level is class I but in terms of O_2 quality class was II and in terms of conductivity level is class III.

According to regulation, class I is represents very good water quality, class II represent good water quality but class III represets middle or polluted water. In terms of conductivity, it is thought that the high pH is due to the carbonates coming from the carbonate rocks around the lake.

The fact that Crater Lake is approximately 1900 meters above sea level is also thought to affect oxygen solubility in lake water. TOC, TN and turbidity values are quite low, pH is generally constant.

In addition, these types of crater lakes have unique qualities. Therefore, it should be monitored for many years in terms of water quality. it is considered to be more appropriate to evaluate water quality in itself.

Table 3: Water quality results

Date	Sample No	Parameters								
		TOC	TN	pH	Temperature	Conductivity	ORP	Dissolved O_2	NO_3^--N	Tubidity
		mg/L	mg/L	-	^{0}C	µS/cm	mV	mg/L	mg/L	NTU
26.06.2018	1	<0.05	0.5786	8.49	20.4	528	123.7	6.98	1.8	0.3
	2	<0.05	0.6703	8.51	19	551	54.9	6.72	1.8	0.46
	3	<0.05	0.4519	8.52	18.4	511	100.2	6.81	1.8	0.58
	4	<0.05	0.5247	8.52	18.4	516	164.8	7.01	2.1	0.28
	5	<0.05	0.3768	8.59	18.6	517	165.9	7.1	2	0.35
	Average	<0.05	0.5205	8.53	18.9	525	121.9	6.9	1.9	0.39
3.08.2018	1	<0.05	0.5786	8.49	20.4	528	123.7	6.98	1.8	0.3
	2	0.9453	0.1039	8.58	21.9	530	90.2	6.53	1.5	0.47
	3	0.6724	0.0116	8.5	20.4	526	106.9	6.77	3.2	0.29
	4	0.8329	<0.05	8.48	21.9	525	108.6	6.58	3.7	0.35
	5	1.1964	<0.05	8.54	20.6	526	111.7	6.73	1.6	0.13
	Average	0.9118	0.2314	8.52	21.0	527	108.2	6.72	2.4	0.31
Quality Class		I (BOD<4;COD<25)	I (<3.5)	I (6-9)	-	III (<1000)	-	II (6-8)	I (<3)	-

Metal measurement results of the samples were given in Table4 and Table 5. In terms of measured metal concentrations; metals other than arsenic, boron sodium potassium were below the limit of measurement.

Table 4: Metal measurement results of the samples I

Date	Sample No	Metals				
		Sn	**Se**	**As**	**Sb**	**Hg**
		mg/L				
26.06.2018	1	<0,05	<0,05	<0,025	<0,1	<0,025
	2	<0,05	<0,05	0,037	<0,1	<0,025
	3	<0,05	<0,05	0,034	<0,1	<0,025
	4	<0,05	<0,05	0,032	<0,1	<0,025
	5	<0,05	<0,05	0,032	<0,1	<0,025
3.08.2018	1	<0,05	<0,05	0,034	<0,1	<0,025
	2	<0,05	<0,05	0,035	<0,1	<0,025
	3	<0,05	<0,05	0,033	<0,1	<0,025
	4	<0,05	<0,05	0,032	<0,1	<0,025
	5	<0,05	<0,05	0,033	<0,1	<0,025

Table 5: Metal measurement results of the samples II

Date	Sample No	Metals															
		Cd	**Pb**	**Cu**	**Cr**	**Zn**	**Fe**	**Mn**	**Al**	**Ba**	**Be**	**Ag**	**Ni**	**K**	**Na**	**B**	**Co**
		mg/L															
26.06.2018	1	<0,002	<0,01	<0,02	<0,02	<0,1	<0,02	<0,02	<0,05	<0,02	<0,002	<0,02	<0,02	7,60	87,9	1,74	<0,005
	2	<0,002	<0,01	<0,02	<0,02	<0,1	<0,02	<0,02	<0,05	<0,02	<0,002	<0,02	<0,02	7,22	84,6	1,75	<0,005
	3	<0,002	<0,01	<0,02	<0,02	<0,1	<0,02	<0,02	<0,05	<0,02	<0,002	<0,02	<0,02	8,38	84,8	1,75	<0,005
	4	<0,002	<0,01	<0,02	<0,02	<0,1	<0,02	<0,02	<0,05	<0,02	<0,002	<0,02	<0,02	7,08	84,7	1,77	<0,005
	5	<0,002	<0,01	<0,02	<0,02	<0,1	<0,02	<0,02	<0,05	<0,02	<0,002	<0,02	<0,02	7,00	81,6	1,76	<0,005
3.08.2018	1	<0,002	<0,01	<0,02	<0,02	<0,1	<0,02	<0,02	<0,05	<0,02	<0,002	<0,02	<0,02	7,94	84,7	1,88	<0,005
	2	<0,002	<0,01	<0,02	<0,02	<0,1	<0,02	<0,02	<0,05	<0,02	<0,002	<0,02	<0,02	7,65	88,69	1,81	<0,005
	3	<0,002	<0,01	<0,02	<0,02	<0,1	<0,02	<0,02	<0,05	<0,02	<0,002	<0,02	<0,02	7,03	82,6	1,83	<0,005
	4	<0,002	<0,01	<0,02	<0,02	<0,1	<0,02	<0,02	<0,05	<0,02	<0,002	<0,02	<0,02	7,30	88,1	1,81	<0,005
	5	<0,002	<0,01	<0,02	<0,02	<0,1	<0,02	<0,02	<0,05	<0,02	<0,002	<0,02	<0,02	7,30	86,7	1,82	<0,005

Arsenic, boron sodium and potassium are thought to be in the structure of magmatic fluids and mixed to the lake water in this way. Arsenic (0.034<0.053) average concentration was below but Boron (1.792>0.707) was above the Turkish Surface Water Quality Regulation limits.

DISCUSSION

As a conclusion;

- These types of crater lakes have unique qualities
- Therefore, it should be monitored for many years in terms of water quality
- It is considered to be more appropriate to evaluate water quality in itself
- According to results water quality was class III.
- In terms of measured metal concentrations; metals other than arsenic, boron sodium potassium were below the limit of measurement

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