



Determination of Nitrite, Nitrate, Phosphate and Fluoride Quantities in Water and Sediment of Eğirdir Lake, Turkey

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Keywords

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Abstract: In this study that was carried out between February 2011 and January 2012, sedimentation of nitrite (NO_2^-), nitrate (NO_3^-), phosphate (PO_4^{3-}), fluoride (F^-) in water and sediment samples of 4 different stations of Eğirdir Lake and their seasonal changes were examined. During the study, ions in water and sediment that collected from 4 different stations and in seasonal periods were measured by Ion Chromatography (IC) device. Eğirdir Lake's water temperature was determined as 7.2-26.7 °C and pH range as 7.58-8.54. As a result of ion analysis of water nitrite and phosphate were not detected in any season. While fluoride was detected in all seasons and all stations, nitrate was measured in different seasons and stations. It was detected that the most accumulated anion in water was fluoride. According to our findings of sediment, nitrite was not detected in any season. While nitrate and fluoride were detected in all seasons and all stations, phosphate was measured in different seasons and stations. It was determined that the most accumulated anion in sediment was nitrate.

Eğirdir Lake water is ranking in I. quality water class in terms of studied parameters.

Eğirdir Gölü'nün (Türkiye) Su ve Sedimentinde Nitrit, Nitrat, Fosfat ve Florür Miktarlarının Belirlenmesi

Anahtar Kelimeler

Eğirdir Gölü
Nitrit
Nitrat
Fosfat
Florür

Özet: Şubat 2011 - Ocak 2012 tarihleri arasında yapılan bu çalışmada; Eğirdir Gölü'nün dört farklı istasyonundaki su ve sediment örneklerinde nitrit (NO_2^-), nitrat (NO_3^-), fosfat (PO_4^{3-}), florür (F^-) birikimi ve mevsimlere göre değişimlerinin incelenmesi amaçlanmıştır. Çalışma süresince; 4 farklı istasyondan mevsimlik periyotlarla alınan su ve sedimentteki iyon ölçümleri İyon Kromatografi (IC) cihazı ile yapılmıştır. Eğirdir Gölü'nün su sıcaklığı 7,2-26,7 °C, pH aralığı ise 7,58-8,54 arasında belirlenmiştir. Suda yapılan iyon analizleri sonucunda; nitrit ve fosfat hiçbir mevsimde tespit edilememiştir. Florür her mevsim bütün istasyonlarda ölçülürken nitrat farklı mevsim ve istasyonlarda ölçülmüştür. Suda en fazla biriken anyonun florür olduğu görülmüştür. Sedimentte yapılan iyon analizlerinde ise; nitrit hiçbir mevsimde tespit edilememiştir. Nitrat ve florür her mevsim bütün istasyonlarda ölçülürken, fosfat farklı mevsim ve istasyonlarda ölçülmüştür. Sedimentte en fazla biriken anyonun nitrat olduğu görülmüştür. Eğirdir Gölü suyu çalışılan parametrelere göre I. kalite su sınıfında yer almaktadır.

1. Introduction

Water is vital for humans and the other living beings. As a result of the developments in technology, available water sources are reducing and becoming polluted by industrial and urban waste.

There are nutritional elements and compounds in water. The most important ones are compounds of nitrogen (N) and phosphate (PO_4^{3-}). The compounds of nitrogen and phosphate can accumulate and cause pollution in still waters by rains, by artificial or natural fertilizers that are used for agricultural purposes mixing in rain water and by drain waters

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mixing in surface waters. Fluoride ion include in waters in different ways and can cause unfavourable impacts for human health especially from drinking waters. In recent years a great number of studies were performed in Turkey and in the world on determination of ion accumulation in aquatic environments (Ağaoğlu et al., 2007; Bulut et al., 2009, 2011; Atılğan et al., 2009; Buhan et al., 2010; Taş, 2011; Ayvaz et al., 2011; Altinkale-Demer and Memiş, 2011; Çiçek et al., 2013). In the aquatic environment acceptable values of nitrite, nitrate, phosphate and fluoride were 10.0 mg/L, 4.2 mg/L, 15.0 mg/L and 1.5 mg/L respectively (Anonim, 2002).

The aim of this study is to determine the levels of nitrite, nitrate, phosphate and fluoride accumulated in water and sediment in different stations of Eğirdir Lake and to evaluate them according to the criteria of Turkish Standarts Institutions and Fisheries Control Regulations.

2. Material and Method

Eğirdir Lake is the 4th largest lake of Turkey with a surface area of 468 km². Its coordinates are 38° 15' N, 30° 52' E and altitude is about 917 m. Its average depth is 14 m and the deepest point is approximately 16.5 m. Its length is 50 km in direction of North-South and varies between 3 and 15 km in direction of East-West.

To determine the levels of nitrite, nitrate, phosphate and fluoride accumulated in water and sediment of Eğirdir Lake, seasonal studies were carried out in 4 stations which their locations and coordinates are given below (Figure 1.).

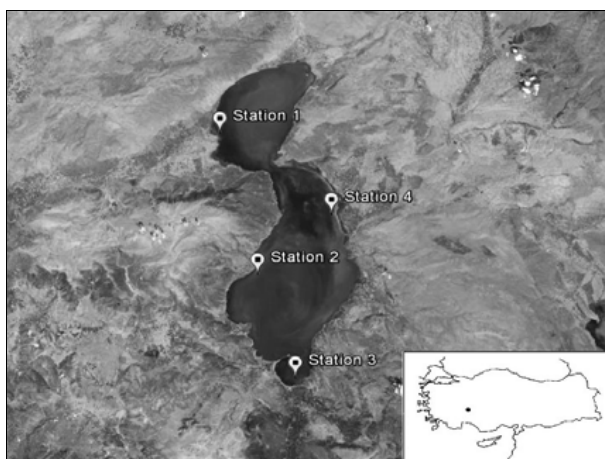


Figure 1. Eğirdir Lake and study stations.

Station 1: Senirkent - Kayaagzı, 38° 08'N, 30° 46'E

Station 2: Barla - Bağören, 38° 01'N, 30° 49'E

Station 3: Eğirdir - Köprü ayağı, 37° 50'N, 30° 52'E

Station 4: Gelendost, 38° 05'N, 30° 56'E

Water temprature and pH value in the stations were measured directly during the field studies. Collected water samples for ion analysis were contained in 500 ml coloured bottles and the sediment samples that were collected from the bottom of the lake by ekman shovel were put in sterile coloured containers and all samples stayed in freezer until the time of analysis.

Ions in water and sediment were measured according to Standard Methods (Anonymous, 2005) with 3 repetition in Dionex brand ICS 3000 model IC device. 1 mL of H₂O₂ and sediment samples (0.5 g) were digested in a mixture of 2 mL of HNO₃ (65%), 6 mL HCl (37%) in a microwave digestion system for 31 min and diluted to 10 mL volume with deionised water. Water samples were analysed directly. The detection limits of each ion are nitrite 0.01 mg/L, nitrate 0.01 mg/L, phosphate 0.05 mg/L, fluoride 0.01 mg/L.

3. Results

3.1. Temperature and pH Values of Water

Temprature of water in Eğirdir Lake was measured between 7.2-26.7 °C. The lowest temprature was measured in Station 1 in winter and the highest temprature was in Station 2 in summer.

It is measured that the pH values of water was 7.58-8.54. While the highest pH was measured in Station 1 in summer, the lowest pH was measured in Station 4 in winter.

3.2. Anions in Water and Sediment

Seasonally measured nitrite, nitrate, phosphate and fluoride values in water and sediment belonging to 4 different stations of Eğirdir Lake were shown in Table 1.

As a result of ion analysis in Eğirdir Lake water, fluoride was measured in all seasons and all study stations, nitrate was measured in all stations except Station 1 in winter and detected in all stations in spring. Nitrite and phosphate values were below the analysis limit for IC device in all seasons.

It was determined that fluoride has the highest value in Station 4 in summer (0.27 mg/L) and the lowest value in Station 4 in winter (0.16 mg/L). Nitrate has the highest value in Station 4 in winter (1.22 mg/L) and the lowest value in Station 2 in winter (0.21 mg/L).

As a result of ion analysis in sediments of Eğirdir Lake, while nitrate and fluoride were measured in all seasons and all stations, phosphate was measured in all stations in spring and summer but in different stations in autumn and winter. Nitrite was below the analysis limit for IC device in all seasons and all stations.

Table 1. Seasonally measured nitrite, nitrate, phosphate and fluoride values in water and sediment belonging to 4 different stations of Eğirdir Lake (mg/L and mg/kg).

Seasons	Stations	Water/Sediment	Nitrite	Nitrate	Phosphate	Fluoride
Spring	Station 1	Water	*	0.34	*	0.21
		Sediment	*	170.00	23.00	33.00
	Station 2	Water	*	0.50	*	0.20
		Sediment	*	147.23	34.32	51.98
	Station 3	Water	*	0.43	*	0.23
		Sediment	*	94.74	19.74	44.41
	Station 4	Water	*	0.52	*	0.24
		Sediment	*	87.94	20.75	36.56
Summer	Station 1	Water	*	*	*	0.20
		Sediment	*	34.76	19.31	39.58
	Station 2	Water	*	*	*	0.21
		Sediment	*	99.09	89.29	188.38
	Station 3	Water	*	*	*	0.21
		Sediment	*	25.91	21.59	59.23
	Station 4	Water	*	*	*	0.27
		Sediment	*	57.36	20.77	65.27
Autumn	Station 1	Water	*	*	*	0.17
		Sediment	*	5.00	*	27.00
	Station 2	Water	*	*	*	0.22
		Sediment	*	56.00	144.00	52.00
	Station 3	Water	*	*	*	0.19
		Sediment	*	17.00	*	11.00
	Station 4	Water	*	*	*	0.20
		Sediment	*	13.00	*	10.00
Winter	Station 1	Water	*	*	*	0.19
		Sediment	*	27.00	25.00	41.00
	Station 2	Water	*	0.21	*	0.20
		Sediment	*	41.00	*	43.00
	Station 3	Water	*	0.76	*	0.23
		Sediment	*	102.00	12.00	49.00
	Station 4	Water	*	1.22	*	0.16
		Sediment	*	32.00	8.00	14.00
Average	Water	*	0.57	*	0.21	
	Sediment	*	63.13	36.48	47.84	

*: Below the analysis limit.

It was determined that nitrate has the highest value in Station 1 in spring (170.00 mg/kg) and the lowest value in Station 1 in autumn (5.00 mg/kg). Phosphate has the highest value in Station 2 in autumn (144.00 mg/kg) and the lowest value in Station 4 in winter (8.00 mg/kg). And finally, fluoride has the highest value in Station 2 in summer (188.38 mg/kg) and the lowest value in Station 4 in autumn (10.00 mg/kg).

4. Discussion

In this study that was carried out in Eğirdir Lake, it was determined that water pH values are 7.58-8.54 and water temperature is 7.2-26.7 °C.

As a result of ion analysis in the water of Eğirdir Lake, fluoride was measured in all seasons and all study stations, nitrate was measured in all stations except Station 1 in winter and detected in all stations in spring. Nitrite and phosphate values were below the analysis limit in all seasons. In general it was

observed that the most accumulated anion in water was fluoride and its highest value was in Station 4 in summer (0.27 mg/L). As a result of ion analysis in the sediment, while nitrate and fluoride were measured in all seasons and all study stations, phosphate was measured in spring and summer for all stations but measured in autumn and winter for different stations. Nitrite values were below the analysis limit in all seasons and stations. In general it was observed that the most accumulated anion in sediment was nitrate and its highest value was in Station 1 in spring (170.00 mg/kg). Levels of these anion amounts were obtained differently because of direct discharge of the agricultural waste and sewage as seasonal.

According to Ministry of Food, Agriculture and Livestock Water Pollution Control Regulations, acceptable values of some ions in a receiver environment (water and sediment) are defined as; for nitrite 0.50 mg/L, for nitrate 50 mg/L, for phosphate 15 mg/L and for fluoride 1.5 mg/L

(Anonymous, 2008). When the ion quantities that were detected in the receiver environment of Eğirdir Lake are compared to the acceptable values of the anions for aquatic environments given above, it is apparent that there is not any danger in the water in terms of anion accumulation. However the sedimental values for Nitrate (spring 87.94 – 170.00 mg/kg, summer 57.36 – 99.09 mg/kg, autumn 56.00 mg/kg, winter 102.00 mg/kg), Phosphate (spring 19.74 – 34.32 mg/kg, summer 19.31 – 89.29 mg/kg, autumn 144.00 mg/kg, winter 25.00 mg/kg) and Fluoride (spring 33.00 – 51.98 mg/kg, summer 39.58 – 188.38 mg/kg, autumn 10.00 – 52.00 mg/kg, winter 14.00 – 49.00 mg/kg) are higher than the acceptable values in four seasons.

In conclusion, Eğirdir Lake has an important fresh water potential in Turkish Lakes Region in terms of ecological characteristics and water quality. According to the standards of drinking and utilizing waters that are placed in Water Pollution Regulations (Anonymous, 2008), Eğirdir lake water is situated in 1st Quality water class in terms of nitrite, nitrate, phosphate and fluoride levels. However, there is an accumulation higher for these anion levels than the acceptable values in the sediment. This situation shows that Eğirdir Lake has been polluted by industrial waste, urban waste, agricultural pesticides and chemical fertilizers from surrounding areas. For this reason, certain measures should be taken against the possible threats that can increase the anionic pollution in the lake, pesticides and chemical fertilizers for agricultural purposes should be prevented from contaminate the lake and their uses should be controlled by management strategies.

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