

DISTRIBUTION AND ABUNDANCE OF *ARTEMIA SALINA* IN THE SALT LAKE BASIN (CENTRAL ANATOLIA, TURKEY)

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ABSTRACT

In this study, the distribution and abundance of *Artemia salina* in 10 different stations of the Salt Lake basin were investigated. In addition, its relationship to pH, dissolved oxygen, temperature, electrical conductivity and water levels were analyzed. Field studies were carried out from July to August of 2010. *Artemia salina* was observed in five of these stations. *Artemia salina* was not seen in some stations that have high electrical conductivity. It is determined that, in the station named Tersakan Lake where electrical conductivity was 154 mS/cm, *Artemia salina* is more abundant when compared to the other stations. But as underground water pumps that are built for the irrigation of agricultural lands decrease water levels, *Artemia salina*'s life is under threat.

RESUMEN: Distribución y abundancia de *Artemia salina* en la Cuenca del Lago Salado (Central Anatolia, Turquía).

En este estudio, la distribución y la abundancia de *Artemia salina* en 10 diferentes estaciones de la cuenca del Lago Salado fueron investigadas. Además, su relación con el pH, oxígeno disuelto, temperatura, conductividad eléctrica y nivel del agua fueron analizados. Estudios de campo fueron llevados a cabo desde julio hasta agosto de 2010. La *Artemia salina* fue observada en cinco de las estaciones de estudio. La *Artemia salina* no fue vista en algunas de las estaciones que tienen alta conductividad eléctrica. Se determinó que, en la estación llamada Lago Tersakan, donde la conductividad eléctrica fue de 154 mS/cm, la *Artemia salina* es más abundante cuando comparada con otras estaciones. Pero como las bombas de agua subterráneas que se construyen para el riego de las tierras agrícolas disminuyen el nivel del agua, la vida de *Artemia salina* está bajo amenaza.

REZUMAT: Distribuția și abundența speciei *Artemia salina* în cuveta Lacului Sărat (Anatolia Centrală, Turcia).

În prezentul studiu, s-au analizat distribuția și abundența speciei *Artemia salina* în 10 puncte de prelevare diferite din lacul Tuz. De asemenea, au fost analizate efectele pH-ului, ale oxigenului dizolvat, temperaturii, conductivității și nivelului apei asupra celor doi parametri populaționali considerați. Cercetările de teren au fost efectuate în perioada iulie-august 2010. *Artemia salina* a fost observată în cinci din cele 10 stații. *Artemia salina* a lipsit în unele stații, în care apa prezintă cantități mari de săruri dizolvate (conductivitate electrică mare). S-a concluzionat că în stația Tersakan Lake unde conductivitatea a fost de 154 mS/cm, *Artemia salina* este mai abundentă decât în celelalte stații. Din păcate, forajele care pompează apă din pânză freatică pentru a fi folosită pentru irigarea terenurilor agricole scad nivelul apei, amenințând existența speciei.

INTRODUCTION

Artemia salina appear naturally in salt lakes, is used as live bait in aquariums, freshwater and marine fish culture, and as the main diet of some crustacean species because of its high nutritional value (Bengtson et al., 1991; Lengyel et al., 2012).

Artemia salina, which constitutes the second level of the food chain in the Salt Lake, feeds on suspended particles, bacteria and algae.

Similarly, flamingos and some other birds feed on *Artemia salina*.

This is why *Artemia salina* has a big importance on the energy cycle in the Salt Lake.

According to Başbuğ (1999), the *Artemia salina* species living in the Salt Lake, and it reproduces parthenogenetically.

In the same research on *Artemia salina* in 1995 (Başbuğ, 1999), reproduction aspects and fecundity were analyzed.

This study was carried out in order to determine and reveal the distribution of *Artemia salina* in the Salt Lake basin, its abundance and its relationship with water parameters in 10 different stations.

MATERIAL AND METHODS

Water was taken a total of eight times (200 liters) from each of the 10 stations (Tab. 1, Fig. 2) in the Salt Lake basin; the water was filtered with a 55 µm plankton net and put into 500 ml plastic bottles.

Right after this, 4% formaldehyde was added into the filtered samples and they were preserved.

The samples were brought to the laboratory and counted under a stereo microscope; individual numbers in the 200 liters were calculated and individual number per one m³ was determined.

On the other hand, some water parameters were calculated in this study.

Study area

Salt Lake (Fig. 1a, b) is situated at the center of Turkey (Fig. 2).

It is the second biggest lake in terms of square measure; it has borders with Aksaray, Konya and Ankara cities.

More than half of the country's salt need is supplied by this lake. Surface area of the lake is 1,500 km² and the altitude is 905 meters.



Figure 1a: Salt Lake.



Figure 1b: Salt Lake.

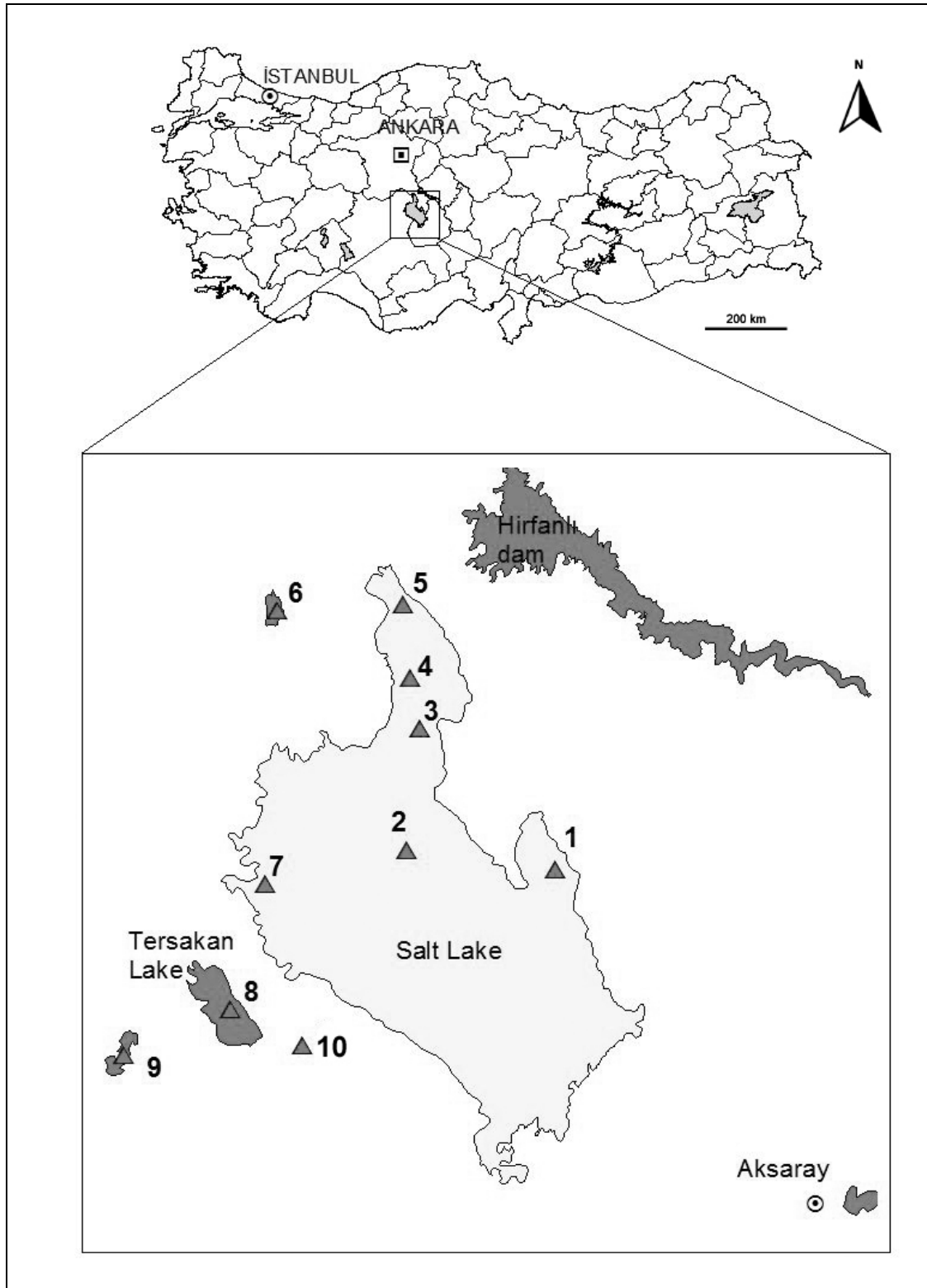


Figure 2: Sampling area and stations (1-10) in Salt Lake basin.

RESULTS AND DISCUSSION

According to table 1, *Artemia salina* is observed only in five of these stations (1, 6, 8, 9, and 10). These water bodies are: Salt Lake Aksaray, Düden Lake, Tersakan Lake, Bolluk Lake and Acı Lake. All of the water bodies where *Artemia salina* was determined are separated from the main water resources of the Salt Lake and shaped as distinctive lakes in time. *Artemia salina* was not seen in other stations.

Table 1: Measured water parameters, coordinates and individuals in one m³ during the study in June, July and August of 2010.

Recorded parameters	Water level (cm)			Individuals in one m ³			Water temperature (°C)			Electrical conductivity (mS/cm)			Dissolved oxygen (mg/l)			pH			GPS coordinates	
	Stations	June	July	August	June	July	August	June	July	August	June	July	August	June	July	August	June	July		August
1. Station (Salt Lake Aksaray)		25	25	23	126	148	141	21	22	21	150	156	153	4.6	4.8	4.6	7.9	7.8	7.8	N 38°46' E 33°36'
2. Station (Salt Lake)		10	9	10	0	0	0	21	22	21	429	442	439	2.9	3.1	3.0	7.9	7.9	8.0	N 38°47' E 33°23'
3. Station (Şereflikoçhisar)		9	9	9	0	0	0	21	21	21	513	517	516	2.8	2.9	2.8	8.3	8.1	8.1	N 38°56' E 33°23'
4. Station (Salt Lake Kulu)		9	8	8	0	0	0	21	22	22	508	513	511	3.6	3.4	3.7	8.1	8.0	7.9	N 39°0' E 33°23'
5. Station (Salt Lake Ankara)		8	8	8	0	0	0	21	22	21	494	502	501	2.8	3.0	2.9	8.0	7.8	8.0	N 39°5' E 33°21'
6. Station (Düden Lake)		26	26	25	208	223	201	20	22	21	13	14	13	7.5	7.4	8.3	9.4	9.1	9.3	N 39°5' E 33°8'

Table 1 (continued): Measured water parameters, coordinates and individuals in one m³ during the study in June, July and August of 2010.

Recorded parameter s	Water level (cm)			Individuals in one m ³			Water temperature (°C)			Electrical conductivity (mS/cm)			Dissolved oxygen (mg/l)			pH			GPS coordinate	
	Stations	June	July	August	June	July	August	June	July	August	June	July	August	June	July	August	June	July		August
7. Station (Salt Lake Kaynak)		12	12	12	0	0	0	20	22	21	204	223	214	4.5	5.1	4.9	8.0	7.8	7.9	N 38°46' E 33°13'
8. Station (Tersakan Lake)		91	86	72	1,041	1,271	1,132	19	21	21	148	154	150	8.9	8.6	8.7	7.9	7.8	7.9	N 38°35' E 33° 4'
9. Station (Bolluk Lake)		46	44	–	285	342	–	20	22	–	141	149	–	7.5	7.4	–	8.4	8.2	–	N 38°30' E 32°54'
10. Station (Acıgöl, Gölyazı)		28	23	22	91	147	95	20	22	21	26	33	31	4.4	4.5	4.4	8.7	8.6	8.9	N 38°31' E 33°13'

Distribution of *Artemia salina* in the Salt Lake

Artemia salina is able to live until 4,500 m altitude, which is a wide range (Xin et al., 1994). The Salt Lake study environment is situated at 905 m altitude. *Artemia salina*, living in hyper saline waters is recorded at more than 600 coastal and inland waters (Van Stappen, 2002). One of these water areas where *Artemia salina* is found naturally as stocks, is in Van Lake, the second biggest lake of Turkey in terms of square meters; it is situated at the center of the country (between Aksaray, Ankara and Konya cities). It is reported that *Artemia salina* in Turkey is found in Ayvalık Saltpan (Koru, 2006), Çamaltı Saltpan (Koru, 2004), Salt Lake Basin (Aksaray, Ankara and Konya) (Triantaphyllidis et al., 1998) and Gökçeada (Çanakkale). In the present study, *Artemia salina* is only found in five of the stations. These stations are; Salt Lake Aksaray, Düden Lake, Tersakan Lake, Bolluk Lake and Acı Lake.

Distribution of *Artemia salina* in the Salt Lake is analyzed by Başbuğ (1999); according to the analysis of these samples collected from these stations, *Artemia salina* is found only in two stations (Devekonağı and Çalören). During the past 15 years, water levels of some water sources decreased while some lakes completely disappeared. The station named as the 5th station by Başbuğ (1999) is the same area which we named as the 1st, Salt Lake Aksaray station in our study. *Artemia salina*'s presence is determined in both studies in the area. Different from Başbuğ (1999), as in our study, new living spaces are determined where *Artemia salina* is distributed.

Abundance of *Artemia salina* in the Salt Lake

According to the data of the field study, it was determined that the number of flamingos in the 8th station, named as Tersakan Lake, where *Artemia salina* is found densely, is much higher than the other water bodies. Related with *Artemia salina* density, it is observed that the flamingo numbers in Düden and Bolluk Lakes are higher than the number of flamingos in the area which we name as the 1st station (Salt Lake Aksaray) and in Acıgöl (Gölyazı). There were no flamingos in the other five areas where *Artemia salina* is not found. This result shows us that there is a direct proportion between the *Artemia salina* density and flamingo numbers.

It is observed that the electrical conductivity in the 8th station, Tersakan Lake, is the most suitable value for *Artemia salina*; and individual number measured per cubic meter is found to be very high in this station. *Artemia salina* is a very economic creature in terms of high feeding value, egg production and being used as aquarium fisheries in order to produce live bait. According to the study's result, in case of building a natural *Artemia salina* facility in future, the most suitable place is Tersakan Lake.

Relation between electrical conductivity and *Artemia salina*

At the end of measuring water parameters, we determined that in these five different areas in the Salt Lake, where *Artemia salina* is observed, the level of salinity content rate is much higher than the other aquatic areas. This result shows that *Artemia salina* can not accommodate in aquatic areas where salinity content rate is high. During the study, the lowest electrical conductivities were measured in July and August, at the 6th station as 13 mS/cm (Düden Lake); the highest electrical conductivity was measured in June, at the 3rd station as 517 m²/cm (Şereflikoçhisar) The densest electrical conductivity was in July, at the 8th station (Tersakan Lake) and measured to be 154 m²/cm. On the other hand, *Artemia salina* is not seen in the stations where electrical conductivity is 204 m²/cm and 517 m²/cm. In this case, 154 m²/cm values for electrical conductivity is defined to be the most appropriate value for *Artemia salina*'s fertility. In addition to this, according to the measured values, *A. salina* can not live in 204 mS/cm or higher electrical conductivity.

Relation between water levels and *Artemia salina*

During the study, it was noticed that there are many underground water pumps in the region built for the irrigation of agricultural lands. These water pumps are used in the irrigation of agricultural lands during the summer season before waters reach the lake in the region. It is observed that water levels in the basin are very low because of the low water capacity of other water resources in the region during summer. Salinity levels increase as water heats up more during summer because of the low water levels. The increase in salinity levels create a toxic effect on *Artemia salina*. This is why, the lives of flamingos living in Salt Lake basin, whose essential nutrients is *Artemia salina*, are under threat.

Finally, the implications of these results might be valuable to balance the conservation and exploitation of natural populations of *Artemia salina* in the Salt Lake basin in Turkey.

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