Turk J Zool
24 (2000) 9–16

A Preliminary Study on the Ostracoda (Crustacea) Fauna of Lake Akşehir

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Received: 08.02.1999

Abstract: In this study, material was collected from Lake Akşehir in the years 1997 to 1999. The materials, collected from six localities, were evaluated and eleven speceis *(Ilyocypris biplicata, Ilyocypris gibba, Candona angulata, Candona compressa, Candona neglecta, Eucypris zenkeri, Cyprinotus salinus, Heterocypris incongruens, Ilyodromus olivaceus, Cypridopsis vidua, Limnocythere inopinata)* belonging to eight genera were determined.

Key Words: Lake Akşehir, Ostracoda, Crustacea, Fauna, Taxonomy, Turkey.

Akşehir Gölü'nün Ostracoda (Crustacea) Faunası Üzerine bir Ön Çalışma

Özet: Bu çalışmada, materyal 1997-1999 yılları arasında Akşehir Gölü'nden toplanmıştır. Altı lokaliteden toplanan materyal değerlendirilmiş ve sekiz cinse ait onbir tür *(Ilyocypris biplicata, Ilyocypris gibba, Candona angulata, Candona compressa, Candona neglecta, Eucypris zenkeri, Cyprinotus salinus, Heterocypris incongruens, Ilyodromus olivaceus, Cypridopsis vidua, Limnocythere inopinata)* saptanmıştır.

Anahtar Sözcükler: Akşehir Gölü, Ostracoda, Crustacea, Fauna, Taksonomi, Türkiye

Introduction

Anatolia is an important region in terms of its geological, ecological and zoogeographical characteristics. Geologically, Anatolia has undergone many changes, and the fauna of the region has also displayed considerable variation. During these changes, many animal species originating from different zoogeographical regions migrated to Anatolia. In particular, many animal species moved to Anatolia in the last glacial period. In this period, life conditions were appropriate for these species in Anatolia. For example, the climate was suitable for many life forms during thei last Ice Age. Many paleontological ad zoological findings in Anatolia have confirmed this theory.

Nevertheless, taxonomic studies on the fauna of Anatolia have been limited to a few groups up to the present time.

Recent extensive studies conducted on certain animal groups have yielded valuable information about Anatolia. The subclass Ostracoda has recently been studied. Schäefer (1) and Hartmann (2) conducted the first studies on the Ostracoda fauna of Anatolia.

The following studies were used for determining freshwater Ostracoda fauna in Anatolia and Thrace: Gülen (3, 4, 5, 6 and 7); Altınsaçlı (8 and 9); Altınsaçlı and Kubanç (10); Kubanç and Altınsaçlı (11); Altınsaçlı and Yılmam (12) and Külköylüoğlu et al. (13 and 14).

The aim of this study was to contributed to knowledge of the recent cypridid ostracod fauna of Lake Akşehir.

Material and Methods

The material was collected from Lake Akşehir in the period 1997-1999. Freshwater ostracods are found in calm and shallow water. Therefore, the material was collected from lake and stream water. In order to collect living froms in the mud, a deep sample container bottom sample container=Bager) and special sieves were used.

Ostracods were collected in shallow water (<1m depth) with a Müller plankton net, and immediately fixed in 4% formaldehyde. In the laboratory, the samples were washed with pressurised tap water, filtered through three standard-sized sieves (of 2: 1: 0.25 mm mesh size, respectively) and stored in 70% ethanol. Then, the samples were conserved in 70% ethanol and glycerine (in a 1:1 ratio). Species identification was based on the soft body parts and valves.

All materials were deposited in the Zoology Museum of the Biology Department, University of Istanbul, Turkey.

Study Area

Lake Akşehir is a tectonic lake which has 35.000 hectares of surface area (maximum size). The deepest part of the lake is 7 meters in depth. According to Yarar and Magnin (15), Lake Akşehir is located in the central Anatolia region (38°36' N and 31°18' E) of Turkey, within the borders of Konya and Afyon Provinces (15). Five streams from the Sultan Mountains in addition to the Eber Channel feed the lake but there is no water discharge. The water is fresh in both the southern and western parts, while the salt ratio increases from 1.3‰ to 2.0‰ towards both the middle and northern parts, as many springs and small streams feed the southern and western parts of the lake. According to many geologists, subterranean spring waters from a depth of about 42 meters make the water of the lake salty as they carry sand. Recently, some parts of the lake have been covered by marshes extending to several kilometres in width. The lake water level is falling as a result of freshwater use inagriculture. Moreover, agricultural pesticides have polluted the water of this lake. Nevertheless, it is an important habitat and wetland for many vertebrates and invertebrates. The material was collected from six localities. These localities are shown in Figure 1.

Lacolities

Locality 1: Lakeshore, Taşköprü Village, Lake Akşehir

Locality 2: Lakeshore, Sorkun Village, Lake Akşehir

Locality 3: Sorkun Stream, Sorkun Village, Lake Akşehir.

Locality 4: Lakeshore, Ortaköy Village, Lake Akşehir.

Locality 5: Lakeshore, Üçkuyu Village, Lake Akşehir.

Locality 6: Lakeshore, Karacaova Plain, Lake Akşehir.

Findings and Taxonomy

The classification of Hartmann and Puri (16) was followed in this study.

Phylum	:	ARTHROPODA
Class	:	CRUSTACEA
Subclass	:	Ostracoda Lattreille, 1806
Order	:	Podocopida G.W. Müller, 1894
Suborder	:	Podocopa Sars, 1866
Superfamily	:	Cypridacea Baird, 1845

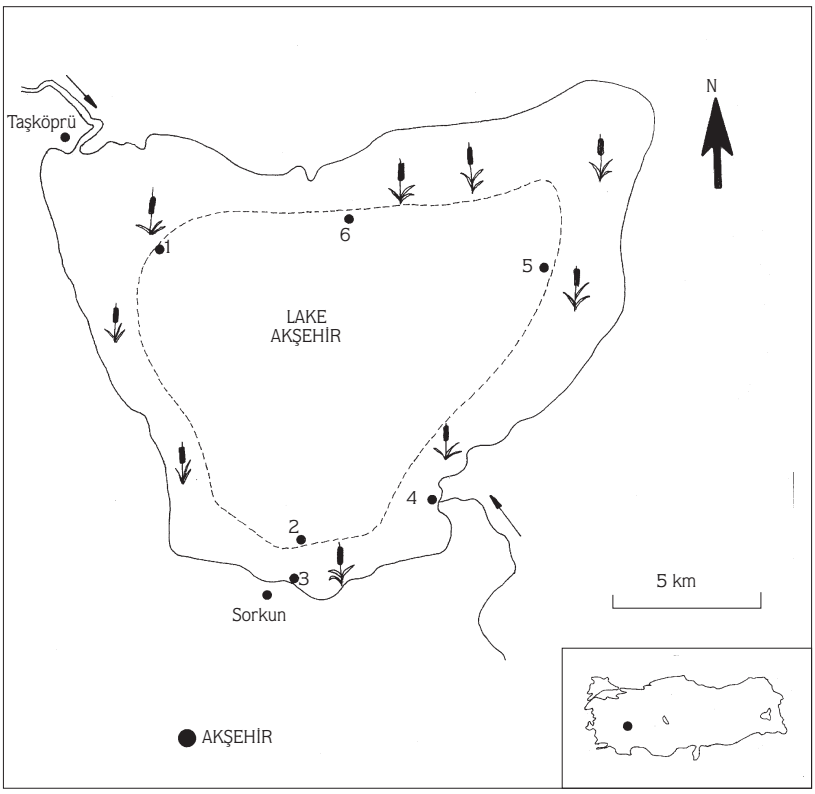

Figure 1. Lake Akşehir and localities.

Family : Ilyocyprididae Kaufmann, 1900

Genus : *Ilyocypris* Brady-Norman, 1889

Ilyocypris biplicata (Koch, 1838).

Material: Locality-2, 19.07.1997, 2VV; Locality-3, 19.07.1997, numerous W and M M; Locality-2, 10.01.1998, 2VV; Locality-3, 11.01.1998, 1V; Locality-2, 18.04.1999, 4VV; Locality-3, 18.04.1999, 7VV and 3M M; Locality-2, 12.06.1999, 3VV; Locality-3, 13.06.1999, 8VV and 4M M.

Previous Records from Turkey: Bursa, Bilecik (5); İzmir (8); İstanbul (13); Lake İznik, Lake Sapanca (9) and Lake Terkos (12).

Known Distribution: Europe, Algeria, North America (17); Europe, Caucasus, North Africa, North America (18); Iran (19) and Bulgaria (20).

Ilyocypris gibba (Ramdohr, 1808).

Material: Locality-1, 19.07.1997, 1V; Locality-2, 19.07.1997, 6VV; Locality-6, 19.07.1997, 2VV; Locality-1, 10.01.1998, 1VV; Locality-2, 11.01.1998, 2VV; Locality-6, 11.01.1998, 3VV; Locality-1, 17.04.1999, 4V; Locality-2, 17.04.1999; 5VV; Locality-6, 18.04.1999, 6VV; Locality-1, 12.06.1999, 12V; Locality-2, 12.06.1999, 8VV; Locality-6, 13.06.1999, 12VV.

Previous Records from Turkey: Zonguldak, Kocaeli (2); İzmir (3); Kütahya, İzmir (4); Balıkesir (5); Adana (7); İzmir (8); Balıkesir (10); Lake Sapanca (9) and Lake Terkos (12).

Known Distribution: Europe, North Africa, Morth America (21); Iran (19); Bulgaria (20); Aegean Sea (22); Belgium (23); Luxembourg (24); Poland (25) and Wales (26).

Family : Candonidae Kaufmann, 1900

Subfamily : Candoninae Kaufmann, 1900

Genus : *Candona* Baird, 1845

Candona angulata Müller, 1900

Material: Locality-2, 19.07.1997, 1M and 2VV; Locality-5, 19.07.1997, 1M and 3VV; Locality-5, 11.01.1998, 2VV; Locality-2, 17.04.1999, 2M M and 2VV; Locality-5, 18.04.1999, 2M M and 4VV; Locality-2, 12.06.1999, 2M M and 5VV; Locality-5, 12.06.1999, 3M M and 4VV.

Previous Records from Turkey: Lake Sapanca (9).

Known Distribution: Britain (27); North Europe (28); North Africa (29, 30 and 31); the Azov Sea, Black Sea (32) and Wales (26).

Candona compressa (Koch, 1838)

Material: Locality-1, 19.07.1997, 2M M and 3VV; Locality-5, 19.07.1997, 2M M and 2VV; Locality-6, 19.07.1997, 1M and 3VV; Locality-1, 17.04.1999, 1M and 2VV; Locality-5, 18.04.1999, 2M M and 4VV; Locality-6, 18.04.1999, 3VV; Locality-1, 12.06.1999, 2M M and 4VV; Locality-5, 12.06.1999, 2 and 4VV; Locality-6, 13.06.1999, 2M M and 2VV.

Previous Records from Turkey: Lake Terkos, İstanbul (12).

Known Distribution: Sweden, England, Germany and Czechoslovakia (17); North Europe, South Europe and Siberia (21).

Candona neglecta Sars, 1887

Material: Locality-1, 19.07.1997, 2M M and 10VV; Locality-2, 19.07.1997, 2M M and 2VV; Locality-5, 19.07.1997, 4VV; Locality-6, 19.07.1997, 2VV; Locality-1, 10.01.1998, 10VV; Locality-2, 11.01.1998, 1M and 2VV; Locality-5, 11.01.1998, 4VV; Locality-6, 11.01.1998, 2VV; Locality-1, 17.04.1999, 3M M and 9VV; Locality-2, 18.04.1999, 5VV; Locality-5, 18.04.1999, 8VV; Locality-6, 18.04.1999, 4VV; Locality-1, 12.06.1999, 2M M and 9VV; Locality-2, 12.06.1999, 4M M and 2VV; Locality-5, 12.06.1999, 2VV; Locality-6, 12.06.1999, 2VV.

Previous Records from Turkey: Gaziantep (2); Kütahya (14); Bilecik, İzmir, Aydın, Bolu, Zonguldak (5 and 6); İzmir (8); Adana (7); Lake İznik, Lake Sapanca (9) and Lake Terkos (12).

Known Distribution: Britain (27); Czechoslovakia (33); Switzerland (34); Sweden (35); Germany (28); Italy, Algeria (17); Europe, Central Asia, North Africa (21); Yugoslavia (36); Iran (2); Bulgaria (20); Belgium (37); Luxembourg (24); France (38) and Poland (39 and 25).

Family : Cypridídae Baird, 1845

Subfamily : Eucypridinae Bronstein, 1947

Genus : *Eucypris* (Vavra, 1891)

Eucypris zenkeri (Chyzer-Toth, 1858).

Material: Locality-3, 19.07.1997, numerous VV; Locality-4, 19.07.1997, numerous VV; Locality-3, 17.04.1999, 15 VV; Locality-4, 18.04.1999, numerous VV; Locality-3, 12.06.1999, 9VV; Locality-4, 13.06.1999, numerous VV.

Previous Records from Turkey: South Eastern Anatolia (2); Eskişehir (4); Bolu, Isparta, Eskişehir (5); Afyon (6) and Lake İznik (9).

Known Distribution: North and Central Europe (28); England, France, Switzerland, Hungary, Yugoslavia (21); Germany (40) and France (41 and 38).

Subfamily : Cyprinotinae Bronstein, 1947

Genus : *Heterocypris* Claus, 1892

Heterocypris incongruens (Ramdohr, 1808)

Material: Locality-4, 19.07.1997, 3VV; Locality-4, 10.01.1998, 2VV; Locality-4, 17.04.1999, 6VV; Locality-4, 12.06.1999, 10VV.

Previous Records from Turkey: Eskişehir, İzmir (4); Antalya, Denizli, Aydın, Muğla, Afyon, Isparta, Bolu, Zonguldak (5); Mersin, Adana (7); İzmir (8); Balıkesir (10); İstanbul (13); Lake Terkos (12) and Sinop (42).

Known Distribution: Cosmopolitan species.

Genus : *Cyprinotus* Brady, 1886

Cyprinotus salinus (Brady, 1886)

Material: Locality-1, 19.07.1997, numerous VV; Locality-6, 19.07.1997, numerous VV; Locality-1, 10.01.1998, 4VV, Locality-6, 10.01.1998, 3VV, Locality-1, 17.04.1999, 12VV; Locality-6, 17.04.1999, 16VV, Locality-1, 12.06.1999, 26VV; Locality-6, 12.06.1999, 34VV.

Previous Records from Turkey: Burdur, Denizli, Aydın, Muğla, İzmir (5); İzmir (8); İstanbul (13 and 14); İstanbul and Rize (42).

Known Distribution: Europe (28); Sweden, Iceland, Britain and France (17); North and Central Germany (21); Europe, Caucasus (18); Yugoslavia (43); Bulgaria (20); Romania (44); Luxembourg (41) and Wales (26).

Subfamily : Cypridopsinae Bronstein, 1947

Genus : *Cypridopsis* Brady, 1867

Cypridopsis vidua (O.F. Müller, 1776)

Material: Locality-3, 19.07.1997, 5VV; Locality-3, 10.01.1998, 2VV; Locality-3, 17.04.1999, 15VV; Locality-3, 12.06.1999, 25VV.

Previous Records from Turkey: Eskişehir (4); Gökçeada Island, İstanbul, Bolu, Zonguldak, Kırklareli (5); Lake İznik and Lake Sapanca (9); Eskişehir (6); Çanakkale, Balıkesir (10) and Ordu (42).

Known Distribution: North and Central Europe, North and South America, the Azores (28); North and East Asia (21); Bulgaria, Yugoslavia (43); Bulgaria (20); Germany (45); Belgium (37); Wales (26); Luxembourg (41); France (38) and Poland (25).

Superfamily : Cytheracea Baird, 1850

Family : Limnocytheridae Klie, 1938

Genus : *Limnocythere* Brady, 1867

Limnocythere inopinata (Baird, 1843)

Material: Locality-1, 19.07.1997, 12M M and 28VV; Locality-3, 19.07.1997, 15VV; Locality-6, 19.07.1997, 5VV, Locality-1, 10.01.1998, 3M M and VV; Locality-3, 11.01.1998, 3VV; Locality-6, 11.01.1998, 5VV; Locality-1, 17.04.1999, 12M M and VV; Locality-3, 18.04.1999, 18VV; Locality-6, 18.04.1999, 21VV; Locality-1, 12.06.1999, 8M M and 6VV; Locality-3, 13.06.1999, 13VV; Locality-6, 12.06.1999, 5VV. Previous Records from Turkey: Lake Van (6); Lake İznik (9); Lake Büyükçekmece (14) and Iğneada (42).

Known Distribution: Scandinavia (47); the Black Sea and Sea of Azov (32); Aegean Sea (22); Germany (45); Germany (46); Greece (48); Belgium (37); Luxembourg (24); Fnahce (41); France (39) and Wales (26).

Discussion

In this study, two species of the genus *Ilyocypris* were determined. These species are *Ilyocypris biplicata* and *Ilyocypris gibba.* Gülen (3, 4, 5 and 7) first recorded them from spring water in Turkey.

Species of the genus *Ilyocypris* are found in a wide range of freshwater bodies, stagnant as well as flowing, from the largest lakes and rivers to the smallest seasonal ditches, pools and canals. They either crawl along the bottom or swim mainly in the bottom water layer of fresh water. Members of the genus are found in weakly saline waters. The family members of Ilyocyprididae are known from recent fossil populations distributed in the Palaearctic, and other populations recorded from Iran, Ceylon, North America and Australia (18).

I. gibba inhabits various types of freshwater, such as rivers, lakes, oxbows, seasonal ditches and canals. They swim well, but usually stay in the bottom water layer.

Many studies have been carried out, by Gülen (3-6), Altınsaçlı (8) Altınsaçlı and Kubanç (10) and Külköylüoğlu et al. (13), in different localities in western Anatolia. These species have been widely distributed in Anatolia: Bursa, Bilecik (5); İzmir (8); İstanbul (13); Lake İznik, Lake Sapanca (9) and Lake Terkos (12). Zonguldak, Kocaeli (2); İzmir (3); Kütahya, İzmir (4); Balıkesir (5); Adana (2) and Balıkesir (10).

These species originated from the Sarmatic Inland

Sea, and they migrated to Lake Akşehir from the Sarmatic Inland Sea. Distribution areas for these species are known to exist in Central Asia, North Africa, South Europe and East Europe.

Three species of the genus *Candona* were found in Lake Akşehir. The center of distribution of the Candonini is holoartic. Many species of the genus *Candona* are typical benthic species of Anatolian lakes.

Candona angulata was recorded for the first time in the bottom mud of Lake Sapanca by Altınsaçlı (9). This species was recorded for the second time in the present study. This species is known from Britain (27), Northern Europe (28), Northern Africa (29.31), the Azov Sea, Black Sea (32) and Wales (26).

Candona neglecta is widely distributed in Anatolia and throughout the world. Satisfactory collections of *Candona neglecta* were possible only from places where the water current was very slow, and a sufficient accumulation of slime and detritus was present at the bottom.

It is found in carious types of waters but more commonly among the benthic fauna of lakes and water bodies fed by springs and streams.

This species is known from Gaziantep (2); Kütahya (4); Bilecik, İzmir, Aydın, Bolu and Zonguldak (5 and 6); İzmir (8); Adana (7); Lake İznik, Lake Sapanca (9) and Lake Terkos (12) in Turkey. It is also known from Britain (27); Czechoslovakia (33); Switzerland (34); Sweden (35); Germany (28); Italy, Algeria (17); Europe, Central Asia and North Africa (21); Yugoslavia (36); Iran (2); Bulgaria (20); Belgium (37); Luxembourg (24); France (38) and Poland (39 and 36).

Candona compressa was found in Lake Akşehir. *C. compressa* was found for the first time in the bottom mud of Lake Terkos by Altınsaçlı and Yılmam (12). The second recording of this species took place in the present study.

It is found frequently in various types of water body This species prefers shallow waters such as canals and oxbows. However, it can also be found in rivers and littoral zones of lakes.

It is known from Sweden, England, Germany and Czechoslovakia (17), from North Europe, South Europe and Siberia (21).

One species of the genus *Eucypris* was found in Lake Akşehir. *Eucypris (Prionocypris)* zenkeri is known from western Anatolia. These localities are in south-eastern Anatolia (2); Eskişehir (4); Bolu, Isparta, Eskişehir (5); Afyon (6) and Lake İznik (9).

This species has a wide distribution according to the findings of several researchers. According to Demirsoy (49), this species of *Eucypris* is a Gondwana and Laurasia relict.

It is known from North and Central Europe (28); England, France, Switzerland, Hungary and Yugoslavia (21); Germany (40) and France (41 and 38).

One species of the genus *Cyprinotus* was discovered in Lake Akşehir. *Cyprinotus* salinus is a halobiont species.

Cyprinotus is a halobiont species.

Cyprinotus salinus has a holoartic range, occurring in Northern Africa, Eurasia and North America. In Anatolia, this species is mainly found near the seashore. However, it has been recorded from inland waters by some researchers. It is also present in the salt lakes of Central Anatolia.

The distribution areas in Turkey were reported by Gülen (5), Altınsaçlı (8), Külköylüoğlu et al. (13) and Kılıç (42). This species has been reported from Europe (28), Sweden, Iceland, Britain and France (17), the Azores, North Africa and East Asia (21), the Caucasus, Ukraine, Caspian Sea (18), southeastern Anatolia (2), Bulgaria (20) and the Sea of Azov (22).

One species of the genus *Heterocypris* was found in Lake Akşehir. *Heterocypris incongruens* is one of the most common species of freshwater ostracod, occurring in every continent. Therefore, can be accepted that this is a Gondwana and Laurasia relict. It is a cosmopolitan species.

Heterocypris incongruens mainly inhabits small water bodies, including ponds, rock pools, trie tracks, and man-made containers such as cement tanks. It is often found in ponds with muddy bottoms poor in plant growth. It is a truly ubiquitous ostracod species.

Bisexual and parthenogenetic populations of this species are commonly found in Anatolia (29, 30).

It is known from Eskişehir and İzmir (4); Antalya, Denizli, Aydın , Muğla, Afyon, Isparta, Bolu and Zonguldak (5); Mersin and Adana (7); İzmir (8); Balıkesir (10); İstanbul (13); Lake Terkos (12) and Sinop (42) in Turkey.

Only one species of the genus *Ilyodromus* was discovered in Lake Akşehir. *Ilyodromus olivaceus* is a typical crenobiont. It has been found in spring water and some lakes in Anatolia.

There are several known distribution areas for *I. olivaceus* in Anatolia. These localities are Antakya (2); Antakya (4); İzmir, Kütahya, Bilecik, Muğla, Bursa, Bolu (5); İzmir (8); İstanbul (13); Lake İznik and Lake Sapanca (9).

It is known that this species is distributed throughout Europe. Its localities are Europe (28); Britain, Hungary, Czechoslovakia, Switzerland (17); North and Central Germany (21); Europe, the Caucasus (18); Yugoslavia (43); Bulgaria (20); Romania (44); Luxembourg (41) and Wales (26).

One species of the genus *Cypridopsis* was determined in Lake Akşehir. *Cypridopsis vidua* is a very common species. İt is found in various aquatic habitats, such as pools, canals, coastal lagoons, marshes, lakes, rivers and rice fields. It is cosmopolitan and is considered a ubiquitous and opportunistic species. This species prefers freshwaters, but it is stressed to saline environments.

It has been recorded from Eskişehir (4); Gökçeada, İstanbul, Bolu, Zonguldak and Kırklareli (5); Bursa and Adapazarı (9); Çanakkale and Balıkesir (10) and Ordu (42) in Turkey. It has also been reported from Russia, North and Central Europe, North and South America and the Azores (28); North and East Asia (21); Bulgaria, Yugoslavia (43); Bulgaria (20); Germany (45); Belgium (37); Wales (26); Luxembourg (41); France (38) and Poland (25).

One species of the genus *Limnocythere* was found in Lake Akşehir. This species is *Limnocythere inopinata.* According to Bronstein (18), *L. inopinata* is the most common representative of the genus *Limnocythere,* not only in Europe, but also throughout the Palaearctic. *L. inopinata* is often considered to be an indicator of water with moderate-to-high salinity and alkalinity, but it should be stressed that it can also be found in freshwater conditions. *L. inopinata* is a benthic species devoid of all swimming powers. It has been reported in Lake Van (5 and 6); Lake Büyükçekmece (14); Lake İznik (9) and İğneada (42) in Turkey.

This species is known from Scandinavia (47); the Black Sea and Sea of Azov 532); the Aegean Sea (22); Germany (45-46); Greece (48); Belgium (37); Luxembourg (24); France (38, 41) and Wales (26).

All the species of Ostracoda are new records for this locality. In this study, we carefully analysed the biogeography of freshwater ostracod species living in Lake Akşehir. Our data provide additional information for the biogeography of this group in Anatolia and adjacent areas.

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