

# The Gastropods of Lake Eğirdir

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**Abstract:** The Gastropoda species and its distribution was investigated in Lake Eğirdir. It was determined that 5 species belonging to Gastropoda, order Prosobranchia (*Theodoxus heldreichi*, *Valvata naticina*, *Graecoanatolica lacustriturca*, *Falsipyrgula pfeiferi* and *Bithynia pseudemmericia*) and 7 species belonging to the order Pulmonata (*Radix peregra*, *Stagnicola palustris*, *Physa fontinalis*, *Physa acuta*, *Planorbis planorbis*, *Planorbis carinatus* and *Gyraulus albus*) were present. Gastropoda species from 9 freshwater stations connected with Lake Eğirdir and 10 freshwater stations that not connected obviously with lake were investigated to determine the effect of aquatic systems around the lake to the malacofauna of Lake Eğirdir.

In addition trophic level and evolution of lake has been discussed according to ecological tolerances and distribution of species in the habitats' paleogeographic and hydrogeographic features.

**Key Words:** Lake Eğirdir, Mollusca

## Eğirdir Gölü (Türkiye)'nün Gastropodları

**Özet:** Eğirdir Gölü'nde yayılış gösteren salyangoz türleri ve türlerin yayılış özellikleri incelenmiştir. Gölde Gastropoda Gastropoda sınıfı, Prosobranchia ordosuna dahil olan 5 tür (*Theodoxus heldreichi*, *Valvata naticina*, *Graecoanatolica lacustriturca*, *Falsipyrgula pfeiferi* and *Bithynia pseudemmericia*) Pulmonata takımına dahil olan 7 türün (*Radix peregra*, *Stagnicola palustris*, *Physa fontinalis*, *Physa acuta*, *Planorbis planorbis*, *Planorbis carinatus* and *Gyraulus albus*) yayılış gösterdiği belirlenmiştir. Gölün malakofaunasına çevredeki sucul sistemlerin etkisini belirlemek amacıyla gölle bağlantılı olan 9 tatlısu istasyonunda yayılış gösteren salyangoz türleri de incelenmiştir.

Ayrıca belirlenen türlerin ekolojik hoşgörülerine, yayılış gösterdikleri habitatların palaeocoğrafik ve hidrocoğrafik özelliklerine bakılarak gölün trofik yapısı veevrimi tartışılmıştır.

**Anahtar Sözcükler:** Lake Eğirdir, Mollusca

## Introduction

Lake Eğirdir is the fourth largest lake in area size (48,800 ha) in Turkey. Tectonic in origin, an important part of the potential water supply is provided by its own sources (TÇVY, 1993). The lake has been classified as oligotrophic (Bildiren, 1991; Tanyolaç, 1993) or mesotrophic (Cirik and Conk, 1995; Turna and Yüce, 1998) by studies made at different times.

According to the literature examined, the first ever study on Lake Eğirdir malacofauna was by Weber (1927), who described *Falsipyrgula pfeiferi* WEBER (1927) from the lake. After that, Schütt (1965) found *Theodoxus* (*Theodoxus*) *heldreichi* (MARTENS, 1879) was present in the lake. Radoman (1976) described *Bithynia turca* RADOMAN, 1976, from Cire village spring, a spring indirectly connected to the lake, and *Graecoanatolica lacustriturca* RADOMAN, 1983, from the lake (Radoman, 1983). Bilgin (1980) recorded in his study on

the freshwater gastropods of western Anatolia *Bithynia pseudemmericia* SCHÜTT, 1964, *Physa acuta* DRAPARNAUD, 1805, and *Planorbis planorbis* (L., 1758) from the lake.

During his study of the gastropod paleogeography of the region Schütt (1990) examined Pleistocene gastropod fossils from lakes Burdur, Yarıklı and Acı and their relations with the present species. The same researcher studied the fossil molluscs of 3 Anatolian plains, Konya, Pasinler and Erzurum. This study involved paleogeographic references to the present ranges of *T. heldreichi*, *G. lacustriturca* and *B. pseudemmericia*, which are still found in Lake Eğirdir (Schütt, 1991).

Bildiren (1991), in a study concerning the benthic fauna of the Lake Eğirdir-Köprü Avlağı area, discussed the distribution of *B. pseudemmericia*, *R. peregra* and *Dreissena polymorpha* (PALLAS, 1771). Şeşen and Yıldırım (1993) studied the distribution of freshwater

gastropods of parasitological importance in Turkey and listed the host species and parasites. Yıldırım and Şeşen (1994) determined *T. heldreichi*, *Valvata (Borysthenia) naticina* (MENKE, 1845), *B. pseudemmericia*, *F. pfeiferi*, *G. lacustriturca*, *Radix auricularia* (L., 1758) and *Planorbis carinatus* (MÜLLER, 1774), *D. polymorpha*, *Anadonta cygnea* (L., 1758) were distributed in the lake in their study on the molluscs of freshwater systems in Burdur and Isparta.

Demirsoy (1999), in his work on Turkey's zoogeography, explains the history of freshwater organisms of Turkey. And provides information about the inland waters and lakes of Anatolia. According to Demirsoy, the lakes of western and central Anatolia showed a loss of saline-freshwater character from the middle Miocene when torites and anatolites surrounded the area onwards. In the Pliocenera lakes of various origins became connected over time creating the central Anatolian lake system, which split into wetlands and lakes in Pleistocenera. Another idea is that all western Anatolian lakes originated from this inland system.

## Materials and Methods

This study was carried out between 1993 and 2001 during all seasons and months of the year. The materials were collected from 13 stations (stations 1-13): stations representative of the lake from as well as 9 units connected with the lake (stations 14-22) (Figure 1). Standard techniques and methods were used (Zhadin 1965, Malek and Cheng 1974).

**-Lake Eğirdir:** 1. SDÜ Eğirdir Fisheries Faculty, 2. Eğirdir sağlık ocağı, 3. Port, 4. Yeşilada, 5. Plaj Mahallesi, 6. Akkeçili village, 7. Gençali village, 8. Taşevi village; 9. Tırtar village, 10. Gelendost, 11. Karaot current decharging point; 12. Mahmatlar village, 13. Bayboğan.

**-Aquatic systems connected with Lake Eğirdir** 14. Kayağzı Kaynak, 15. Karaot, 16. Aksu Çay, 17. Konne Çay, 18. Kovada channel, 19. Lake Kovada, 20. Pınar Pazarı spring, 21. Cire village spring and its extensions., 22. Aşağı Gökdere spring and its extensions.

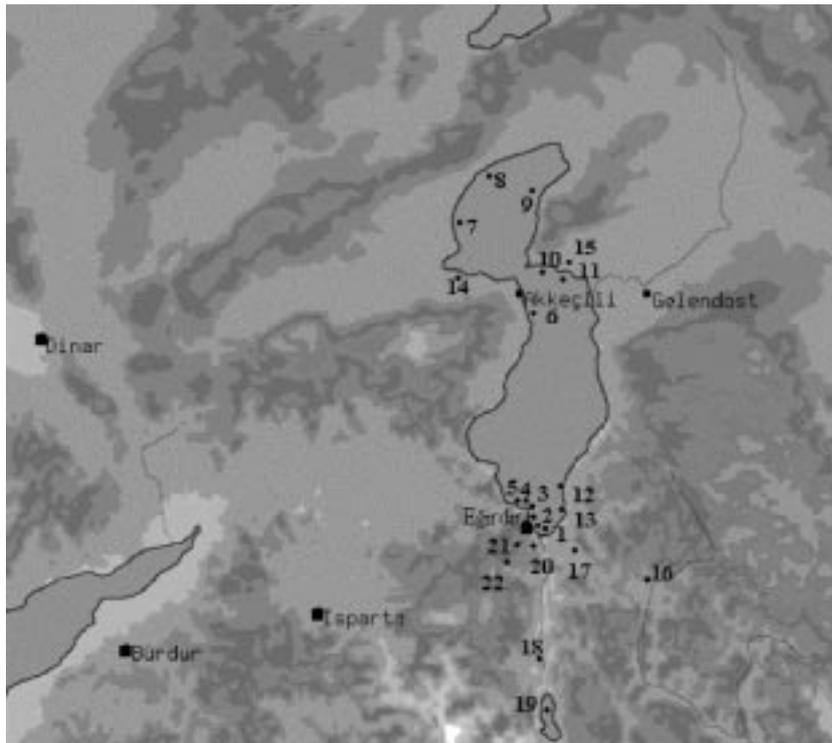


Figure 1. Study area

## Results

### Species identified from Lake Eğirdir

The species of gastropods collected from Lake Eğirdir are listed below. Plate 1 shows the distribution of taxa in stations (1-13). Plate 2 shows the species distributed in aquatic systems (stations 14-22) connected with Lake Eğirdir. The pictures of gastropods are given in Plates 1 and 2.

### A . GASTROPODA

#### Prosobranchia species

*Theodoxus (Theodoxus) heldreichi heldreichi* (MARTENS, 1879) (Plate 1.1)

*Valvata (Borysthenia) naticina* (MENKE, 1845) (Plate 1.2)

*Graecoanatolica lacustriturca* (RADOMAN, 1973) (Plate 1.3)

*Falsipyrgula pfeiferi* (WEBER, 1927) (Plate 1.4)

*Bithynia pseudemmericia* (SCHÜTT, 1964) (Plate 1.5)

#### Pulmonata species

*Radix peregra* (MÜLLER, 1774) (Plate 1.6)

*Stagnicola palustris* (MÜLLER, 1774) (Plate 1.7)

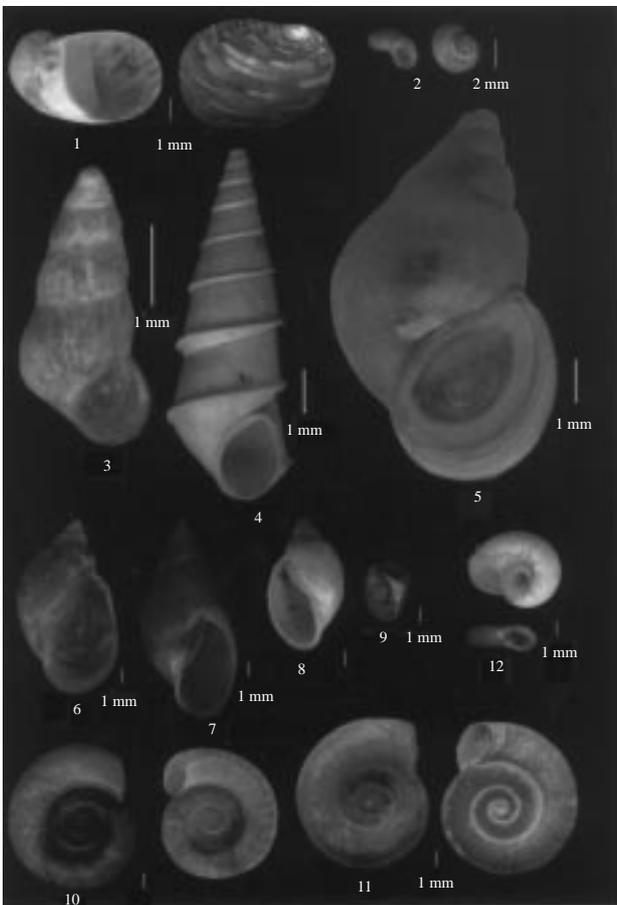
*Physa fontinalis* (L., 1758) (Plate 1.8)

*Physa acuta* (DRAPARNAUD, 1805 ) (Plate 1.9)

*Planorbis planorbis* (L., 1758) (Plate 1.10)

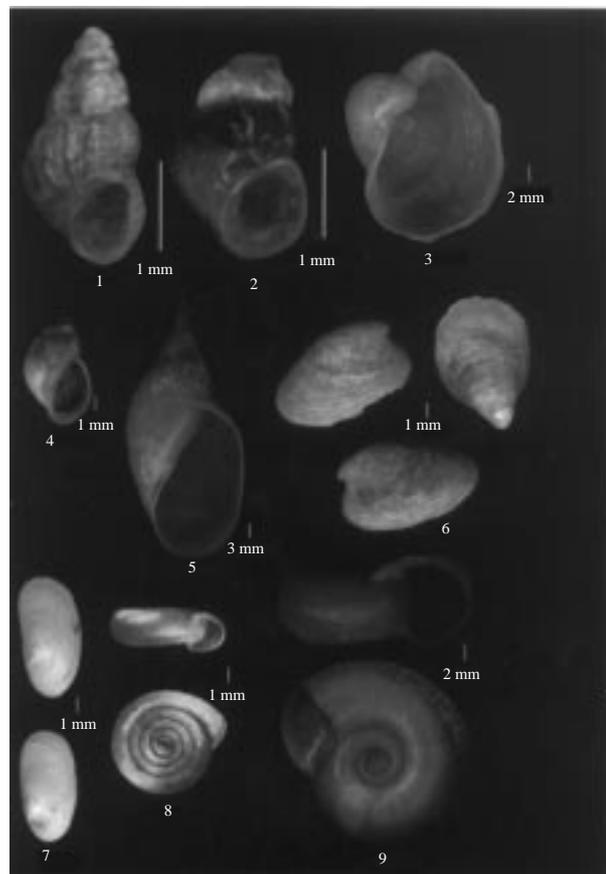
*Planorbis carinatus* (MÜLLER, 1774) (Plate 1.11)

*Gyraulus albus* (MÜLLER, 1774) (Plate 1.12)



1. *Theodoxus heldreichi heldreichi*; 2. *Valvata naticina*; 3. *Graecoanatolica lacustriturca*; 4. *Falsipyrgula pfeifferi*; 5. *Bithynia pseudemmericia*; 6. *Radix peregra*; 7. *Stagnicola palustris*; 8. *Physa acuta*; 9. *Physa fontinalis*; 10. *Planorbis planorbis*; 11. *Planorbis carinatus*; 12. *Gyraulus albus*

Plate 1. Species of gastropods collected from Lake Eğirdir.



1. *Graecoanatolica kocapinarica*; 2. *Bithynia turca*; 3. *Radix auricularia*; 4. *Galba turuncatula*; 5. *Lymnaea stagnalis*; 6. *Ancyclus fluviatilis*; 7. *Acroloxus lacustris*; 8. *Bathyomphalus contortus*; 9. *Planorbis corneus*

Plate 2. Species of gastropods collected from other aquatic systems connected to Lake Eğirdir.

**Discussion**

While keeping its oligotrophic character despite various alloctonic and otoc tonic factors, Lake Eğirdir hosts malacofauna parallel to this trophic level.

According to our research on the malacofauna of Lake Eğirdir, 5 species from the class Gastropoda, order Prosobranchia (*T. heldreichi*, *V. naticina*, *G. lacustriturca*, *F. pfeiferi*, *B. pseudemmericia*) and 7 species from the order Pulmonata (*R. peregra*, *S. palustris*, *P. fontinalis*, *P. acuta*, *P. planorbis*, *P. carinatus*, *G. albus*) are distributed in the lake (Tables 1 and 2).

Mollusca species inhabiting the lake, evaluated in terms of their ecological needs and paleogeographical histories, show a qualitative and quantitative parallelism with the oligotrophic lentic system. Especially Prosobranchia species, except *V. naticina*, living in the lake generally prefer lentic and lotic systems isolated from pollutant effects, in poorly vegetation, and with low trophic levels (Zhadin, 1965; Hart and Samuel 1974, Roth 1987).

Species endemic to Anatolia are also distributed in systems hydrogeologically connected to the lake. Of these, the distributional patterns of *B. pseudemmericia* is strong evidence for paleogeographic status and the connectivity of freshwater systems in Anatolia; the species is distributed in lakes Eğirdir, Beyşehir, and Çapalı, and in Karamuk swamp, İncirli spring (Afyon-Dinar), and Kırkgöz spring (Antalya) at the present, while

fossils are found in Lake Burdur, Konya Plain, Lake Hazar, and Pleistocene deposits around Horasan (Schütt 1965, Bilgin 1980, Şeşen ve Bilgin, Yıldırım 1999a).

*G. lacustriturca* is quantitatively the most abundant gastropod in the lake. This species has been identified from Lake Beyşehir, streams around Dinar-Suçıkan and Pleistocene deposits of Lake Burdur. Another species of the genus, *G. Kocapinarica*, is restricted to a Kocapınar source only 15 km from the lake (Radoman, 1983; Yıldırım, 1999; Schütt, 1992). *G. pamphylica* is distributed in Kırkgöz spring (Antalya), Titreyengöl (Manavgat) and Kırkpınar spring (Antalya-Korkuteli), while *G. tenuis* is found in streams around Acıgöl (Denizli) (Radoman, 1983; Schütt, 1990; Yıldırım 1999a).

Another prosobranch in the lake, *F. pfeiferi* is a local endemic and its distribution matches the oligotrophic character of the species. Another species belonging to the same genus, *F. beysehirana*, live in Lake Beyşehir. Both were previously regarded as subspecies by some researchers, though they have been considered allopatric species recently (Weber, 1927; Schütt, 1990; 1991; Yıldırım and Şeşen, 1994; Yıldırım, 1999a).

Pulmonates distributed in the lake are generally widespread eurytopic species These especially inhabit shallow, muddy areas (Senirkent shores, Hoyran Boğazı, Kayıkhaneler, Eğirdir port etc.), shallow, slow flowing parts and extensions of small springs (Kayaağzı, Konne and Pınar Pazarı), and calm parts of stream entrances (Aksu Çay). According to their ecological needs,

Table 1. The species recorded in stations from Lake Eğirdir (Stations numbers and names are given in the Materials and methods section).

	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>T. h. heldreichi</i>	+	+		+		+						+	+
<i>V. naticina</i>	+	+	+	+		+	+	+	+	+	+	+	+
<i>G. lacustriturca</i>			+	+	+	+					+	+	+
<i>F. pfeiferi</i>			+	+		+					+	+	+
<i>B. pseudemmericia</i>				+		+	+				+	+	+
<i>R. peregra</i>	+	+	+	+		+	+	+	+	+	+	+	+
<i>S. palustris</i>	+					+	+	+	+	+	+	+	+
<i>P. acuta</i>						+	+	+	+	+	+	+	
<i>P. fontinalis</i>						+	+						
<i>P. planorbis</i>						+	+	+	+	+	+	+	+
<i>P. carinatus</i>						+	+	+	+	+	+	+	+
<i>G. albus</i>	+	+		+		+	+	+	+	+	+	+	

Table 2. Species present in Lake Eğirdir and other aquatic systems connected to it (\*different subspecies: *T. h. fluviocola*).

	14	15	16	17	18	19	20	21	22	23
<i>T. h. heldreichi</i>	+									
<i>V. naticina</i>	+	+		+		+		+		
<i>G. lacustristorca</i>	+									
<i>F. pfeiferi</i>						+				
<i>B. pseudemmericia</i>			+							
<i>R. peregra</i>	+				+			+		+
<i>R. auricularia</i>		+								
<i>S. palustris</i>	+			+		+				
<i>P. acuta</i>	+			+	+	+		+		+
<i>P. fontinalis</i>						+				
<i>P. planorbis</i>	+	+		+				+		
<i>P. carinatus</i>		+					+			
<i>G. albus</i>	+			+	+	+		+		+

Pulmonata species are generally eurytopes (Zhadin, 1965; Malek and Cheng, 1974; Hart and Samuel, 1974; Ertan et al., 1996). Their abundance can reach immense sizes in aquatic systems with high trophic levels. For that reason, in areas with shallow water (environs of Hoyran, port etc.), areas where anthropogenic effects have become dominant (fishing activities, tourism etc.), and where allocthonous deposits are high (alluvial charge points, domestic and agricultural dumping sites) a recent burst of Pulmonate populations has been observed. The most apparent example of this phenomenon was noted during test performed by the Eğirdir Fishery Institute and Fisheries Faculty while raising fish in cages. In the past species like *R. peregra* and *P. acuta* could only be found in quite densely vegetated, shallow parts of the lake, but they are now found abundantly in all parts of the port; 3-4 m deep areas, and in locations away from the port. The increase in closely follows rises in the trophic level, but the parallel parasitic increase also effetely populations of species of economic importance. The increasing infectious rate of *Bucephalus polymorphus* (a trematode) between 1993 and 1995 to 100% and the development of *Stizostedion lucioperca* inoculated into the lake in the 1950s as the dominant vertebrate later on resulted mainly from the increase in *Dreissena polymorpha* (Bivalvia) in correlation as well as changes in parasitological cycles (Yıldırım et al., 1996; Diler and Yıldırım, 1997).

For the stations chosen in Lake Eğirdir, *G. lacustristorca* and *R. peregra* were the most widespread species. Although *G. lacustristorca* is very common in the Göller Bölgesi (Yıldırım, 1999a), its general preference is for waters of high oxygen content. The common presence of the species in the lake is proof of the low trophic levels of the lake as a whole. However the presence of *R. peregra* as an eurytopics species (Hart and Samuel, 1974; Ertan et al., 1996), especially in very shallow, muddy, and well-vegetated parts of the lake, may be as a result of the lake's evolution. Although the lake maintains an oligotrophic structure, being open to uncontrollable anthropogenic and alluvial deposits and allochthonous factors induce this evolution. A quantitative increase in other pulmonates is proof of the effect and evolution. As pulmonates are generally eurytopes, they are widely distributed in waters with high trophic content (Zhadin, 1965; Malek and Cheng, 1974; Hart and Samuel, 1974; Ertan et al., 1996).

The stations with the highest species numbers were Akkeçili village (station 5), Karaot current discharging point (station 10) and near Mahmatlar village (station 11). The reasons for the richness of species include their shallowness, well vegetated nature, and relatively clean environment.

The gastropod composition of Lake Eğirdir is very similar to that other water bodies in the area (Table 2).

However, the lack of *B. contortus*, *A. lacustris*, *L. stagnalis*, and *P. corneus* in the lake is related to the biological needs and/or trophic level of the lake. When the mollusc composition of the lake is compared with that of other systems not connected with it, a great resemblance with Beyşehir Lake is seen. That ancient hydrological connections caused this significant resemblance is clear. Further evidence for this connection are the finds of similar fossils in the areas (Schütt, 1992; Yıldırım,

1999a) and the presence of *L. stagnalis* and *P. corneus*, species that are very common in Lake Beyşehir in Karaot.

In conclusion, Lake Eğirdir shows a malacofauna in line with to the optimal level of trophic character. Hydrogeographic connections made through the area during the paleogeographic development of the lake should be considered an important factor for the existence of the present malacofauna.

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