

The gastropod fauna and their abundance, and some physicochemical parameters of Lake Gölbaşı (Hatay, Turkey)

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Abstract: An investigation was carried out on the native gastropod species in Lake Gölbaşı, Hatay. During the research 3 species belonging to the subclass Pulmonata (*Gyraulus piscinarum*, *Radix labiata*, *Anisus leucostoma*) were detected along with 9 species of the subclass Orthogastropoda (=Prosobranchia) including *Theodoxus jordani*, *Semisalsa contempta*, *Semisalsa longiscata*, *Bithynia phialensis*, *Valvata saulcyi*, *Valvata piscinalis*, *Melanoides tuberculatus*, *Melanopsis praemorsa ferussaci*, *Melanopsis costata costata*. These gastropod species were collected from 4 stations chosen in the lake. Furthermore, turbidity, dissolved oxygen, pH, and temperature were measured at the sampling sites.

Key words: Mollusca, Gastropoda, Fauna, Lake Gölbaşı

Gölbaşı Gölü'nün (Hatay: Türkiye) gastropod faunası ve onları etkileyen bazı fizikokimyasal parametreler

Özet: Hatay ili sınırları içerisinde bulunan Gölbaşı Gölü'nün ekolojik yapısına uyum sağlayan yerli gastropod türleri araştırılmıştır. Yapılan araştırmaya göre gölde Pulmonata alt sınıfına ait 3 tür (*Gyraulus piscinarum*, *Radix labiata*, *Anisus leucostoma*), Orthogastropoda (=Prosobranchia) alt sınıfına ait 9 tür (*Theodoxus jordani*, *Semisalsa contempta*, *Semisalsa longiscata*, *Bithynia phialensis*, *Valvata saulcyi*, *Valvata piscinalis*, *Melanoides tuberculatus*, *Melanopsis praemorsa ferussaci*, *Melanopsis costata costata*) tespit edilmiştir. Bu gastropod türleri Gölde tespit edilen 4 istasyonda belirlenmiştir. Ayrıca örnek alınan alanda suyun bulanıklığı, sıcaklığı, çözülmüş oksijeni ve pH'sı ölçülmüştür.

Anahtar sözcükler: Mollusk, Gastropod, Fauna, Gölbaşı Gölü

Introduction

Lake Gölbaşı formed after Lake Amik was drained in 1968. It occupies an area of 12 km² including a marshland of 4 km². The lake used for irrigation is fed by spring waters from the hills with a total flow rate of approx. 2.5 - 3 m³/s. Maximum depth following

irrigation season in the summer is 4 m with an average of 1.5 m, whereas it is 6 m with an average of 3.5 m in the winter. Gölbaşı Lake has been classified as eutrophic (Şereflişan, 2003). The lake has a significant feature on account of mollusk fauna (Şereflişan, 2001).

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Turkey, one of the zoogeographically unique areas of Western Palaearctic, has an interesting aquatic and terrestrial mollusk fauna, which is richer than the adjacent areas of Europe due to its location between 2 continents (Demirsoy, 1996). Terrestrial prosobranch species are tolerant to a variety of ecological conditions. Due to their biomonitoring potential, prosobranchs are used for ecological studies (Şereflişan, 2001).

The study of the species of the order Prosobranchia in Turkey dates back to 1800s, although there has been a substantial increase in the number of the recent studies. Today, although not fully established, aquatic mollusk fauna of the Aegean, Mediterranean region, as well as parts of Eastern and Southeastern Turkey have partly been clarified (Yıldırım et al., 2006a).

This study evaluated the data obtained from the present study and literature. It was also aimed to fill a gap in the number of the studies made to determine the gastropod fauna of the provincial area of Hatay.

Materials and methods

Samples were collected from 4 stations between June 2003 and May 2004 (Figure 1). Stations were defined with respect to their habitats. Their habitat

characteristics of different stations were shallow and sludge bottom with 0-2 m deep, sludge-sandy ground and sparsely vegetated areas with 2-4 m deep, sandy ground area with 4-6 m deep, and sandy bottom and hard ground area with floating water plants in between 6-8 m deep, respectively for Station 1, 2, 3, and 4. Sampling was carried out with standard techniques mostly (Zhadin, 1965) by dragging and with scoops, sieves, pliers, lenses and small brushes. The materials were preserved in 70% ethyl alcohol. 70% Ethyl alcohol was added drop by drop at frequent intervals to water in which animals were kept and checking that the sample was covered with a lid. After ensuring that the animals were narcotized, they were transferred to containers with fixatives. The common chemical used for fixation of animals in the field was 4 to 10% neutral formalin solution (Alfred et al., 1997). Mollusks were identified according to Schütt (1982) and Bilgin and Şeşen (1991).

Oxygen, temperature, pH, and turbidity were measured directly at each sampling station by the aid of digital instruments. Oxygen and temperature were measured by YSI model 52 oxygen meter and pH was measured by Orion model 420A pH meter. Turbidity was measured by sechi disk. Data including months, abundance and stations were evaluated according to Cluster Analyse with Statistica 7.0 Program.

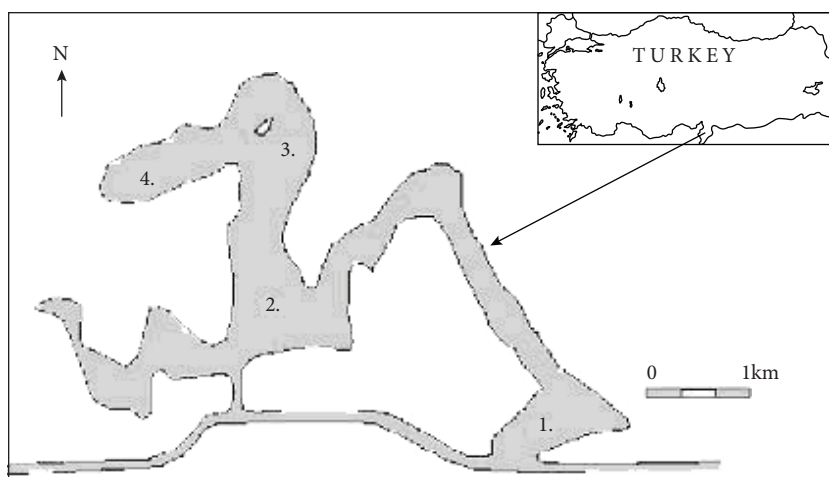


Figure 1. Sampling stations at Lake Gölbaşı.
1: 1st station (Lat: 36°30'10.63"N ; Long: 36°29'9.90"E),
2: 2nd station (Lat: 36°30'17.97"N ; Long: 36°29'26.04"E),
3: 3rd station (Lat: 36°30'14.38"N ; Long: 36°29'45.89"E),
4: 4th station (Lat: 36°30'33.55"N ; Long: 36°29'35.90"E)

Results

Subclass Orthogastropoda (=Prosobranchia part.)

- Theodoxus jordani* (Sowerby, 1832)
Semisalsa contempta (Dautzenberg, 1894)
Semisalsa longiscata (Bourguignat, 1856)
Bithynia phialensis (Locard, 1894)
Valvata (Cincinna) saulcyi (Bourguignat, 1853)
Valvata (Cincinna) piscinalis (Germain, 1936)
Melanoides tuberculatus (Müller, 1774)
Melanopsis costata costata (Olivier, 1804)
Melanopsis praemorsa ferussaci (Roth, 1839)

Subclass: Pulmonata

- Anisus leucostoma* (Millet, 1813)
Radix labiata (Rossmässler, 1835)
Gyraulus piscinarum (Bourguignat, 1852)

In our research on malacofauna in Lake Gölbaşı a total number of 12 species of the class Gastropoda were identified as *Gyraulus piscinarum*, *Radix labiata*, *Anisus leucostoma*, *Theodoxus jordani*, *Semisalsa contempta*, *Semisalsa longiscata*, *Bithynia phialensis*, *Valvata saulcyi*, *Valvata piscinalis*, *Melanoides tuberculatus*, *Melanopsis praemorsa ferussaci* and *Melanopsis costata costata* (Figure 2).

***Gyraulus piscinarum* (Bourguignat, 1852)**

Locality: Lake Gölbaşı

Station: 2 1 3 4

Habitat: Sludge ground in littoral zone

Distribution in Turkey: Eastern Mediterranean (Schütt and Kavuşan, 1983; Yıldırım et al., 2006a)

Except for *G. piscinarum*, 4 other species of the genus *Gyraulus* including *G. parvus*, *G. albus*, *G. laevis*, *G. euphraticus* were defined by several researchers in Turkey (Bilgin, 1967; Paydak, 1967; Bilgin, 1980; Şeşen and Bilgin, 1988; Schütt, 1988; Yıldırım et al., 2006a).

***Radix labiata* (Müller, 1774)**

Locality : Lake Gölbaşı

Station : 2 3 1 4

Habitat : Sludge ground in littoral zone and from sparsely vegetated areas

Distribution in Turkey : Throughout Turkey (Yıldırım et al., 2006b)

2 species of the genus *Radix* including *R. labiata* and *R. auricularia* were defined in Turkey (Yıldırım et al., 2006b; Şahin and Yıldırım, 2007).

***Anisus leucostoma* (Millet, 1813)**

Locality : Lake Gölbaşı

Station: 1 2 3

Habitat : Shallow soft ground

Distribution in Turkey : The Mediterranean regions (Bilgin and Şeşen, 1991; Yıldırım, 1999).

4 species of genus *Anisus* class including *A. spirorbis*, *A. leucostoma*, *A. vortex*, and *A. vorticulus* were defined in Turkey (Bilgin, 1973; Bilgin, 1980; Yıldırım et al., 2006a).

***Theodoxus jordani* (Sowerby, 1832)**

Locality : Lake Gölbaşı

Station : 3 2 1

Habitat : Sandy bottom

Distribution in Turkey : The Mediterranean regions (Yıldırım et al., 2006a).

Defined by several researchers in Turkey, there are 11 species of the genus *Theodoxus*, namely *T. fluviatilis fluviatilis*, *T. fluviatilis euxinus*, *T. heldreichi heldreichi*, *T. heldreichi fluvicola*, *T. anatolicus*, *T. syriacus*, *T. altenai*, *T. jordani*, *T. cinctellus*, *T. danubialis*, and *T. subthermalis* (Bilgin, 1967; Geldiay and Bilgin, 1969; Bilgin, 1980; Schütt, 1988; Soylu, 1990; Schütt and Şeşen, 1993; Yıldırım et al., 2006a).

***Valvata saulcyi* (Bourguignat, 1853)**

Locality : Lake Gölbaşı

Station : 2 1 3

Habitat : Sandy bottom and hard ground

Distribution in Turkey : The Mediterranean regions (Yıldırım, 1999)

***Valvata piscinalis* (Germain, 1936)**

Locality : Lake Gölbaşı

Station : 2 1 3

Habitat : Sandy bottom and hard ground

Distribution in Turkey : The Marmara, Aegean and Mediterranean regions, as well as Central Anatolia (Yıldırım et al., 2006a)

4 species of the genus *Valvata* defined in Turkey are *V. piscinalis*, *V. saulcyi*, *V. cristata*, and *V. macrostoma* (Bilgin, 1967; Paydak, 1967; Bilgin, 1980; Schütt and Kavuşan, 1983; Şeşen ve Bilgin, 1988; Soylu, 1990; Schütt and Yıldırım, 1999; Yıldırım et al., 2006a).

***Melanoides tuberculatus* (Müller, 1774)**

Locality : Lake Gölbaşı

Station : 2 3 1

Habitat : Gravel bottom, sandy bottom and hard ground

Distribution in Turkey : The Mediterranean and Southeastern Anatolian regions (Yıldırım et al., 2006a). Defined by several researchers in Turkey, there is 1 species of the genus *Melanoides*, namely *Melanoides tuberculatus* (Yıldırım et al., 2006a).

***Melanopsis praemorsa costata* (Olivier, 1804)**

Locality : Lake Gölbaşı

Station : 3 2 4 1

Habitat : Gravel bottom and sandy bottom

Distribution in Turkey : The Mediterranean regions (Yıldırım et al., 2006a).

***Melanopsis praemorsa ferussaci* (Roth, 1839)**

Locality : Lake Gölbaşı

Station : 2 1 3 4

Habitat : Gravel bottom and sandy bottom

Distribution in Turkey : The Mediterranean regions (Yıldırım et al., 2006a).

Researchers defined 4 species of the genus *Melanopsis* including *M. costata*, *M. praemorsa*, *M. buccinoidea* and *M. nodosa* (Yıldırım et al., 2006a).

***Bithynia phialensis* (Conrad, 1852)**

Locality : Lake Gölbaşı

Station : 2 3 1

Habitat : Shallow gravel bottom, averagely hard ground

Distribution in Turkey : The Mediterranean regions (Yıldırım et al., 2006a)

Researchers defined 6 species of the genus *Bithynia* in Turkey including *B. phialensis*, *B. pseudemmericia*,

B. tentaculata, *B. leachi*, *B. badiella*, *B. pesici* (Schütt, 1965; 1990; Bilgin, 1980; Yıldırım et al., 2006a).

***Semisalsa contempta* (Dautzenberg, 1894)**

Locality : Lake Gölbaşı

Station : 3 2 1 4

Habitat : Shallow gravel bottom of averagely hard ground

Distribution in Turkey : The Mediterranean regions (This study)

***Semisalsa longiscata* (Bourguignat, 1856)**

Locality : Lake Gölbaşı

Station : 3 2 1

Habitat : Shallow gravel bottom of averagely hard ground

Distribution in Turkey : The Mediterranean regions (Schütt, 1982; Yıldırım, 1999)

Researchers defined only one single species of genus *Semisalsa*, *S. longiscata* in Turkey (Schütt, 1991, Yıldırım, 1999).

Among collected specimens, *Semisalsa longiscata*, *Melanopsis costata costata*, *Semisalsa contempta*, *Theodoxus jordani* and *Bithynia phialensis* were the commonest species (Figure 2; Table 1).

Environmental parameters

Selected physicochemical parameters are shown in Table 2. Monthly variations of the some physicochemical parameters are presented in Figure 3. The level of dissolved oxygen averaged 7.5 ± 1.7 mg/l and the water temperature averaged 21.4 ± 7.0 °C. pH averaged 7.7 ± 0.3 and secchi disc depth average was 1.5 ± 0.2 m.

The stations with the highest species numbers were the 2nd and 3rd, followed by the 1st and 4th (Figure 4, 5). It was observed that *A. Leucostoma* was found more abundant compared to the other species through the whole lake when statistical data were analyzed with Cluster Method (Figure 6). According to monthly evaluations, abundance of *M. praemorsa costata*, *S. longiscata*, *S. contempta*, ve *T. Jordani* were highest in summer months and lowest in winter months. The numbers of the whole species for June, July and August were as 603.82 ± 462.10 , 618.80 ± 469.64 , and 620.40 ± 465.90 , respectively. It was also

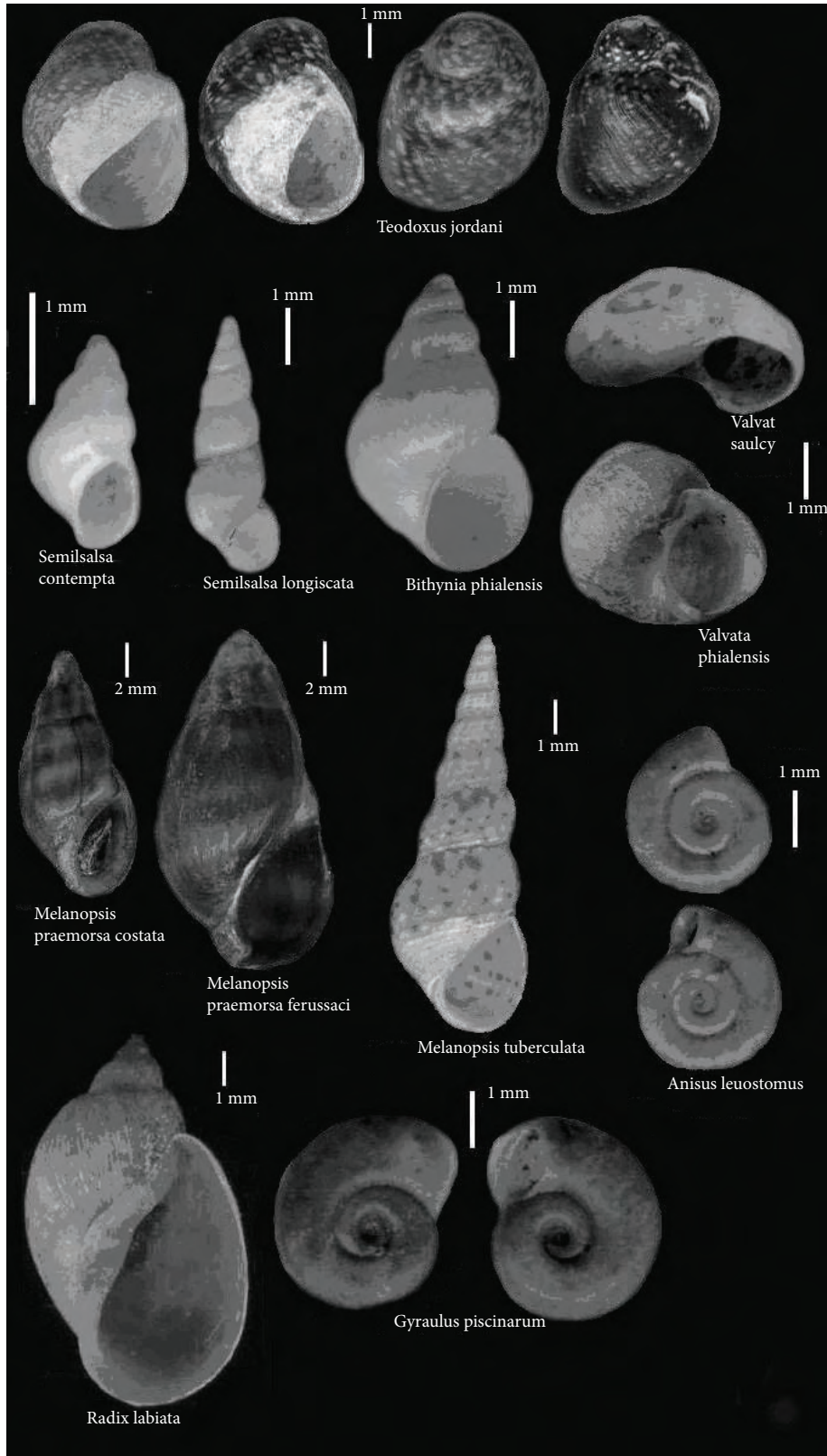


Figure 2. Species of gastropods collected from Lake Gölbaşı.

Table 1. Species abundance (individual/m³)

Species	1 st station	2 nd station	3 rd station	4 th station
<i>Theodoxus jordani</i>	650	850	1240	-
<i>Semisalsa contempta</i>	320	560	1125	25
<i>Semisalsa longiscata</i>	170	885	1660	-
<i>Bithynia phialensis</i>	358	750	640	-
<i>Valvata (Cincinna) saulcyi</i>	150	220	84	-
<i>Valvata (Cincinna) piscinalis</i>	250	315	120	-
<i>Melanopsis praemorsa costata</i>	90	801	1420	100
<i>Melanopsis praemorsa ferussaci</i>	428	667	185	78
<i>Melanoides tuberculata</i>	58	429	173	28
<i>Anisus leucostoma</i>	1548	928	295	-
<i>Radix labiata</i>	269	317	305	72
<i>Gyraulus piscinarum</i>	320	657	233	125

Table 2. Selected physicochemical measurements of Gölbaşı Lake

Parameters	2003								2004					Average	Sd
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May			
1 st station	Secchi Disc (m)	0.5	0.7	0.7	0.9	1	1.2	1.1	1.2	1.3	1.1	0.9	0.7	0.9	0.2
	Water (°C)	28	31	33	29	24	18	14	11	13	17	21	23	21.8	7.3
	Dissolved O ₂	6.3	6.1	5.9	6.4	4.5	9.6	9.5	9.4	8.6	8.2	7.4	6.7	7.3	1.6
	pH	7.9	8.2	8.4	8.3	8	8	7.8	7.6	7.7	7.7	7.6	7.7	7.9	0.2
2 nd station	Secchi Disc (m)	0.8	0.9	1.1	1.2	1.2	1.4	1.4	1.5	1.6	1.4	1.2	1	1.2	0.2
	Water (°C)	28	31	32	28	23	18	14	12	13	17	21	24	21.5	6.9
	Dissolved O ₂	6.5	6.2	5.9	6.5	4.8	9.7	9.9	9.3	8.8	8.4	7.5	6.9	7.5	1.6
	pH	7.7	8.1	8.4	8	7.9	7.9	7.7	7.5	7.6	7.6	7.5	7.6	7.7	0.2
3 rd station	Secchi Disc (m)	1.2	1.5	1.7	1.5	1.4	1.3	1.5	1.5	1.6	1.3	1.2	1.1	1.4	0.1
	Water (°C)	27	30	32	28	23	18.5	14	12	13	16	21	23	21.2	7.0
	Dissolved O ₂	6.5	6.4	6	6.6	4.7	9.8	9.6	9.6	8.8	8.4	7.6	6.9	7.5	1.6
	pH	7.6	8.1	8.2	8.1	7.9	7.8	7.5	7.4	7.5	7.5	7.5	7.4	7.7	0.2
4 th station	Secchi Disc (m)	2.1	2.2	2.2	2.6	2.8	2.9	2.9	3	3.2	2.9	2.6	2.5	2.6	0.3
	Water (°C)	27	30	32	28	23	17	13	12	14	18	21	24	21.5	6.8
	Dissolved O ₂	6.6	6.5	6.1	6.7	4.9	9.5	9.4	9.6	9.2	9	8.8	7.3	7.8	1.6
	pH	7.5	8	7.9	7.9	7.9	7.6	7.4	7.3	7.4	7.3	7.3	7.2	7.5	0.2

showed that April and October had a critical importance with regard to the population density and transitional periods (Figure 7). In these transitional periods, while populations of *S. longiscata*, *M. praemorsa costata*, *M. praemorsa ferussaci*, *A. leucostoma*, *R. labiata* and *G. piscinarum* decreased, *T. jordani*, *S. contempta*, *V. saulcyi*, *V. piscinalis*, and

M. tuberculata populations increased. There was not any fluctuation in the population of *B. phialensis*. It was concluded that some species such as *M. praemorsa costata* (770.86 ± 556.37), *S. longiscata* (905.58 ± 618.24), *S. contempta* (668.91 ± 345.19), and *T. Jordani* (913.77 ± 257.84) exist more abundantly compared to others.

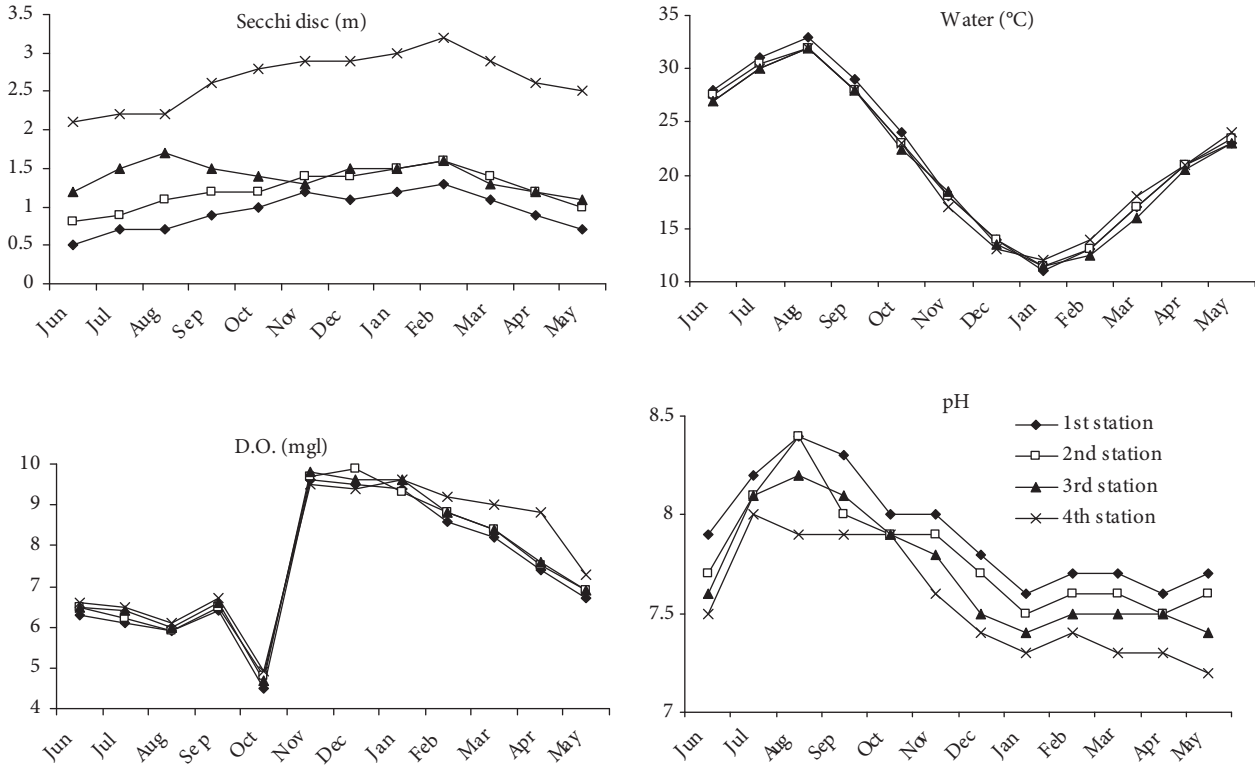


Figure 3. Monthly variations of some physicochemical measurements (June 2003-January 2004).

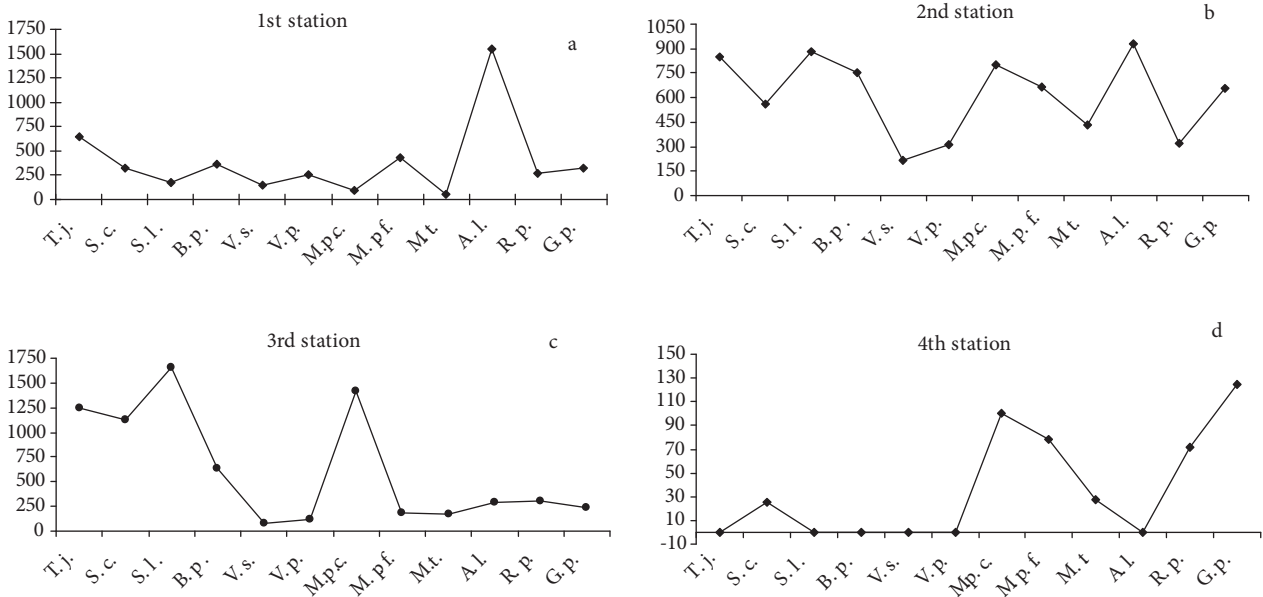


Figure 4. a-d: Species abundance at each station.

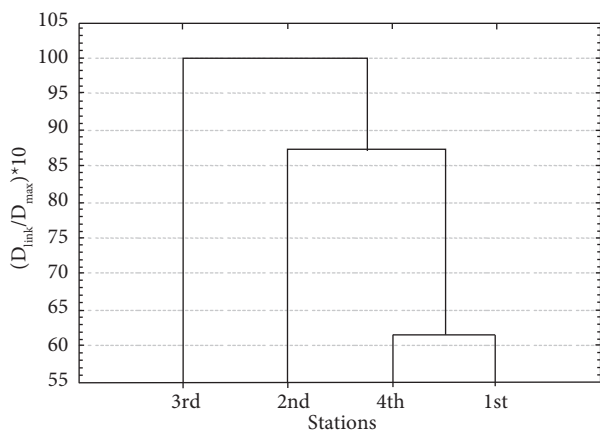


Figure 5. The index of population density and similarities for the different stations (Statica 7.0, Cluster Analiz).

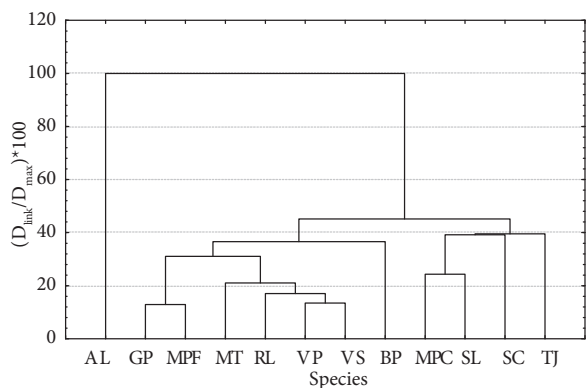


Figure 6. The index of population density and similarities for the different species (Statica 7.0, Cluster Analiz).

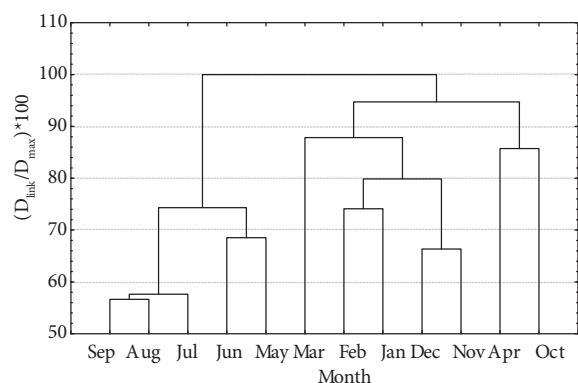


Figure 7. The index of population density and similarities for the different sampling periods (Statica 7.0, Cluster Analiz).

Discussion

Dissolved oxygen was increased by decreasing the rate of temperature among physicochemical parameters of Lake Gölbaşı. It was observed that whereas pH elevated with the plankton biomass, turbidity decreased significantly. Because phytoplankton uses CO₂ in photosynthesis, the pH of lake water increases as carbonic acid form. These findings are supported by the eutrophic characteristics of Lake Gölbaşı. (Şereflişan, 2003). Turbidity was found lowest for the 4th station (with a 6-8 m depth) because of the replenish the water by different springs at the bottom.

The paleogeographic connections have the most impact on the present distributions of the aquatic mollusks of Turkey (Demirsoy, 1996; Yıldırım, 1999).

Throughout this study concerning freshwater faunas, certain species of both orders Archeogastropoda and Mesogastropoda are found. The former includes a genus belonging to the family Neritidae and 7 species of the genus *Theodoxus*. The Palearctic genus *Theodoxus* lives in running waters of turbulent ecosystems includes taxa living in springs, rivers, lakes and even in low-salinity waters (Yıldırım et al., 2006a). They often live, in large groups, on the benthic zones of running or turbulent waters, on the solid banks and sometimes on the vegetation (Roth, 1987; Yıldırım, 1999; Yıldırım, 2004). In our study, *Theodoxus* specimens were collected from the gravel bottom.

The order of Mesogastropoda in Turkey includes 28 genera belonging to five families, 52 species along with 10 subspecies (Yıldırım, 1999). In Turkey there are two genera of the family Valvatidae, including *Valvata*. The distribution pattern of this species is in conformity with the location of Anatolia in the Palearctic region and the distribution pattern of the euryoecious pulmonates in the region (Purchon, 1977; Hart and Samuel, 1974).

In the order Mesogastropoda, the family Hydrobiidae is the one including the most species and subspecies (Zhadin, 1965). Belonging to this family and detected in this research, *Semisalsa contempta* and *S.longiscata* were collected from both hard and soft bottoms (a heterogeneous distribution type).

Bithynia, a bithyniid genus of euryoecious characteristic (Hart and Samuel, 1974), is represented by only *Bithynia phialensis*, which was found in large numbers in this research. Likewise, members of the family Melaniidae and Melanopsidae are generally of euryoecious origin. Of these, 2 *Melanopsis* and 1 *Melanooides* taxa were determined. *M. tuberculata* was detected in our research on the shallow sandy bottom.

The subclass Pulmonata normally belongs to eurytopic species spreading especially on shallow and muddy bottoms (Hart and Samuel, 1974; Ertan et al., 1996). *Radix labiata* was detected in the research on the muddy bottom while *Anisus leucostoma* on the shallow soft bottom.

It was detected that *A. leucostoma* abundance was more than higher than that of the all species sampled during 12 months. We know that there is no study on the population dynamics of these species before and therefore, effective factors on this situation should be investigated in a future study. Also, interspecific interactions and competition must be examined to

determine the main effects on population distributions of the different species.

Because, in summer months, plankton production propagates in the high water temperature, all species can obtain adequate feed to grow. Therefore our data showed that population abundance of the species differed from each other significantly in transitional periods (April-October).

It was concluded that population densities of the species were affected by the nutritional conditions of Lake Gölbaşı being a eutrophic character. Despite some studies in different areas of Turkey, our information on the aquatic gastropods is far from being complete. Thus, we hope that the present study will contribute to the definition of freshwater mollusk fauna in Turkey.

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