FRESHWATER SNAILS FAUNA OF LAKES REGION (GÖLLER BÖLGESI), TURKEY

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Abstract. In this study, existent freshwater snails collected from 184 stations from Lakes Region of Turkey have been determined. A total of 32 prosobranch taxa from 18 genera and 10 families and 18 pulmonate taxa from 12 genera and 4 families have been recorded. 25 of the prosobranch taxa and 2 of the pulmonate taxa are Anatolian endemics.

Keywords: freshwater snails, Lakes Region of Turkey, endemisms.

Rezumat. Fauna de melci de apă dulce din Regiunea Lacurilor (Göller Bölgesi), Turcia. În acest studiu, se prezintă melcii de apă dulce colectaţi din 184 staţii din Regiunea Lacurilor din Turcia. În total au fost identificate 32 specii prosobranhiate aparţinând la 18 genuri şi 10 familii şi 18 specii pulmonate din 12 genuri şi 4 familii. 25 dintre speciile prosobranhiate şi 2 dintre speciile pulmonate sunt endemice în Anatolia.

Cuvinte cheie: melci de apă dulce, Regiunea Lacurilor în Turcia, endemisme.

INTRODUCTION

Environmental deterioration arising from human activities has been threatening the natural habitats within Göller Bölgesi (The Lakes Region), a biodiversity center for many groups including freshwater snails in Turkey. For this reason, the area is known to have high conservational importance for the threatened species. However, the faunal inventories and thus conservational studies for many invertebrate groups that show substantial endemism in the area are far from being complete.

Although significant investigations on gastropods of the Lakes Region started by 1960s and contributors are not numerous (YILDIRIM, 1999), the area can still be referred to as one the most studied parts of Turkey concerning freshwater snails. Literature survey for the area can be summarized as follows:

STURANY (1902) surveyed some of the important freshwater locations in Mediterranean and Central Anatolian regions of Turkey and described several terrestrial and freshwater gastropods.WEBER (1927) described *Falsipyrgula pfeiferi* from Lake Eğirdir. SCHÜTT (1964) described 4 new species (*Chilopyrgula zilchi*, *Bithynia pseudemmericia*, *Horatia bunarbasa* and *Hydrobia pamphylica*) from Kırkgöz Springs in Antalya. He later recorded (SCHÜTT, 1965) the distributions of *Theodoxus, Viviparus, Valvata, Hydrobia, Pseudamnicola, Bythinella, Falsipyrgula, Sadleriana, Lithoglyphus, Horatia,* and *Bithynia* taxa from various locations in Turkey and described *Theodoxus altenai* as a new species. BILGIN (1967) recorded 12 pulmonate and 10 prosobranch species from various freshwater habitats in İzmir region. GELDIAY & BILGIN (1969) recorded 20 species and 5 subspecies of mollusks from numerous freshwater sites in Turkey. SCHÜTT & BILGIN (1970) described *Pseudamnicola geldiayana* and *P. natolica symrnensis* as new species from the area. RADOMAN (1973) described new prosobranch species from the Balkans and Anatolia and discussed their phylogenetic relations. Enigmatic genera *Kirelia, Falsipyrgula, Pseudorientalia, Turkorientalia* were described from the area. He also described one new genus (*Graecoanatolica*) ascribed to a new monogeneric subfamily Graecoanatolicinae and 5 new species for this genus from the area including *G. lacustristurca* from Lake Eğirdir. He transferred *Hydrobia pamphylica* into *Graecoanatolica*. *Horatia bunarbasa* and two new sympatric species were placed into genus *Islamia*. The same author (RADOMAN, 1976) discussed the speciation and distribution of Bythinellidae from the same region and described *Bythinella turca* as new species from Isparta province. BILGIN (1980) studied 231 freshwater habitats in western Turkey and recorded 29 Prosobranchia, 19 Pulmonata, and 9 Bivalvia species. SCHÜTT (1990) studied the relationships of the Pleistocene gastropod fossils of Lakes Burdur, Yarışlı and Acıwith present day species. He also reviewed the palaeogeography of Konya, Pasinler and Erzurum plains based on fossil molluscs. YILDIRIM & SCHÜTT (1996) studied the mollusc species of Lake Beyşehir. YILDIRIM & MORKOYUNLU (1997) described *Sadleriana byzanthina demirsoyi* from Lake Burdur basin and provided information on its ecology and feeding. YILDIRIM (SCHÜTT &YILDIRIM, 1999) described a new *Falsipyrgula* from Lake Beyşehir (SCHÜTT &YILDIRIM, 1999). YILDIRIM (1999a) reviewed the Prosobranchia species that have been recorded in Turkey and discussed their zoogeography. YILDIRIM (1999b) studied the extant and fossil freshwater gastropod taxa in Lake Burdur. YILDIRIM & KARAŞAHIN (2000) studied the freshwater Gastropoda species distributed in the province of Antalya. SCHÜTT & YILDIRIM (2003) described *Tefennia tefennica* n. gen et n. sp. from a spring pond in province Burdur.

The Lakes Region is situated within the western Toros Mountains in south-western Turkey. The direction change of the Toros Mountains to the north of Antalya Bay resulted in the formation of narrow and long mountain belts surrounding depressions in which numerous lakes were formed. These lakes are lined symmetrically with Lake Eğirdir in the center.

Some of these lakes have dried up as a result of either natural events or agricultural activities**. Köyceğiz Lake** (36° 54 'N 28° 38' E) is a freshwater barrier lake. It has a surface of 8,000 ha and is located at sea level. **Acı Lake** (37°

49' K 29° 48 'D), as a result of its high concentration of sodium sulphate (Na_2SO_4), is the second most brackish lake in Turkey. Its surface area is of 21,000 ha and elevation is 836 m. **Çorak Lake** (37° 41' K 29° 46 'D) is a small tectonic brackish lake. It has been mostly dry during the last 10 years. **Salda Lake** (37° 33' K 29° 40 'D) is a slightly brackish tectonic lake. Its surface area is of 4,370 ha and elevation is 1,139 m. It contains high concentrations of magnesium sulfate ($MgSO_4$). **Karataş Lake** (37° 23' K 29° 58 'D) is a small and shallow freshwater lake. Its surface is of 1,190 ha and elevation is 1053 m. **Yarışlı Lake** (37° 34' K 29° 58 'D) was used to be a freshwater lake connected to Burdur Lake. At the present, it is a shallow lake with high concentrations of sodium phosphate, sodium chloride and sodium sulfate. It has a surface of 1,400 ha and elevation reaches 915 m. **BurdurLake** (37° 44' K 30° 11 'D) is a small, closed, tectonic lake. Its surface area is of 23,700 ha and elevation is 857 m. It contains high concentrations of sodium, sulfur and chloride. **Eğirdir Lake** (39° 00' K 30° 54 'D) is the second largest freshwater lake in Turkey. It is a tectonic and oligotrophic lake. Its surface area reaches 47,250 ha and elevation 918 m. **Karamık Reeds** (38° 26' K 30° 50 'D) is a freshwater swamp consisting of numerous ponds containing reeds (*Phragmites*), cattails (*Typha*), and other water plants. Its surface area is of 4,500 ha and elevation is 1,002 m. **Akşehir** and **Eber** Lakes (38° 36' K 31° 18 'D) are two connected and closed freshwater lakes. Akşehir Lake is a tectonic lake. Their combined surface area, including a 1,500-ha corridor between them, is 53,600 ha and elevation is 966 m. **Beyşehir Lake** (37°45' K 31°30 'D), located in a depression formed after the Neogene, is the largest freshwater lake in Turkey. Its surface covers 73,000 ha and elevation reaches 1,123 m. Lake Kovada, a freshwater lake, has the characteristics of a tectonic polje. **Gölcük Lake** is located in a volcanic depression. The freshwater lakes **Söğüt** and **Kestel** within the Burdur province and Lake **Avlan** within the Antalya province have dried up (ANONYMOUS, 1993).

MATERIAL AND METHODS

Study encompasses 184 stations from 7 provinces within and around Lakes Region consisting of 20 lakes, 19 ponds, 29 fountains, 59 springs, 53 streams and 4 canals. In addition, 5 fossil localities around Lake Burdur have also been studied. A list of the stations is mentioned in the text as numbers are as follows:

A) **Stations in Afyonkarahisar province** (1-3. Lakes, 4. Ponds, 5-10. Springs): 1. Eber Lake; 2. Karamık Reeds; 3. Çapalı Lake; 4 . Suçıkan ponds near Dinar; 5. Spring by Karakuyu Lake; 6. Yapağılı Village (Dinar); 7. Gökgöl Village (Dinar); 8. Ilıca spring (Dinar); 9. İncirli springs (Dinar); 10. Suçıkan spring near Dinar.

B) **Stations in Antalya province** (1. Lake, 2. Pond, 3. Fountain, 4-11. Springs, 12-31. Streams and Brooks): 1. Yeşil Göl pond near Gömbe; 2. Yamanlar pond; 3. Fountain in İnnice Village (Korkuteli,Yeşilyayla); 4. İnnice Village spring; 5. Yarıkpınar (Korkuteli); 6. Kırkpınar (Korkuteli); 7. Spring on Gömbe-Yayla road; 8. Ulupınar spring (Kumluca); 9. Yarıkpınar (Kemer); 10. Kırkgöz springs (Döşemealtı); 11. Spring near Kırkgöz; 12. Bayındır Village brook near Gömbe; 13. Gömbe stream; 14. Alakır stream (Finike); 15. Ulupınar brook (Kumluca); 16. Brook in Phaselis beach (Kemer); 17. Varsak brook; 18. Kepez brook and fish ponds (Antalya); 19. Düden waterfall; 20. Kurşunlu waterfall; 21. Köprüçay stream; 22. Acısu (Serik); 23. Ilıca stream (Manavgat); 24. Gömeşli brook (Serik); 25. Titreyen Göl (Manavgat); 26. Manavgat stream; 27. Manavgat waterfall; 28. Manavgat stream donwstream Oymapınar dam; 29. Alara stream; 30. Kargı stream; 31. Dimçay (Alanya).

C) **Stations in Burdur province** (1-9 Lakes, 10-19 Ponds, 20-44 Fountains, 45-68 Springs, 69-80 Streams and Brooks, 81-83 Canals, D: dried): 1. Burdur Lake; 2. Yarışlı Lake; 3. Bayındır Lake; 4. Karataş Lake; 5. Yamadı Lake; 6. Salda Lake; 7. Karacaören dam lake; 8. Sögüt Lake (D); 9. Kestel Lake (D); 10. Hacılar pond; 11. Başpınar pond (Tefenni); 12. Pınarbaşı pond (Karamanlı); 13. Karaçal dam lake; 14. Dereköy pond; 15. Alanköy pond; 16. Dereköy pond (Yeşilova); 17. Ponds at entrance to Çanaklı Village; 18. Pond and wells by Kuyubaşı Village; 19. Kızılsu dam reservoir; 20. Sarı Seki fountain (Altınyayla); 21. Çataloluk spring (Altınyayla); 22. Kozpınar (Gölhisar); 23. Fountain in Uylupınar Village (Gölhisar); 24. Terzipınar (Gölhisar); 25. Aziziye Village fish ponds and fountain; 26. Fountain on Burdur-Büğdüz road; 27. Fountains in Kavak Village (Yeşilova); 28. Cistern at Burdur-Denizli border (Devrent district); 29. Fountain and spring at Kırlı altı in Bayındır Village; 30. Fountain and brook below Taşpınar Village; 31. Fountain in Taşpınar Village; 32. Kara Ahmet Spring in Akçaköy; 33. Çifte Çeşme Fountain on Elden road; 34. Fountain below Çardak Village; 35. Tank and fountain near graveyard below Örencik Village; 36. Small fountain below Örencik; 37. Taşkapı Fountain (Ağlasun); 38. Fountain in Yazır Village (Ağlasun); 39. Fountain in Atatürk park on Isparta-Ağlasun road; 40. Cistern in Konak Village; 41. Fountain in Kocaaliler town at Bucak-Antalya split; 42. Milyas (Kocaaliler Village); 43. Akçapınar Fountain in Üzümlübel Village (Bucak); 44. Körpınar in Üzümlübel Village; 45. Spring and its extension in Halebi Village; 46. Gölpınar spring (Altınyayla); 47. Akcasu spring (Altınyayla); 48. Spring near a fish farm in Aziziye Village; 49. Spring II near fish farm in Aziziye Village; 50. Spring in Kapaklı Village; 51. Spring in Kayaaltı Village; 52. Spring southeast of Yarışlı Lake; 53. Yarışlı Village trout farm; 54. Kümbetli Spring (Koca Pınar Village); 55. Spring in Koca Pınar Village; 56. Hoşmuşa Spring in Akçaköy (Yeşilova); 57. İğdeli Spring in Akçaköy; 58. Kocasu Spring in Ulupınar Village (Yeşilova); 59. Kendir Bögeti Spring in Armut Village; 60. Spring below Çardak Village; 61. Kokarpınar Spring in Soğanlı Village; 62. Brooks near Onur trout farm in Yeşilbaşköy (Ağlasun); 63. Spring near old mill in Yeşilbaşköy (Ağlasun); 64. Başgöz Spring in Kuşbaba Village; 65. Spring pond near Yazıpınar (Kestel Village, Bucak); 66. Pınarbaşı Spring (Kestel Village, Bucak); 67. Hocapınar Spring (Kestel Village, Bucak); 68. Spring in Soğanlı Village; 69. Dalyan stream (Altınyayla); 70. Brook near Kurna Village; 71. Brook on leftside of Büğdüz road; 72. Düger Village brook; 73. Akçaköy brook; 74. Brook on the margin of Yazıköy

near Burdur Lake; 75. Bozçay stream at Yazıköy; 76. Stream connected to Burdur Lake (Soğanlı Village); 77. Brook next to Kirazlı trout farm; 78. Brook in Kibrit Village; 79. Brook along Ağlasun-Isparta road; 80. Brook in Pınarbaşı trout farm (Kestel, Bucak); 81. Irrigation canal in Hıdırellez district (Bucak); 82. Irrigation canal and pond near Hacılar Village; 83. Irrigation canal in Yazıpınar Village (Bucak).

Fossil collection sites around Burdur Lake: 1.Çendik beach; 2. Burdur sand pits; 3. Yarışlı lake; 4. Düğer Village; 5. Senirce Village sand pits.

D) **Stations in Denizli province** (1-2. Lakes, 3. Pond, 4. Spring): 1. Acı lake; 2. Çivril Lake; 3. Gemiş Village pond; 4. Gemiş Village spring.

E) **Stations in Isparta province** (1-2. Lakes, 3-7. Ponds, 8-10. Fountains, 11-24. Springs, 25-36. Streams and Brooks, 37. Canal):1. Eğirdir Lake; 2. Kovada Lake; 3. Keçiborlu dam reservoir; 4. Gelincik dam; 5. Gökçepınar Village pond; 6. Kayaağzı pond; 7. Karaot pond; 8. Fountain on Gönen road; 9. Kavacık Fountain on Akdağ near Keçiborlu; 10. Çifte Çeşmeler on old Isparta road; 11. Pazarköy springs; 12. Kayaağzı spring; 13. Spring by Aksu stream; 14. Spring by Konne stream; 15. Pınar Pazarı spring; 16. Cire Village spring; 17. Kocapınar Spring (Aşağı Gökdere); 18. Spring in Sevinçbey Village; 19. Büyükgökçeli Spring; 20. Fele Spring; 21. Arslandoğmuş Village spring; 22. Köşkpınar, Gümüşgün; 23. İncirlipınar Spring in Gölbaşı Village; 24. Pınargözü brook (Yenişarbademli); 25. Aksu Stream; 26. Yılanlı Village brook; 27. Kızıldere brook at Pazarköy; 28. Konne stream; 29. Cire Village brook; 30. Keçiborlu Stream; 31. Brook near Uluborlu; 32. Salur Stream; 33. Göksu Stream (Çandır); 34. Gelincik Village brook; 35. Hüyük Village brook; 36. Keçili Village brook; 37. Kovada Canal.

F) **Stations in Konya province** (1-2. Lakes): 1. Beyşehir Lake; 2. Akşehir Lake.

G) Stations in Muğla province (1. Lake, 2. Pond, 3-7. Springs, 8-17. Streams and Brooks): 1. Köyceğiz Lake; 2. Kız Lake; 3. Kız Lake Spring I; 4. Kız Lake Spring II; 5. Spring near Karamuar brook in Fethiye; 6. Fethiye Yakapark Spring I; 7. Yakapark Spring II; 8. Fethiye Yakapark source extension I; 9. Fethiye Yakapark source extension II; 10. İnnice Village spring; 11. Eşen stream; 12. Fethiye Akçay; 13. Fethiye Eynazlı brook; 14. Brook at 6 km distance to Fethiye; 15. Fethiye Karamuar brook; 16. Akçapınar stream; 17. Kadın Azmağı stream.

RESULTS AN DISCUSSIONS

A total of 32 Prosobranchia species/subspecies from 18 genera and 9 families have been recorded in the Lakes Region. Of these, 25 species are endemic to Anatolia (YILDIRIM, 1999a; YILDIRIM et al., 2006). On the other hand, 18 species from 12 genera and 4 families of Pulmonata have been recorded (YILDIRIM et al., 2006; GLÖER & YILDIRIM, 2006a, b; GLÖER & RÄHLE, 2009). Account of families is given below in systematical order, along with the distributional data concerning the study area.

Family: **NERITIDAE** RAFINESQUE 1815

Species of *Theodoxus*, single representative of the family in Turkey, are found generally in flowing waters attached to rocks or stones in shallow parts. As passive transportation is not likely, direct hydrogeographic and paleogeographic factors are responsible for the distribution of the species (ZHADIN, 1952; ROTH, 1987). 4 out 9 species/subspecies found in Turkey can be encountered in the region and 3 of these are endemic exclusively to the area. *Th. heldreichi* is endemic to Lakes Beyşehir and Eğirdir, while *Th. fluvicola* is more common in undisturbed and mainly lotic systems of the southern Aegean and Lakes Regions (provinces of İzmir, Manisa, Aydın, Denizli, and Isparta) (BILGIN, 1980; SCHÜTT & ŞEŞEN, 1989, 1992; SCHÜTT, 1991; YILDIRIM, 1999a). *Th. altenai* is a larger species endemic to Kırkgöz Springs in Döşemealtı, Antalya. *Th. anatolicus* on the other hand is probably the most widespread *Theodoxus* in Turkey: in provinces of Izmir, Manisa, Aydın, Afyon, Antalya, Burdur, Denizli, Eskişehir, Adana, Mersin, and Kahramanmaraş (BILGIN, 1980; SCHÜTT & ŞEŞEN 1989, 1992; SCHÜTT 1991; YILDIRIM 1999a). It is also present in Samos and Cyprus (BANK & MAASSEN, 1998) (Table 1).

Table 1. Species of Neritidae distributed in the Lakes Region.
Tabel 1. Speciile de Neritidae distribuite în Regiunea Lacurilor.

Taxa	Localities						
	Muğla	**Denizli**	**Burdur**	**Antalya**	**Isparta**	**Afyonkarahisar**	**Konya**
Theodoxus heldreichi heldreichi (MARTENS 1879)					1		1
Th. heldreichi fluvicola SCHÜTT & ŞEŞEN 1992		4	83	5, 6, 19, 20, 27, 28	19, 20	6, 7	
Th. altenai SCHÜTT 1965				10			
Th.anatolicus (RECLUZ 1841)	3, 4, 5, 6, 7, 8, 9		52 54, 55, 56, 66, 67			4, 5, 9, 10	

Family: **VIVIPARIDAE** GREY 1847

Out of 2 euryoecious *Viviparus* species distributed in Turkey, often present in eutrophic lotic systems (ZHADIN, 1952), *V. contectus* is found in the area. The species was reported from Erzurum (GERMAIN, 1936), Black Sea Region (SCHÜTT, 1965), Lakes Region (BILGIN, 1980), also outside Turkey from the basins of the Baltic Sea, the Black

Sea, the Caspian Sea and eastern Siberia (ZHADIN, 1952), northern and central Europe, Germany, northern Spain, Portugal, Italy and the Balkans down to Macedonia (FECHTER & FALKNER, 1990) (Table 2).

Table 2. Species of Viviparidae distributed in the Lakes Region.
Tabel 2. Speciile de Viviparidae distribuite în Regiunea Lacurilor.

Taxa	Localities	
	Isparta	Konya
Viviparus contectus (MILLET 1813)	7	1

Family: **THIARIDAE** TROSCHEL 1857

Only one species to Paleotropical genus *Melanoides* OLIVIER 1804 occur in Turkey. Euryhaline and parthenogenetic species *M. tuberculatus* is thought to be native in Turkey (ŞEŞEN & BILGIN, 1988; SCHÜTT & ŞEŞEN, 1989), although it is invasive in many parts of the world (Table 3).

Table 3. Species of Thiaridae distributed in the Lakes Region.
Tabel 3. Speciile de Thiaridae distribuite în Regiunea Lacurilor.

Taxa	Localities
	Muğla
Melanoides tuberculata (MÜLLER 1774)	1

Family: **MELANOPSIDAE** ADAMS & ADAMS 1854

Genus *Melanopsis* FERUSSAC 1807 is represented in the area by one species: *Melanopsis praemorsa*. The taxonomy of the species is complex and some populations of the circum-Mediterranean *M. praemorsa* may actually represent several independent species. It is found commonly in provinces İzmir, Balıkesir, Antalya, Aydın, Denizli, Manisa, Kahramanmaraş, Sakarya, Ankara, Hatay, Diyarbakır, Urfa, and Mardin (SCHÜTT, 1965; GELDIAY & BILGIN, 1969; BILGIN, 1980; SCHÜTT, 1983) (Table 4).

Table 4. Species of Melanopsidae distributed in the Lakes Region.
Tabel 4. Speciile de Melanopsidae distribuite în Regiunea Lacurilor.

Taxa	Localities	
	Muğla	Antalya
Melanopsis praemorsa (LINNAEUS 1758).	1, 10	2, 20, 21, 22, 23, 24, 29, 30, 31, 32

Family: **BITHYNIIDAE** TROSCHEL 1857

Of the 2 genera found in Turkey, *Bithynia* LEACH, 1818 is found in the Lakes Region. Of 6 *Bithynia* species present in Turkey, 2 are recorded with anatomical evidence from the area (YILDIRIM, 1999a; GLÖER & YILDIRIM, 2006b): *Bithynia pseudemmericia* and *B. pesicii.* The former is commonly represented in the Quaternary sediments of Konya and Burdur basins (SCHÜTT, 1990; YILDIRIM, 1999b) (Table 5).

Table 5. Species of Bithyniidae distributed in the Lakes Region (F: fossil).
Tabel 5. Speciile de Bithyniidae distribuite în Regiunea Lacurilor (F: fosilă).

Taxa	Localities					
	Muğla	Burdur	Antalya	Isparta	Afyonkarahisar	Konya
Bithynia pseudemmericia SCHÜTT 1964		F1-5	2, 10, 11	1	1, 2, 3, 8, 9	1
B. pesicii GLÖER & YILDIRIM 2006	16, 17					

Family: **HYDROBIIDAE** TROSCHEL 1857

It is the most diverse family of Gastropoda in freshwater systems. The variability is also observed in ecological tolerance and distributional ranges (ZHADIN, 1952). In the study area, the family is represented by 16 species/subspecies (15 being endemics) from 10 genera (Table 6).

Of the subfamily Pseudamnicolinae, *P. geldiayana* is endemic to the springs around Denizli, Dinar, and Çivril (SCHÜTT & BILGIN, 1970; BILGIN, 1980), while rather widespread endemic *P. n. smyrnensis* is found in fresh waters around İzmir, Aydın, Denizli, and Isparta (SCHÜTT, 1965; SCHÜTT & BILGIN, 1970; BILGIN, 1967; 1980).

All of the 3 Pyrgorientaliinae species characterized with carinated shells are endemic to Turkey: *P. zilchi* and *K. carinata* in Lakes Region, *K. murtici* in Manavgat area (Antalya). *P. zilchi* is confined to Kırkgöz Springs in Antalya (SCHÜTT, 1964; BILGIN, 1980), while *K. carinata* is found only in Lake Beyşehir (RADOMAN, 1973).

Of Horatiinae, *S. b. byzanthina* is confined to western Anatolia: Bilecik, İzmir (SCHÜTT, 1965); Manisa, Kütahya, Aydın (BILGIN, 1980), while *S. b.demirsoyi* is endemic to south-western Anatolia (YILDIRIM et al., 2006). The other endemic species, *H. parvula*, is seemingly widespread as reports from Isparta (Manastır Spring and Keçiborlu Stream), Tokat, Mardin and Diyarbakır are present (SCHÜTT, 1965; BILGIN, 1967; 1980).

Of Notogean subfamily Tateinae, euryhaline and parthenogenetic *P. antipodarum* (originally confined to New Zealand) has become invasive through introductions via ships (ZHADIN, 1952). Literature reports come from Deveönü

pond (Çay, Afyon), Selçuk, Finike stream (BILGIN, 1980), also outside Turkey from Australia, western and southern Europe and USA (ZHADIN, 1952; LEVRI et al., 2007; RADEA et al., 2008).

Endemic genus *Tefennia* of Pseudohoratiinae and its sole species *T. tefennica* are found in Başpınar Spring near Tefenni, Burdur (YILDIRIM et al., 2006).

Of Islamiinae, southern European genus *Islamia* RADOMAN, 1973 is represented by 3 species restricted to Kırkgöz springs in Turkey: *Islamia anatolica* RADOMAN 1973; *I. pseudorientalica* RADOMAN 1973 and *I. bunarbasa* (SCHÜTT 1964).

As two Balkan species undergone extinction, all recent Graecoanatolicinae taxa are endemic to Lakes Region. Two Anatolian species, *G. conica* and *G. brevis*, have also gone extinct. Remaining taxa are distributed in the provinces Denizli, Burdur, Afyonkarahisar, Isparta, and Antalya (SCHÜTT, 1964; 1990; RADOMAN, 1973; YILDIRIM & SCHÜTT, 1996).

Table 6. Species of Hydrobiidae distributed in the Lakes Region (F: fossil).
Tabel 6. Speciile de Hydrobiidae distribuite în Regiunea Lacurilor (F: fosilă).

Taxa	Localities						
	Muğla	**Denizli**	**Burdur**	**Antalya**	**Isparta**	**Afyonkarahisar**	**Konya**
Pseudamnicolinae RADOMAN 1977							
Pseudamnicola geldiayana SCHÜTT & BILGIN 1970						6	
P. natolica smyrnensis SCHÜTT 1970			32, 56		19 , 20, 21		
Pyrgorientaliinae RADOMAN 1973							
Pyrgorientalia zilchi (SCHÜTT 1964)				10			
Kirelia carinata RADOMAN 1973							1
Horatiinae RADOMAN 1973							
Sadleriana byzanthina byzanthina (KÜSTER 1852)	3, 4						
S. byzanthina demirsoyi YILDIRIM & MORKOYUNLU 1997			52, 54, 55	5, 6			
Horatia parvula (NAEGELE 1894)					30		
Tateinae THIELE 1925							
Potamopyrgus antipodarum (GRAY 1843)	1						
Pseudohoratiinae RADOMAN 1973							
Tefennia tefennica SCHÜTT & YILDIRIM 2003			11				
Islamiinae RADOMAN 1973							
Islamia pseudorientalica RADOMAN 1973				10			
I. anatolica RADOMAN 1973				10			
I. bunarbasa (SCHÜTT 1964)				10			
Graecoanatolicinae RADOMAN 1973							
Graecoanatolica tenuis RADOMAN 1973		4				7, 9	
G. lacustristurca RADOMAN 1973			54, F1-5		12		
G. pamphylica (SCHÜTT 1964)				5, 6, 10, 25			
G. kocapinarica RADOMAN 1973					17		

Family: **AMNICOLIDAE** TRYON 1863

Members of the single genus *Bythinella* in Turkey are generally stenoecious species with limited distributions (ZHADIN, 1952). Endemic *B. turca* has been recorded only in Cire spring near Eğirdir, Isparta (RADOMAN, 1973; YILDIRIM, 1999a) (Table 7).

Table 7. Species of Amnicolidae distributed in the Lakes Region.
Tabel 7. Speciile de Amnicolidae distribuite în Regiunea Lacurilor.

Taxa	Localities
	Isparta
Bythinella turca RADOMAN 1976	16

Family: **PYRGULIDAE** BRUSINA 1881

3 recent species of *Falsipyrgula* RADOMAN 1973, the only genus in Turkey, are restricted to Lakes Region: *Falsipyrgula pfeiferi* from Lake Eğirdir, *F. beysehirana* and *F. schuetti* from Lake Beyşehir. *Falsipyrgula osmana* (BUKOWSKI 1930) are known from the Quaternary sediments of Lake Burdur (WEBER, 1927; SCHÜTT, 1965, 1990; SCHÜTT & YILDIRIM, 1999; YILDIRIM, 1999b) (Table 8).

Table 8. Species of Pyrgulidae distributed in the Lakes Region.
Tabel 8. Speciile de Pyrgulidae distribuite în Regiunea Lacurilor.

Taxa	Localities	
	Isparta	**Konya**
Falsipyrgula pfeiferi (WEBER 1927)	1	
F. beysehirana (SCHÜTT 1965)		1
F. schuetti SCHÜTT & YILDIRIM 1999		1

Family: **VALVATIDAE** GRAY 1840

2 genera (*Valvata, Borysthenia*) and 3 species of Valvatidae are present in the study area. Unlike other Prosobranch groups, the Valvatidae members are euryoecious in general (HART & SAMUEL, 1974). *V. piscinalis* and *B. naticina* are widespread in Turkey (BILGIN, 1967, 1980) and in Palearctic region (ZHADIN, 1952; SCHÜTT, 1983; FECHTER & FALKNER, 1990). *V. cristata,* which was present in dried lakes Avlan and Karagöl (SCHÜTT, 1965), is relatively rare in comparison and it has a southern European distribution in general (FECHTER & FALKNER, 1990) (Table 9).

Table 9. Species of Valvatidae distributed in the Lakes Region (F: fossil).
Tabel 9. Speciile de Valvatidae distribuite în Regiunea Lacurilor (F: fosilă).

Taxa	Localities				
	Burdur	Antalya	Isparta	Afyonkarahisar	Konya
Valvata piscinalis (MÜLLER 1774)					1
V. cristata (MÜLLER 1774)	F1-5				1
Borysthenia naticina (MENKE 1845)	4	10, 24	1, 2, 6, 12, 14, 16	1, 2, 3	

Order: **PULMONATA** CUVIER 1814

Suborder : Basommatophora KEFERSTEIN 1864

Unlike many Prosobranchia taxa, the members of this group are euryoecious and eurytopic. They are often indicators of eutrophic environmental conditions. Accordingly the endemism is not high and often overlooked.

Family: **ACROLOXIDAE** THIELE 1931

Genus *Acroloxus* BECK 1837 represents the family in the region with a single species. *A. lacustris* can be found in oxygenated waters, between aquatic plants in the marginal zone of slow running waters (Table 10).

Table 10. Species of Acroloxidae distributed in the Lakes Region.
Tabel 10. Speciile de Acroloxidae distribuite în Regiunea Lacurilor.

Taxa	Localities		
	Burdur	Isparta	Afyonkarahisar
Acroloxus lacustris (LINNAEUS 1758)	11	6, 28	8

Family: **LYMNAEIDAE** RAFINESQUE 1815

Genus *Lymnaea* LAMARCK 1799 is represented in the study area by Holarctic *Lymnaea stagnalis. Stagnicola* LEACH 1830 is represented in the area by two species: *S. palustris* and *S. tekecus.* The latter is a recently described endemic species and tentative identifications based on shell characters as *S. palustris* from the region may actually belong to *S. tekecus* or undescribed species. *Galba truncatula* belonging to genus *Galba* SCHRANK 1803 is highly important from the economic point of view in Turkey due to its role in transmission of digenean parasites. Genus *Radix* MONTFORT 1810 is represented by three common species: *R. labiata, R. balthica*, and *R. auricularia. R. labiata* is most common of its kin in the area (Table 11).

Table 11. Species of Lymnaeidae distributed in the Lakes Region.
Tabel 11. Speciile de Lymnaeidae distribuite în Regiunea Lacurilor.

Taxa	Localities				
	Muğla	Burdur	Antalya	Isparta	Afyonkarahisar
Lymnaea stagnalis (LINNAEUS 1758)		5		7	1, 2, 3
Stagnicola palustris (MÜLLER 1774)		4, 5, 11, 77, 82, 83		1, 2, 12, 18, 25, 26, 27, 29, 32, 37	
S. tekecus (GLÖER & YILDIRIM 2006)			10	28	
Galba truncatula (MÜLLER 1774)		20, 21, 22, 24, 29, 35, 36, 61, 64, 66, 70, 83	2, 3, 5, 9, 12, 13, 24, 28	9, 10, 23, 25, 27, 28,29, 30	1, 2, 3, 4, 5, 10
Radix labiata (ROSSMÄSSLER 1835)		7, 10, 11, 20, 21, 35, 36, 45, 48, 52, 54, 56, 61, 62, 63, 64, 72, 76, 77, 78, 80, 81, 82, 83	2, 6, 8, 10, 18, 19, 22, 24, 26, 27, 28	1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 18, 23, 25, 26, 27, 28, 29, 32, 34, 35, 37	1, 2, 3, 4, 5, 8, 9
R. balthica (LINNAEUS 1835)	2, 6				
R. auricularia (LINNAEUS 1758)		5		7	1, 2, 3

Family: **PHYSIDAE** FITZINGER 1833

Two genera, each with single species are found in Turkey and in the study area (ZHADIN, 1952): *Physa* DRAPARNAUD, 1801 and *Physella* HALDEMANN, 1843. *Physa fontinalis* is Holarctic, while *Physella acuta* is an invasive species originating from N. America (Table 12).

Table 12. Species of Physidae distributed in the Lakes Region.
Tabel 12. Speciile de Physidae distribuite în Regiunea Lacurilor.

TAXA	LOCALITIES				
	Denizli	Burdur	Antalya	Isparta	Afyonkarahisar
Physa fontinalis (LINNAEUS 1758)	3			1	1, 2, 3, 4
Physella acuta (DRAPARNAUD 1805)		7, 82	8, 18, 24, 28	1, 2, 12, 18, 25, 26, 27, 28, 29, 32, 37	1, 2, 3, 8

Family: **PLANORBIDAE** RAFINESQUE 1815

Genus *Planorbis* MÜLLER 1774 is represented by two common species: *P. planorbis* and *P. carinatus. Bathyomphalus* CHARPENTIER 1837 and its sole member in Turkey, *B. contortus*, is reported only in the Lakes Region (YILDIRIM et al., 1994, 1997). *Gyraulus* CHARPENTIER 1837 is a diverse genus represented by (at least) 3 species from the region. Of these, *G. pamphylicus* was recently described from Kırkgöz springs and, as in *Stagnicola* case, previous *Gyraulus* records at least from Antalya region, may not be reliable. *P. corneus* (single species of *Planorbarius* DUMÉRIL 1806 in the region) is remarkably rare in the study area. *A. fluviatilis* (single representative of *Ancylus* MÜLLER 1773 in the region) prefers running lotic waters with high oxygen content (Table 13).

Table 13. Species of Planorbidae distributed in the Lakes Region.
Tabel 13. Speciile de Planorbidae distribuite în Regiunea Lacurilor.

Taxa	Localities				
	Burdur	Antalya	Isparta	Afyonkarahisar	Konya
Planorbis planorbis (LINNAEUS 1758)	20, 52, 54, 55, 56, 61, 82	13, 15, 20, 23	11, 12, 25, 26, 27, 28, 29, 34	6, 7, 8, 10	
P. carinatus (MÜLLER 1774)	5		7	1, 2, 3	
Bathyomphalus contortus (LINNAEUS 1758)			6, 7, 12		
Gyraulus albus (MÜLLER 1774)	4, 51, 59		1, 2, 12, 16, 18, 28, 37	1, 2, 3, 4, 10	1, 2
G. laevis (ALDER 1838)	15, 27, 73	3, 5, 12, 23, 24, 28	18, 29, 30, 34, 35	4, 5, 7	
G. pamphylicus (GLÖER & RÄHLE 2009)			10		
Planorbarius corneus (LINNAEUS 1758)	5		7	1, 2, 3	
Ancylus fluviatilis MÜLLER 1774	11		1, 15, 16, 17		

Of the 50 freshwater snail species/subspecies taxa, it is seen that the species richness and endemism is much higher in Prosobranchia. All determined taxa belonging to Prosobranch families Pyrgulidae, Bithyniidae, Amnicolidae are endemics, while only single taxa, each from Neritidae and Hydrobiidae, are non-endemics. Hydrobiidae, Planorbidae, and Lymnaeidae are the richest families in terms of species numbers. The presence of endemism in Basommatophoran taxa suggests the ancient endemism centre character of the area (Fig. 1).

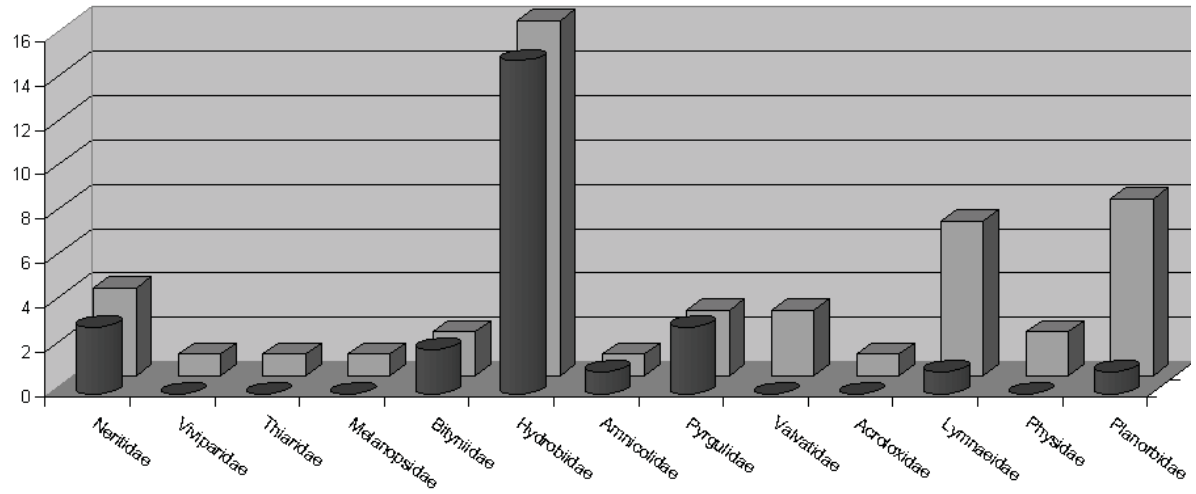

Figure 1. Comparison of endemic (front row) and total nominal taxa for each families.
Figura 1. Comparaţie între taxonii endemici şi numărul total de taxoni ai fiecărei familii.

CONCLUSIONS

In conclusion, Lakes Region acted as an important speciation and dispersal centre for gastropod species. The rich gastropod fauna of Anatolia has not been sufficiently surveyed, but threats to all freshwater ecosystems are increasing. The changes also involve total loss of habitats though gradual or immediate drying. Taxonomy for most taxa, especially for those described based on the conchological characters, is very complex and many new species may be overlooked in general surveys due to convergence of shell characters. Accordingly taxonomical surveys are essential for the understanding of the malacofauna of the Lakes Region, a diversity centre for the Anatolian freshwater snail fauna.

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