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Preliminary research on macrozoobenthic fauna and Gastropoda species in some fresh waters of The Black Sea Region, Türkiye

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Abstract

Commonly found in terrestrial and aquatic ecosystems, Gastropoda members are the class with the highest number of species within the Mollusca. Freshwater Gastropods which are generally listed in primary consumer play a crucial part in aquatic environments by feeding numerous fish species and vertebrate species. In Türkiye, the Black Sea Region is also a privileged geography in terms of its topography and historical development history of aquatic systems, rich in rivers and lakes. In this research, field studies were conducted from 20 different stations in the Black Sea region between 2017-2018. Benthic macroinvertebrate samples were collected from lakes and rivers with an Ekman grab sampler and hand net. Samples were washed in situ and fixed with 70% ethyl alcohol. Totally 10442 benthic macroinvertebrate individuals belong to 21 taxa were determined in the study. In the region, Oligochaeta was the dominant taxa with 56.80% dominancy value and followed by Chironomidae and Gastropoda with 18.26 and 8.24, respectively. As third dominant taxa, Gastropoda members were consist of 870 individuals belong to 11 taxa. It was determined that *Gyraulus elenae* and *Radix labiata* from Gastropoda were widely distributed in the region. These species have broad tolerance to pollution. In the study, it was determined that both densities of species and population were increased in the regions of the rivers that are far from the settlement areas or that have not been intervened and in the littoral parts of the lakes. In general, a decrease was observed not only in the Gastropoda members but also in the expected population density of the macrozoobenthos members in the parts of the streams that are under anthropogenic pressure.

Key words: Gastropoda, Black Sea Region, Mollusca, taxonomy

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Karadeniz Bölgesi'nin bazı tatlı sularında makrozoobentik fauna ve Gastropoda türleri üzerine ön araştırmalar, Türkiye

Özet

Karasal ve sucul ekosistemlerde yaygın olarak bulunan Gastropoda üyeleri, Mollusca içinde en fazla türe sahip sınıftır. Genellikle birincil tüketici listesinde yer alan tatlı su Gastropodları, çok sayıda balık türü ve omurgalı türünün besinini oluşturduğundan sucul sistemlerde önemli bir rol oynamaktadır. Türkiye'de de Karadeniz Bölgesi, topoğrafyası ve su sistemlerinin tarihsel gelişim tarihi açısından, akarsular ve göller açısından zengin, ayrıcalıklı bir coğrafyadır. Bu araştırmada 2017-2018 yılları arasında Karadeniz Bölgesi'ndeki göl ve nehirleri içeren 20 istasyondan zoobentik örneklemeler ekman kepçesi ve el kepçesi ile yapılmıştır. Çalışmada 21 taksona ait toplam 10442 bentik makroomurgasız birey toplanmışır. Araştırma alanında Oligochaeta üyeleri baskın (%56,80 dominansi) grup olup, bunu sırasıyla %18,26 ve % 8,24 dominansi değerleri ile Chironomidae ve Gastropoda grupları izlemektedir. Üçüncü baskın grup olan Gastropoda üyelerinin 11 taksona ait 870 birey içerdiği tesspit eilmiştir. Gastropoda'dan *Gyraulus elenae* ve *Radix labiata*'nın bölgede yaygın olarak yayılış gösterdiği belirlenmiştir. Bu türler kirliliğe karşı geniş toleransa sahiptir. Çalışmada, akarsuların yerleşim yerlerinden uzak veya müdahale edilmemiş bölgelerinde ve göllerin kıyı

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kesimlerinde hem tür hem de popülasyon yoğunluğunun arttığı tespit edilmiştir. Genel olarak sadece Gastropoda üyelerinde değil, akarsuların antropojenik baskı altında olan kısımlarında makrozoobentoz üyelerinin populasyon yoğunluğunda da bir azalma gözlenmiştir.

Anahtar kelimeler: Gastropoda, Karadeniz Bölgesi, Mollusca, taksonomi

1. Introduction

Almost every ecosystem, from little ephemeral pools to vast lakes and small springs to large rivers, can be home to aquatic invertebrates. Among the more extreme habitats are hot springs, sewage treatment facility lagoons, oil pools, and extremely salty seas. Aquatic invertebrates live in a range of habitats within a body of water. Aquatic invertebrates are incredibly diverse in their representations of the world. Aquatic invertebrates are numerous and diverse, but they are frequently unnoticed and few people are even aware of their existence, much less their significance. The enormous diversity of aquatic invertebrates limits our current understanding of their life histories, ecology, and geographic spread. Because different species have differing tolerances to various pollutants, aquatic invertebrates are also used to evaluate the health of streams, lakes, and wetlands. Invertebrates, for instance, are frequently the first species to perish or disappear if a water body gets polluted since they are typically intolerant of pollution. This indicates that a body of water that doesn't have these taxa but does have more tolerant species is probably polluted. These investigations, however, necessitate precise identification of the invertebrates that were gathered in samples [1].

With around 118,000 species, molluscs are possibly the most diverse category of metazoans after arthropods. Gastropoda and Bivalvia, the two largest molluscan classes, have repeatedly and successfully colonized continental ("fresh") seas. Almost all aquatic ecosystems, including rivers, lakes, streams, swamps, subterranean aquifers, springs, temporary ponds, drainage ditches, and other transitory and seasonal waterways, are home to freshwater gastropods. The majority are submerged dwellers, and many are adapted to specific environments, including soft sediment, aquatic flora, boulders, stones, and wood. Some are able to survive for extended periods of time without water (such as some Ampullariidae), while others can spend a lot of time aestivating in the soil during dry seasons. There are very few groups that can be found in highly salinized inland settings like the Caspian Sea or salt lakes in Central Asia, Africa, and Australia (most notably some of the rissooidean families) [2].

Freshwater gastropods play a crucial part in aquatic environments by feeding numerous fish species and vertebrate species. They include species that are widely distributed in rivers and lakes and are used as indicators in aquatic systems monitoring studies. Due to its position between two continents, Türkiye, one of the zoogeographically distinct locations of the Western Palaearctic, has a more diverse mollusc fauna than the nearby regions of Europe [3]. Species of prosobranchs can survive in a range of ecological settings. Prosobranchs are used in ecological studies because of their capacity for biomonitoring [4].

It is clear from studies on freshwater molluscs in Türkiye that the first checklist, which identified 72 taxa, was conducted in 1999 in freshwater and brackish water. One of the checklists that was released in 2006 listed 28 taxa and just the freshwater pulmonate species. In the same year, a second prosobranchia checklist was published, and 80 taxa were found. Since 2006, no research on this topic has been conducted. The existence of 204 taxa (164 species belonging to the Gastropoda and 40 species belonging to the Bivalvia) and all freshwater-related investigations were reported by Gürlek et al. [5]. According to Mollusca checklist conducted by Gürlek et al., we can see that the studies have a particular interest in the Central Anatolia, Mediterranean, and Aegean seas. Eastern Anatolia and the Eastern Black Sea regions are the least explored geographical areas based on the number of species discovered and the average scientific study (Figure 1).

Present study aims to investigate the macrozoobentic community composition and distribution of the Gastropoda in the Black Sea Region. It also aims to fill the gap in species diversity of Gastropoda in the region. To determine the community of macrozoobenthic invertebrate and the species composition of Gastropoda, 20 different stations were sampled as İkizdere Stream (Rize), Uzungöl (Trabzon), Uzungöl 2 (Trabzon), Uzungöl 3 (Trabzon), Kavaklıdere (Gümüşhane), Doğankent River (Giresun), Kumru River (Ordu), Bolaman River (Ordu), Ordu River (Ordu), Cernek Lake (Samsun), Akgöl (Samsun), Sarıkum Lake (Sinop), Erfelek Waterfall (Sinop), Yenice River (Zonguldak); Efteni Lake (Düzce), Efteni Lake 2 (Düzce), Efteni Lake 3 (Düzce), Melen River (Düzce), Nazlı Lake (Bolu), Lake Abant (Bolu).

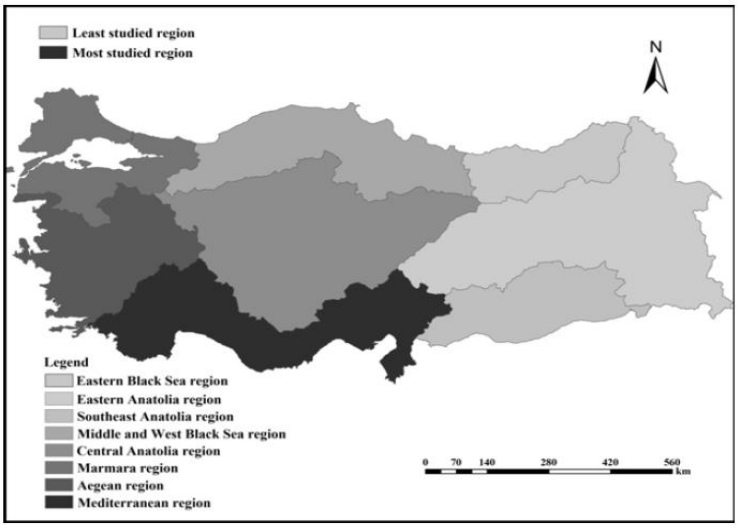

Figure 1. Distribution and density of malacological studies in Türkiye according to the eight regions (The color is darkening from the least studied region to the most studied region). From [5]

2. Material and method

2.1. Study Area

Benthic macroinvertebrate samples were collected from 20 stations in the Black Sea region (Figure 2). Black Sea Region include four basins of 25 freshwater basins of Türkiye as Eastern Black Sea Basin, Kızılırmak Basin, Yeşilırmak Basin and Western Black Sea Basin. Our sampling sites cover three of them: Basins of Eastern Black Sea, Kızılırmak, and Western Black Sea (Table 1).

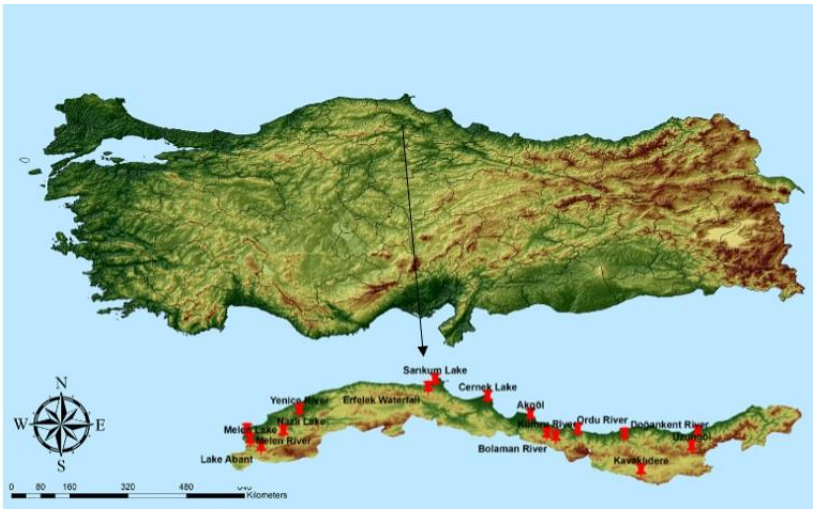

Figure 2. Geographical positions of sampling stations in Türkiye

Eastern Black Sea Basin is between 40º 15'- 41º 34' north latitudes and 36º 43'- 41º 35' east longitudes in the northeast of Türkiye. This basin, which extends to the east of the Black Sea in the north, the Kaçkar Mountains in the east, the Yamanlı, Soğanlı, Kemer, and Iğdır Mountains in the south, and the Çarşamba Plain in the west, constitutes 2.92% of Türkiye with an area of 2,284,439 ha. Almost all of the streams flow vertically into the sea in narrow and deep valleys. The highest peak of the mountains extending parallel to the coast is 3,937 m high on the Kaçkar Mountains [6].

The Western Black Sea Basin is located between 40º 34' 42"- 4^{1o} 27' 52" north latitudes and 30º 52' 33"- 35º 12' 12" east longitudes. The Western Black Sea Basin is bounded by the Sakarya Basin in the southwest, the Kızılırmak Basin in the southeast, and the Black Sea in the north. The Western Black Sea Basin, which covers approximately 3.7% of Türkiye's surface area, has a precipitation area of 28,855 km^2 [7].

The circumference of the Kızılırmak Basin, which has a precipitation area of 82 221 km^2, which is approximately 10.49% of Türkiye's surface area, is 3 546 km and the length of the basin is 293 km [8].

Table 1. Location and freshwater basin of sampling stations

Station	Province	Geographic coordinates (X-Y)	Freshwater Basin
İkizdere Stream	Rize	40.41448974; 40.93328857	Eastern Black Sea
Lake Uzungöl	Trabzon	40.29608154; 40.61932373	Eastern Black Sea
Kavaklıdere	Gümüşhane	39.23229980; 40.12048339	Eastern Black Sea
Doğankent River	Giresun	38.88867187; 40.87249755	Eastern Black Sea
Kumru River	Ordu	37.26489257; 40.88610839	Eastern Black Sea
Bolaman River	Ordu	37.44671630; 40.82928466	Eastern Black Sea
Ordu River	Ordu	37.91088867; 40.97009277	Eastern Black Sea
Cernek Lake	Samsun	36.02392578; 41.66168212	Kızılırmak
Akgöl	Samsun	36.91888427; 41.28631591	Kızılırmak
Lake Sarıkum	Sinop	34.91949462; 42.01647949	Western Black Sea
Erfelek Waterfall	Sinop	34.77832031; 41.85089111	Western Black Sea
Yenice River	Zonguldak	32.07867431; 41.38269042	Western Black Sea
Lake Efteni	Düzce	31.04907226; 40.76751708	Western Black Sea
Melen River	Düzce	30.98028564; 40.96392822	Western Black Sea
Lake Nazlı	Bolu	31.74768066; 40.94152832	Western Black Sea
Lake Abant	Bolu	31.28131103; 40.60668945	Western Black Sea

2.2. Sampling and laboratory studies

Benthic macroinvertebrate samples were collected from lakes and streams with an Ekman grab sampler and hand net. Samples were washed in situ using a series of sieves with decreasing mesh sizes of 2 mm, 1 mm, and 0.5 mm. The material was preserved in 70% ethyl alcohol, taken to the laboratory, and sorted under a stereomicroscope. After the samples had been sorted, gastropods were prepared for identification. Zhadin [9], Bilgin [10], Glöer [11] and Glöer and Meier-Brook [12] were used for species identification of Gastropoda samples. All macroinvertebrate samples were stored in the ESOGU Hydrobiology Laboratory.

3. Results

In the present study, total of 10442 individuals belong to 21 invertebrate taxa were recorded (only Gastropoda samples were identified to the species level) from the stations (Table 2). Distributions of benthic macroinvertebrates of sampling stations were shown in Figure 2. And also, a total of 11 species from Gastropoda were determined. Three species as *Melanopsis praemorsa*, *Potamopyrgus antipodarum* and *Borysthenia naticina* of them are new records for the Black Sea Region.

According to our results, Oligochaeta was the dominant taxon with 56.80% dominancy value and followed by Chironomidae and Gastropoda with 18.26 and 8.24, respectively. Apart from these dominant groups, Bivalvia comprised of 5.69 % and Ephemeroptera 5.13%, while the other taxonomic groups (Hirudinea, Coleoptera, Elmidae, Hemiptera, Odonata, Diptera, Ceratopogonidae, Simuliidae, Chaoboridae, Trichoptera, Plecoptera, Collembola, Isopoda, Asellidae, Gammaridae and Palaemonidae) together reached about 5.88% (Table 2).

As third dominant taxa, Gastropoda members were consist of 870 individuals belong to 11 taxa. Among the identified Gastropoda species, it can be classified as six species which are *Viviparus mamillatus, Hydrobia ventrosa, Melanopsis praemorsa, Potamopyrgus antipodarum, Theodoxus fluviatilis* and *Borysthenia naticina* belong to Prosobranchia and five species which are *Radix* sp., *Radix labiata, Physella acuta, Gyraulus elenae* and *Planorbis planorbis* belong to Pulmonate. *Theodoxus fluviatilis* was the dominant species in the region among the Gastropoda members with 36.44% dominancy value. It was followed by *Potamopyrgus antipodarum* and *Radix labiata* with 15.40% and 13.10%, respectively. Also, species of *G. elenae* detected in eight stations and *Radix labiata* detected in seven stations were widely distributed in the region (Table 2).

Table 2. Dominancy values of benthic macroinvertebrates identified at different sampling stations in Black Sea Region, Türkiye. Gastropoda species recorded for the first time in the lake are marked by an asterisk (*)(St 1: İkizdere Stream; St 2: Uzungöl; St 3: Uzungöl; St 4: Uzungöl (littoral); St 5: Kavaklıdere; St 6: Doğankent River; St 7: Kumru River; St 8: Bolaman River; St 9: Ordu River; St 10: Cernek Lake; St 11: Akgöl; St 12: Sarıkum Lake; St 13: Erfelek Waterfall; St 14: Yenice River; St 15: Efteni Lake (littoral); St 16: Efteni Lake; St 17: Efteni Lake 2; St 18: Melen River; St 19: Nazlı Lake; St 20: Lake Abant)

Taxa/Sampling stations	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Total dominancy value (as %)**
Gastropoda (as total)	0.52	13.28	0.66	0.66	18.82	2.43	24.44	0.58	4.55	64.18	15.66	73.45	0.75	5.56	20.69	50.00	10.00	10.71	0.10	2.59	8.24
Viviparus mamillatus (Küster, 1852)	-	1.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.59	
Radix labiata (Rossmassler, 1835)	-	5.88	0.66	0.66	-	2.43	-	-	-	-	7.23	-	-	2.78	-	-	-	-	0.10	-	
**Radix* sp.	-	-	-	-	-	-	-	-	-	-	-	-	0.75	-	-	-	-	-	-	-	
Physella acuta (Draparnaud, 1805)	0.52	2.52	-	-	-	-	-	-	-	-	4.82	-	-	-	-	-	-	-	-	-	
**Gyraulus elenae* Vinarski, Glöer&Palatov, 2013	-	3.53	-	-	11.29	-	-	-	4.55	-	3.61	-	-	2.78	-	5	1	10.71	-	-	
**Hydrobia ventrosa* Montagu, 1803	-	-	-	-	-	-	-	0.58	-	-	-	-	-	-	-	-	-	-	-	-	
Melanopsis praemorsa (Linnaeus, 1758)	-	-	-	-	7.53	-	24.44	-	-	-	-	-	-	-	-	-	-	-	-	-	
**Potamopyrgus antipodarum* (Gray, 1843)	-	-	-	-	-	-	-	-	-	-	-	21.82	-	-	-	-	-	-	-	-	
Theodoxus fluviatilis (Linnaeus, 1758)	-	-	-	-	-	-	-	-	-	-	-	51.63	-	-	-	-	-	-	-	-	
**Borysthenia naticina* (Menke, 1845)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12.07	-	-	-	-	-	
Planorbis planorbis (Linnaeus, 1758)	-	-	-	-	-	-	-	-	-	64.18	-	-	-	-	8.62	-	-	-	-	-	
Bivalvia	-	-	-	22.90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.69
Oligochaeta	23.56	56.13	84.28	62.10	56.45	97.11	10.93	38.48	4.55	-	30.12	0.16	1.49	-	66.38	16.67	7	71.43	12.86	60.06	56.80
Hirudinae	0.52	-	-	0.04	-	-	0.32	-	-	-	-	-	-	-	-	-	-	-	-	0.15	0.04
Ephemeroptera	8.90	8.91	-	-	7.26	0.07	32.48	47.52	63.64	-	19.28	-	55.22	2.78	0.86	-	1	10.71	0.62	4.27	5.13
Coleoptera	-	1.85	-	-	-	-	-	-	-	1.49	0.60	0.16	-	-	-	-	-	-	-	0.91	0.19
Elmidae	-	-	-	-	1.61	-	0.32	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07
Hemiptera	-	3.53	-	-	-	-	-	-	-	-	3.01	-	-	-	-	-	-	-	0.21	3.96	0.52
Odonata	-	1.01	-	-	1.08	-	2.25	0.29	-	2.99	12.05	0.33	0.75	-	-	-	-	-	-	1.37	0.50
Diptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.21	-	0.02
Chironomidae	62.83	15.29	15.06	14.30	13.98	0.39	6.11	2.04	2.27	31.34	19.28	7.65	20.15	-	11.21	33.33	1	7.14	71.19	22.87	18.26
Ceratopogonidae	0.52	-	-	-	0.27	-	-	0.29	-	-	-	-	1.49	-	-	-	-	-	-	-	0.05
Simuliidae	-	-	-	-	0.27	-	0.64	2.33	-	-	-	-	-	66.67	-	-	-	-	-	-	0.34
Chaoboridae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.86	-	-	-	-	-	0.01
Trichoptera	3.14	-	-	-	0.27	-	20.58	2.92	15.91	-	-	-	4.48	25.00	-	-	-	-	-	-	0.99
Plecoptera	-	-	-	-	-	-	1.93	0.58	-	-	-	-	-	-	-	-	-	-	-	-	0.08
Collembola	-	-	-	-	-	-	-	-	-	-	-	0.16	-	-	-	-	-	-	-	-	0.01
Isopoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.81	3.20	1.58
Asellidae	-	-	-	-	-	-	-	-	2.27	-	-	-	-	-	-	-	-	-	-	-	0.01
Gammaridae	-	-	-	-	-	-	-	4.96	6.82	-	-	18.08	15.67	-	-	-	-	-	-	-	1.46
Palaemonidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.61	0.04

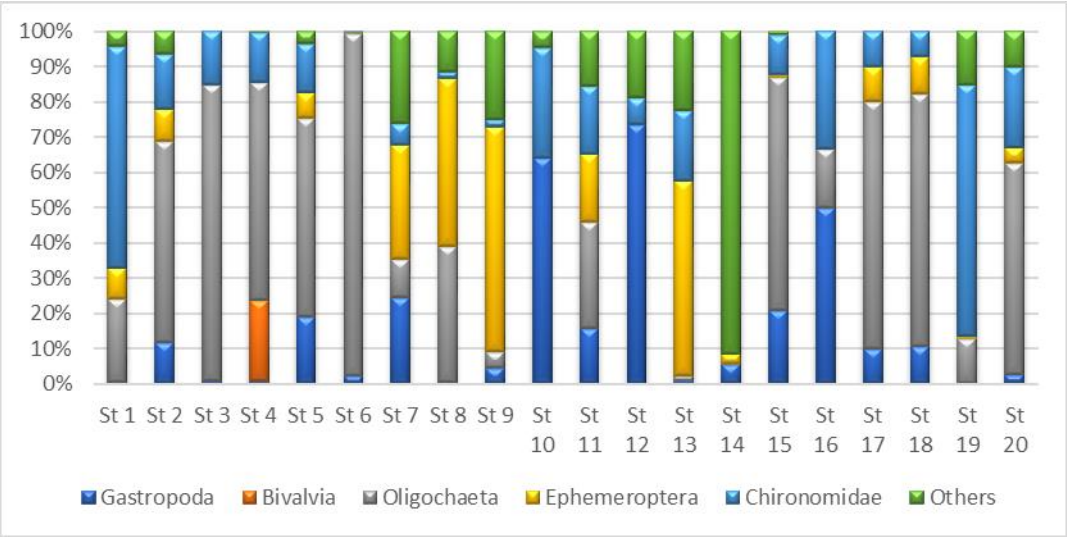

Figure 3. Distributions of benthic macroinvertebrates in the Black Sea Region

Among our sampling stations, İkizdere Stream, Uzungöl, Kavaklıdere, Doğankent River, Kumru River, Bolaman River and Ordu River are located in Eastern Black Sea Basin. In the basin, Oligochaeta was the dominant taxon with 68.84% dominancy value and followed by Chironomidae and Bivalvia with 13.03% and 7.78%, respectively. As fourth dominant taxon, Gastropoda had 3.73% dominancy value. All identified Gastropoda species, *Viviparus mamillatus, Radix labiata, Physella acuta, Gyraulus elenae, Hydrobid* sp. and *Melanopsis praemorsa,* are new records for the basin. In Lake Uzungöl, we were sampled three stations. According to results, the dominant taxon in the lake was Oligochaeta with 69.13% dominancy value. It was followed by Chironomidae and Bivalvia with 14.71% and 12.26%, respectively. Among Gastropoda species, *V. mamillatus, R. labiata, P. acuta* and *G. elenae* were identified in the lake. These species are new record for Lake Uzungöl.

Lake Cernek and Akgöl are located in Kızılırmak Basin. Gastropoda was dominant taxa with 29.61% dominancy value in the basin. It was followed by Chironomidae and Oligochaeta with 22.75% and 21.46%, respectively. Two gastropod species were determined in the basin as *G. elenae* and *Planorbis planorbis*. These species are new records for the lakes.

Stations of Sarıkum Lake, Erfelek Waterfall, Yenice River, Efteni Lake, Melen River, Nazlı Lake and Lake Abant are located in Western Black Sea Basin. In the basin, Chironomidae was the dominant taxa with 36.31% dominancy value. Oligocaheta and Gastropoda were the second and third dominant taxa with 24.36% and 19.63% dominancy value, respectively. *Viviparus mamillatus, Radix labiata, Gyraulus elenae, Potamopyrgus antipodarum, Theodoxus fluviatilis, Radix* sp., *Borysthenia naticina* and *Planorbis planorbis* were identified among Gastropoda species in the basin. *Theodoxus fluviatilis* was the dominant gastropod species in the area. *G. elenae, P. antipodarum, Radix* sp. and *B. naticina* are new records for the Western Black Sea Basin. Also, *Melanopsis praemorsa* and are new record for the Black Sea Region.

4. Conclusions and discussion

The present study contributes to the knowledge on the macrozoobenthic fauna and Gastropoda species of the Black Sea region. Results of this study shown that macrozoobenthic fauna of Black Sea Region was dominated by three group invertebrates, Oligochaeta, Chironomidae and Gastropoda. These are typical taxa of many freshwater systems and they have been known as tolerant organisms to pollution.

As a result of the study, total of 11 species from Gastropoda were determined and three species as *Melanopsis praemorsa, Potamopyrgus antipodarum* and *Borysthenia naticina* of them are new records for the Black Sea Region. These three gastropods' species are member of Prosobranchia whose can be able to tolerate a wide range of abiotic conditions from coastal estuaries to freshwater ecosystems [4, 13]. In addition, one of them, *Potamopyrgus antipodarum*, known as global invaders and it is originated from The New Zealand. The most common aquatic invertebrate in the world, *Potamopyrgus antipodarum*, is found throughout North America, Europe, Asia, and Australia with the exception of Africa and Antarctica [14]. For nations in a globalized society, biological invasions cause several ecological and economic issues [15]. There are various aspects to this species' expansion strategies. Ship ballast water, aquatic plants, fish, and birds are used to carry them [16]. In Türkiye, it was firstly recorded in 1980 [10]. Then, reports of it came from different places from regions of Aegean, West Mediterranean and Marmara to West Anatolia (Gaziantep) and Black Sea (Kızılırmak) [17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28]. With this study, *P. antipodarum* was detected from only one sampling site, Lake Sarıkum, with high population density (21.82%) after *Theodoxus*

fluviatilis (51.63%). Because of connected to the Black Sea, Lake Sarıkum is typically a lagoon lake and eutrophic lake with a brackish characteristic and salinity ranging from 1‰ to 5‰ [29]. Although, benthic macroinvertebrate community structure of Lake Sarıkum was investigated by different researchers. *P. antipodarum* was not detected before in the lake. Six species of gastropoda, *Theodoxus fluviatilis*, *Planorbis planorbis*, *Hydrobia ventrosa*, *Valvata* sp., *Bittium reticulatum* and *Rissoa splendida*, had been recorded previously from Lake Sarıkum [30, 31]. When compare the results, we can conclude that variations in species composition, richness and diversity are probably the result of changes in the lake's natural conditions. Recently, [28] were reported that *P. antipodarum* was the second dominant species in the Delice River (Kızılırmak River Basin) with 31.43% after *Physella acuta* (46.88%), and *Theodoxus fluviatilis* and *Pseudamnicola natolica* are associated taxa with *P. antipodarum*. As we indicated before *P. antipodarum* can be found in a wide variety of aquatic habitats including lakes, streams, and estuaries. It is reported that the invasion success of *P. antipodarum* is based on different characteristics of the species, such as parthenogenetic reproduction high population growth rates, escape from natural enemies, behavioural traits, and tolerance to a wide variety of physical and chemical conditions [32]. According to the previous literatures, presence of *P. antipodarum* which was not detected in Sarıkum Lake before, might be considered as invasive for the lake due to its second dominant population in the area. This species may have spread naturally to this lagoon lake by crawling, floating, drifting on vegetation, dispersing via animal vectors, or dispersing on land.

Borysthenia naticina, who has Ponto-Baltic distribution in lakes [11], was detected from only one sampling site, Lake Efteni (Western Black Sea) as dominant gastropoda species (12.07%) with *Planaorbis planorbis*. Although distribution of *B. naticina* is primarily confined to eastern Central Europe, Eastern Europe and Türkiye, this species reported as a rare and zoogeographically restricted in Germany and endangered in some other European countries [33]. It is reported that *B. naticina*' distribution in Türkiye includes the Mediterranean [17]. Although typical habitats of *B. naticina* is given as large and medium-sized lowland rivers [33], different researchers have recorded the presence of *B. naticina* previously from the lake (Lakes, Sapanca, Karataş, Eğirdir, Kovada) rather than river (Istranca Stream and Yuvarlakçay) in Türkiye [5]. It is known that especially Prosobranchia species, except *B. naticina*, living in the lake generally prefer lentic and lotic systems isolated from pollutant effects, in poorly vegetation, and with low trophic levels [34]. Lake Efteni, where the species detected area, is a small and shallow lake. Erturk et al. were indicated that the lake is under severe environmental threat in terms of receiving land-based sources of pollutants especially of diffuse character and it is currently in transition from mesotrophic to eutrophic state [35]. *B. naticina*, is known to be euryoecious species, previous data dealing with an ecological characteristics of the *B. naticina* has been supported by our findings from Lake Efteni, whose has mesotrophic to eutrophic state.

The third new record gastropod species for the Black Sea Region, *Melanopsis praemorsa*, is common species inhabiting relatively clear river system in the Mediterranean region. In the present study it was determined in two streams (Kavaklıdere and Kumru rivers) at Eastern Black Sea region.

According to previously Gastropoda species studies, *Viviparus mamillatus*, *Viviparus ater*, *Radix auricularia*, *Radix labiata*, *Stagnicola palustris*, *Lymnaea stagnalis*, *Radix auricularia*, *Radix labiata*, *Stagnicola palustris*, *Physa fontinalis*, *Gyraulus albus* and *Planorbis planorbis* were reported before in Lake Abant [5]. In this study, we were determined only *Viviparus mamillatus* species in the area.

As a result of the study a total of 11 species from Gastropoda were determined. Among the gastropods the most common species is *Gyraulus elenae* (8 stations), *Radix labiata* (7 stations). *Planorbis planorbis* had the highest abundance (64.18%) followed by *Theodoxus fluviatilis* (51.63%) and *Potamopyrgus antipodarum* (21.82%). And also, three species as *Melanopsis praemorsa*, *Potamopyrgus antipodarum* and *Borysthenia naticina* are new records for the Black Sea Region. When the results were compared, it can be concluded that variations in species composition, richness and diversity were probably the result of changes in the lake's natural conditions. The significant loads of organic nutrients (such as phosphorus and nitrogen) were the most important and critical factor influencing trophic changes and species composition in an aquatic ecosystem.

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