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Short Communication: Mollusks biodiversity of Lake Sevan, Armenia

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Abstract. *Mashkova IV, Krupnova TG, Kostryukova AM, Harutyunova LJ, Varuzhan HS, Egorov NO. 2018. Short Communication: Mollusks biodiversity of Lake Sevan, Armenia. Biodiversitas 19: 1509-1513.* The paper considers mollusks biodiversity in the freshwater lakes of Lake Sevan, Armenia. Lake Sevan is the largest water body in Armenia and one of the largest freshwater lakes in Eurasia. Since 1930 it has been actively used for irrigating Ararat plain and in hydropower. So, its water level fell by 20 m, and its volume became 40% less. Since mid-2000 when two tunnels had been built water level started to grow. For the last 6 years, water level was reported to grow. As a result of our study, 11 aquatic mollusks species (10 gastropod and 1 bivalve taxa) were currently found living in the Sevan lake. We found *Lymnaea stagnalis* (Linnaeus, 1758), *Radix auricularia* (Linnaeus, 1758), *R. tumida* (Held, 1836), *R. balthica* (Linnaeus, 1758), *R. lagotis* (Schrank, 1803), *Galba truncatula* (O. F. Müller, 1774), *Planorbis planorbis* (Linnaeus, 1758), *Bathyomphalus contortus* (Linnaeus,1758), *Gyraulus acronicus* (Férussac, 1807), *Valvata piscinalis* (O. F. Müller, 1774), *Euglesa casertana* (Poli, 1791). Lymnaeidae represented the largest number of species. The most abundant species was *Lymnaea stagnalis* (Linnaeus, 1758).

Keywords: Biodiversity, bivalves, freshwater lake, gastropods, mollusks

INTRODUCTION

Lake water is often used for drinking, agricultural and industrial needs. But uncontrolled human activity can lead to the dramatic decline of water level in waterbodies. One of the most notorious environmental catastrophes is connected with Aral Sea that was the fourth large inland lake in the world. Since 1960-s a large-scale and inefficient irrigation in the upper river basin have resulted in declining volume of water running into Aral Sea and caused its shallowing (Matsui et al. 2017).

Lake Sevan is the largest water body in Armenia and one of the largest freshwater lakes in Eurasia. Since 1930 it has been actively used for irrigating Ararat plain and in hydropower. So, its water level fell by 20 m, and its volume became 40 % less. Since the mid 2000s when two tunnels had been built water level started to grow. For the last 6 years, water level was reported to grow by 2.44 m. In October 2010 it reached 1900.04 m. According to the Government Committee on Sevan, water level will have reached 1903.5 by 2029 (Vardanian 2012).

Aquatic organisms population recovery (National Research Council 1992) is an important factor of lake ecosystem recovery. Mollusks are an important part in food chains of freshwater lake ecosystems (Runck 2007) and they play a major role in distributing elements between the lake water and bottom sediments (Hussain and Pandit 2012; Krupnova et al. 2015; Krupnova et al. 2017). There is no study of mollusks and limited studies (Jenderedjian et al. 2012; Shcherbina 2013) of benthic macroinvertebrate community in Lake Sevan during recent years.

The aim of the work is to study mollusks biodiversity in Lake Sevan after water level restoration.

MATERIALS AND METHODS

Study area

Lake Sevan in Armenia is a unique ecosystem that is exposed both to natural factors (geochemical anomalies, active tectonics, landslide activity, and natural fluctuations of the water level in the lake) and to anthropogenic activities (economic activities, artificial water-level fluctuations). The lake basin is 1262 km^2 and presents a huge tectonic depression closed by mountains all around except to the North-West, where the watershed line goes down the lake level, and where the only dump Hrazdan River originates.

The lake is situated between 40°19′ N and 45°21′ E, at an at an altitude of 1,900 m above sea level and is composed of two parts, Malyi Sevan and Bolshoi Sevan, differing both in the origin and time of formation (Shcherbina 2013). 30 large and small rivers including two big springs flow into Lake Sevan. 4 rivers flow into Malyi Sevan, the rest – into Bolshoi Sevan. The river network around the perimeter of the lake and in the relevant parts of

the basin is distributed unevenly. It is much less in the pool of the Malyi Sevan. There are so-called closed areas. Especially dense river network covers the South coast. Numerous rivers and temporally active watercourses drain from the North-East coast (RABE 2010). The Sevan trout, *Salmo ischchan* (Kessler, 1877), is an endemic fish species of Lake Sevan in Armenia (Bogdanowicz et al. 2017).

Since 1933, when the Sevan-Hrazdan irrigation-energy complex was built, and in 1937-1962, when the lake water was intensively used for the development of agricultural industry in the adjacent territories, there were man-made fall in water level, water quality impairment, and transition from oligotrophic to mesotrophic status of the lake (Gabrielyan and Khosrovyan 2004).

From 1978, when the National park Sevan and channels Arpa-Sevan, Vorotan-Arpa were built, water level rose, and it had increased by 360.5 cm by 2011 (Krylov et al. 2013).

In 2005-2009, in the framework of the Russian-Armenian biological expedition, a comprehensive study of hydrological and biological regime of Lake Sevan in the initial period of its water level rise was carried out (RABE 2010). The flora and vegetation of the lake and its tributaries, the structure of plankton and benthic communities were described in that research. It was shown that the water level rise contributed to the positive dynamics of populations of biota. So, there have been significant changes in species structure and number of fish population. The species richness of zooplankton and the appearance of two new for the lake species of Cladocera family among the dominants were observed (Krylov et al. 2013). However, by 2011, the stocks of fish in the pelagic zone of the lake dropped to its lowest values ever recorded (Krylov et al. 2013).

In 2011 a complex assessment of the ecological state of Lake Sevan was given relying on the research that proved the necessity to monitor water and environment of the coastal areas constantly. Located on the territory of the National park Lake Sevan is currently under a serious human-made impact being actively exploited in recreational aims. There is data of increasing eutrophication of the lake at the present stage, which may be caused by several reasons. For example, the removal of nutrients from the watershed as a result of water level rise and flooding of soils, the growth of the mining sector and the pollution of basins of the watershed of Lake Sevan (Gevorgyan et al. 2016).

Unfortunately, insufficient hydrobiological shooting during the vegetation period does not allow the authors to be certain about the current state of Lake Sevan. Available hydrochemical data of the lake water and the changing parameters of aquatic organisms communities indicate the ongoing process of eutrophication (Krylov et al. 2013; Krylov et al. 2015). The trophic status of the lake is expected to vary in the future, and it will acquire additional features of the eutrophication process associated with fouling, benthic fauna, macrophytes overgrowing.

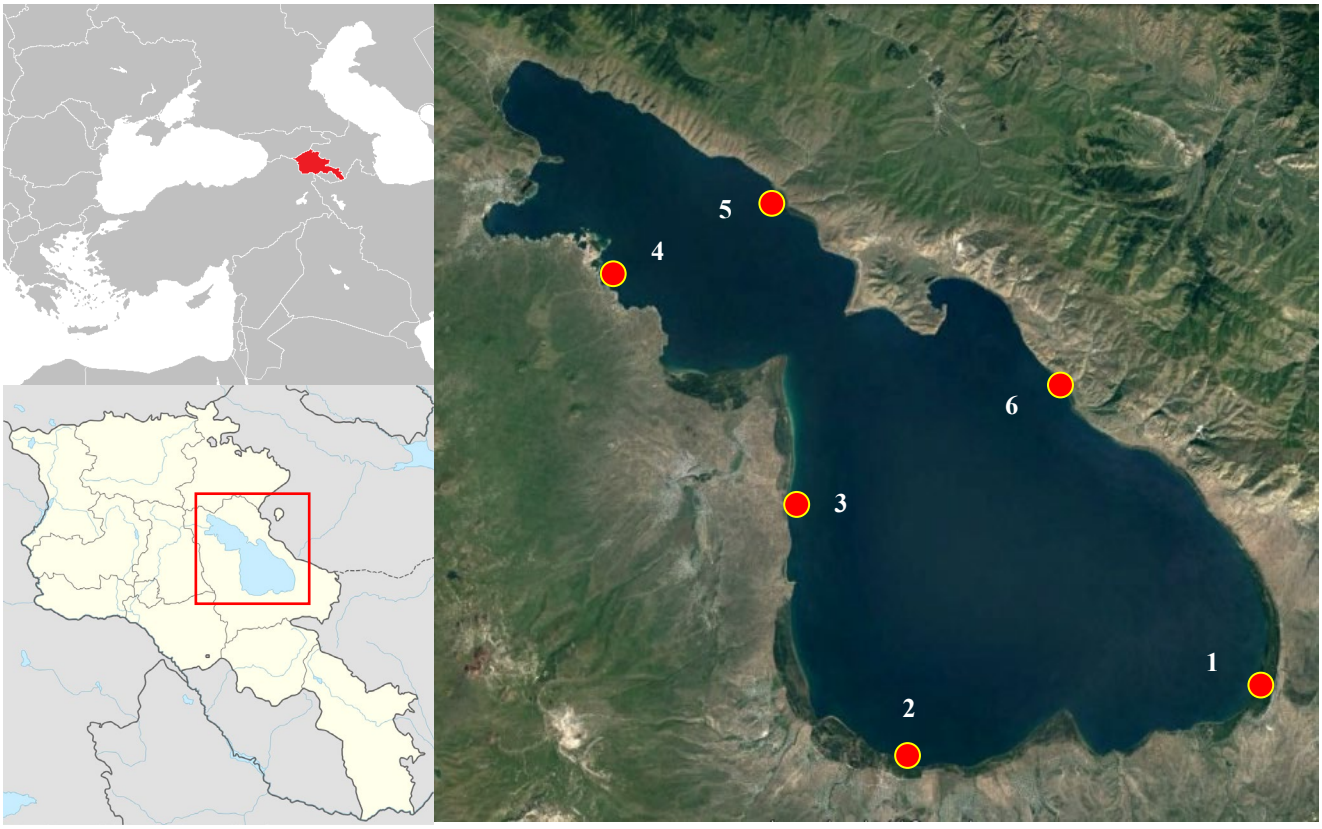

Figure 1. Location of Lake Sevan, Armenia and sampling sites-sections: 1. Vardenis, 2. Martuni, 3. Gavar, 4. Modelnyi, 5. Chambarak and 6. Babadzhan

Sample collection

Sample collection was carried out in June-July, 2016-2017. Six sites sections were determined for Lake Sevan, Armenia, namely: Vardenis, Martuni, Gavar, Modelnyi, Chambarak and Babadzhan (Figure 1).

Most of the collected samples are of high quality as the aim of the current *work* was to study diversity of gastropods. Mollusks were gathered manually or with a scraper in shallow waters, and on the coasts - from those washed ashore. Sample collection was partly made during hydrobiological shooting with the help of the Petersen dredge (1/40 m^2). In the field, samples were fixed with spirit 96 %, after that, in cameral conditions, the gathered material was put in spirit 70 %. The species composition of gastropods was identified using manual of Armenia mollusks (Akramovsky 1976) and collections of Scientific Centre of Zoology and Hydroecology NAS RA. The nomenclature of species is made according to the analytical catalog of freshwater mollusks of Russia (Vinarski and Kantor 2016).

RESULTS AND DISCUSSION

Results

Mollusks in Lake Sevan were presented by 11 species belong 4 families and 2 classes (Table 1, Figure 2). Class Gastropoda was presented by 3 families Lymnaeidae, Planorbidae, and Valvatidae. The maximum number of species (6) was recorded for Lymnaeidae. We found only one species of Bivalvia**.** The most abundant species was *Lymnaea stagnalis* (Linnaeus, 1758). Among all the studied species there was none that was met in all the sites.

Table 1. Richness and abundance of mollusks in Lake Sevan, Armenia

Species	Sites					
	1	2	3	4	5	6
Class: Gastropoda						
Lymnaeidae						
Lymnaea stagnalis (Linnaeus, 1758)	32	-	50	16	23	11
Radix auricularia (Linnaeus, 1758)	1	7	5	4	2	5
R. tumida (Held, 1836)						
R. balthica (Linnaeus, 1758)	-	-	4	10	-	6
R. lagotis (Schrank, 1803)	13	6	2	9	-	-
Galba truncatula (O. F. Müller, 1774)	6	-	-	5	-	-
Planorbidae						
Planorbis planorbis (Linnaeus, 1758)	18	-	6	13	3	5
Bathyomphalus contortus (Linnaeus,1758)	7	6	-	-	6	-
Gyraulus acronicus (Férussac, 1807)						
Valvatidae						
Valvata piscinalis (O. F. Müller, 1774)	40	-	-	-	-	-
Class: Bivalvia						
Sphaeriidae						
Euglesa casertana (Poli, 1791)	-	43	-			10

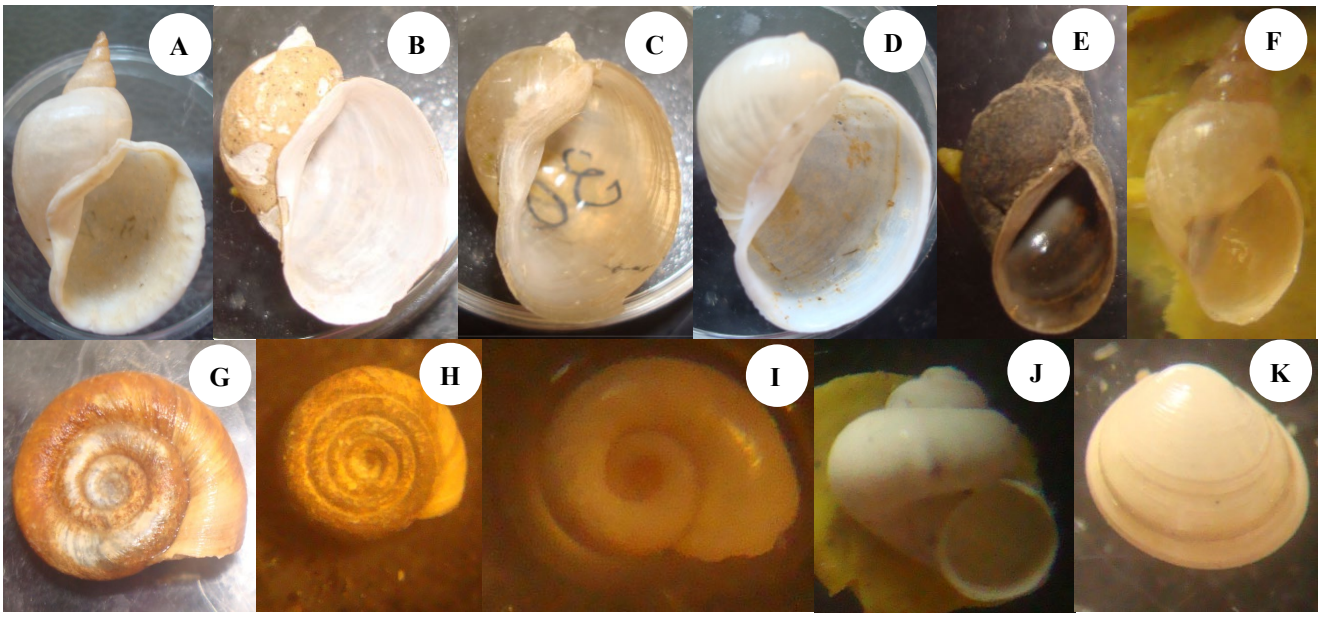

Figure 2. Different species of molluscs from Lake Sevan. A. *L. stagnalis*, B. *R. auricularia*, C. *R. tumida*, D. *R. balthica*, E. *R. lagotis*, F. *G. truncatula*, G. *P. planorbis*, H. *B. contortus*, I. *G. acronicus*, J. *V. piscinalis*, K. *E. casertana*

Discussion

In the upper littoral zone of the rocky areas and in the thickets of macrophytes of Lake Sevan (to a depth of 5 m), the most common are gastropods. The representatives of Valvatidae inhabiting the sublittoral from its upper border to the profundal play a significant role in malacofauna of the lake. Changes in the littoral have had an impact on the distribution of gastropods, the majority of which was related to large-stoned and rocky area of the upper littoral zone. In the upper littoral gastropods remain in the thickets of submerged plants. A large number of Bivalvia was registered in site 2. Bivalves reach their maximal development within 5-10 m deep in Lake Sevan and about mostly they live up to 40 m deep.

There are a few literature data on richness of mollusks before man impact to Lake Sevan. It was noted (Oganesyan et al. 2013) that species of the family Lymnaeidae such as *L. stagnalis*, *R. lagotis*, *R. balthica* and *R. persica* lived in Lake Sevan in the 1930s. In the period 1928-1955 biomass of gastropods was ranged from 0.03-0.13 g/m^2. In 1962-1979 gastropod biomass was increased and it was amounted to about 0.4 g/m^2 (Oganesyan et al. 2013). In 1990-2004, the biomass of gastropods was begun to decrease to 0.05-0.08 g/m^2, *L. stagnalis* was the dominant species of gastropods in the littoral (Oganesyan et al. 2013). As it can be seen in Table 1, *L. stagnalis* continues to belong to the dominant species. *R. lagotis*, *R. balthica* and R. *persica* were presented in Lake Sevan. In 1976–2004 gastropods of the families Lymnaeidae, Planorbidae and Valvatidae were registered (Jenderedjian et al. 2012). Gastropods were not found during the expeditions 2005-2009 (RABE 2010). In 2016-2017 we found 10 species of gastropod: *L. stagnalis*, *R. auricularia*, *R. tumida*, *R. balthica*, *R. lagotis*, *G. truncatula*, *P. planorbis*, *B. contortus*, *G. acronicus* and *V. piscinalis*. It is possible to observe restoration of the population of gastropod in Lake Sevan.

According to the literature data, bivalves were represented only by genus Euglesa in Lake Sevan since the 1930s. In the present time part of species are in genus Pisidium. Seven species of bivalves were represented in 1954. There were *Euglesa cingula* (Gojdics, 1953), *Pisidium nitidum* (Jenyns, 1832) (the unaccepted name *E. nitida* (Jenyns, 1832), *E. casertana* (Poli, 1791), *P. milium* (F. Held, 1836) (the synonym *P. tetragonum* (Normand, 1854), the unaccepted name *E. tetragona* (Normand, 1854), *P. nitidum* (Jenyns, 1832) (synonym *P. nitidum fedderseni* (Westerlund, 1890), the unaccepted name *E. fedderseni* (Westerlund, 1890) and *P. personatum* (Malm, 1855) (the unaccepted name *E. personata* (Malm, 1855). *P. milium* has disappeared in 1954-1978 (Ghukasyan 1990; Jenderedjian et al. 2012). Studies conducted in 1954-1989 showed that *E. cingula*, *P. nitidum* and *E. casertana* were dominant species (Ghukasyan 1990). The share of *E. casertana* increased with the increase in the trophicity of the lake because that species has a greater resistance to reduce the oxygen content in the lake water.

Only two species of bivalves, *E. casertana* and *P. subtruncatum* (*Malm,* 1855) were found during the expeditions 2005-2009 (RABE 2010). *P. subtruncatum* was registered for the first time in Lake Sevan. Also *P. subtruncatum* was found in 2010 (Shcherbina 2013). In our work, we found only *E. casertana*. Most of the bivalves species were lost with the growth of water level.

The reduction of the bivalves richness occurred at the stage of lowering the water level because they are sensitive to the change of environment. Opposite, Family Lymnaeidae has the greatest abundance and richness. An ability to adapt to survive in dry season lets pulmonary mollusks populate any waterbodies successfully.

In conclusion, the Lake Sevan is characterized by a small population of molluscs throughout the history of its study from the 1930s to the present day. In 2016-2017 we found 11 mollusks species (10 gastropods and 1 bivalve). The dominant species of gastropods is preserved *L. stagnalis*. Gastropods richness has increased compared time before man impact to Lake Sevan. The number of species of bivalves has been reduced to a single species *E. casertana.* Family Lymnaeidae has the greatest abundance and richness. So, the biodiversity of pulmonary mollusks is stable in Sevan lake.

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