

**THE DISTRIBUTION OF RARE PONTO-CASPIAN MOLLUSKS**  
***Clathrocaspia knipowitschii* (Makarov, 1938) (GASTROPODA: HYDROBIIDAE)**  
**ON THE TERRITORY OF THE REPUBLIC OF MOLDOVA**

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**Abstract.** The paper includes new data about small, endangered gastropod *Clathrocaspia knipowitschii* collected in the Republic of Moldova. Information about distribution, frequency, abundance and biomass of *C. knipowitschii* are presented. The highest abundance sampled by grabs was 4480 ind./m<sup>2</sup>, the calculated maximum of biomass was 5.12 g/m<sup>2</sup> accordingly. The height of shells varied from 0.65 to 2.59 mm. The total number of *C. knipowitschii* was 81 specimens.

**Keywords:** Caspiinae, new records, Dniester, Moldova.

**Rezumat. Distribuția rarei moluște ponto-caspice *Clathrocaspia knipowitschii* (Makarov, 1938) (Gastropoda: Hydrobiidae) pe teritoriul Republicii Moldova.** Lucrarea include date noi despre gastropodul mic și rar, pe cale de dispariție, *Clathrocaspia knipowitschii*, colectat în Republica Moldova. Sunt prezentate informații despre distribuția, frecvența, abundența și biomasa *C. knipowitschii*. Cea mai mare abundență a fost de 4480 ind./m<sup>2</sup>, biomasa maximă calculată a fost de 5,12 g/m<sup>2</sup> corespunzătoare. Înălțimea cochiliei a variat de la 0,65 până la 2,59 mm. Numărul total de *C. knipowitschii* a fost de 81 exemplare.

**Cuvinte cheie:** Caspiinae, date noi, Nistru, Moldova.

## INTRODUCTION

*Clathrocaspia knipowitschii* (Makarov, 1938) is an endemic Pontocaspian mollusk from the Hydrobiidae Stimpson family, 1865. This is the most specious group of molluscs in the Ponto-Caspian region (WESSELINGH et al., 2019). Many synonyms of this species exist; the most common of them are: *Caspia gmelini*, *Caspia knipowitchi*, *Pyrgula (Caspia) knipowitchi* (Makarov, 1938), *Caspia makarovi* and many others (MAKAROV, 1938; ZHADIN, 1952; BIRSHEIN et al., 1968; WESSELINGH et al., 2019; ANISTRATENKO et al., 2021). On the one hand, this is due to taxonomic uncertainty, partially connected with the small sizes and small number of living specimens of this rare and sensitive to low oxygen species. On the other hand, the type material of *C. knipowitschii* are lost (ANISTRATENKO et al., 2021).

According to latest re-evaluation of the taxonomic status, the name is *Clathrocaspia knipowitschii* (Makarov, 1938). The height of shell is up to 2.2-2.4 mm, the width is up to 1.3 mm. The shell consists of 4.0–4.5 whorls and has a characteristic ornament with spiral ribs, which is crossed by axial lines, creating a reticulate sculpture (MAKAROV, 1938; ZHADIN, 1952; BIRSHEIN et al., 1968; ANISTRATENKO, 2013).

The first record of this species as *Caspia gmelini* var. *knipowitschii* nov. was published by MAKAROV (1938). These molluscs have been found by them at the mouth of the Dniester River up to village of Gradenitsy and in the wetland lakes such as Putrino Lake and Beloe Lake, which are located near the actual borders of the Republic of Moldova (Fig. 1). They predominantly inhabit the river mouth areas and estuaries of big rivers flowing into the Black Sea and the Sea of Azov (ANISTRATENKO et al., 2021).

Information about this species on the territory of our country have been published by YAROSHENKO (1957), GONTEA (1985) and MUNJIU (2012). The aim of this paper is to investigate the current state of *C. knipowitschii* on territory of the Republic of Moldova.

## MATERIAL AND METHODS

There are four water basins on the territory of the Republic of Moldova, such as the Dniester River basin, the Prut River basin, the Small rivers of the Danube River basin and the Small rivers of the Black Sea basin (Fig. 1). Since 2000 the author performed sampling on all the above-mentioned basins on 22 common sampling stations and more than 60 additional sampling stations.

However, according to data about the distribution of *C. knipowitschii*, the focus was on sampling from the Dniester River basin. The Dniester is the biggest river on the territory of the Republic of Moldova, having a length of 657 km (including the Middle and Low Dniester River), and its catchment area is about 70% of the country's territory. The total length of the Dniester River is 1352 km.

During 2015-2020 a routine sampling was performed on the Dniester River within the present state borders of Moldova. 11 sampling stations were investigated in total: Naslavcea, Volcineț, Soroca, Camenca, Hirjău (Erjovo), Goian, Cocieri, Vadul-lui-Vodă, Varnița, Sucleia, Palanca (Fig. 1).

Sampling was performed seasonally, near the river bank at a depth of 0.3-1.5 m. For quantitative sampling Ekman grab with an area of capture of 0,025 m<sup>2</sup> and a dredge with an area of capture of 8 m<sup>2</sup> were used (ABAKUMOV,

1983; \*\*\*. AQEM, 2002; MUNJIU et al., 2015). Additionally, a hand net was used for qualitative sampling. Samples were preserved by adding 4 % formaldehyde or 70 % ethanol. All molluscs were sorted in the laboratory and identified using identification keys (ZHADIN, 1952; BIRSHTEIN et al., 1968; KUTIKOVA & STAROBOGATOV, 1977; TSALOLIHIN, 2004; ANISTRATENKO, 2013; ANISTRATENKO et al., 2021).

The identification of species, pictures of molluscs and all measurements of sizes has been carried out with a stereomicroscope SteREO Discovery.V8 (Zeiss) and upright microscope Axio Imager A.2 (Zeiss). The biomass was determined via weighting on an analytical balance ABS 80-4 Kern to 0.0001g. The density and biomass of molluscs was converted into ind./m<sup>2</sup> and g/m<sup>2</sup>. Statistical analysis was performed using the Excel 2010 (Microsoft) software.

## RESULTS

During 2015-2020s, a routine sampling was performed on 11 sampling station of the Dniester River, adding up to a tTotal of 386 quantitative and qualitative samples. The species was found in 6 out of 11 sampling stations (Fig. 1.).

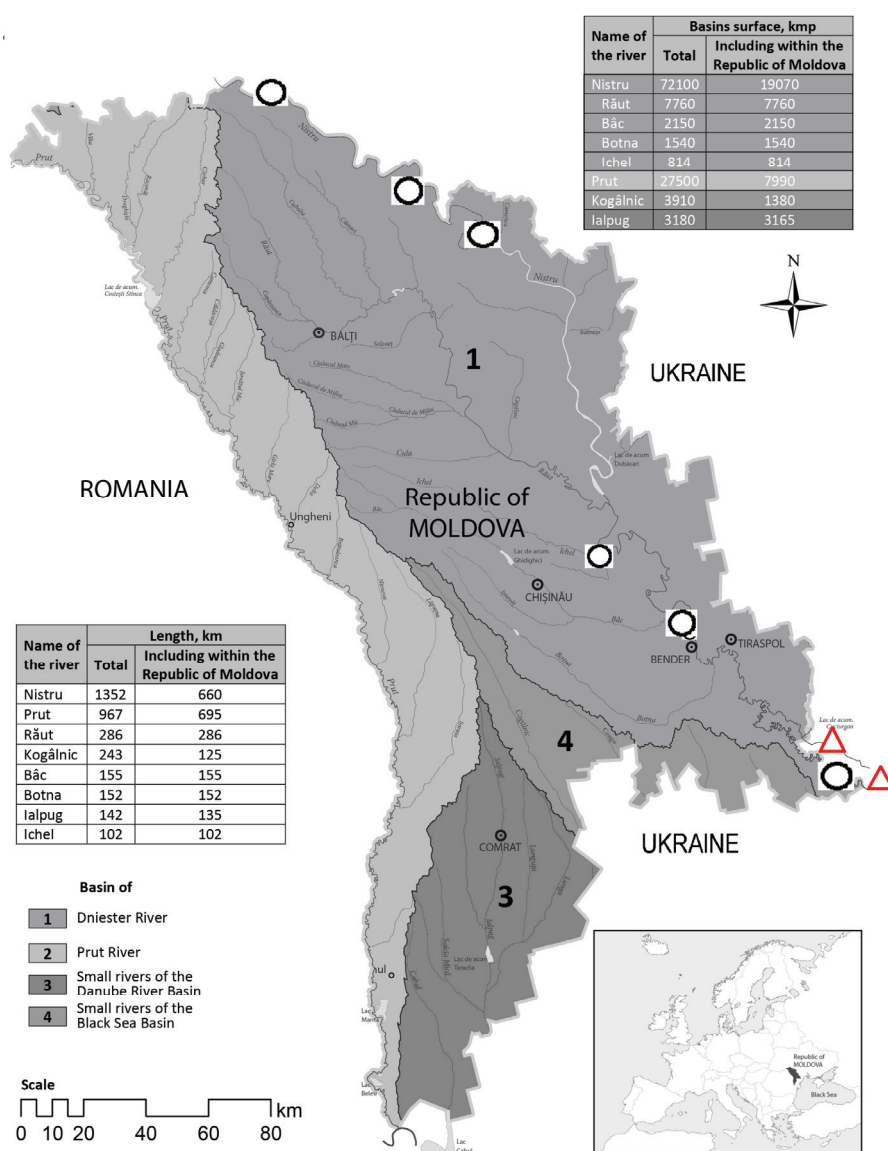


Figure 1. Map of water basins from Republic of Moldova.

△ - First records by Makarov (1938) village Gradenitsy and wetland lakes.

○ - Dniester River sampling stations where *C. knipowitschii* has been registered during 2016-2020; from North to South:

○ - Volcineț, Soroca, Camenca, Vadul-lui-Vodă, Varnița and Palanca.

Molluscs have been found only in the riverbed of the Dniester River. *C. knipowitschii* was found in the following sampling stations: Volcineț, Soroca, Camenca, Vadul-lui-Vodă, Varnița, Palanca (Table 1). Palanca is the

nearest (approximately 4 km) locality on the territory of the Republic of Moldova to the type locality described by MAKAROV (1938).

The total number of individuals of *C. knipowitschii* amounted to 81 specimens from 25 samples (Table 1). This is 11% from samples in 6 sampling stations where *C. knipowitschii* have been found during 6 years (2015-2020). It should be noted that, from 2000 until 2015, only empty shells or sporadic specimens have been found in all common sampling points including the Dubăsari and Cuciurgan reservoirs.

Table 1. The location and occurrence of *C. knipowitschii* in the Dniester River during 2015-2020 on the territory of the Republic of Moldova.

Location		Total sampling 2015-2020			Substrates*
Sampling stations	Latitude/Longitude	N	N with <i>C. k</i>	No. of molluscs	
Volcineț	48°26'43"/27°41'49"	36	5	28	gravel, mud, sandy, macrophytes
Soroca	48°7'57"/28°20'24"	40	4	14	Gravel, stones, sandy, mud, macrophytes
Camenca	Left bank 48°0'45"/28°42'17" Right bank 48°03'43"/28°42'5"	38	6	22	Stones, gravel, sandy, mud, macrophytes, filamentous algae
Vadul-lui-Vodă	47°05'19"/29°05'22"	36	6	7	clay, gravel, sandy, mud, filamentous algae, macrophytes
Varnița	46°52'56"/29°29'00"	36	3	9	sandy, mud, gravel, filamentous algae
Palanca	46°24'46"/30°08'39"	38	1	1	mud, macrophytes, gravel, sandy

**Legend:** \*Substrates are arranged in decreasing order of area. N - total number of samples per sampling station, N with C.k - number of samples including *C. knipowitschii*. Nr - number of specimens of *C. knipowitschii* per sampling station.

*C. knipowitschii* have been found in quantitative and qualitative sampling by grab, dredge and hand net. The common elements for all sampling stations where *C. knipowitschii* has been registered are the visible current of water, gravel, sandy, mud and submerged aquatic vegetation (Fig. 2). At the same time it should be noted that the molluscs can inhabit the river bottom in places with enough stable water level. While water level decreases, the bottom of the river should not be exposed.



Figure 2. Sampling stations, 1) Volcineț, 2) Soroca, 3) Camenca, 4) Vadul-lui-Vodă (original).

According to the obtained results, the abundance of molluscs varied from 1 up to 4480 ind/m<sup>2</sup> and biomass from 0.001 up to 5.12 g/m<sup>2</sup> correspondingly. Maximal abundance and biomass were registered in quantitative sampling by grab in the Camenca sampling point on the left bank of the Middle Dniester in 09.07.2015. Minimal abundance and biomass were registered in Palanca in sampling by hand net, on 28.10.2019 when only one specimen was registered.



Thus, the population density does not increase towards the river mouth, which might be expected given that *C. knipowitschii* prefers river mouths and estuaries.

Additionally, morphometric analyses were performed on the basis of 10 live adult specimens of molluscs collected from one point and one day (Table 2).

Table 2. Morphometric measurements of the shells (mm) of *C. knipowitschii* collected from the Soroca sampling station of the Dniester River basin during summer 2020 on the territory of the Republic of Moldova. N – number of measured specimens; H – height; W – width; Min – minimal value; Max – maximal value; Mean – mean value; and SD – standard deviation.

	N=10	H Height (mm)	W width (mm)	Ratio H/W
Mean±std	10	2,06±0,31	0,98±0,11	2,10±0,16
Min-Max		1,55-2,59	0,82-1,15	1,88-2,38

The results of the measurements of all studied molluscs showed that the height of the shells varied from 0.65 mm in juvenile specimens up to 2.59 mm in adults (Fig. 3). The characteristic features of species, i.e. its reticulate (lattice like) sculpture can be seen in–Fig. 3.1, 3.2 and 3.5. A single radula of *C. knipowitschii* was removed from ethanol-fixed material and purified in KOH for imaging (Figs. 3; 4).

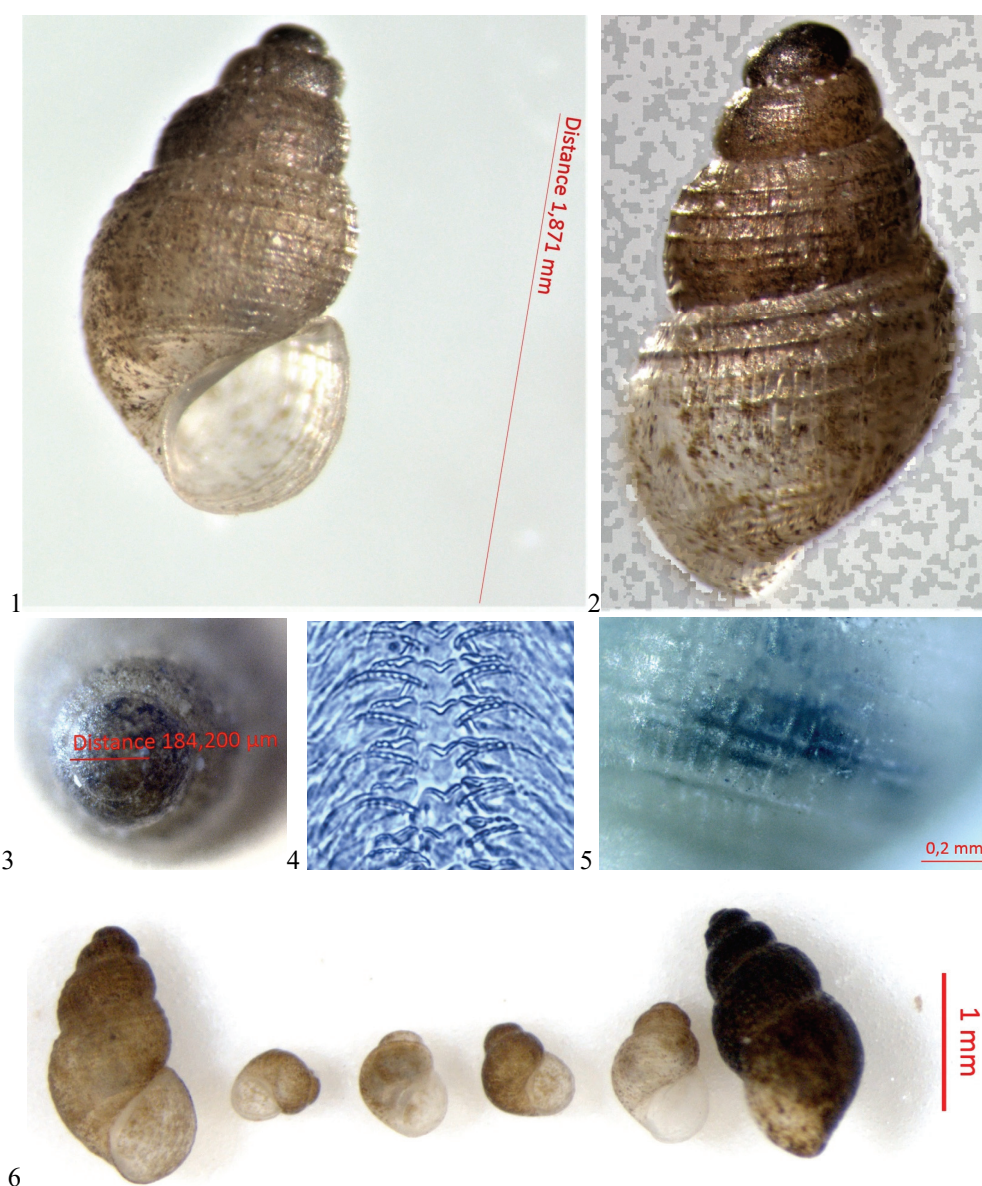


Figure 3. *Clathrocaspia knipowitschii* (Makarov, 1938), 1) frontal view, 2) dorsal view, 3) apical view of protoconch, 4) radula, 5) shell surface, reticulate (lattice like) sculpture, 6) adults and juvenile specimens (All pictures are original).

The main conchological characteristics as show on Fig. 3 and Table 2 in general correspond to the determination of *Clathrocaspia knipowitschii*.

Results of this investigation give a possibility to say that a stable population of the rare and endangered Pontocaspian mollusc *C. knipowitschii* exists on the territory of Republic of Moldova in the Dniester River basin. Moreover, in the last years, these molluscs reappeared and spread from the mouth of the Dniester river up to the Middle River on the approximatively of 650 km from the Dniester River mouth.

## DISCUSSIONS

The finding of rare and endangers mollusc *C. knipowitschii* at about 650 km from the Dniester River mouth was unexpected especially considering that this species preferred the estuaries. However, an analogical situation was described in Bulgaria with *Clathrocaspia milae* which closely resembles *C. knipowitschii*, this species was found in the Danube River in about 500 km up of the Black Sea (BOETERS et al., 2015). They adapted not only to the anomalohaline salinity regimes of estuaries, but also to freshwater conditions.

According to the published data of the Laboratory of Hydrobiology and Ecotoxicology of the Institute of Zoology (ZUBCOV et al., 2019) during 2015-2019 the total mineralization of the Dniester River was on average 300-400 mg/l,  $\text{HCO}_3^{2-}$  250-200 mg/l,  $\text{Ca}^{2+}$  - 50-65 mg/l,  $\text{Cl}^-$  - 23-27 mg/l,  $\text{SO}_4^{2-}$  - 45-60 mg/l. That corresponds to freshwater conditions.

The maximal density of *C. knipowitschii* was registered in the Dnieper-Bug estuary, near Kherson and consists of 4590 spec./m<sup>2</sup> with biomass of 7.73 g/m<sup>2</sup> (ANISTRATENKO, 2013), which is comparable to our data about maximal abundance of 4480 ind/m<sup>2</sup> and biomass 5.12 g/m<sup>2</sup>.

If the morphometric measurements of the shells in this study and literature data are compared, it should be noted that the maximal height, i.e. 2.59 mm, is slightly higher and the mean width is slightly smaller than the one described by ANISTRATENKO (2013). At the same time, this author remarks the wide range of shell variability. Because of this, another morph, or another species may exist on the territory of the Republic of Moldova, but genetic studies are needed for comprehensive identification in additional conchological studies and studies of soft-body morphology.

## CONCLUSIONS

The rare and endangered Pontocaspian gastropod *C. knipowitschii* reappeared on the territory of Republic of Moldova and spread from estuary to the 650 km from Dniester River mouth.

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## REFERENCES

- ABAKUMOV V. A. 1983. *Guidelines on the methods of hydrobiological analysis of surface waters and bottom sediments*. (Rukovodstvo po metodam gidrobiologicheskogo analiza poverkhnostnykh vod i donnykh otlozheniy). Gidrometeoizdat. Leningrad. 239 pp. [In Russian].
- ANISTRATENKO V. 2013. On the taxonomic status of the highly endangered Ponto-Caspian gastropod genus *Caspia* (Gastropoda: Hydrobiidae: Caspiinae). *Journal of Natural History*. Taylor & Francis Group. London. **47**: 1-2, 51-64.
- ANISTRATENKO V., NEUBAUER TH. A., ANISTRATENKO OLGA, KIJASHKO P. V., WESSELINGH FR. P. 2021. A revision of the Pontocaspian gastropods of the subfamily Caspiinae (Caenogastropoda: Hydrobiidae) in *Zootaxa*. Magnolia Press. Auckland. **4933**(2): 151-197.
- BIRSHTEIN Y. A., VINOGRADOV L. G., KONDAKOV N. N., KUHN M. S., ASTAKHOVA T. V., ROMANOVA N. N. 1968. *Atlas bespozvonochnykh Kaspiskogo morya*. Pishchevaya Promyshlennost (Vsesoyuznyi Nauchno-issledovatel'skii Institut Morskogo Rybnogo Khozyaistva i Okeanografii), Moskva. 412 pp. [In Russian].
- BOETERS H. D., GLÖER P., GEORGIEV D., DEDOV I. 2015. A new species of *Caspia* Clessin et W. Dybowski, 1887 (Gastropoda: Truncatelloidea: Hydrobiidae) in the Danube of Bulgaria. *Folia Malacologica*. The Association of Polish Malacologists Publisher. Varsava. **23**: 177-186.
- GONTEA F. A. 1985. *The malacofauna of water bodies of Dnestr river. (Malakofauna vodoyemov Dnestra)*. Autoreferatul tezei de doctor în științe biologice. Chișinău. 22 pp. [In Russian].

- KUTIKOVA L. & STAROBOGATOV YA. 1977. *Keys to the Freshwater Invertebrates of the European part of USSR: (Opredelitel' presnovodnykh bespozvonochnykh Yevropeyskoy chasti SSSR)*. Gidrometeoizdat Press. Leningrad. 510 pp. [In Russian].
- MAKAROV A. K. 1938. Rasprostraneniye nekotorykh rakoobraznykh (Mysidacea, Cumacea) i limannykh mollyuskov v ust'yakh i otkrytykh limanakh Severnogo Prichernomor'ya / Distribution of some crustaceans (Mysidacea, Cumacea) and liman mollusks in estuaries and open limans of the northern Black Sea region. *Zoologicheskii Zhurnal*. Akademiya, Moskva. **17**(6): 1055-1062 [In Russian].
- MUNJIU OXANA. 2012. Actual species composition of freshwater mollusks of the Republic of Moldova. *Geocological and Bioecological Problems of the Northern Black Sea Region*. Proceedings of the International Conference. Tiraspol: 205-207 [In Russian].
- MUNJIU OXANA, TODERAŞ I., BANU V. 2015. Sampling of zoobenthos. In “*Hydrochemical and hydrobiological sampling guidance*”. Eds. Toderaş I., Zubcov E., Bileţchi L. Elan Poligraf Press. Chişinău: 18-22.
- TSALOLIHIN S. YA. 2004. *Keys to the freshwater invertebrates of Russia and adjacent countries*. (Opredelitel' presnovodnykh bespozvonochnykh Rossii i sopredel'nykh stran. T.6. Mollyuski, Polikhety, Nemertiny). Nauka Press. Sankt Peterburg. **6**. 528 pp. [In Russian].
- WESSELINGH F. P., NEUBAUER T. A., ANISTRATENKO V. V., VINARSKI M., YANINA T., TER POORTEN J. J., KIJASHKO P., ALBRECHT C., ANISTRATENKO O. Y., D'HONT A., FROLOV P., GÁNDARA A. M.; GITTENBERGER A.; GOGALADZE A.; KARPINSKY M.; LATTUADA M.; POPA L., SANDS A. F., VAN DE VELDE S., VANDENDORPE J., WILKE T. 2019. Mollusc species from the Pontocaspian region – an expert opinion list. *ZooKeys*. University Publisher. Sofia. **827**: 31-124.
- YAROSHENKO M. F. 1957. *Hydrofauna of Dniester River. (Gidrofauna Dnestra)*. Izdatelstvo akademii nauk SSSR. Moscow. 169 pp. [In Russian].
- ZHADIN V. I. 1952. *Mollusca of fresh and brackish waters of the USSR*. In: *The key-books on fauna of the USSR*. AN SSSR. (Mollyuski presnykh i solonovatykh vod SSSR) Publishing house of Academy of Sciences of the USSR. Moscow-Leningrad. **43**. 346 pp. [In Russian].
- ZUBCOV ELENA, BAGRIN N, ANDREEV N., BILEŢCHI LUCIA, ZUBCOV N. 2019. Long-term dynamics of mineralization and main ions in the water of the Dniester. In: *Hydropower impact on river ecosystem functioning: Proceedings of the International Conference, (Mnogoletnyaya dinamika mineralizatsii i glavnykh ionov v vode Dnestra)*. Eco-Tiras. Chişinău: 130-134. [In Russian].
- \*\*\*. AQEM CONSORTIUM. 2002. A comprehensive method to assess European streams using benthic macroinvertebrates, developed for the purpose of the Water Framework Directive. *Manual for the application of the AQEM system*. AQEM CONSORTIUM. Germany. 202 pp.

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