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Aquatic Invasions Records

First record of Asian clam *Corbicula fluminea* (Müller, 1774) in the Republic of Moldova

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Abstract

Living individuals of Asian clam *Corbicula fluminea* (Müller, 1774) (Bivalvia: Veneroida: Sphaeriacea: Corbiculidae) have been recorded for the first time in the Republic of Moldova (Prut River basin, November 2009). Perhaps, this invasive species entered the Prut River basin from the Romanian or Ukrainian territories, where this species was previously recorded. This invasive species may negatively influence the native bivalves as they are in competition for both nutrient resources and substrate.

Key words: Asian clam, *Corbicula fluminea*, living individuals, Prut River basin, Republic of Moldova

Introduction

The Republic of Moldova is a small European country, situated in the Southeast part of Europe, neighboring Romania and the Ukraine. The alien molluscs in the freshwater ecosystems of R.Moldova until recently were represented by 6 species: *Potamopyrgus (Hydrobia) jenkinsi* Smith, 1889 (Yaroshenko 1957); *Theodoxus palassi* Lindholm, 1924 (Dyagileva 1986); *Dreissena bugensis* Andrusov, 1897 (Filipenko and Leiderman 2006); *Ferrissia fragilis* Tryon, 1863 (Son 2007a); *Theodoxus euxinus* Clessin, 1886 (Coada and Popa 2006); *Sinanodonta woodiana* Lea, 1834 (Munjiu and Shubernetski 2008). In the present paper we report the first record for R. Moldova of the Asian clam, *Corbicula fluminea* (Müller, 1774).

Corbicula fluminea is a fresh and brackish water bivalve mollusc with a yellow-green solid, globular shell with concentric rings (Zhadin 1952). This is an invasive species which very quickly spreads and inhabits new environments and has been proved to cause harm to the native bivalve molluscs. This invasive species is originally native to South-East Asia, Africa and Australia (Zhadin 1952), it was also introduced in North America in 1924 (Counts 1981). In Europe it was reported for the first time in 1980 (Mouthon 1981). In the Ukrainian sector of the Danube delta some juveniles of *Corbicula* spp. were found in 1995, which initially were identified as another species (Son 2007b). In the Romanian sector of the Danube delta the first living individuals of *Corbicula fluminea* (Müller, 1774) were collected in the winter of 1997 (Scolka and Gomoiu 2001) and this clam was later found along the Danube River.

Materials and methods

In R. Moldova the first empty *Corbicula* shells were found on the bank of river near the village of Cislita-Prut (the Lower Prut, R.Moldova). This was an evident indicator of *Corbicula* presence in the Prut River. Living individuals of Asian clam *Corbicula fluminea* (Müller, 1774) (Figure 1) were found in the Prut River at the sampling site Cislita-Prut in November 2009 (45°53'13"N, 28°17'16"E) (Figure 2). Molluscs were hand-collected and with the use of a Petersen grab.

Results and discussion

The invasive mollusc was found in the riverbed on the muddy bottom substrate at depths up to 1м. More than 100 living individuals were found with lengths of 3-19 mm along a transect 0.7×25m. This collected sample of mussels was

divided into four size-age groups according to the shell length: up to 0.5mm; 6-10mm; 11-15mm; 16-20mm (Figure 3). Most numerous (90 specimens) was the group with shell length 6-10 mm. The *C. fluminea'* maturation period begins when shell length reaches 6-10mm (Sousa 2008), thus the most numerous group were considered sexually mature.

According to the mollusc' density – 6.23 ind/m^2 and biomass – 1,82 g/m^2, *C. fluminea* is in second place within all *Bivalvia* in the Cislita-Prut, after the native bivalve mollusc - *Unio tumidus* (Philipsson, 1788) – 16 ind/m^2 and 530 g/m^2. Considering that *Corbicula* sp. is able to bury into the substratum up to 45cm, their density may be more than the above mentioned (Son 2007b).

During our previous sampling (2004) *Corbicula fluminea* was not recorded. Hence, it is likely that this species of mollusc appeared and expanded to a numerous population during the period 2005-2009.

It should also be noted that, in this Lower sector of the Prut River, the concentration of oxygen varied between 6.38-10.43 mg/l or 69.4-85.2% of water saturation. The content of suspended matter varied between 25-99.9 mg/l (Zubcov et al. 2008), during our sampling time the content of suspended mater was 71.9 mg/l. The bottom was muddy.

Considering the above mentioned, we are able to conclude that the conditions of the studied sampling site of the Prut River are not the most favorable for the mollusc *Corbicula fluminea* because this species prefers fine, clean sand and a high level of dissolved oxygen (de Sousa 2008). However, the reproductive strategy of *Corbicula*, with the presence of free floating larvae, is an advantage for successful invasion to new water bodies.

One of the factors contributing to the invasive success of *C. fluminea* may be that *C. fluminea* is an androgenic clone species (molecular study, Komaru and Konishi 1999). Clone species may have advantages in comparison to recombinant species regarding introductions to new ecosystems. Usually successfully introduced clone species are comprised of well adapted individuals to new environmental conditions, in contrast the recombinant species have only few such individuals (Grebelnyi 2008).

The fact that *Corbicula fluminea* is both a diploid and a triploid hermaphroditic androgenic mussel (Komaru and Konishi 1999) has caused problems with both the taxonomy and diagnosis

Figure 1. *Corbicula fluminea* (Müller, 1774) from the Prut River (Photo by O.V. Munjiu).

Figure 2. Location of the Prut River (fragment of Google maps).

of this species. From the beginning of its introduction, the population of the clone species usually consists of a clean-line, which in the conditions of isolation may be significantly different from the original ones. The taxonomic significance of phenotypic variability is estimated differently by different authors. According to some authors, the differences do

not exceed the morphotype limits of *Corbicula fluminea* (Renard et al. 2000), while according to others, these differences are treated as another species or another morph (Pfenninger et al. 2002).

For mussel identification of those found in the Prut River, traditional descriptions (Zhadin 1952) and also some parameters described by M.O. Son (Son 2007b) and A.V. Korniushin (Korniushin 2004) were used.

The shells have an oval-triangular shape with thin and closely spaced rings; shell length in most cases is larger than shell height (Figure 1). The lock presented in Figure 4 is identical to the original figure "the lock of *Corbicula fluminea* (Müller)" presented in Zhadin (1952). Taking into consideration these diagnostic peculiarities we assumed that the mussels collected in the Prut River were *Corbicula fluminea* (Müller, 1774).

One important note is the fact that the intrapopulation diversity of *Corbicula fluminea* color, collected in the Cislita-Prut, reflected a high phenotypic diversity and a high sustainability potential of the population (Figure 1).

Both phenotypic and genotypic diversity is the basis for natural selection, the reserve for adaptation to environmental changes and the basis for the established population.

In summary, the invasive mollusc species *Corbicula fluminea* was recorded for the first time in R. Moldova and we have the reason to believe that the established population of *Corbicula fluminea* in the sampling site Cislita-Prut was founded during the last few years. Such invasions cause negative influences on native mussels because of the ability of *Corbicula fluminea* to form large populations in a short time in the natural habitat not favorable for it. Probably the factors that contributed to the successful invasion are the appearance of a clone resistant to these conditions and the phenotypic diversity of this population. Population establishment is probably due to the repeated invasion by free floating larvae.

The presence of *Corbicula fluminea* in Romanian and Ukrainian parts of the Danube River can indicate that this species has invaded the Prut River from this source. The possible ways of such invasion are Danube via river flooding or by navigation.

These clams negatively influence the native bivalves as they are in competition for both nutrient resources (filter-feeding) and substrate. Thus, we need to pursue a further investigation of invasive species in R. Moldova. Special attention should be paid to the investigations of freshwater bodies which belong to the "Wetland Danube River Area", i.e. the lower part of the so-called "Southern Invasion Corridor" where additionally the Giurgiulesti International Free Port on the Danube part of R.Moldova (about 480 meters), was built in 2006. Therefore, the risk of invasion of alien species has been increased via this pathway. Biological invasions could negatively influence the formation of faunas and structural-functional characteristics of these water ecosystems.

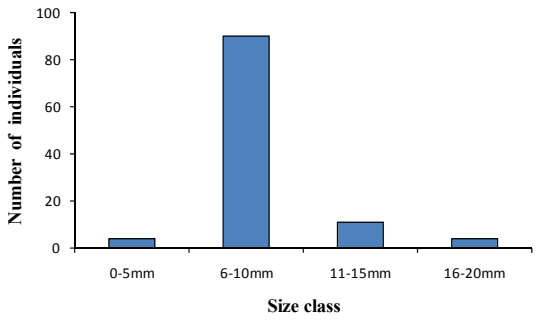

Figure 3. Size composition of *Corbicula fluminea* from the Prut River.

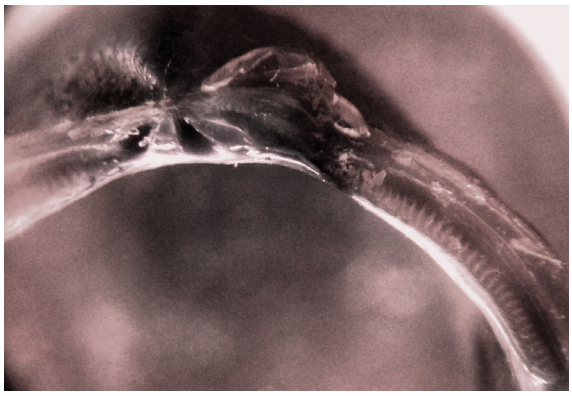

Figure 4. The lock of *Corbicula fluminea* from the Prut River (Photo by O.V.Munjiu).

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References

Coada V, Popa V (2006) Malacological diversity of the Dniester River in sector Otaci – Vadul-lui-Voda. Academician Leo Berg – 130. Collection of Scientific Articles. Bendery, pp 66–68

Counts CL III (1981) *Corbicula fluminea* (Bivalvia: Sphaeriacea) in British Columbia. *Nautilus* 96(1): 12-13

de Sousa RG (2008) Factors contributing to the invasive success of *Corbicula fluminea* (Müller, 1774). PhD thesis. Un. de Porto, 137 pp

Dyagileva GM, Stavinskaya AM (1986) Study of spreading the Ponto-Caspian fauna in Dniester River. In: First Congress of Moldavian hydrobiologists. Kishinev, Shtiintsa, pp 42–44

Filipenko SI, Leiderman AI (2006) The dynamic of developing dreissenid populations in Cuciurgan-cooling reservoir of the Moldovan Power Station. Academician Leo Berg – 130: Collection of Scientific Articles, pp 116–118

Grebelnyi SD (2008) Cloning in nature. Proceedings of Zoological Institute, Russian Academy of Sciences, St. Petersburg, 288 pp

Komaru A, Konishi K (1999) Non-reduction spermatozoa in three shell color types of the freshwater clam *Corbicula fluminea* in Taiwan. *Zoological Science* 16: 105–108, doi:10.2108/zsj.16.105

Korniushin AV (2004) A revision of some Asian and African clams assigned to *Corbicula fluminalis* (Müller, 1774) (Mollusca: Bivalvia: Corbiculidae), with review of anatomical characters and reproductive features based on museum collections. *Hydrobiologia* 529: 251–270, doi:10.1007/s10750-004-9322-x

Mouthon J (1981) Sur la presence en France et au Portugal de *Corbicula* (Bivalvia, Corbiculidae) originaire d'Asie. *Basteria* 45: 109–116

Munjiu O, Shubernetski I (2008) First record of *Sinanodonta woodiana* (Lea, 1834) (Bivalvia: Unionidae) in Moldova. *Aquatic Invasions* 3: 441–442, doi:10.3391/ai.2008.3.4.12

Pfenninger M, Reinhardt F, Striet B (2002) Evidence for cryptic hybridization between different evolutionary lineages of the invasive clam genus *Corbicula* (Veneroida, Bivalvia). *Journal of Evolutionary Biology* 15: 818–829, doi:10.1046/j.1420-9101.2002.00440.x

Renard E, Bachmann V, Cariou M, Moreteau J (2000) Morphological and molecular differentiation of invasive freshwater species of the genus *Corbicula* (Bivalvia, Corbiculidae) suggests the presence of three taxa in French rivers. *Molecular Ecology* 9: 2009–2016, doi:10.1046/j.1365-294X.2000.01104.x

Skolka M, Gomoiu M-T (2001) Alien invertebrates species in Romanian waters. Ovidius University, *Annals of Natural Sciences, Biology - Ecology Series* 5: 51–55

Son MO (2007a) North American fresh water limpet *Ferrissia fragilis* (Tryon, 1863) (Gastropoda: Planorbidae) – a cryptic invader in the Northern Black Sea Region. *Aquatic Invasions* 2: 55–58, doi:10.3391/ai.2007.2.1.6

Son MO (2007b) Invasive mollusks in fresh and brackish waters of Northern Black sea Region. Odessa, 132 pp

Yaroshenko MF (1957) Hydrofauna of Dnister River. AN SSSR, Moscow, 168 pp

Zhadin VI (1952) Mollusca of fresh and brackish waters of the USSR. In: The key-books on fauna of the USSR, Vol. 43. AN SSSR, Moscow-Leningrad, 346 pp

Zubcov E, Ungureanu L, Zubcov N, Shubernetski I, Munjiu O (2008) The influence of some abiotic factors on phytoplankton development and biotic processes in the Prut River ecosystems. In: Proc. of the 37th IAD Conf. "The Danube River Basin in a changing World" Chisinau, pp 82–86