Ruthenica, 2024, vol. 34, No. 2: 93-97.
Published online April 4, 2024.
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The finding of *Unio pictorum* (Linnaeus, 1758) (Bivalvia: Unionidae) in the Om' River, Western Siberia

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ABSTRACT. Juvenile and subadult individuals of the painter's mussel *Unio pictorum* (Linnaeus, 1758) were recorded in dredge samples from the Om' River in the Omsk City (southwestern part of Western Siberia). Information on the size-weight characteristics of *U. pictorum* from the site, its abundance and biomass are given. Possible consequences of the introduction of this neobiotic species into aquatic ecosystems of the Irtysh River basin are discussed.

https://doi.org/10.35885/ruthenica.2024.34(2).4

Находка моллюска *Unio pictorum* (Linnaeus, 1758) (Bivalvia: Unionidae) в реке Омь (Западная Сибирь)

С.И. АНДРЕЕВА

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РЕЗЮМЕ. Во время гидробиологической съемки на реке Омь в черте г. Омска (юго-западная часть Западной Сибири) в дночерпательных пробах были зарегистрированы молодые особи перловицы *Unio pictorum* (Linnaeus, 1758). Приводится информация о размерно-весовых характеристиках *U. pictorum* из данного местообитания, его численности и биомассе. Рассматриваются возможные последствия вселения этого необиотического вида для водных экосистем бассейна Иртыша.

Introduction

The Western Siberian part of the former (Pleistocene) range of the unionid species *Unio pictorum* (Linnaeus, 1758), the painter's mussel, is restored during latest decades [Babushkin *et al*., 2023]. This species is considered a neobiotic in the Ob-Irtysh basin. The available data indicates a relatively high rate of expansion of *U. pictorum* from the Ural to the Western Siberian plain [Khokhutkin *et al*., 2003; Andreeva *et al*., 2009; Babushkin *et al*., 2021, 2023]. The first discovery of the species in the region was made in 2000 in the artificial reservoirs built on the Iset River [Khokhutkin *et al*., 2003]. Since then, *U. pictorum* established populations in left-bank tributaries of the Irtysh River. Further in 2020, a large, naturalized population of *U. pictorum* was discovered in the lower reaches of the Tobol River [Babushkin *et al*., 2021]. In September 2022 and in September 2023, during a hydrobiological survey on the Om' River in Omsk City (southern part of Western Siberia), juvenile individuals of *U. pictorum* were recorded in dredged bottom samples [Andreeva *et al*., 2023]. The discovery of the species in the right-bank tributary of the Irtysh confirms the assumption [Babushkin *et al*., 2021] that the dispersal of this mollusc along the rivers of the West Siberian Plain is ongoing.

This report provides information on the morphology and ecology of the species in its new habitat, the Om' River.

Material and methods

The material for this report was obtained from benthos bottom samples dredged in September 2022 (6 samples) and in September 2023 (12 samples) in the Om' River within the boundaries of Omsk City. The samples were collected from two sites: 2 km upstream from the railway bridge (coordinates 55.017°N, 73.503°E) and 0.5 km downstream from the bridge (coordinates 55.012°N, 73.468°E). The sampling and laboratory processing of the malacological material was carried out according to the standard methods [Zhadin, 1960; Vinberg, Lavrentiev, 1983]. The species identification of the collected molluscs was based on the use of conchological, anatomical and molecular methods. During the identification procedure, special attention was paid to the shape and proportions of the shell, the

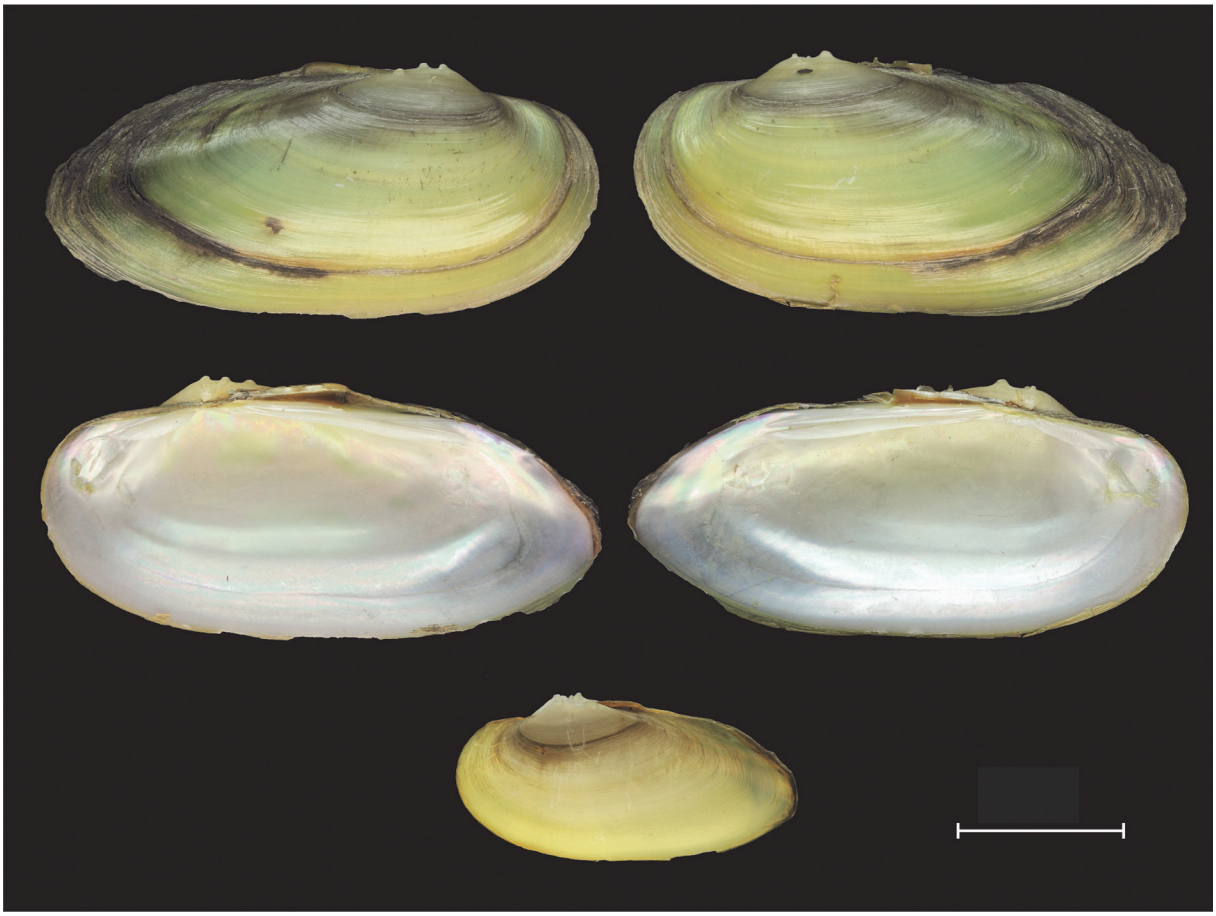

FIG. 1. The shell valves of *Unio pictorum* from the Om' River (Omsk City, around the railway bridge, collected on 12.09.2023). Scale bar – 10 mm.

РИС. 1. Створки раковин *U. pictorum* из р. Омь в г. Омске в районе железнодорожного моста (дата сбора 12.09.2023). Масштабная линейка – 10 мм.

colour and sculpture of the shell surface, and the hinge features. Publications providing information on the taxonomy of the genus *Unio* were used to identify the species [Zhadin, 1952; Rizhinashvili, 2007; Babushkin *et al*., 2021]. Following the morphological and anatomical analysis, the species identification was confirmed using molecular genetic methods. The methods of DNA isolation, primer sets and conditions for PCR, sequencing, processing of primary sequences, and their alignment are described in detail in Bolotov *et al*. [2020]. The age of the molluscs was determined by counting the growth lines (annual rings) on the surface of the periostracum. A total of 8 specimens of *U. pictorum* were found and examined.

Molecular genetic analysis was carried out on the facilities of the Russian Museum of Biodiversity Hotspots at the N. Laverov Federal Center for Integrated Arctic Research of the Ural Branch of the Russian Academy of Sciences (Arkhangelsk, Russia). Sequencing was performed at the Central Research Center "Genome" at the Institute of Molecular Biology of the Russian Academy of Sciences (Moscow, Russia). Photos of shells were taken using a Canon EOS 7D digital camera with a Canon EF 100mm f/2.8L Macro IS USM lens.

Results and discussion

During the hydrobiological survey of the Om' River in Omsk City in September 2022, around the railway bridge, juvenile specimens of *U. pictorum* were registered from the single right-bank station. In September 2023, molluscs were already found at three right-bank stations. at depths from 0.5 to 1.8 m on silted sand with an admixture of stones or rubble. Above the bridge, molluscs lived near the shore at a depth of 0.5 m on sandy silt with weakly rounded stones and isolated submerged macrophytes (*Potamogeton perfoliatus*, *Myriophyllum verticillatum)*. Below the bridge – at a depth of 1.5–1.8 m on silted sand with an admixture of small rocky nodules without macrophytes.

The transparency of the water, in the places where the molluscs were found, was less than 1 meter. The collected individuals share the same mtDNA COI haplotype, which is identical to that found in the

Table 1. Size and weight characteristics, and morphometric indices of the studied specimens of *U. pictorum* of the Om' River.
Табл. 1. Размерно-весовые характеристики и морфометрические индексы особей *U. pictorum* из р. Омь.

№	Age	Weight, g	Shell length (L), mm	Shell height (H), mm	Shell convexity (B), mm	H/L	B/L	B/H
				2022				
1	0+	–	4.1	2.3	1.4	0.56	0.34	0.61
2	1+	–	6.0	3.2	2.0	0.54	0.33	0.62
3	1+	–	9.8	4.9	3.1	0.50	0.31	0.63
				2023				
4	0+	0.43	3.0	1.7	1.0	0.57	0.33	0.59
5	1+	0.51	16.2	8.0	5.8	0.49	0.36	0.71
6	2+	0.71	19.2	9.4	6.6	0.49	0.34	0.70
7	3+	2.64	34.7	14.8	10.9	0.43	0.30	0.74
8	3+	3.71	37.5	16.0	11.5	0.43	0.31	0.72

samples of *Unio pictorum* from the Tobol, Tura and Pyshma river basins [Babushkin *et al*., 2021].

The shell shape and colour in the studied specimens is varied depending on the size of the individual. Recently settled juvenile mussels have a transparent, whitish shell of irregular rounded-oval shape with a length of 3.0 mm. In 9.8 mm long individuals, the translucent white shell has elongated-oval shape, whereas 16.2 mm long molluscs have the white shell, yellowish at its lower edge and of elongated shape (which is typical for the adult specimens of *U. pictorum*). The shells of larger molluscs are painted in a bright olive colour. The shells of recently settled molluscs up to 10 mm length bear five to seven solid outgrowths, or spikes, on each valve. These outgrowths, probably, protect juveniles from mechanical damage when settling on rocky bottoms during the transition to the bottom life. In larger mussels, these structures are preserved on the top of the shell in the form of an umbonal sculpture (Fig. 1). The size and weight characteristics of the studied specimens are given in Table 1. The change in the proportions of the shell and its morphometric indices in the process of ontogenesis can be reported. As the molluscs grow, the length and width of a shell increase, and the growth of the shell in height slows down, which determines shell proportions of an adult individual.

The foot in studied specimens has a dark spot, which is characteristic of this species [Rizhinashvili, 2007]. The hinge structure was also quite typical for *U. pictorum*. There is one long lamellar lateral tooth and two cardinal (pseudocardinal) teeth on the right valve. Parallel brush-like outgrowths are visible on the upper surface of the main massive cardinal tooth. There are two lateral long lamellar teeth on the left valve. Cardinal teeth are massive and have parallel outgrowths in the form of a brush on their upper surface.

In 2022 sample, the maximum shell length of *U. pictorum* in the Om' River reached 9.8 mm with one clearly defined growth line. The 2023 sample contained the individual with the maximum shell length 37.5 mm with three growth lines. Judging by the number of the lines, the largest molluscs in the 2023 sample was 3+ in age, that is, they settled on the bottom at least three years ago, in 2020. The absence of large-sized shells in the sample, both on the river bottom and in shoreline debris, suggests that the invasion occurred no more than four to five years ago. Judging by the width of the intervals between the annual rings (Fig. 1), the invaders have found favourable living conditions in the Om' river. It is also evidenced by a quantitative indicator: at the control station, with the equal number of individuals, the biomass of this mussel increased sharply over the year (Table 2).

Zoobenthos community in the Om River, where *Unio pictorum* was found, is represented by groups of animals common to riverine waters of Western Siberia (Table 2); the most diverse are bivalves, which dominate in numbers and biomass. The most abundant species in the samples is *Pisidium inflatum*. Of the chironomid larvae, *Procladius ferrugineus* Kieffer, 1918, *Chironomus plumosus* (Linnaeus, 1758), *Glyptotendipes* sp. and *Cryptochironomus* sp. were found (each represented by few specimens).

Unio pictorum is a large-bodied and relatively long-lived filter-feeding mollusc. According to various authors [Alimov, 1981; Filippov, Gerasimova, 1992; Rizhinashvili, 2007; Piechocki, Wawrzyniak-Wydrowska, 2016], in the European rivers and lakes it can live up to 9-16 years (according to Aldridge [1999] estimate, the longevity of *U. pictorum* may extend to 22 years) and attain the maximum shell size around 140 mm. The consequences of its naturalization in the Irtysh River basin can be manifold. First, the establishment of a new filter-feeding species will contribute to the restructuring of trophic networks of

Table 2. Abundance (numerator, ind./m^2) and biomass (denominator, g/m^2) of zoobenthos near the right bank of the Om' River around the railway bridge, September 2022 and 2023.

Табл. 2. Численность (числитель, экз./м^2) и биомасса (знаменатель, г/м^2) зообентоса у правого берега р. Омь в окрестностях железнодорожного моста, сентябрь 2022–2023 гг.

Taxa	Above the bridge		Below the bridge	
	2022 г.	2023 г.	2022 г.	2023 г.
Total	1640 44.2	400 297.0	120 3.5	200 22.8
Mollusca, Bivalvia:	1400 42.1	320 288.2	80 3.3	120 22.6
Unio pictorum	120 9.2	120 282.0	–	40 20.2
Amesoda asiatica (Martens, 1864)	40 0.20	–	40 2.80	–
Pisidium decurtatum Lindholm, 1909	120 5.44	120 5.20	–	–
P. inflatum (Muehlfeld in Porro, 1838)	960 26.36	80 1.00	40 0.52	80 2.36
Hensloviana dupuiana (Normand, 1854)	120 0.88	–	–	–
Euglesa sp.	40 0.04	–	–	–
Mollusca, Gastropoda:	40 1.16	–	–	–
Digyrcidum starobogatovi Andreeva et Lazutkina, 2014	40 1.16	–	–	–
Oligochaeta	40 0.08	40 0.00	–	–
Hirudinea	40 0.20	–	–	–
Insecta, Chironomidae larvae	80 0.20	–	40 0.16	80 0.20
Insecta, Odonata larvae	–	40 8.80	–	–
Insecta, Tabanidae larvae	40 0.44	–	–	–

ecosystems as they were formed in historical times. Due to its large size and massive shell, *U. pictorum* is practically of no importance as a food item for benthivorous fish, and the energy assimilated by its populations (according to Rizhinashvili [2007], it constitutes 20 to 60% of the energy assimilated by non-predatory zoobenthos) will not be used to maintain fish stocks. On the other hand, the significant role of unionid mussels in the processes of self-purification of waterbodies and the involvement of suspended substances in the biogeochemical cycle has been emphasized in the literature. Mass reproduction of large filtrating species can play a positive role for the aquatic ecosystems of the Irtysh basin, especially since the tributaries of the Middle Irtysh are subject to anthropogenic eutrophication and pollution by easily oxidized organic substances, and rivers and lakes in the region have a high degree of eutrophication, reaching the level of "blooming" of water [Bazhenova *et al*., 2019].

Further, it can be assumed that the invasive species will compete with native species of filter feeders, which can potentially lead to a decrease in the abundance and biomass of native zoobenthos. However, direct competition for food sources between *U. pictorum* and filter-feedings clams of the family Sphaeriidae is unlikely as these molluscs belong to different size groups and therefore use water from different horizons of the water column for filtration. *U. pictorum* is likely to diverge with large native filter feeders of the unionid genus *Anodonta* with comparable shell sizes due to different biotopic preferences. According to the author's observations, *U. pictorum* prefers to settle on dense bottoms with admixture of pebble (which is facilitated by the protection of massive spines in juveniles and shell thickness), while molluscs of the genus *Anodonta* with thin-walled shells inhabit silty-sandy substrates. Thus, the dispersal of *U. pictorum* in the Irtysh basin under the current state of aquatic ecosystems can

be considered as a positive factor contributing to self-purification of water masses in the process of life activity of the neobiotic mussels. Other authors also point out that the introduction of alien species into aquatic ecosystems does not necessarily lead to negative consequences but may even have a positive effect [e.g., Reise *et al*., 2023].

The establishment of an almost sedentary benthic mollusc in the right-bank tributary of the Irtysh River, located upstream of the mouth of the Tobol River (a left-bank tributary of Irtysh), where the most recent records of living *U. pictorum* populations were made, is due to the fish-parasitizing stage in the life cycle of the mussel. Upstream migrations of fish infected by *U. pictorum* glochidia facilitated the painter's mussel dispersal along the tributaries of the Irtysh River [Babushkin *et al*., 2021]. Probably, in the near future, one should expect to find this species in other right-bank tributaries of the Irtysh impacted by migrations of glochidia-infested fishes, and also in the Middle Ob basin.

Acknowledgments

The author is grateful to her colleagues, A.V. Karimov and Yu.N. Khmelnitsky (Omsk), for assistance in the field-works, and to O.V. Aksenova (Arkhangel'sk) for photographs of mollusc shells and design of the photo table, and G.V. Bovykina (Arkhangel'sk) for conducting molecular genetic analysis.

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