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Research Article

Biotopic distribution of Molluscan fauna in the Sura and Moksha river basins

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Abstract
Rivers and lakes are complex ecosystems that, in recent years, have faced increasing habitat degradation. Aquatic mollusks serve as important indicators in hydrobiological monitoring. This study investigated mollusk communities in the basins of the Sura and Moksha Rivers (Republic of Mordovia). Sampling was conducted at 21 localities. A total of 34 species belonging to 9 families of mollusks were recorded. In the Insar River, *Oxyloma elegans* was found at half of the surveyed sites, as well as in the Chermelei and Alatyr Rivers, indicating shoreline overgrowth with riparian vegetation. In two oxbow water bodies in the Bolshie Berezniki District, mollusks with corroded shells were discovered, suggesting a specific ionic composition of the water that promotes shell degradation. A rare shell form of the pond snail *Ampullaceana ampla*, which is otherwise widely distributed at other river sites, was found in the Alatyr River and warrants further study into the environmental conditions contributing to its formation. *Unio crassus*, found in the Moksha River, is listed in the Red Data Book of the Republic of Mordovia. The Raup-Crick index revealed similarity among mollusk communities inhabiting the headwaters of the Insar River and the tributaries of the Sura River.
Keywords: Aquatic ecosystems, Species composition, Molluscan fauna, Russia

Introduction
Aquatic ecosystems are complex and dynamic environments where living organisms interact closely with their physical surroundings. These systems include both freshwater and marine habitats, ranging from small ponds to vast oceans (Miranda et al., 2021; Xu et al., 2021; Bondarev, 2024). They encompass a wide variety of biomes such as rivers, lakes, wetlands, mangrove forests, and coral reefs, each with distinct characteristics and life forms uniquely adapted to their specific environmental conditions (Mukherjee et al., 2023; López-Rojas et al., 2023; Zou et al., 2024; Figueiredo et al., 2024). One of the defining features of aquatic ecosystems is their ability to support high levels of biodiversity, thanks to the wide range of

available habitats and ecological niches. This makes them vital for the conservation of global biodiversity (Murguia-Flores et al., 2023). Importantly, aquatic ecosystems do not exist in isolation; they are closely linked to terrestrial ecosystems, with energy and matter continuously exchanged between different components of the biosphere (Caparros-Santiago et al., 2021; Xiang et al., 2022; Senkevich et al., 2024).

Freshwater mollusks are a key component of aquatic ecosystems and an important subject of hydrobiological research, as they play a crucial role in aquatic food webs and in the self-purification processes of water bodies (Kutikova & Starobogatov, 1977; Bespalaya et al., 2021; Mabrouki et al., 2023; Akramova et al., 2024). Gastropods and bivalves often dominate benthic invertebrate communities, both in terms of abundance and biomass (Alimov, 1981; Chakraborty et al., 2021; Koperski, 2022). The interfluve area between the Sura and Moksha River basins in the Republic of Mordovia, with its diverse natural conditions and a wide range of waterbody types, represents a particularly valuable region for such research.

Scientific interest in mollusks in this area dates back several decades (Lobachev, 2011). For instance, in the early 1970s, an attempt was made to summarize data on the mollusk fauna of the Insar–Sura interfluve (Stepanov, 1973). In that study, the author recorded 35 species of freshwater mollusks and noted an uneven distribution of species across different habitats. Most species preferred small, shallow, non-flowing water bodies with good thermal conditions. The highest species richness (22 species) was observed in floodplain oxbow lakes along the Sura River, while the fewest (6 species) were found in the river channel itself.

Significant research on aquatic mollusks in this region was also conducted by A.G. Kamenev. His studies on the hydrobiological characteristics and bioproductivity of the Sura and Moksha River systems included data on the presence, abundance, and biomass of nearly 50 mollusk species (Kamenev, 1992).

The aim of the present study is to investigate the freshwater mollusk communities in the interfluve between the Sura and Insar Rivers, as well as in the Moksha River.

Material and methods

Field sampling of mollusks was conducted during August–September of 2015–2017 and from May to July 2024. A total of 29 sampling sites were surveyed, including locations along the Alatyr River (site 21a), Insar River (sites 3, 4, 5a, 5d, 6a, 6b, 6c, 10, 19a, 19b, 19c, 19d), Bolshoi Piksaur River (site 9), Tashaga River (site 14), Chermelei River (site 15), and Lasha River (sites 16a and 16b). In addition, samples were collected from floodplain lakes (sites 2, 11, 12, 13a, 13b, 21b, 22) and ponds (sites 1, 7, 8, 17) (Table 1, Fig.1).

Table 1. Sampling locations for mollusks in rivers, oxbow lakes, and ponds within the water bodies of the Republic of Mordovia

№№	Locality	Biotope
1	Kochkurovo distr., Rasskazovo settl.	Kuliklei Pond
2	Kochkurovo distr., 5 km E of Sabaevo vill.	lake near Sura River
3	Ruzaevka distr., 1 km E of Novaya Murav'yovka vill.	Insar River
4	Ruzaevka distr., Insar-Akshino vill.	Insar River
5a, 5b	Ruzaevka distr., Krasnoe Seltso vill.	Insar River
6a, 6b, 6c	Saransk City distr., 1 km N of Zykovo vill.	Insar River
7	Zubova Polyana distr., 10 km N of Svezhenkaya settl.	pond on Yuva Brook
8	Torbeevo distr., Zhukovo vill.	Zhukovsky Pond
9	Bolshie Berezniki distr., Degilyovka vill.	Bolshoi Piksaur River
10	Saransk City	Insar River
11	Bolshie Berezniki distr., 8 km S of Simkino vill.	Trostnoe Lake
12	Bolshie Berezniki distr., 8 km S of Simkino vill.	Krugloe Lake
13	Bolshie Berezniki distr., 8 km S of Simkino vill.	Dolgoe Lake
14	Bolshie Berezniki distr., 1 km N of Veise vill.	Tashaga River
15	Bolshie Berezniki distr., Simkino vill.	Chermelei River
16a, 16b	Dubyonki distr., 3 km SE of Yavleika vill.	Lasha River
17	Staroe Shaigovo distr., 1 km S of Nikolskaya Salovka vill.	pond on Vedzha River
18	Krasnoslobodsk distr., Penkovo settl.	oxbow lake
19a	Romodanovo distr., Romodanovo settl.	Insar River
19b	Romodanovo distr., Kamenka vill.	Insar River
19c	Romodanovo distr., Ivanovka vill.	Insar River
19d	Romodanovo distr., 1 km of Pushkino vill.	Insar River
20	Ichalki distr., 1 km N of Baevo vill.	Insar River
21a	Ardatov distr., 1 km SW of Supodeevka vill.	Alatyr River
21b	Ardatov distr., 1 km SW of Supodeevka vill.	Teryalka Lake
22	Ardatov distr., 1 km NE of Turgenevo settl.	Ruzan Lake
23	Krasnoslobodsk distr., Laushki vill.	Moksha River

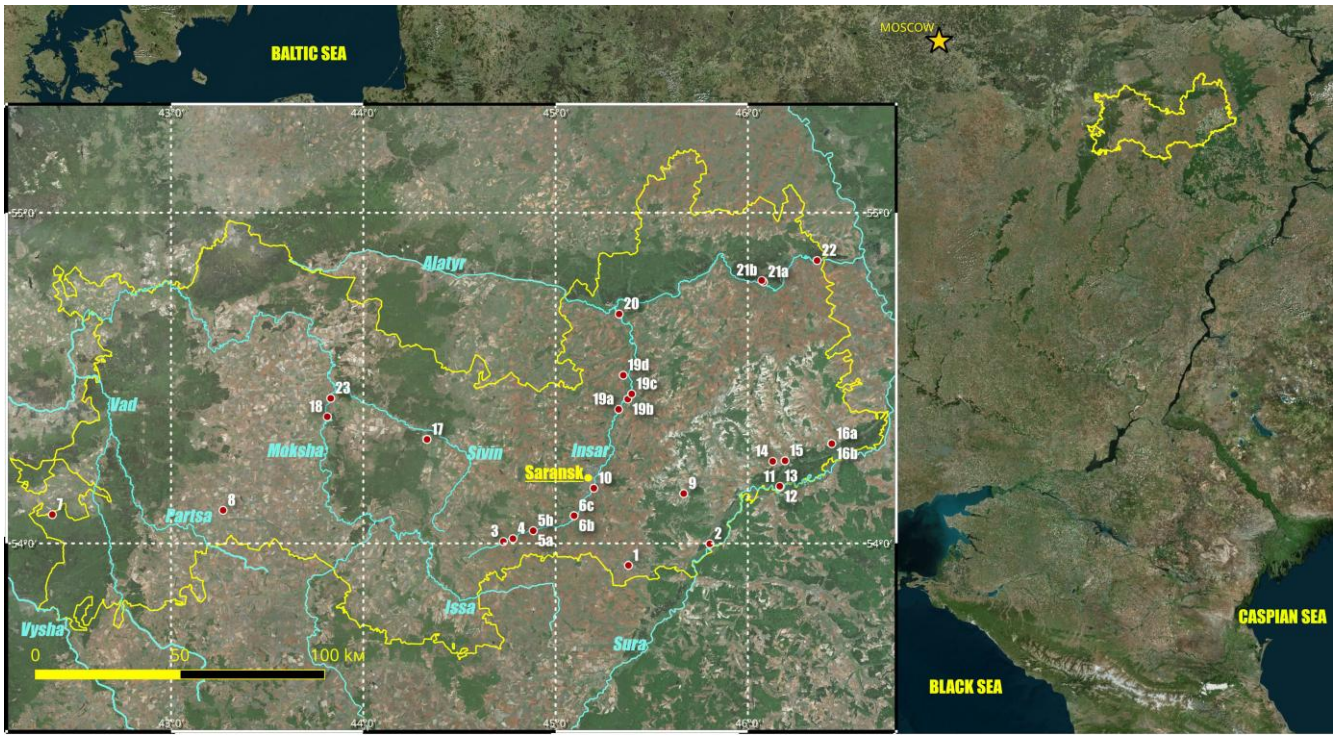

Figure 1. Sampling stations for mollusks in the Republic of Mordovia: Insar River (sites 3, 4, 5, 6, 10, 19), Alatyr River (site 20), Lasha River (site 16), Chermelei River (site 15), Tashaga River (site 14), Bolshoi Piksaur River (site 9), Moksha River (site 23); ponds (sites 1, 7, 8, 17); oxbow lakes (sites 2, 11, 12, 13, 18, 21, 22).

Mollusk collection was carried out manually from the bottom substrates in shallow waters, as well as from the surfaces of aquatic and riparian vegetation and stones. A water net was also used for sampling (Zhadin, 1952). At each site, 2–3 samples were collected simultaneously and combined into a single composite sample. GPS coordinates were recorded at each sampling point. Photographs were taken using an Honor X8a mobile phone.

Sample processing was conducted in the laboratory of the Department of Zoology and Ecology, Penza State University. Species identification was based on shell morphology and soft body anatomical features, using identification keys and taxonomic literature (Korniushin, 1996; Starobogatov et al., 2004; Kruglov, 2005; Khokhutkin et al., 2009; Khokhutkin, Vinarsky, 2013; Andreeva et al., 2010; Bogatov, Kiyashko, 2016; Kiyashko et al., 2016). Species names follow the current taxonomy according to MolluscaBase eds. (2025).

Linear measurements of small mollusks were taken under an MPS-1 stereomicroscope using an ocular micrometer (accuracy ±0.1 mm). For larger snails (shell length >10 mm), a vernier caliper was used (accuracy ±1 mm). To accurately identify species within the family *Lymnaeidae*, the distal parts of the copulatory system were dissected and the relative lengths of the prepuce and penis sheath were analyzed (Figure 2). Mollusks infected with trematodes were identified by dissection of soft tissues.

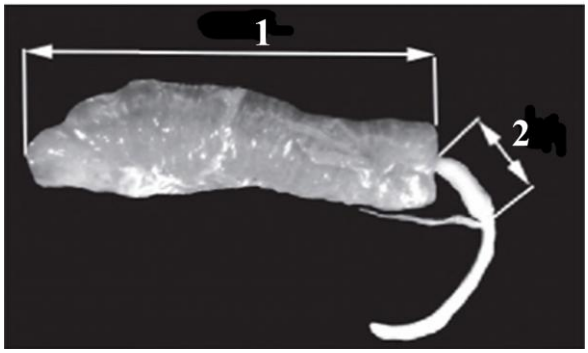

Figure 2. Copulatory organs of *Lymnaea stagnalis*: 1 – praeputium, 2 – penis sheath.

To characterize mollusk communities, we used indicators such as species richness and occurrence frequency (calculated as the proportion of samples in which a given species was present relative to the total number of samples). Community similarity based on species composition was assessed using cluster analysis with the Unweighted Pair Group Method with Arithmetic Mean (UPGMA), based on Raup–Crick similarity indices. Calculations were performed using MS Excel 2010, and cluster analysis was carried out in PAST software version 2.15 (Hammer et al., 2001). The following abbreviations are used throughout the text: H – shell height, W – shell width.

Results

A total of 34 mollusk species representing 9 families were identified (Table 2). The most species-rich families were: *Lymnaeidae* (8 species), *Sphaeriidae* (7), *Planorbidae* (6), and *Unionidae* (5). The species composition reflects data collected from 24 distinct biotopes across 31 sampling stations.

Table 2. Species composition and occurrence frequency of mollusks in various aquatic habitats of the Republic of Mordovia

No.	Taxon	Occurrence, %
	Family Succiniidae	
1	*Oxyloma elegans* (Risso, 1826)	37
	Family Bithynidae	
2	*Bythinia tentaculata* (Linnaeus, 1758)	40
3	*Opisthorchphorus troschelii* (Paasch, 1842)	9
	Family Viviparidae	
4	*Viviparus (Contectiana) contectus* (Millet, 1813)	3
5	*Viviparus viviparus* (Linnaeus, 1758)	9
	Family Valvatidae	
6	*Valvata (Cincinna) piscinalis* O.F. Müller, 1774	17
7	*Valvata depressa* C. Pfeiffer, 1821	6
	Family Physidae	

8	*Physa fontinalis* (Linnaeus, 1758)	3
	Family Lymnaeidae	
9	*Lymnaea stagnalis* (Linnaeus, 1758)	29
10	*Galba truncatula* (O.F. Müller, 1774)	6
11	*Stagnicola saridalensis* Mozley, 1934	11
12	*Stagnicola palustris* (O.F. Müller, 1774)	6
13	*Stagnicola corvus* (Gmelin, 1791)	6
14	*Ampullaceana balthica* (Linnaeus, 1758)	3
15	*Ampullaceana ampla* (Hartmann, 1841)	23
16	*Radix auricularia* (Linnaeus, 1758)	34
	Family Planorbidae	
17	*Planorbarius corneus* (Linnaeus, 1758)	11
18	*Planorbis planorbis* (Linnaeus, 1758)	20
19	*Gyraulus albus* (O.F. Müller, 1774)	23
20	*Anisus vortex* (Linnaeus, 1758)	14
21	*Anisus leucostoma* (Millet, 1813)	3
22	*Bathyomphalus contortus* (Linnaeus, 1758)	3
	Family Unionidae	
	Unio sp. (juvenus)	3
23	*Anodonta complanata* Rossmässler, 1835 [= *Pseudanodonta complanata* (Rossmässler, 1835)]	3
24	*Anodonta piscinalis* Nilsson, 1823 [= *Colletopterum piscinale* (Nilsson, 1823)]	3
25	*Unio crassus* (Philipsson in Retzius, 1788) [=*Crassiana crassa* Philipsson in Retzius, 1788]	3
26	*Unio pictorum* (Linnaeus, 1758)	3
27	*Unio tumidus* (Philipsson in Retzius, 1788)	3
	Family Sphaeriidae	
28	*Sphaerium rivicola* (Lamarck, 1818)	9
29	*Sphaerium corneum* (Linnaeus, 1758)	23
30	*Sphaerium nucleus* (Studer, 1820) [= *draparnaldi* Clessin, 1873]	17
31	*Musculium lacustre* (O.F. Müller, 1774)	3
32	*Pisidium amnicum* (O.F. Müller, 1774)	26
33	*Euglesa ponderosa* (Stelfox, 1918)	14
34	*Euglesa* (*Henslowiana*) *ostroumovi* Pirogov & Starobogatov, 1974 [= *Euglesa henslowana* (Sheppard, 1825)]	11

Family Succiniidae

Oxyloma elegans (Risso, 1826)

Range type: Euro-Siberian

Ecology: This species inhabits silty substrates and thrives among riparian vegetation near water bodies. Although considered rare in most regions, known populations tend to exhibit high abundance (Shikov, 2023; Georgiev, 2006). *O. elegans* disperses during spring floods and summer overflows, colonizing new habitats in river valleys, streams, and lake shores. However, its presence is limited by frequent wave action caused by motorboat activity, which disturbs the shoreline environment. In our study, this species was recorded at sites 5b, 6a, 8, 10, 11, 13, 15, 17, 18, 19g, 21a, 21b, and 22.

Family Bithynidae
Bithynia tentaculata (Linnaeus, 1758)
Range type: Euro-Siberian
Ecology: Inhabits flowing and permanent standing waters, including coastal lagoons (Dussart, 1979). Prefers mixed substrates, primarily sand with varying levels of silt. Often found in syntopy with *Opistorchophorus troschelii*. Observed at sites 6a, 6b, 6c, 8, 10, 13, 17, 18, 19a, 19d, 20, 21a, 21b, and 22.

Opistorchophorus troschelii (Paasch, 1842)
Range type: Euro-West Siberian
Ecology: Occurs in heavily vegetated lakes, slow-flowing rivers, and temporary (often drying or freezing) water bodies (Kiyashko et al., 2016). Prefers sandy-silty bottoms. Frequently found in association with *B. tentaculata*. Recorded at sites 12, 13, and 22.

Family Viviparidae
Viviparus (Contectiana) contectus (Millet, 1813)
Range type: European
Ecology: Inhabits shallow, vegetated inlets with little to no current, as well as lakes. Typically found on the substrate and among dense aquatic vegetation (Kiyashko et al., 2016). Observed in Dolgoe Lake (site 13).

Viviparus viviparus (Linnaeus, 1758)
Range type: European
Ecology: This species inhabits rivers, lakes, and reservoirs, often forming dense populations (Kiyashko et al., 2016). It prefers sandy substrates with low silt content or gravelly bottoms mixed with clay and sand. Observed in the pond on the Vedzha River (site 17) and Ruzan Lake (site 22).

Valvata (Cincinna) piscinalis O.F. Müller, 1774
Range type: Euro-Siberian
Ecology: A widespread and morphologically variable freshwater snail of the Palearctic region. Found in rivers and lakes (Kiyashko et al., 2016). It inhabits both small standing water bodies and large rivers and reservoirs. Prefers sandy substrates with varying degrees of siltation. Often occurs alongside *Valvata antiqua*. Recorded at sites 6a, 6b, 6c, 10, 15, and 21b.

Valvata depressa C. Pfeiffer, 1821
Range type: Euro-Siberian
Ecology: Distributed throughout Europe and Western Siberia. Inhabits rivers, lakes, large ponds, and reservoirs. Found in Chermelei River (site 15) and an oxbow lake (site 18).

Family Physidae
Physa fontinalis (Linnaeus, 1758)
Range type: Euro-Siberian
Ecology: This species primarily inhabits small standing water bodies (Kiyashko et al., 2016). It is found in lakes among dense aquatic vegetation on soft substrates. Observed in Dolgoe Lake (site 13).

Family Lymnaeidae
Lymnaea stagnalis (Linnaeus, 1758)
Range type: Holarctic

Ecology: This species is most commonly found in stagnant or slow-flowing water bodies rich in aquatic vegetation, including both temporary and permanent habitats. It is rare in river floodplains and large deep lakes. Typically inhabits littoral zones among hydrophytes (Kiyashko et al., 2016). It may co-occur with *Anisus balthica*. Observed at sites 1, 2, 7, 12, 13, 17, 19a, 19b, 21a, and 22.

Galba truncatula (O.F. Müller, 1774)
Range type: Cosmopolitan
Ecology: Amphibious species inhabiting the littoral zones of lakes, splash zones in rivers, and various small temporary water bodies such as puddles, marshes, and water-filled hoof prints in wet meadows (Kiyashko et al., 2016; Dreyfuss et al., 2021). Recorded in the Insar River (site 10).

Stagnicola saridalensis (Mozley, 1934)
Range type: Central Palearctic
Ecology: This species occupies a broad range of habitats, most commonly found in temporary floodplain water bodies and both permanent and temporary off-floodplain lakes. It is comparatively rare in lotic habitats. In large lakes, rivers, and reservoirs, individuals are mostly found in silty shallow littoral zones. In bays of large mountain lakes, they inhabit submerged boulders (Vinarsky, 2013). Recorded at sites 6b, 11, 12, and 22.

Stagnicola palustris (O.F. Müller, 1774)
Range type: Euro-West Siberian
Ecology: Predominantly inhabits small temporary water bodies, often to some extent marshy (Kiyashko et al., 2016). Found in rivers in sections with slow current. Observed in Kuliklei Pond (site 1) and the lake near Sura River (site 2).

Stagnicola corvus (Gmelin in Linnaeus, 1791)
Range type: European
Ecology: Occurs in temporary standing waters and small rivers with slow current sections (Kiyashko et al., 2016). Found in the pond on the Vedzha River (site 17).
Taxonomic notes: Several Russian malacologists have recognized two additional species morphologically and ecologically close to *S. corvus*. However, European specialists treat these taxa as part of *S. corvus*.

Ampullaceana balthica (Linnaeus, 1758)
Range type: Trans-Palearctic
Ecology: Most commonly found in permanent, stagnant water bodies (Kiyashko et al., 2016). Prefers sandy substrates with varying degrees of siltation. This species can co-occur with *Lymnaea stagnalis*. Observed in the Insar River (site 19b).

Ampullaceana ampla (Hartmann, 1841)
Range type: Euro-Siberian
Ecology: Inhabits permanent water bodies with stagnant or slow-flowing water (Kiyashko et al., 2016). Recorded at sites 3, 5a, 5b, 10, 14, 15, and 21a.

Radix auricularia (Linnaeus, 1758)
Range type: Holarctic
Ecology: Found in lakes, ponds, oxbow lakes, and less frequently in streams and channels; typically on vegetation or near the bottom (Kiyashko et al., 2016). Recorded at sites 1, 8, 10, 17, 18, 19a, 19b, 19c, 21a, 21b, and 22.

Family Planorbidae

Planorbarius corneus (Linnaeus, 1758)
Range type: Euro-West Siberian
Ecology: Inhabits large stagnant and flowing water bodies on aquatic vegetation (Kiyashko et al., 2016). Found at sites 8, 12, 13, and 17.

Planorbis planorbis (Linnaeus, 1758)
Range type: Trans-Palearctic
Ecology: Mainly inhabits flowing, permanent and temporary water bodies (Kiyashko et al., 2016; Dussart, 1979). May co-occur with *Planorbis umbilicatus*. Recorded at sites 2, 10, 11, 12, 18, 21b, and 22.

Gyraulus albus (O.F. Müller, 1774)
Range type: Euro-Siberian
Ecology: Found in permanent water bodies (Kiyashko et al., 2016; Dussart, 1979). In the studied region, occurs in rivers, ponds, and lakes, primarily inhabiting sandy or gravelly-sandy substrates with varying degrees of siltation. Recorded at sites 1, 6b, 6c, 8, 10, 15, 18, and 22.

Anisus vortex (Linnaeus, 1758)
Range type: Euro-Siberian
Ecology: Inhabits permanent water bodies (lakes, rivers, and their oxbow lakes) as well as some temporary water bodies connected to permanent ones (small swamps or roadside ditches) (Kiyashko et al., 2016). In the studied region, the species occurs in lakes, oxbow lakes, and ponds among macrophyte stands. Recorded at sites 2, 13, 16a, 17, and 21b.

Anisus leucostoma (Millet, 1813)
Range type: Euro-Siberian
Ecology: Found in temporary water bodies (Kiyashko et al., 2016). Recorded in the Kuliklei Pond (1).

Bathyomphalus contortus (Linnaeus, 1758)
Range type: Euro-Siberian
Ecology: Inhabits permanent flowing and stagnant water bodies (Kiyashko et al., 2016; Bikashvili et al., 2021). Recorded in the lake near the Sura River (2).

Family Unionidae

Anodonta complanata Rossmässler, 1835 [= *Pseudanodonta complanata* (Rossmässler, 1835)]
Range type: European
Ecology: Widely distributed across Europe. In Russia, found in the basins of the Volga, Black Sea, Baltic Sea, and Northern Dvina. Inhabits river sections with pronounced currents and backwaters on sandy-silty or silty substrates; penetrates fresh and brackish waters of inland seas (Bogatov, Kiyashko, 2016). Recorded in the Insar River (19a).

Anodonta piscinalis Nilsson, 1823 [= *Colletopterum piscinale* (Nilsson, 1822)].
Range type: Euro-Siberian
Ecology: Occurs in rivers and associated water bodies on sandy-silty substrates. Serves as food for birds and mammals and is an intermediate host for trematodes (Maslennikov, 2015). Recorded in the Moksha River (23).

Unio crassus (Philipsson in Retzius, 1788) [= *Crassiana crassa* Philipsson in Retzius, 1788]
Range type: European

Ecology: Rare species. Found in rivers with sandy and sandy-silty substrates characterized by strong currents. Similar lifestyle to other family members. Development includes a larval stage. Larvae (glochidia) swim freely for up to 4 days, then develop on fish gills for 4–5 weeks. Reproduction starts at 3–4 years. Dioecious species, with known hermaphroditism. Average lifespan 10–15 years. Recorded in the Moksha River (23).

Unio pictorum (Linnaeus, 1758),
Range type: Europe (except north and northeast), Western Transcaucasia, and southeastern Siberia (Bogatov, Kiyashko, 2016)
Ecology: Found in rivers and lakes. Recorded in the Moksha River (23).

Unio tumidus (Philipsson in Retzius, 1788)
Range type: Distributed in Europe (except northern and northeastern parts) and southern Eastern Siberia (Bogatov, Kiyashko, 2016).
Ecology: Inhabits rivers and lakes. Recorded in the Moksha River (23).

Family Sphaeriidae
Sphaerium rivicola (Leach in Lamarck, 1818)
Range type: Euro-West Siberian
Ecology: Rheophilic species. Occurs in rivers and floodplain water bodies recently separated from the main river channel. Found on sandy and silty substrates at depths up to 2.5–3.0 m (Bogatov, Kiyashko, 2016). May co-occur with *Sphaerium solidum* and *Sphaerium corneum*. Recorded in the Insar River (19, 20a) and Alatyr River (21a).

Sphaerium corneum (Linnaeus, 1758)
Range type: Euro-Siberian
Ecology: Typical habitats are slow-flowing rivers, floodplain water bodies, and large lakes (Bogatov, Kiyashko, 2016). Found in small and large rivers with weak or strong currents, ponds, lakes, floodplain water bodies, and reservoirs. In the Kama River basin, prefers mixed substrates (sandy-pebbly, sandy-gravelly, pebbly-clayey, sandy-clayey, and soft sandy substrates with varying degrees of silt and plant detritus). May co-occur with *Sphaerium rivicola* and *Sphaerium scaldianum* (Ovchankova, 2021). Recorded at sites 5b, 6b, 6c, 10, 12, 17, 19a, 19b.

Sphaerium nucleus (Studer, 1820) [= *Amesoda drapagnaldii* Clessin, 1873]
Range type: Holarctic (Starobogatov, Kornyushin, 1986)
Ecology: Associated with marshy water bodies and slow-flowing river oxbow lakes (Bogatov, Kiyashko, 2016). Recorded at sites 6a, 6c, 13, 17, 19a, 21a.

Musculium lacustre (O.F. Müller, 1774)
Range type: Holarctic
Ecology: Inhabits a variety of water bodies, from small puddles and canals to large rivers and lakes (Bogatov, Kiyashko, 2016; Mouthon, 2004). In the studied region, associated with shallow floodplain zones and vegetated river sections. Typically found among macrophytes on silty sandy substrates. Recorded in the Zhukovsky Pond (8).

Pisidium amnicum (O.F. Müller, 1774) [= *Pisidium inflatum* (Megerle von Mühlfeld in Porro, 1838)].
Range type: Euro-Siberian
Ecology: Rheophilic. Mainly associated with rivers and floodplain water bodies near river channels. In lakes, found on sandy substrates of open areas, often in the surf zone (Bogatov, Kiyashko, 2016). In the Kama basin, inhabits mixed substrates: sandy-silty, sandy-gravelly

with varying degrees of silt and presence of plant detritus (Ovchankova, 2021). Recorded at sites 3, 4, 5b, 6a, 6b, 6c, 9, 16a, 16b.
Taxonomic notes: Russian zoologists continue to consider *Pisidium inflatum* a separate species (Andreeva et al., 2020).

Euglesa ponderosa (Stelfox, 1918)
Range type: Euro-Siberian
Ecology: Ecological density range as broad as its geographical distribution. Associated with small rivers and less frequently with streams (Bogatov, Kiyashko, 2016). Recorded at sites 4, 5a, 5b, 6b, 15.

Euglesa (*Henslowiana*) *ostroumovi* Pirogov & Starobogatov, 1974
Range type: Euro-Siberian
Ecology: Species of this section are limnophilic. Typical for floodplain water bodies of medium and large rivers; also found in small rivers and common in lakes (Kornyushin, 1996). Recorded at sites 4, 6b, 6c, 18.

Discussion
As noted above, 34 species were recorded within the territory of the Republic of Mordovia. When analyzing animal communities, alongside species richness, the frequency of occurrence index for individual species is considered, which characterizes the uniformity of their distribution within the biocenosis. Species with a frequency of occurrence ≥ 50% are classified as widely distributed (dominant) species (Shitikov et al., 2003). Species occurring in 25–50% of samples are considered accessory species (Stepanovsky, 2001). Species with an occurrence frequency not exceeding 10% are regarded as rare (Methodology…, 1975).
In the current collections, no constant species were detected. There are five accessory species: *B. tentaculata* (40%), *O. elegans* (37%), *R. auricularia* (34%), *L. stagnalis* (29%), and *P. amnicum* (26%). Three species have an occurrence frequency of 23%: *G. albus*, *Sphaerium corneum*, and *A. ampla*. Eleven species are rare, recorded only in a single sample: *A. leucostoma*, *B. contortus*, *V. (C.) contectus*, *P. fontinalis*, *A. balthica*, *M. lacustre*, *A. complanata*, *A. piscinalis*, *U. crassus*, *U. pictorum*, and *U. tumidus*.
The pond snail *Ampullaceana ampla* is relatively widely distributed across seven rivers, and a rare shell was found in the Alatyr River near Supodeevka village (Ardatov district) (Figure 3A). In all identification keys for pond snails used by us, snails with such shells were previously identified as *Lymnaea monnardi* (Hartmann, 1841). However, these mollusks are currently attributed to the species *A. ampla*.

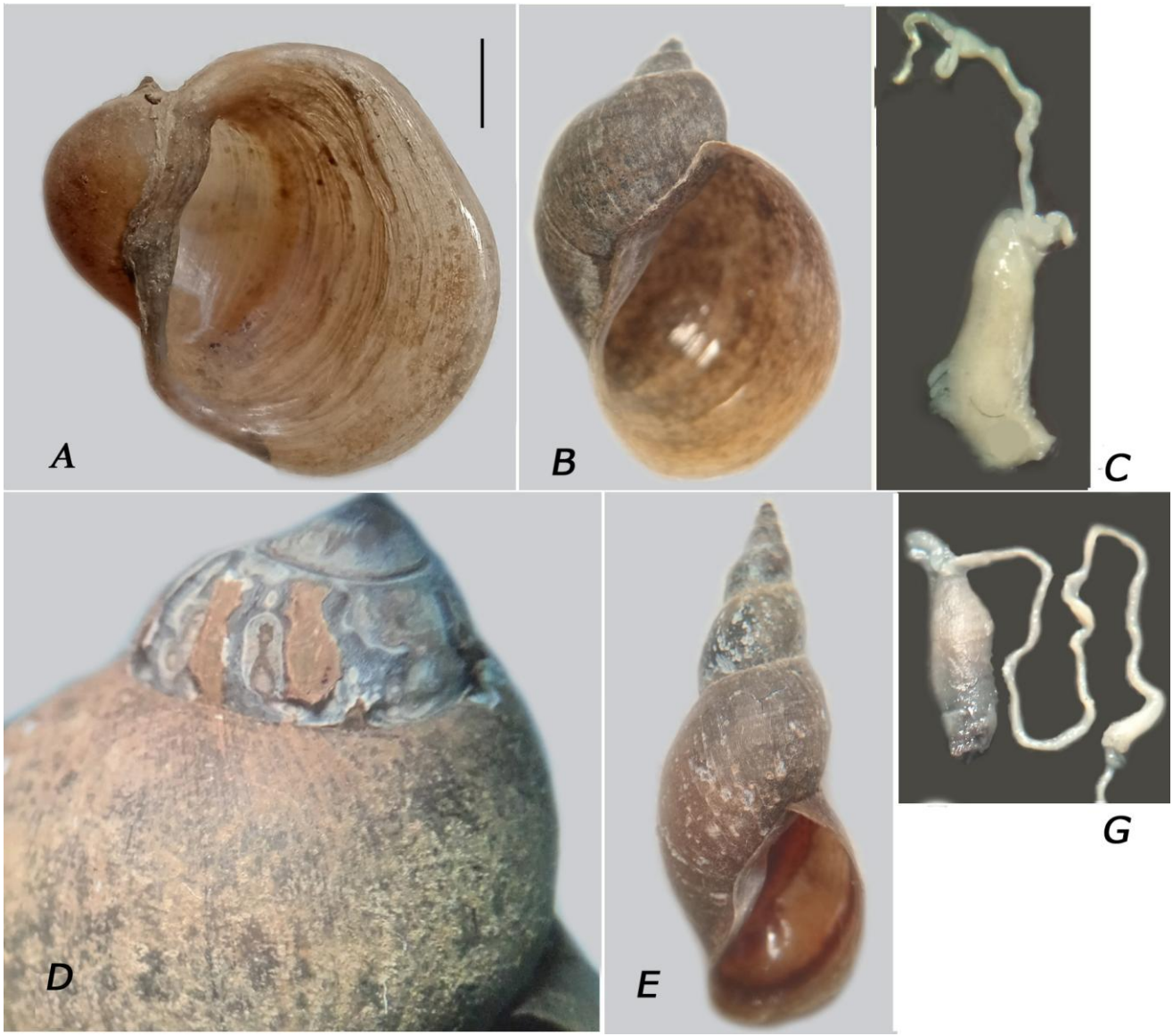

Figure 3. Different shells of the species *Ampullaceana ampla*: A – Alatyr River (Ardatov distr.), B – Tashaga River (Bolshie Berezniki distr.), C – copulatory organs; top of the shell *Viviparus* (*Contectiana*) *contectus*: D – Dolgoe Lake (Bolshie Berezniki distr.); *Stagnicola saridalensis*: E – shell and G – copulatory organs – Trostnoe Lake (Bolshie Berezniki distr.).

In the oxbow lakes Dolgoe Lake and Trostnoe Lake (Bolshie Berezniki district), snails *Viviparus (Contectiana) contectus* (Fig. 3D) and *Stagnicola saridalensis* (Figs. 3E, 3G) with heavily eroded shells were found. Similar shell degradation in *S. saridalensis* was observed in the oxbow lake Goreloe Lake (floodplain of the Staraya Sura River) in Penza City (Komarova et al., 2024). The authors suggest that the cause of such damage is related to changes in the ionic composition of the water. In soft waters, shells appear corroded. A decrease in calcium concentration below 4 mg/L leads to impaired calcium assimilation and shell mineralization (Kruglov, 2005).

Large bivalves found in samples from the interfluve area are represented by very young individuals of *Sphaerium* and *Unio* species. They were detected in the Insar River. *Anodonta*

complanata (Figs. 4A, 4B, 4C) was caught near Romodanovo settlement, while *Unio* sp. was found near Zykovo village (Fig. 4D).

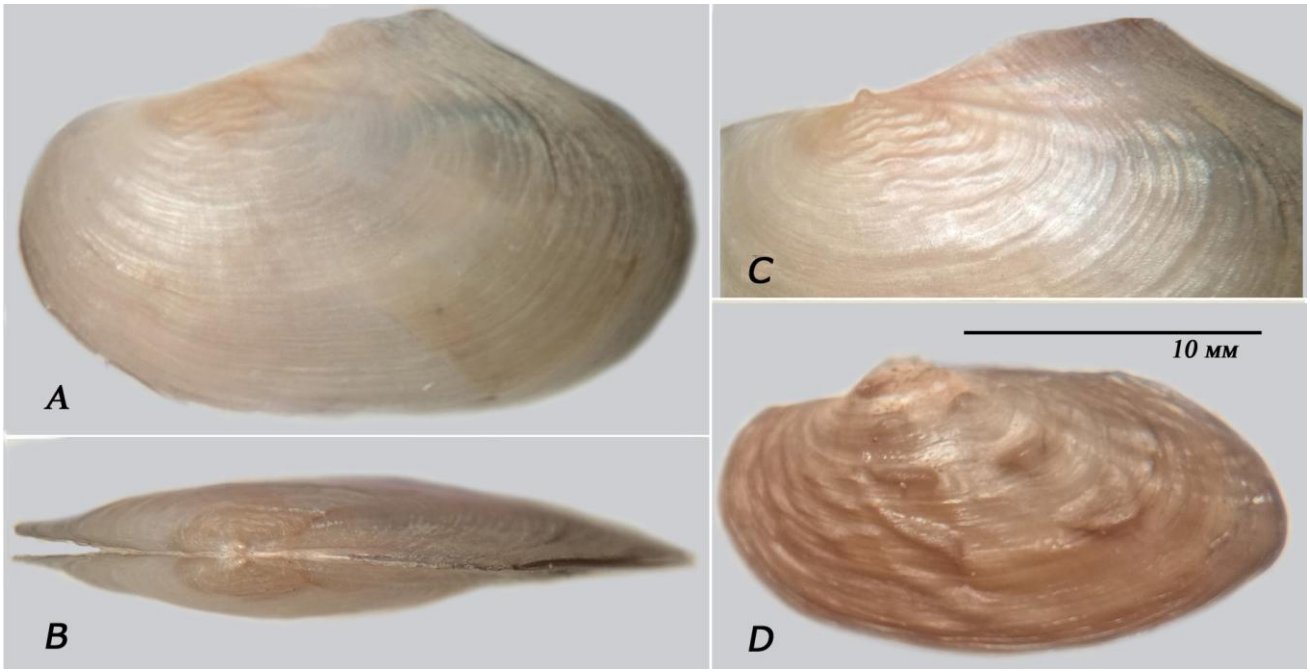

Figure 4. Young mollusk *Anodonta complanata* from the Insar River near of Romodanovo settl.: A – side view, B – top view, C – crown sculpture; young mollusk *Unio* sp.: D – side view.

Large bivalve mollusks were found in the Moksha River. One of the species, *Unio crassus*, is rare in the Republic of Mordovia (Fig. 5). In the section near Laushki village, Krasnoslobodsk district, the population density of *U. crassus* is high. Additionally, three other Unionidae species were recorded at this site: *Unio pictorum*, *Unio tumidus*, and *Colletopterum piscinale*. The abundance of *U. crassus* accounts for 50% of the total Unionidae population.

Figure 5. A shell of a thick pearl mussel, *Unio crassus* (Philipsson in Retzius, 1788) from the Moksha River near the village of Lauschi, Krasnoslobodsky District.

To assess the similarity of the malacofauna between the interfluve areas of the Sura and Insar rivers, as well as one section of the Moksha River, the Raup-Crick species similarity index was calculated (Figure 6). Three clusters were identified.

The first cluster includes the malacofauna of the studied section of the Moksha River. This community is characterized by large bivalve mollusks inhabiting rivers with a strong current.

The second cluster groups the malacofauna of the upper reaches of the Insar River (stations 3, 4, 5a, 5b, 6b, 6c) and tributaries of the Sura River — Bolshoi Piksaur River (9), Tashaga River (14), Chermelei River (15), and Lasha River (16a, 16b). At most of these stations, the bivalves *Pisidium amnicum* and the pond snail *Ampullaceana ampla* were recorded.

The third cluster combines mollusk communities from various types of aquatic habitats — rivers, lakes, and ponds — geographically located further north. This cluster includes eurybiotic species such as *Lymnaea stagnalis* and *Planorbis planorbis*. One subgroup within this cluster groups lake communities (stations 11, 12, 22), where *Stagnicola saridalensis* was found, and ponds (stations 1, 2, 7), two of which — Kaliklei Pond (1) and a pond on Yuva Brook (7) — contain the pond snail *Stagnicola palustris*.

Another subgroup unites communities of the Insar River (station 19) in its middle course and the Alatyr River (21a), as well as a pond on the Vezhda River (17) and the oxbow lake Dolgoe Lake (13). These sites showed higher species diversity compared to others and included *L. stagnalis*, *Bithynia tentaculata*, and *Sphaerium nucleus*.

The third subgroup within this cluster includes communities of the Insar River at stations 6a, 10, 19d, 20, as well as oxbow lakes in the Moksha River floodplain (18), the Alatyr River (21b), and Zhukovsky Pond (8). In all these water bodies, mollusks *Oxyloma elegans* and *B. tentaculata* were noted.

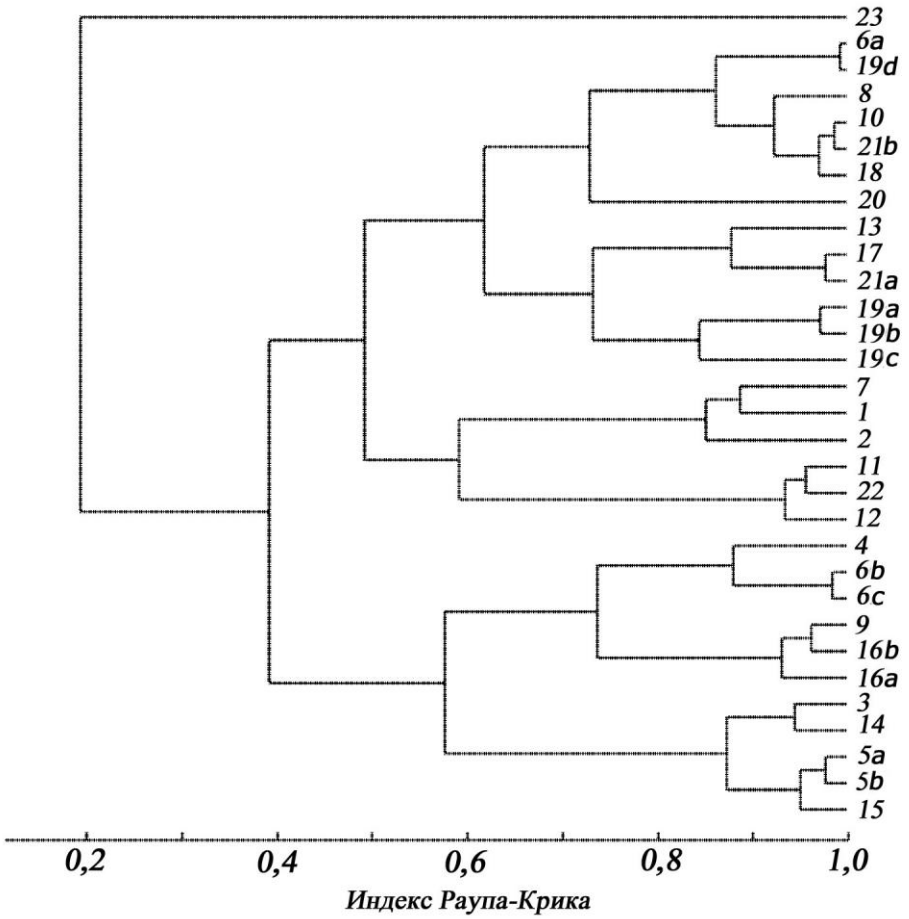

Figure 6. Raup-Crick similarity index of mollusk communities across different river basins in the Republic of Mordovia.

Conclusion

This study documented 34 mollusk species from 9 families across various watercourses and water bodies within the Republic of Mordovia. The amphibiont species *Oxyloma elegans* was frequently encountered in the Insar River, appearing in 50% of surveyed sites, as well as in the Chermelei and Alatyr Rivers, suggesting progressive riparian vegetation overgrowth along the banks. In the oxbow lakes, Dolgoe Lake and Trostnoe Lake (Bolshie Berezniki district), specimens exhibiting shell corrosion were observed, indicative of a distinctive ionic composition of the water that facilitates shell degradation. Additionally, a rare shell morphotype of the pond snail *Ampullaceana ampla* was detected in the Alatyr River, despite the species' broader distribution in other river sites. This finding warrants further investigation into the environmental parameters contributing to this phenotypic variation. Among the large bivalves recorded in the Moksha River, *Unio crassus*—a species listed in the Red Data Book of the Republic of Mordovia — was notably abundant. Application of the Raup-Crick similarity index revealed significant faunal affinities between mollusk communities inhabiting the upper reaches of the Insar River and the tributaries of the Sura River.

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