Variation of Thick Shelled River Mussel *Unio crassus* in Lithuania in Respect to Habitat Characteristics



Fig. 1. Typical *U. crassus* Philipsson, 1788 from Lithuanian rivers (example from Nemunėlis river).

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Monitoring of Unio crassus *Philipsson, 1788* ***in Lithuania***

In 2016 *U.crassus* was studied in 58 rivers (238 points) (Fig. 2):
1) monitoring have been started after detection of alive mussels;
2) not less than 3-5 sites per one river.

The total length of studied rivers was 3955.3 km, but appropriate for *U.crassus* was only 889.7 km (or 22.5% of the all studied rivers).

Average (of 22.5% of appropriate rivers) ≈ 8.7 ind./m^2

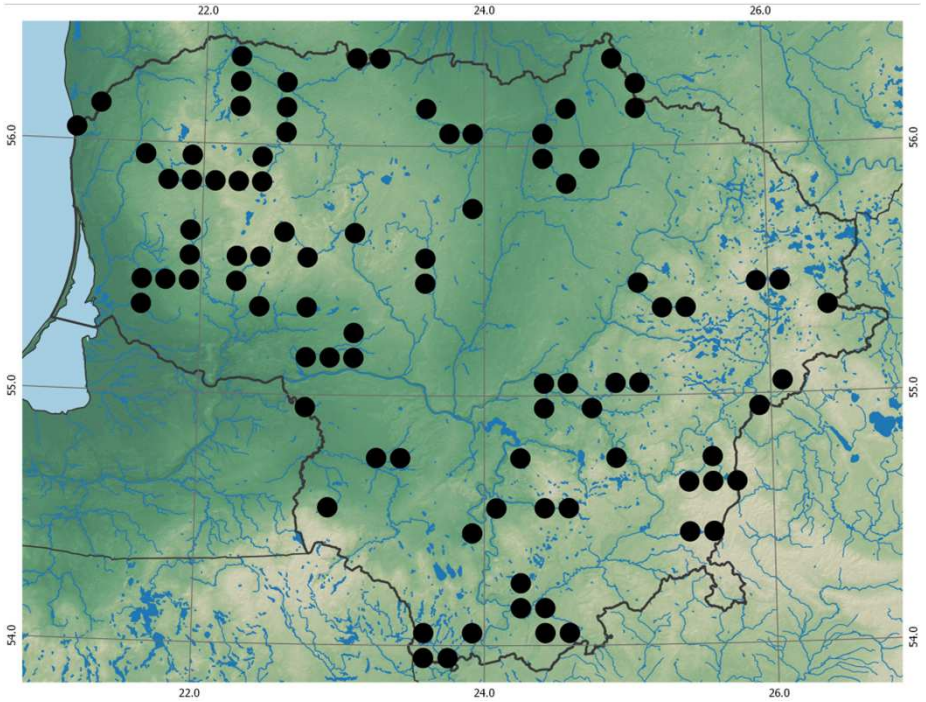


Fig. 2. Map of Lithuania with points of *U. crassus* detection in 2016.

- Study on UCRA was carried out according to the contract No. VPS-2016-105-EU between Lithuanian Fund for Nature and the Lithuanian Ministry of Environment.
- Study was financed by the European regional development Fund of the Republic of Lithuania and the State budget, by the European Union's program of investment funds 5 priority "Environment, sustainable use of natural resources and adaptation to climate change“ 05.5 .1-EPMA-V-018 instrument for biodiversity protection.

Table 1. ***Evaluation of abundance and habitat quality by the ask of the Lithuanian Ministry of Environment.***

Status	Favourable	Satisfactory	Bad
B1. River bed structure	Sand, gravel, without sludge	Sludge layer < 5 cm	Sludge layer > 5 cm
B2. Water quality	Colourless / pale yellow; odourless	Brown; the smell of sludge	Brown; a chemical smell by pollution
B3. Water and coastal lighting	70 %-90 %	40-70 %	< 40 % or > 90 %
B4. Riverbed overgrowth plants	Plants are absent	Overgrowth of aquatic plants < 10 %	Overgrowth of aquatic plants > 10 %
B5. Water flow regulation	Is absent	Variable natural affluent	Artificial, stable barriers, coasts, fortifications
B6. Recreation	Is absent	The river is used for tourism (several boats per day)	The river is used for active tourism, fishing; has equipped beaches
B7. Fish	Groups of fish	Some individual fish	You can't see any fish
Abundance			
P1. *U. crassus* ind./m^2	≥ 10	3-9	0–2

The results have revealed that these visual assessment criterias often do not allow to evaluate the real state of *U. crassus*.

Status of U. crassus according IUCN

IUCN: it was assessed as Endangered (EN A2ce) species based on losses across the range;

LT (Fig. 4): it was assessed as Endangered species (EN A2bc+4bc) based on:

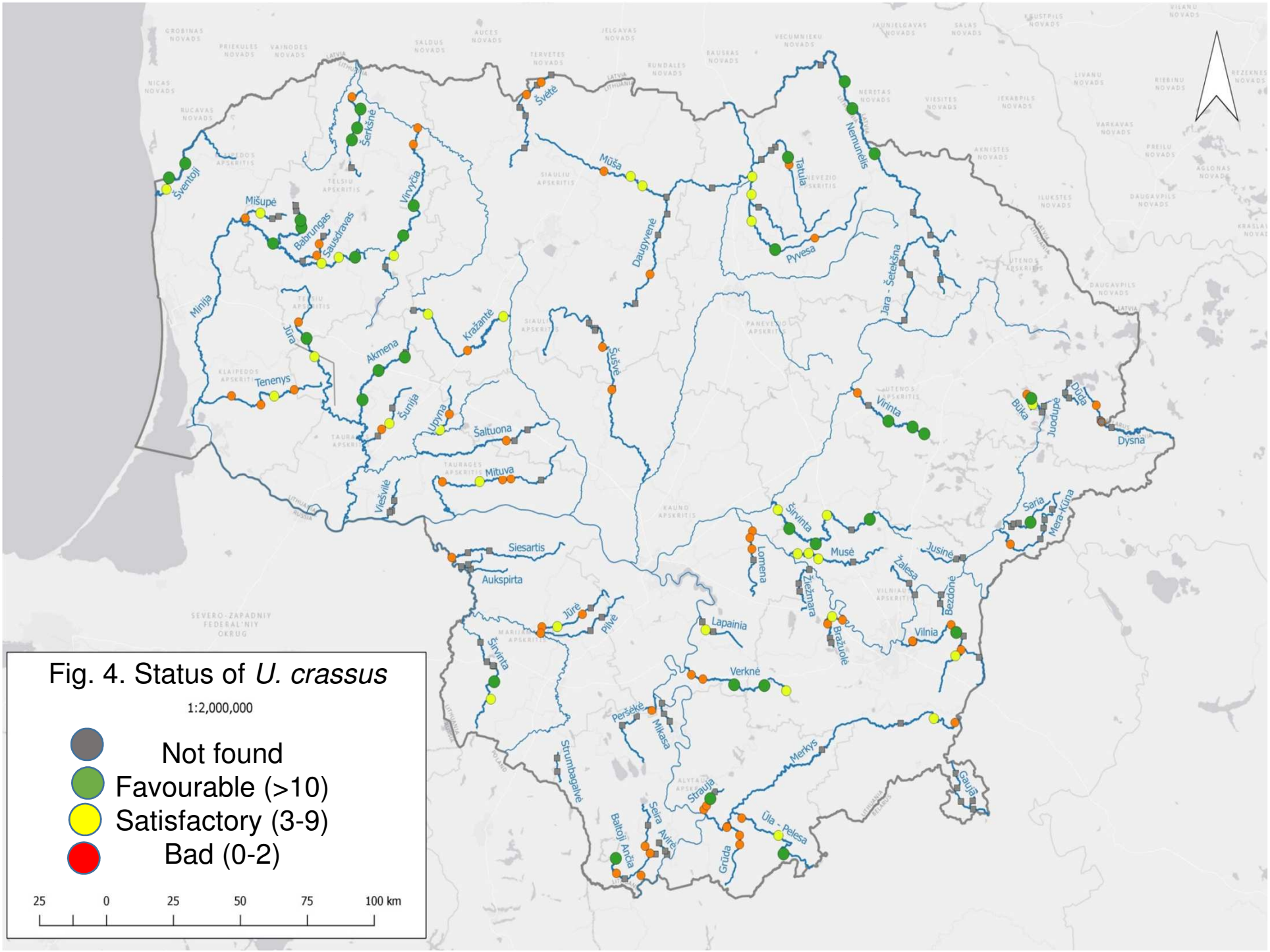
- an index of abundance appropriate to the taxon;
- decline in area of occupancy, extent of occurrence and quality of habitat.



Fig. 3. Sedimentary rocks on *U. crassus* from the river Pyvesa, Pasvalys‘ district

- 14 rivers (111 of the studied sites) were no longer suitable for of *U. crassus*;
- In 16 rivers (59 of the studied sites) the status of the bivalve population was assessed as bad (0-2 ind./m^2);
- In 13 rivers (32 of the studied sites) – satisfactory (3-9 ind./m^2);
- In 15 rivers (34 of the studied sites) – good (>10 ind./m^2).

*Indicative note: abundance can reach up to 423 ind./m^2 (data from Strauja river).


Fig. 4. Status of *U. crassus*
1:2,000,000
Not found
Favourable (>10)
Satisfactory (3-9)
Bad (0-2)
25 0 25 50 75 100 km
Šventoji
Mišupė
Babrungas
Šausdravas
Šerkšnė
Virvyčia
Minija
Jūra
Akmena
Tenenys
Šyša
Šventė
Mūša
Kražantė
Šušvė
Šunija
Upyna
Šaltuona
Mituva
Viešvilė
Daugyvenė
Nemunėlis
Tatula
Pyvesa
Jara - Šetekšna
Virinta
Būka
Juodupė
Dūkšta
Dysna
Širvinta
Musė
Lomena
Žiežmara
Žalesa
Jusinė
Bezdonė
Saria
Mera-Kūna
Siesartis
Aukspirta
Jūrė
Pilvė
Širvinta
Lapainia
Verknė
Bražuolė
Vilnia
Peršėkė
Mikasa
Strumbagalvė
Merkys
Straujа
Seira
Avirė
Baltoji Ančia
Grūda
Ūla - Pelesa
Gauja

Does the length of the river affect abundance?

- Strauja – only 14.3 km long, but UCRA – 72 ind./m^2 (min-max: 23-423 ind.m^2);
- The biggest abundance have been found in rivers of 51-75 km long:
- Baltoji Ančia (82.2 ind./m^2), Virinta (37.6 ind./m^2), Šerkšnė (26.05 ind./m^2), Babrungas (21.8 ind./m^2), Šventoji (near Baltic Sea) (18.4 ind./m^2), Šventoji (18.6 ind./m^2), Akmena (16.6 ind./m^2);
- Less or the same abundance have been detected in longer (95-191 km) rivers: Virvytė (18.85 ind./m^2), Pyvesa (16.4 ind./m^2), Nemunėlis (16.1 ind./m^2).





Fig. 5. Moment of monitoring and *U. crassus* in Virvytė. Photo by Remigijus Karpuška.

For this presentation:

There were selected:

- 15 studied rivers where *U.crassus* was detected and
- 10 rivers where *U.crassus* was absent.

Selection was based on the available data of the hydrochemical data of different years from the Environmental Monitoring of The Environmental Protection Agency of Lithuania (http://vanduo.gamta.lt/cms/index?rubricId=82db6301-04a9-4403-bf63-9ae6e53e8b0d).

The data of chemical monitoring in 2016 presented in Fig. 6.

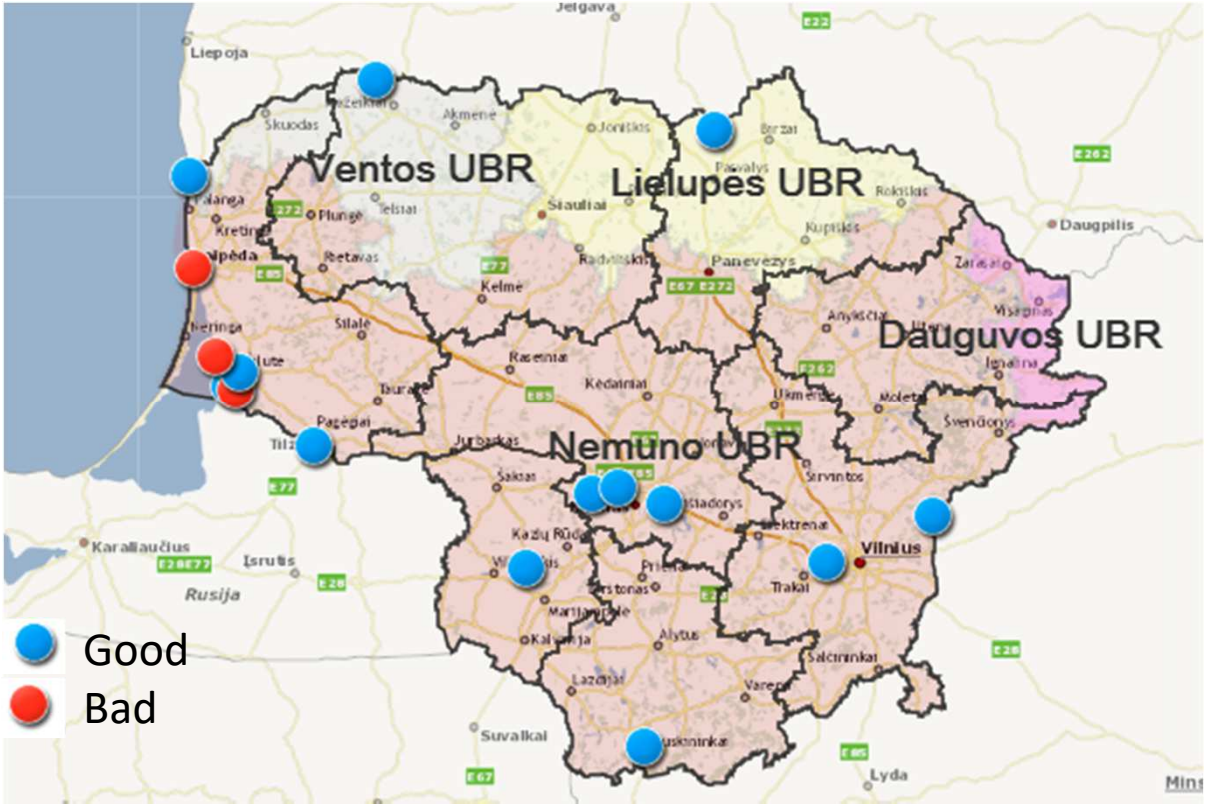


Fig. 6. Map of Lithuania with 15 points of evaluation of chemical state of rivers in 2016.

http://www.arcgis.com/apps/SimpleViewer/index.html?appid=ec43cec2369b4ed593d7ca4e4bd13238

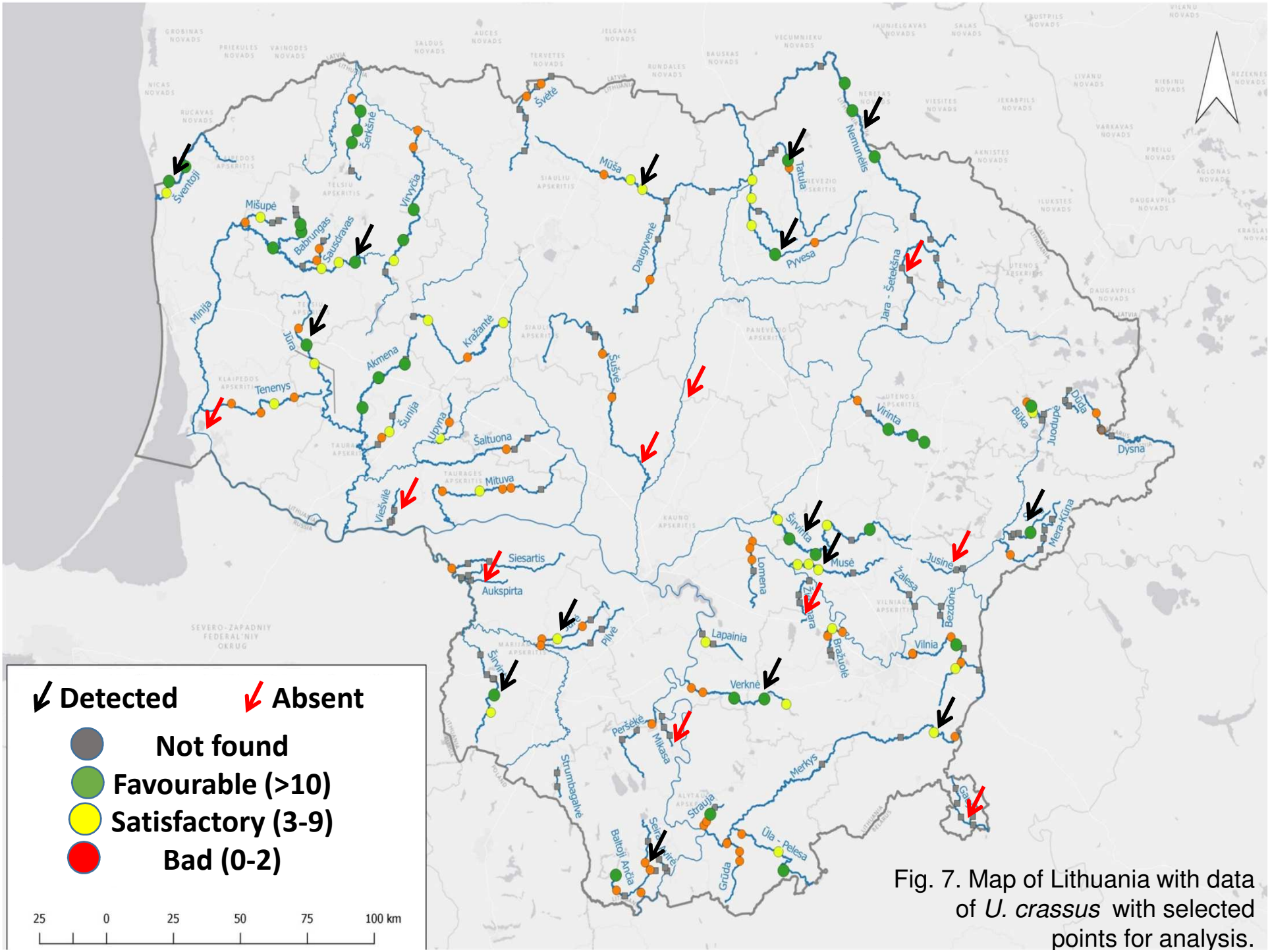


Fig. 7. Map of Lithuania with data of *U. crassus* with selected points for analysis.

Table 2. ***Summarized hydrochemical data of selected rivers***

	U. crassus was detected ↙			*U. crassus was absent* ↙		
Parameters	Median	Min	Max	Median	Min	Max
Speed, m/s	0.36	0.08	5.43	0.33	0.05	0,84
Flow, m^3/s	4.82	0.02	64.81	3.05	0.01	58,05
Acidity - pH	7.9	7.2	8.5	8.03	7.3	8.6
Suspended material, mg/l	5.6	0	**26.7**	6.05	0	**56**
O_2, mg/l	9.4	5.2	12.1	9.1	4.3	12.9
O_2, %	82	52	140	82	39	135
BOD7, mgO_2/l	2.4	1.1	**6.3**	2.9	0.9	**11**
COD, Cr mgO_2/l	28	17.25	**52**	30.63	14.25	**72**
NH_4-N, mg/l N	0.06	0	**3.04**	0.09	0.00	**11.93**
PO_4-P, mg/l P	0.04	0.01	**0.55**	0.04	0.00	**1.84**
Detergents, mg/l	0.04	0.01	0.11	0.06	0.02	0.12

BOD7 - Biological Oxygen Demand, 7 days; **COD -** the **chemical oxygen demand** - an indicative measure of the amount of oxygen that can be consumed by reactions in a measured solution, using potassium dichromate (Cr).

Age of U. crassus in analysed rivers

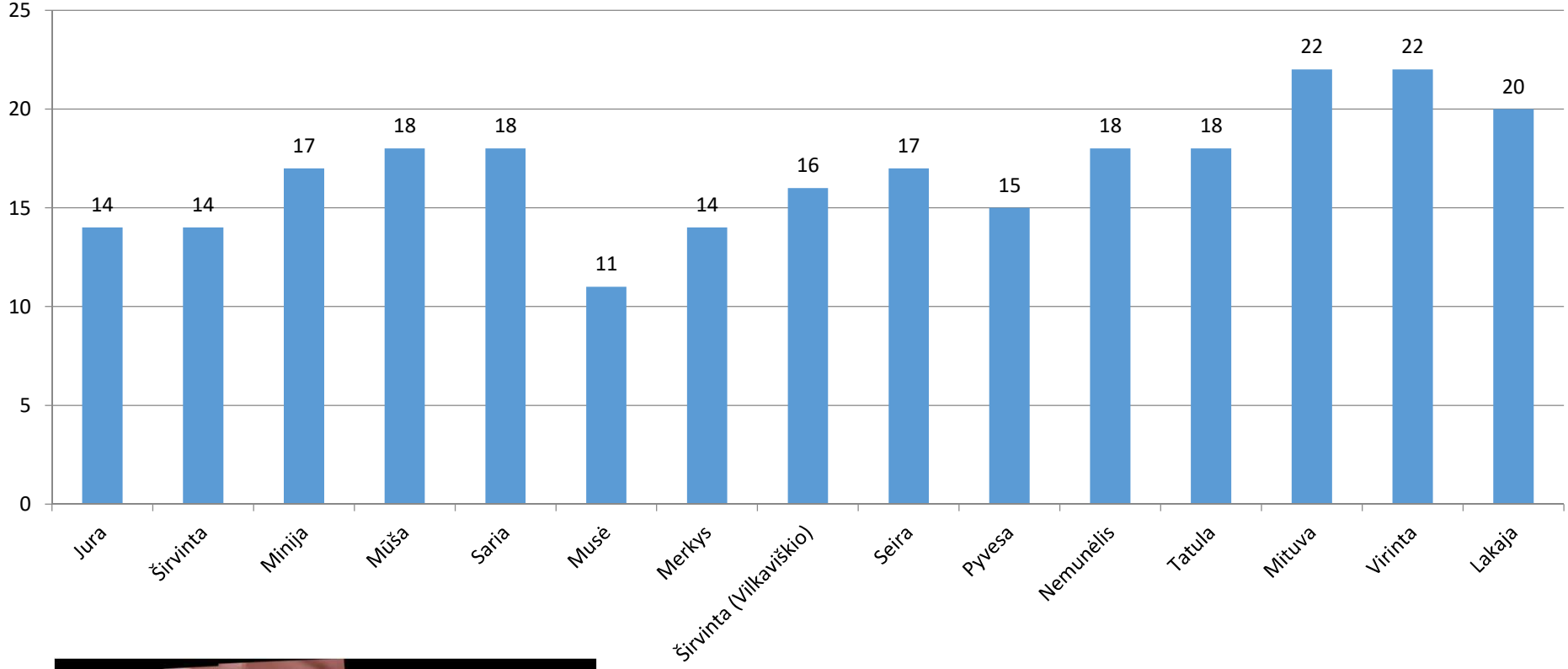




Fig. 8-9. The age of the biggest/ oldest individuals of *U. crassus in analysed rivers* and cross-section of shell for age determination.

Age determination:

- counting the annual shell growth increments by eye.

- shell was cross-sectioned (from the umbo to the ventral margin of the dextral valve of each specimen).

Does the variation of shell coloration depend on the hydrochemical parameters of river?

It was observed that majority of dark shells after gently cleaning of the surface by warm water and sponge, presented lighter colors than it seemed at first.

The dark color was caused by deposit of sediment on the shell surface.



Fig. 10. Color of shells after cleaning in Minija (on the left) and Seira (on the right) rivers.

Does the shell coloration variate in the same river?

It was observed that ussually the shell coloration of younger individuals is lighter, but this is not absolute fact (fig. 11)

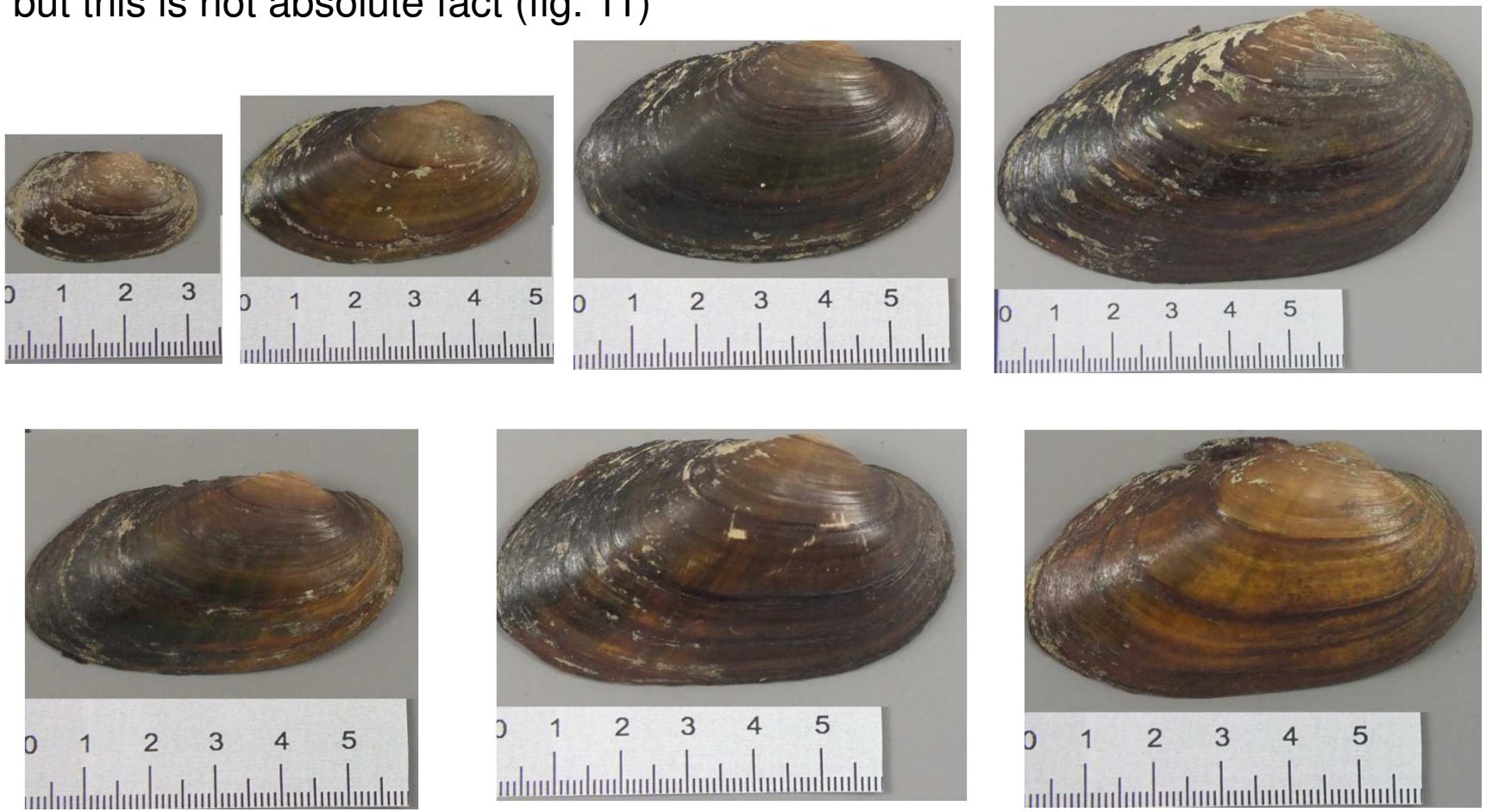


Fig. 11. Color of shells of *U. crassus* in Mūša river.

Variation of shell coloration and form in different rivers

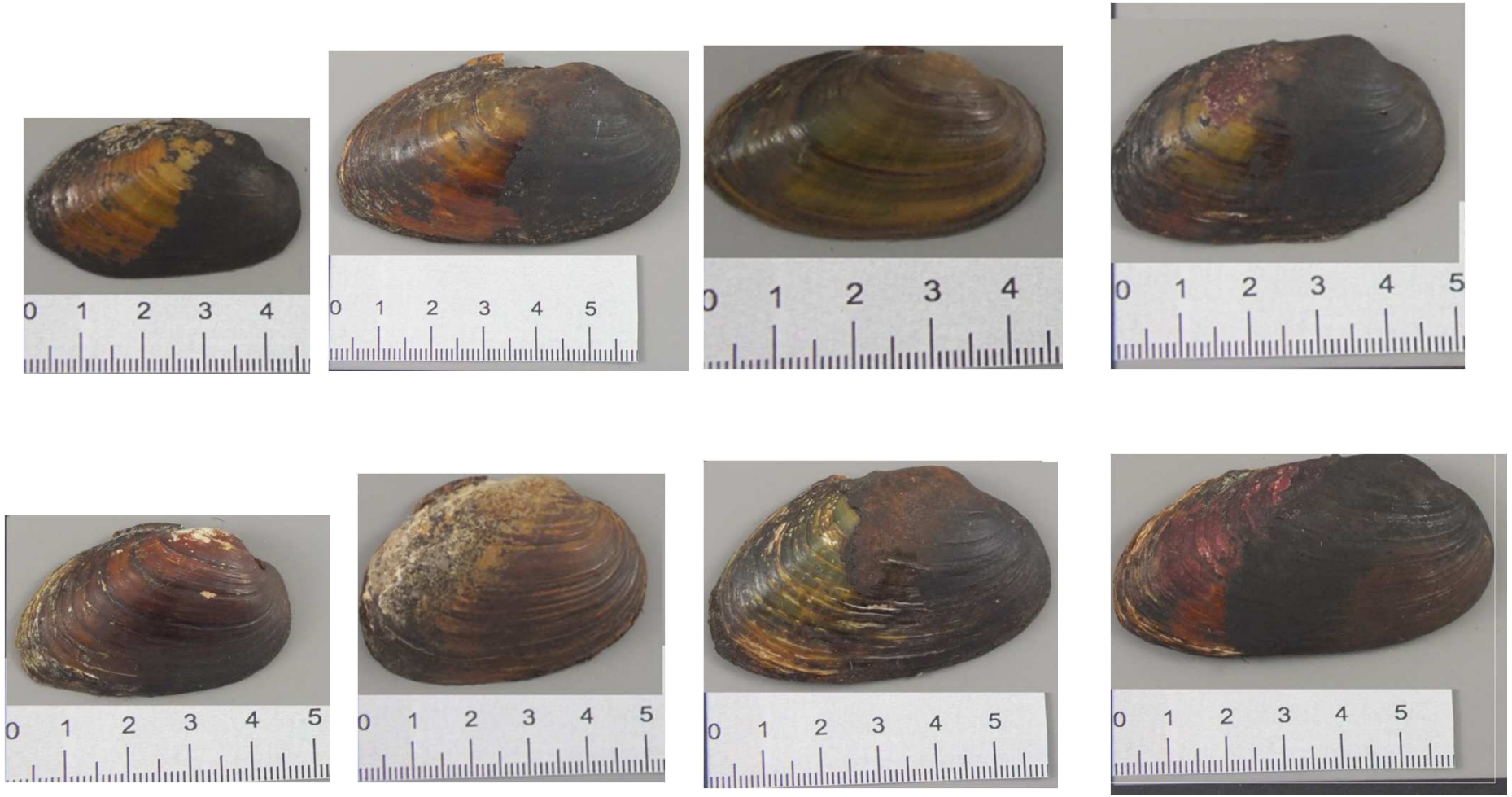


Fig. 12. Color of shells from different rivers: Above from the left: Pyvesa (1-2), Mituva, Merkys.
Below from the left: Lakaja, Širvinta (Vilkav), Seira, Merkys.

Some remarks for conclusions

- The best ecological status of rivers was established in the areas of eastern and south-eastern and western Lithuania as the least affected by human activity in Minija, Jūra, Saria, Širvinta (Šventoji), Merkys rivers.
- Most of the water quality problems in surface of the water bodies were found in intensive agricultural areas of the north, central and south-western Lithuania in Širvinta (Vilkaviškis), Mūša, Pyvesa, Tatula rivers.
- The maximal abundance of molluscs in studied rivers ranged from 16 to 105 ind./m^2, but *U. crassus*' populations were fragmented.
- The biggest nitrogen concentrations were found in Mūša (NH_4 till 3.043 mg/l N, NO_3 till 0.157 mg/l N, NO_2 till 5.821 mg/l N) where the biggest shells (83 x 33 x 44 mm) of *U. crassus* were measured.



Fig. 13. View of the some studied rivers in Lithuania.

Some remarks for conclusions

- Rivers with *U. crassus* differed from those without *U.crassus* in higher water level, natural stream, permeable dams or no dams, lower chemical pollution parameters.
- Any *U.crassus was* over 22 years of age.
- Majority of references stated that *U. crassus* shells are very dark, almost black; that the majority of the youngest shells are the brighter and the oldest ones are the darkest. Our results showed that dark color usually depend on sediment amount on the shells.



Fig. 14. View of the some studied rivers in Lithuania.

We would like to express our thanks to our collegues, co-working on the resaerch during monitoring of U. crassus:

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