Together with Limnological Institute
Siberian Branch of the Russian Academy of Sciences

Monitoring of Lake Baikal pollution by toxic elements using endemic sponges.

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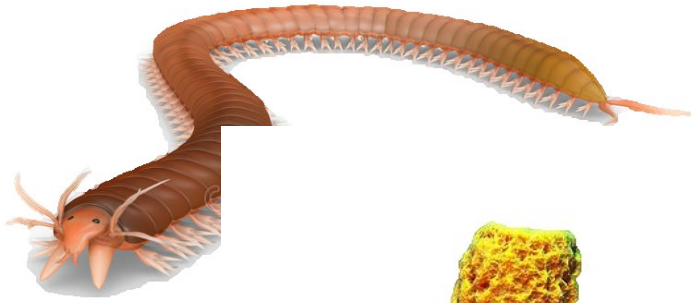
ISINN, 2024

Aquatic invertebrates as biomonitors of pollution by inorganic contaminants in aquatic ecosystems



Pictures from:
Paiva, Filipa. (2014). "Ship transport of marine invasive species and its stress re[illegible] .
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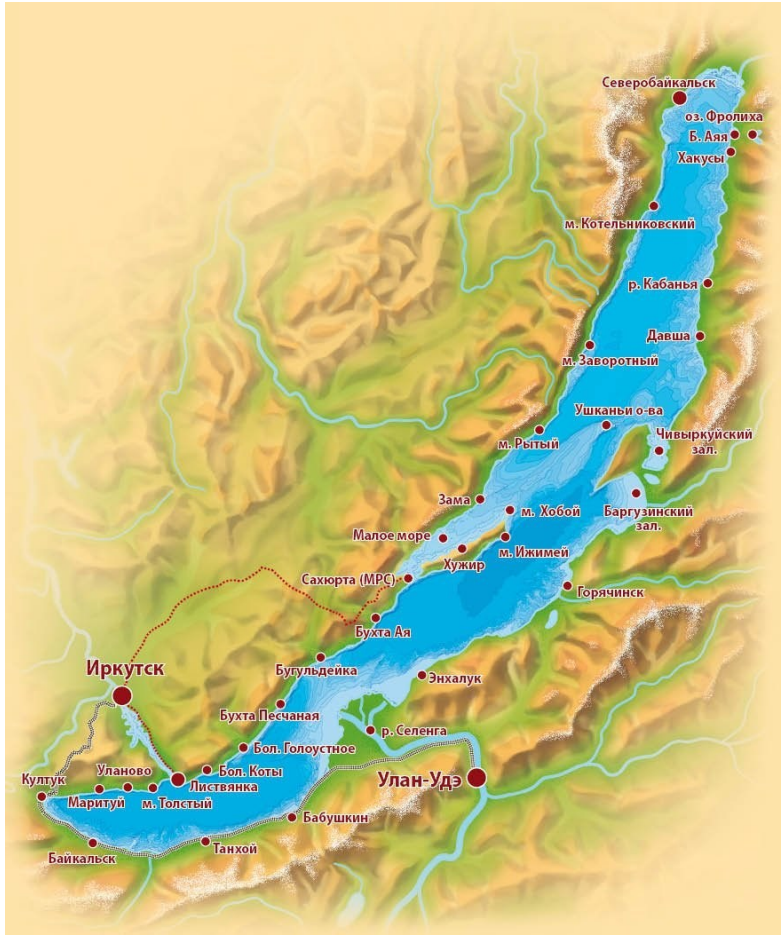
Sponges

- The earliest sponge fossils are 680 Ma old.
- Filter feeders, so they play an important role in aquatic ecosystems.
- Bioindicators of the state of aquatic ecosystems, since pollutants accumulate in their bodies.
- Events of mass diseases and mortality of sponges in different aquatic ecosystems were noted.

Fossil sponge

Lake Baikal

- Ancient lake (was formed 25-30 Ma ago)
- The maximum depth is 1642m.
- Contains 20% of the world's fresh water reservoirs
- UNESCO World Heritage Site.



Endemic sponges from lake Baikal

Lubomirskia baikalensis

Picture: Evgeniy Safonov

Disease and mortality of sponges

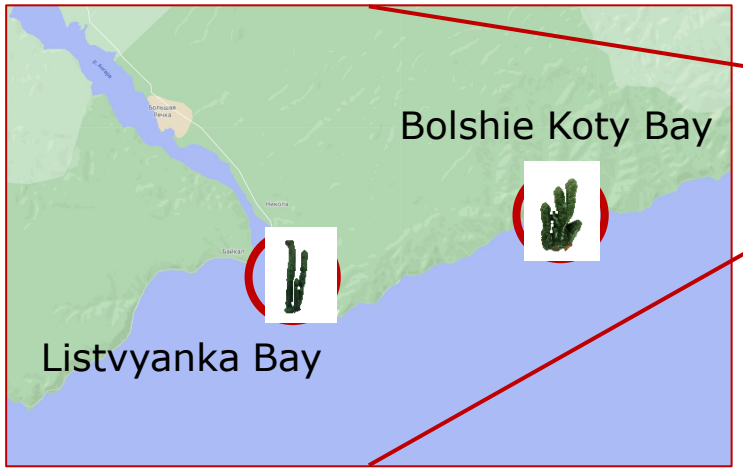
In the last decade, events of mass diseases and mortality of sponges have been observed on Lake Baikal, which indicates negative changes in the ecosystem of the lake.

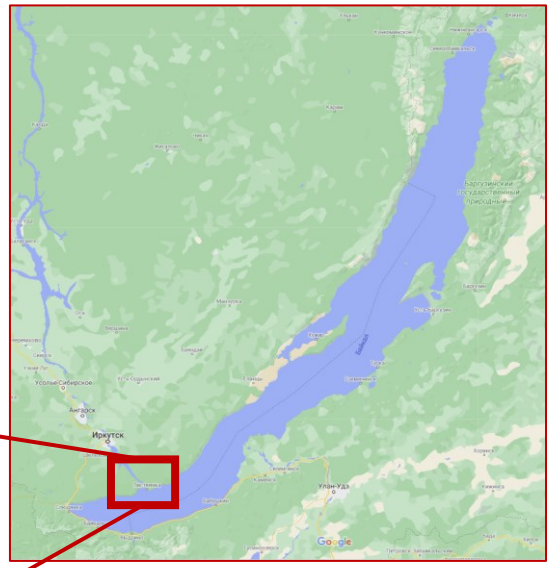
Research goal

- **Assessement of the the prospects of using Baikal endemic sponges as bioindicators of lake pollution by toxic elements.**
- Research tasks:
  - to determine the elemental content of rock substrates, sponges and water collected in two bays of Lake Baikal with different levels of anthropogenic loading;
  - to assess the level of substrate pollution using several ecological indices;
  - to calculate the bioaccumulation factor, to evaluate the distribution of elements along the length of the sponges in order to choose the most appropriate sampling area;
  - to identify trace elements and determine their concentrations in the sponges.

Sampling

Samples of endemic Baikal sponges of the species *Lubomirskia baikalensis* were collected at two points (*n*=20) - with high (Listvyanka village) and low (B. Koty village) anthropogenic load.





Pictures from:
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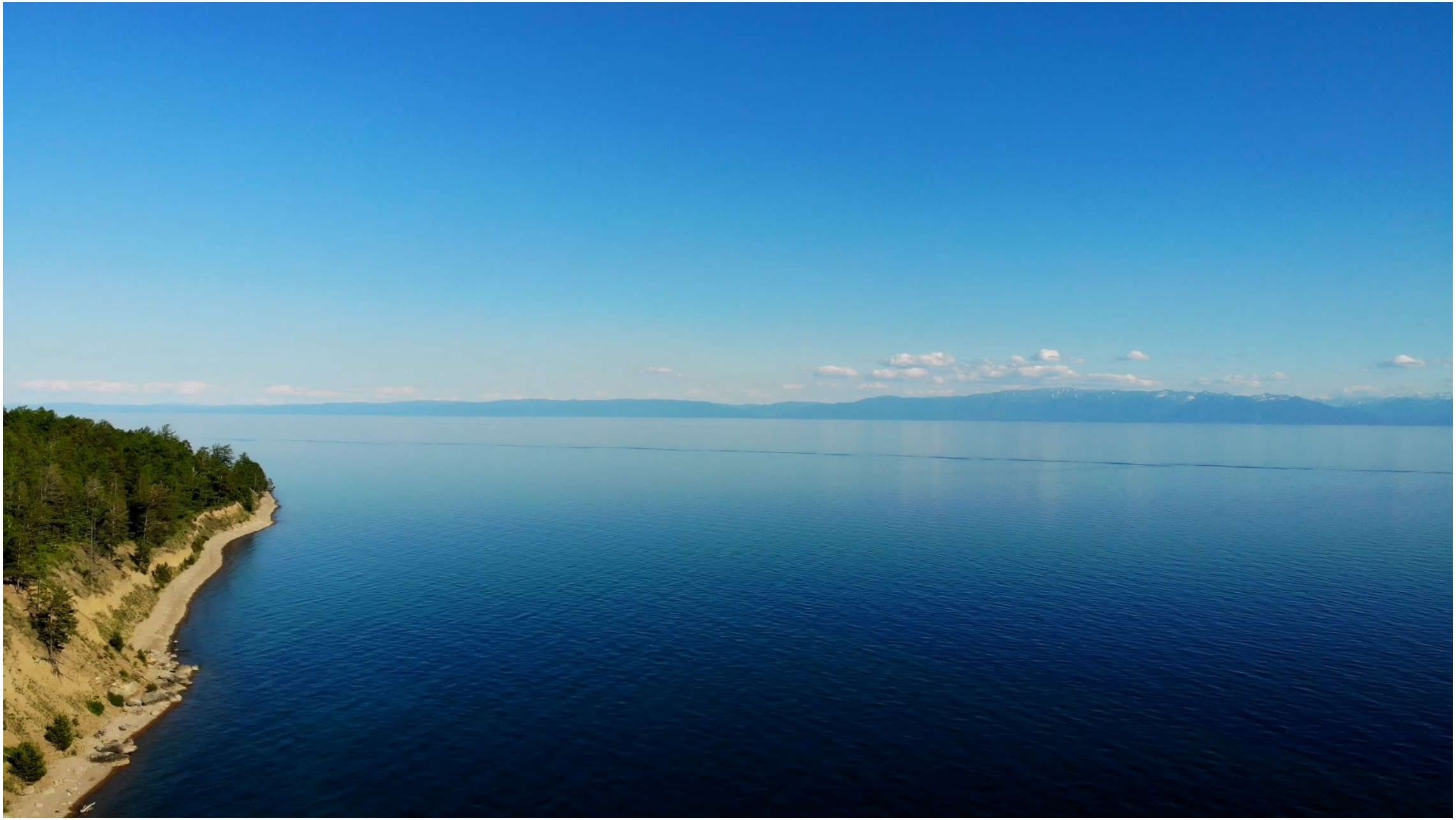


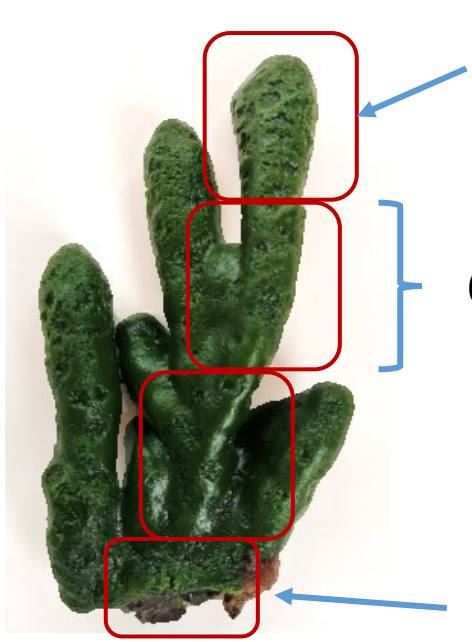
Methods

The elemental composition of the samples and their substrates was determined at the Sector of Neutron Activation Analysis and Applied Research, LNF, JINR.

After collection, the samples were:

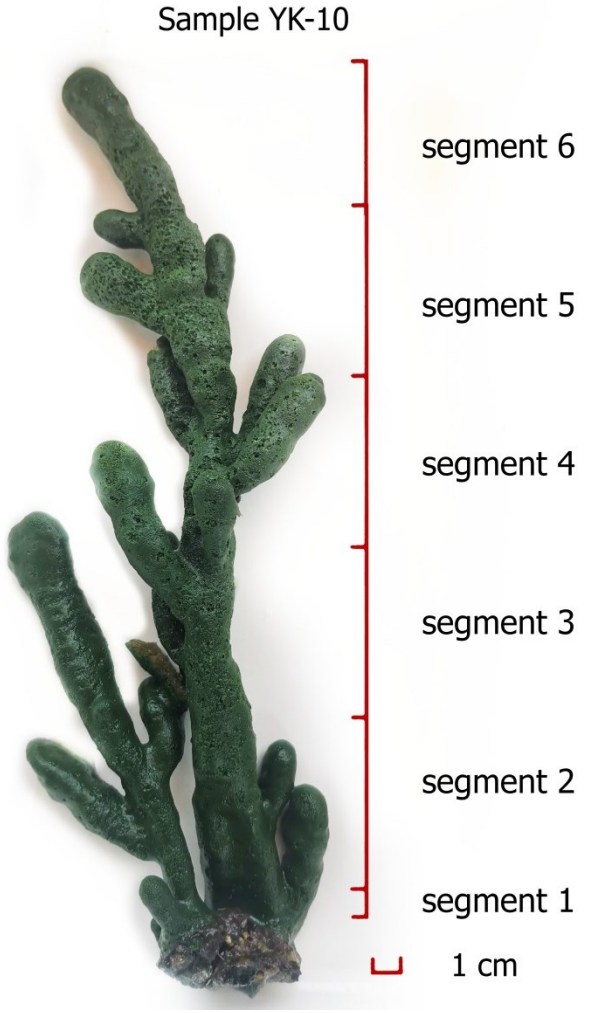
- Dried to constant mass
- Separated from the rock substrates
- Divided into equal parts of 6 cm each
- Milled to dust

A fragment length of 6 centimeters corresponds to 6 years, since the growth rate of sponges of this species is about 1 cm per year the substrate and each section of the sponge sample were analyzed separately using neutron activation analysis and ICP-AES.



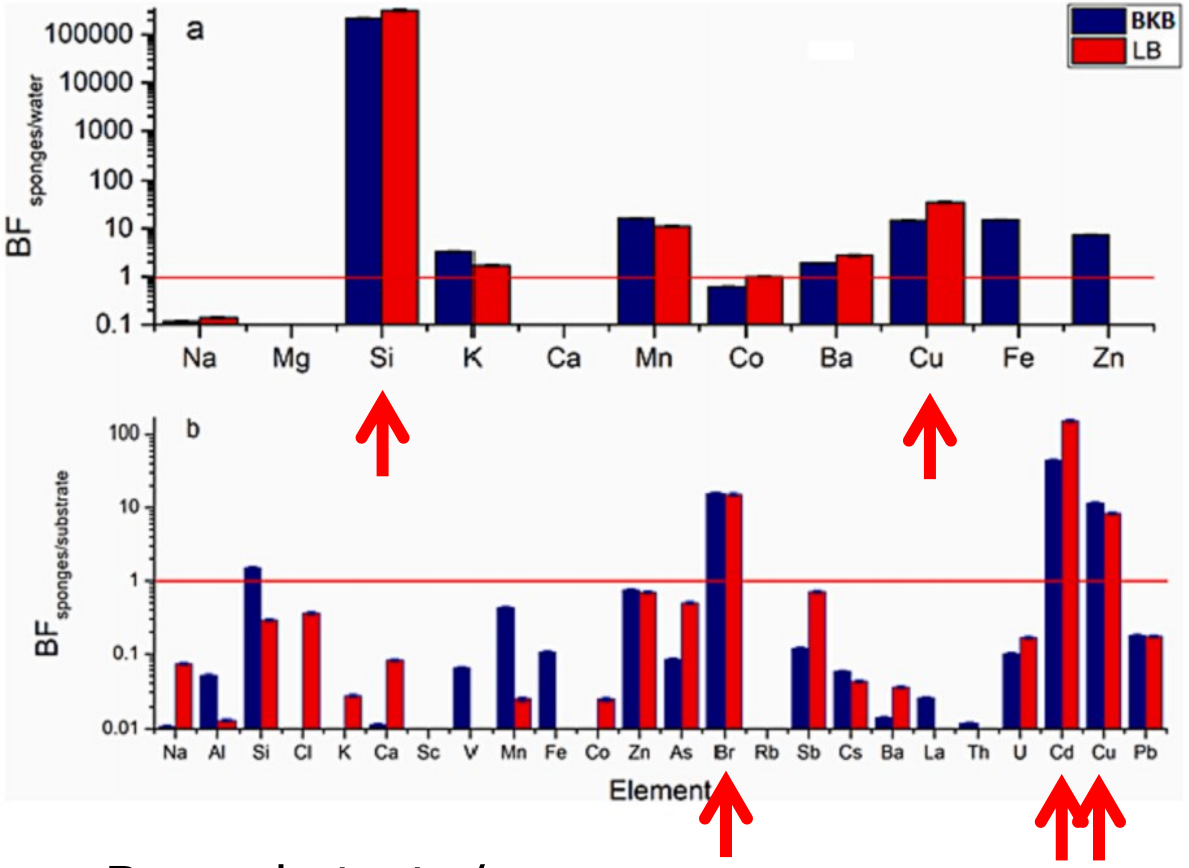
Methods

- The difference in heavy metal concentrations in sponges collected from different geographical locations was determined;
- The accumulation of heavy metals in different parts of the sponge body was evaluated
- The contribution of the substrate to the elemental composition of the sponge was estimated



Results. Bioaccumulation factor values

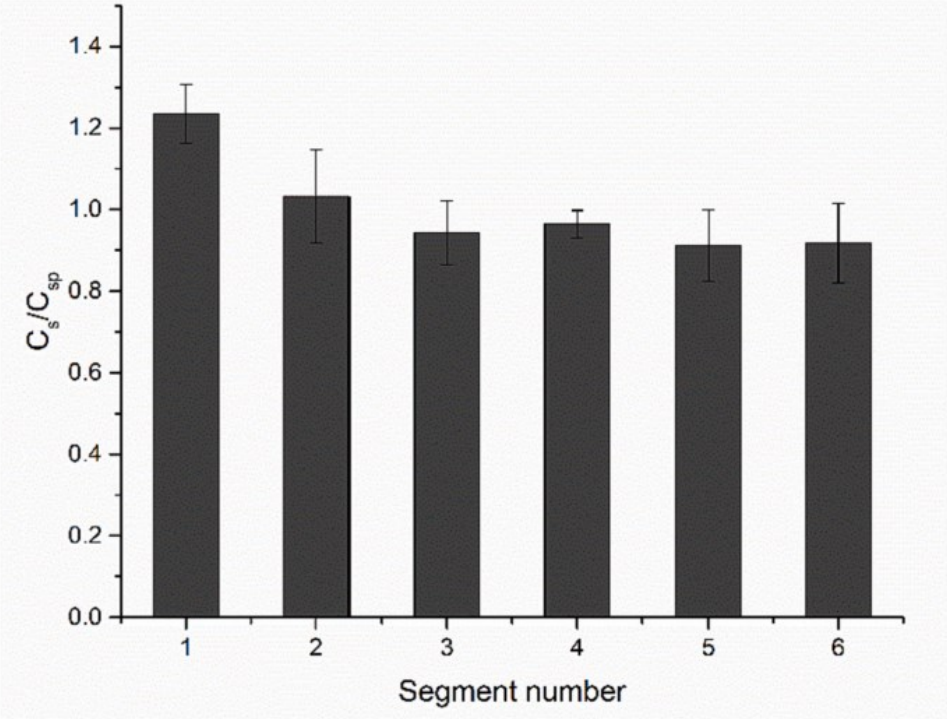
- The main constituent of sponges, Si, is accumulated from water.
- Sponges are capable of accumulating high levels of Br, Cu, Cd

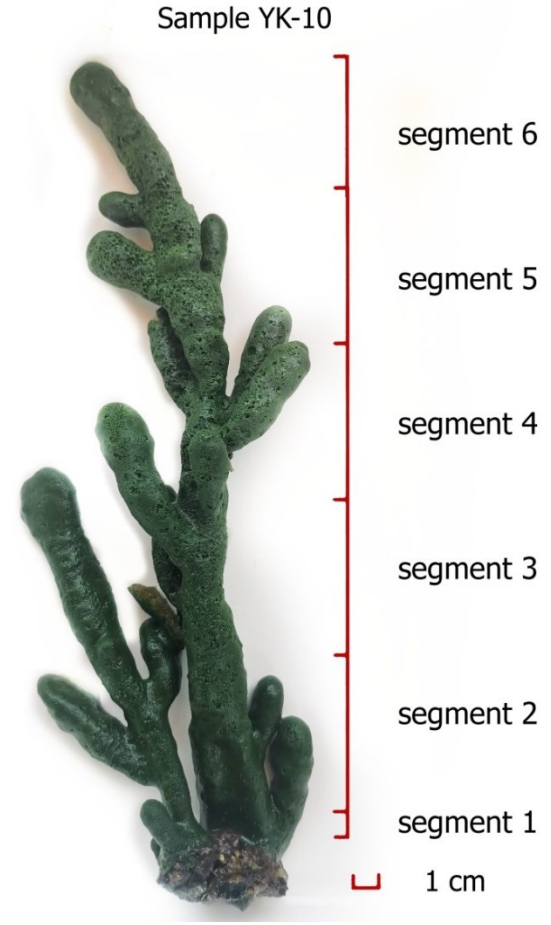


- A – water/sponges B – substrate/sponges

Results. Distribution of Si in different sponge body segments

- The lower part of the sponge body is more robust and contains a stronger skeleton, which accounts for the higher silica (Si) content of the lower segment

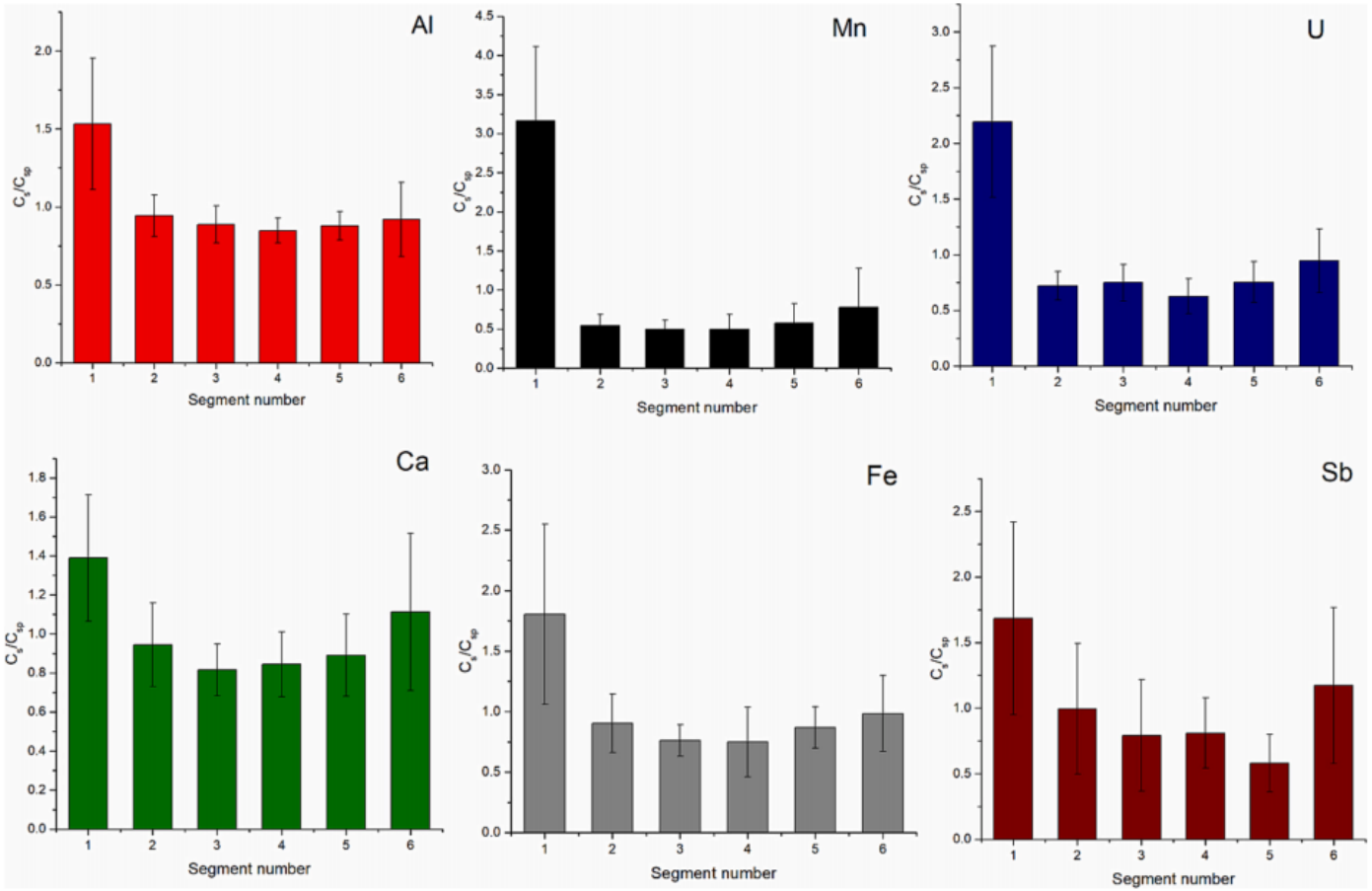




Results. Distribution of Al, Mn, U, Ca, Fe and Sb in sponge segments

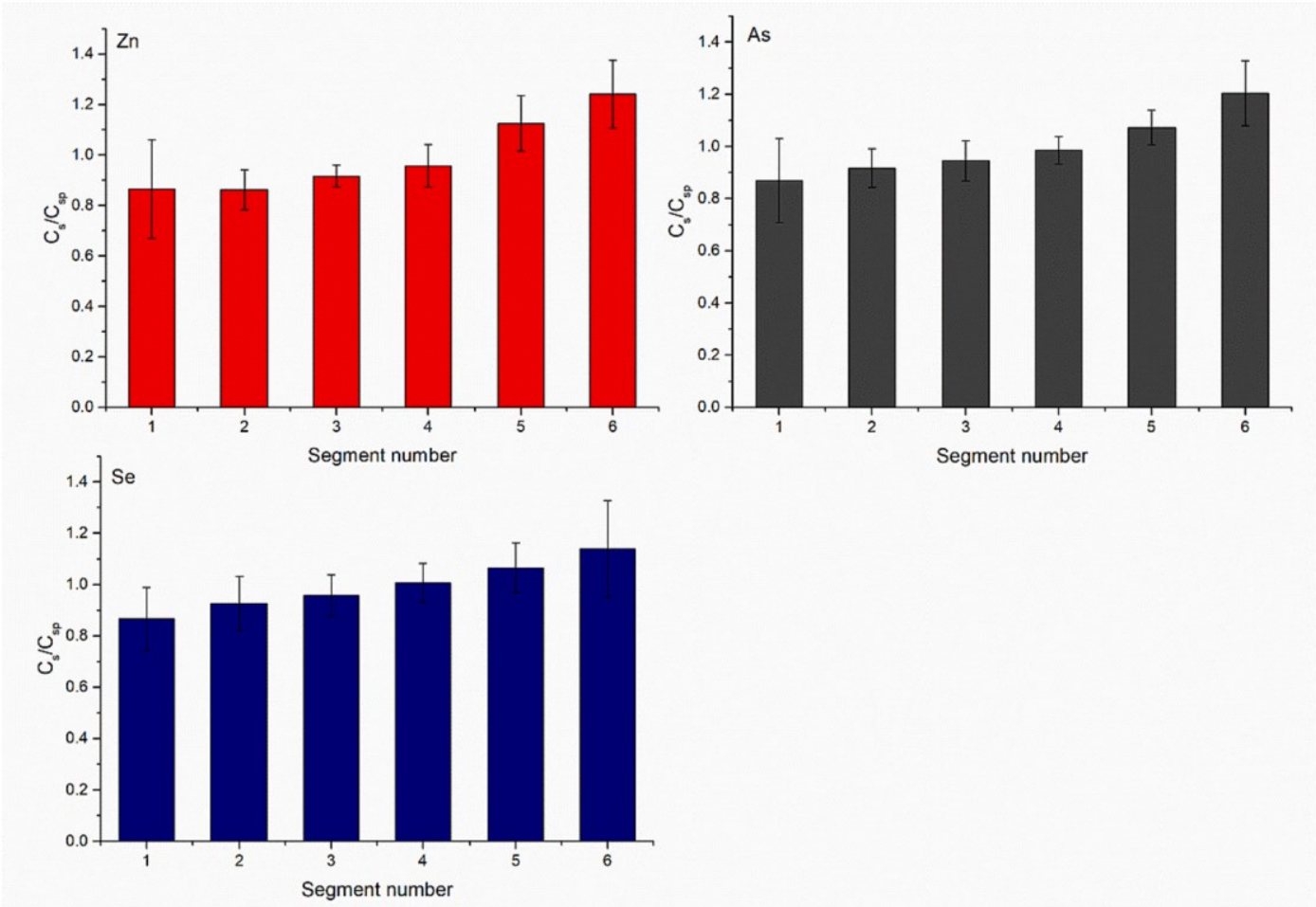
The distribution of these elements in the sponge body is the same as that observed for silica.

Probably, these elements are located to a greater extent in the sponge skeleton.



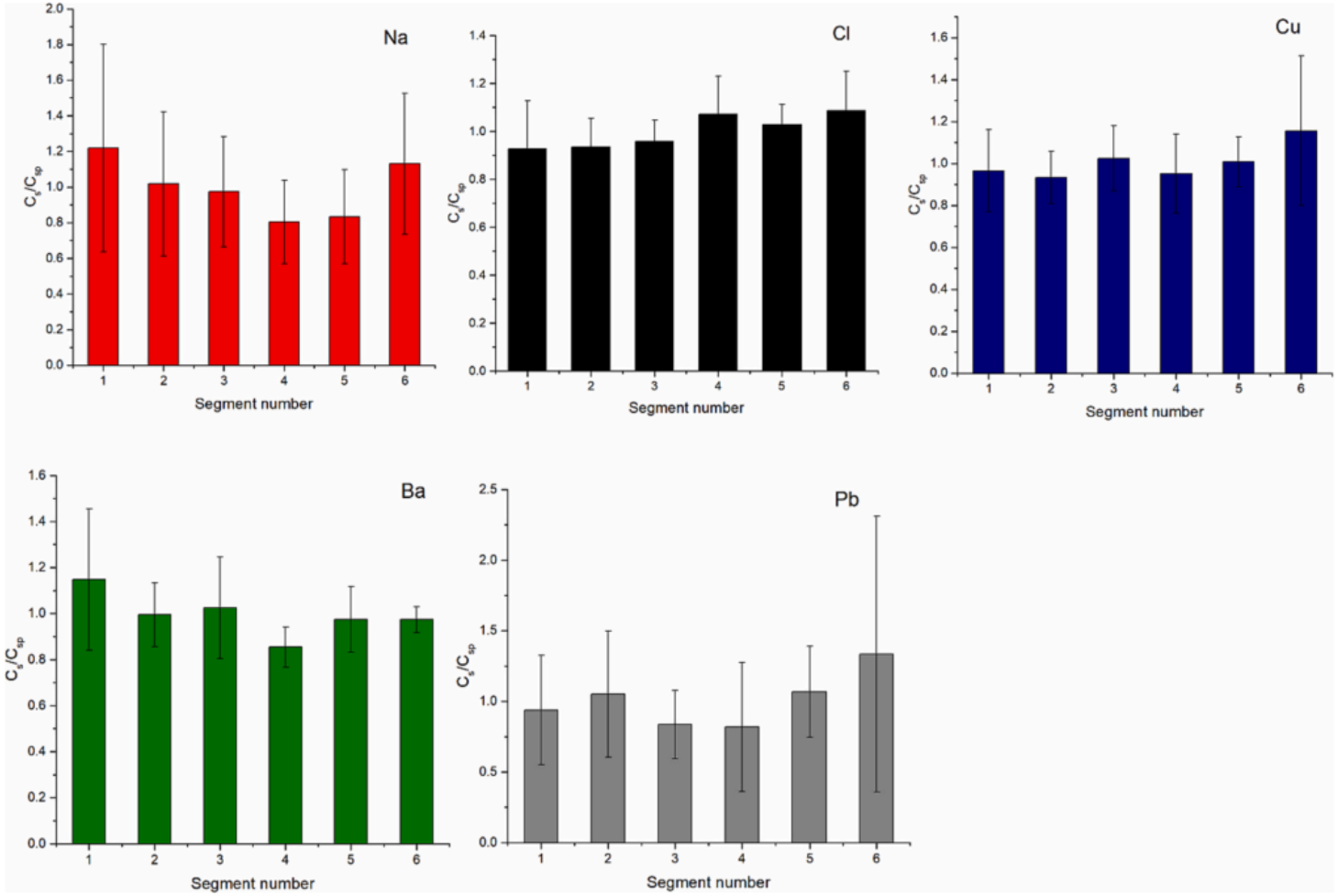
Results. Change in the concentrations of Zn, As, Se in sponge segments.

The distribution of these elements in the body of the sponge has an opposite trend. Probably, they are contained to a greater extent in the sponge tissues rather than in the skeleton.

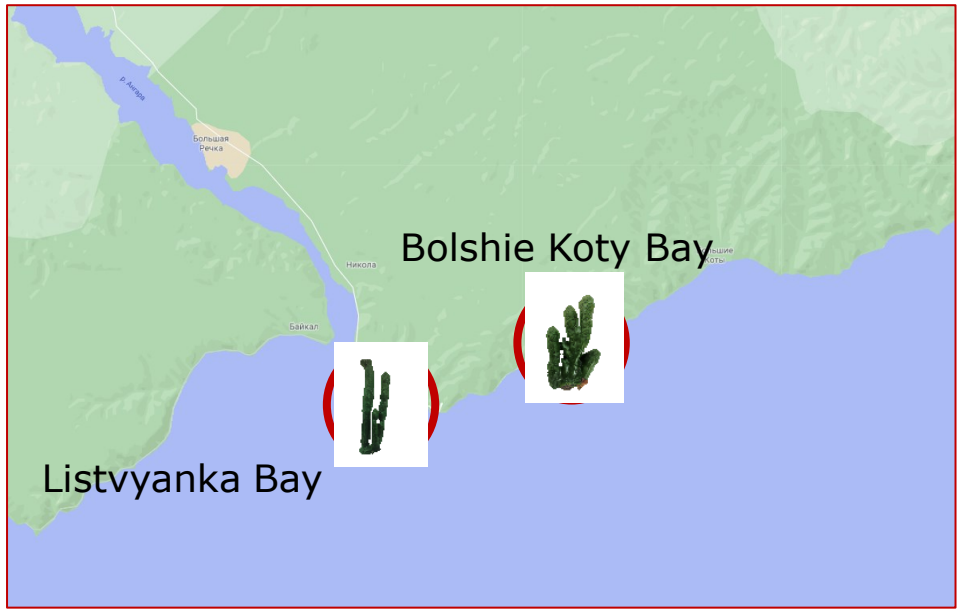


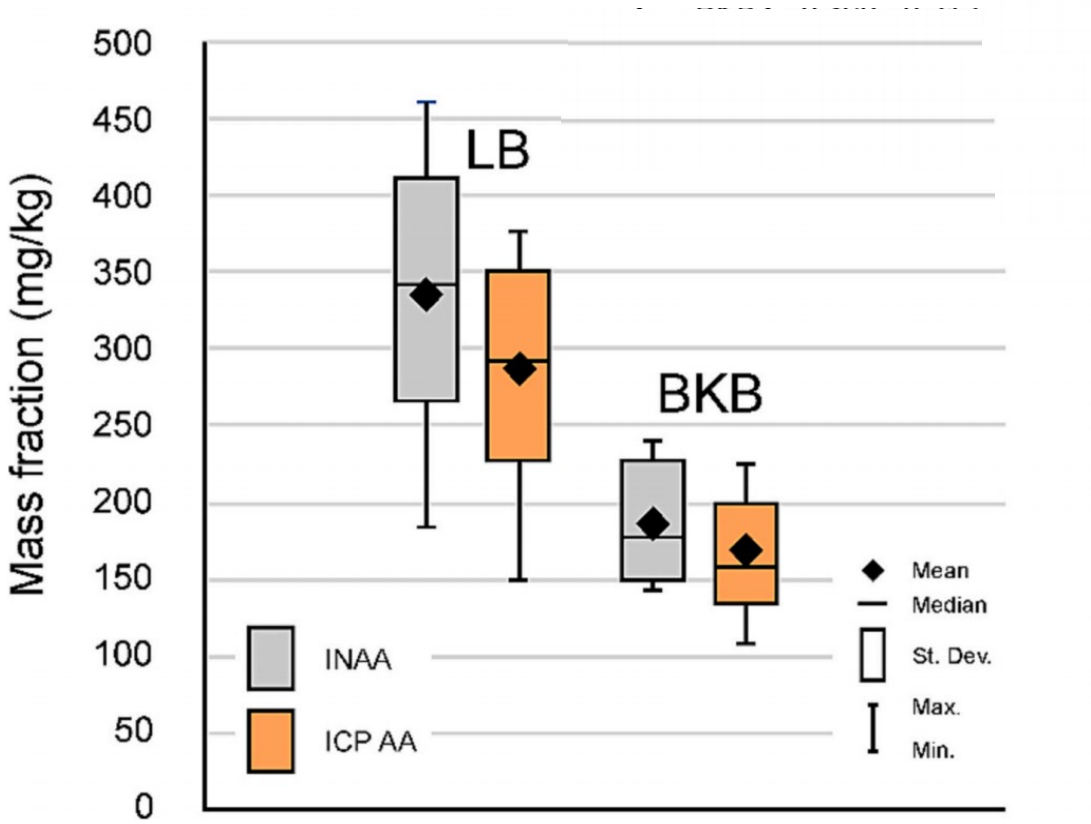
Results. Change in the concentrations of Na, Cl, Cu, Ba, Pb in sponge segments

The distribution of these elements has a disorganized character in the body of the sponge and does not allow us to draw any conclusions about distribution patterns



Results. Content of copper in L.baikalensis collected at two different sites and determined by two analytical techniques



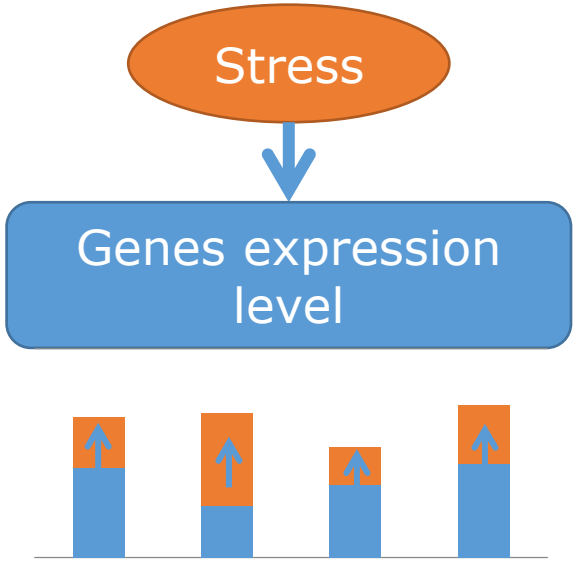


Conclusion

- Significant differences between the content of Cl, Ca, V, Zn, As, Se, Ba, Cd, and Cu in the samples collected in two bays were noticed, which can be explained by the different level of anthropogenic pressure in the studied areas.
- The obtained results showed that Baikal sponges L. baikalensis accumulated predominantly Cu and Cd and, to a lesser extent, Br, Ba, and Zn. Baikal endemic sponges L.baikalensis are suitable as bioindicators of water pollution with toxic elements and can be used in further monitoring studies

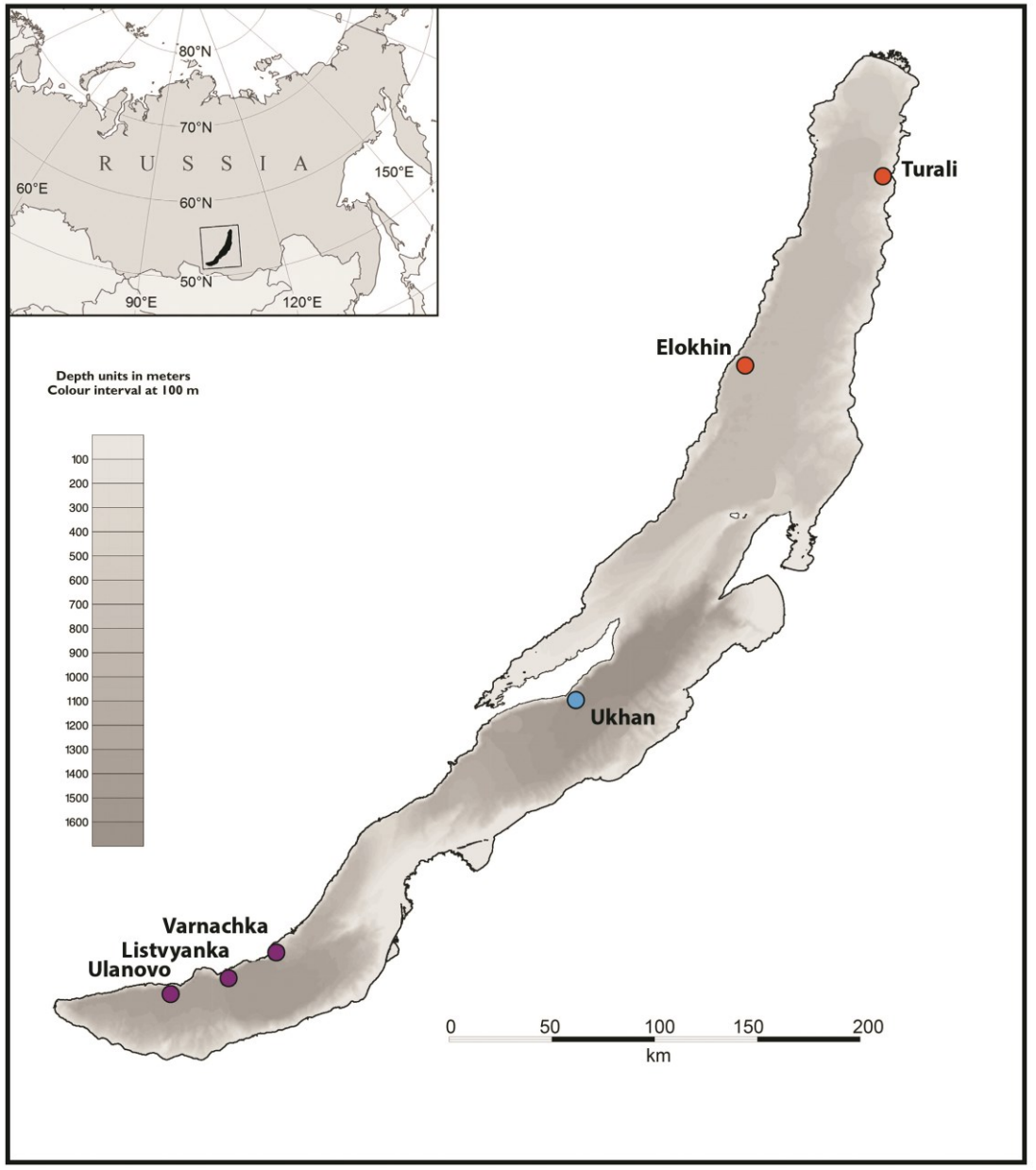
Where else Baikal sponges are used as bioindicators

- Monitoring of sponge diseases in different areas of the lake to determine the status of the ecosystem
- Analyzing expression levels of stress genes to identify areas where changes in the ecosystem cause stress
- Population genetic structure analysis, which in the long term will capture dramatic changes in population size in different areas



Further prospects

- For further study, samples of 5 sponge species from 6 regions of Lake Baikal were collected to analyze pollution by toxic elements in different regions of the lake and to select the most suitable sponge species for biomonitoring.



Thanks for your attention