Scientists take first census of Arctic freshwater molluscs in 130 years

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Based on previously released data and their own investigations, researchers at the St Petersburg University Laboratory of Macroecology and Biogeography of Invertebrates have assessed the diversity of freshwater molluscs in the Circumpolar region of the World. In total, they registered 104 species of these invertebrates living in waters within the Arctic Circle. Their hermaphroditism, their ability to freeze in ice and their 'friendship' with birds have all helped them to enter the Arctic and to survive under its harsh conditions.

The list of species compiled by the scientists reflects all of the information available on this question, including that which they themselves obtained during many expeditions into both Asian and American parts of the Circumpolar area. The last such list was published in Sweden in 1887, and now it is utterly outdated.

According to the authors, less than 2% of the world's freshwater molluscs have managed to find their way to the Arctic. Due to the peculiar life conditions in this region, the number of different species of snails and bivalves living there is small. Having analysed the biology and ecology of Arctic molluscs, the scientists speculated as to which biological traits helped these invertebrates make it to the Arctic Circle and survive there.

"Above all, it is their hermaphroditism, thanks to which any one of them can, when their numbers are limited, mate with any other member of the population, or even to fertilize oneself," said Maxim Vinarski, the head

of the Laboratory of Macroecology and Biogeography of Invertebrates at St Petersburg University. "Another useful trait is that they can travel by air, for example with birds being attached to their feathers or legs. Beyond that, the short life cycle of Arctic molluscs helps them to breed quickly and form sustainable populations in northern waters. It should also be pointed out that these invertebrates can overwinter being frozen into ice. It would seem that this combination of biological traits is the 'entry ticket' to the Arctic for molluscs, allowing them to pass through an invisible filter created by the environment."

A genetic and biogeographical analysis showed that no species of Arctic freahwater molluscs is endemic to this region; all species also occur elsewhere. It turns out that all freshwater molluscs that live in this circumpolar region came from lower latitudes. In 2017, Professor Vinarski and Ivan Nekhaev, a senior research associate in the Department of Applied Ecology at St Petersburg University, came up with similar findings for Greenland, and now their conclusions can be extended to cover the entire Arctic region. These scientists suggest that the absence of endemic molluscs north of the Arctic Circle is due to the geological youth of this region, which has comparatively recently shed its glacial covering.

The biologists also compared the species richness of freshwater molluscs in separate sub-regions of the Arctic: the European polar region, the far north of Siberia, Beringia and North America. It turns out that Siberia is the most diverse region, with 57 of the 104 species they described living there. The least diverse fauna is in North America, where only 39 species of freshwater molluscs occur. Such a disparity cannot be explained by an insufficient knowledge of North American molluscs, which have been under study for more than 200 years.

These scientists took a separate look at the Arctic and the subarctic geothermal waterbodies, which they believe could have served as a

potential refuge for molluscs during the Pleistocene glacial epochs. Unlike most aquatic habitats of the northern polar region, whose thermal regime is determined to a great extent by seasonal changes of temperature, geothermal springs maintain high water temperature (more than 20 degrees Celsius, sometimes up to 40 degrees) year-round. Most freshwater snails and bivalves do not survive in such extreme conditions, but the University biologists established that no fewer than five species of the subclass Pulmonata (lung-breathing snails) are capable of overcoming the thermal shock after settling in geothermal springs and of forming viable populations there.

Although Arctic biota on the whole is extremely vulnerable to global changes and human impact, only three molluscs from those on the list have received international conservation status: Margaritifera margaritifera (a freshwater pearl mussel), Euglesa hinzi and Valvata mergella. Most Arctic species are abundant and quite widespread, but, according to the University biologists, this does not mean there is no need to protect them. In addition to the intense economic development of the Arctic, leading to the degradation of freshwater ecosystems, global climate changes have also had a negative impact.

"Because of warming in the Arctic, animal species that used to live in less harsh conditions have begun to filter into the region. And, with the global climate changes, we can already conclude that at least three species of snails and bivalves will be able to extend their habitats into the Extreme North. This might have an unpredictable effect on the indigenous ecosystems—it could, for instance, oust the native species of molluscs. It is also possible that the foci of parasitic diseases will move to the north, and many aboriginal freshwater molluscs will become the intermediate hosts of parasitic worms. Up until now, the effect of alien species on the Arctic freshwater communities has been minimal, but in the next few decades the situation could change," Professor Vinarski cautioned.

More information: Maxim V. Vinarski et al, Freshwater Mollusca of the Circumpolar Arctic: a review on their taxonomy, diversity and biogeography, *Hydrobiologia* (2020). DOI: 10.1007/s10750-020-04270-6

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