Atlantic amphipods are now reproducing in Arctic waters

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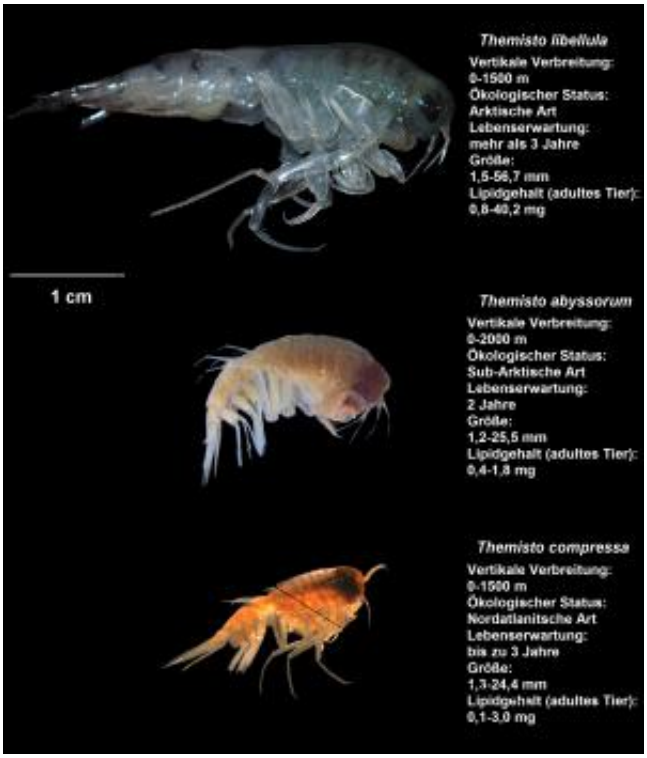

An overview of the three different Themisto species found in the sediment traps and investigated in this study. One can see the bigger size of the arctic species Themisto libellula in comparison to its relatives from the sub-arctic and the North Atlantic. Credit: Angelina Kraft, Alfred-Wegener-Institut

Biologists from the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) have for the first time shown that amphipods from the warmer Atlantic are now reproducing in Arctic

waters to the west of Spitsbergen. This surprising discovery indicates a possible shift of the Arctic zooplankton community, scientists report in the journal *Marine Ecology Progress Series*. The primary victims of this "Atlantification" are likely to be marine birds, fish and whales. The reason is that the migrating amphipods measure around one centimetre, and so are smaller than the respective Arctic species; this makes them less nutritious prey.

Amphipods have a preference which made it easy for AWI biologists to recognise these changes. This is because the sea dwellers, which are classed as zooplankton, would appear to like hiding. "Their favourite hiding places apparently include our sediment traps which have been suspended for 13 years in HAUSGARTEN, the AWI long-term observatory in the Fram Strait. We had originally anchored our funnel-shaped traps at a depth of some 300 metres there in the West Spitsbergen Current in order to catch downward floating material such as algae or excrement from zooplankton. However, from the start we also found several amphipods in the traps. The sample containers are full to the brim, especially in summer months. We therefore believe that the animals are actively swimming into the traps", states AWI plankton specialist Dr. Eva-Maria Nöthig.

The by-catch rapidly proved to be a valuable sample set, because over years changes were not only seen in the number of amphipods caught, but also in the species composition. "In the first four years our catches consisted exclusively of the Arctic and sub-Arctic individuals Themisto libellula and Themisto abyssorum. We found examples of the smaller species Themisto compressa, which is native to the Atlantic Ocean, in our sediment traps in July 2004 for the first time. They had apparently come that far north during a warm phase of the West Spitsbergen Current", the scientist reports.

A one-off discovery? By no means! During subsequent years what had

begun as an exception turned into a seasonally recurrent rule. From this time scientists documented ever more examples of the Atlantic species Themisto compressa, especially in summer months. Despite this, scientists at that time believed water in the West Spitsbergen Current, with its average temperature of 3 to 3.5 degrees Celsius, to be too cold to permit the animals from the southern part of the North Atlantic, which have a greater sensitivity to cold, to reproduce there.

New findings contradicted this assumption: "The catches in the months of August and September 2011 contained ovigerous females and recently hatched juveniles of the Atlantic species for the first time. Moreover in following months we were able to provide evidence of the migrating amphipod in all stages of development, despite the fact that the warm phase of the West Spitsbergen Current had already subsided", says Eva-Maria Nöthig.

The scientists began to calculate: the water masses of the West Spitsbergen Current running northwards require approximately 150 days to get from the North Atlantic to the Arctic Ocean. Too long to transport females already bearing eggs from their native habitat at 60 degrees north latitude in time for their larvae to hatch near the west coast of Spitsbergen. "In view of these facts, we believe that the Atlantic amphipods are reproducing in the waters of the eastern Fram Strait. This means the animals reach sexual maturity here and also have their offspring here", Eva-Maria Nöthig says.

She and her colleagues see the findings as a sign of a shift in the ecosystem in the eastern Fram Strait. "We know from our long-term measurements in the Fram Strait and at HAUSGARTEN as well as from scientific literature that there have always been phases in the past in which comparably warm Atlantic water has advanced far northwards. However, we have been unable to find a single indication that conditions ever changed as fundamentally as to permit these Arctic waters to serve

as a nursery ground for Atlantic amphipods", says Eva-Maria Nöthig.

Scientists do not yet know whether the migrants will now continue their northward spread and whether they will compete for a habitat with the two native species of amphipods. However, whenever new actors emerge in a habitat, changes can occur in its range of species and food web. Eva-Maria Nöthig: "The Atlantic amphipods have a body length of around one centimetre, shorter than the Arctic species Themisto libellula which is up to five centimetres long. Predators of Arctic amphipods will need to catch around five times the number of Atlantic amphipods in order to ingest an equivalent amount of energy to that obtained previously. The victims of these changes will probably be those species at the end of the food chain."

The biologists' results are underpinned by the oceanographic long-term observations of the West Spitsbergen Current which AWI scientists are conducting at HAUSGARTEN and with the help of a mooring right across the Fram Strait. According to this, the water temperature of the northern current at a depth of 250 metres has risen by some 0.8 degrees Celsius between 1997 and 2010.

More information: Angelina Kraft, Eva-Maria Nöthig, Eduard Bauerfeind, David J. Wildish, Gerhard W. Pohle, Ulrich V. Bathmann, Agnieszka Beszczynska-Möller, Michael Klages (2013): First evidence or reproductive success in a southern invader species indicates possible community shifts among Arctic zooplankton, *Marine Ecology Progress Series*, MEPS 493:291-296 (2013), DOI: 10.3354/meps10507, Online publication date: November 20, 2013. www.int-res.com/abstracts/meps/v493/p291-296/

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