When the sea ice melts, juvenile polar cod may go hungry

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Credit: Alfred Wegener Institute

Polar cod fulfil a key role in the Arctic food web, as they are a major source of food for seals, whales and seabirds alike. But the polar cod themselves might soon be the hungry ones. Under the ice of the central

Arctic, the juvenile fish are indirectly but heavily dependent on ice algae. As a result, retreating sea ice could have far-reaching impacts on the food web. Though researchers have long since suspected this relation existed, an international team of researchers led by the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI), have now successfully confirmed it.

Arctic sea ice offers a veritable nursery ground for polar cod: young fish between one and two years old live in cracks and crevices under the ice. They drift along with the ice, which is most likely how they make their way from their spawning grounds in the waters of northern Siberia to the central Arctic. During their journey, the young polar cod feed on amphipod crustaceans, which in turn feed on ice algae. As such, there is a direct relation between the polar cod and the ice algae, which could ultimately threaten the young polar cod's survival. This was the key outcome of a study recently published in the journal "*Progress in Oceanography*". Amongst others, the research institute Wageningen Marine Research in the Netherlands joined in the study.

"Generally speaking, our findings indicate that polar cod are heavily dependent on ice algae," says first author and AWI biologist Doreen Kohlbach. "That means the rapid retreat of Arctic sea ice poses an especially serious threat for polar cod. When the ice retreats, it takes with it the basis of their diet. Given the polar cod's pivotal role, this could also produce changes throughout the entire food web."

In the study, Kohlbach and her colleagues analysed the stomach contents of the fish—which they had caught directly under the sea ice in the course of a several-week-long expedition to the Arctic Ocean on board the research vessel Polarstern. Between Greenland, Spitsbergen and Russia, the researchers dragged a specially designed under-ice net alongside the ship.

The fish's stomach contents showed the researchers what they had recently eaten. What they found: the amphipod crustacean Apherusa glacialis is at the top of the young polar cod's menu. In turn, the crustacean primarily feeds on diatoms that grow directly on or under the sea ice.

In a second step, the researchers confirmed the presence of carbon from the ice algae in the fish. To do so, they analysed the fatty-acid patterns and the composition of stable isotopes in the polar cod's muscle and other tissues. In the food web, certain fatty acids are passed on unchanged from the algae to the animals that feed on them. "When we find the fatty acids from the ice algae in the meat or tissues of a fish, it tells us the fish or its prey must have fed on the algae," says Kohlbach. A subsequent isotope analysis makes it possible to determine the precise percentage of ice-algae carbon in the fish's diet.

"The analysis shows that diatoms make up the most important source of carbon for polar cod," explains Kohlbach. In fact, the outcomes indicate that between 50 and 90 per cent of the young polar cod's carbon stems from ice algae. "Even though we had assumed there was a connection between the ice algae and polar cod from the outset of the study, these high values surprised us."

Last year the researchers successfully confirmed the importance of ice algae as a food source for animal species primarily found in deeper waters. Their latest study proves that this dependency also applies to the next link in the food chain. In addition, both studies have yielded valuable data that can be integrated into ecosystem models—which are in turn essential to forecasts of how the retreat of sea ice will affect the Arctic ecosystem.

More information: Doreen Kohlbach et al, Strong linkage of polar cod (Boreogadus saida) to sea ice algae-produced carbon: evidence

from stomach content, fatty acid and stable isotope analyses, *Progress in Oceanography* (2017). DOI: 10.1016/j.pocean.2017.02.003

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