

Food web

Ice algae: The engine of life in the central Arctic Ocean

Algae that live in and under the sea ice also serve as a nutritional basis for animals living at great depths

[12. July 2016] Algae that live in and under the sea ice play a much greater role for the Arctic food web than previously assumed. In a new study, biologists of the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research showed that not only animals that live directly under the ice thrive on carbon produced by so-called ice algae. Even species that mostly live at greater depth depend to a large extent on carbon from these algae. This also means that the decline of the Arctic sea ice may have far-reaching consequences for the entire food web of the Arctic Ocean. Their results have been published online now in the journal *Limnology & Oceanography*.

The summer sea ice in the Arctic is diminishing at a rapid pace and with it the habitat of ice algae. The consequences of this decline for the Arctic ecosystem are difficult to predict. Scientists of the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research showed the significance of ice algae for the Arctic food web in this context. "A number of studies have already speculated that ice algae are an important energy source for the polar ecosystems. We have now been able to show that not only animals associated with ice meet the majority of their carbon needs from ice algae, but that, surprisingly, so do species that mostly live at greater depths," says lead author Doreen Kohlbach.

In a new study, she and her colleagues examined copepods, amphipods, crustaceans and sea angels from the central Arctic Ocean and their dependence on ice algae. A number of these species use the underside of the sea ice as their habitat. Many other species of zooplankton, however, spend their entire lives floating in water depths up to 1000 metres and more.

"We now know that ice algae play a much more important role for the pelagic food web than previously assumed. This finding also means, however, that the decline of the ice could have a more profound impact on Arctic marine animals, including fish, seals and ultimately also polar bears, than hitherto suspected," says Doreen Kohlbach.

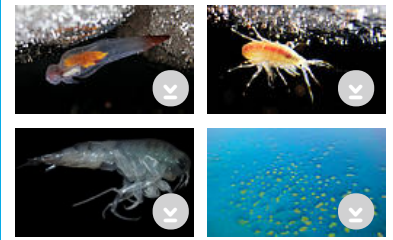
The AWI researcher was able to establish the close relationship between zooplankton and ice algae using fatty acids as biomarkers, which are passed on unchanged in the food chain. The typical fatty acids in ice algae are thus indicators of whether an animal has ingested carbon from ice algae via food. In order to precisely determine the proportion of ice algae carbon in the diet, Doreen Kohlbach also performed an isotope analysis of these biomarkers. The scientist took advantage of the fact that ice algae inherently have a higher proportion of heavy carbon isotopes incorporated in their cells than algae that float freely in the water. On the basis of the ratio of heavy to light carbon isotopes in the biomarkers it is possible to determine the exact proportion of carbon derived from ice algae in the organisms along the food web.

The result showed that ice-associated animals derive between 60 and 90 percent of their carbon from the ice. For animals living at greater depths, the percentages were between 20 and 50 - significantly higher than expected. "Personally, I was most surprised by the percentage in the predatory amphipod *Themisto libellula*, which lives in the open waters and is not known to hunt under the surface of the ice. We now know that it obtains up to 45 percent of its carbon from ice algae, which had been eaten by its prey," says AWI sea ice ecologist and co-author Dr Hauke Flores. "We found that pelagic copepods also obtain up to 50 percent from these algae, even though we had assumed that they mainly feed on algae from the water column," Hauke Flores continues.

These figures were also surprising in view of the fact that ice algae mainly grow in spring when little light penetrates the ice, which is still thick at that time of the year. The samples, however, were taken in the summer - and the percentage of ice algae carbon in the food chain was still relatively high. The AWI scientists now wonder what the figures look like at other times of the year. They are also interested in whether a greater distinction can be made between the various ice algae and whether perhaps there is a key alga.




Based on the new study, it is now possible to back up the flow of ice algae carbon through the summer food web in the central Arctic using specific figures. AWI biologists can use these figures in model




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calculations to assess the consequences of the sea ice decline for the Arctic ecosystem.

Original publication

Doreen Kohlbach, Martin Graeve, Benjamin Lange, Carmen David, Ilka Peeken, Hauke Flores: *The importance of ice algae-produced carbon in the central Arctic Ocean ecosystem: food web relationships revealed by lipid and stable isotope analyses* [↗](#), Limnology & Oceanography, DOI: 10.1002/lno.10351 [↗](#)

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