Food web in the marginal ice zone: material flow from sea ice through to myctophid fish

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The seasonal prevalence of the sea ice zone is a critical element in the Southern Ocean ecosystem structure and dynamics. Sea ice formed in coastal polynyas in autumn and winter is transported northward and covers a vast area of the Southern Ocean. This ice contains a large variety of sea ice biota (SIB), such as ice algae, protozoans, and crustacean larvae. The SIB is released as the sea ice melts from the ice edge in spring and summer. Although a flood of SIB biomass is released into the water column, there is little information on the pathway and dynamics of the SIB released into the Southern Ocean. The sea ice changes that occur with climate change should affect the Southern Ocean ecosystem via this pathway.

We have been investigating the flow of materials derived from SIB through to the Southern Ocean ecosystem after its release into the water column. In a series of studies, we found the nursery grounds of the Antarctic myctophid fish *Electrona antarctica*, which is an important component of the oceanic food web, in the waters influenced by sea ice. This paper introduces a study of 1) the dynamics of SIB inferred from the flora of floating sea ice (ice algae) and the water column at the ice edge and 2) detritus containing diatoms found in the stomachs of *E. antarctica* larvae. The origin of the diatoms is discussed.

A comparison of the numbers of algal cells in sea ice and the water column revealed that more than 90% of the cells of the dominant diatom species were removed from the surface mixed layer. Most of the algal cells were thought to sink into deeper waters or to be grazed by zooplankton close to the sea ice. Detritus served as a food item for early stage larvae of *E. antarctica*, and some of the diatom species in the detritus were usually dominant in the SIB assemblage, suggesting that the *E. antarctica* larvae feed on SIB indirectly, eating the faecal pellets of zooplankton or aggregates.

In January 2017, we conducted drifter observations using a sediment trap in the vicinity of the ice edge; these should provide more direct information on the dynamics of sinking material from the SIB. Regarding the food habits of *E. antarctica* larvae, a metagenome analysis of the diatoms in the stomach and a biomarker analysis will be conducted to determine the detailed pathway of material flow from sea ice.

Keywords: sea ice biota, ice algae, food web, marginal ice zone, marine snow, detritus

