Palmer LTER: Microscopic analysis of ice assemblages in new-year sea ice in the Western Antarctic Peninsula, June-July 1999

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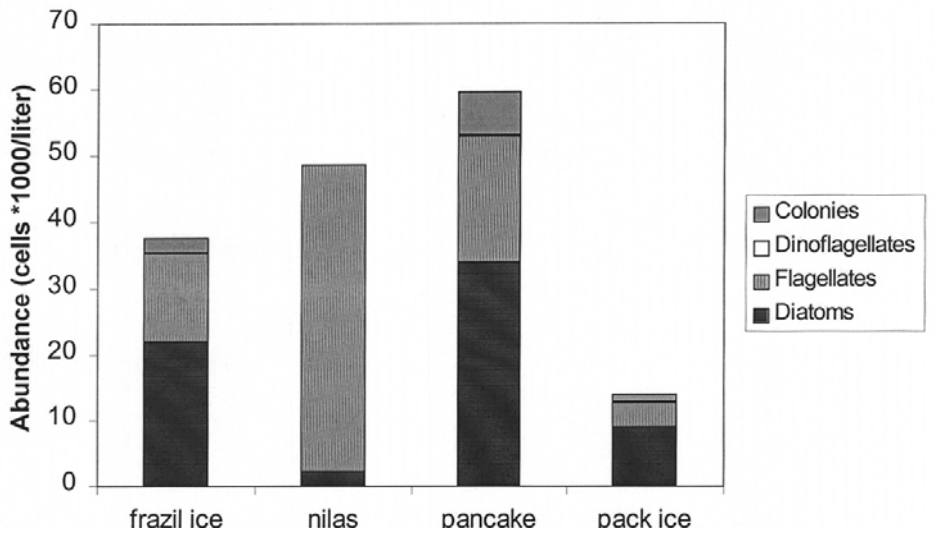
The LTER program is testing the hypothesis that the annual advance and retreat of the sea ice affect the structure and function of the marine antarctic coastal ecosystem West of the Antarctic Peninsula.

Microalgal growth is observed both in sea ice (epontic algae) and in the water column (phytoplankton). In winter, when seawater freezes, the microalgae are incorporated and concentrated in the developing ice from the water column (Garrison et al. 1983). Ice microalgal communities in the Scotia, Weddell, and Ross seas show high biomass with important contribution to annual primary production as well as a characteristic assemblage (Horner, 1985; Spindler, 1994). Hypothetically, in the following spring, these algae modify water-column populations by seeding the mixed layer during ice melting (Garrison, et al. 1987). An unknown amount of the yearly productivity in the western Antarctic Peninsula area is due to the development of ice microalgae. Two winter cruises were scheduled to estimate winter abundance, biomass, and total primary productivity due to seasonal sea ice microalgae and phytoplankton and to characterize the assemblages responsible for this production.

During the first of these cruises, sampling was done in the western Antarctic Peninsula between 64º-70º S and 62º-80º W, from 17 June and 8 July 1999, aboard the U.S. research ship *Nathaniel B. Palmer* (Smith and Stammerjohn this issue). Stations visited included open water, medium and thin pack ice, and pancake, frazil and nilas ice. Water-column samples were taken from surface to bottom with 10-liter Niskin bottles attached to the CTD rosette. Sea ice was collected with buckets or with an ice-coring auger. Ice samples were melted in large volumes of filtered seawater (roughly in a ratio of 1:3). One liter aliquot of sample (seawater or melted ice) was concentrated through 0.8 micrometer membrane filter and analyzed under a fluorescent microscope (Booth 1993). At least 300 cells were counted whenever possible, otherwise the whole filter was analyzed. Samples for qualitative analysis were collected and preserved with Lugol's iodine in order to improve the taxonomic determination of cells.

The winter microalgal community was composed mainly of diatoms and unidentified phytoflagellates. Overall, diatoms were dominant in the ice samples and phytoflagellates in the water column. Total cell abundance was low in all the stations, nevertheless an elevated diversity of species was found. In surface waters the cell concentration was about one order of magnitude lower than in the summer (between 2-6 x 10^4 cells per liter) (Smith, et al. 1996). The maximum development of the phytoplanktonic populations was found in near shore waters with young sea ice coverage (frazil ice, pancakes, or nilas), and the lower concentration in waters with pack ice

coverage. The abundance of ice microalgae populations varied with ice type: pack ice presented the lower abundance of cells (average 14 x 10^3 cells per liter) and pancake ice the highest (60 x 10^3 cells per liter) (figure). Also, the composition of algae varied with ice type: in ice formed under turbulent conditions (frazil, pancake and pack ice), diatoms were more abundant than phytoflagellates. The exception was the assemblage associated with nilas, where flagellates dominated over diatoms.



Average microalgae abundance in different ice types in the Western Antarctic Peninsula during June and July 1999.

Phytoflagellates consisted mainly of <10 micrometer forms and were present in colonies in various stations. An elevated diversity of diatoms species was found, both in the water column and in the ice. The ice diatom assemblage was dominated mostly by pennates; centric diatoms dominated in only a few instances. Pennate diatoms include cells between 10 um and 100 um, also larger forms (> 800 micrometers) as in the case of *Trichotoxon reinboldii*. Diatoms present in most of the ice samples belonged to the genera *Chaetoceros*, *Membraneis* and *Fragilariopsis* and *Proboscia truncata* and *Corethron criophilum*. Specimens of the genus *Asteromphalus*, cited as benthic, were also present. Some dinoflagellates were found in a few stations, but were not numerically abundant.

Some diatom cells presented winter morphological structure (for example *Proboscia truncata* and *Eucampia antarctica* var. *recta*), and others presented resting spores, such as *Chaetoceros socialis*. However, in the young ice sampled, *E. antarctica* var. *recta* was found in the summer stage. The winter microalgal community was not a resting assemblage since cells from the genera P*roboscia*, *Eucampia*, *Fragilariopsis* and *Chaetoceros* were dividing.

In conclusion, the phytoplanktonic community was an order of magnitude less abundant than in the summer. The ice microalgae, found in new-year ice, represented an important contribution to the abundance and diversity of the winter microalgal community of the area. Ice samples showed a characteristic taxonomic composition, with

planktonic and benthic forms. These results agree with those found by Garrison et al. (1987) for the Scotia Sea, although our samples are qualitatively different from those of other areas of the Southern Ocean where *Fragilariopsis* spp. dominate numerically. Both phytoflagellates and diatoms seem to be incorporated in ice, but apparently diatoms are more successful in this habitat and constitute an actively growing population.

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