

BEST-BSIERP *Bering Sea* PROJECT

UNDERSTANDING ECOSYSTEM PROCESSES IN THE BERING SEA 2007–2013

Bering Sea Ice

LIFE IN THE FREEZER

While life in association with sea ice has been studied for hundreds of years in many Arctic and Antarctic regions, very little information had been gathered from the Bering Sea. This is surprising, as the Bering Sea has the largest seasonal sea ice extent of any Arctic region. Our group focused on the biological activity within the sea ice, trying to understand the amount and fate of primary production contributed by tiny algae living within the sea ice.

We discovered that each spring vast amounts of sea ice algae accumulate in highly concentrated thin bottom layers of the sea ice floes (Figure 1), and we observed

concentrations of algae within these layers that exceeded water column phytoplankton concentrations by a factor of 100 to more than 1,000 from mid-March to the end of June. The total amount of plant biomass within the bottom 10 cm of the ice is about the same as for the phytoplankton integrated over the upper 20 m of the water column. During the ice covered period, pelagic crustaceans, mainly the euphausiid *Thysanoessa raschii* (sometimes known as Arctic krill) is likely ingesting sea ice algal material. With the onset of ice melt, the ice algal biomass was rapidly released into the water column and

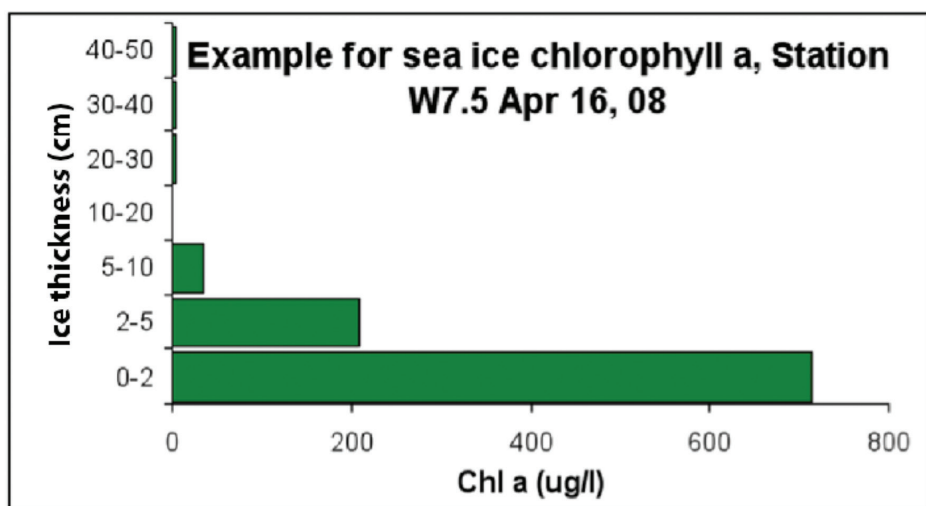
helped support the food webs in the water column and at the seafloor.

How We Did It

During expeditions in spring 2008, 2009, and 2010 we sampled dozens of different ice floes (Figure 2), at various locations, for the sea ice algal abundance and growth rates. Sea ice samples were taken with a specialized ice corer (Figure 3). Back on the ship, ice cores were melted and the melted samples were analyzed for concentration of algal pigments, mainly chlorophyll *a*. We compared these data to the algal development below the sea ice by

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Fig. 1

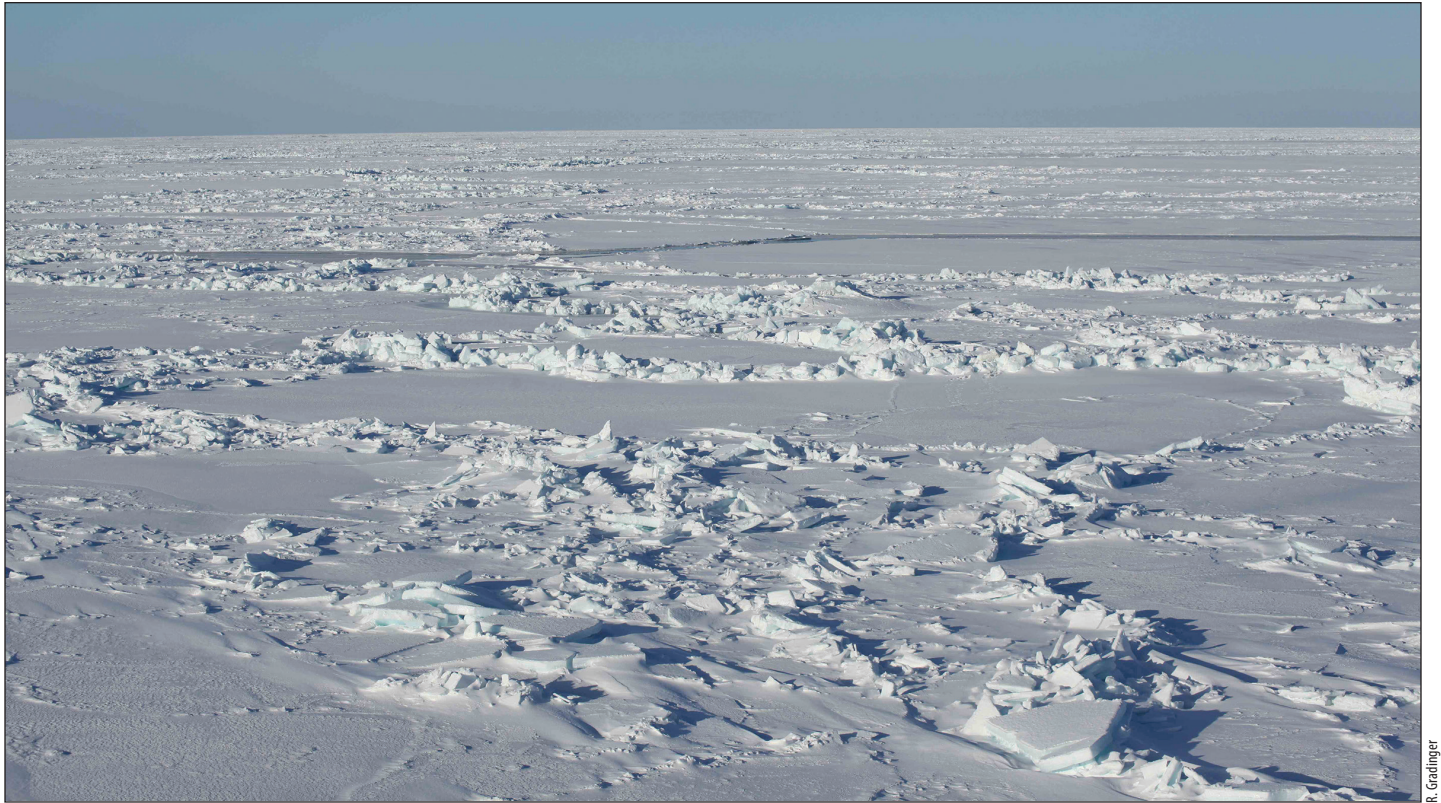


Vertical distribution of ice algal pigments in an ice floe collected in the Bering Sea. The ice was 50 cm thick, and the highest algal pigment concentrations occurred in the bottom 2 cm of the ice floe. Water column phytoplankton concentrations at the same locations were two orders of magnitude lower.

The Big Picture

The Bering Sea supports an incredibly rich marine ecosystem with a wealth of marine resources exploited by commercial and subsistence harvests. Change in ocean conditions, including sea ice characteristics, impact the functioning of marine systems. To enable predictions on future scenarios, we need to understand the interplay between the current system components like fish, birds, plankton, sea floor, and sea ice plant and animal life. Our project provides one of the building blocks to understand how the Bering Sea ecosystem functions and how it might change in the future.

Fig. 2



R. Grading

Sea ice covering the Bering Sea as seen from an icebreaker in March 2009.

Fig. 3



C. Morel

Taking ice samples with an ice corer.

collecting water from below the sea ice, using a small water sampler deployed through holes in the ice. We also measured when and how those algae melted out of the ice by collecting sinking material with sediment traps under the ice. We used chemical markers to follow the fate of the ice-derived matter in the food web.

Why We Did It

Sea ice is an integral part of Arctic marine ecosystems, serving as breeding and migration ground for marine mammals, resting area for birds and seals, and as a realm for hundreds of different species, from microscopic, unicellular plants to larger animals. Given all the recent changes in temperature and ice conditions in the Bering Sea, the

big questions were (1) how important are these sea ice related ecosystems for the Bering Sea food web, (2) how much ice algal biomass is formed during spring prior to the ice melt, and (3) how is the production linked to the water column and seafloor communities.

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