BEST-BSIERP
Bering Sea PROJECT
UNDERSTANDING ECOSYSTEM PROCESSES IN THE BERING SEA 2007–2013

Bering Sea Krill and the Impact of Climate Change

SOME LIKE THEIR ALGAE ON ICE

We often hear about decreases in ice coverage and thickness in polar regions, and we can see how climate change is affecting large organisms, like polar bears, but it also affects organisms toward the bottom of the food chain. Euphausiids, more commonly known as krill, are large shrimp-like zooplankton (Figure 1) that are an important food source for larger organisms, including fish, seals, seabirds, and baleen whales. In the eastern Bering Sea, ice typically covers much of the wide shelf in late winter through spring. In early spring, intense blooms of ice algae form in and on the bottom of the ice. There are also algae that thrive in the water (phytoplankton), but they are present in low amounts when there is ice cover and begin to bloom only later, after the ice retreats. We wanted to determine the importance of ice algae in the krill diet and the possible effects of an ice-free springtime on krill.

Fig. 1

Krill species Thysanoessa inermis *and* T. longipes*, separated from a bongo net tow collection taken on the outer shelf of the southeastern Bering Sea.*

How We Did It

We worked primarily at night, when krill migrate to the surface water. Krill were captured with a bongo net (Figure 2) that was towed behind our research vessel, and then incubated in water containing the natural community of plankton from the same location. During the incubations, light levels were adjusted to simulate the light exposure to which the krill were acclimated.

To examine the krill's eating habits, we measured the abundance and type of plankton—including ice algae, phytoplankton, and the very small microzooplankton (protozoa)—before and after krill were allowed to feed. We were able

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The Big Picture

Based on long-term observations, we know that krill are more successful in cold years, when there is lots of ice, than in warm years. It is possible that the earlier-blooming, possibly more nutritious, ice algae kick-start and bolster krill growth and reproduction. If ice cover and extent diminish in the Bering Sea in the future, some species of krill may be less productive, while other species that are not as dependent on ice algae as a food source may be less affected.

THE TROPHIC ROLE OF EUPHAUSIIDS IN THE EASTERN BERING SEA: ECOSYSTEM RESPONSES TO CHANGING SEA-ICE CONDITIONS
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to determine what they ate, how much, and whether or not they preferred one type of plankton over another. We also analyzed the lipid (fat) profiles in both natural water samples and in the krill themselves before and after feeding. Different types of plankton have different distributions of lipid structures. These can be used to track specific groups of plankton, such as ice algae, through the food chain. Finding these compounds in krill tells us what was eaten and stored in their bodies. The total lipid amount is an important source of calories for those that eat them.

Through a series of shipboard incubations, we were able to analyze changes in plankton concentration before and after krill grazing. We have seen that some krill—*Thysanoessa raschii*, in particular—rely heavily on ice algae as a food source, and the chemical signatures of the ice algae are seen as increased lipids within the krill. The more oceanic counterpart of *T. raschii*, namely *T. inermis*, rely more on planktonic algae and microzooplankton. Changes in sea ice extent and duration in the Bering Sea, with consequent changes in ice algae availability and concentration, may affect the reproductive success of the regional *T. raschii* population to a greater extent than *T. inermis*.

Plankton samples were collected and taken to the lab, where the different quantities and types of plankton were counted. Subsamples of the water collected for incubation were analyzed for lipid biomarkers. At the end of each experiment, the krill were frozen and brought to the lab, along with samples of the plankton collected on filters for biochemical analysis.

Fig. 2

Bongo net deployment at dusk during a summer research cruise.

Why We Did It

Understanding the impact of climate change on krill in the Bering Sea is important because they are a dietary staple for many organisms in that region and a rich source of calories as lipids. Our feeding experiments showed that the most abundant species of krill, *Thysanoessa raschii*, devoured ice algae, when available, at very high rates, up to five times the rate at which they could consume phytoplankton. After the ice melted back and planktonic algae bloomed in the water column, *T. raschii* fed on planktonic algae and microzooplankton. Not all species of krill are alike, though. *Thysanoessa inermis* typically lives farther offshore than *T. raschii*. In this region of the Bering Sea, ice is not as extensive in late spring as it is inshore, and therefore ice algae are less available. Not surprisingly, we found *T. inermis* fed primarily on planktonic algae and microzooplankton.

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