Greenhouse effect could hurt Bering Sea

by the Geophysical Institute
University of Alaska Fairbanks

FAIRBANKS — At this time of year in Alaska, it's hard to worry about the news that the world is getting warmer. Most people don't care about the details — they just wish the heat would hurry up and get here.

Nevertheless, in odd moments between trying to coax frozen vehicles to run and digging out extra woollies from the back of the closet, you might spare a little time to be concerned about the effects of ice-free winters on the Bering Sea.

This shallow sea at the western border of North America has at least two distinctive features. The Bering Sea is an enormously productive body of water. It supports both huge fisheries and impressive populations of marine mammals and seabirds.

It also carries a seasonal topping of sea ice, a cover that by winter's end can extend over 600 miles south of Bering Strait. We think these two features may very well be connected.

To explain why seasonal sea ice may contribute to the number of animals living between the strait and the Aleutians, it's necessary to consider some basics of ice physics and of marine biology. First, freezing seawater exudes salt as it turns to ice, so sea ice is less salty than the sea from which it froze.

Thus, when warm water comes, the melting sea ice releases water that is nearly fresh. Fresh water is less dense than saltwater, so the meltwater floats on the sea surface.

Now to explain what this floating puddle of less salty water has to do with the number of fish in the ocean, one needs to consider the nature of marine food chains. Walrus, pollock, puffins and so forth are all top consumers in a chain of edible organisms that begins with microscopic marine plants — phytoplankton.

The top consumers don't eat phytoplankton; they eat something that's eaten something that's eaten something else, and so on eventually down to something that ate phytoplankton. It's easy to see how the term *food chain* came to be applied to these multi-step connections.

Overall, the Bering Sea doesn't seem to be especially well-endowed with phytoplankton. That makes its rich supply of top consumers something of a mystery, since each step in the food chain uses up something like 90 percent of the available food energy. We believe the low-salt water left by the melting sea ice provides a clue to this mystery.

In late April, when the ice begins to melt, phytoplankton are held near the sea surface by the low-salinity layer. That means they are trapped where the light is and can't sink down into dimness where they could not grow or reproduce. Powered by sunlight, the trapped phytoplankton thrive and multiply in an ice-edge bloom.

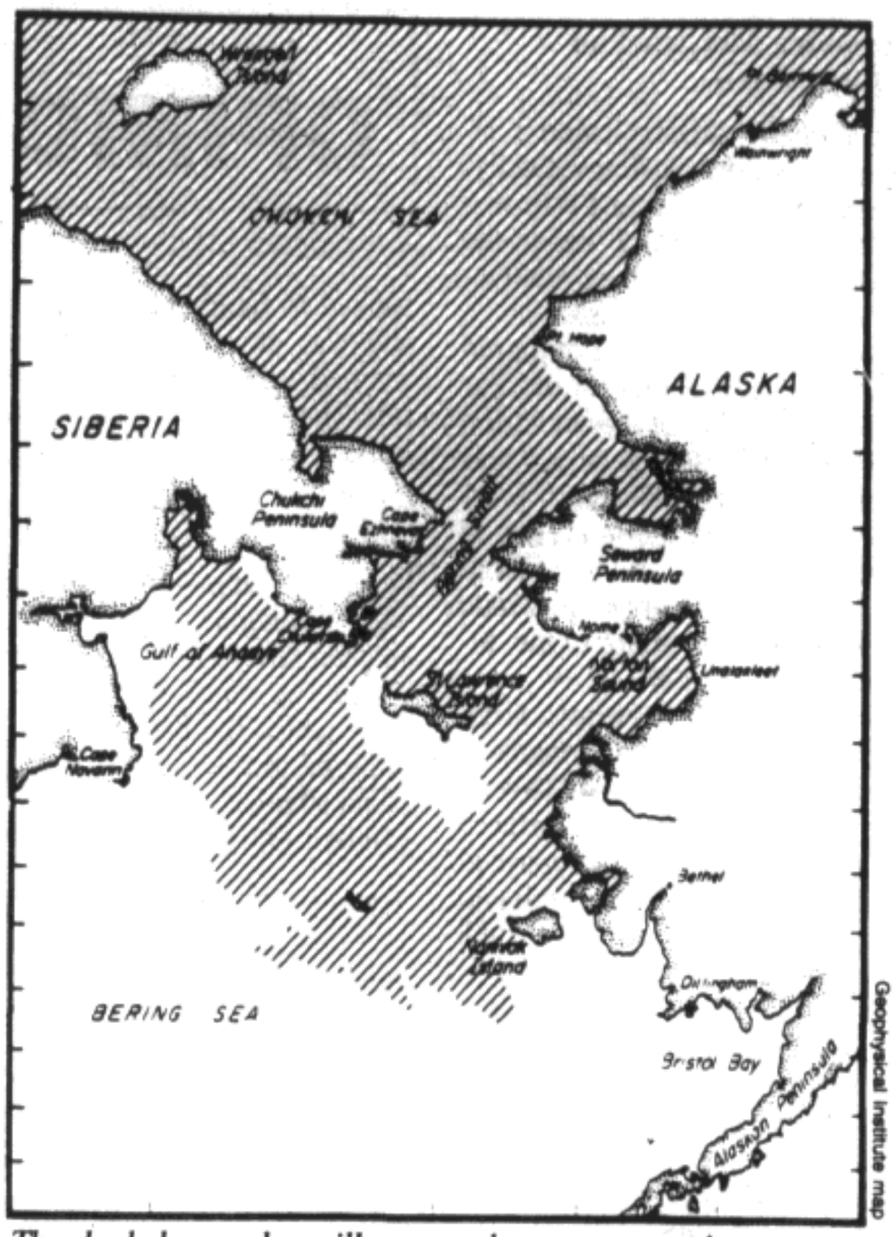
In the cold early-spring sea there are very few of the tiny animals that graze on phytoplankton, so these microscopic marine plants grow and reproduce exuberantly. Eventually, as the trailing freshwater skirts of the sea ice move too far north to maintain the low-density layer, the microscopic plants sink.

A great many of them end up as food for bottom-dwelling animals, and a great many of these animals are quite good-sized — clams and other mollusks, for example. In effect, the food chain based on the ice-edge bloom has cut out the middle animals, with all those 90 percent losses, and come up with a highly efficient shortcut.

Bottom-feeding fish, like flounder, and bottom-feeding mammals, like gray whales and walrus, are only a couple of steps away from the phytoplankton.

So that, in essence, is our theory of one reason why the Bering Sea has so many top consumers. It is a theory; later spring blooms occur elsewhere in the Bering Sea, when the water is warmer and the relative importance of ice-edge effects compared to other blooms has yet to be worked out.

Unfortunately, with the greenhouse effect and the warming climate, humankind may be running an uncontrolled experiment on the ice cover of the Bering Sea. We may only discover just how important the ice edge was when it's gone.



The shaded area above illustrates the average maximum extent of the Bering Sea ice pack. Marine mammals such as walrus often congregate at open areas within the pack.