The Bering Sea: Current status and recent events

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Bering Sea observations indicate persistent warming and species impacts

Observations over the previous four years show persistent warm and ice-free conditions from late winter through summer, despite large variability in climate indices such as the Arctic Oscillation (AO) and the Pacific Decadal Oscillation (PDO). If such conditions continue, it will have an impact on the ecosystem, as Arctic species seek colder waters and subarctic species become dominant. On the southeast Bering Sea shelf (57ºN), the warmest vertically-averaged summer ocean temperatures of the decade occurred in 2001-2003 (6ºC mean temperature relative to 4ºC mean temperature in 1995-1997), and sea ice is now nearly non-existent in the southeast.

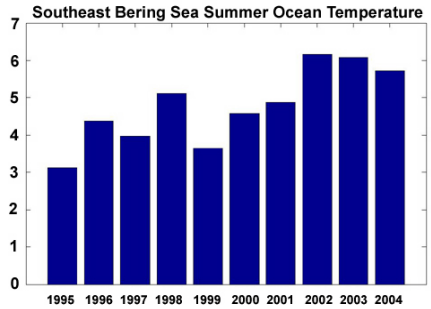

Fig. 1 Average annual summer water temperature at the Mooring 2 site in the southeast Bering Sea.

These conditions follow a major transformation, or regime shift, of the Bering Sea around 1977, which changed from a predominantly cold Arctic climate to a warmer subarctic maritime climate as part of the PDO. This shift was accompanied by a major re-organization of the marine ecosystem over the following decade. Fisheries surveys and model calculations support a shift in the importance of pollock to the ecosystem, to over 50% of the energy flow at mid-trophic levels in the 1980s from near 10% in the 1950/1960s. A major Arctic change influenced the Bering Sea began in the late 1980s, as a shift in polar vortex winds (the AO) reinforced the warm Bering conditions, especially promoting an earlier timing of spring meltback of sea ice.

Warm, ice-free conditions may favor pelagic over benthic components of the ecosystem. A cold-water amphipod is no longer found in abundance in the southeastern Bering Sea. Over the last decade, annual fisheries surveys indicate a continued decline in recruitment of fish and shellfish to cold-water stocks, such as Greenland Turbot and snow crab. The biomass of Greenland Turbot has declined to 17% of its pre-1977 peak. However, walleye pollock, which prefers warmer waters as the ice retreats, is characterized by a large, rather stable, population. Pollock biomass increased 400% following the 1977 regime shift and has generally maintained high sustained values. Pacific walrus is another species showing northward movement due to the lack of sea ice and warmer temperatures. While it is difficult to show direct causality, the timing of reductions in other marine mammals suggests some loss of their traditional Arctic habitat. Weather data beginning in the 1910s and proxy data (*e.g.*, tree rings) back to 1800 suggest that, except for a period in the 1930s, the Bering Sea was generally cool before 1977, with sufficient time for slow growing, long-lived, cold-adapted species to adjust.

It was hypothesized that the overall climate change occurring in the Arctic, as indicated by warmer atmospheric and oceanic temperatures and loss of 15% of sea ice and tundra areas over the previous two decades, is making the Bering Sea less sensitive to the intrinsic climate variability of the North Pacific. Indeed, when the waters off the west coast of the continental U.S. shifted to cooler conditions after 1998, the subarctic did not change, in contrast to three earlier PDO shifts in the 20th century.

Thus, it was projected that the Bering Sea will more likely continue on its current warm trajectory, with biomes transitioning northward at the expense of cold and ice-adapted species. A more complete discussion is in Overland and Stabeno (*EOS*, 2004, Vol. 85, No. 33) and Stabeno and Overland (*EOS*, 2001, Vol. 82, No. 29).

Coccolithophore bloom in the eastern Bering Sea

The eastern Bering Sea coccolithophore bloom, appeared once again this past summer. Dr. L. Eisner and J. Murray of NOAA's Auke Bay Laboratory spotted the aquamarine-colored water during two legs of this year's BASIS cruise which appeared to be confined to the waters above the pycnocline. These waters were found in early September between 58.13ºN, 168ºW and 59ºN and 170ºW. During the second leg of the BASIS cruise in late September, the aquamarine waters were between 59.5ºN, 172ºW and 60ºN and 173ºW. The bloom was not observed during the summer annual Hokkaido University T/S *Oshoro Maru* cruise (Dr. S. Saitoh, Hokkaido Univ., pers. comm.). Early in the summer, there were reports of reddish water between the Pribilof Islands. To my knowledge, the source of the color was never determined.

Poor recruitment of some Pribilof Island seabirds

There have been several reports of poor recruitment by diving seabirds in the Pribilof Islands this past summer. Various researchers conducting studies on and around the islands have mentioned recruitment problems with some of the species. Anomalous circulation patterns were also observed early in the summer from satellite drifters (Dr. P. Stabeno, Pacific Marine Environmental Laboratory, pers. comm.). More factual reports will be forthcoming.

Arctic Climate Impact Assessment Report

A multi-national task force of the Arctic Council, and the International Arctic Science Committee have released a report on arctic climate change and its impacts. The report was published in two sections, an overview report and a fully referenced scientific report. The 140-page overview report (available as a pdf file at http://www.acia.uaf.edu/) is meant to be a "plain language synthesis of key findings accessible to policy makers and the broader public".

Ecosystems of the Subarctic Seas (ESSAS) Symposium and BEST Science Plan

GLOBEC International and PICES are sponsoring a symposium on "Climate variability and sub-Arctic marine ecosystems" to be held May 16-20, 2005, in Victoria, B.C., Canada. The deadline for papers has already passed, but registration is still open at http://www.pml.ac.uk/globec/structure/regional/essas/symposium/annoucement.htm.
During the meeting there will be an open discussion of an implementation plan for BEST (Bering Sea Ecosystem Study). The BEST Science Plan has been published and is available on the ARCUS website at http://www.arcus.org/Bering/science_plan.html.

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