The Bering Sea: Current status and recent events

by Jeffrey M. Napp

Current status of the Bering Sea ecosystem

Do you believe in string theory? No, not the model of fundamental physics that replaces zero-dimensional point particles with one-dimensional extended objects (strings), but the statistical relationship observed in the Bering Sea where cold years occur sequentially like beads on a string. The winter of 2005/2006 was cold, with significantly more sea ice than had been observed in several previous years, although much less than during the 1970s (**Fig. 1**). It is noteworthy that the 2005/2006 event followed a familiar atmospheric pattern associated with cold winters: a negative Arctic Oscillation Index combined with La Niña conditions on the equator. This past winter (2006/2007) was characterized by a positive Arctic Oscillation Index and mild El Niño on the equator, but the weather was colder, with significantly more ice farther south than in the previous year. During late April, winds were still blowing from the northeast and air temperatures were –29°C (with wind chill). Cold waters in the eastern Bering Sea this year were facilitated by conditioning of the water column the previous year. Recent studies by James Overland and Phyllis Stabeno (NOAA-PMEL) to downscale IPCC climate predictions concluded that such cooling periods with large interannual variability will soon disappear, and the global warming signal will become predominant (http://www.alaskamarinescience.org/2007/bsai.htm).

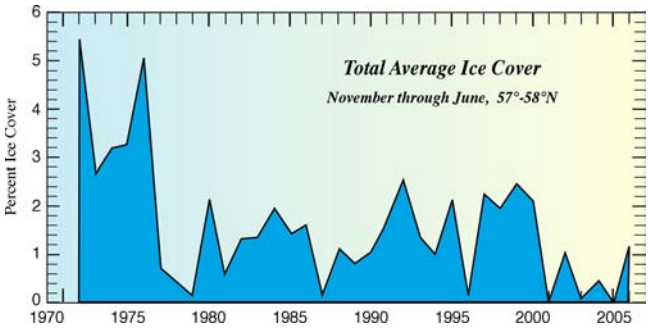

Fig. 1 The annual percentage of ice cover in a one degree (57°–58°N) box stretching from the Alaskan coast to shelf break from November through May. This box is just north of NOAA mooring M2. Figure courtesy of P. Stabeno, NOAA-PMEL.

Spring survey of the eastern Bering Sea

The spring 2007 research cruise by the Coast Guard icebreaker USCGC *Healy* (**Fig. 2**) was the first one funded by the Bering Ecosystem Study (BEST), a program sponsored by the U.S. National Science Foundation. A group of researchers from Columbia University, Princeton University, University of Alaska at Fairbanks, University of Washington, Western Washington University, National Oceanic and Atmospheric Administration, and the Fish and Wildlife Service conducted a multi-disciplinary cruise in both ice-covered and ice-free areas. Overviews of the expedition can be found at two web sites: http://www.polartrec.com/best-cruise/ overview and http://www.pmel.noaa.gov/foci/ice07. The expedition was a significant advancement over other recent cruises because it was able to sample within the ice-covered areas. The scientific expertise of almost 50 investigators on board included: ocean physics and chemistry (macronutrients, iron, gases), phytoplankton species, physiology and production, zooplankton community composition, abundance and distribution, benthic community composition, production, nutrient generation, fisheries hydroacoustics, seabird and marine mammal abundance and distribution, and pinniped satellite tracking.

Fig. 2 The 128-m Coast Guard icebreaker USCGC Healy *in the ice of the eastern Bering Sea viewed from a support helicopter. The ship is named for Captain Michael "Hell-Raising" Healy, a rough and tumble captain of U.S. revenue cutters in Alaska in the 1880s. Photo by D. Forcucci, Scientific Liaison for the ship.*

The cruise started with a transect along the 70 m isobath from mooring M2 in the southeast to St. Lawrence Island in the north (**Fig. 3**). This transect has been sampled in three consecutive springs (2005–2007) that correspond to warm, cool, and cold years. The data obtained provide important information regarding interannual variation along the front that separates the southern and northern communities of the eastern Bering Sea. After defining along-shelf distributions of physics, chemistry, plankton,

fish, birds and mammals, the expedition focused on documenting cross-shelf patterns from north to south, moving in and out of ice-covered and ice-free areas with ease. The polynyas of St. Lawrence and St. Matthew Islands were of special interest, as ice was forming in the St. Lawrence polynya during our short time there. Brief stops at St. George and St. Paul Islands allowed scientists to visit local schools to explain the purpose of the expedition to the residents. Some local teachers and high-school students were able to visit the vessel and learn more about the research.

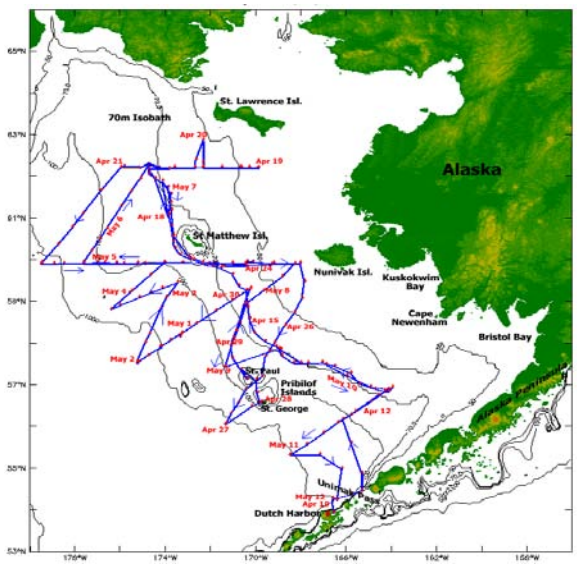

Fig. 3 Cruise track of the USCGC Healy *(April 10 to May 12, 2007).*

Of particular interest to many was the investigation of primary production under the ice. On numerous occasions, scientists were lowered over the side of the *Healy* to sample ice and ice algae (**Fig. 4**). In addition to samples of the ice, and determining nutrient concentrations of the brine, primary production was measured by monitoring the evolution of oxygen. Casual observations of the ice broken and overturned by the ship indicated considerable spatial variability in the amounts of under-ice phytoplankton. Nevertheless, when it was present it seemed like it was pervasive (**Fig. 5**).

Bering Sea Integrated Ecosystem Program

As this column is being written, the National Science Foundation (NSF) Polar Programs Division and the North Pacific Research Board (NPRB) are meeting to determine the next round of proposals for integrated research in the eastern Bering Sea. Scientists who responded to calls for proposals the previous winter will soon learn whether or not they were funded to participate. NSF's BEST Program plans to conduct at least three more spring cruises with an icebreaker and perhaps some summer cruises with NPRB investigators to understand how climate variability and the loss of sea ice will affect the ecosystem.

Fig. 4 Scientists were lowered to the ice in a "basket of adventure". The Rescue Swimmer is in the yellow dry suit and a crew member with rifle (our Bear Watch) is seen at the top of the picture. Photo by J. Napp.

Fig. 5 A close-up of ice with associated algae. Color of overturned and broken ice behind the ship reveals the extent of a coating of under-ice algae. Photo by J. Napp.

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Dr. Jeffrey (Jeff) Napp is a Biological/Fisheries Oceanographer at the Alaska Fisheries Science Center of NOAA-Fisheries. He is Head of the Recruitment Processes Program at the Center and co-leader (with Dr. Phyllis Stabeno) of NOAA's Fisheries Oceanography Coordinated Investigations (FOCI). His own research is focused on physical and biological processes at lower trophic levels that affect recruitment variability in fish populations. He was active as Principal Investigator in both Bering Sea (NOAA's Bering Sea FOCI, Southeast Bering Sea Carrying Capacity) and Gulf of Alaska (FOCI, GLOBEC) Programs, and currently serves on a Science Steering Committee to implement a U.S. science initiative for the Bering Sea (BEST: Bering Ecosystem Study). Jeff is the Chairman of the PICES Monitor Technical Committee.