

## The Bering Sea: Current Status and Recent Trends

by Lisa Eisner

### *Climate and oceanography*

In the Bering Sea, winter–spring ocean temperatures in 2012 remained cold with lots of sea ice, similar to 2008 and 2010. This created the most extensive cold pool of the recent decade for summer 2012 (Fig. 1). Unlike a year ago, the summer of 2012 was relatively calm, and this resulted in a rather thin (~10 m) mixed layer that rapidly warmed in June through July, especially in the north, producing near-normal sea surface temperatures in summer (Fig. 2). Given the relatively low heat content on the Bering Sea shelf at present, we are probably looking at a moderate to heavy ice year for 2013, although weather in late winter and early spring can change this prediction.

In the Arctic, summer sea ice cover continued its downward trend into 2012, with a new record low, since records began in 1979, in September 2012. However, the distribution of the Arctic sea ice in early August differed somewhat from recent years, with high ice concentrations persisting in the Chukchi Sea and in the western portion of the Beaufort Sea.

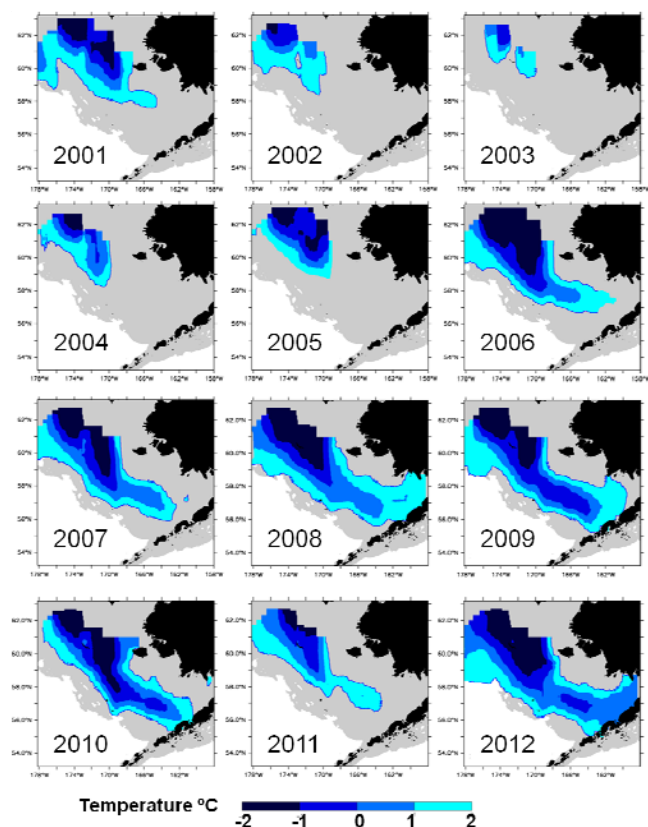


Fig. 1 Summer cold pool locations on the eastern Bering Sea shelf from bottom trawl surveys, 2001–2012. Figure courtesy of J. Overland.

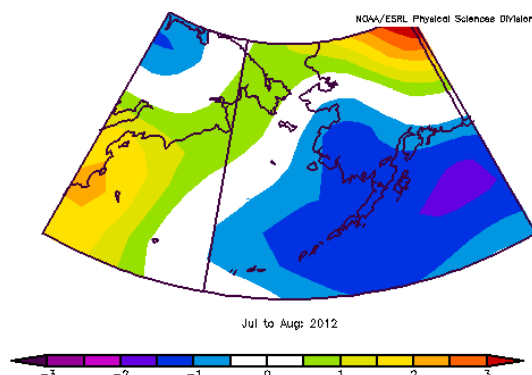


Fig. 2 NOAA sea surface temperature anomalies (deviations from 1981–2010 climatology) for July–August 2012. Figure courtesy of J. Overland.

### *Bering Sea and Chukchi Sea surveys in 2012*

Several fisheries oceanography surveys took place during summer and early fall 2012 in the Bering Sea. Hokkaido University's T/S *Oshoro Maru* conducted a survey in the Aleutian Islands and eastern Bering Sea shelf. NOAA's Alaska Fisheries Science Center carried out a summer shelf bottom trawl survey, a summer shelf midwater trawl survey, a summer Aleutian Island bottom trawl survey, and a late summer ecosystem survey. The Russian Pacific Federal Fisheries Research Institute's (TINRO) R/V *Professor Kaganovsky* conducted a bottom survey, benthic micro survey, an acoustic and trawl survey (pollock) in August, and a pelagic survey (salmon) September to October, in the western Bering Sea.

One interesting result from the NOAA summer bottom trawl survey was that pollock (*Theragra chalcogramma*) were aggregated inside the cold pool within the 0°C temperature contour (Fig. 3). This was unusual since pollock were found outside the 1°C contour in past years.

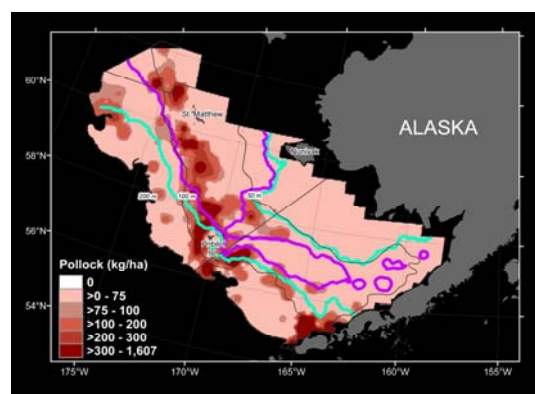


Fig. 3 Walleye pollock distribution in relation to 0°C (purple) and 1°C (aqua) temperature contours from NOAA bottom trawl surveys in the summer of 2012. Figure courtesy of R. Lauth.

Bottom trawl survey biomass estimates of pollock were similar or slightly up compared to 2011, at 3.49 million mt (Fig. 4, top), but average pollock size was smaller. The survey biomass of Pacific cod (*Gadus macrocephalus*) remained strong (0.9 million mt for the third consecutive year (Fig. 4, bottom), with multiple year classes present.

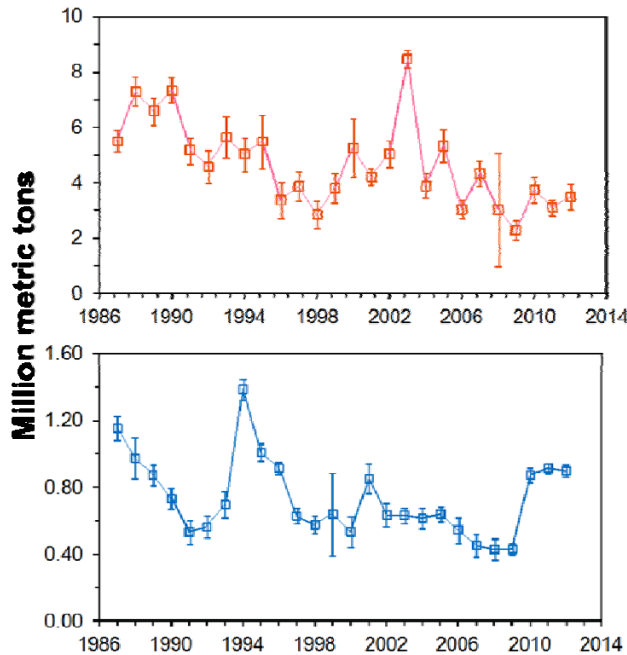


Fig. 4 NOAA bottom trawl survey biomass estimates of pollock (top) and Pacific cod (bottom) in the eastern Bering Sea, 1987–2012. Figures courtesy of R. Lauth.

In the Chukchi Sea, a myriad of surveys were conducted by the U.S., Japan, Russian Federation, China and Korea (see [http://data.aos.org/maps/arctic\\_assets/](http://data.aos.org/maps/arctic_assets/)). Here we focus on fisheries data collected by two ecosystem sampling programs: the Arctic Ecosystem Integrated Survey (Arctic EIS) and the Russian–American Long-Term Census of the Arctic (RUSALCA), a joint U.S.–Russia research program in the Bering and Chukchi Seas.

NOAA and the University of Alaska Fairbanks, with support from the U.S. Bureau of Ocean Energy Management (BOEM) carried out Arctic EIS surveys on the U.S. side of the Chukchi Sea in August–September 2012. Oceanography and plankton, surface and acoustic midwater trawls, and seabird observations in the north Bering Sea and Chukchi Sea were conducted on the F/V *Bristol Explorer*. Bottom trawls were deployed over the same time period in the Chukchi Sea on the F/V *Aquila*.

Age-0 Arctic cod (*Boreogadus saida*), a key ecologically important species in the Arctic, were concentrated in the northern Chukchi Sea in surface waters (Fig. 5). Acoustic backscatter data also indicated that aggregations of age-0 Arctic cod dominated the backscatter from 69–71°N, while Pacific herring (*Clupea pallasii*) were dominant from 66–67.5°N. The highest fish biomass from bottom trawl

surveys in the Chukchi Sea were Arctic cod, saffron cod (*Eleginus gracilis*) and Pacific herring (Fig. 6, top). Adult herring had the highest overall biomass in the surface trawls. Invertebrates were abundant in the Chukchi Sea shelf ecosystem, with 336 taxa caught in bottom trawls (Fig. 6, bottom), far outweighing total fish biomass. Arctic EIS surveys (oceanography, plankton, surface trawls and midwater acoustics) will be repeated in August 2013.

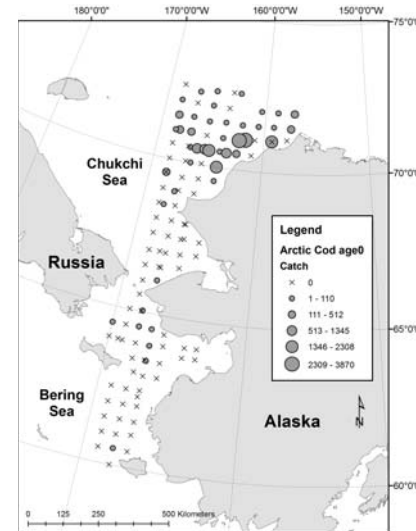


Fig. 5 Number of age-0 Arctic cod caught in Arctic EIS surface trawls, August to September, 2012. Figure courtesy of E. Farley.

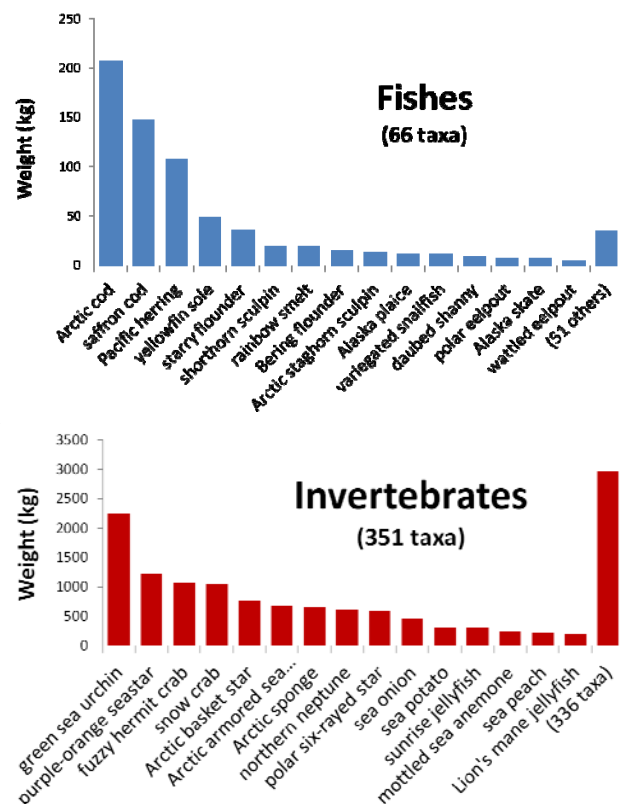


Fig. 6 Bottom trawl fish (top) and invertebrate (bottom) catches in the Chukchi Sea, August to September 2012. Figures courtesy of R. Lauth and F. Mueter.

RUSALCA conducted ecosystem surveys collecting a suite of oceanographic parameters, plankton, fish and invertebrates in the Chukchi Sea aboard the R/V *Khromov* in August–September 2012. Bottom otter trawls were deployed at 16 stations in Russian and U.S. waters in September 2012 (Fig. 7). Bottom depths were in a range from 39–97 m. The catch included at least 31 species, but fewer species were caught and fewer tissue samples and photographs were taken in 2012 than in 2009 because of foul weather and ice. The ship did not reach the northern continental slope stations where several first and rare records of species were found in 2009. However, having draft pages from the new identification guide, *Pacific-Arctic Marine Fishes* (Mecklenburg and others, due out in 2014), enabled relatively rapid and more accurate identification of fishes by RUSALCA program scientists.

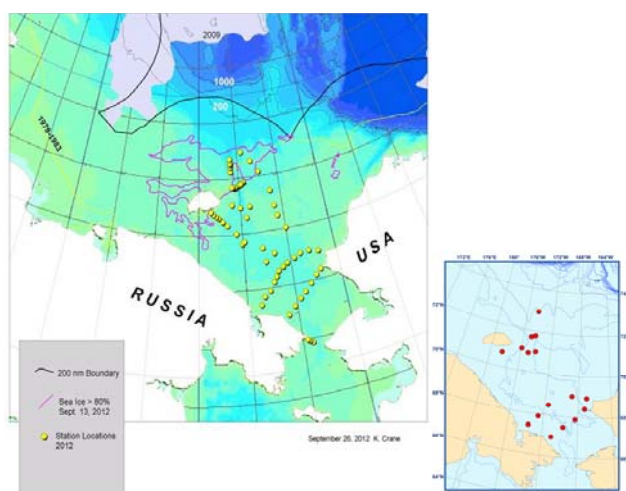


Fig. 7 2012 RUSALCA leg 2 ecosystem stations. Small map shows locations of fish collections. Maps courtesy of K. Crane and C. Mecklenburg.



Fig. 8 *Liparis tunicatus* (top) and *Myoxocephalus scorpius* (bottom) from 2012 RUSALCA surveys. Photos by C. Mecklenburg.

Two of the most striking highlights of the RUSALCA 2012 otter trawl catch were: (1) unusually large numbers of postlarval juvenile kelp snailfish, *Liparis tunicatus* (Fig. 8, top), with the greatest numbers at stations in the southwestern Chukchi Sea off the Chukotka Peninsula (in 2004 and 2009, few were caught despite sampling at more

stations), and (2) unusually low numbers of shorthorn sculpin *Myoxocephalus scorpius* (Fig. 8, bottom) of any age at any station. In 2004 and 2009, this climate sentinel species was widespread and one of the three most abundant species in RUSALCA bottom trawls on the continental shelf. In 2012, however, it dropped to 11th place, even though the stations sampled included some of the most productive locations sampled in the previous years. Research over the coming months will focus on these and other observations from the RUSALCA 2012 data.

### Upcoming science meetings

Meetings in the first half of 2013 of interest to scientists working in the Bering Sea include:

- ESSAS (Ecosystem Studies of Subarctic Seas) Annual Science Meeting on “*Spatial dynamics of subarctic marine ecosystems*”, January 7–9, Hakodate, Japan;
- Alaska Marine Science Symposium, January 21–25, Anchorage, U.S.A.;
- Lowell Wakefield Symposium on “*Responses of Arctic marine ecosystems to climate change*”, March 26–29, Anchorage, U.S.A.;
- The North Pacific Anadromous Fish Commission workshop on “*Migration and survival mechanisms of juvenile salmon and steelhead in ocean ecosystems*” April 25–26, Honolulu, HI, U.S.A.

**Acknowledgements:** Many thanks to the following scientists who helped create this report: Drs. Nicholas Bond, Kathleen Crane, Ed Farley, Robert Lauth, Jim Overland, Catherine Mecklenburg, Franz Mueter and Olga Temnykh.



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