Late-season Arctic research cruise reveals warm ocean temperatures, active ecosystem

November 11 2020

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ecosystem. Credit: University of Maryland Center for Environmental Science/Lee Cooper

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"The water and air temperatures were warmer, and we had ecosystem activity that normally doesn't occur late in the season," said University of Maryland Center for Environmental Science Research Professor Jacqueline Grebmeier, chief scientist on the research cruise and a national and international leader in Arctic research.

Grebmeier and Cooper were part of a small team of researchers from the University of Maryland Center for Environmental Science, the University of Alaska Fairbanks, and Clark University that completed an unusual late-season Arctic research cruise due travel challenges presented by COVID-19 pandemic. They found an ecosystem—expected to be powering down to low-level winter activity with sea ice forming—to be still active, likely due to unseasonably warm ocean temperatures. Sea ice formation was still a number of weeks away.

"2020 turned out to be the second lowest minimum sea ice extent, meaning that sea ice retreated back closer to the North Pole," Grebmeier said. "We had warming water up to 3 degrees Celsius higher than typical

all the way through water column. That means you can't cool it down that quickly to build ice."

And ice is important. It's the ice that sets up that really productive spring system to power the ecosystem.

"Without ice forming you don't get that spring ice algal production, which is the first hit of nice, fresh carbon that the animals in the sediments use to increase their growth," she said. "So some open water areas are going to bloom later in the season because it will be like opening a larger playing field and provide food for water column animals like zooplankton, while others that depended on that ice algal production in the bottom shallow shelf sediments are going to have more limited seasonal food."

The late fall season sampling indicates that delays in sea ice formation are supporting late-season biological production that has not been commonly observed before.

"The biomass of microalgae in the water column was unexpectedly high and not much lower than often observed in the middle of the summer under near 24-hour daylight," said University of Maryland Center for Environmental Science Research Professor Lee Cooper, who led water column biological and chemical measurements.

Grebmeier and Cooper are also seeing shifts in these benthic animals. The clams and worms that live on the bottom of the Arctic and are an important food source for everything from bottom-feeding fish to walruses and diving sea ducks.

"We are seeing declines in the biomass in a lot of areas so there isn't as much food on the sea floor as there used to be, meaning less food available for the things that we traditionally think of as Arctic animals,"

said Cooper. "The ecosystem is changing."

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"It's kind of like you took a balloon and you squeezed it, and the southern part of it is getting smaller and the northern part is getting bigger. There's a contraction of these rich Arctic fatty benthic animals from the south to higher amounts in the north," said Grebmeier.

The researchers usually do their annual observations July-September, but the COVID-19 pandemic resulted in delays and pushed their cruise into October for the first time. Maintaining the continuity of long-term observations is crucial as the region is affected by climate change.

"We've been working up there for nearly 30 years annually. This would've been a gap in the measurements, and this was a critical year given the low ice extent," said Cooper. "We did the full suite of sampling we do in observing program, we just did it in October."

The research vessel Norseman II carried the scientists for the three-week research cruise. Prior to the cruise, the science crew undertook a COVID-19 quarantine in Anchorage, including multiple testing, before flying to Nome and transferring directly to the ship to avoid any potential viral exposure to residents in the Bering Strait region. The individual participating universities had their own stringent requirements and testing protocols prior to approving travel.

The team stopped at several established observing stations where scientists can monitor everything from the temperature and salinity of the water and the amount of zooplankton (fish food) swimming around to harmful algal blooms of phytoplankton and animals living in the sediment. The goal is to observe and document how the Arctic creatures are responding to climate change and track those ecosystem changes under further loss of sea ice.

The Distributed Biological Observatory (DBO) is a series of standard stations occupied seasonally by national and international ships and moorings that take continuous physical, chemical and biological measurements in the U.S. Arctic waters to document how biological systems are changing and/or adapting as a result of environmental change. Grebmeier led an international team of scientists to establish the DBO in the North American Arctic.

The Arctic Marine Biodiversity Observing Network, led by Katrin Iken at University of Alaska Fairbanks' College of Fisheries and Ocean Sciences, is part of a national network studying how biodiversity and species distributions are changing as a result of climate change in the U.S. Arctic.

The researchers also visited the Chukchi Ecosystem Observatory, a set of highly instrumented oceanographic moorings that monitor the ecosystem year-round.

"This was a really worthwhile effort that paid off in making biological data available from a part of the year where there have been historically few observations," said Grebmeier.

The samples obtained and brought back to home laboratories in Maryland, Washington State, and Alaska will support multiple long-term projects. The scientists were also able to collect samples for others who couldn't go on the cruise due to COVID travel and research restrictions.

Provided by University of Maryland Center for Environmental Science

Citation: Late-season Arctic research cruise reveals warm ocean temperatures, active ecosystem (2020, November 11) retrieved 3 May 2024 from https://phys.org/news/2020-11-late-season-arctic-cruise-reveals-ocean.html