Disappearing Alaskan sea ice is significant for Arctic marine ecosystem

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A new study shows that plant materials originating in Arctic sea ice are significantly incorporated into marine food webs that are used for subsistence in local communities of the greater Bering Strait region.

The study led by scientists from the University of Maryland Center for Environmental Science traced persistent biological compounds that are uniquely generated by microscopic plants in sea ice and found that the compounds are present throughout the base of the food web. The research has the potential to demonstrate the importance of sea ice ecosystems as a source of food in Arctic waters in Alaska and beyond.

"It is widely thought that the loss of sea ice habitat will have far-reaching implications for Arctic ecosystems," said lead author Chelsea Wegner Koch, a graduate research assistant and the University of Maryland Center for Environmental Science.

"As sea ice breakup occurs earlier and forms later each year, the open water period is expanding and the sources of food are shifting away from sea ice and towards greater proportions of open water production. This production in the absence of sea ice differs in the quality, quantity, and timing of delivery to the seafloor," she said.

Efforts to account for the proportional shifts in contributions of ice algae have been incomplete due to the lack of a specific tracer that can be definitively assigned to ice algae rather than open-water phytoplankton. The compounds reaching the seafloor that were studied are associated with food for a range of seafloor animals that in turn provide food for ecologically and culturally important organisms, such as the bearded seal, Pacific walrus, gray whale and spectacled eider that forage on the shallow sea floor.

The study, published in the journal *PLOS ONE* with scientists from Clark University, Université Laval, and the Scottish Association for Marine Science, used sediment samples collected in the field during research cruises in the Bering and Chukchi seas, as well as samples collected from an automated under-ice moored sediment trap that operates over the winter offshore of Wainwright on Alaska's North

Slope.

Findings showed a transition to more dependence on sea ice materials in direct relation to sea ice coverage, but that the sea ice biomarkers persisted year-round and were primarily released as snow melted on the sea ice coverage present in the winter.

"Particularly as sea ice coverage decreases—and in recent years has become negligible in the north Bering Sea—we are entering a new era where we will have to use approaches such as this to evaluate how the ecosystem will obtain the basic building blocks needed to sustain the food web, including human communities that depend upon them for food security," said Koch.

The study also showed that ice-sourced food rapidly reaches the seafloor sediments, suggesting that when significant ice cover is present in the winter and spring, long-term reserves of organic matter can remain accessible to seafloor animals even if production declines.

"These reserves may buffer shifting food sources in the near-term for organisms that live within the surface sediments but are likely to become inaccessible in the future if current sea ice declines continue," said Koch.

The study shows that in the northern Bering Sea, the sea ice biomarkers indicate comparatively minimal inputs of ice algae in recent years and a more open water-dominated system that will favor different organisms than have persisted in this region in the past. One final implication of the work is that it also can be potentially used to provide regional insights into paleoclimate indications of sea ice cover since the sea ice compounds persist in the sediments.

"By incorporating the extensive existing datasets of the physics and

chemistry of the region, we can potentially improve interpretations of the sea ice biomarker dynamics to reveal changes in sea ice but also productivity relevant to long-term climate studies in the region," said Koch.

"Seasonal and latitudinal variations in sea ice algae deposition in the Northern Bering and Chukchi Seas determined by algal biomarkers" was published in *PLOS ONE* by Chelsea Wegner Koch, Lee Cooper, and Jacqueline Grebmeier of the University of Maryland Center for Environmental Science; Thomas Brown of Scottish Association for Marine Science; Catherine Lalande of Universite; Laval; and Karen Frey of Clark University.

Provided by University of Maryland Center for Environmental Science