Learning About Sea Ice and Its Use from the Kiŋikmuit

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Sea ice in a changing Arctic

Over the past few years, Arctic sea ice has received increasing attention by the public, mostly in the context of Earth's climate warming and environmental change. Newspaper and television coverage typically discuss the shrinking and thinning of Arctic ice by referring to scientific studies based on satellite data or climate models. While scientifically accurate, this type of information from satellites or computer models is generally collected at a very coarse resolution and it provides only a limited view of the characteristics of the ice itself.

Consider, for example, the finding that the Arctic sea ice summer extent has decreased by about 10% per decade for the past three decades, with a dramatic reduction of almost 25% below the previous record minimum in 2007 (Stroeve et al., 2008). The satellite data entering into these observations are usually taken for a single day when ice extent is at its lowest level, typically in the first half of September. As the satellite orbits the Earth, each spot measurement, a so-called 'pixel,' is pieced together into a large mosaic of the Arctic. A pixel covers roughly 16 by 16 miles (25 by 25 km). The entire width of Bering Strait is covered by four such pixels. The portion of the sea that can be seen by an observer at Wales, as pictured on the many photographs featured in this book, accounts for less than 10% of a single pixel.

This coarse scale is sufficient for a general study of how Arctic sea ice helps regulate Earth's climate, most importantly by reflecting sunlight away from the ocean. However, such data is of less value if we want to learn about how marine mammals utilize different ice types or to get practical information for coastal communities that rely on shore-fast and drifting ice for hunting, transportation, and other use.

In a changing North that experiences not only a warmer climate and ice retreat, but also increasing ship traffic and industrial activities, demand is great for more detailed information about the characteristics of the ice cover and its seasonal waxing and waning. Planning and oversight associated with these various activities requires both broad and in-depth understanding of the ice, typically for a particular location. For this, answers to many specific questions are to be found, for example: How do ice movement and under-ice currents vary with season and distance from shore? In order to assess potential impacts of increasing human activities in the Arctic, information from one scientific discipline is often not enough.

Also, sea ice can be thought of not only as an inert material, like a solid rock, but also as a *process* that links different parts of the ocean and coastal land environment, and determines how animals, people, the ocean, and the land interact with one another in a specific local setting. These different interactions depend not only on the amount of ice but also very much on the type of ice and its properties. To understand it, other questions are to be answered. How much multi-year ice is embedded in the ice pack? How deeply grounded and how stable is the coastal shore-fast ice? During fall freeze-up, is the ice forming as slush and pancake ice or does the ocean freeze quietly with sheet ice? The list goes on and on.

Scientists' and users' perspectives on sea ice

Scientists approach these types of research questions often by breaking down the task into many smaller, manageable pieces. Each of these pieces is then studied by a group of experts from a specific discipline. While this approach is well proven and highly successful for many types of scientific research, it may not be always appropriate for keeping track of, and finding explanations to the changes in the ice cover and its impacts on the environment, marine ecosystems, and human uses of the ice.

A very different way of studying the ice is tied to its practical use, for example as a provider of food or a platform for travel and other activities. In Alaska, Inupiaq or Yupik knowledge of sea ice is derived largely from close, repeated observation and building of a vast body of knowledge that is continually tested and reaffirmed or modified by time spent observing the ice from shore, in boats, and on the ice itself.

A number of studies have already documented and discussed Inuit, Inupiaq, and Yupik sea-ice expertise in great detail (Nelson 1969; Krupnik et al. 2010; Krupnik and Jolly 2002; George et al. 2004; Oozeva et al. 2004; Gearheard et al. 2006; Laidler 2006; Laidler and Ikummaq 2008; Laidler and Elee 2008). Thanks to this work, it can be argued that indigenous communities across the Arctic are aware of the depth and extent of environmental change that is presently affecting their regions. People who are engaged in daily activities on ice and on the land, those who rely upon traditional knowledge and close monitoring of the environment can usually notice change at an earlier stage than do scientists who use models and instrumental observations. While generally focused upon a particular location, this systematic knowledge of hunters and other subsistence users provides a broad and in-depth perspective on the formation, growth and decay of sea ice, its seasonal and annual variations, and long-term change.

Extensive observation also allows members of northern communities, like Wales, to benefit from the resources and services the ice offers to them, such as access to game, a platform for travel and watching for animals, a place to butcher the kill, educate young hunters, and even to rest—and to do it in a safe and effective manner. User-based hunters' knowledge of ice can contribute substantially to broader understanding of ice formation and dynamics, as demonstrated through our project, in earlier studies, and in many testimonies of indigenous experts at community and scholarly meetings. Hunters and other local users of sea ice keep track not only of one, but of several dozen or possibly more characteristics of the ice environment, related to biology, geophysics and the weather conditions.

Such a holistic, multifaceted vision of ice as a *process* rather than a material—a 'frozen water'—has been the most effective way for local observers to recognize many signals of Arctic change that people in Wales and other northern communities see happening. When scientists also recognized the signals of environmental shifts in the Arctic region in the late 1990s, Bering Strait and the North Alaskan coastal zone became crucial locations for tracking changes in the polar ice cover and associated trends in marine life. This is why so many scientists are now coming to places like

Wales, Diomede, Gambell, Barrow, and other Alaskan communities to partner with local residents in the documentation of their knowledge about ice and marine life.

We have been fortunate and privileged in having Kiŋikmiut experts from Wales share their knowledge and understanding of ice in their native area for this book. Only a small portion of what is really known by hunters and elders is documented in this 'ice dictionary'. This expertise is precious to the studies of Arctic change and to the preservation of the Kiŋikmiut tradition alike. The Kiŋikmiut knowledge of the ice is of special value because of the location of their community. Positioned at the junction between two oceans and two continents, in a region with complex and highly variable ice patterns, the Kiŋikmiut thrived for many centuries because they have mastered successfully the use of both the shore-fast and drifting ice environment.

In an attempt to examine sea ice and its changing nature from different perspectives, we have been working at the interface between the local users' perspective (that is, the knowledge of Inupiaq and Yupik hunters) and western science. Now, with support of local experts like Winton Weyapuk, Jr., in Wales, Joe Leavitt in Barrow, Paul Apangalook and Leonard Apangalook, Sr., in Gambell, Chester Noongwook in Savoonga, Roman Armaergen in Uelen, Russia, and others, we are comparing ice observations within the context of our different interests and visions. Hence, taken as a whole, detailed observations from several communities across the Bering Strait region can shed light on today's large-scale shifts in the ice regimes, changes in marine animal behavior, and the impact of those changes upon people's use of the ice.

On the users' side this new collaboration includes an extended monitoring of the local ice conditions, an examination of the yearly ice cycle from the users' perspective, and collection of many traditional terms and definitions of sea ice, as exemplified in this 'dictionary' that includes over 120 Kiŋikmiut terms. On the scientists' side, we examine remote sensing data from satellites and coastal ice radars, various ice distribution charts, as well as on-ice measurements of thickness and properties.

Whereas our study is locally-tied to certain communities in the Bering Strait region and in Northern Alaska (see map on page 6), it is a part of a much larger effort that is currently underway as a part of the International Polar Year 2007– 2008 program. The *SIKU* project, as well as the ongoing work by Shari Gearheard and her partners (2006), is aimed at building a comparative framework for the examination of sea ice knowledge of indigenous ice experts from many communities in Canada, Greenland, Alaska, and Chukotka. Such an ambitious study of Arctic people's knowledge of ice has never been undertaken before. It will offer an invaluable and much anticipated term of reference to the scientists' models and projections that address the current changes in Arctic ice in a broader trans-polar and regional way.

Windows to the past

Working with local partners and learning indigenous knowledge of ice may help scientists advance their research in many other areas. One of the most promising applications is expanding the time range of scientific records. Satellite images of sea ice are available since the 1970s only. Records of local weather stations, with rare exceptions, are silent on the status of ice, its dynamics and major types. Many historical sea ice charts of the early explorers cover the High Arctic areas that are far away from the coastal zone and from the practical issues of today. Thus, applying the knowledge of Arctic residents scientists interested in former ice conditions in the North may literally open certain 'windows' to the past that are, otherwise, closed to them.

The wealth of knowledge that today's Kiŋikmiut experts may bring to the old historical sources was well demonstrated when people commented on Alfred Bailey's photographs of ice hunting in 1922. Only a portion of this information is presented in the captions to Bailey's images published in this book. Many are worth noting, like Winton Weyapuk's discussion of temperatures and lack of snow melt in May 1922 in one of the photos (p.80), unusual by today's standards. Another facet of the former ice dynamics can be seen in Bailey's photos featuring hunters wearing snowshoes, taglut, on young ice in springtime (pp. 11, 80). Evidently, the spring melt in the old days went through a longer (or slower?) process of thawing and refreezing that led to the wide-spread formation of young unstable ice, siguliaq, in April and May. Today, the spring disintegration of ice goes so fast in May, even in April, that there is hardly any need for special implements, in order for hunters to be able to walk over unstable spring ice.

In a similar way, other historical sources may be carefully re-read through a Kiŋikmiut eye to the great advancement of our knowledge about past ice conditions. For example, the recent book of letters and diaries written by Ellen Kittredge Lopp (Lopp-Smith and Smith 2001) between 1892 and 1902 contains numerous references to ice and weather events, ice conditions, start of spring whaling and walrus hunting that may serve as good evidence of ice dynamics in the Wales area.

For example, the Kiŋikmiut crews were actively hunting walrus on the moving ice floes in early-mid June, even in late June in 1893, 1898, 1901, and also in 1922, during Bailey's visit. Today, walrus commonly pass northward through Bering Strait on the retreating ice in mid- or late May and by early June there is no ice left off Wales anymore, as happened in 2007 and 2008. Even more fruitful would be applying the knowledge of today's experts to the early weather logs of the first missionaries and teachers from the 1890s, as was done in our St. Lawrence Island project (Oozeva et al. 2004). That would allow us extend our knowledge of the ice dynamics in the Bering Strait area by over a hundred years, back to the time of commercial whalers and the first International Polar Year of 1882–1883.

Adaptation, continuity, and change

Local sea-ice knowledge, such as the many terms and stories about ice compiled in this dictionary, may play an important role in guiding adaptation to a changing Arctic, both as a result of climate warming and socio-economic change. The challenges and opportunities that go hand-in-hand with the rapid change that is sweeping across the North require careful and responsible planning and action. The earlier and more pronounced expression of global climate trends in the Arctic has already forced the people of northern Alaska to devise ways in which traditional lifestyles can be adapted in the face of change.

The photographs compiled in this book showing modern-day activities on ice in comparison with those documented by biologist Alfred Bailey in 1922 contain a powerful message of continuity and change. The striking similarities and apparent continuity in the way Wales hunting crews organize their activities and gear on ice today and eighty-nine years ago is an illustration of people's resilience. It is also a testimony to their attachment to certain ways of using and behaving on ice that may be potentially vulnerable under the condition of rapid climate or socio-economic change. At the same time, the rapidity with which the hunting gear used by the Kiŋikmiut crews has been modernized to increase the efficiency and success in hunting indicates that the hunters are very adept at exploring new ways.

Moreover, the story of the resumption of the bowhead whaling in the ice leads off Wales in 1970 after a gap of many decades (in which two of our project team members participated as young men) suggests that even in the face of adversity and loss of expertise, a sustainable way forward can be found. Many other indigenous communities in the region, like Savoonga, Kivalina, Diomede, as well as Sireniki, Lorino, Uelen in Russia have also resumed whaling in leads and drifting ice in the past two to three decades. They have demonstrated enormous resources of innovation and resilience in the use of ice. This stock or resilience and innovation possessed by the polar residents of today will be, perhaps, their strongest asset in facing the challenges of future change.

This perspective is not meant to trivialize many prospective impacts of rapid climate or social change in the polar regions and the upheaval it may create in people's lives. Challenges such as relocation of coastal communities under the threat of coastal erosion; potential shifts in distribution of marine mammals due to new ice patterns; or the socio-economic transformations brought by environmental change indicate that a concerted effort by many interested parties will be needed to deal with adversity in the face of change.

We see our book and our partnership with the Native Community of Wales as a contribution to that common effort. It points to the importance of local knowledge and of a long history of observing and responding to change that may be crucial to people's preparedness for what likely will be a vastly different Arctic that their children and grandchildren are to inherit. It is our shared hope that by the time of the next International Polar Year in 2057, the Kiŋikmiut words for sea ice recorded in this book will be used in hunters' boats and on ice in the Bering Strait.

Killed bull walrus is pulled for butchering on the edge of the drifting ice floe. June 26, 1922.
(Photo: Alfred M. Baile, Denver Museum of Nature and Science, BA21-430)