CANADA'S ARCTIC MARINE ATLAS

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INTRODUCTION

Reflecting on Canada's storied history, the northern half of the country deserves more than a passing thought. From the search for the Northwest Passage to the recognition of land claims, the Arctic has loomed large in the imagination, geography, economy, law, and policy of Canada. It will continue to do so into the future, as Canada fulfills its role as a leader in Arctic affairs and as the Arctic shapes Canada's destiny and self-understanding.

The Canadian Arctic is a homeland and frontier, frigid and friendly, a source of riches and priceless just as it is. A place of competing visions and understanding—intimately known to Inuit, eagerly explored by adventurers, carefully studied by scientists, and yet filled with the unknown and the rapidly changing. It is deserving of respect, awe, wonder, and attention. The Canadian North is the largest area inhabited by a single Indigenous people and home to more Bowhead Whales, Beluga Whales, Polar Bears, and Narwhal than any other place on the planet.

In this atlas of Canadian Arctic waters, we celebrate what is known about the area and its inhabitants and ecosystems. We also acknowledge how much more is to be learned, if Canada is to serve as an able steward of all that its Arctic has and stands for. Inuit have thrived in the Arctic because they understand the fine details of land and sea in all their innumerable variations from day to day, year to year, generation to generation. Canada, too, can thrive as an Arctic nation only if it is guided by knowledge and care, created by hard work and by thoughtful listening to the land and its people.

The atlas, data, and beyond

We cannot know a region at a glance. We cannot capture a region in a map. Instead, we look back and forth from detail to panorama, from the remarkable properties of the Narwhal tusk to the great sweep of human history. In this atlas, we present a series of views of the Canadian Arctic marine environment, from physical geography, to biology and ecology, and on to human patterns and administration. The intent is to provide an introduction to what makes the region special, why it matters, and why it is worth the effort to govern it responsibly. This is especially true in a time of rapid climate and environmental change (see "The Changing Arctic" on page 6).

In each theme covered by the atlas, we provide several examples of key species, phenomena, or activities that help show the growth of our understanding of an ecosystem, as well as why that knowledge is important. While it is tempting to wait for better information, decisions will continue to be made based on what we know at the time. A dose of caution can help reduce the risk of mistakes, but neither the risk of unintended impact nor the risk of missed opportunity can be eliminated entirely.

If we are to act on the basis of the best available information, it is essential that existing information is in fact available. In compiling the data and creating the maps in this atlas, we have made use of extensive data in public archives and databases, for which we are very grateful. We have also had access to some data that are not, or not yet, publicly available, for which we are also grateful. Finally, we are aware of additional data that is not yet accessible, for a variety of reasons, and we encourage the holders of those data to make use of public archives as soon as possible. While the right to publish is important in research, good governance is a greater aim in the long run, and can be achieved only with access to all existing information.

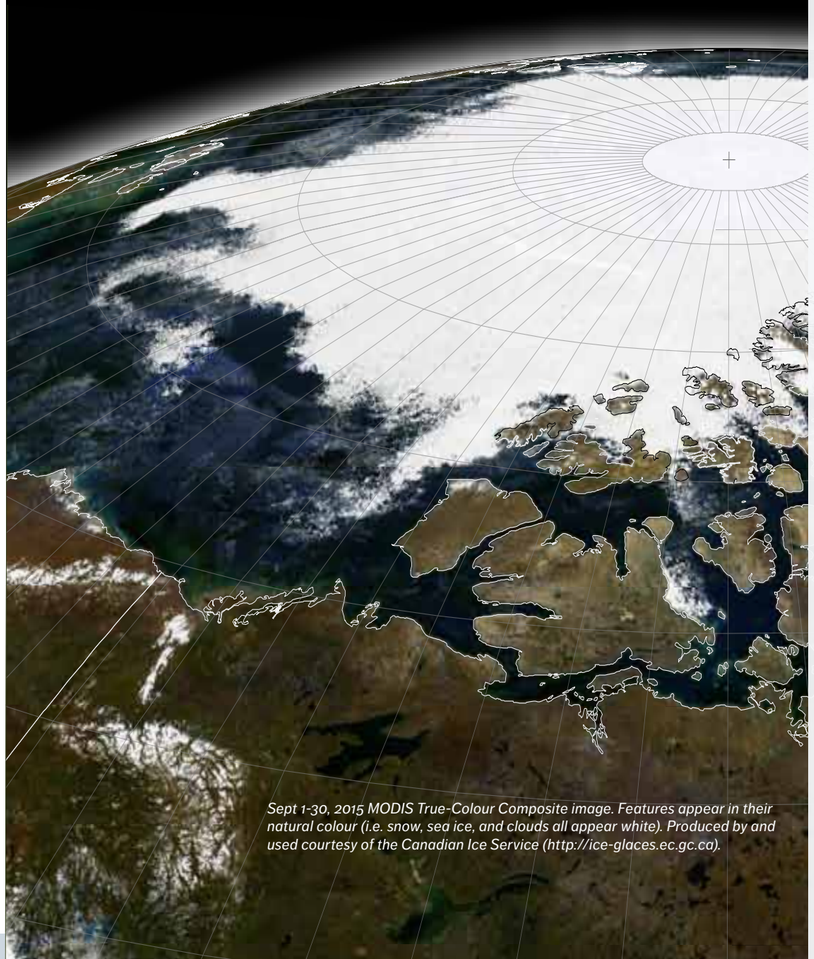
Combining data from different sources and across different intellectual and ecosystem domains is essential to building a complete picture of the Canadian Arctic. It is, however, challenging to match data collected at different scales and times and for different purposes. Understanding an ecosystem requires thinking of it as a system, a set of interacting pieces that influence one another in different ways over time and space. Overlaying data on water currents, sea ice, plankton, fish, seabirds, and marine mammals can produce thought-provoking results, but does not by itself tell us why some areas stand out for abundance and richness.

A further step, beyond the scope of this atlas, is to conduct syntheses that aim to connect not just data but understanding of how an ecosystem works, how it will respond to change, and how human actions will affect it. The well-being of the Canadian Arctic and its people depends not on simply understanding the region one part at a time or one decision at a time, but on creating a shared vision for the region and developing together the knowledge needed to achieve that vision. Doing so is a social process rather than a scientific one, although science and Inuit knowledge can contribute. Simply put, if we do not know where we want to go, we will never get there. But if we know what we want, we will know what we need to learn in order to realize our goals.

We present this atlas in recognition of all those who have contributed to the understanding the atlas reflects, and in the hope of a future of abundance and well-being in the Canadian Arctic and beyond.

Photo facing page: Subsistence hunters at the polyna edge. (photo: Jennifer Provencher)

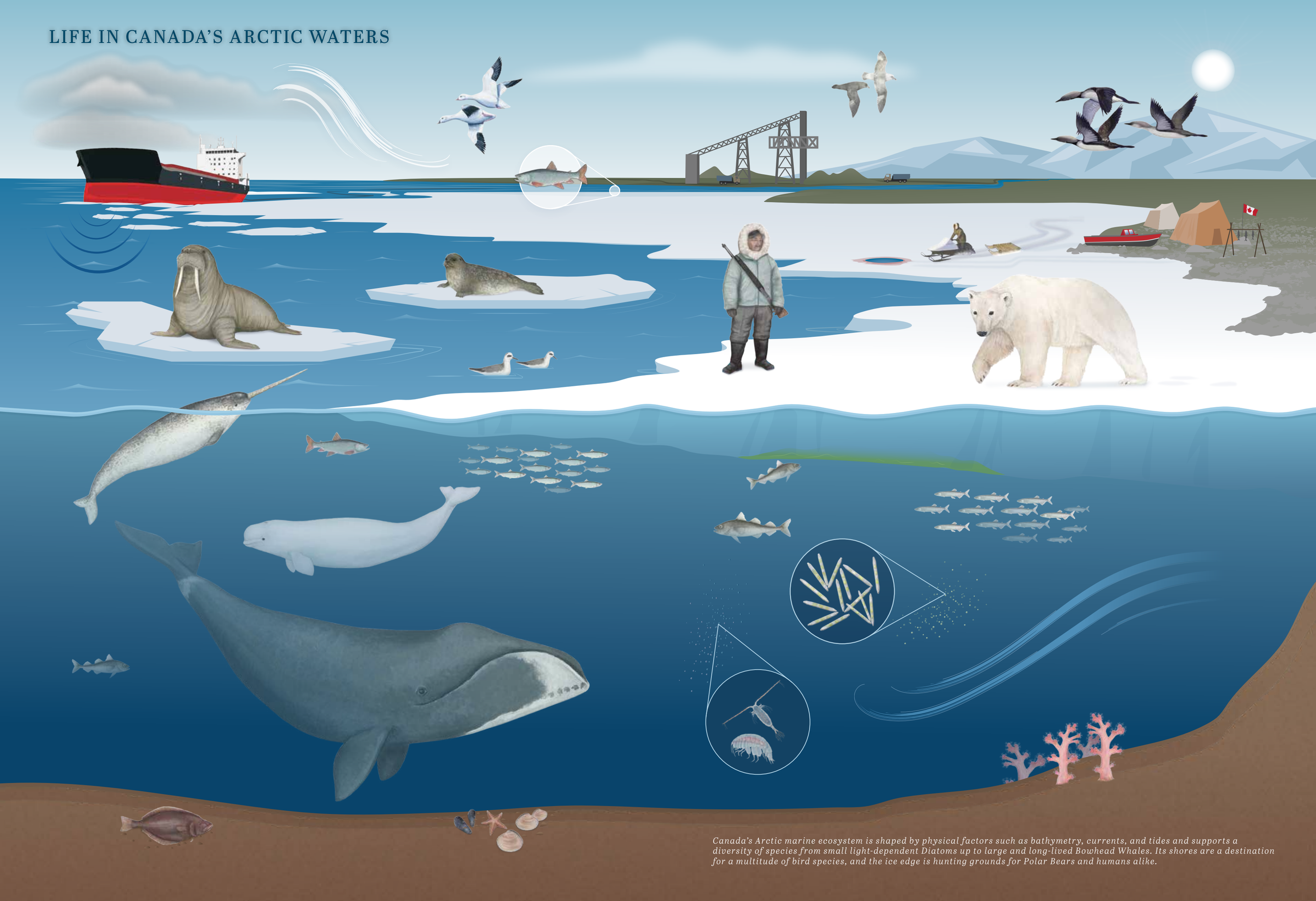
Canada's Arctic Marine Atlas by Topic



Sept 1-30, 2015 MODIS True-Colour Composite image. Features appear in their natural colour (i.e. snow, sea ice, and clouds all appear white). Produced by and used courtesy of the Canadian Ice Service (http://ice-glaces.ec.gc.ca).

The Canadian Arctic

LIFE IN CANADA'S ARCTIC WATERS



Canada's Arctic marine ecosystem is shaped by physical factors such as bathymetry, currents, and tides and supports a diversity of species from small light-dependent Diatoms up to large and long-lived Bowhead Whales. Its shores are a destination for a multitude of bird species, and the ice edge is hunting grounds for Polar Bears and humans alike.

THE CHANGING ARCTIC

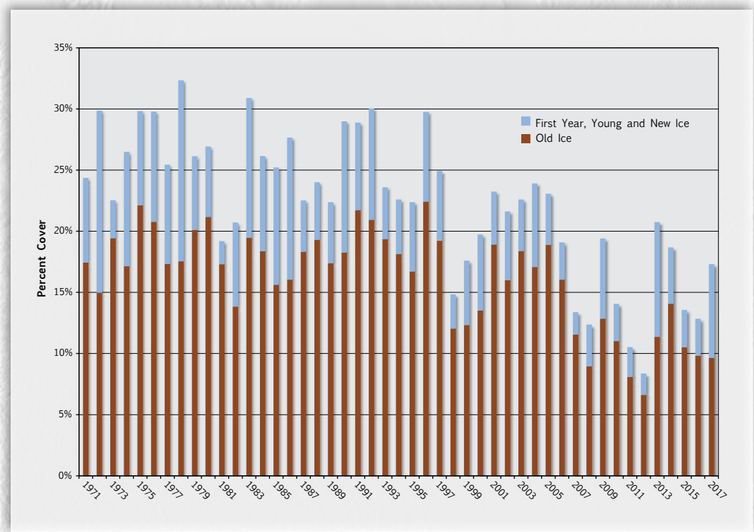
The loss of summer sea ice in the Arctic is one of the most visible signs of climate change on the globe. And it is only one symptom of how quickly the region's ecosystems are changing. Sea ice covers less area than it used to, in all months of the year. It is thinner and more vulnerable to rapid retreat. Sea surface temperatures are rising, too, partly because sunlight falls now on open water instead of reflecting off ice and snow.

For species adapted to cold and to ice, these changes are a threat. Sea ice algae, Arctic plankton, and Polar Bears must all adapt. Other species may move into the warmer Arctic. Killer Whales, for example, arrive in northern waters earlier, in greater numbers than before, and stay later. This is not good news for the marine mammals Killer Whales like to eat.

Less obvious but potentially more significant, warmer waters and less ice are restructuring the Arctic food web from the bottom up. Arctic plankton species face competition from subarctic plankton. Atlantic Cod, Atlantic Pollock, Capelin, and Haddock are moving northward. Seabirds find it harder to fill their bellies and feed their young. The ice is a less reliable platform for Walrus to haul out and rest in summer, for seals to build birthing lairs in deep snow, or for humans to travel across as they hunt.

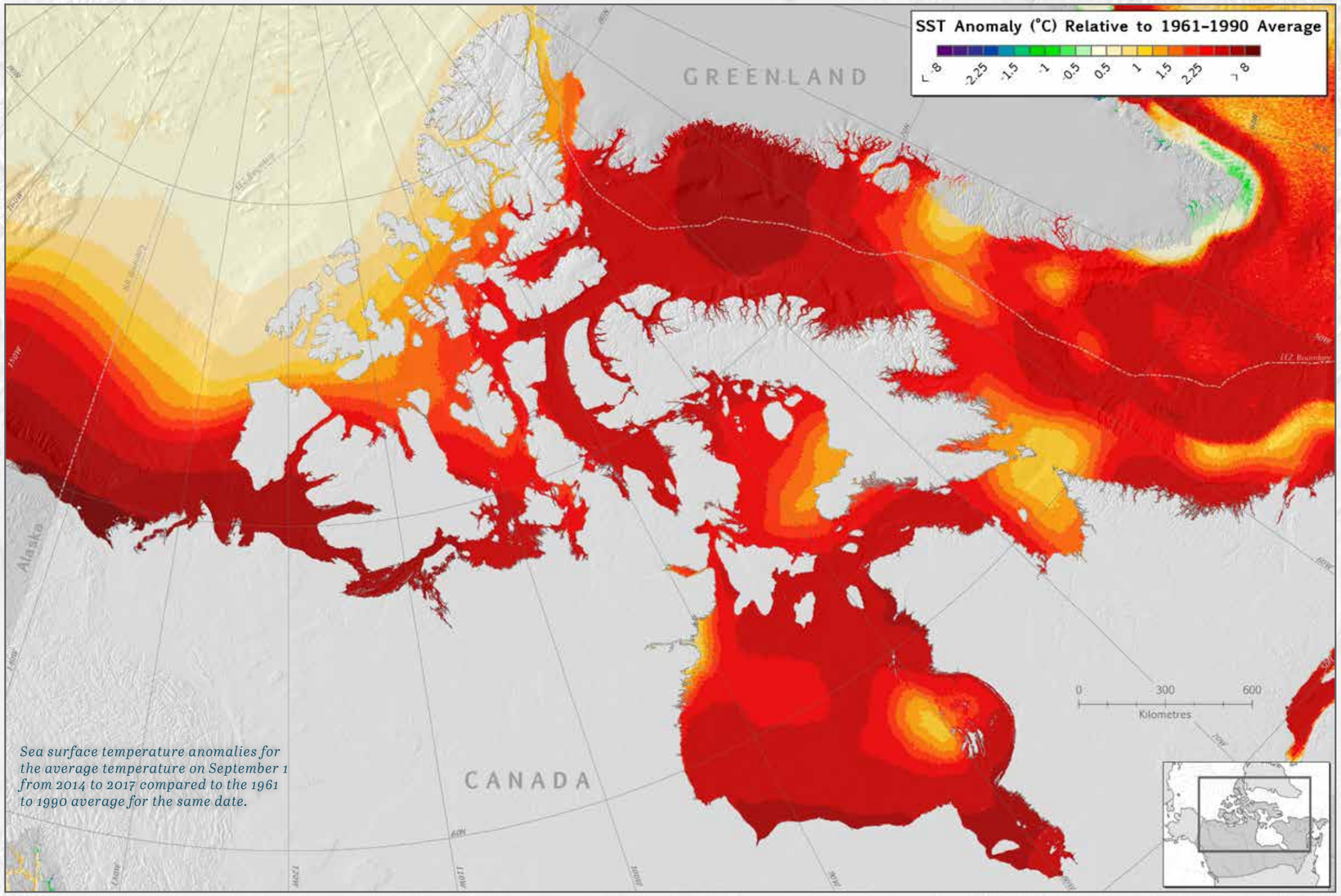
Amid these changes, the data in this atlas must be viewed with some caution. Field studies from decades ago provide valuable information, but may no longer reflect current conditions. We can expect broad patterns of ocean currents and marine productivity within the Arctic to remain intact. We can use the available information to manage human activities in ways to minimize further stress on Arctic ecosystems, species, and Indigenous peoples. We can continue to monitor the Arctic marine environment to detect and understand further change. And we can cherish what we have today and do our best to give our children and grandchildren the opportunity to do the same.

Historical Ice Coverage by Ice Age for the Canadian Arctic for the Week of September 10, 1971–2017.



DATA SOURCES
- Canadian Ice Service. 2018. Ice Graph. http://icewebt.cis.ec.gc.ca/CISWebApps/
- Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.

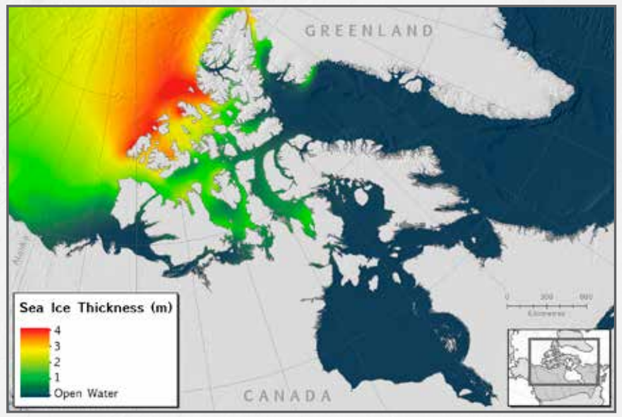
Mean Sea Surface Temperature Anomaly for Sept 1, 2014–2017



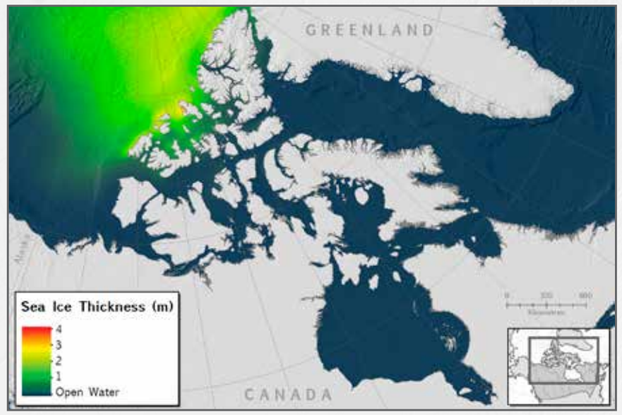
Sea surface temperature anomalies for the average temperature on September 1 from 2014 to 2017 compared to the 1961 to 1990 average for the same date.

DATA SOURCES
- SST anomaly data: Gemmill, W., Katz, B., and X. Li. 2007. DAILY REAL-TIME, GLOBAL SEA SURFACE TEMPERATURE - High-Resolution Analysis: RTG_SST_HR. NOAA/NWS/NCEP/EMC/MMAB, Science Application International Corporation, and Joint Center for Satellite Data Assimilation Technical Note Nr. 260. http://polar.ncep.noaa.gov/mmab/papers/tn260/
- Basemap Data: Atlas of Canada 1:1M, ESRI, Flanders Marine Institute, Natural Earth.

Mean Sea Ice Thickness in September: 1980–1989



Mean Sea Ice Thickness in September: 2010–2017



Decadal average sea ice thickness for the month of September: 1980–1989 compared to 2010–2017.

DATA SOURCES
- Sea Ice Thickness: Averages were derived from data downloaded from PIOMAS model grid data, downloaded from http://psc.apl.uw.edu/research/projects/arctic-sea-ice-volume-anomaly/data/model_grid. See Zhang, Jinlun and D.A. Rothrock. 2003. Modeling global sea ice with a thickness and enthalpy distribution model in generalized curvilinear coordinates, Mon. Wea. Rev. 131(5): 681-697.
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