Appendix 2. Control (article) text

Changes in the Far North

Global warming and other environmental issues are changing the Arctic marine ecosystem, from the bottom up.

Species Associated with Arctic Sea Ice

Ice Algae
Ice algae are primary producers that grow directly on the underside of sea ice.

Ice Copepod
The bodies of ice copepod are up to 70% fat, which helps them survive the long Arctic winter.

Arctic Cod
Sea ice contains nooks and crannies that provide the Arctic Cod refuge from predators.

Ringed Seal
Ringed seals spend much of their lives on sea ice, giving birth and raising pups in dens under the snow.

Walrus
Walrus heft their large bodies, up to 1,900kg, on to sea ice to rest and drift to new feeding grounds.

Polar Bears
Polar bears, highly dependent on sea ice, are threatened by global warming due to loss of habitat and prey.

Human Beings
Subsistence hunting and fishing plays a key role in the way of life for many Arctic Indigenous peoples, who use sea ice as a hunting platform.

The Arctic marine ecosystem is special: many of the species are closely linked with sea ice. As global warming progresses and the area of year-round sea ice cover shrinks, the range and quality of ice habitat will also decrease. Over the last 30 years, temperatures have increased almost twice as fast in the Arctic as compared to the rest of the world. Arctic ice and snow are melting so quickly, and polar ecosystems are changing so fast, that Inuit elders have said, "the weather today is harder to know."

For marine mammals that depend on sea ice, its loss is a significant problem. Diminishing sea ice means diminishing habitat for polar bears and ice-dependent seals. Polar bears excavate snow caves to give birth to their cubs; these caves are often on land, but sometimes are dug on sea ice. The polar bear's main prey is the ringed seal, and bears use sea ice as a platform to reach and locate ringed seals. Locating food in the spring is an especially urgent quest for mother polar bears, which have not eaten for half a year by the time their cubs are born.

Photo: USFWS

Article adapted by Jessica Brunacini from Stephanie Pfirman, "Changes in the North" in *Climate Change: Picturing the Science* (pgs. 45-69), by G. Schmidt and J. Wolfe, 2008, New York; W.W. Norton & Company.

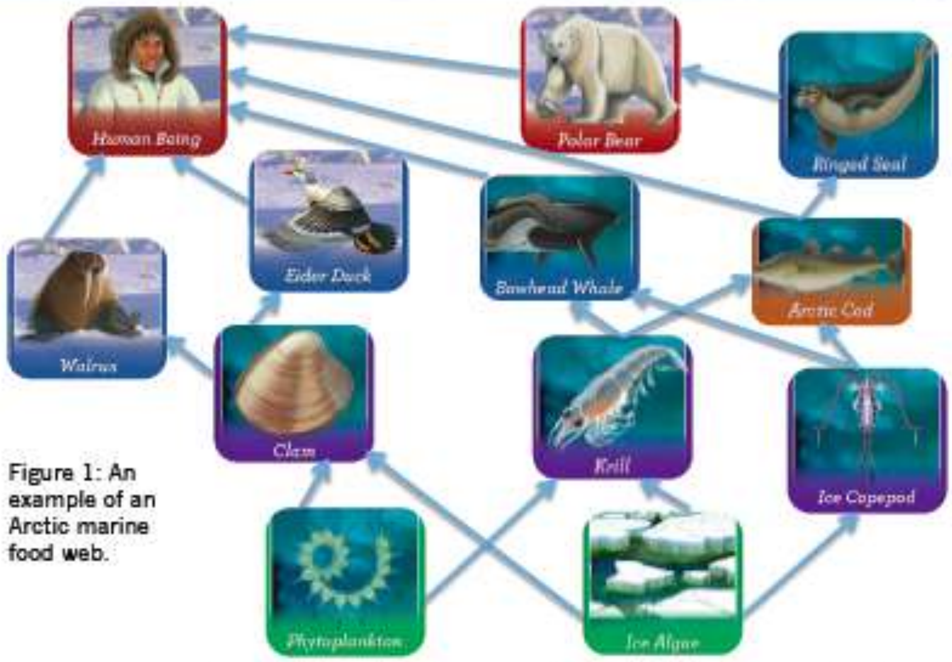

Figure 1: An example of an Arctic marine food web.

Ringed seals also breed on the sea ice in snow lairs. When the snow is not thick enough to support a seal lair through the winter, the seal pups can be exposed to the cold and die. Unstable sea ice that breaks up prematurely also forces young ringed seals into the water too early to be reared properly, and they do not survive.

These changes in sea ice will affect not just the seals and polar bears, but will have consequences for the rest of the ecosystem that depends on them. Of all the marine "country food" in the Arctic, the ringed seal is the most critical for the Inuit, for the same reason that the seal is important to polar bears: it is the most abundant seal species in the Arctic, numbering in the millions. Ringed seals are able to create breathing holes in the densest sea ice using the heavy claws on their foreflippers. Since every seal must breathe, these holes are the best places for a bear or an Inuit to hunt for one, even during difficult ice conditions when little other food is available.

Changing ecosystems in the sea also affect ecosystems on land. Consider the marginal ice zone, where drifting pack ice encounters open water. This border is an area of high productivity during the spring because nutrients, built up in surface waters under the ice during the long winter, are finally exposed to sunlight. The combination of sunlight and nutrients culminates in a burst of algae blooms from April through May: ice algae grow on the underside of sea ice and phytoplankton in the surface waters. The algae are eaten by a variety of zooplankton, such as ice copepod and krill, which in turn are fed on by fish like the Arctic cod and seabirds like the ivory gull.

Springtime productivity in the marginal ice zone is so high, in fact, that birds and whales migrate thousands of kilometers from all over the globe to feed here. And we do, too: Arctic fisheries, including the Barents and the Bering seas, are among the most productive in the world, providing about 10 percent of the world catch. Alaskan fisheries alone provide more than half of the fish caught in U.S. waters.

Biological activity during the spring bloom is so intense because much of the food is kept floating in the upper part of the water column due to the density stratification caused by melting ice. This freshwater melt makes the surface layer less dense than the more salty water beneath. It is like adding pepper and other spices to an oil and vinegar salad dressing: the species settle through the top layer of oil and then remain there at the interface along the top of the vinegar. But because so much food is produced in the ocean during the spring bloom, not all of it can be eaten right away, and some settles to the sea floor. In shallow regions, the rain of food supports bottom-dwelling organisms, such as clams, and other species that feed from the sea floor, including walrus and bearded seals, who use prominent whiskers to feel along the soft bottom sediment for prey.

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Arctic whales, such as narwhals, belugas, and bowheads, migrate along the edge of the pack ice, moving north when it retreats in summer and south as it extends in the winter. Whales in and around ice-covered waters need to find open spaces between floes, or along their edges, where they can come to the surface to breathe. The bowhead whale, however, can break through up to 61 centimeters of ice cover with its head to make a small breathing hole. Like the Arctic whales, many seabirds are local; the ivory gull, for instance, spends the entire year in the region. In the Arctic, seabirds nest on land, along cliffs (to escape predators), or on the ground, but they fly to sea to forage along the edges of the sea ice and in other places where prey is concentrated by ocean currents. Ivory gulls and eider ducks often dive underwater to catch their food.

Climate change is not the only environmental stress on the Arctic – the transport of pollutants from areas further south is also a concern. Despite the remoteness of the Arctic and its seemingly pristine condition, agricultural and industrial pollutants are transported north with the same winds that bring heat from the tropics. Once there, the contaminants move through the physical and biological system. Because some chemicals, such as PCBs and insecticides, attach to fat and do not degrade easily, they wind up accumulating at the top of the food chain – and you are what you eat. As a result, polar bears in Greenland and other regions of the Artic have such high levels of contaminants in their bodies that their reproductive ability may be impaired. Combining this toxic load with difficulties in obtaining prey due to climate change may be the downfall of some high-level Arctic organisms, including sea birds and polar bears: as animals starve, they draw down on reserves of fat, and if it is loaded with contaminants, this will exacerbate health problems. Eating contaminated organisms also exposes Arctic people to health risks: blood samples from a number of residents of eastern Canada, Greenland, and eastern Siberia have indicated elevated levels of persistent organic pollutants such as PCBs and the insecticide DDT.

Another potential pressure on the Arctic marine ecosystem is overharvesting. Overharvesting occurs when larger numbers of species are killed than the population can replace through natural reproduction. Hunting and fishing play a crucial role in the subsistence life ways of many Arctic Indigenous communities. As global warming and other environmental issues continue to impact the Arctic marine ecosystem, the added pressure of hunting and fishing could undermine the population health and sustainability of species on which Native communities depend. There are ways to protect at-risk populations of species, however. Legislation can manage hunting and fishing through the use of community- and ecosystem-based management that closely monitors populations and sets sustainable harvesting quotas. Marine protected areas can also be established to protect some or all of the species in a designated area from being harvested, possibly allowing populations to recover.

One small change can have a significant impact throughout the Arctic marine ecosystem, making it especially sensitive to the effects of global warming and other environmental challenges. Human actions, both near and far, affect these unique species and the habitat in which they live.

Global Warming

When coal, oil, and gas (fossil fuels) are burned to produce energy and electricity, they release carbon pollution that contributes to global warming. The use of fossil fuel energy for the production and distribution of consumer goods creates carbon pollution. Homes and businesses also use large amounts of fossil fuel energy for heating, cooling, and lighting needs. Carbon pollution from cars, trucks, SUVs, and other passenger vehicles is increasing as more people around the world choose to drive. Increasing carbon pollution and global warming reduce the amount of Arctic sea ice.

Luckily, there are actions that people can take to combat global warming. Solar, wind, geothermal, and nuclear energy sources can be used to produce energy and electricity that helps prevent global warming. Manufacturers can cut down on carbon pollution by switching to renewable energy, increasing energy efficiency, and using recycled materials. Homes and businesses can also use less energy when building insulation is improved and energy efficient appliances and products are used. Lastly, walking, biking, carpooling, and using public transportation can help combat global warming by cutting down on carbon pollution. Reducing new carbon pollution, as well as trapping and storing existing carbon pollution, slows and possibly reverses global warming, which allows for the restoration of Arctic sea ice.