WILDLIFE AND GLOBAL WARMING

Navigating the Arctic Meltdown

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ARCTIC COD

The importance of the Arctic cod in its icy, marine ecosystem is no fish story: There is no exaggerating the vital role this small fish plays in anchoring the food web in our planet's northernmost ocean. Hiding beneath the sea ice and in its cracks and crevices, Arctic cod are the main consumers of plankton (microscopic animals and plants) that flourish around sea ice. They are also a primary food source for many Arctic animals at the top of the food chain that are already at risk in habitats damaged by rising temperatures.

Sea ice is not just a platform on which animals live, it is also a kitchen of sorts—a place bustling with productivity, where nutrients concentrate, algae thrive and tiny invertebrates, larval fishes and Arctic cod graze. Now, however, the interactions between the sea ice and the ocean floor that sustain this productivity are also threatened by global warming.

In the spring, melting sea-ice triggers an explosive bloom of marine plants. Algae start to grow when snow at the sea-ice surface melts. More algae sprout from the underside of the ice in long, trailing strands. Other free-floating (pelagic) algae called phytoplankton start to thrive in nearby open water, nourishing small animals collectively known as zooplankton. These zooplankton range in size from single-celled organisms to crustaceans, worms, mollusks and jellyfish an inch or more in size. Larger crustaceans in turn sustain the next link in the Arctic marine food chain, the Arctic cod—a fatty, oily fish that provides high-quality food for marine mammals and seabirds at the top of the chain.

Sea-ice ecosystems in shallower waters over the near-shore continental shelves are highly productive. Food particles and nutrients washed into the sea from river deltas rain down through the water column to the sea floor. Eventually they are recycled to the surface by water currents, providing nutrients to support the growth of more

ice algae and plankton. With global warming, however, sea ice has decreased in extent and retreated away from shores, where deeper waters limit the recycling of nutrients from the ocean floor. Without this nutrient-rich infusion, other links in the food chain are broken and the entire Arctic food web starts to unravel. Productivity in the sea-ice "kitchen" on which cod rely ceases, leaving predators fewer places to look for this fish so essential to their survival.

A SMALL BUT SIGNIFICANT FISH

The Arctic cod *(Boreogadus saida)* is a slender, elongated fish that resembles other members of the cod family such as Atlantic cod, rock cod, haddock and tomcod. Brownish and spotted above, silvery below, this cod ranges in length from seven to 15 inches and is easily distinguished by its deeply forked tail, three dorsal fins, projecting mouth and small whisker or barbel located under the chin.

Arctic cod have the most northerly distribution of any fish, occurring to 84 degrees north latitude and above. They range all around the North Pole, across Arctic seas off northern Russia, Alaska, Canada and Greenland. This widespread distribution and their relative abundance makes them a key component of Arctic food webs. Although not commercially harvested in North America, Arctic cod are considered excellent table fish in Russia, where offshore fleets fishing for capelin often haul in large numbers as bycatch.

Arctic cod are found close to shore among ice floes and also offshore in depths to 3,000 feet. During the fall they may congregate in large numbers and move into coastal waters. Arctic cod feed and hide in the narrow, rough cracks beneath the ice. At times they also form huge schools in open waters. They descend to greater depths when ice melts or breaks and ocean surface temperatures rise. Antifreeze-like compounds in their bloodstream allow these polar fish to tolerate the most frigid waters of the Arctic Ocean, where temperatures routinely fall below the freezing point of fresh water. These cod are also tolerant of changes in salinity and turbidity.

Arctic cod spawn each year in the late fall and early winter. Females produce from 9,000 to 21,000 eggs about 0.06 inch in diameter, the fewest and largest eggs of any species in the cod family. Larvae appear from May through July, and the larval stage lasts about two months. Many other aspects of the Arctic cod's life cycle remain a mystery.

Ringed seals, like this one, are solitary animals that dive from the icy platforms on which they live to pursue their preferred prey, the Arctic cod.

Research indicates that they attain sexual maturity at two to four years of age and that populations consist of separate stocks with different feeding and spawning areas and migration routes. They have a short life span—about six years, according to Canadian researchers.

WARMING TRENDS

The fate of polar bears, ringed seals, ivory gulls and other predators depends not just on ice as a substrate, but on the myriad interactions of the supporting food web largely hidden just beneath the surface. Unfortunately, due to toxins, oil spills, overharvesting and now global warming, this web is starting to show signs of unraveling. While the loss of any single species can seriously disrupt a food chain, the loss of a web-anchoring species such as the Arctic cod in northern areas could be calamitous. There is simply no substitute for Arctic cod in the diet of many species of marine mammals, seabirds and fish.

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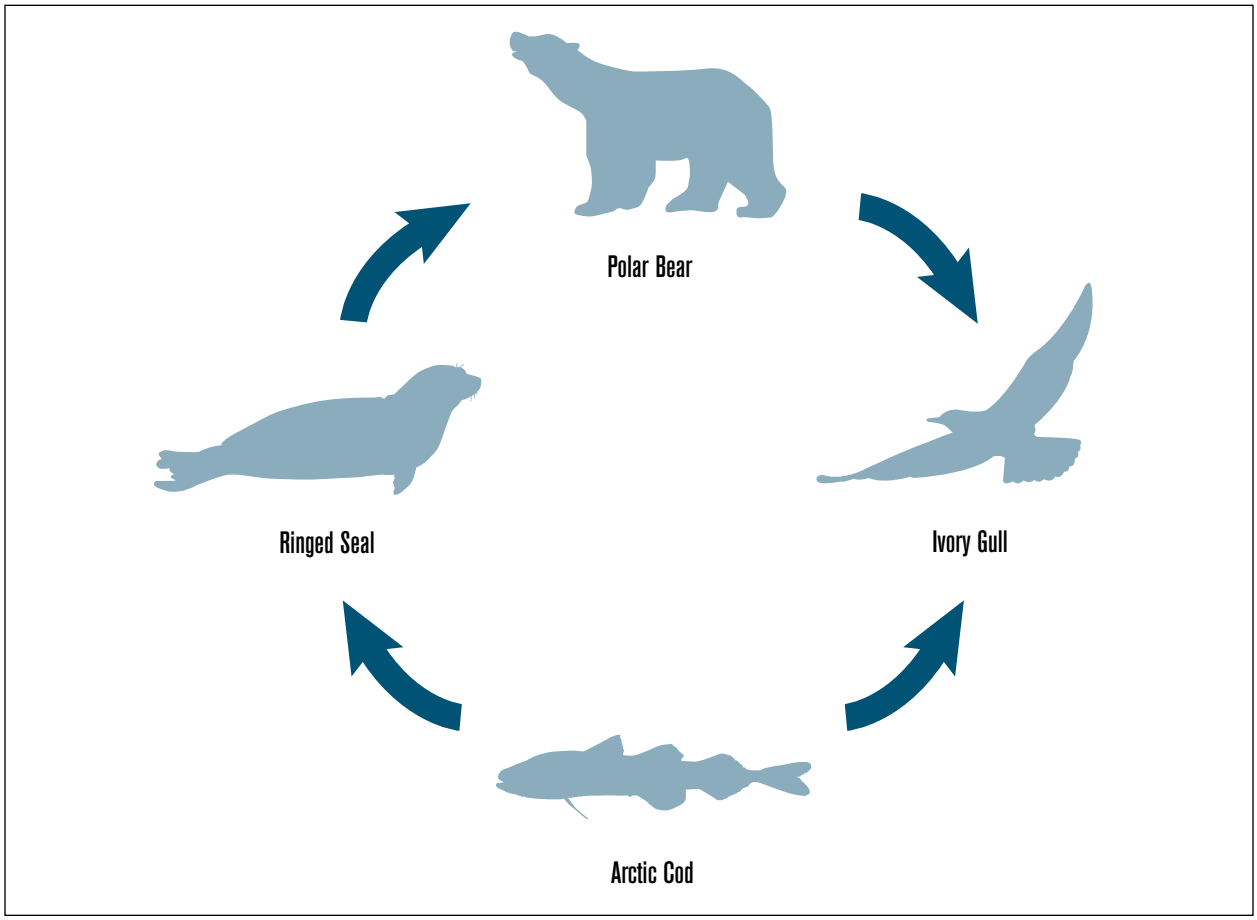
In Canada, narwhals feed predominantly on Arctic cod—as many as 64 cod have been found in the stomach of a single narwhal. Ringed seals also depend heavily on Arctic cod, and they are an important summer food for spotted seals in the Chukchi Sea of Alaska. Seabirds eat these cod, too. Fulmars, kittiwakes and ivory gulls take Arctic cod at the sea surface and scavenge dead ones and remains left behind by other predators; murres and guillemots dive for Arctic cod in the open sea. Larger fish, including Arctic char,



Arctic cod anchor the complex food web that supports the larger predators that feed on and at the edges of the sea ice. Ringed seals and ivory gulls eat the cod, and polar bears eat the seals, leaving leftovers for the gulls to scavenge. The cod feed on the plankton that thrive around nearshore ice. As temperatures rise and this ice disappears or moves farther offshore, scientists fear this web will unravel.

Greenland halibut and Atlantic salmon, feed on Arctic cod at various times. On islands and along the coast of Russia, heaps of Arctic cod washed ashore by fall and winter storms often extend for miles and provide winter food for polar bears, Arctic foxes and local people.

Cod spawn in the same nearshore waters every year, and many of these areas are slated for energy development. With their buoyant eggs and planktonic young, Arctic cod are highly vulnerable to toxins and other disturbances associated with oil and gas development and production. However, changes from global warming pose the greatest threat to this important Arctic prey species.

Food available to Arctic cod is closely tied to primary production. In polar waters, the critical burst of very high productivity occurs only during the short summer season. With less sea ice available to harbor this productivity and less nutrient recycling to sustain it as the remaining ice retreats to deeper waters, scientists fear the Arctic cod will decline in abundance—a blow to the large predators that depend on this fish.

One such predator is the ringed seal, the most numerous and widespread marine mammal in the northern hemisphere. Earlier snowmelts are prematurely destroying the snowdrift lairs of these seals, leaving their pups exposed to adverse weather and increased predation. "We're seeing snow melts happening when many of the pups are still dependent on those caves," says seal expert Brendan Kelly of the University of Alaska Southeast. Any disruptions to their food web will only exacerbate the problems these seals face because of global warming.

PREPARING FOR THE MELTDOWN

To keep the Arctic marine food web from unraveling, we must act now to reduce the emission of greenhouse gases. In addition, we should take other important steps to help the Arctic cod and its predators navigate a looming bottleneck of complex threats posed by climate change:

- **Curtail pollutants that accumulate in the tissues of Arctic animals.** While the United States and other

countries have banned several harmful chemicals, the use of others continues, and new chemicals are still being developed. All such compounds should undergo stringent evaluation for their effects on wildlife and humans. Manufacturers and waste disposal facilities should undertake best practices to minimize the release of all toxins.

- **Limit shipping traffic in Arctic waters.** As global warming melts the Arctic pack ice on which the Arctic food web depends, the potential for huge increases in ship traffic arises. Indeed, the fabled "Northwest Passage" that explorers sought for hundreds of years is on the verge of becoming a reality as pack ice recedes. Increased ship traffic brings noise, disturbance, sewage release, fuel spills, garbage and potential introduction of invasive species from ballast water or ship hulls. Proposals to increase ship traffic must account for detrimental impacts on Arctic wildlife.

- **Ensure long-term sustainability of hunting and fishing.** Overfishing has had devastating impacts on fisheries at lower latitudes, particularly for species such as Atlantic cod. Increasingly ice-free Arctic waters will open up potential new fishing grounds and could drive overexploitation of Arctic fish stocks currently not even monitored. Any commercial harvest of Arctic cod should be carefully managed in view of the great importance of these fish in the Arctic food chain.

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