U.S. Fish & Wildlife Service

Alaska's Changing Climate

Arctic National Wildlife Refuge

An Extreme Environment

The Arctic has a complex climate characterized by little sunlight in winter, long summer days, strong winds, low temperatures, and little rainfall[1]. Ice—present as snow, ice sheets, glaciers, sea ice, and permafrost—is a prominent feature and is sensitive to small temperature increases.

The climate throughout the Arctic varies widely from place to place, across the seasons, and from year to year. As a result, there are a number of regional arctic climates, each supporting specific combinations of animals and plants.

Evidence of a Warming Climate

Increasing temperatures, melting glaciers, reduced surface area and thickness of sea ice, thawing permafrost, and rising sea level are all indications of warming throughout the Arctic. Available data from Alaska and western Canada indicate that winter temperatures in this area have increased as much as 5 to 7°F in the past 50 years[2].

Although the amounts of snow and rain are hard to assess in cold, windy environments, it appears that precipitation has increased across the Arctic by about 8% over the past 100 years, with much of the increase occurring as rain-on-snow during the winter[2]. Snow-covered areas have decreased by about 10% over the past 30 years, with the most significant decreases occurring in April and May[3]. Permafrost temperatures in boreholes within the Arctic Refuge were up to 5°F warmer in 2004 than they were in 1985.

A Wild and Vulnerable Place

The Arctic Refuge contains undisturbed lands ranging north to south across five different ecological zones: lagoons, beaches, and salt marshes in coastal marine areas; coastal plain tundra; alpine tundra in the Brooks Range mountains; spruce forests interspersed with tundra south of the mountains; and spruce, birch, and aspen within the boreal forests of interior Alaska. Forty-three fish species, 45 mammal species, and more than 195 bird species have been observed within the Arctic Refuge.

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A female polar bear with her cub within the Arctic Refuge. The polar bear was listed as threatened in May of 2008 due to shrinking sea ice habitat.

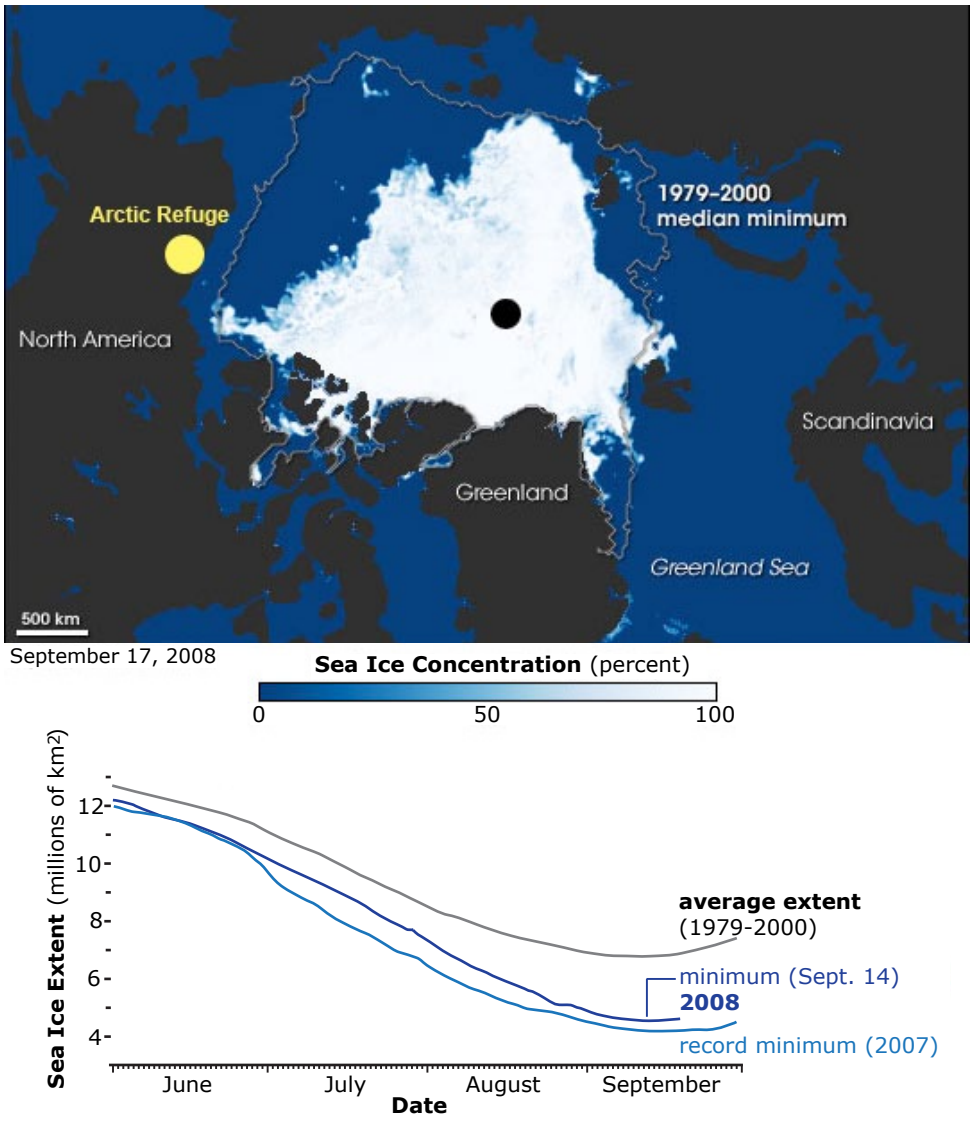
These creatures, as well as mosses, lichens, and vascular plants, are adapted to the specific characteristics of their arctic environment and its short growing season. As a consequence, these plants and animals are especially at risk from impacts of climate change that modify local conditions and may reduce the availability of appropriate living spaces.

For example, shorebirds and waterfowl use river deltas, barrier islands, lagoons, and other coastal areas for nesting and staging. These areas are vulnerable to the predicted effects of climate change such as flooding as a consequence of rising sea levels, and increased storm surges resulting from increases in both storminess and open water. A variety of research projects are being undertaken to help determine additional climate-change effects on Refuge wildlife species and their habitats.

Monitoring Climate Changes and Impacts

Refuge researchers, along with other agencies and scientists, are studying the impacts of global climate change within the Arctic Refuge. Some early findings from these ongoing studies include:

- Sea ice has thinned and decreased in extent. Shorefast ice tends to form later in fall. In September 2007, the extent and concentration of sea ice in the Arctic Ocean was significantly less than ever previously recorded. Although total area of ice was slightly greater in September 2008, volume of ice continued to decline because of thinning.
- Coastal erosion within the Refuge east of Kaktovik averaged 1.6 feet per year between 1948 and 2001, based on repeat aerial photography. This is less than the rates of up to 8 feet per year measured by the same methods in areas east and west outside of the Refuge.
- Pregnant polar bears increasingly select land over sea ice for denning, possibly because of deteriorating sea-ice conditions.
- Polar bears have drowned in unusually large expanses of open water, and have been found dead in emaciated condition.
- Recent incidents of cannibalism among polar bears may be due to the nutritional stresses related to longer ice-free seasons.



NASA map by R. Simmon and J. Allen, and graph by M. Scott.

The map (top) shows the extent of sea ice on September 17, 2008, measured by NASA's Aqua satellite. Percent ice coverage is in shades of light blue to white. The gray line traces the boundary of the area normally covered by ice at the summer minimum based on data from 1979-2000. The graph (bottom) shows the daily retreat of sea ice during 2008 (dark blue line) compared to both the long-term average (1979-2000, gray line) and the 2007 record low (bright blue line).[4]

- Muskox numbers have declined on the Refuge. A potential factor is mid-winter icing caused by freezing rain and thaws. This icing reduces access to food and also increases the amount of energy each animal uses. Other factors, for example predation, disease, or changes in plants, may also play a role in reduced numbers of muskoxen.
- Permanent vegetation plots and repeat-photograph studies so far do not show dramatic or consistent changes in Refuge vegetation. This is in contrast to areas of western Alaska, where shrub cover increases have been seen in photographs taken in 1999-2000 compared to photos taken in 1948-1950.
- On the Refuge coastal plain, permafrost warmed 3 to 5°F between 1985 and 2004. If predicted air temperature warming of 9°F occurs over the next century, some of the permafrost north of the Brooks Range will likely thaw.
- McCall Glacier and other alpine glaciers in the Refuge have receded dramatically over the past half-century, and the rate of ice melt has increased in recent years. If ice loss continues to accelerate according to current trends, all Brooks Range glaciers will disappear in 80 to 100 years.

Sources:

1 The National Snow and Ice Data Center, http://nsidc.org/arcticmet/basics/arctic_climate.html

2 "Impacts of a warming Arctic: Arctic Climate Impact Assessment," 2004, Cambridge University Press, page 22

3 "Impacts of a warming Arctic: Arctic Climate Impact Assessment," 2004, Cambridge University Press, page 31

4 "Arctic sea ice reaches annual minimum," 2008, NASA Earth Observatory, http://earthobservatory.nasa.gov/IOTD/view.php?id=9115

Related Links:

"A method for the detection of the severe rain-on-snow event on Banks Island, October 2003, using passive microwave remote sensing," http://www.agu.org/pubs/crossref/2008/2007WR005929.shtml

"Arctic Climate Impact Assessment," http://www.ucsusa.org/global_warming/science_and_impacts/impacts/arctic-climate-impact.html

Arctic Climate Research at the University of Illinois, http://arctic.atmos.uiuc.edu/

"Arctic sea ice reaches annual minimum," http://earthobservatory.nasa.gov/IOTD/view.php?id=9115

"Arctic sea ice younger than normal," http://earthobservatory.nasa.gov/IOTD/view.php?id=8596

"Detailed view of arctic sea ice," http://earthobservatory.nasa.gov/IOTD/view.php?id=7370

"Food and Water Security in a Changing Arctic Climate," http://www.iop.org/EJ/article/1748-9326/2/4/045018/erl7_4_045018.html

"Polar Bear Conservation Issues," http://alaska.fws.gov/fisheries/mmm/polarbear/issues.htm

"Polar Bear Denning," http://arctic.fws.gov/pbdenning.htm

The National Snow and Ice Data Center, http://nsidc.org/arcticmet/basics/arctic_climate.html

Understanding climate change in the Arctic, http://www.damocles-eu.org/

US Global Change Research Program, http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts/regional-climate-change-impacts/alaska

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