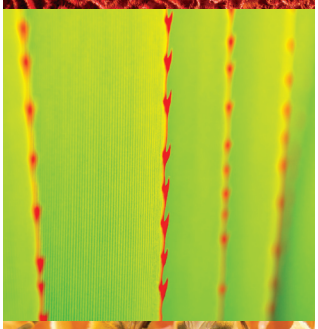
ECOREGION: POLAR/SUBPOLAR



For centuries, humankind has been fascinated with the harsh winds, vast frigid waters, and landscapes built of ice and snow in the polar/subpolar ecoregion. The extreme climate and unique landscape have attracted explorers seeking adventure and compelled people to create new methods to live in these inhospitable conditions.[1] The region is a complex ecosystem composed of the vast, deep, ice-covered Arctic Ocean, surrounded by the continental land masses that include Alaska, Northern Canada, and Eurasia. Encompassing a range of landscapes from mountains and glaciers, to flat plains and wetlands, the Arctic landscape is shaped by temperature and the processes of freezing and thawing. This landscape provides a variety of habitat types for the many plant and animal species that call the region home.

Due to the role that the ice and cold climate of the Arctic landscape play in regulating water levels and salinity in oceans around the world, the region is closely linked to a variety of different ecosystems. While the Arctic is considered one integrated system, three specific ecosystems are often identified within it: ***terrestrial***, *freshwater*, and *marine*. Throughout these three systems, the cold climate, rather than their geological history, is the principal factor that gives them their distinct characters.[2]

Terrestrial

Due to biting winds, sub-zero temperatures and months on end with little sunlight, few species can survive in the Arctic. In fact, Arctic **fauna** account for only about 3% of the global total and their diversity tends to diminish with increasing latitude.[3]

Freshwater

Freshwater streams and wetlands are among the most abundant and productive ecosystems in the Arctic. Some of the world's largest rivers are found throughout the region and almost all are created by rainwater and/or melting snow and ice flowing on top of **permafrost**. The freshwater flow into the surface of the Arctic Ocean is a main factor in the formation of ice cover. Without this freshwater flow, warmer Atlantic Ocean water would melt the ice. Together with lakes and ponds, arctic wetlands are summer home to hundreds of millions of migratory birds.[4]

Marine

Much of the marine ecosystems of the Arctic consist of shallow water, coastal shelves, and vast sheets of ice. Marine waters are cooled greatly by freshwater that enters them from surface runoff and from glaciers melting on land. Because it reflects solar radiation back into the atmosphere, sea ice regulates exchanges of heat, moisture, and salinity in the polar ocean. In addition, the ice serves as a key habitat for polar bears, seals, and walruses.[5]

"It makes it hard to hunt in fall time when the ice starts forming. It's kind of dangerous to be out. It's not really sturdy. And after it freezes there's always some open spots. Sometimes it doesn't freeze up until January."

Benjamin Neakok

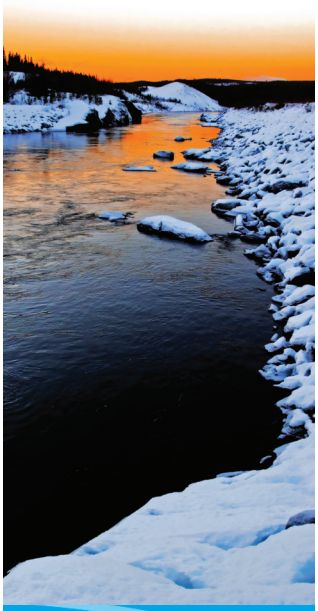
Impacts of Climate Change

Over the last several decades, temperatures in the Arctic have risen at almost twice the rate of temperatures throughout the rest of the world. As a result, the glaciers, sea ice, and permafrost that dominate the landscape throughout the region are warming and melting.[6] This reduction in the ice and snow drastically alters the habitats of much of the wildlife that lives in the region.[7] These impacts of climate change on the Polar/Subpolar region will also have a large impact on ecosystems throughout the rest of the world. Melting land-based ice (such as glaciers) will raise sea levels, and lower sea water salinity all over the world. Thus, rising temperatures in the Arctic affects both the plants and animals of the Polar/Subpolar region, as well as those that live in and depend on the oceans all over the world.[8]

SPOTLIGHT ON A SPECIES

Weighing in at an average of around 1,700 to 4,000 pounds and brandishing foot-long tusks, the Pacific walrus, *Odobenus rosmarus*, is one of the many creatures that call the Polar/Subpolar region home and are being affected by climate change.[9] A highly gregarious mammal, the walrus is found in herds upon its favorite habitat, large, thick ice floes, in the Bering and Chukchi Seas. To search for food most efficiently, walruses remain in the vicinity of the same floe area while the ice field moves with the wind and ocean currents. In this way they avoid over-grazing on the animals that occupy the sea floor. The walrus' feeding behavior, which consists of digging through and re-suspending the sediments and nutrients on the floor, improves access to food for many other members of the marine ecosystem.[10]

As the climate changes and average temperatures increase, these ice floes that the walrus calls home are melting. The result has been a decrease in the number of walruses. The rate and seasonal timing of melting sea ice floes are changing the nature of the ice itself — from thick and broken pack ice to a thin and more rounded pack, which is unsuitable as a resting place. This decrease in habitat restricts the mobility of the walrus. In 2007, the early disappearance of summer sea ice pushed females and calves onto land in abnormally dense herds. As a result, females and young had to abandon large regions of their at-sea feeding grounds, and many calves died on land due to trampling by the dense herds.[11]



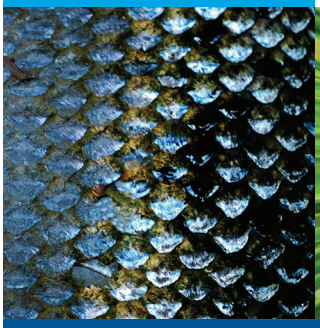
Because the walrus plays a significant role within the larger ecosystem, its decline in numbers may affect the feeding ability of others in the ocean floor community, as well as people who feed on the walruses.[12] For example, many marine mammals provide a stable food source for people in Alaska's coastal communities. Traditional Alaskan Native observers have noted that during recent years the sea ice is much thinner, breakup occurs much earlier, formation of shore-fast ice comes later each year, and the extent of the ice pack has greatly decreased. Safety and survival are becoming daily concerns for many people in these communities.[13]

Any end to the harvest of walrus is a great cause for concern among rural residents. Many Alaska Native community residents believe subsistence foods are healthier for them and provide better protection against the cold environment. Their hunting activities define and establish their sense of family and community. As a consequence, changing climate may also be threatening the most basic ethical and spiritual values in Native culture.[14]

PROFILING A CLIMATE STEWARD

The effects of climate change are expected to be most dramatic in the polar regions. This is because as the planet warms, the extent of ice and snow that covers the Earth in the winter time will be reduced. Ice and snow are more reflective than water and dirt; if the total area that the ice and snow covers is reduced or its duration on the ground shortened, more of the Sun's energy can be absorbed by the ground than would have been possible if the snow and ice were there. Because more of the Sun's energy will be absorbed in these areas, the temperature will increase by even more than it would have as a result of the increase in greenhouse gases that cause global warming alone.

Making accurate snow and ice measurements that show how these variables are changing from year to year is very important for determining what the climate of Alaska could look like in the decades to come. Every winter since 1999, the *Alaska Lake Ice and Snow Observatory Network* (ALISON) has recorded snow depth, snow density, the temperature at the bottom and top of snow cover, and ice thickness at field sites located on ponds and lakes throughout Alaska.



As part of the ALISON project, students and teachers across Alaska go to field sites to make important measurements regarding the current condition of snow and ice. Using samples and data collected along a pond or lake, students can calculate important measures of the snow and ice, including the temperature gradient and how much heat is escaping into the atmosphere through the snow or ice. The various groups of students then send their information to the University of Alaska Fairbanks' Geophysical Institute at www.gi.alaska.edu/alison.

These data sets collected by the students are extremely valuable. They can be used to document the effects of climate change occurring in the Arctic now, as well as for predicting what could happen in the future. In addition to being a great activity for students, this program contributes to important scientific data sets that could help predict the effects of future climate change.

FOR MORE INFORMATION

- The Arctic Climate Impact Assessment website provides information on the impact of climate change on the Arctic. http://amap.no/acia/ACIAContent.html
- The article, *Scientific Studies on Climate Change in Alaska's National Parks*, provides an overview of potential effects of climate change on Alaska's National Parks. Alaska Park Science Journal. *Scientific Studies on Climate Change in Alaska's National Parks*, Volume 6, Spring 2007.
- The article, *The Wales/Deering Subsistence Producer Analysis Project*, gives detailed data on subsistence cultures in Alaska. Callaway, Don. 2003. T*he Wales/Deering Subsistence Producer Analysis Project*. Alaska Park Science. Summer 2003. National Park Service. Anchorage, AK.
- The article, *Changing Climate: Consequences for Subsistence Communities*, gives a concise analysis of the effects of climate change on subsistence communities, especially in Alaska. Callaway, Don. *Changing Climate: Consequences for Subsistence Communities*. www.nps.gov/akso/AKParkScience/ClimateChange/callaway.pdf
- The U.S. Environmental Protection Agency's Climate Change website includes information on climate change, impacts, and what you can do. www.epa.gov/climatechange/
- The U.S. National Assessment of Climate Variability and Change gives a report on the potential effects of global warming in the United States. www.nacc.usgcrp.gov
- The ENERGY STAR website provides a directory of energy-efficient products for schools, businesses, and residential homes. www.energystar.gov
- The Intergovernmental Panel on Climate Change is the definitive source of unbiased climate change science. www.ipcc.ch

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