



CLIMATE CHANGE: A SERIOUS IMPACT ON ARCTIC ECOSYSTEMS

Temperatures are increasing, glaciers are retreating, the permafrost¹ is melting and pack ice is disappearing, to say nothing of the fact that sea level is rising, all proof that the Arctic climate is warming.

It is known that the climate at a global scale is changing. Global surface temperature has increased an average of 0.6 °C in the last 50 years. But in the Arctic, average temperatures have increased almost two times faster than elsewhere, and climate change there is particularly intense. For example, ice thickness, according to recent data, has decreased 40% over the last 25 years. If this trend continues, in a few decades, the Arctic will be almost entirely free of ice during the summer months.



Credit: Martin Fortier

The polar bear is threatened by the loss of sea ice.

Moreover, the current decrease in pack ice is occurring more rapidly than any of the models, even the most pessimistic, had predicted. Contrary to what happens when the white pack ice reflects solar radiation, the open, ice-free water (dark blue) warms because it absorbs more of solar energy. In this way, the gradual disappearance of pack ice contributes greatly to global warming.

Climatic warming

Climatic warming in the Arctic is projected to be greater than world averages during the 21st century. And more significant changes are already predicted:

- average temperatures will rise from 3 to 7 °C, with an even greater increase during the winter;
- precipitation will increase 20%;
- pack ice will continue to shrink rapidly, thus contributing to global warming;
- the surface area of Arctic lands covered by ice will decrease 10 to 20%.

Climatic changes in the Arctic have already led to repercussions on a global scale. These effects include disturbances to ocean currents, rising sea level, release of methane trapped in the permafrost, movement of plant and animal populations, as well as access to important mineral and natural gas resources.

Ecosystems vulnerable to climate change

Arctic ecosystems, both terrestrial and marine, have already begun to change in response to thawing permafrost and increases in temperature. The Arctic provides habitat for a great diversity of plants, birds, and animal and marine species, as well as some four million humans who are well adapted to conditions among the most extreme on the planet. However, it is clear that the survival of Arctic ecosystems is closely tied to the environmental changes resulting from global warming.

Take the case of phytoplankton, which are necessary to the survival of several species found in Arctic ecosystems. Phytoplankton are not

abundant in the Arctic Ocean, except for certain areas where physical and chemical conditions are favourable to their growth. These areas are very important since they serve as feeding grounds for numerous marine species.

The productivity of the entire food web² depends on physical factors that can be affected by climate change. The Arctic cod clearly illustrates this situation. Temperature regulates the timing of egg hatching and the survival of the larva of this species, essential to the Arctic food chain. It is easy to imagine the impact that a significant deviation in temperature, at a critical period in the hatching and survival of eggs, could have on the future of the Arctic cod.



Credit: http://www.arcticodiv.org/Fish/Boreogadus_saida.html

Arctic cod is a key species in the Arctic ecosystem.

What makes up the Arctic region ?

The Arctic consists primarily of an ocean surrounded by land. This vast region, situated around the North Pole, is mostly covered by snow and ice at the extreme north, while boreal forests cover the southern portion. Between the two is a large tundra zone. The Arctic includes Greenland and Iceland, as well as the northernmost portions of Canada, the United States, Finland, Norway, Russia and Sweden.

Will there still be polar bears at the end of the 21st century?

Climate change will have impacts on all parts of the Arctic ecosystem. Numerous Arctic animals, such as polar bears, seals and seabirds, owe their survival to the productivity of the ocean and the presence of pack ice, both of which depend largely on climatic conditions. It is already apparent that the warming of the Arctic is disrupting habitats, breeding grounds and food sources of various animal species. In addition, we know that changes in current or surface temperatures could affect Arctic fish stocks.

Furthermore, thawing of the permafrost represents a true technical challenge with regard to infrastructures

such as roads or buildings, since the ground becomes unstable. And add to that the shrinking of the ice pack, which has a significant effect on the Inuit's traditional activities as well as their ability to travel. However, with regard to climate change, as with other issues, nothing is ever black and white. The disappearance of the ice pack will make navigation possible for a greater portion of the year, make it easier for ships to pass through the Arctic basin and, eventually, open up new navigation routes.

Given the complexity of the global climate, other surprises could yet occur that would affect the situation in the Arctic.



Credit: Doug Barber

Diver in search of underice phytoplankton in the Beaufort Sea.

Research will help to better understanding the problem

Scientists do not yet have all the information necessary to accurately predict the extent of the consequences of global warming. Discoveries by Québec-Océan researchers, primarily as part of the ArcticNet³ network, are already providing a better understanding of the various aspects of the rapid transformation taking place in the Arctic. They show the effects of warming on Arctic ice conditions, water masses and ecosystems. Researchers use a variety of tools, including remote sensing, which can be used to assess the effects of climate on changes to Arctic marine ecosystem productivity.

To more fully explore the consequences of climate change on society and on Arctic coastal ecosystems, integrated regional impact studies (IRIS) are currently underway. Québec-Océan researchers are investigating, for example, the effects of warming in the Arctic on marine mammals, deep-water organisms and the instability of the littoral zone. The consequences of warming on the biophysical environment are, in turn,

evaluated in terms of future risks to Arctic communities. The IRIS-based approach makes it possible to estimate the scale and socio-economic costs of the impacts of climate change.

¹ *Ground that stays permanently frozen*

² *Series of related food chains displaying the movement of energy and matter through an ecosystem*

³ *Networks of Centres of Excellence*

Find out more

- [Facts on Arctic Climate Change](#)
- [Climate Change and the Arctic](#)
- [ArcticNet](#)
- [International Panel on Climate Change - Chapter 15 Polar Regions](#)
- [Climate Change in the Arctic: An Inuit Reality](#)
- [Climate Change - Impacts and Adaptation](#)
- [Consortium on Regional Climatology and Adaptation to Climate Change](#)