

Ice Climate-Education 2007

The Arctic Highway across the Arctic

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The ice has melted

By special reporter Liv Toudal Olsen, off the coast of Tromsøe, 17th May, 2040.

Over the last 35 years the polar icecap of the Arctic Ocean has almost disappeared. Every week, from late spring until late autumn, ships cross this once inaccessible and dangerous region.

For the sake of vocational experience, this school has sent yet another student on a voyage, sailing from Hamburg to Yokohama. In order to give you a first hand knowledge of the climate changes, your special reporter will report to you over the next few days from onboard the *Nanok Maersk*.

Many years have passed by since it was possible to cross the Arctic Ocean for the first time by ship. At that time ships sailed through either the North-East or the North-West Passage. Today, however, further global warming has led to the effect that it is now possible to cross the Arctic Ocean directly. In late summer and at the beginning of autumn, the Arctic Ocean is now completely ice-free.

From April, where the polar ice has not yet melted, it is possible to sail along the coasts of Norway and Siberia to the Bering Strait. From there on the way is clear for Japan and China. This is the voyage that I am about to undertake. Three days ago I signed on in Hamburg, and I am now in Tromsøe. On the way we anchored in Bergen, if only for a few hours, but the trip along the coast of Norway has lasted longer than anticipated because of bad weather. Depending on the amount of ice, the sailing distance to the Bering Strait will be between 5,000 and 5,500 kilometres. If all goes well, it will take about 5 days, and we should then reach Yokohama, Japan, 3 days later.

FACTS

Roald Amundsen was the first man to sail through the North-West Passage. It took him three years from 1903-06.

In 1969 an American 125,000 ton heavy super jumbo, specially rebuilt for this mission, passed through the ice masses of the North-West Passage. This was the first merchant vessel to make use of the sea route between the East Coast and the rich oil strikes in Alaska.

A changed Arctic climate

The region which we are about to cross is the part of the world which has experienced the most drastic climate changes within the last decades because of the ongoing global warming. Over the

last 30 years the Arctic temperature has increased by 4.8 degrees centigrade on average. This is the cause of the rapidly melting ice. A drastic temperature change primarily in the winter has significantly shortened the period with severe frost, and this has had a decisive effect. The winter cold ensured the preservation of the thick ice layer.

The temperature change has also had the effect that the Arctic, which used to have a more stable climate, now has periods with thaw and frost, alternately, and an ever-increasing amount of precipitation. All these factors have helped create an entire new Arctic, which is very different from what it used to be 30 years ago. New opportunities have unfolded for the indigenous people and for people coming to the region. However, the development has done much environmental damage to the region as well.

A self-increasing climate change

The climate changes have emerged because of the accumulation of greenhouse gasses in the atmosphere. The Earth accumulates solar energy in the form of electromagnetic radiation. Some of this radiation is reflected back into space while the rest warms up the Earth, which then radiates the energy as infrared heat radiation. Due to greenhouse gasses in the atmosphere like, for instance, carbon dioxide, the heat radiation is incapable of escaping into the atmosphere. The energy is then accumulated, which results in a global warming process.

When some of the Arctic ice melts, this results in a self-increasing process: A surface made of snow and ice reflects 85-90 percent of the radiation back into space while the surface of the sea only reflects 10 percent of solar radiation. It follows therefore that when the ice melts into the sea, the Earth will accumulate more solar radiation.

A new island on Greenland

Rising temperatures and the warm winters have also had the effect that the glaciers in the Arctic region and the inland ice on Greenland have been reduced significantly.

The climate changes were not really paid any serious attention to until 2005 when a new island - about 2 kilometres long - emerged on Greenland. Until then the island had been embedded in a glacier, and it was believed that it was a part of the Greenland mainland. Already in 2002 it had been observed that the glacier which connected the island and the Greenland east coast had diminished in size, and when the ice melted away completely in 2005, the island appeared as an independent one.

This was obvious proof of how the release of carbon dioxide had caused the beautiful Arctic ice to melt.

FACTS

Warming Island (Uunartoq Qerqertaq) lies close to the Greenland town Ittoqqortoormiit. It was discovered and named by Dennis Schmitt, an American expert on Greenland. It was given this name because it has been fathered by global warming.

Where did the birds go? And is that a forest?

By special reporter Liv Toudal Olsen, 80°N, 65°E, 19th May, 2040.

The climate changes have had a serious environmental impact on the habitats in the Arctic region. When the thaw sets in and the permafrost starts to melt, the birch wood is given favourable conditions of growth in an area stretching as far as to the coast along the Arctic Ocean. Among other things, this development radically influences the conditions under which the bird life of the tundra exists.

At the moment I am reporting to you from somewhere between the North Pole and the northern point of Novaya Zemlya. The Russian island is twice the size of Denmark but only has 2,700 inhabitants, who work on the military bases, which the Soviet Union established during the Cold War. The island used to be an important atom bomb testing site.

The tundra is changing

The Arctic region has always been famous for its special vegetation zone: the tundra - the vast Arctic steppes with its marshy surface and breath taking view. Sadly, this breeding ground for lots of migratory birds, some of which can be spotted in the Jutland Wadden Sea, is now disappearing.

Because of the warm climate, the permafrost is now thawing, and thus one vital limitation for the growth of vegetation in the Arctic region is disappearing. The permafrost inhibited trees and bushes from taking root because of want of water, and nutrients were scarce, too.

Now that the cold is gone, the once so wild and unforested Arctic steppe has changed into a fertile soil for much vegetation. Most visibly, trees are taking root.

As new plants are emerging, others vanish. The vegetation that used to exist in the Arctic tundra, had adapted to the cold, the lack of water and nutrients, and the brief growing season. Some of the most common plants were the lichens, which could exist under extreme conditions, practically anywhere, but were especially common in dry and cold regions. This kind of vegetation was therefore characteristic of the Arctic tundra, which has now disappeared almost entirely.

Lichens

Lichens are two different organisms, which co-exist in a symbiosis, i.e. they are dependent on each other. Lichens consist of a fungus and a monocellular green alga or blue-green alga. Due to this symbiosis, lichens can exist where most plants cannot. The fungi form the structural part of the lichen while algae cells are embedded closely and safely underneath the outer fungi cells. Through photosynthesis the algae can produce glucose for themselves and the fungi cells, the latter being incapable of this. In order to acquire the carbohydrate produced by the algae, the fungi cells produce substances which make the algae cells permeable. Besides carbohydrate, the algae supply the fungi with vitamins and nitrogen. In return for this, the fungi protect the algae from drying out and supply them with water from the air and the soil. This interaction makes it possible for the lichens to survive extreme climate conditions - in the Arctic below an air temperature of almost minus 20° centigrade.

The trees are advancing

The temperature decides where trees can grow – and this is only possible in regions where the summer temperature average is at least 10° centigrade. Because of rising temperatures, forests are expanding as far north as the Siberian coast along the Arctic Ocean, and in the years to come the tundra will change into willow scrub and birch wood.

The vegetation has not had time to adapt to the drastic climatic changes, which have occurred within the last 50 years – evolution does just not happen overnight but takes generations. The changes we witness today are not the result of evolution but are due to the collapse of the ecosystem because the physical conditions have changed so rapidly that the original plants have not had time to adapt. Instead, new forms of vegetation take root because they are better suited for living under these new conditions. Plants which earlier existed further south are now getting a foothold and are changing the landscape and the fundamental conditions for plants and animals alike. Bushes, trees, and other big plants outmatch smaller plants, which thrived well in the tough Arctic climate.

When the tundra changes into a wooded region, this may add to the greenhouse effect because the bright tundra landscape reflects more light into space than the expanding, dark forest would do.

The birds are fleeing

Birds which earlier settled in the open tundra landscape, and whose existence depended on this, are now facing some serious problems even though this was not the case in the beginning.

Unlike mammals, the birds are not dependent on the sea ice, and in the beginning they benefited from the growing vegetation, which thrived in the warmer climate with an increasing amount of rain. However, when the permafrost disappeared, thus leaving the tundra exposed to plants and trees, many birds, especially migratory birds, fell prey to the changed conditions. Migratory birds would breed in the Arctic tundra in the summer and would seek food along the west coast of Jutland and in Germany and Holland in the winter. These birds had adapted to the flat regions and depended on the open space. Now they had great difficulty in finding breeding grounds and food in the Arctic. To make matters worse, their winter habitats have been affected, too. Global warming is responsible for the melting of huge parts of the inland ice on Greenland, making the sea level rise in the North Sea, for instance. This means that the wading areas will be dry for a shorter period than earlier and that the migratory birds have great difficulty in finding food in the winter.

Fish stocks and sea mammals under threat

By special reporter Liv Toudal Olsen, 78°N, 131°E, 20th May, 2040.

The anticipated boom in the fishing industry has come to nothing. The gap in the ozone layer is blamed for this. Marine mammals who are dependent on the sea ice are under threat of becoming an endangered species in the future.

This morning we sailed past the Island of Komsomolet. For about an hour we passed huge, drifting ice floes. Using binoculars we spotted a polar bear far off in the distance. It was a sad creature to watch. It is unusual to spot ice floes and polar bears in these parts this late in the spring. Actually, it is quite extraordinary to encounter any polar bears in these parts at all. We are probably witnessing a poor creature which has been drifting the ice for some time and is likely to starve to death.

The food chain falls prey to UV-radiation

There has always been a great interest in the ocean and fishing because the haul has been an important source of proteins and crucial for the economy of the fishing villages. Man being the last link in the food chain has depended on a stable food chain. Today, however, man is not as dependent on the marine food chain as before. We should not be too sorry about this because the climate changes have created quite a mess.

UV-radiation has caused drastic changes for the environment in the ocean. Plankton algae, which form the basis for the food chain in the ocean, are very sensitive to the alarmingly raised level of UV-radiation. Even though this level has stabilised, it is yet to fall. As a consequence of the radiation, the algae do not produce as many fatty acids as normal. This is incredibly important because fatty acids are vital for the next link in the food chain, e.g. spawn. In addition, this has led to a serious weakening of the fish stock.

At the same time the fish are affected by UV-radiation; especially eggs and larvae, which are found close to the sea surface, are easily exposed to radiation. All this has meant that the fish stocks have not exploded as much as expected once the sea temperature rose. It was expected that the cod stock would rise because the temperate water would provide better conditions for the cod. Earlier it has been observed how the Arctic Ocean has been abundant of the cod in warm periods whereas the shrimps have dominated the cold periods.

For the moment neither cod nor shrimps are in abundance, and if this development continues, one should be fearful of the risk that this might lead to a drastic fall in the biodiversity. The higher up you look in the food chain, the more critical it looks because other factors may come into play as well, like, for instance, pollution and lack of sea ice.

The seals are under threat

The population of seals in the Arctic is threatened by the lack of sea ice. Seals are very dependent on solid ice, especially in the breeding period. Seals, both the ringed seal and the harp seal, are in need of the solid ice on which they normally give birth. Baby seals are not born with water-repellent fur and can therefore not survive in the water. The seals also need solid ice and snow to make holes in which they can hide themselves and their young from predators. The problem that the seals are faced with is that the ice starts to melt as early as in March and April and hence becomes unstable in the midst of their breeding season. Several young perish either because of thin ice or else they fall prey to predators, as they have no place to hide in.

The extinction of the polar bear

Today, the count of the polar bear population has reached new depths, and if nothing is done to reverse this development, the polar bear may very well be extinct in a few years. Since the millennium, the polar bear population has been declining because of the melting sea ice. The bears have been using the ice for hunting their primary prey: the ringed seal. Without the ice they do not stand a chance of catching seals because they are better swimmers than bears. On the ice, however, the bears are much faster, which explains why the ice is vital for the survival of the bears.

The polar bear is also dependent on the ice during the breeding season when the she-bear hibernates. In contrast to the brown bear couple, which hibernate throughout the winter, the male polar bear does not hibernate. Normally a she-bear starts to hibernate in November to get ready to give birth to its young one, which does not leave its hole until March or April. All winter long, the young one is hiding from the male bears which would otherwise attempt to eat the young. The fact that the ice is unstable early in spring presents a problem to the young when they emerge from their holes.

Besides, the bears have not adapted to the temperate climate. The polar bear stands to succumb to the climate changes like other species before it, the mammoth, for instance.

Black gold, green forests, and a changing society

By special reporter Liv Toudal Olsen, the Bering Strait, 20th May, 2040.

Life in the Arctic has changed. Despite materialistic prosperity, the communities are disintegrating, and nature is still creating problems.

The Bering Strait

We have now reached the Bering Strait, which all too clearly bears evidence to the extent of the climate changes. Containerships and tankers, which transport oil and freight around the northern hemisphere, pass the Bering Strait on a daily basis.

The sea route across the Arctic is now the shortest route when transporting goods between Europe and the Far East. For this reason this has proven extremely profitable for the shipping companies. In the past they had to pass through the Mediterranean, The Suez Canal and all the way around India to reach China. Economically speaking, this is not the only benefit from global warming. Now that the ice has melted, the region has turned into a regular Klondike where oil is drilled for on a large scale. The search for oil has in no way been futile because Greenland has really struck gold, so to speak. The oil has made Greenland extremely wealthy and compensates by far for what, somewhat unexpectedly, has been lost on the fishing industry, i.e. jobs.

The sealer culture has been lost.

For a thousand years fishing, sealing and hunting have been the Greenlander's primary trade and his most important way of providing food. Sadly, the global climate changes have brought an end to this. Anyway, the loss of this trade was probably inevitable in the modernisation process of the country; only it would have been part of a *natural* development.

With the melting of the sea ice, the prospects for further hunting have evaporated, as the seals are gone too. Traditional hunting methods, which for centuries have been adjusted to the Arctic environment, are now obsolete. The winter sea ice is no longer suitable for hunting because the edge of the ice on which the animals are staying in the winter has become unstable and far too risky to set foot on.

The sealers are no longer capable of passing on their cultural heritage, and almost all the villages have been abandoned. People have moved to the towns, which, according to the first mate on the ship, have given some of them mental problems. They have suffered a mental blow, despite the fact that they have not been sealing for many years.

The Greenlanders are getting fat

As society in Greenland has settled in a few major towns, their way of life has increasingly taken on a western outlook regarding consumer goods and foodstuffs.

At first, obesity and its side effects were only something associated with USA. From there on, however, it has spread to Europe and Asia and finally to the Arctic. According to many experts, the Greenlander has put on weight because he has had to change his traditional diet due to the climate changes.

Agriculture in the Arctic

As the fishing and sealing industry has come to an end, agriculture has become the new trade. The temperate climate, the long growing season, and the increased amount of precipitation have provided favourable conditions for cultivating the soil. The soil has become more fertile, which is yet another positive aspect for the farmers who need to feed their animals. Sheep are the most common livestock because they are very hardy and therefore able to survive even periods of frost with scarce food.

The permafrost is gone

Along with the disappearance of the permafrost, the infrastructures in Siberia and Greenland have disintegrated. Unlike many other countries, the permafrost made it possible to travel on land and partly on water in the winter. In Siberia, materials could easily be transported across the ice. Only in the summer when the active layer was thawing, this sort of traffic had to stop in order not to damage the once unique nature of the tundra. In Greenland, too, the transportation went smoothly in the winter. Riding dog sledges, and later snowmobiles, one could easily cross the snow-covered rocks or the icy fiords. Today, sailing the waters is easier than ever before; however, transportation on land has become more difficult. The Siberian roads have been made muddy and practically impassable because of the rain and the thawing permafrost. Time and money have been spent on making roads for trucks. Still, in Greenland the situation is even more difficult because the rocky landscape has made it a heavy task to make passable roads. To make matters worse, the temperate climate has not only made a mess of the infrastructure; it has also made houses collapse in Siberia. These houses were built when the permafrost was still active, but as it started thawing, the soil under them caved in. In Greenland this is not that big a problem because most houses have been erected on rocks.

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