

In this unit you'll find out about the impacts of global warming on the Arctic and Africa.

The Arctic region lies within the Arctic Circle (the 66.5° line of latitude). It consists of the ice sheet surrounding the North Pole, as well as the northern parts of eight countries – Canada, Greenland, Russia, USA (Alaska), Iceland, Norway, Sweden, and Finland. The area has an incredibly cold climate: January temperatures average -35 °C, and July temperatures -1.5 °C. Much of the Arctic is ice.

However, increasing average temperatures are melting the Arctic ice. In 2006, NASA reported that the amount of permanent sea ice decreased by 14% between 2004 and 2005 – equivalent to an area three times the size of the UK. The rate at which the ice is melting has risen massively. Until recently, 80% of solar radiation was reflected from the polar ice caps. Now the amount of ice has decreased, and the area of open ocean has increased. Oceans are darker than ice and snow, and absorb more energy – converting it to heat. This speeds up the warming effect, which melts more ice and creates a vicious cycle, called the **positive ice albedo feedback**.

At current rates, 50-60% of Arctic ice will be lost by 2100. One theory suggests that it could disappear entirely by 2070.

Impacts on the environment

Increasing temperatures have led to:

- the **tree line** (the edge of the habitat within which trees will grow) moving north, and also to higher altitudes.
 - **tundra** ecosystems in Arctic areas (which withstand intense cold) being lost as the climate warms and other plants take over.
 - permanently frozen ground (or **permafrost**) thawing out.
 - the spread of species such as the spruce bark beetle in Alaska – changing the food chain.
 - increases in the number and extent of northern coniferous (or **boreal forest**) fires in Arctic Russia.
- 10 million hectares burn each year, losing 0.8% of the world's coniferous forest. Boreal ecosystems account for 37% of the world's carbon pool on land, and are effective carbon sinks.

Fish stocks and polar bears

The marine ecosystem has altered considerably as a result of Arctic warming. It is difficult to assess the true impact of warming because so much commercial fishing of species such as cod has taken place. But the shrinking ice sheets have certainly affected marine species in the Arctic. Warmer water has reduced the quantity of marine plants on which many smaller fish feed. In turn, the reduction in smaller fish species has affected those higher up the food chain, such as cod and halibut, which in turn affects larger marine species such as seals. This has a **negative multiplier effect**. Smaller seal stocks reduce the available food supply for polar bears.

The melting Arctic ice has had a devastating impact on polar bears. They hunt seals on the ice, and the faster annual ice melt has reduced their spring hunting season. Hudson Bay is now ice-free for three weeks longer than it was in 1985, giving polar bears less time in which to hunt the reduced numbers of seals. Female polar bears rely on the spring to build up their body fat to ensure their survival during the summer when the ice they hunt on recedes naturally. Currently, each animal loses 80 kg of fat during the longer summer, making them susceptible to disease, and reducing their ability to reproduce or feed their cubs. Now they face the danger of complete extinction.

Socio-economic impacts

Global warming poses social and economic threats to the 155 000 Inuit living in the Arctic region. Global warming is disrupting their lifestyles, which are adapted to the cold but predictable climate in the Arctic. The impacts include the following:

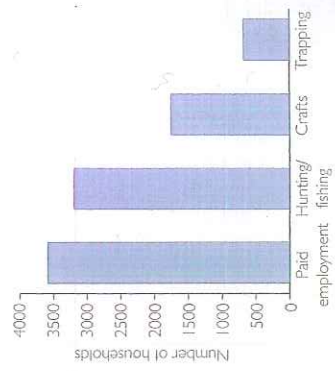
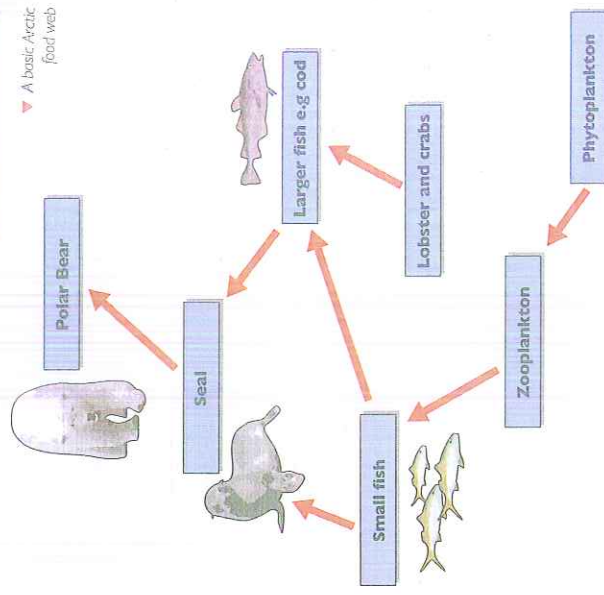
- Each winter Inuit must take their fishing shacks and equipment on to the ice for three months. Now the weaker and thinner sea ice collapses easily, making it more dangerous.
- The ice used to protect Inuit villages along the coast. However, coasts are now exposed to more ocean waves and storms, causing the destruction of entire villages, and forcing people to move further inland.
- 24 Inuit villages in Alaska are now threatened by flooding.
- 80% of Inuit still hunt caribou, fish, and marine mammals – all of which are declining in numbers. As marine stocks decline, the Inuit rely more on hunting caribou for income, which in turn places greater pressure on caribou stocks. 70% of Inuit income is from paid employment or hunting, so declining stocks hit Inuit incomes hard.



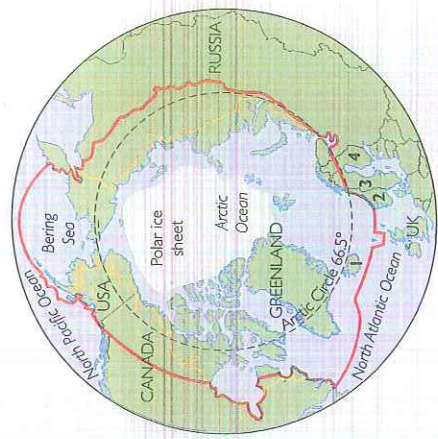
▲ Polar bears face extinction

Does it matter if polar bears become extinct?
What do you think?

▼ A basic Arctic food web



▲ The distribution of Arctic employment



Key

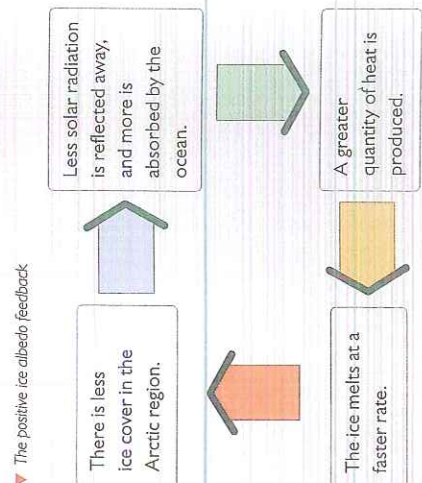
- 1 Iceland
- 2 Norway
- 3 Sweden
- 4 Finland

Key

- Arctic region
- Tree line

▲ The Arctic region

● **Albedo** is the amount of solar radiation reflected by the Earth's surfaces. Ice and snow (light coloured surfaces) reflect most, and dark rock surfaces reflect least.



▼ The positive ice albedo feedback

The impacts of global warming - the Arctic

Socio-economic impacts continued...

Environmental change creates further problems. Caribou and marine animals provide vital nutrition for the Inuit. Together, caribou, seal, narwhal, fish, and walrus provide over 90% of their food, and reductions in their numbers are dangerous for Inuit lifestyles – especially as a high protein intake is needed to cope with the cold. Imported food is expensive. Clyde River settlement on Baffin Island has 450 residents, who eat 100 tonnes of seal meat annually. To import replacement food would cost US\$1 million, and provide less iron, magnesium, and calcium than the natural diet.

Bringing home a seal supper on Baffin Island ▶



Are there any benefits from global warming?

The melting ice creates some commercial advantages for the Arctic region. The Northern Sea Route, north of Canada, is the quickest way of travelling from Europe to the Pacific and Asia, but, until now, the ice has only allowed ships to use it for about 6 weeks between August and October. Now, tourist ships are able to visit northern Canada, and 30% of Inuit now earn income from sculpture or print-making for tourists. In 2007, the North–West Passage between Canada and the Arctic melted sufficiently to allow shipping through for the first time.

However, this brings problems too. Oil tankers have negotiated Arctic waters for nearly 40 years, bringing oil from the shores of northern Alaska. Greater frequency and use of the passage north of Canada increases the risk of pollution and of oil spills in the Arctic. Now, Russia has started to allow nuclear waste disposal in its Arctic waters off the coast of its North Western territories, posing a further threat to the marine ecosystem.

Over to you

- 1 Research and design a short presentation on the issues facing the Inuit, e.g. those living in Nunavut, a Canadian Inuit territory.
- 2 In pairs, classify the effects of global warming on Inuit communities.

	Economic	Social	Environmental
Short-term			
Medium-term			
Long-term			

- 3 Draw a spider diagram to show the future of Inuit communities if: **a** seal and fish stocks continue to fall, **b** tourist numbers continue to rise, and **c** sea routes around the Arctic open up further.
- 4 Discuss which you see as the bigger threat: declining fish stocks or opening up the Arctic to increased shipping.

On your own

- 5 Define the terms from the text: positive ice albedo feedback, tree line, tundra, permafrost, boreal forest, negative multiplier effect.
- 6 Research the Arctic climate, using www.worldclimate.com or similar. Compare northern Canada with Greenland and northern Russia. What challenges does the climate present for people?