MARINE update 61

Assessing the impacts of climate change in the Arctic

INTRODUCTION

The Arctic is the largest inhabited region on Earth: a vast area of fjords and tundra, jagged peaks and frozen seas, glaciers and icebergs. It's the realm of the polar bear and a wealth of other impressive wildlife, and is home to indigenous peoples who have adapted to live in one of the harshest environments in the world. The Arctic also contains the most productive marine ecosystem in the world, with four of the world's 10 largest fisheries, and its icy waters house the largest deep-water coral reef in the world.

The Arctic influences both regional and global climate, as surface waters that flow north into the area cool and become more saline and dense, sinking and flowing back out of the Arctic at great depths. Known as 'thermohaline circulation', this is an important feature of the world's oceans and carries heat from the tropics to the poles.

RECENT CHANGES

The Arctic region is undergoing rapid environmental changes. Over the last century, average air temperature in the Arctic has warmed at twice the average global rate. As a result of this warming, the annual average sea ice extent has declined by 8% in the last 30 years and, between the 1960s and 1990s, its thickness fell by 10-15%. The extent of summer sea ice has decreased at an alarming rate and the Arctic's annual ice melt is starting earlier and earlier. In the Beaufort Sea, for example, studies have found that sea ice is beginning to break up 5.3 days earlier per decade.

Implications for wildlife

The earlier break up of sea ice is having serious consequences for polar bears, which rely on sea ice to hunt their preferred prey of ringed seals. An early ice melt limits the bears' hunting season and forces them to come to shore earlier. Studies from Hudson Bay show that for every week earlier that ice break-up occurs, bears will come ashore 10kg lighter. Not only does the failure to build up sufficient fat reserves cause polar bears problems in waiting out the fasting season, but the consequent inability of mothers to lactate leads to greater mortality among cubs.

The distribution of marine species is shifting, reflecting changes in the Arctic environment. For example, between the 1920s and 1960s a 1°C rise in sea temperature saw the northward migration of Atlantic cod and Norwegian herring. In addition to affecting the migration of Atlantic cod, increased sea temperature has led to an increase in this species' recruitment and growth rates in the Arctic.

Implications for people

Scientists estimate that shorter and warmer Arctic winters have led to an 8% increase in rainfall regionally over the last 100 years, and indigenous people are experiencing greater difficulty in drying their food. A higher level of moisture in the air is leading to dried food going mouldy or sour.

The reduction in sea ice is exposing coasts to erosive forces. Increased coastal erosion – which can amount to several metres per year – causes environmental and socio-economic risks and effects. In Arctic northern Russia and North America, there are already examples of settlements being abandoned owing to erosion.

PREDICTED CHANGES

Scientists predict that air temperatures in the Arctic may rise by as much as 4-7°C in the next 100 years. Some now believe that by 2040, the Arctic could be largely ice-free in the summer. A reduction in sea ice will lead to more heat being absorbed and less reflected back to space, which will exacerbate regional warming. Carbon dioxide (CO_2), which is the principal cause of climate change, is also dissolving into the oceans, forming carbonic acid. It is predicted that by 2050, the seas will become more acidic than at any time in the past 20 million years.

Implications for species

Extreme changes in the pattern and distribution of sea ice in the Arctic will reduce habitat availability for many species and isolate breeding and foraging areas. This could mark the demise of species such as the polar bear and have serious impacts on other species such as ringed seal, Arctic cod and walrus. As the Arctic becomes warmer, polar-adapted species may be out-competed by immigrant species.

Diminishing sea ice is likely to reduce foraging opportunities for beluga whales; and it could have an impact on the sea ice algae ecosystem, which forms the basis of the Arctic food chain. Conversely, localised bays are seeing an increase in sea ice: this can close gaps in the ice that whales use as breathing holes, and can result in some animals, such as narwhals, becoming trapped under the ice.

With less ice cover, the Arctic Ocean will absorb more CO_2, resulting in further ocean acidification. Acidification will compromise the calcifying process for numerous groups of species including keystone species such as certain phytoplankton, molluscs and sea urchins. Slow-growing coldwater corals – already surviving in marginal conditions – will struggle to absorb the calcium they need as waters become more acidic.

Implications for Arctic productivity

Increased open water and rising temperatures could bring about a shift in species composition within the Arctic plankton community, resulting in there being types of plankton not typically eaten by current Arctic species. There will also be a potential reduction in the productivity of the ecosystem under the ice. But by allowing more sunlight through, a decrease in sea ice could increase production of microscopic organisms in the open waters of the Arctic ecosystem. Cod and herring could show higher rates of reproduction and growth in the short term as sea temperatures increase, although it is less clear what will happen as waters become more acidic.

However, as temperatures rise, changes in the timings of breeding seasons is occurring, meaning that prey species such as zooplankton are no longer available for predators, such as fish fry, at the critical time for their survival. This leads to breeding failure and threatens populations of some species.

Implications for the rest of the planet

There is a risk that warmer seas and a higher proportion of fresh water in the sea will reduce the thermohaline circulation, potentially altering ocean currents and global weather patterns.

With a 2-3°C global average rise in global air temperature, the entire Greenland ice sheet could reach a point where it begins to melt irreversibly. If this happens, it is predicted that it will cause a 6-8m rise in sea level over the coming centuries, with major impacts around the world. Within the Arctic as coastal ice reduces, the risk of erosion and flooding of the coastline will increase. With much of the region consisting of low lying land, this has substantial implications for fauna, flora and people and their infrastructure.

Critically, increased coastal erosion and sea level rise will expose more of the permafrost to degradation, which will lead to methane – a greenhouse gas 20 times more powerful than CO_2 – being released from within and under the soil. With the potential for as much as a 50% reduction in the extent of permafrost, the potential amount of methane that could be released is massive; this will further fuel climate change.

As the Arctic continues to warm, tipping points will be reached where impacts on the region will be irreversible. If the Arctic Ocean becomes essentially ice free in the summer and if its outer regions remain ice free in the winter, then thresholds for substantial change will be exceeded. Step changes in physical and biological processes could follow, including: sea temperatures rising as much as air temperatures; increases in the depth to which waters are mixed; changes in the strengths and patterns of currents; variations in the thermohaline circulation; and dramatic changes in the nutrient levels of surface waters.

Other impacts

Finally, a loss of sea ice is predicted to lead to an increase in shipping traffic, with unstrengthened vessels able to navigate through the Arctic seas. In particular, the Northern Sea Route and North-western Passages will become more accessible as winters becoming milder and the summers extended. This will dramatically increase the risk of oil spills in the region and could lead to further disputes over sovereignty of the polar region. Less sea ice could also open up opportunities for increased oil and gas extraction. This would further exacerbate climate change and the threats to the Arctic.

ADAPTATION OPTIONS

The Arctic is under threat from a number of pressures. In addition to climate change and ocean acidification, overfishing, noise and toxic pollution, oil and gas exploration and production, and even corroding nuclear arsenals all have impacts. Adaptation strategies should focus on reducing all of these threats to relieve the overall pressure on the Arctic and give it the best opportunity to adapt to changing conditions.

Since 1992, WWF has been working with partners across the Arctic and internationally to combat these threats and preserve the Arctic's rich biodiversity in a sustainable way. We play a pivotal role in negotiating protection against oil development in sensitive areas and in developing a network of marine parks across the region. We campaign for a reduction in the number of animals accidentally caught and killed in fishing gear and the development of sustainable fisheries and hunting practices. WWF works with the International Maritime Organisation to establish safe routes and safe standards for ships. To read more about our Arctic programme, visit: *www.panda.org/arctic*

WWF has been working on polar bear conservation for 20 years, and today we have projects in the Norwegian, Canadian, US and Russian Arctic. Our primary activities include supporting research, community-based work on reducing conflicts between humans and wildlife, and the creation of reserves and protected areas. More information on our work can be found at *www.panda.org/polarbears*

MITIGATION OPTIONS

Within the Arctic region, opportunities exist to reduce climate change and the feedback mechanisms, such as release of methane, that exacerbate it. Decisions to leave oil and gas reserves unexploited will reduce further emissions of greenhouse gases and other impacts. Methane hydrates in the region need to be monitored, and measures taken to reduce their release.

There is also an urgent need to reduce global emissions of greenhouse gases, particularly CO_2. It is critical that we keep the rise in global average temperature well below 2°C compared to pre-industrial levels. To achieve this, current IPCC advice is that global levels of CO_2 in the atmosphere need to be stabilised at below 350 parts per million. To increase the changes of this, CO_2 emissions need to be reduced by 80% by 2050 and 40% by 2020 (across the globe). Details of WWF's climate change programme can be found at: *wwf.org.uk/climatechange*

To achieve such reductions in emissions will require action from an international level to an individual one – particularly by implementing energy efficiency measures and using low-carbon energy sources, which already exist and are developing rapidly. When these are combined with controls on energy demand, these measures may be sufficient to meet the challenge – but only if the right decisions are taken in the next 2 years. The UK Stern Review concluded that any delay in mitigation makes adaptation to climate change much more difficult and costly.
To see how individual action can help, visit WWF's One Planet Futures Campaign website: *wwf.org.uk/oneplanet*

The mission of WWF is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:
· conserving the world's biological diversity
· ensuring that the use of renewable natural resources is sustainable
· reducing pollution and wasteful consumption

wwf.org.uk/researcher/issues/livingseas

for a living planet®

For more information contact:
elbrown@wwf.org.uk

WWF-UK

Panda House, Weyside Park
Godalming, Surrey GU7 1XR
t: +44 (0)1483 426444
f: +44 (0)1483 426409