



for a living planet

MARINE update 57

January 2006

Assessing the impacts of climate change in the North-east Atlantic

INTRODUCTION

A recent assessment of how the North-east Atlantic will be affected by climate change shows that dramatic changes are unfolding and will intensify in the coming decades.

Climate change affects the marine environment through many guises and impacts upon all aspects of the ecosystem. In June 2005, WWF convened a workshop with a wide range of specialists who considered how the wildlife of the North-east Atlantic would be affected. The full report can be downloaded from www.wwf.org.uk/filelibrary/pdf/climatechangeandseas01.pdf.



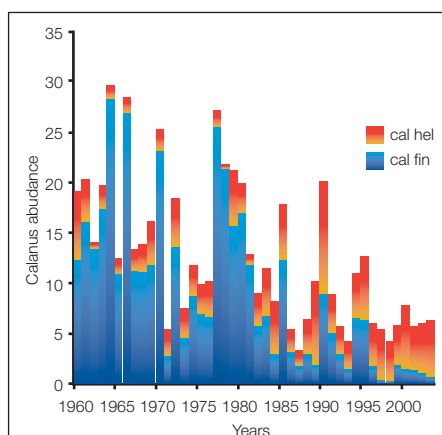
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The basking shark's main food source, plankton, is the basis of the marine food chain. However, rising temperatures are causing dramatic changes to plankton populations.

RECENT CHANGES

Our seas are already experiencing great changes as a result of climate change. For example:

- Plankton communities have undergone such serious changes that this phenomenon is described as a regime shift. This includes a 110km shift north in species distribution and a huge (possibly 60 per cent) reduction in zooplankton productivity.
- In the North Sea, 70 per cent of fish are reported to have moved north or offshore.
- As many as 80 per cent of seabird chicks starved to death in many nesting sites in 2004 and 2005. In some cases, all chicks were lost.



Abundance of the zooplankton species *Calanus* in the North Sea from 1960 to 2003. The ratio of *Calanus finmarchicus* cold water species (blue) and *Calanus helgolandicus* warm water species (red) are shown in relation to total *Calanus* abundance in each annual bar.

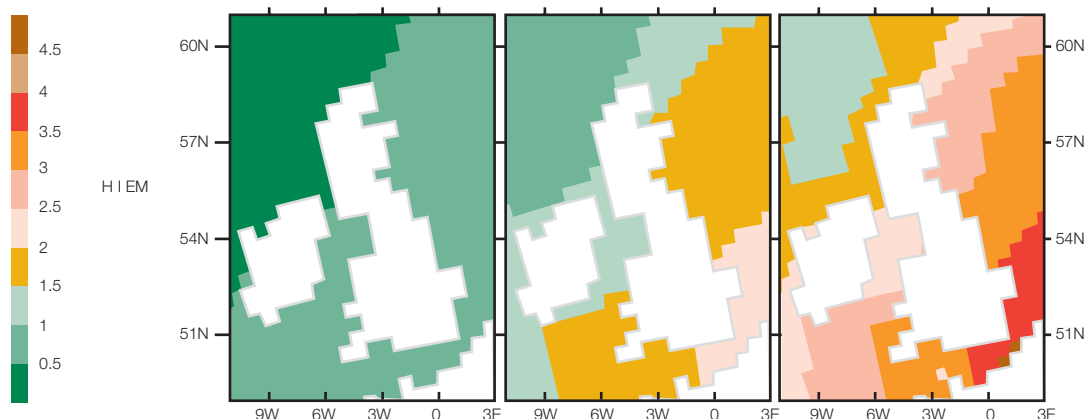
source: SAHFOS

These changes are of great importance, especially for an ecosystem that is already under pressure from over-exploitation of fish, discharge of pollutants, loss of saltmarshes and impacts from the oil, gas, tourism and aggregates sectors.

PREDICTING CHANGES

Further changes are predicted not only to continue, but also to speed up and increase. Established models, which use field evidence and widely agreed science, predict the following changes:

Changes in annual average sea surface temperatures by the 2020s (left), 2050s (centre) and 2080s (right) based on model-simulated 1961-1990 averages for the high emissions of greenhouse gases scenario as predicted by the Hadley Centre's HadRM3 model. Source: UKCIP02



- Temperatures will continue to rise on a gradient south to north and will be warmer in the south. Seas off South-east England, for example, may become 4°C warmer on average by 2080.
- By 2050, oceans will be more acidic than during the past 20 million years.
- Storm surges (localised rises in sea level) will increase to the extent that events which occur once in every 120 years now will increase to once in every seven years in some areas by 2080.
- Sea levels will also rise on a gradient south to north in the UK. South-east England could experience an 80cm increase in sea levels.
- North Atlantic Oscillation (a measurement of pressure differences over the sea surface) is likely to continue in a more positive phase for four decades.

Based on these and other predicted changes in rainfall patterns, layering in water (stratification), ocean currents and atmosphere patterns, it is thought that further detrimental changes to the region's wildlife can be expected.

Phytoplankton (plant-based) communities will continue to change. Disruption to this fundamental basis of the food chain could lead to the disintegration of the entire ecosystem.

Zooplankton (animal-based) communities will also alter further due to changes in phytoplankton, increasing temperatures and acidity. These changes could also impact upon the rest of the food chain. Zooplankton is the main food source for fish, including basking sharks, and some whale species.

Fish species will change and, in some regions, disappear. Cod may well disappear from UK waters. Sandeels, a major food source for other fish, seabirds, porpoises and minke whales, are already failing. A further demise of this link in the food chain will be catastrophic for some animals and will jeopardise their future existence in the region.

Seabirds will be further affected by changes lower down the food chain as well as directly by physical changes to the seas and coasts from climate change. The future of some colonies of puffins, common guillemots and kittiwakes is now in question in parts of Scotland, Northern Ireland and the North Sea. Terns nest very close to the water's edge, and their nests are vulnerable to being washed out more frequently by storm surges.

Seals, whales, dolphins and porpoises are most at risk if a number of impacts accumulate to affect the breeding of these generally long-lived animals which are slow to reproduce.

Sandeels play a critical role in maintaining the rest of the food chain. Changes to their productivity are being severely reflected – particularly in breeding seabirds.



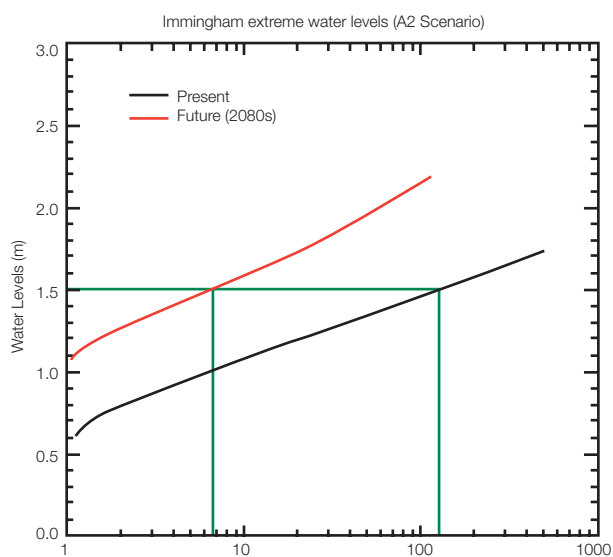
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COMBINED EFFECTS

Climate change is bringing about a number of changes. Each on its own poses a threat to wildlife, but acting together, they may push the ecosystem beyond its ability to cope and recover. Predicting these changes becomes ever more difficult, but in-depth knowledge of animals and ecosystems can be applied to anticipate likelihoods. Temperature changes, for example, cause some animals such as fish to ingest more food. This puts further pressure on food sources and increases their intake of pollutants, which in turn may be passed up the food chain to top predators. Acidity and temperature increases are thought to undermine the development of eggs and larvae, and sandeels spawn in mobile sand banks which can be disrupted by more frequent storm surges. There are many examples of such combined effects. Additionally there are pressures from other activities such as fishing, dredging and coastal development, in addition to pollution.



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Predicted changes (by the 2080s) in storm surge return periods at Immingham (From Hulme *et al.*, 2002)

Whole ecosystem changes can arise as links in the food chain change in relation to each other. The breeding cycles of different plants and animals are controlled by factors that have evolved over millennia and need to be synchronised perfectly for consumption of food sources at critical times. Some breeding cycles take their cues from the length of day, others from temperatures, yet others from a combination of factors. Therefore as temperatures change, but other breeding cues don't, breeding cycles become out of synchrony and the food chain breaks. This has a potential knock-on effect upon all life further up the food chain. Such mismatching and knock-on effects are predicted to occur in coming decades, with serious consequences.

Some southern marine species will increase in frequency in the North-east Atlantic in the short term. However, in the long term because of increasing ocean acidification, the UK will not necessarily be host to a Mediterranean marine wildlife as it will not have adapted to the predicted acidity.

If sited sensitively, renewable technologies such as this underwater turbine have a huge potential to help us shift from fossil fuels to clean energy.

FACTORS OF MAJOR SIGNIFICANCE

Whole ecosystem changes brought about by rising temperatures will continue to be the main driving force in the short term. In coastal areas, spikes in summer temperatures may cause significant damage. In the longer term, ocean acidification is likely to have major impacts on marine wildlife. The study has found that plankton – the very basis of the food chain – are especially vulnerable to the impacts of climate change, particularly temperature and acidity. Sandeels, too, play a critical role in maintaining the rest of the food chain and changes to their productivity will be severely reflected, particularly in breeding seabirds.

Combined with the consequences of human development, the coastal environment will be particularly affected by climate change. Areas with hard sea defences and other development will prevent wildlife from retreating up the coasts as sea levels rise. Storm surges will bring more flooding to coastal areas and rising air temperatures will damage sea shore environments. Unusual spikes in storms, temperatures, rainfall and other weather events will also cause serious damage to coastal communities.

The North Sea is more isolated and shallow than other areas of the North-east Atlantic, and its coastal areas are low lying, particularly on the continent. England is dipping into the North Sea due to the release of weight from Scotland after the last Ice Age. All this causes the North Sea to be more vulnerable to climate change than other sea areas. In addition, it is a heavily industrialised and fished sea, which brings added impacts. Its coastal zone is densely populated, and some major coastal cities will be affected by the predicted flooding, storm surges and sea level rises.

REDUCING IMPACTS

Many predicted changes will continue for decades – some for centuries, given the amount of carbon dioxide (CO₂) already in the atmosphere. It is critical that CO₂ emissions are dramatically and rapidly cut to minimise their impact on the marine environment. WWF urges the UK government to meet its targets to cut CO₂ emissions by 20 per cent by 2010 and 60 per cent by 2050. The power sector is the biggest CO₂ emitter and must reduce its climate change contribution urgently. The transport sector is close behind. It, too, must play its full part in reducing emissions.

Because it is home to the oil and gas industry – a major source of greenhouse gases – the marine environment has much to offer in terms of reducing climate change. The potential for marine renewable technologies in the North-east Atlantic is huge, and a rapid shift from fossil fuels to clean renewable marine energy would significantly reduce climate change and its impacts. WWF calls upon the UK government to address the integrated management of our seas in its forthcoming draft Marine Bill. Marine Spatial Planning, a crucial component of any new Bill, should enable human use of the sea to coexist with nature and thereby reduce environmental impacts. Climate change must be regarded as a critical factor in implementing Marine Spatial Planning.

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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



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