UK 2012 Climate Change Risk Assessment

Marine and Fisheries

Sector Perspective

- UK territorial waters provide essential resources (e.g. fish, gas, oil, building materials) and are home to critical infrastructure assets. Direct marine-related activities contribute about £45 billion/year and 900,000 jobs to the UK economy, with 95% of imports and exports transported via a maritime route.[1] The Department for Environment, Food and Rural Affairs (Defra) has overall responsibility for marine and fisheries policy at UK Government level, with some relevant responsibilities devolved to the appropriate Government Departments in Scotland, Wales and Northern Ireland.
- The marine environment is becoming increasingly busy and is affected by many different social and economic factors. In particular, population growth and changes in patterns of consumer demand have a major impact on the seas around us, especially in terms of the consumption of fish and shellfish and the volume of goods transported by ship to and from the UK.
- The diversity of this sector means it is the subject of many national and international laws, regulations, policies and conventions covering, for instance, fisheries, biodiversity, maritime safety and bathing water quality. A key policy driver is the commitment to increase the development of marine renewable energy in order to help meet UK climate change mitigation targets.
- The marine environment is affected both directly and indirectly by changes in climatic conditions. The waters around the UK have warmed by around 1°C over the last 100 years.
- Many marine industries are used to dealing with uncertainty and variability in the weather. However, the potential impacts of climate change on this sector could be intensified in the future and there are strong interdependencies with other sectors (e.g. energy, health and business, industry and services).

[1] All 2007 figures.

Marine and Fisheries

Climate change is projected to result in further changes in rainfall patterns and seawater temperature, as detailed in the UK Climate Projections (UKCP09), and also in changes to ocean pH and Arctic sea ice. Overall, such changes may present both challenges and opportunities for the marine and fisheries sector. For example, a decline in water quality in shellfish waters (due, for instance, to more frequent sewer overflows) may present challenges, but increased melting of Arctic sea ice, although environmentally damaging, may open up commercially viable routes for shipping, saving millions of pounds in fuel costs.

The Climate Change Risk Assessment (CCRA) has completed an assessment of a range of impacts for which this sector may need to prepare. Some of the key points from this assessment are summarised here.

The results presented here do not take account of changes in society (e.g. population growth, economic growth and developments in new technologies); nor do they take account of responses to climate risks (e.g. future or planned Government policies or private adaptation investment plans).

Focus on… Biodiversity and Ecosystems

Overall, climate change might have serious consequences for the way marine ecosystems function. By the end of the century, warmer temperatures may increase rates of 'carbon cycling' near the sea's surface by up to 20%, diverting resources away from species such as seabed worms, crustaceans and molluscs and therefore disrupting foodwebs and potentially fisheries. Similarly, an increase in eutrophication (where bodies of water receive excess nutrients and therefore experience a 'bloom in vegetation', for example) may disrupt marine food webs. Projections suggest that warmer temperatures and altered rainfall patterns would encourage growth of phytoplankton, even given the same or lower nutrient inputs from human activities.

A number of species, including certain seabirds as well as non-native plants and animals, may establish themselves in the UK for the first time, while others may disappear. The puffin, for instance, may lose breeding sites in south-west and eastern England and eastern Scotland (including Shetland). The gannet may lose breeding sites in south-west England but the yellow-legged gull may establish populations in the UK for the first time.[2]

The CCRA assessed nine key marine invasive non-native species that are already present in UK waters (often arriving in association with shipping, for example) and are considered to pose a risk. The analysis showed that the projected rise in seawater temperatures for seas around the UK would mean that all of these species may be able to expand their range by the 2080s to encompass the entire UK.

Confidence

M

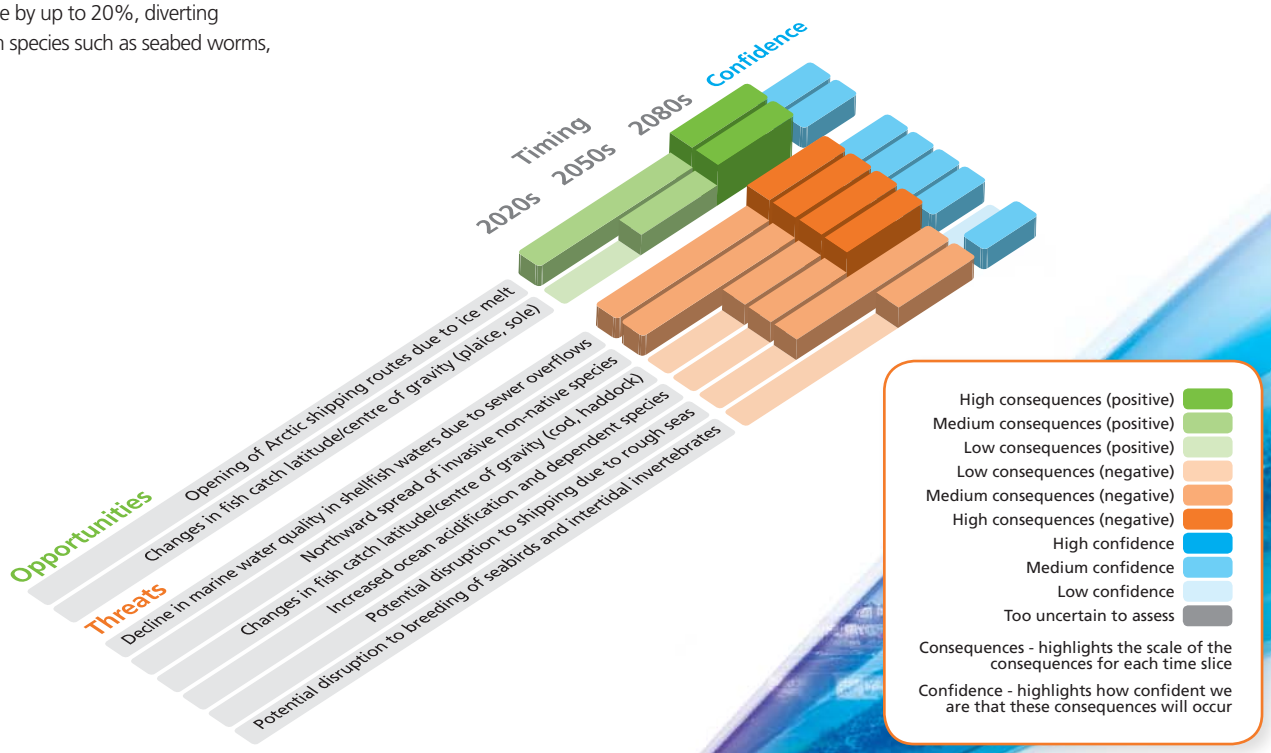
Species distribution: out of a sample of 44 species of rocky shore invertebrates analysed, 16 are projected to expand their range within the UK, four may experience a contraction and 16 are anticipated to experience no change.[3]

Focus on… Marine Transport

Arctic sea ice is an important part of the global climate system. The natural variability of ice extent affects both the reflection of solar radiation and heat exchange between the ocean and the atmosphere; it also modifies systems such as the Gulf Stream. Changes to sea ice therefore may have major environmental consequences, most notably affecting the habitats for animals (and indigenous people) that rely on the frozen environment to survive. The effects on the UK, although also potentially significant, have not been analysed in detail for this first CCRA.

Polar sea ice is already reducing in extent and coverage. Annual average Arctic sea ice extent has decreased by 3.7% per decade since 1978. Continuation and acceleration of this shrinkage is opening up two potentially key shipping routes in the summer: the North West Passage and the North East Passage to the Pacific and Asia. These short-cuts offer quicker journeys, lower fuel costs and avoidance of Suez and Panama Canal fees.

If winter weather becomes rougher around the UK (although projections are highly uncertain), this may cause more frequent disruption to ferry services off the north-western coast of Scotland and across the Irish Sea. Temporary port closures, damage to cargo and increased costs of maintaining navigation channels (e.g. due to changes in sedimentation patterns) are among the potential outcomes.



Confidence

M Total navigable days per year through the North East Passage: between 30 and 90 by the 2020s, between 90 and 120 by the 2050s and between 120 and 180 by the 2080s.

L Percentage of ferry services disrupted off north-west Scotland: 12% by the 2020s (current figure: 5%).

Focus on… Fisheries

By absorbing carbon dioxide (CO_2) from the atmosphere, seas are reducing the rate of climate change. One negative result, however, is that they are becoming more acidic. A range of species and ecosystems are vulnerable to this acidification, with particularly serious economic implications for commercial shellfish species.

Rising sea temperatures may lead to a continued shift northwards in the distribution patterns of some species of fish and shellfish. The implications of these shifts for the UK fishing industry are complex since some shifts may mean greater fuel costs for vessels that continue to target these resources, whereas other shifts may result in species becoming more abundant in UK waters, offering new fishing opportunities. In terms of 'year-class strength' (the number of fish or shellfish of a given age group that survive from egg production to be exploited by fisheries), climate change may have a negative impact on some species (e.g. cod and haddock) but a positive effect on others (e.g. plaice and sole).

Confidence

M Acidification of the North Sea: pH may be reduced by between 0.2 and 0.5 units by 2100 (compared to pre-industrial levels).

M Distribution shifts (example): plaice may move 140 km to the north-west over the next 70-80 years.

Focus on… Health and Disease

Traditionally, sewage discharges have been a major source of pollution affecting UK tidal waters. Although sewage treatment techniques have improved, contamination due to storm-tank and sewer overflows and runoff from farmland remain significant. Contaminated shellfish have been implicated in some outbreaks of the 'winter vomiting' norovirus amongst humans. Increased frequency of intense rainfall events caused by climate change may increase sewer spill frequency and heighten such risks.

The CCRA has also considered the potential for increases in blooms of harmful marine algae and in human illness due to changes in the prevalence of serious marine pathogens known as *Vibrios*.[4] Elsewhere in the world, rising sea temperatures have been associated with increases in illness associated with these organisms. Apart from the findings from the specific analysis highlighted above, the CCRA found currently available evidence to be inconclusive, and that there is a clear need for enhanced surveillance.

Confidence

M Potential annual cost of sea-borne infections: £1-9 million by the 2020s rising to £10-99 million by the 2050s (although costs highly uncertain).

[2] Huntley *et al.*, (2007) A climatic atlas of European breeding birds.
[3] JNCC (2009) UK Seabirds in 2008. Report No.396.
[4] Disease-causing microbes.

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The Challenge of Adaptation

Due to the inherent variability and frequent hostility of the marine environment, the marine and fisheries sector generally has extensive experience of coping with climate impacts. Nevertheless, there are marked differences across the sector in terms of both climate change adaptation needs and the scope for (and nature of) potential adaptation actions.

In some cases, action is already being taken or the basis for such action already exists. For example, surveys of shellfish production areas and bathing waters are conducted regularly and may generate important data that could be harnessed to support the introduction of adaptation strategies designed to combat the risk of shellfish contamination.

In other cases, preliminary steps are still required before specific adaptation actions can be identified and implemented. For instance, with regard to transmission of sea-borne diseases, there is an initial need to quantify the risks through efficient monitoring programmes.

The implementation of adaptation actions may require initiatives that could potentially present a range of major challenges. For example, development of commercial ports to serve the North West and North East Passages would require significant co-operation, planning and investment at an international level.

Similarly, adaptation to potential disruption of ferry services may involve the development of more stable ship designs and the amendment of ferry routes/ schedules to accommodate rougher winter weather. Efforts may also be needed to encourage members of the public to purchase and consume the different species of fish that may increase around the UK as a result of climate change, taking pressure off traditional target species that are expected to decline.

There are also many areas where gaps in knowledge currently limit understanding of potential climate change impacts and adaptation actions. Key issues where clearer understanding is needed include:

- Harmful algal bloom species, sea-borne viruses and bacteria, their biology and their epidemiology.
- The potential biological, ecological, socio-economic and other impacts of ocean acidification.
- Anticipated future distribution patterns for a wider range of marine species of importance to UK fisheries and conservation.
- Areas in UK waters potentially habitable by existing and incoming non-native species.
- Interactions between seabirds and other species in an ecosystem (e.g. fish and plankton).
- Sensitivity of fish eggs and larvae to changing climatic conditions, including shifts in the zooplankton community, ocean acidification, etc.

Where to Get Further Information

For copies of the CCRA Marine and Fisheries Report, the CCRA Evidence Report and Devolved Administration Reports, please visit www.defra.gov.uk/environment/climate/government/.

How the CCRA was conducted

The CCRA reviewed the evidence for more than 700 potential climate impacts on the UK economy, society and environment. Over 100 of these impacts across 11 sectors were taken forward for more detailed analysis, having been selected on the basis of likelihood, potential consequences and how urgently adaptation action may be needed to address them.

A plausible range of climate change scenarios was used in the analysis. Some aspects of socio-economic change (e.g. population growth) were also taken into consideration. Adaptation policies that are planned for the future were not considered, so that the underlying level of risk could first be compared across sectors.

For the marine environment, the results presented here are based on the UKCP09 Medium emissions scenario for the 2080s (2070-2099). For climate variables over land, the results are based on the UKCP09 Medium emissions scenario for the 2020s (2010-2039) and the Low, Medium and High emissions scenarios for the 2050s (2040-2069) and the 2080s (2070-2099). Projections of Arctic sea ice changes are based on the Hadley Centre HadCM3 model. A range of climate projections representing lower, central and upper estimates were considered within each emissions scenario.

Risks are categorised as low, medium or high based on their economic, social and environmental consequences.

The CCRA findings are also categorised as having low, medium or high confidence. The level of confidence is the degree to which the findings are considered valid, based on the type, amount, quality and consistency of the evidence studied.

Further information on how the CCRA results should be interpreted is presented in the CCRA Evidence Report. www.defra.gov.uk/environment/climate/government/

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