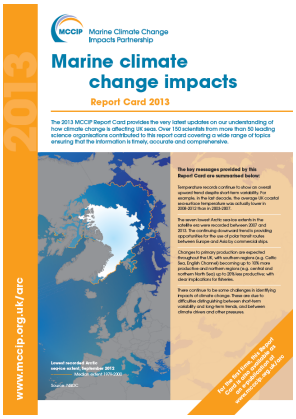
MCCIP Marine Climate Change Research Priorities 2014

MCCIP Marine Climate Change Impacts Partnership

Climate change is impacting on the marine environment in many ways. These impacts have been reported in the latest UK Marine Climate Change Impacts Partnership (MCCIP) report card, published in November 2013. Over 150 leading UK scientists provided contributions to the report card, across 33 marine and coastal topics.

These 33 reports, along with the UK Climate Change Risk Assessment (CCRA) and Charting Progress 2, have identified significant gaps in our knowledge that must be addressed to help respond to marine climate change.

Here we present the most urgent research priorities which should be of significant interest to funders of scientific research, as well as policy makers, marine managers and industry.

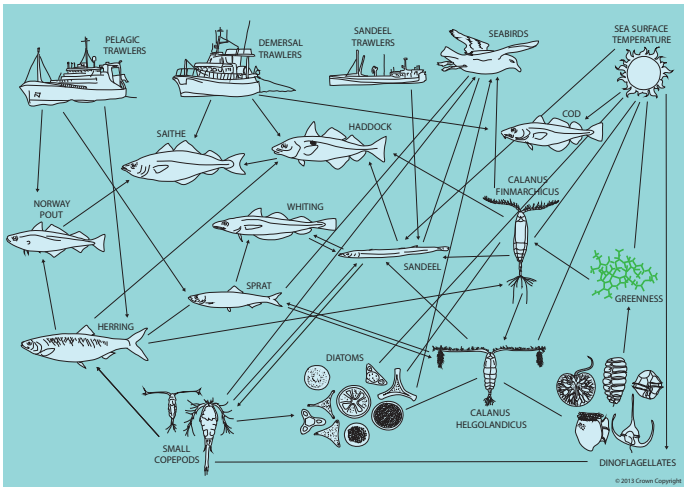


Our approach

All members of the four UK Marine Monitoring and Assessment (UKMMAS) evidence groups (*Ocean Processes (OPEG); Healthy and Biologically Diverse Seas (HBDSEG); Clean and Safe Seas (CSSEG) and Productive seas (PSEG)* were invited to undertake a research priorities assessment exercise. Some groups chose to provide a collective response, whereas others nominated individuals to undertake the assessment on behalf of their group. Following analysis by MCCIP, the top priorities were identified and sent to the UKMMAS evidence group leads for final agreement.

Whilst this assessment considered the four UKMMAS groups separately, there are strong inter-dependencies across the four evidence groups. For example, the fishing industry, a PSEG topic, is vulnerable to the impacts to sea surface temperature change (OPEG) on marine ecosystem health (HBDSEG and CSSEG; see Figure). These inter-dependencies need to be recognised as part of taking an ecosystem approach to marine management.

The top research priorities identified for each evidence group area are summarised on the following page, and are presented alphabetically by evidence group. The top priorities represent the highest ranked knowledge gaps for each evidence group, based on their importance to marine policy, scientific research and UK growth and sustainability.



A marine ecosystem model for a UK fishery, as an example of interdependencies across evidence groups (Image: Defra MF1228 - Physics to Fisheries "Fizzyfish")

How is it relevant to policy?

Understanding marine climate change research priorities is important for a range of policy needs, including:

- The UK Marine Science Strategy which identifies "Responding to climate change and its interaction with the marine environment" as one of three key priority areas.
- The Climate Change Act. Identifying evidence needs is a key part of reporting under the five-year cycle of Climate Change Risk Assessment (CCRA) and National Adaptation Programme (NAP). Organisations responding to the Adaptation Reporting Power (ARP) also need to identify their evidence needs.

At a broader level, improving climate change information for marine spatial planning and EU directives, such as the Marine Strategy Framework Directive (MSFD), will be critical to their successful implementation.

MCCIP is producing a new report card on the implications of climate change for marine protected areas and achieving good environmental status under the MSFD.

For complete transparency, and to help aid others wishing to undertake further analysis, short supplementary papers on source material and methodology are provided on the MCCIP website:

http://www.mccip.org.uk/arc

Ocean Processes (OPEG)

Arctic sea ice

Improved physical understanding of the Arctic system and links to other regions *To better predict change we need an improved understanding of physical and biogeochemical processes in the Arctic system and sustained observations of its state as input to model projections. We also need to know more about how the Arctic system links to other regions (via tele-connections) through process studies combining modelling and observations.*

Atlantic heat conveyor

The link between climate and the Atlantic heat conveyor *The accuracy of seasonal to decadal predictions of North Atlantic climate, and of the Atlantic heat conveyor itself, are limited by a lack of observations and a full understanding of the physical processes that link the Atlantic heat conveyor to the wider climate.*

Ocean acidification

How acidification will affect marine life *Although the processes of acidification are relatively well understood, knowledge of the impacts on marine species and their ability to adapt to increased acidity is limited.*

How pH will change at local and regional scales *Biogeochemical feedbacks between ocean acidification and climate change and the impact of these global scale changes to local and regional scales.*

Sea level

How sea levels at our coasts will change locally *The planning and adaptation community require sea level change information at the regional level. This information cannot be obtained with any confidence from current climate models.*

Healthy and Biologically Diverse Seas (HBDSEG)

Deep sea habitats

Distribution, structure and variability of deep-sea biological communities *There is a lack of baseline data on the distribution and structure of deep-sea biological communities in UK waters and how they vary in time. Understanding the responses of these systems to climate change requires good baseline information.*

Fish

Integrating observational and modelling work to make more robust predictions *More work is needed to combine individual-based laboratory experiments, long-term survey data and statistical and process-based models to make robust predictions that take account of both direct and indirect climate change impacts on fish.*

Jellyfish

Is climate change affecting the frequency of jellyfish blooms? *Mass blooms of jellyfish may, very occasionally, cause serious economic damage to tourism and aquaculture. While there are some suggestions that jellyfish abundances may be increasing, we do not understand when and why blooms occur. Efforts to improve the monitoring of jellyfish should be supported.*

Plankton

What are the links between warming, plankton and fisheries? *Mechanistic links (and responses) between climate warming, plankton and fisheries (and other higher trophic levels such as seabirds) to form a predictive capacity. This includes understanding and predicting rapid and abrupt ecosystem shifts relating to climate change.*

Shallow and shelf subtidal habitats

Large scale changes in benthic species *Knowledge of large scale benthic (bottom living) species distribution within UK waters is required, in order to detect changes over large areas of the seabed and patterns of benthic response to climate change.*

Clean and Safe Seas (CSSEG)

Coastal flooding

Changes to coastal defences and natural flood management measures *A better understanding is needed of climate change impacts on coastal defence deterioration rates, fragility and failure, as well as flood management contribution from natural systems such as inter-tidal habitats.*

Integrated assessments of future coastal development and flood losses *Reliable predictions of new coastal development, siting of new infrastructure and protection measures are needed to undertake integrated assessments of future flood losses.*

Human health

Environmental monitoring and linking clinical cases to the marine environment *Understanding human health impacts from pathogens occurring in, or released into, the marine environment is hampered by a lack of monitoring and joined up epidemiological reporting systems. This makes it difficult to definitively link clinical cases back to climatic events in the UK marine environment.*

Modelling of future extreme weather events and human health impacts *Short lived or localised extreme weather events (especially heat waves and episodic downpours) are not captured well by climate models. This limits our ability to predict the future impacts of climate change on important pathogens and algal toxins in coastal and marine environments. For example, the outputs from climate models are at too large a scale to predict how combined sewer overflow discharges, and their related pathogens, may respond to localised rainfall events.*

Nutrient enrichment

The nitrogen cycle and its temperature dependence *Understanding the role and temperature dependence of processes that are the key sinks for nitrogen – denitrification and anammox – which currently have large uncertainties.*

Productive Seas (PSEG)

Built structures (coastal)

The rate of 21st century sea-level rise and erosion and impacts on coastal structures *Improved estimates of future sea-level rise are required to understand socio-economic effects associated with increased flooding and erosion (particularly in realtion to extreme events and trigger points), and resultant implications for coastal structures.*

Interactions between future climate change impacts and other coastal flood system variables for planning *A better understanding of how climate change will interact with other flood system variables is needed for future assessments of coastal flood impacts (e.g. sediment transport processes and coastal morphology, drainage, interactions between groundwater, fluvial and surface water flooding and cliff stability and morphology).*

Fisheries

Response of fishing fleets and dependent economies *A UK-wide assessment of social and economic implications of climate change for fishing fleets and dependent economies is needed as there have been very few studies which have quantified these.*

Vulnerability of the fishing industry to ocean acidification *The threat posed by ocean acidification is not well constrained, particularly for the UK shellfish industry.*

What is MCCIP? The Marine Climate Change Impacts Partnership (MCCIP) is a partnership between scientists, government, its agencies, non-governmental organisations (NGOs) and industry. The principal aim is to provide a coordinating framework for the UK, so as to be able to transfer high quality evidence on marine climate change impacts, and guidance on adaptation and related advice, to policy advisers and decision makers.

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