

Placing Ocean Acidification in a Wider Fisheries Context (PLACID)

Marine Theme Objective: Effects of the Environment on Fish Stocks

What's the issue?

Evidence suggests that absorption of atmospheric carbon dioxide (CO₂) in the ocean has already decreased pH levels by 0.1 pH units since 1750, and CO₂ concentrations are projected to rise further by the end of the century as fossil fuel reserves continue to be exploited. The potential effects of ocean acidification (OA) are poorly understood but have prompted considerable interest among scientists and concern among policy makers, NGOs and the UK fishing industry. In the UK, fisheries generate more than £800 million of revenue per year and support 30,000 jobs. Aquaculture generates £350 million and supports a further 4,200 jobs. According to the 2008 UK Climate Change Act the government is required to conduct a Climate Change Risk Assessment (CCRA) every five years, and shortly after that, to put in place a National Adaptation Programme (NAP). The first UK CCRA (published in January 2012) highlighted that important maritime industries (notably aquaculture and fisheries) may be threatened to OA but knowledge concerning these effects is still severely limited. Most of the OA research undertaken to date has concentrated on plankton and benthic invertebrates of limited direct commercial importance. The PLACID project will help to address some of the major knowledge gaps, concentrating mainly on commercial shellfish species (lobsters, crab, and whelks).

What are the aims of the project?

- To examine the direct physiological effects of OA on commercial invertebrate (as suggested by Defra, on lobster or crab, cockle and whelk) species through laboratory studies and links to projects elsewhere. This will include a literature review of national and global studies on effects of ocean acidification relating to fisheries and aquaculture;
- To quantify socio-economic consequences of ocean acidification in the United Kingdom, associated with losses to commercial shellfish fisheries and aquaculture (building on the CCRA analysis conducted by Pinnegar et al. 2012)
- To use models to provide mechanistic predictions of species responses to ocean acidification. This includes a targeted initiative focusing on "state of the art" Dynamic Energy Budget (DEB) models.
- To examine the implications of changes in larval energetic requirements and zooplankton community structure on fin-fish larvae growth and mortality and thus 'knock on' implications for fish stock-recruitment dynamics.
- To continue monitoring and surveillance (for 3 more years) of PCO₂ and carbonate chemistry (pH, DIC, TA) in UK territorial waters, through discrete sample collection (and processing at NOC Southampton) and underway pCO₂ measurements aboard RV Cefas Endeavour.

THE MAJOR CRUSTACEAN FISHERIES OF ENGLAND AND WALES

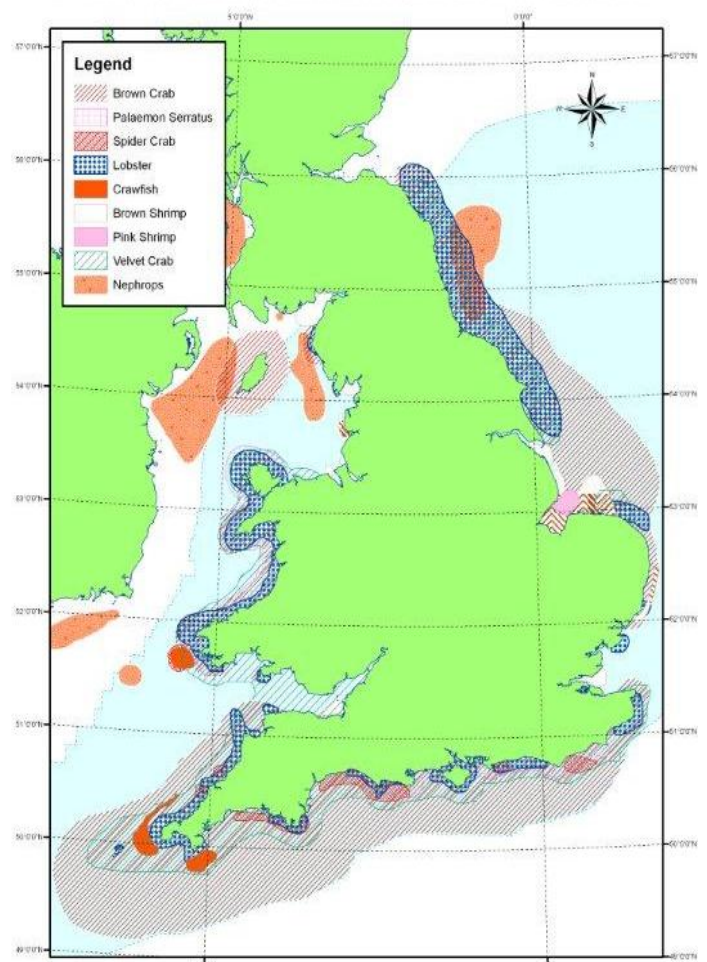


Figure 1 – Map showing the distribution of shellfish species (© Cefas Shellfish Team)



Department
for Environment
Food & Rural Affairs

Which policy areas will the research inform?

The United Kingdom Climate Change Act 2008 made the UK the first country in the world to have a legally binding long-term framework to cut carbon emissions. It also created a requirement to introduce 'adaptation' measures, including: a UK-wide climate change risk assessment (CCRA) that must take place every five years; a national adaptation programme (NAP) which must be put in place every five years to address the most pressing climate change risks to England; and powers to direct "reporting authorities" (companies with functions of a public nature such as water and energy utilities) to prepare reports on how they are assessing and acting on the risks and opportunities arising from a changing climate.

In January 2012 the UK published its first CCRA and Cefas were lead authors of the 'marine and fisheries' sector report. This report highlighted that many maritime industries and aquatic organisms are highly sensitive to climate change, but it also demonstrated that the level of knowledge concerning marine climate change impacts and particularly the effects of ocean acidification are limited. The effects of OA are now considered to represent one of the biggest threats to global marine biodiversity and large-scale research programmes have been instigated to try to quantify and characterize the potential level of threat.

What are the results from the project and how will they be used?

The PLACID project will help to address some of the major knowledge gaps, concentrating mainly on commercial shellfish species (lobsters, crab, cockles and whelks). In particular the project will generate:

1. Experiments: A series of laboratory experiments to assess the synergistic effects of temperature, pCO₂ and food will be assessed under multifactorial experiments at the Ocean Acidification 'state of the art' facilities at Cefas Weymouth.
2. Economics: different evaluations and risk techniques will be used to analyse the wider effects of ocean acidification and the potential effects on the UK shellfish and aquaculture.
3. Modelling: DEB modelling will be used to "scale up the" effects observed in laboratory experiments. The DEB work will help to inform the resource/energy needed for an organisms to allocate energy to growth, reproduction and reserved under controlled and disturbed conditions
4. Monitoring: spatial and temporal information from water samples will be used to inform the current estate of the carbonate chemistry in the North Sea and some inshore areas.



Figure 2: Juvenile lobster during an experiment in the Cefas Laboratory. (© Dr Silvana Birchenough)

Where can I find further information about this and related research?

For more information about this project, please contact Dr. Silvana Birchenough (silvana.birchenough@cefass.co.uk) or Dr. John Pinnegar (john.pinnegar@cefass.co.uk)

Useful links:

[http://www.cefass.defra.gov.uk/our-science/marine-climate-change-centre-\(mc3\)/climate-change-impacts/ocean-acidification-experimental-facility.aspx](http://www.cefass.defra.gov.uk/our-science/marine-climate-change-centre-(mc3)/climate-change-impacts/ocean-acidification-experimental-facility.aspx)

Alternatively, please contact Defra's Marine Evidence Team: marinescience@defra.defra.gov.uk

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