

# How can we assess the impact contaminants have on the health statuses of the marine environment?

Marine Theme Objective: Human pressures and impacts on the marine environment

## What's the problem?

More than 100,000 known human-made chemicals are present in the marine environment. Directly measuring all these chemicals isn't feasible and due to interactions between them it is often very difficult to predict the impact, either individually or as mixtures, of these chemicals on marine species. Therefore so called "biological-effect" techniques are used to provide a cost effective and integrated measure of the potential for a chemical to cause adverse health effects in the marine environment. A biological effect may be defined as the response of an organism (ranging from the expression of a protein or the onset of a disease), a population, or a community to changes in its environment, man-made or natural. To have confidence in the use of biological effect tools it is imperative that the techniques have well developed international accepted methodologies, assessment criteria, and a process for integrating chemical-biological effect relationships in order that they can be used to inform environmental managers and stakeholders on the current health status (e.g. is it getting better or worse?) of the marine environment.



Figure 1: Fish cages being deployed offshore to monitoring the impact of oil and gas platforms.

## What are the aims of the project?

Defra have a commitment to a UK national marine monitoring programme (Clean and Safe Seas Environmental Marine Monitoring Programme; CSEMP) which involves chemical contaminant monitoring in fish and sediments and biological effects. The programme has been running for ca 10 years and uses techniques recommended by the Oslo and Paris Commission (OSPAR) status and trend Joint Assessment Monitoring Programme (JAMP).

The aim of this project was to review the status of the techniques currently used in the programme and provide advice and recommendations as to their future use and implementation.

In addition, the review was to take account of how biological effect techniques could be used in meeting the descriptors in the EU Marine Strategy Framework Directive (MSFD), and also to identify gaps in knowledge, take account of new technologies, and to fully evaluate the strengths and weaknesses of the current monitoring programme.

## Which policy areas will the research inform?

Information from this project will be used in the formulation of policy for the management of the marine environment, including the implementation of the OSPAR Joint Assessment Monitoring Programme (e.g. are the levels of PAHs, metals, organotins or other contaminants in the marine environment at a level which may give rise to adverse health effects) and subsequent reporting for UK Charting Progress 2 (CP2) and the OSPAR QSR 2010. It will also provide baseline data for defining descriptors of Good Environmental Status under the MFSD.

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

The review undertaken suggested a road map for taking forward biological effect monitoring and assessment, under the responsibility of Defra in UK marine waters, and discussed the implications for the CSEMP. The main findings of this review include:

1. Following the publication of CP2 the offshore contaminant-related biological effect component of the monitoring programme needs to be reviewed, with the aim of removing redundancies and streamlining the programme. This may lead to a reduction in the number of sites visited on an annual basis, with detailed investigative studies undertaken at “hotspot” locations. For example, at sites on the Dogger Bank (North Sea) where there are elevated levels of fish with liver cancer.
2. At present sufficient data exists in England and Wales for offshore waters to conduct an integrated chemical-contaminant-biological effect health assessment, but further work in Scottish waters may be needed to fully implement the integrated approach as described by OSPAR.
3. It was highlighted that the current contaminant-related biological effects monitoring programme for inshore waters is inadequate with no coherent strategy within the CSEMP. It is essential that the data for inshore waters, including estuaries, should be expanded to allow a full assessment using internationally agreed protocols and strategies. Once comprehensive data sets exist (sufficient spatial and temporal coverage) these can be analysed to provide an integrated assessment to meet the requirements of both OSPAR and the MSFD (i.e. to define marine quality descriptors and to establish a long term program for the detection of long term temporal trends).
4. Inshore and estuarine locations need to be monitored using invertebrates and fish, in line with current developments within ICES and OSPAR for integrated monitoring across maritime areas. To achieve this there is a need to develop an integrated chemical biological effect estuarine and coastal programme under the

UKMMAS CSEMP umbrella.

5. Within the UK CSEMP the current suite of techniques are robust and reliable with internationally agreed protocols and well developed AQC, and as such, can be used for assessment purposes and to direct management action. However, in terms of diagnosis of health, the suite of techniques is inadequate to fully understand the causes of impact. In this respect it was identified that a research phase of the programme should continue to address this issue using, for example, newly emerging genomic and proteomic techniques assessed in an integrated manner against existing biological effects tools.

This programme has kept the UK at the forefront of biological effects research, enabling the UK to influence and advise in an authoritative manner on the uptake of new biological effects techniques. Conversely, it allows Defra to advise if recommended techniques are not fit for purpose and should be removed from programmes such as the JAMP, thus ensuring that resources are not wasted on ineffective tools and that the monitoring effort is fit for purpose.



Figure 2: The marine mussel is a key indicator organism recommended by OSPAR. These animal sentinels (mussels or fish) are particularly useful as they integrate the effects of all bio-available hazardous substances present in an environment and can discriminate chemical insult from other factors (e.g. physical changes that may impact ecology).

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

For more information visit <http://www.ospar.org/> or <http://www.defra.gov.uk/marine/science/monitoring/ukmas-background.htm>

Alternatively, please contact Defra's Marine and Fisheries Science Unit: [marinescience@defra.gsi.gov.uk](mailto:marinescience@defra.gsi.gov.uk)

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