

The application of biological-effects tools to inform the condition of European Marine Sites

A number of marine sites have been designated as Special Areas of Conservation (SAC) in England under the EC Habitats Directive. Natural England has a duty to monitor these, report on their condition, and advise on risks to features for which sites have been designated. Currently, condition assessments are informed by traditional biological community-level census techniques, contextual information on pressures/impacts (eg chemical data, fishing activity etc), and expert judgement.

In recent years, biological-effects tools (which include biomarkers), have been developed to complement traditional biological and chemical environmental monitoring. Biomarkers measure sub-lethal effects in individual organisms triggered by exposure to environmental pollution. The advantage of these tools are that they integrate effects from all pollutants, and act as an early warning of impacts at the community and population levels.

In 2004, English Nature (a predecessor body of Natural England), commissioned a review on the potential of biomarkers to provide information on the health of marine and terrestrial wildlife (English Nature 2004). This was followed by a stakeholder workshop consisting of practitioners and policy makers. The review and workshop highlighted the scope and potential usefulness of these tools and recommended that a trial should be conducted on a water body with known pollution gradients.

The aim of this project was to undertake such a trial, in order to assess the feasibility and value of developing a cost-effective and practical methodology based around biomarkers to assist in condition assessment of marine SACs. A steering group was set up to oversee this project, comprising of Natural England experts in marine ecology, ecotoxicology and pollution, and external experts in biomarkers from the Environment Agency and the Joint Nature Conservation Committee (JNCC).

What was done

Biomarkers were deployed at two marine SACs in the South West of England. These were the Fal & Helford SAC and Plymouth Sound & Estuaries SAC. The sites were chosen as they have been relatively well studied in recent years with chemical and biological information being collated to inform the EA Review of Consents

(Langstone *et. al.* 2003a and b). Within each SAC, sampling sites were chosen in relation to the site's interest features and known chemical contamination.

A suite of biomarkers were tested on samples of *Carcinus maenas* (Common shore crab) and *Mytilus edulis* (Common

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mussel), as these were invertebrate animals endemic to each SAC site. The range of biomarkers deployed include specific biomarkers - which indicate exposure to specific chemicals, and non-specific biomarkers - which provided a measure of general health and functioning of the animal.

Results from individual biomarker responses were assessed to identify spatial patterns within each site. Results from the full suite of biomarkers were integrated and ranked to provide an overall quality biomarkers classification, termed as the Biomarker Response Index (BRI). This was specially developed as a tool to interpret complex biomarker datasets for this project.

Results and conclusions

Biomarker results from the trial:

- Biomarkers measured in crabs and mussels from both sites highlighted that some organisms are exposed to contaminants, and are being impacted at the sub-lethal level.
- Particular specific biomarkers responses appear to follow gradients of known chemical contamination.
- Use of the BRI provided a simple representation of the integrated biomarker results and allowed identification of "hot spots" of pollution.
- Comprehensive interpretation of the biomarker results was limited by the availability of adequate field chemical and biological information.

Feasibility and value of developing a biomarkers methodology for marine SACs:

- A methodology and strategy for Natural England to incorporate biomarker based sampling into future risk and condition assessments of marine SACs was proposed.
- The study confirmed that biomarkers are not designed to be used in isolation, but rather they form part of a weight-of-evidence approach in integrated environmental assessments.
- Further work is required to understand what these biomarker responses mean for the

health of individuals, and what the subsequent risks are to populations and communities.

Natural England's viewpoint

This study was useful in testing the practical application of biomarkers to address the legislative requirements of the EC Habitats Directive. Added value was gained due to the fact that this study ran in parallel with an Environment Agency / Defra commissioned project which examined how (the same) biomarkers could inform assessments required under the Water Framework Directive (WFD) in the Ribble estuary.

It is clear that biomarkers could have a role in environmental risk and condition assessments. They can be used as either initial screening tools, confirmatory diagnostic tools, or as part of an integrated weight of evidence environmental assessment. As marine SACs in England will be subject to varying degrees of pressures (eg pollution), and have differing amounts of biological and chemical monitoring information available to inform their condition, a "one size fits all" approach to biomarker assessment is not appropriate. We would support a flexible approach to their deployment as proposed in this report.

We would agree with the projects findings that biomarkers should be used in conjunction with, not in place of, existing assessment procedures, providing a means of prioritising among sites of concern or to follow the progress of remedial action. The report also highlighted the degree to which interpretation of biomarker results is limited where there is a lack of supporting chemical and biological data.

There are significant costs associated with monitoring of the marine environment. Natural England will continue to work with the Environment Agency, CEFAS and others in identifying where biomarkers could provide a cost-effective means of informing assessments of ecosystem health in marine SACs.

Selected references

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English Nature, 2004. *Evaluation of potential use of biomarkers as long-term monitoring tools in assessing ecological quality in terrestrial and aquatic environments of the UK*. English Nature Research Reports Number 593, 26pp.

Further information

For the full details of the research covered by this information note see Natural England Research Report NERR009: '*The application of*

biological-effects tools to inform the condition of European Marine Sites'.

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