Environmental indicators: a structured approach to the evaluation of impacts arising from human activities at sea

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Introduction

This poster outlines a recently-commissioned multidisciplinary project aimed at improving the regulatory effectiveness of UK indicator applications across a variety of marine activities and spatial scales. An important stimulus for this work is provided by the recent implementation of a framework for the more effective co-ordination of marine monitoring in the UK. Its purpose is to enhance the capability to evaluate the success of environmental protection policies, and to develop a strategic response to new monitoring requirements under OSPAR and EU auspices. An improved reporting system based on objectives and supporting indicators will be an integral part of this framework. Properly constructed, this will also have a pivotal role in delivering an ecosystem-based approach to environmental management, the operational implications of which are exemplified in the evolving EU Marine Strategy. Thus it will provide a tool to inform policy makers and the general public, to identify and assess environmental problems, to set priorities and to determine the effectiveness of alternative policy options.

Within the EU, the European Environment Agency has actively promoted the use of indicators in international evaluations using the DPSIR approach:

Driving force (e.g. macro-economic dependencies)

Pressure (e.g. discharge or dredging activity)

State (e.g. concentration of a contaminant in the environment)

Impact (e.g. ecosystem degradation)

Response (e.g. measures taken to ameliorate adverse effects)

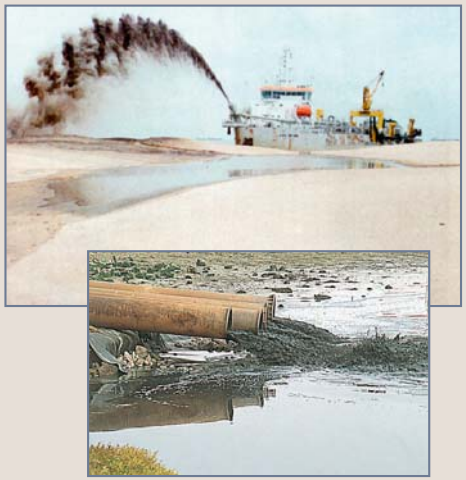
This has been adopted in the present study and, through the targeting of a variety of human inputs or activities affecting the marine environment, a system for the tiered application of indicators (i.e., within and across activities and spatial scales) is being evolved.

Theme 1: application and validation of environmental indicators in policy making and legislation

The dynamic nature of this theme, the desire to incorporate stakeholder views and account for the dynamic regulatory framework have made it more appropriate to develop specific research lines which determine the scope of the research, and which will be pursued as part of the ongoing survey of the relevant legal material and literature on indicators. These lines are:

- the need to develop a clear legal and policy framework,
- the development of clearer language, concepts and cooperation between legal, scientific and socio-economic research in the field, ensuring that account is taken of the changing regulatory paradigm, including the development of the 'Better Regulation' agenda, the Marine Bill and the Marine Strategy Directive,
- ensuring input from socio-economic work on indicators and scientific work on indicators to ensure that a complete context for the operational use of indicators is present.

These lines are being explored through a review of the current policy framework for indicator use, and analyses of statutory frameworks, case law and legal commentaries, with input from Themes 2 and 3, and MarBEF.



Top picture: Dredger recharging an intertidal mudflat using dredged material.
Bottom picture: Discharge pipe.

Theme 2: indicator applications (driving force and pressure) at local, regional and national scales

(1) Consideration of activity specific and across activity pressure indicators at different spatial scales.

Attempts are being made to derive appropriate pressure indictors, which are activity-specific and explore the geographical scales (local, regional, national) at which they can be best deployed. The activities of dredged material disposal, aggregate dredging and discharges are being employed as case studies. Similarly, the feasibility of identifying across-activity pressure indicators is being explored.

(2) Explore the feasibility of aggregating pressure indicators.

The ability to link to observed impacts (Theme 3) should be increased if a pressure indicator can combine different sources of available information. For example, the capability to link observed impacts to the amount of dredged material deposited might be greatly enhanced if an indicator contained information on the amount disposed of, the nature and quality of the material and the frequency of disposal. We intend to explore innovative formulations by exploiting the large amounts of data collected as part of the licensing process, and to determine their effectiveness through interaction with Theme 3. To date we have identified sources of information using dredged material disposal and aggregate extraction as case studies, and we are exploring comparable sources of information on marine outfalls.

(3) Integration of pressure indicators across human activities so they can be useful to management needs.

Many human activities at sea are conventionally viewed 'sectorally', and this is accentuated by the administratively-defined boundaries that may be placed upon them (e.g., areas licensed for aggregate extraction, dredged material disposal or windfarm construction). While such boundaries are not illogical, we are seeking to encompass the potential for 'cross-sectoral' pressures through appropriate suites of indicators used separately or in combination. The work is closely integrated with effort under Theme 3. In doing so, the intention is to aid the licensing and consenting process on local, regional and wider scales, enabling improved identification of any cumulative impacts and providing appropriate tools for implementation of the concept of marine spatial planning.

Small pictures on the right: Examples of faunal communities occupying coarse substrata.
Bottom picture: Dredger extracting gravel from the seabed.

Theme 3: indicator applications (state and impact) at local, regional and national scales

The measure of the state of the natural environment has resonance with the general public, for whom this is the ultimate expression of success or failure of management. Consequently, there are many indicators of state for ecosystem components but relatively few for pressure of human activities or the socio-economic response to these pressures. State & impact indicators provide feedback on the state of the ecosystem components or attributes and the extent to which management objectives, which usually relate to state, are met. They are used widely in global and regional assessments (e.g., Quality Status Reports). At the regional and local level they may be useful in detecting and quantifying deteriorating environmental quality so that appropriate action may be taken to halt or even reverse the trend. While most state & impact indicators describe the quality of a particular aspect of the environment, a more recent trend has been to try to identify indicators that reflect and report on ecosystem structure and function.

At present, the management of environmental state is hampered by the varied perception of significance of changes, the inability to quantify links between ecosystem components, the variability of specific state indicators and a lack of suitable indicators. In the light of these challenges, Figure 1 shows where and how ME4118/Theme 3 will contribute significantly to advance the selection and operational use of state & impact indicators.

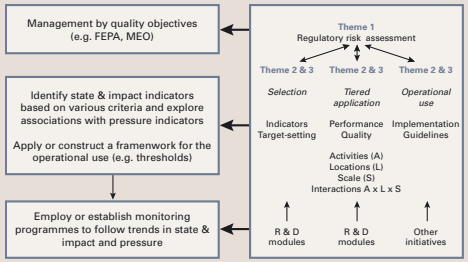


Figure 1. Structure of ME4118 and interface with Theme 3

The most desirable indicators (e.g., in terms of sensitivity) might not always be the most operationally useful. This often leads to the choice of less sensitive indicators that are reliable and for which acceptable and unacceptable limits are known. Understanding and predicting the links between pressure and state is fundamental to achieve operational objectives. Although this is an aspiration for site- or activity specific indicators, this process will be complex when synergistic and additive impacts occur, especially if the interactive impacts are due to various types of human activities operating on larger spatial scales. In such cases, demonstrating and evolving a tiered system with interconnections across various scales and activities, as advocated by this study, is expected to contribute significantly to advance the selection and operational use of environmental indicators. Once pressure and state & impact indicators are in place, monitoring programmes can be employed or established to describe trends.

R&D Module 1:
development of indicators for the assessment of the significance of PAH concentrations in marine sediments.

R&D Module 2:
development of an integrated indicator of biogeochemical and ecological status in marine sediments.

R&D Module 3:
potential of acoustic techniques for deriving summary indicators of sea-bed environmental status.

R&D Module 4:
the role of simulated data sets in evaluating the management utility of environmental indicators.

R&D Module 5:
developing new tools for identifying indicators of anthropogenic changes: age determination in a widely-distributed marine benthic polychaete.

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