

How do we assess the condition of the seabed? What are the critical factors in maintaining goods & services?

Marine Theme Objective: Science for Integrated Marine Management

What's the problem?

The state of the seabed is important as it not only provides habitat for benthic marine communities but also plays a vital role in breaking down dead organic matter, recycling carbon and nutrients that are needed to support primary and secondary production. The capacity of the seabed to provide these goods and services depends on the type of substrate (rock, gravel, sand, mud) and the local conditions under which they are found; some habitats are naturally dynamic while others are comparatively stable. Problems arise when human activities, such as dredging and trawling, change the conditions beyond the range naturally experienced by the habitats. Stable habitats will be very sensitive to physical disturbance, while dynamic habitats will be less sensitive. There is a growing need to understand the relative sensitivities of a range of habitats so that human pressures can be managed more effectively and appropriately.

What are the aims of the project?

This project aims to develop quantitative measures of the ecological function of seabed substrates and apply these to map habitat sensitivity which, when combined with maps of anthropogenic pressures, will enable evidence-based assessments of the health of the seabed.

It will make use of a conceptual model described by Tett et al, 2007 (Figure 2) to explore the resistance and resilience of habitats to increasing disturbance (pressure). The ecological function under investigation differs between soft and hard substrates. For soft substrates (sand, mud) the principal function is that of recycling carbon and nutrients; this will be investigated using geochemical techniques. For hard substrates the focus will be on their capacity to support and maintain epifaunal communities; this will be investigated by looking at the functional diversity of epifaunal communities using Biological Traits Analysis. Crossover between the geochemical and biological studies will be examined by extending the Traits Analysis into soft sediments and the geochemical techniques into coarser sediments, as far as is practical. Sensitivity will be considered as a function of the resistance and resilience of the system to disturbance.

The project will run until 2014.



Figure 1: A seabed community on mixed coarse substrate in a relatively undisturbed area of seabed (source: Cefas).

Which policy areas will the research inform?

The concept of 'seabed health' encompasses its physical, chemical and biological properties, as well as the functions that it performs. This work will inform policy relating to the management of the marine environment, and underpin assessment of 'seabed integrity' and Good Environmental Status to be made under the Marine Framework Strategy Directive (MSFD). It will also provide valuable information for measures proposed in the Marine and Coastal Access Bill, including taking forward Marine Planning and assessing what measures may be required to ensure Marine Conservation Zones meet their objectives.



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

Mapping Seabed Sensitivity

The results of the project will enable the sensitivity and status of seabed habitats to be mapped spatially. These maps will be overlaid with maps of various human pressures in UK waters to provide an assessment of the relative vulnerability of areas of the UK seabed to the different pressures, which will be of value in marine spatial planning. As the maps are underpinned by mathematical models, a degree of scenario testing will be possible to investigate the potential outcomes of various management actions, such as opening or closing vulnerable areas to certain types of fishing gear. This will be useful in deciding which management measures should be put in place in order to achieve 'Good Environmental Status'.

It is the intention that metrics of the structure and function of sediments and hard substrates developed by this project will have a basis in simple measurements of seabed parameters that can be routinely collected. This will facilitate the establishment of robust, cost effective monitoring programmes which will be required to make future assessment of the ecological status of the marine environment.

The Biological Traits Analysis will help us to better understand the functional diversity of benthic marine communities; that is the range of ecological functions that they perform. Knowing which species perform which tasks is important in assessing the value of biodiversity; a highly 'diverse' community that performs just a few tasks may be less ecologically valuable than a less diverse community that performs many more tasks. It is also useful to know the degree of functional redundancy in a benthic community; this occurs when many species in a community perform the same task, so the loss or absence of one of those species would not critically endanger the ecosystem function of the community. However, if a particular function is performed by only a few species, then there is a greater need to ensure their conservation.

Through this analysis the project will be able to link the biological component of seabed functioning to its physical and chemical processes and provide an understanding of

their response to natural habitat change or anthropogenic pressure. In its practical application, the work will help to determine the level of seabed disturbance that vulnerable seabed areas can be subject to, while maintaining their ecological function at acceptable levels. This will be helpful in defining what is meant by 'good' environmental status as distinct from 'pristine conditions'. It will also enable a much more adaptable and appropriate approach to managing fishing effort than blanket bans on certain activities or closures of economically important fishing grounds.

Reference: Tett, P., Gowen, R., Mills, D., Fernandes, T., Gilpin, L., Huxham, M., Kennington, K., Read, P., Service, M., Wilkinson, M., & Malcolm, S. 2007. Defining and detecting Undesirable Disturbance in the context of Eutrophication. *Marine Pollution Bulletin*, 55, 282-297.

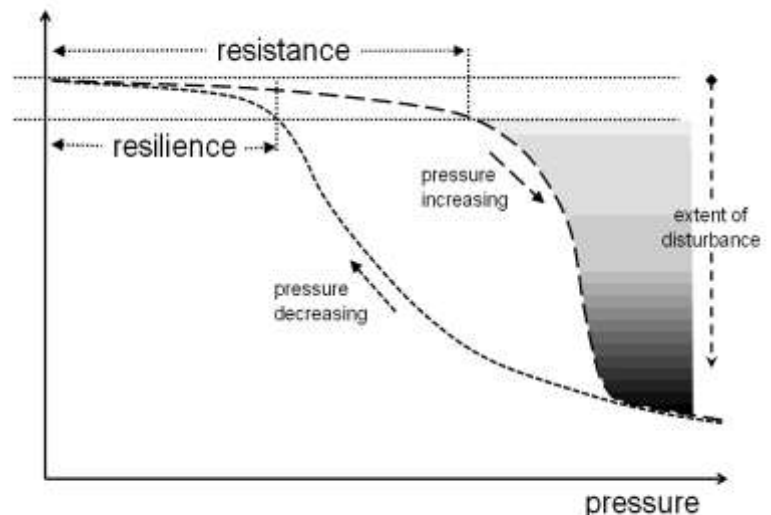


Figure 2: Conceptual diagram of ecosystem health and undesirable disturbance (redrawn from Tett et al, 2007).

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

Further details of the project can be downloaded from the Defra website, or contact the project leader at roger.coggan@cefas.co.uk

Alternatively, please contact Defra's Marine and Fisheries Science Unit:

marinescience@defra.gsi.gov.uk

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