MarBEF Theme 3: Socioeconomics of Marine Biodiversity

The role of marine biodiversity in directly providing goods and services

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Marine biodiversity plays a significant role in directly providing goods and services that benefit people as well as regulating and modulating ecosystem functions that underpin the delivery of ecosystem services. These services have been summarised in the Millennium Ecosystem Assessment as provisioning, regulating, cultural and supporting services. For example, the North Sea is important for fisheries and is home to approximately 244 species of fish but it is also one of the most important breeding grounds for birds which people value for their existence and which support the leisure time of recreational birdwatchers. Furthermore, several social groups such as fishers, NGOs and coastal villages gain part of their identity through their relationship with the sea.

In utilising marine resources and services, human activities are often detrimental to the sustainability of these services. In many parts of the world, marine biodiversity and ecosystem functioning are under intense pressure from natural and anthropogenic activities such as fishing, recreational uses, nutrient input and global climate change. As a result, biodiversity is declining, raising concerns about the consequences of such loss on the provision of ecosystem goods and services, and human wellbeing.

The Convention for Biodiversity and the Marine Strategy Directive require the EU to protect the marine environment and halt biodiversity loss through enhancing the efficiency and effectiveness of policies that regulate human activities. This can be achieved by conducting interdisciplinary studies involving ecological, social and economic aspects to understand the causes and effects of these activities, and then developing frameworks to communicate the findings to stakeholders including decision-makers. Sustainable management of European seas such as the North Sea therefore requires careful consideration of all values concerned, including industrial activities, recreation and fisheries as well as their impact on nature and biodiversity and social values.

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Within the EU-funded Network of Excellence MarBEF, we recognised that much of the information needed to consider these impacts is either unavailable or scattered between different countries and institutions. There is a need for a single framework that brings the available information together in a way that enables policymakers to consider all functions and interactions of the sea in policymaking. Integrated research activities form the core pursuit of Theme 3 in MarBEF, where we have brought together economists, cultural anthropologists, historians, ecologists and environmental lawyers to conduct joint research activities under the guidance of government policy advisors.

Our goal is to integrate research and data from network members to understand the economic, social and cultural value of marine biodiversity and hence develop the research base required to support the sustainable management of marine biodiversity. Through this interdisciplinary research, we aim to bridge the gap between natural and social science, and develop tools to make research outputs available for operational use to managers of the marine environment. Our research activities encourage communication between

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managers, scientists and socio-economists, leading to research that will facilitate good management and objective policy-making.

The team involved

The dedicated group responsible for this inter-disciplinary MarBEF Theme is jointly led by Dr Melanie Austen (Head of Science, Plymouth Marine Laboratory) and Prof Paul Holm (Rector, Roskilde University). The team responsible for conducting economic valuation of goods and services includes Dr N Beaumont, Prof E Ierland, Dr D De Groot, Prof T Dentinho, Dr S Mangi, Prof G Edwards-Jones, Dr JP Atkins, and Dr E Uytewaal. Cultural anthropologists and historians involved in the project include Dr A Delaney, A Marboe and Dr D Starkey, while ecologists include Prof M Kaiser, Dr S Degraer, Dr S Derous, Dr D Burdon and Dr A Ruijs. The team in charge of application of current management and legislation includes Dr R Barnes and Dr H Rees.

We have divided our research activities into four main areas:

- Socio-economic valuation of marine biodiversity in several case-study areas
- Development of a 'biological valuation' scheme to synthesise a unified index of biological importance of marine habitats so that habitats can be spatially mapped with an indication of their ecological importance
- A review of the application of environmental indicators within previous and current management and legislation of marine ecosystems
- Synthesis of the research findings to develop decision support systems for the management of marine ecosystems.

Training is a key objective of MarBEF Theme 3, to build European capability in this new area of interdisciplinary research. We are guiding six MarBEF-supported PhD students in conducting comparative studies in the Azores (Portugal), Isles of Scilly (UK), Flamborough Head (UK), Dutch/Belgian coast, Sylt-Rome (Denmark) and Gulf of Gdansk. In addition, a number of MSc student projects have been initiated to conduct site-specific studies that feed results into the PhD work. MarBEF has also enabled us to secure national funding for additional MarBEF-associated PhD students.

What we have done so far

We have completed the development of a marine biological valuation methodology that is able to integrate all available biological information of an area into one indicator of intrinsic value. This methodology should be applicable in every marine environment, independent of the amount and quality of the available biological data and the habitat type, and should be acceptable by a wide scientific audience.

We have developed a methodology to value one of the most important services provided by marine biodiversity: gas and climate regulation. This research used the Isles of Scilly as a case study. Net annual carbon photosynthetic fixation values were estimated by mapping habitats of keystone species of kelp and seagrass and using literature data to quantify their productivity as well as remote sensing methods to estimate phytoplankton productivity. The economic value of this service was then estimated using the marginal damage costs avoided. An adjacent Atlantic Ocean comparison site was used to indicate the relative importance of island biodiversity to this marine service. The Isles of Scilly marine environment was approximately twice as productive as the Atlantic Ocean region, fixing 136 495 tC y^{-1} with a mean net present value of €59,109,529, while that of the Atlantic Ocean region was calculated to be €28,641,727.

Initial statistical analyses have been completed for the economic value people place on the existence of European marine biodiversity using the contingent valuation methodology (CVM). This economic value of marine biodiversity was indirectly assessed by asking respondents what was their 'willingness to pay' (WTP) to avoid a reduction in abundance of various marine taxa including mammals, birds, fish, invertebrates and algae. A total of 747 respondents were surveyed in the Azores, Isles of Scilly, Flamborough Head and Gulf of Gdansk. Initial findings confirm that mammals are loved by all, and respondents were willing to pay to conserve them. Fish are more important than birds in the Gulf of Gdansk and Azores, while UK people value birds more than fish. Invertebrates and algae are generally least valued, probably because these two taxa are not as charismatic as the rest. There are demographic differences in the value of marine biodiversity (e.g. fish versus birds) and our research will be exploring these further.

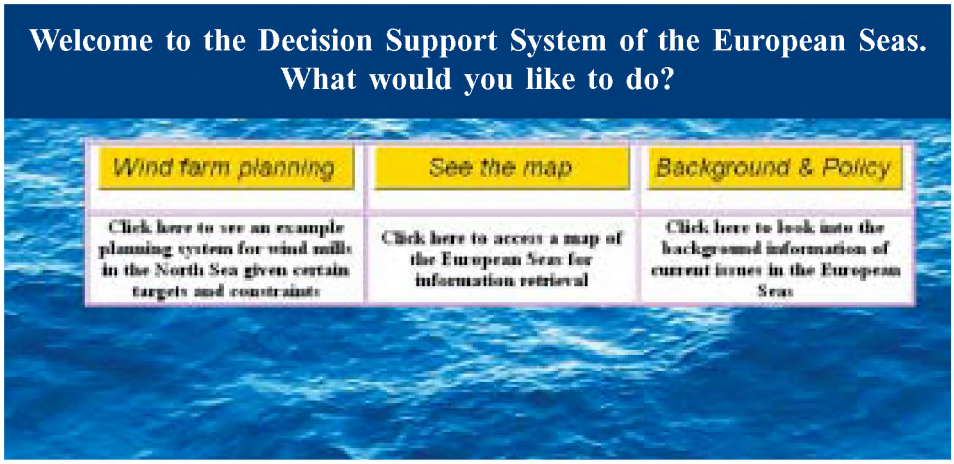
Through a MarBEF associated PhD student-ship, work is also underway to apply the total economic value (TEV) framework to three case-study areas in southwest England through a process of (1) identifying the marine habitats and the goods and services they provide; (2) providing estimates of the value of these goods and services to humans under the TEV framework; and (3) determining estimates of the value of marine conservation under various policy options using Impact Pathway Approach.

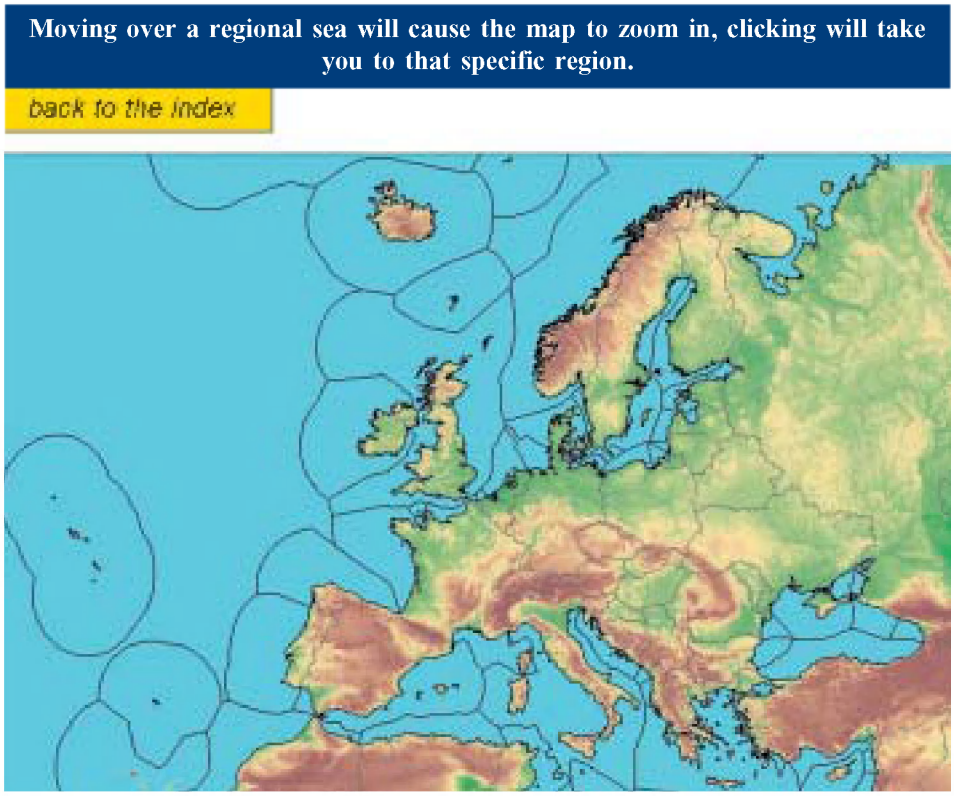
Fieldwork on the socio-cultural valuation of marine biodiversity has been completed in two case-study areas: Isles of Scilly and Pico-Faial. In order to evaluate marine biodiversity from a socio-cultural perspective, our team used Q-methodology, a means of discourse analysis, to delineate the various stakeholder perspectives, their areas of consensus and divergence. Factor analysis was used to analyse the data, and the findings were presented as discursive perspectives. These perspectives are important to policymakers, planners and scientists as they provide a socio-cultural basis for future management policies. Four main perspectives are evident from this work so far: management perspective, contingent value perspective, future policy perspective, and goods and services perspective. These perspectives were drawn from grouping individual cultural values and, once grouped, naming them according to a point they had in common. Those which addressed policies, for example, were named the management perspective. This method allows for similarities across stakeholder groups to be uncovered, increasing the likelihood of managers being able to see agreement or discord.

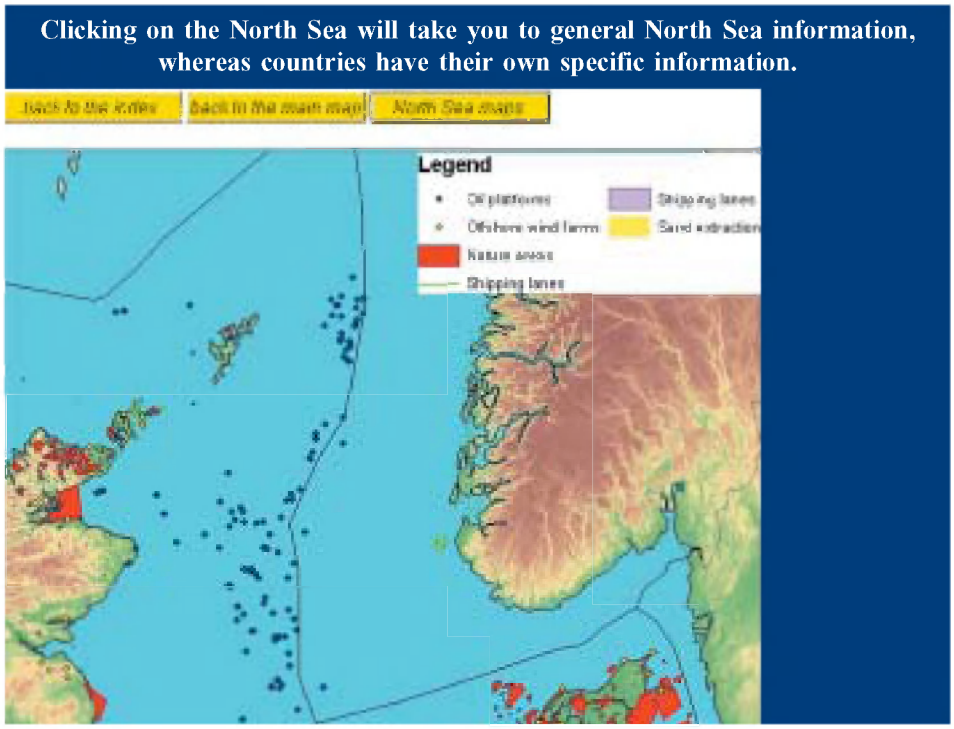
The economic, social and biological values from the case-study areas will be combined to produce a decision support system for European seas. The system comprises maps, a planning module and background information on functions and social values. On page 9 (opposite) are a few screen-shots of what such a system could look like.

The challenges of interdisciplinary research

It has been a challenge to develop and implement joint research across the natural and social sciences where such collaboration did not previously exist before MarBEF. We are starting to demonstrate the intellectual and







policy-related advantages of developing this new area of joint marine biodiversity research.

The main goal of MarBEF Theme 3 is to develop a decision support system to provide cost-effective strategies for effective management of marine ecosystems. The aims of such a system are to maximise conservation of biodiversity, ecosystem functioning and sustainable use of marine ecosystems under varying anthropogenic and environmental impacts. Through joint discussions, we have developed the main structure of the decision support system and its potential applications. Through consideration of the valuation protocols, we have made decisions on issues such as data need, data format, data quality control (e.g. ecosystem component sep-aration, temporal variability and spatial replication), gridding and the choice of scoring system.

The integration of the material obtained in the case studies is an important element in the development of the decision support system. The economic valuation studies will produce a detailed insight into the economic values obtained through the CVM method for avoiding reductions in biodiversity. The case studies will allow us to specify differences in WTP amongst socio-economic classes and other important explanatory variables.

From the biological valuation studies, it will now be possible to integrate spatial maps from case-study sites into the decision support system and provide a grid-based overview of the ecological values of the various case-study areas. This may be of use in the selection of marine protected areas or areas to locate infrastructure such as wind turbine parks.

We are still deciding how the results from the socio-cultural valuation can be directly incorporated into the decision support system. Our results show that the method can provide an overview of important issues brought forward by the stakeholders, allowing us to classify stakeholder interests into categories. These perspectives are very important in the preparation of well-designed policies.

The next steps

We need to finalise how the different valuation methods and studies can all be captured in the decision support system. If a direct comparison of valuation techniques seems impractical, then we could use qualitative analyses of the complementarities and conflicts in the different approaches to produce the decision support tool.

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