

## Economic valuation of biodiversity and ecosystem services

The UN “Millennium Ecosystem Assessment” highlighted the multiple benefits that ecological systems provide to society, and also recognized that if policy and planning decisions are to be truly sustainable, there is always a need to take account of the ecosystem approach and integrate a socio-economic dimension.



Plymouth Marine Laboratory (PML) is at the forefront of developing tools for integrating the socio-economic dimension with our well established marine science expertise, to ensure that the value of biodiversity

and ecosystem services is adequately captured in all types of assessment and evaluation. PML scientists believe that this fast developing science area offers improvements to a wide range of tools for decision making, including:

1. Through integration into currently accepted assessment and appraisal methods (and methods in development such as marine planning tools ) at different temporal and spatial scales to clarify and support decision making processes, e.g. SEA for Severn Barrage, risk assessment for MSC *Napoli*;
2. For raising levels of awareness, to argue for strategic allocation of funds or particular policy options, e.g. to support policy development processes as per the Marine Bill;
3. Through integration of the value of ecosystems goods and services into life-cycle analysis and carbon footprinting applications, to ensure that environmental impact is adequately quantified.

The following case studies are examples of projects which have adopted the valuation of ecosystem goods and services approach.

### Economic valuation of UK marine biodiversity

Defra commissioned PML to undertake “An Economic Valuation of UK Marine Biodiversity” to support and guide the development of the Marine Bill (*Beaumont et al 2008*). A goods and services approach was applied to determine the economic value of marine biodiversity in the UK, with 13 different goods and services being identified: food provision; raw materials; leisure and recreation; resilience and resistance; nutrient cycling; gas and climate regulation; bioremediation of waste; biologically mediated habitat; disturbance prevention and alleviation; cultural heritage and identity; cognitive values; option use value and non-use values.

The likely impact of a decrease in biodiversity on each of these services was assessed and, where possible, a monetary value was assigned. It was concluded that a decline in UK marine biodiversity could result in a varying and currently unpredictable change in the provision of each of these goods and services. This could result in severe impacts on society and the economy, including reduced resilience and resistance to change, declining marine environmental health and water quality, reduced fisheries potential, loss of recreational opportunities, decreased employment, and reduced carbon uptake with knock-on impacts for managing climate change.

The goods and services approach developed at PML highlights the social and economic importance of marine biodiversity and marine ecosystems, and provides a comprehensive and transferable framework, which will facilitate the future management of marine biodiversity and, as such, will be beneficial to support and influence marine environmental policies in future.

Good and services provided by marine biodiversity in the UK	Monetary value (£ per annum; 2004 figures)	Evaluation method	Under / Over estimate	Link to biodiversity Low (1) and High (5)
Food provision	£513 million	Market	Under estimate	3
Raw materials	£81.5 million	Market	Under estimate	3
Leisure and recreation	£11.77 billion*	Market	Over estimate	3
Resilience and resistance (1)	Work in progress	Work in progress	Work in progress	5
Nutrient cycling	£800 - £2320 billion**	Replacement	Use with caution	4
Gas and climate regulation	£0.4 - £8.47 billion	Avoidance	Under estimate	5
Bioremediation of waste	Work in progress	Work in progress	Work in progress	5
Biologically mediated habitat (2)	Work in progress	Work in progress	Work in progress	5
Disturbance prevention/alleviation (3)	£0.3 billion***	Avoidance	Under estimate	4
Cultural heritage and identity	Work in progress	Work in progress	Work in progress	3
Cognitive values	£317 million*	Market	Over estimate	4
Option use value	Work in progress	Work in progress	Work in progress	5
Non-Use values : bequest and existence	£0.5 - 1.1 billion	Contingent valuation	Under estimate	5

\*Based on 2002 values.

\*\*Replacement cost of treating UK waters once, not per annum.

\*\*\*In addition to £17-£32 billion capital costs.

(1) The extent to which ecosystems can absorb recurrent natural and human perturbations and continue to regenerate without slowly degrading or unexpectedly flipping to alternate states.

(2) Habitat which is provided by living marine organisms.

(3) The dampening of environmental disturbances, such as storms and flooding, by biogenic structures, such as wetlands.

## MarBEF - Marine Biodiversity and Ecosystem Functioning EU network



PML has played a major role in the leadership and management of the Marine Biodiversity and Ecosystem Functioning EU network (MarBEF, [www.marbef.org](http://www.marbef.org)) and co-leads the theme “Socio-economic Importance of Biodiversity”.

PML's role within this project involves managing communication between Theme members, from a range of different disciplines (e.g. economics, social anthropology and ecology), and coordinating Theme research, including the identification and valuation of goods and services provided by marine biodiversity. We are investigating the economic, cultural and biological value of marine biodiversity at different sites across Europe, including the Isles of Scilly and Flamborough Head in the UK, as well as legislative aspects of managing human impacts on marine biodiversity. To date we have defined the ecosystem goods and services that are provided and regulated by marine biodiversity and established methodologies by which they can be valued. These are being tested at the case-study sites all over Europe.

Whilst economic valuation of biodiversity and ecosystem services has immediate application for decision making, economic valuation studies can also be combined with ecosystem modelling to predict changes in economic value in time and space.

## Lyme Bay assessing socio-economic impact of potential spillover effects



PML and the University of Plymouth have recently been commissioned by Defra to monitor the ecological, social and economic impacts of the 60 square nautical mile closed area in Lyme Bay. PML is leading the socio-economics

part of the study, is reviewing the current social and economic issues and interviewing local stakeholders about their perceptions towards the closed area. We will also be conducting a cost-benefit analysis to help improve the level of understanding of the social and economic impacts of marine protected areas. The information collected as part of the study will help inform future impact assessments.

## COST-IMPACT - Costing the impact of demersal fishing on marine processes and biodiversity



A European Union funded programme, coordinated by PML, which involved 10 European partners at a cost of 2.6 million euros.

The programme investigated the impact that different types and amounts of demersal fishing has on benthic biodiversity, and hence nutrient cycling, and the effects which these changes have at an ecosystem level were then modelled.

The results of the modelling fed directly into a socio-economic analysis which evaluated the costs and benefits of the various fishing regimes. The final output was a Decision Support System to aid the development of future sustainable fishing strategies, which also ensure the optimal utilisation of the environment.

The most important potential application at present of economic valuation combined with ecosystem models is to predict the ecological impact of human activity and thereby provide guidance on the levels of protection which can be justified for biodiversity in economic terms.

An outline of this project is depicted in the diagram below.

