ENGLISH NATURE

The Ecosystem Approach

Coherent actions for marine and coastal environments

working today
for nature tomorrow

A report to the UK Government

Marine and coastal environments provide many opportunities for leisure and employment.
Ramsgate marina, Kent.
Dan Laffoley/English Nature

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"The oceans are the cradle of life on earth, the engines that govern our climate, the repository of a vast and diverse wildlife. They are an integral part of all our lives and their protection and preservation are our greatest challenge."

BBC, The Deep Blue, 2003

Seas, tides, weather and geological processes shape the coast over time. Roger Covey

Sustaining benefits - for all - for ever

As long ago as 1992, at the Earth Summit in Rio de Janeiro, it was recognised that the traditional sectoral approach to natural resource and environmental management was insufficiently addressing human impacts on the environment. The need instead to take a holistic Ecosystem Approach started to appear in initiatives and agreements. The Ecosystem Approach is now seen as key in delivering sustainable development[1]. There are clear commitments for implementing the Ecosystem Approach stemming from the World Summit on Sustainable Development and the Convention on Biological Diversity. Parties to these agreements still have a significant way to go in meeting these commitments and delivering *truly sustainable* development. The challenge is converting such policy concepts into actions that make a difference to the environment, dependent economic activities and overall quality of life for everyone.

This report aims to make a significant contribution to that process. It is directed at senior decision-makers, and scientific and policy advisors who have a role in shaping the future for our coasts and seas. The report will also be of general interest to a wider audience. The report provides an interpretation of what the Ecosystem Approach is, as well as providing a framework to help set actions on sustainable development firmly within the context of the Ecosystem Approach. This will help authorities progress the adoption of the Ecosystem Approach in successive, practical steps. This framework provides 'sign posting' of priority areas, where more detailed practical actions can then be developed with stakeholders. This process will support a major shift in practical action towards sustainable development using the Ecosystem Approach.

A further intention is to support the delivery of existing policy commitments that require adoption of the Ecosystem Approach. This will include fulfilling a commitment made by the UK Government to explore ways of turning the Ecosystem Approach into a practical reality (Defra, 2004), as well as supporting work to implement the Ecosystem Approach through the OSPAR Convention. It could also support more generally, the sustainable management of fisheries using the Ecosystem Approach, as agreed recently at Malahide in Ireland (EU, 2004). The Convention on Biological Diversity is now seeking regional or country-level examples of operational guidance, and refinement of the original principles for implementing the Ecosystem Approach. These examples will help form a future web-based sourcebook and this report can contribute to that process.

Dan Laffoley & Ed Maltby
November 2004

[1] In this report, sustainable development means using natural resources in a way that avoids irreversible damage to ecosystem structure and function, the loss of irreplaceable features or a reduction in ecosystem resilience. Environmental interests must be considered alongside social and economic interests, so as to prevent the irreplaceable loss of natural features, functions or processes, and to ensure a long-term and dependable flow of benefits from the exploitation of renewable natural resources. Delivering such sustainable development will involve significant measures to recover ecosystem structure and function, where the flow of benefits is already reduced or impaired, or where ecosystem resilience is at risk.

The seas are being used as locations for new industries, such as this windfarm at Scroby Sands on the east coast of England. Dan Laffoley/English Nature

1 Introduction

"Obviously man has to enter the sea. There is no choice in the matter. The human population is increasing so rapidly and land resources are being depleted at such a rate, that we must take sustenance from the great cornucopia."

Jacques Cousteau,
The Silent World, 1953

This report is for decision-makers, scientific and policy advisors who have an interest in the future of our coasts and seas. It will also be of interest to non-governmental organisations and stakeholder[2] groups. It originates from analyses of the current status of the application of the Ecosystem Approach to the coasts and seas around the UK and mainland Europe. It also draws from general progress made on developing the Ecosystem Approach within the Convention on Biological Diversity (CBD).

In our view, the level of analysis to which the Ecosystem Approach is currently being subjected at the concept level is distracting attention from developing practical actions. Current management actions around the world are not as successful as they need to be to stem losses of biodiversity and deterioration of ecosystems, and to support recovery and delivery of sustainable development. Global commitments have been made, but success will depend on new approaches to social, economic and environmental issues. Barriers to using the Ecosystem Approach for delivering genuine sustainable development must now be overcome if these commitments are to be met.

A crucial element is translating the high-level principles (from the CBD) into practical actions at regional, country and local levels. Parties to the Convention have yet to make substantial progress on meeting this challenge. The focus should be on using the 'building blocks' of knowledge, experience and 'best practice' we already have to far better effect.

The objective of this report is to identify a limited range of priorities for action and demonstrate how these could lead to significant improvements in the delivery of sustainable development in marine and coastal environments. Our priorities have been designed to take account of the areas where advisors and decision-makers may be least familiar with the issues. Priorities are not just about new areas of work; they often relate to areas where knowledge, experience and, sometimes, 'best practice' already exist. Often it will be the case of using these tools in a more coherent and effective way. Sometimes new work will also be required.

This report is not intended to be a comprehensive guide to the Ecosystem Approach nor a detailed description of current development and guidance on implementation. It consolidates the relationship of the Ecosystem Approach with sustainable development, and therefore incorporates the important realms of social sciences and economic issues. Authorities and advisors need help to achieve this consolidation. This framework provides an important opportunity to bridge traditional barriers between social, environmental and economic aspects that often hamper effective working. The framework outlined can be applied at all spatial scales and throughout the global marine and coastal environment. It will enable a more consistent approach to be taken to identifying priorities to secure coherent and effective implementation.

[2] A stakeholder is considered by this report to be anyone affected by, or with an interest in, a decision or issue related to marine and coastal environments.

The direction provided in this report will help authorities deliver greater benefits, which have not been realised to date. These include:

- healthy marine ecosystems and productive fisheries, providing sustained yields of natural renewable resources for human consumption.
- greater co-ordination and effective linkage of management actions across the land-sea interface.
- reduced conflict between sectors and greater understanding and clarity of the shared benefits across stakeholder groups.
- more co-ordinated and effective use of institutional resources.
- better value for money from marine and coastal research.
- increased social inclusion with enhanced benefits for society.
- integrated application of science and stakeholder knowledge to support policy and management decisions.

Scavengers, such as the shore crab *Carcinus maenas,* are a key part of the foodweb on the seashore.
Dan Laffoley/English Nature

2 Ecosystems and the Ecosystem Approach

"Ecosystems are not only more complex than we think, ecosystems are more complex than we can think."

F B Golley, 1993

Ecosystems are subdivisions of the Earth's surface and lower atmosphere within which natural processes operate and biological communities perpetuate themselves. Often they do not have readily identifiable boundaries because many of their intrinsic processes (e.g. supply of water or nutrients) originate beyond any obvious habitat or structural limits and operate at a range of scales.

In contrast to more readily-definable ecosystems (e.g. a lake or a forest), the character of the sea appears relatively seamless with ecological processes operating over large scales and distances. Boundaries can be subtle, being defined by temperature, currents, depth, stratification and salinity. In practice, the scale of the marine ecosystems most suitable for application of the Ecosystem Approach are the scales at which it is most appropriate to manage particular human activities. Scales ranging from ocean to regional sea to estuary are all equally appropriate.

The Ecosystem Approach is considered by the CBD as the primary framework for achieving sustainable development, based on maintaining fully functioning ecosystems. Various definitions have been given to this concept but the core of the approach lies in integrating and managing the range of demands placed on the environment. In this way it can support essential needs indefinitely, and provide benefits for all, without deterioration.

Definitions of the Ecosystem Approach

The Ecosystem Approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. The application of the Ecosystem Approach will help to reach a balance of the three objectives of the Convention: conservation; sustainable use; and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

Convention on Biological Diversity, 2000

The Ecosystem Approach is the comprehensive integrated management of human activities, based on best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of the marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity.

EU Marine Strategy Stakeholder Workshop, Denmark, 4 – 6 December 2002

'Sustaining benefits - for all - for ever' captures the essence of the paradigm shift required in both thinking and actions. It requires movement from a predominantly sectoral approach (maximising opportunities and short-term gains for individual sectors set against one another), to coherent implementation of actions across the relevant social, economic, and environmental sectors. This is where benefits are optimised in the long-term and for all, as a fundamental tenet for sustainable development[3].

[3] A more detailed explanation and information on the Ecosystem Approach concept can be found through a list of recommended literature and websites provided at the end of this report.

The 12 principles recommended by the Conference of Parties of the Convention on Biological Diversity (2000) to guide signatory countries in the practical application of the Ecosystem Approach

1 The objectives of management of land, water and living resources are a matter of societal choice.

2 Management should be decentralised to the lowest appropriate level.

3 Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.

4 Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: reduce those market distortions that adversely affect biological diversity; align incentives to promote biodiversity conservation and sustainable use; and internalise costs and benefits in the given ecosystem to the extent feasible.

5 Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the Ecosystem Approach.

6 Ecosystems must be managed within the limits of their functioning.

7 The Ecosystem Approach should be undertaken at the appropriate spatial and temporal scales.

8 Recognising the varying temporal scales and lag-effects that characterise ecosystem process, objectives for ecosystem management should be set for the long-term.

9 Management must recognise that change is inevitable.

10 The Ecosystem Approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

11 The Ecosystem Approach should consider all forms of relevant information including scientific and indigenous and local knowledge, innovations and practices.

12 The Ecosystem Approach should involve all relevant sectors of society and scientific disciplines.

Bladder Wrack *Fucus vesiculosus*, St Martin's, Isles of Scilly. Dan Laffoley/English Nature

The Ecosystem Approach was adopted by the CBD in May 2000 as the fundamental tool for delivery of the Convention's three primary objectives. It was endorsed by the World Summit on Sustainable development (WSSD) in Johannesburg (2002) and features strongly in the subsequent Plan of Implementation. Use of the Approach also links to commitments made by European Union Heads of Government, at Gothenburg, to halt the rate of loss of biodiversity by 2010. The new European Water Framework Directive is highly compatible with the application of the Ecosystem Approach. The Ecosystem Approach has also been recommended as a strategic approach to implementing the requirements of the Ramsar Convention, as well as numerous other international agreements on the marine and coastal environment.

Subsequent guidance from the CBD has formed the starting point for practical implementation. The CBD work programme on the Ecosystem Approach has elaborated 12 principles and five points of operational guidance and explains some of the important considerations when managing ecosystems. These 12 cross-cutting principles need to be considered holistically rather than selectively. However, it is legitimate to give different weights to each principle according to particular circumstances of application. More recently, further advice has been generated by the CBD on the application of the Ecosystem Approach in the context of Integrated Marine and Coastal Area Management (AIDEnvironment *et al*, 2004).

Traditional recreational use at the coast: beach huts at Wells-next-to-the-Sea, North Norfolk Heritage Coast. Dan Laffoley/English Nature

This generic advice is being augmented by best practice emerging from programmes and projects that are starting to implement the approach. Of particular relevance are river catchment management plans. These include some of the case studies that come closest to full implementation of the Ecosystem Approach.

Best practice from projects implementing the Ecosystem Approach in the UK

A recent review of 110 UK projects (that came within the definition of the Ecosystem Approach) concluded that the following characteristics are important for successful implementation:

- The development of a management plan
- Good stakeholder involvement
- Good public awareness
- Good co-operation amongst stakeholders and agencies
- Good communication amongst stakeholders
- Good information sharing
- Adequate personnel resources
- Adequate funding
- The availability of scientific information
- Subsequent changes in the management of activities

In particular, the development of a management plan is seen as a tool that can shift perceptions from single interest management to a more holistic approach. The duration of projects was found to be important, with the longest running delivering greatest benefits.

Source: Turner, 2004.

Some voluntary organisations have a crucial role to play at the coast: Caister-on-Sea lifeboat, Norfolk. Dan Laffoley/English Nature

3 The Ecosystem Approach and sustainable development

"The same regions do not always remain sea or always remain land but all change their condition in the course of time."

Aristotle, 384 – 322 BC

The term 'sustainable development' is often mis-applied. It is a simple concept that when rigorously applied leads to a very effective framework for problem solving. Several definitions exist; the most frequently cited being that of the United Nations' Bruntland Report (WCED, 1987):

> *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*

The UK Government's definition as set out by the Sustainable Development Commission (1999) involves four objectives: social progress which recognises the needs of everyone; effective protection of the environment; prudent use of natural resources; and maintenance of high and stable levels of economic growth and employment. These objectives underpin the UK Government's Marine Stewardship initiative and the delivery of its vision "to provide for clean, healthy, safe, productive and biologically diverse oceans and seas."

The most common model used to understand and implement sustainable development is the three pillars model (Barrow, 1995), which views sustainable development as simultaneously achieving a sustainable society, economy and environment, with a balance between the three elements. This model is especially appropriate when considering the Ecosystem Approach, as it directly relates to the three main goals established by the CBD: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources.

The correlation between the primary goals of the CBD and three pillars of sustainable development:

conservation of biological diversity ⇨ environmental sustainability

sustainable use of its components ⇨ economic sustainability

fair and equitable sharing of benefits ⇨ social sustainability

Achieving the goals of the CBD ensures sustainable development, with the Ecosystem Approach as a fundamental delivery mechanism. Effective progress towards sustainable development through the adoption of the Ecosystem Approach requires all sectors to become engaged.

Coastal heath habitat, sensitive ecosystems at the coastal margins: Isles of Scilly.
Dan Laffoley/English Nature

Developing the Ecosystem Approach as part of the European Marine Strategy

Work undertaken by the European Commission and Member States has concluded that the 'roadmap' for implementing the Ecosystem Approach should have the following characteristics.

It should:

- Have a vision, high level principles and strategic goals.
- Have regionally-based operational objectives.
- Set out clear limits, targets and indicators.
- Be common across all areas, all uses and all sectors, and acknowledge that people are intrinsic components of ecosystems.
- Be characterised by simplicity.
- Set out landmarks and principal routes, with a strategy to deliver them.
- Have actions with associated delivery tools.
- Undertake assessment, monitoring and scientific research.
- Embrace regional diversity through a regional approach.
- Embrace the principles of adaptive management as a progressive approach.
- Have pre-agreed risk management actions.

Derived from: EU Marine Strategy Stakeholder Workshop, Denmark, 4 – 6 December 2002.

4 Progress on adopting the Ecosystem Approach in marine and coastal environments in the UK and under the European Marine Strategy

In the UK, the Ecosystem Approach and the CBD principles have been accepted as a cornerstone of the Government's Marine Stewardship process. This is the framework for delivering the UK's marine sustainable development strategy. In addition, initial views on practical implementation are also emerging from some sectors such as fisheries, and in the form of local area-based initiatives.

Within Europe, the Ecosystem Approach features prominently within the reformed Common Fisheries Policy and in the outcomes from the North Sea Ministers Conferences and OSPAR, where there is a strong commitment to its implementation. Guidance on using the Ecosystem Approach is under preparation as part of the development of the European Marine Strategy. This strategy will provide a future framework within which Member States will work to achieve sustainable use of marine resources.

To have application across all European Seas, with their widely differing ranges of environmental, biological, cultural and social conditions, any guidance supporting the European Marine Strategy will be quite generic. This is being prepared by the European Commission, Member States, Accession Countries to the European Community, Regional Seas Conventions and marine and coastal stakeholders in the context of a wider global understanding of the Ecosystem Approach.

Newlyn Harbour, Cornwall.
Paul Knapman/English Nature

Sailing is an increasingly popular recreational activity: Plymouth Sound. Dan Laffoley/English Nature

The detailed and practical implementation of the strategy will be for the Member States to decide upon and deliver. This will be through working with Regional Seas Conventions, industry, communities, NGOs and stakeholders. Regional Seas Conventions, such as OSPAR, will have a particularly important role to play in helping to elaborate the Europe-wide objectives in more detail, and in developing and delivering action plans at regional levels.

The current guidance supporting the European Marine Strategy has a strong focus on strategy, objectives and indicators, limits and targets. It is also expected to provide advice in a range of other important areas. Greater consideration of the objective setting processes involving social and economic sectors, as well as how priorities will be identified at a practical level, is also now needed.

The UK is looking first to the European Marine Strategy to see how the overarching framework develops, within which more detailed guidance can be produced in the future. The UK Marine Stewardship process has yet to formulate practical implementation procedures for the Ecosystem Approach. A broad range of current government reviews will inform this next critical step, as well as the overarching framework being developed through the EU Marine Strategy, and the framework set out in this report. In particular, the work conducted by the UK in the Irish Sea as part of the Review of Marine Nature Conservation (Vincent *et al*, 2004), has already explored a range of issues that are central to delivering the Ecosystem Approach at a regional seas and national level.

The development of the European Marine Strategy and the UK Marine Stewardship process are major policy initiatives and are very significant and positive steps towards using the Ecosystem Approach at a regional and country-wide level. The next key challenge will be moving from political levels and generic principles and guidance to practical implementation, using the Ecosystem Approach to influence and improve management arrangements on a day-to-day basis.

5 Ways of delivering the Ecosystem Approach in marine and coastal environments

The remainder of this report is directed towards improving delivery of sustainable development in marine and coastal environments using the Ecosystem Approach. Attention needs to be directed towards:

- **enhancing the role of adaptive management processes** involving all marine and coastal sectors as part of the overall strategy for implementing the Ecosystem Approach. This is an essential step in marine and coastal environments, where information may be scarce and understanding of ecosystem responses to management measures is limited.

- **implementing a common framework for applying the Ecosystem Approach at a more practical level.** This report proposes a framework embracing 'seven areas of coherence' and suggests the key priorities for action within each area. This will enable countries to prioritise actions to enhance the levels of coherence necessary for delivering sustainable development.

Kelp forests are an important feature of ecosystem structure, providing habitat for many species.
Paul Brazier/JNCC

An example of human intervention to prevent erosion of chalk cliffs: Thanet, Kent.
Dan Laffoley/English Nature

6 Applying adaptive management as a cornerstone for implementing the Ecosystem Approach

"If there is a rule, it is that the problems of management change with every step made."

David Cushing, The Provident Sea, 1988

Protection of ecosystems is often a race against time. Limited knowledge can be used as an excuse for delaying implementation of the Ecosystem Approach. This allows damaging pressures to occur whilst effort is put into gathering more information. Adopting processes that enable existing data to be used, whilst taking account of further information when it becomes available, is a critically important part of implementing the Ecosystem Approach. So too are measures to ensure that management processes adapt to meet the needs of changing circumstances, instead of 'paper plans that sit on office shelves' while the outside world continues as before. Data and information will never be complete and so an important part of the Ecosystem Approach is adaptive management combined with the precautionary approach.

Adaptive management, sometimes described as 'learning through doing' (Walters, 1997), recognises the need to manage systems in a stepwise manner. This means evaluating the most favourable first step towards an agreed goal, adopting it and then monitoring the outcomes. This approach to management 'by experiment' makes the best possible use of available information but accepts that there is always uncertainty associated with the results. Adaptive management relies heavily on scenario-building to select the best option, and on focussed monitoring to measure progress. At the end of the initial learning period, management can be refined and new objectives set to provide the feedback mechanism in this iterative process.

Adaptive management offers a practical means of integrating knowledge across social and economic as well as ecological scales (Walker *et al*, 2002). It can accommodate unexpected events by encouraging approaches that build up resilience to changing circumstances. A basic model for adaptive management in marine systems has been described (Mee, 2004) and is currently being tested in a number of trans-boundary waters including the Black Sea through funding from the Global Environment Facility.

Seal numbers are used to help define ecosystem health: grey seal *Halichoerus grypus*. Paul Kay

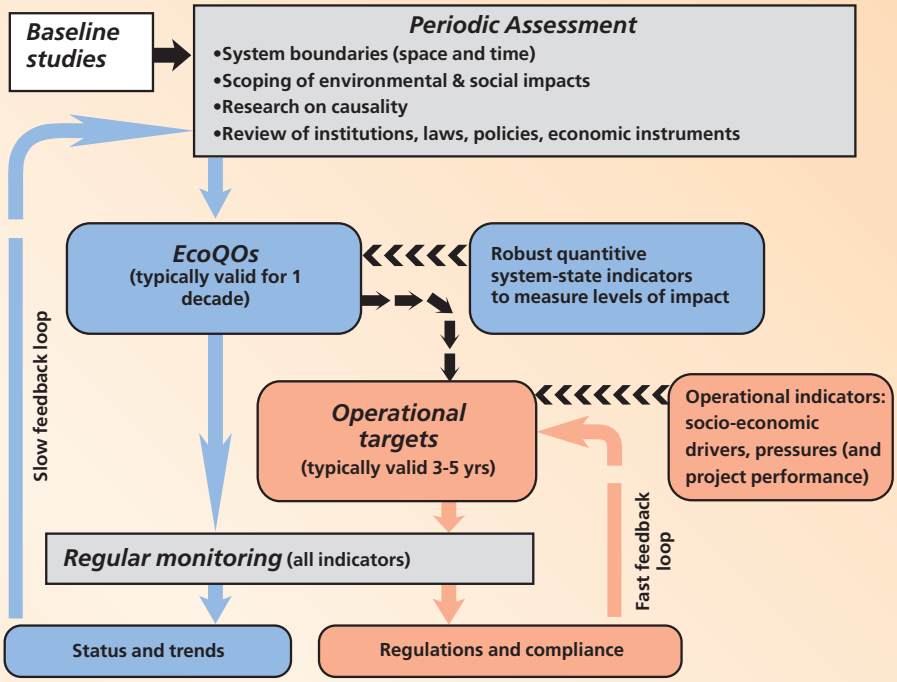
Within Europe, adaptive management needs to be more fully embraced as an essential component of implementing the Ecosystem Approach. It should be used to initiate integrated management processes, where gaps in knowledge could hinder and prevent progress. Its application will also support the move away from reactive approaches, to a more proactive way of avoiding environmental degradation. To deliver this, particular attention will need to be directed towards developing marine monitoring programmes that are sufficiently robust to support adaptive management processes.

The adoption of clear timetables to review and upgrade management processes needs to be built explicitly into the strategies being developed throughout Europe to implement the Ecosystem Approach. It will also be important to the overall success of implementing the Ecosystem Approach to learn from experience of using adaptive management elsewhere, particularly when developing the European Marine Strategy and the UK Marine Stewardship process.

Boats at Blakeney, North Norfolk Heritage Coast.
Dan Laffoley/English Nature

A framework for adaptive management of the marine environment

This figure illustrates the practical approach to adaptive management developed from experiences in the North Sea Ministerial Process and the Black Sea Environmental Programme, and currently considered as 'best practice' for the Global Environmental Facility's International Waters Focal Area (Mee, 2004). The approach is designed to involve stakeholders in setting long-term Ecosystem Quality Objectives (EcoQOs). These are key attributes of the system if it were in good ecological health. The EcoQOs are set following a multidisciplinary assessment conducted through a 'joint fact finding' process where stakeholder representatives work alongside specialists.

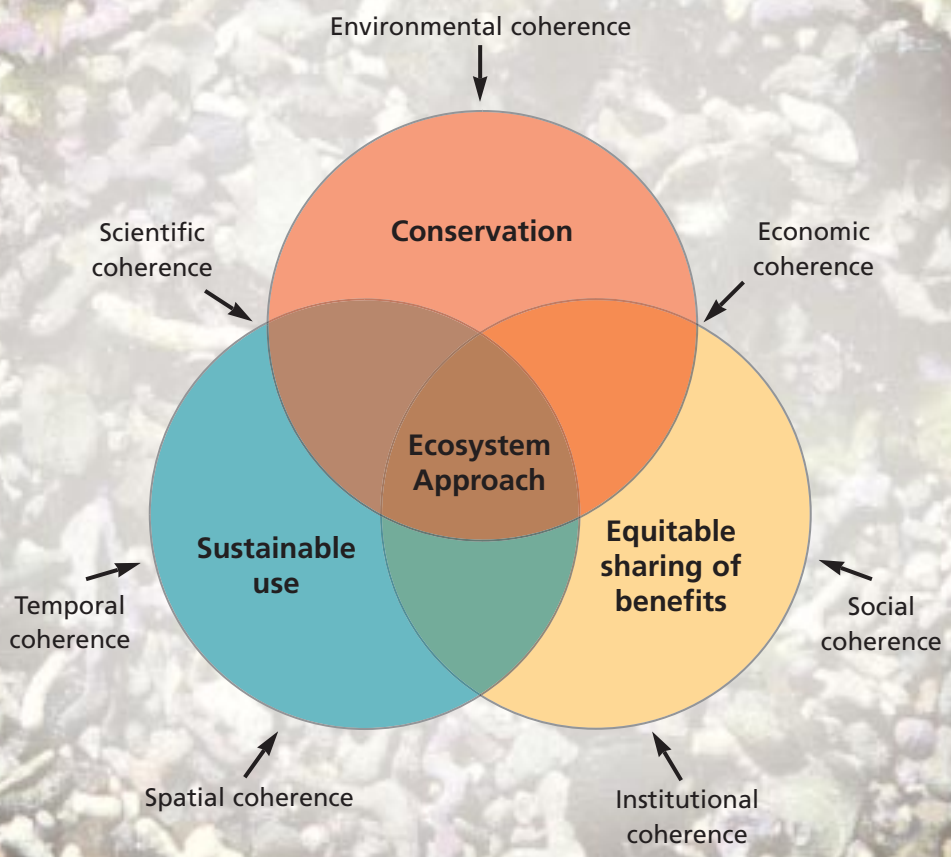


An example of a proposed EcoQO for the North Sea responds to concerns regarding seal population decline: *No decline in population size or pup production of equal to or more than 10% over a period of up to 10 years*. This simple statement has huge implications. It requires improved understanding of the factors leading to high mortality, and management action to control them. These actions to reduce human pressure on the environment can be expressed as short-term operational targets, closely linked to regulatory mechanisms. This allows a pragmatic stepwise approach towards achieving the EcoQOs; progress towards the EcoQO is monitored after each step and new operational targets are agreed for each subsequent one.

The important feature of the adaptive management framework is that it recognises that improvements in the status of the marine environment often require decadal timeframes, but political planning processes rarely involve cycles of more than a few years. Operational targets can be designed to be reached relatively quickly and with credit being given to those involved. The EcoQOs can also be reviewed periodically, enabling them to be adjusted as scientific information improves or the environment changes. Each review provides an opportunity to maintain awareness and political momentum.

Adaptive management requires a firm commitment to the long-term monitoring of meaningful indicators and full disclosure of all information attained. Carefully chosen indicators, supported by scientific research, may provide early warnings of major ecosystem changes. Present levels of monitoring the UK's marine ecosystem, for example, are insufficient for such proactive management to occur.

The three goals of the Convention on Biological Diversity, as the methodological framework for sustainable development, to be delivered through the seven areas of coherence



Some species, such as the free-living, bed-forming, purple nodular coralline seaweed 'maerl', are very easily damaged by human activities and may only recover, if ever, over decades or centuries.
Francis Dipper/JNCC

7 'Seven areas of coherence' - a framework to support practical implementation of the Ecosystem Approach

"To put it bluntly, we all have to do a better job. Scientists must be big enough to admit that their traditional approach to providing advice has to be abandoned in favour of a more comprehensive and robust approach.... Managers must be big enough to accept that not everything can be done at once, that proper management of scarce scientific resources requires clear choices about priorities...."

John Farnell, Director of Conservation Policy, European Commission DG Fisheries, 2004

The frameworks being developed for application of the Ecosystem Approach within Europe and elsewhere are often more strategic and conceptual than practical. The Ecosystem Approach needs to become embedded firmly within the framework of sustainable development. A key element in achieving this is a focus on improving coherence in the actions that should be taken to translate the Ecosystem Approach into a practical and effective reality.

A focus on improving the coherence of our efforts

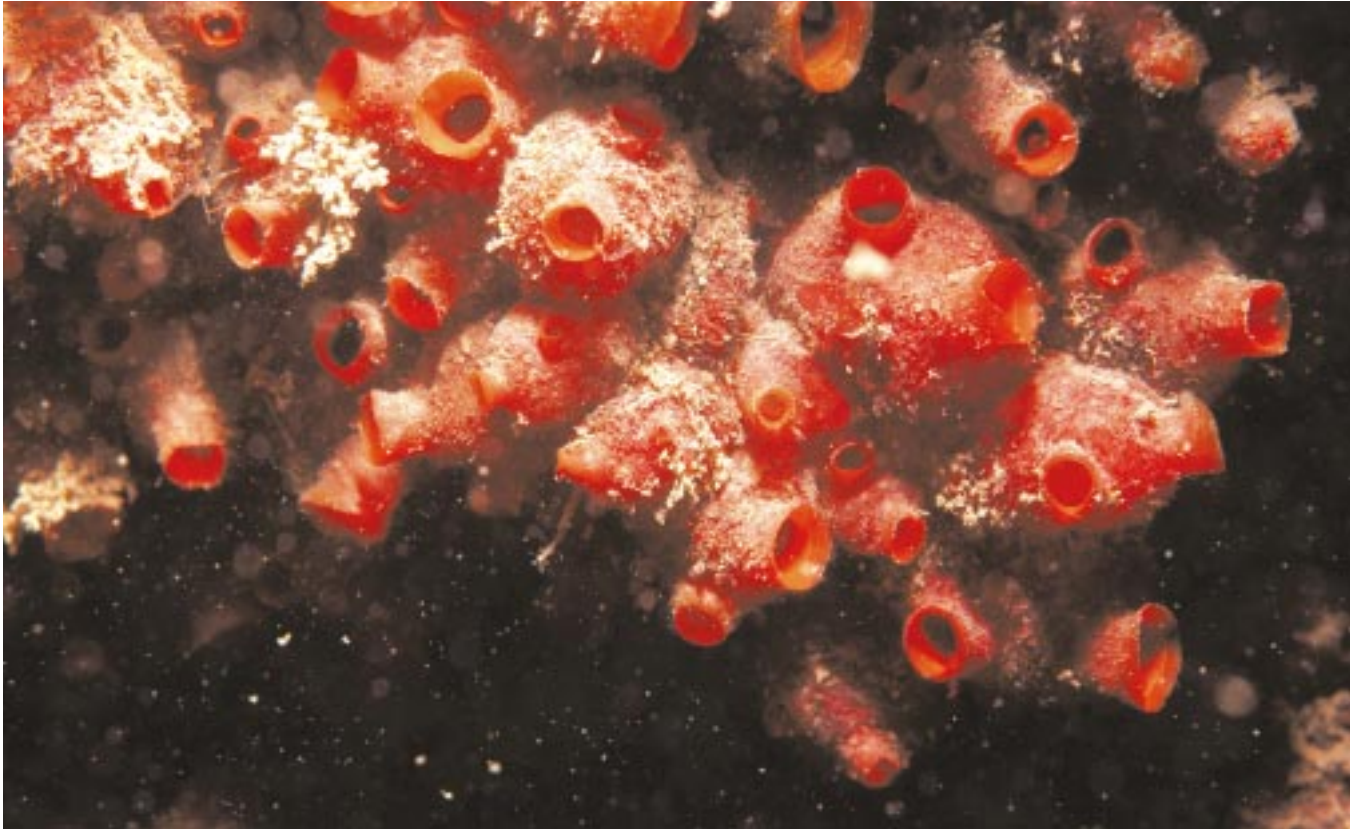
The focus on 'coherence' in contrast to 'integration' is in recognition of the pressing need to bring efforts together in a more logical, consistent and orderly manner. Coherence reflects the need to go beyond simply integrating existing measures, to achieve more fundamental reorientations of perspectives, relationships and actions within and across sectors. There are real differences between integration and what can be achieved by better coherence. Integration alone can potentially incur the cost of being reductionist, or attempts to create new structures that may be politically impracticable. Coherence potentially delivers the *benefit* of the sum of the parts exceeding the whole. It enables the development of strong and focussed actions needed to deliver sustainable development. Without such a fundamental reassessment across sectors it is unlikely that the adoption of the Ecosystem Approach will be radical or effective enough to make real and lasting changes in the long-term decline in ecosystems, the biodiversity they contain, and the social and economic benefits that they can provide.

The analysis and experience underlying this report suggests that a new framework comprising 'seven areas of coherence' provides a new, workable and valuable framework for the Ecosystem Approach, building on existing efforts to deliver sustainable development. The areas of coherence provide a useful means of conceptualising the broad scope of the Ecosystem Approach and as focus for prioritising the actions required for its delivery. The seven areas are:

- Environmental coherence
- Economic coherence
- Social coherence
- Spatial coherence
- Temporal coherence
- Scientific coherence
- Institutional coherence

To deliver sustainable development through the Ecosystem Approach the seven areas of coherence must be addressed. Environmental, economic and social coherence reflect the three pillars of sustainability. Spatial and temporal coherence reflect the fact that ecosystems operate at different scales and change over time; both from 'locked-in' climate change and also from the impact of future human activities. Scientific coherence recognises the need to provide best available information to be used for management purposes. Finally, institutional coherence reflects the need to work beyond the boundaries of how society traditionally organises itself. The seven areas are not mutually exclusive, but focussing in this way makes it easier to identify practical actions under the Ecosystem Approach and thereby to deliver sustainable development.

Natural erosion creates landscapes of great beauty: chalk cliff at Thanet, Kent. Dan Laffoley/English Nature



Sea-squirts, related to this species, are now providing powerful new drugs to help treat tumours. *Dendrodoa grossularia*. Keith Hisock/*MarLIN*

Identifying priorities for action now

Recommendations in this report focus on a limited number of priority actions within each area of coherence. The authors consider it better to address a limited number of key issues well, rather than try and address everything at once and probably fail. These priorities should help guide implementation in the UK and elsewhere in Europe. They could be viewed as pre-requisites for delivery of sustainable development. Some key priorities may vary outside Europe from the ones given here, depending on how well social, economic and environmental aspects are developed and on levels of threats to ecosystems and biodiversity.

Within Europe, other measures will also be required. For example, many more actions are needed for fisheries management than are set out here. Whilst even this set of priorities, devised from a UK perspective, may appear large, the implications for individual sectors are relatively modest. The coherence framework co-ordinates actions across sectors, with the resultant effects being more than the sum of all the actions put together. This represents a significant step towards delivering sustainable development.

Further work is needed by authorities, working with stakeholders, to develop the detailed practical actions required to address these priorities and build societal support and understanding. In some cases, actions are likely to focus on existing work or best practice, and, in other cases, new work will be needed. It is important that any assessments of the costs of implementing the Ecosystem Approach take this into account. Examples and emerging best practice are provided in the following pages to illustrate this point.

A framework with global application

Whilst specific actions and emphases may vary, achieving coherent actions across regions and at all spatial scales is possible. This ranges from large geographical scales of marine ecosystems, through to scales that more readily relate to local communities. It may also encompass individual organisations or departments charged with playing their part in adopting the Ecosystem Approach and delivering sustainable development.

Rock samphire
Crithmum maritimum,
St Martin's, Isles of Scilly.
Dan Laffoley/English Nature

The relationship between the priorities given under the seven areas of coherence identified in this report, and the 12 guiding principles of the Ecosystem Approach as defined by the Convention on Biological Diversity

The table shows how the work involved in addressing each priority helps support the application of the guiding principles. This focus on a limited range of carefully chosen priority areas will result in a significant shift towards putting the Ecosystem Approach into operation, and thus towards delivering sustainable development.

The 12 principles of the Ecosystem Approach
(● expected major interactions)

Seven areas of coherence with priorities for action	1 Objectives are societal choice	2 Decentralised management	3 Indirect effects	4 Economic context	5 Ecosystem structure and function	6 Manage within limits of ecosystem functioning	7 Spatial and temporal scales	8 Objectives for the long-term	9 Recognising change is inevitable	10 Integration and balance between conservation and use	11 All relevant forms of information	12 Relevant sectors of science and society
Environmental coherence												
• Taking a fully representative approach to biodiversity	●		●	●	●	●				●	●	●
• Using surrogate information sources					●		●			●	●	
• Defining the ecosystem outcomes being sought	●	●		●	●	●		●		●		●
• Avoiding damaging the genetics of species			●	●	●	●				●		
• Implementing strict site protection measures				●	●	●		●	●	●		
Economic coherence												
• Defining economic objectives	●		●	●		●		●		●		●
• Developing management effectiveness indicators	●			●	●	●	●			●	●	
• Using best practice for assessing environmental impacts			●	●	●	●					●	
• Addressing combined and cumulative impacts			●	●	●	●	●	●	●		●	●
• Fishing within ecosystem limits			●	●	●	●	●	●		●		
• Taking an integrated approach to nutrient enrichment			●	●	●	●	●	●		●	●	●
Social coherence												
• Stakeholder participation and transparency in decisions	●	●		●			●	●		●	●	●
• Planning decision-making processes	●	●	●	●			●		●	●	●	●
• Effective participation by all relevant stakeholders	●	●		●		●	●	●		●	●	●
• Understanding and ownership of biodiversity benefits	●			●	●			●		●	●	●
Spatial coherence												
• European Marine Strategy spatial framework	●	●		●	●	●	●	●	●	●	●	●
• Implementing a spatial planning framework	●	●	●	●	●	●	●	●	●	●	●	●
• Spatial regulation and management of the resource	●	●	●	●	●	●	●	●	●	●	●	●
• Spatial distribution of the resource	●		●	●	●	●	●				●	●
• Providing a common coastline and bathymetry data set			●	●								
Temporal coherence												
• Working with 'locked-in' changes to the environment			●	●	●	●		●	●			●
• Working with past impacts and 'shifting baselines'			●	●	●	●		●	●		●	●
• Sustaining long-term political ambition	●	●		●	●	●		●		●		●
• Establishing a timeframe-relevant indicator set	●		●	●	●	●	●					
• Implementing a regional sea management plan timetable	●	●	●	●	●	●	●	●	●	●	●	●
Scientific coherence												
• Aligning science to society and sustainable development	●	●		●		●			●	●	●	●
• Undertaking regional seas-scale science	●		●	●	●	●	●		●		●	●
• Improving access to data	●	●					●			●	●	●
• Widening the scope of scientific advice	●										●	●
• Supporting greater ownership and use of advice	●									●	●	●
• Improve the synthesis of existing science			●		●	●			●	●	●	●
Institutional coherence												
• Reforming institutional arrangements	●	●		●			●	●		●	●	●
• Providing high-level support and co-ordination	●	●	●	●	●	●	●	●		●	●	●
• Providing adequate support at local levels	●	●	●	●		●	●	●		●	●	●

Internationally important conservation sites often exist in close proximity to centres of population and key economic interests. Chesil Beach and the Fleet Lagoon, Dorset.
Roger Covey/English Nature

7.1 Improving environmental coherence

Conservation of biological diversity is fundamental to supporting and delivering sustainable development. Current approaches to the environmental management of biological diversity are in need of modification if they are to be sufficiently coherent and robust to achieve sustainable development using the Ecosystem Approach as a methodological framework.

In the future, a number of new commitments will come increasingly into play. These have been agreed at global and regional levels and include, for example, the establishment of ecologically-coherent and fully-representative networks of Marine Protected Areas.

These networks will not just need to include the very best sites but also other representative areas that have a functional role to play in delivering coherence.

Priority 1: Deliver a fully representative approach to marine and coastal biodiversity.

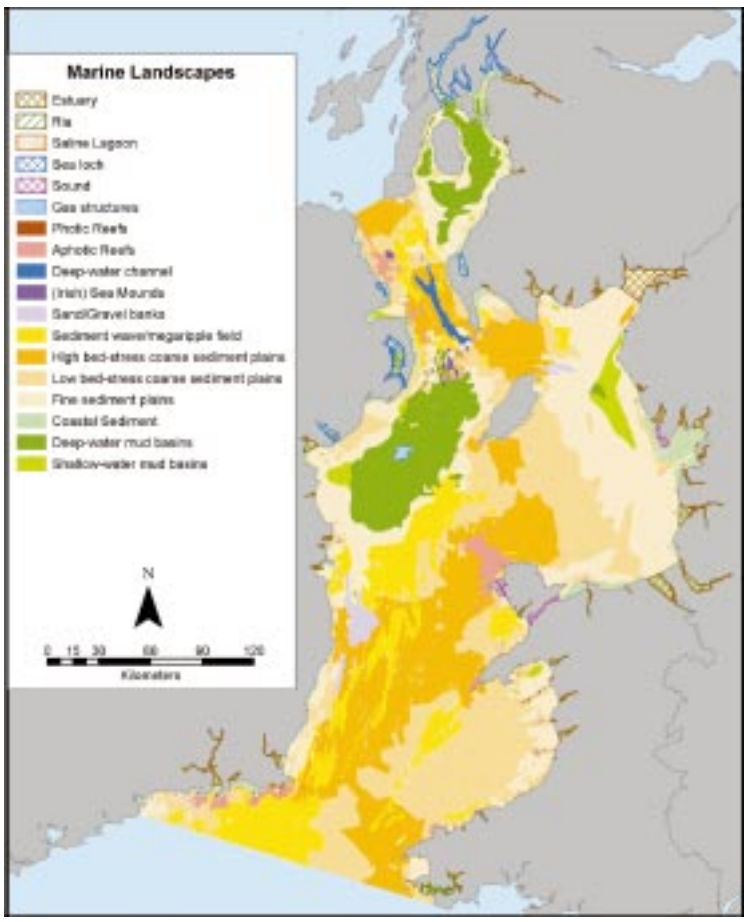
Past progress within the marine and coastal environment can be characterised, throughout Europe, as having had an emphasis on rare, threatened, declining or endangered species, and protected areas at a localised scale. As new information comes to light, more and more species and habitats are found to fall within these categories, generating long lists of habitats and species needing individual action, with an increasing requirement and cost for more data to support these processes. Typically, actions are only taken to restrict human activities when the future viability of species or biological communities is in doubt, or where proof of damage to the ecosystem or its features is produced. Management processes accordingly fail to keep up and declines continue. Within the marine and coastal environment, where knowledge is often a limiting factor, this will ultimately turn out to be a costly and largely unsuccessful strategy, by which time often irreversible damage will have occurred.

A significant shift in thinking and action is now required on policies for the protection, conservation and management of marine and coastal biodiversity - working towards a fully representative approach. This should include protecting examples of all major ecosystem components in conjunction with their characteristic habitats and species. This approach will need to encompass further special measures needed to safeguard rare, threatened or declining species and complement current measures already in place.

Priority 2: Use surrogate information on the marine environment, in lieu of detailed biological information.

Some see the level of information available as a barrier to achieving sustainable development. In marine and coastal environments, methods for collecting this information have developed from small-scale studies into broader programmes. These often necessitate gathering detailed information on the resource using direct observations or sampling methods. Near the coast this approach has often provided adequate biological information, but out at sea detailed information is usually sparse or absent.

The costs and timescales required to provide detailed biological information throughout our seas severely constrain approaches that require detailed evidence-based information. New broad-scale methods are needed that use surrogate information about the resource, *in lieu* of detailed biological knowledge. For example, readily available and observable information on underwater landscapes should be considered as an acceptable surrogate for detailed biological information, to help inform decisions, especially out at sea. This approach will only be acceptable if a basic relationship is established through ground-truthing of the relationship between the biological and physical aspects. At a more local level there will need to be a continued emphasis on supplementing such surrogate information by direct observations and sampling.



Visualisation of the spatial distribution of the environmental resource: the mapping of marine landscapes in the Irish Sea. This type of map, produced as part of a trial to implement a new framework for marine nature conservation, is now being prepared for other sea areas around the UK. The map is derived from existing geophysical information on the composition and nature of the seabed, ground-truthed with survey data on the distribution of marine biodiversity (for additional information see Vincent *et al*, 2004).

Priority 3: Identify the environmental outcomes being sought through applying the Ecosystem Approach.

To enable people and industry to interact more effectively with environmental concerns, a better understanding is needed of what is required to support sustainable development at the coast and in the sea. Identification of the desired environmental outcomes will help build the combined social, economic and environmental objectives for sustainable development that the Ecosystem Approach should help deliver.

This will provide a basis for engagement with other sectors, through the provision of a context for the setting of policies and the establishment of strategies. It will also act as a framework against which to assess management progress in the future.

Coastal lichens.
Dan Laffoley/English Nature

Examples of environmental outcomes that could be sought for coasts and seas as a result of implementing the Ecosystem Approach

- Regulators and stakeholders have a greater understanding of the risks and impacts from nutrient enrichment in the marine environment. Nutrient inputs (both point source and diffuse) are controlled through appropriate management and target setting. The risks from nutrient enrichment are reduced to acceptable levels and the problem of eutrophication has been tackled.

- Inputs of hazardous non-synthetic and synthetic chemicals, which harm the marine environment, are removed altogether, or are reduced, so that their concentrations in the sea do not exceed background levels.

- Plans and management measures are in place and implemented to allow the coast and adjacent habitats to adapt to long-term coastal evolution.

- Management of freshwater and brackish habitats in the coastal margins is fully integrated and there are natural transitions from saline to brackish and freshwater habitats.

- Sufficient land has been secured and is being effectively managed in sustainable locations to accommodate those freshwater and brackish habitats near the coast that would otherwise be lost due to rising sea level and/or erosion.

- Designated site boundaries can accommodate coastal change and are managed within the context of the coastal ecosystem.

- There is better management of coastal habitats, including adjacent farmland, to sustain and enhance biodiversity.

- Fish that are a source of food in the marine food chain, especially for higher-level predators, are present in sufficient numbers to sustain or allow populations of species higher up the food chain to recover.

- Incidental killing and destruction of wildlife and habitats is minimised through technical measures, and is removed altogether when unacceptable levels of damage occur despite such measures.

- Populations of fish species used for human consumption are present at a level that can sustain our demands in the long-term, as well as providing sufficient fish to support marine food chains.

- Improved management across the wider sea and the use of sanctuary and recovery areas allow populations of marine species that are slow growing, or only reach reproductive age after many years, to recover and increase in abundance.

Source: adapted from English Nature, 2004.

The commonly occurring toothed topshell *Osilinus lineatus* (above) and species of barnacles are being used to help monitor the effects of climate change.
Dan Laffoley

Priority 4: Recognise the intrinsic value of genetic diversity and act to avoid damaging the genetic diversity of species.

Species natural genetic variability enables them to adapt to changes in their environment. Maintaining the resilience and adaptability of species will become even more important over the coming decades as the full impact of climate change is realised. This issue is often overlooked in the management of our coasts and seas, but it is fundamental to the delivery of sustainable development. Reducing the genetic variation of a species will constrain its ability to survive environmental change, or change brought about by human activities.

There are many issues that relate to the genetics of species that are fundamental to achieving sustainable development. These include:

- a single species may contain several genetically distinct sub-species, whilst management (e.g. commercial fisheries) may group these together for convenience.
- the adaptation of a species to a habitat can be very subtle, so assumptions about recovery, on the basis that the human pressure has been removed and the habitat 'appears to be the same', may be too simplistic.
- human exploitation pressures can result in fish maturing at a smaller size producing fewer and poorer quality eggs, resulting in a significantly lower contribution to the overall population.
- the total variety of genes in a population of a single species (the 'gene pool') may be much smaller and far more easily damaged than previously thought.
- reducing the total numbers of individuals in a population (as in commercial fishing) can result in the loss of the 'rare genes' that play a particularly significant role in helping the species adapt to changes in the environment. These genes may be widely scattered throughout the population, probably with an uneven distribution.

Warming of seawater around the south west of the UK, by the Gulf Stream, results in the presence in our marine ecosystems of species such as the pink seafan *Eunicella verrucosa*. JNCC

Common dolphins *Delphinus delphis*. Caroline Weir

'Managing' the genetic diversity of species in the sea is necessary to deliver sustainable development. It raises some challenging questions about management of biodiversity resources, the maintenance of commercial fish stocks 'within safe biological limits', and the steps now needed to deliver sustainable development. It will require new approaches to management if the basic definition of sustainable development is not to be compromised. This needs to include maintaining a full spectrum of sizes of individuals for species that are commercially exploited, maintaining large numbers of individuals in populations, and adopting a fully representative approach to protecting and managing biodiversity. As understanding of genetics and the links to management is generally poor, it also requires a strong precautionary approach, such as using areas of strict protection where species can flourish. There are strong links between this priority and priorities 1 and 5 in this section.

Patterns of fishing can influence the genetics of fish species: inshore and offshore fishing boats in harbour. Paul Knapman/English Nature

"I believe we need substantial areas where *all* extractive activities are prohibited."

HRH Prince of Wales, 2004

Priority 5: Introduce strict measures to protect biodiversity.

It is widely acknowledged that there are specific examples where improvements have been made to the condition of marine and coastal ecosystems (e.g. better controls on sewage discharges and point-source releases of heavy metals). Despite such successes, delivery of sustainable development is being prevented by poor condition or declining health of many other components of these ecosystems. This relates particularly, but is not restricted, to those ecosystems components that are subject to heavy commercial exploitation (e.g. fish stocks, associated biodiversity and habitats). Delivering sustainable development will require:

- recovering and safeguarding ecosystem structure and function.
- recovering and safeguarding biodiversity, from the gene pool through to populations.
- increasing resilience of the ecosystem to impacts.
- defining what the 'natural condition' is, thereby enabling an improved understanding of the type and severity of human impacts, and the level of benefits that ecosystems could safely provide if managed properly.

Such benefits will not be delivered through existing management practices with minimal interventions, or by strategies that try and understand the full complexity of ecosystems and subsequently 'manage' what are considered to be the key impacts. Excluding all extractive pressures from well defined areas, as part of a wider-sea management process, appears to be the only way that such benefits can be delivered with any degree of certainty. Experience is beginning to show that even modest erosion of the principle of excluding all extractive uses (e.g. prohibiting commercial fishing in an area but allowing recreational angling) reduce the benefits that could be accrued, and any recovery that might be achieved.

If sustainable development is the ultimate goal, then higher levels of protection for biodiversity and ecosystems are required. The longer society takes to implement such measures, the greater the impact on the sea, thereby increasing the risk of irreversibly hindering its future health and productivity.

The benefits to sustainable development from introducing strict levels of protection for biodiversity structure and ecosystem functioning through Marine Protected Areas.

1 Providing undisturbed spawning conditions and habitats, allowing the restoration of natural population structures of exploited species (age, size, gender and gene pools), leading to:
   - Provision of essential fisheries management data, including improved understanding of recovery rates, natural mortality and natural dynamics.
   - Provision of a reservoir of species and genetic information, and potential positive spill-over effects (e.g. increased catches) into the surrounding unprotected areas.

2 Protection and recovery of biodiversity at all levels, which can lead to:
   - Improved resilience to environmental changes.
   - Improved understanding of recovery rates and natural dynamics.
   - Protection of species for potential future use.
   - Improved recreational resource.
   - Increased habitat complexity, providing nursery and spawning areas, and potentially flood and storm protection.
   - Increased biogeochemical cycling, for example: nutrient cycling; waste degradation; gas and climate regulation.

3 Allowing the public to see and understand the effects of human activities and the benefits of management.

4 Providing long-term monitoring, benchmarks, control areas, and places for research in areas unaffected by human activities.

Source: derived and adapted from Secretariat of the Convention on Biological Diversity, 2004.

7.2 Improving economic coherence

The seas provide major routes for transporting goods.
Dan Laffoley/English Nature

The seas and coasts are becoming increasingly crowded places as growth continues in many sectors, such as shipping, and as new space is sought to locate developing industries, such as offshore wind farms. More coherent management approaches *within* sectors will produce some improvements. This will, however, be inadequate to deliver sustainable development since conflicts *amongst* sectors can also be the origin of undesirable pressures. Mechanisms to deliver more coherent actions within and between sectors will deliver real solutions.

The social, economic and environmental benefits provided to civil society by maritime and coastal ecosystems in the UK

Benefits are often dependent on one another, difficult to cost accurately, and include:

Direct Use

- **Providing raw materials** - sources of oil, gas, sand and gravel, worth over £14 billion a year.
- **Food and employment** - around £546 million of fish is landed stimulating around £800 - £1,200 million a year of economic activity.
- **Providing genetic resources** - opportunities for cross breeding and engineering.
- **Providing medical resources** - current benefits and future drugs.
- **Providing ornamental resources** - shells, driftwood.
- **Spiritual and cultural values** - religion, folk lore, painting.
- **As an education opportunity** - education, training and research worth around £83 million a year.
- **Coastal tourism -** a major contributor to the economy.
- **Recreation** - a recreational angling industry worth around £1 billion a year.
- **As a physical environment** - equivalent to about £11 billion a year with possibly £48 billion to be invested in offshore wind turbines in the coming years.

Indirect Use

- **Flood and storm protection** - coastal wetlands provide sustainable protection from the effects of storms and floods.
- **Nutrient cycling** - putting nitrogen and phosphates back into food chains.
- **Climate regulation** - absorbing, buffering and trapping excess carbon dioxide and slowing climate change.
- **Bioremediation of waste** - purifying effects of wetlands, estuaries and other habitats.
- **Functional habitats** - required to supply all other goods and services.

Source: Adapted from English Nature, 2004. Monetary values are for the UK alone.

Fishing nets. Dan Laffoley/English Nature

Priority 1: Establish the economic objectives for the marine and coastal environment and the scale of current and potential benefits available from these ecosystems.

Current management of economic interests is largely undertaken on a sectoral basis with little integration between each sector. A greater understanding is needed of the overall economic objectives, and how these relate to environmental objectives and the full range of benefits provided by the ecosystem. Addressing this priority will help deliver effective spatial planning and the appropriate management of human activities. There are strong links between this priority and addressing priority 4 in the section on improving social coherence.

Priority 2: Implement measures to assess management effectiveness, including using social, economic and environmental indicators.

Given the strong links between sustainable development and the Ecosystem Approach, the success of marine management measures should be assessed by combining socially, economically and environmentally-based performance indicators. This is because assessment need to link economic processes to social and environmental aspects. This should apply irrespective of the scale of management. Such considerations are of fundamental importance in delivering sustainable development using the Ecosystem Approach. International focus, guidance and practice are starting to emerge on such issues (Pomeroy, Parks & Watson, 2004).

Priority 3: Ensure that a minimum standard of environmental best practice is implemented across all economic sectors.

Delivering sustainable development using the Ecosystem Approach means that a priority should be placed on ensuring all marine and coastal users adopt environmental best practice. This is already well established in some sectors and may involve Strategic Environmental Assessment, Environmental Impact Assessment of a specific development, or appropriate assessment as carried out under the Habitats Directive. Assessments often vary both in quality and in how well the results are used and fed back into management strategies. This in turn affects the usefulness of these tools for delivering sustainable development.

Overall best practice should be developed and implemented, especially on the planning and timing of such assessments, feedback into management strategies, and achieving an appropriate level of full and open public consultation. Assessment and feedback processes should be applied consistently across all sectors. Current loopholes by which damaging activities continue and are unassessed should be closed. This should be accompanied by better and more consistent application of these assessment tools. Fishing activities are notable for largely falling outside this process and should be brought fully within this framework. Depending on the weighting given to such matters in the decisions that

Natural resources, such as gas fields under the seabed, make an important contribution to the economy. Leman Alpha gas drilling platform. BP

are taken, these tools can help reduce, avoid or eliminate significant damage to characteristic biodiversity and ecosystem resilience. Such a move would also help to internalise the costs of avoiding or mitigating environmental impacts. This already happens in UK sectors such as oil, gas, aggregates and ports.

Priority 4: Introduce measures to understand and address the combined and cumulative impact of development pressures.

The focus of impact studies should shift from a general emphasis solely on the studies of single source, single origin human uses, to those that also encompass multiple stresses. This involves combined and cumulative impacts arising from our use of the seas. By providing a clear spatial and integrated framework within which to understand multiple stresses, marine spatial planning will increase our ability to make informed decisions about avoiding or managing combined and cumulative impacts (Gilliland *et al*, 2004). Such a framework would also ensure that duplication of effort on seeking the same baseline information to drive individual assessment processes is minimised. This is important if management processes are to become more effective over time. Any gaps in the understanding of multiple stresses should be filled using geographically-dispersed and multidisciplinary projects. This will ensure that the inherent variability of ecosystems is addressed during the research, allowing any recommendations to have a wide application to other marine situations, thus maximising benefits and value for money.

Priority 5: Bring fishing pressure within the limits of ecosystem functioning by reducing fishing effort significantly, and by ending ecologically unsustainable fishing practices.

Within the economic sector, fisheries continue to have a disproportionate impact on the health of marine ecosystems in comparison to the benefits they provide. Fishing is one of the few human impacts that can be

The seabed provides a source of aggregates for industry and the building trade. Paul Gilliland/English Nature

detected at an ocean-wide scale; marine capture fisheries are the source of half of the most serious environmental impacts affecting marine ecosystems in the North-east Atlantic (OSPAR, 2000). Fish are also, however, an essential source of protein for human populations. Managing fisheries issues for the long-term is fundamental to the delivery of sustainable development.

Whilst there are many issues that need to be tackled to establish a truly long-term profitable and sustainable future for fisheries (see for example Cabinet Office, 2004, for a list of recommendations for the UK fishing industry), two measures stand out beyond all others. The first is reducing fishing effort to within limits that ecosystems can reliably and consistently support. This will provide overall stability, avoiding short-term 'boom and bust' events. The second is ending ecologically-unsustainable fishing practices. Whilst the search continues with increasing creativity to find ways of capturing fish while minimising impacts on marine ecosystems, some aspects are already proven to be environmentally unsustainable. Amongst these is fishing for sharks, skates and rays, fishing for deep-water species, and deep sea trawling, where the species are very long lived, reach maturity after many years, and where scientists find it difficult or impossible to assess stocks and provide sustainable harvesting rules. For other stocks, further measures should be developed to ensure that exploitation and trade comply with the principles of sustainable development.

Priority 6: Adopt an integrated approach to the management of nutrients; particularly the interaction between catchments and the sea, supported by the development of tools to assess risk and scales of impact.

Addressing water quality issues is fundamental to the delivery of sustainable development. Other than the obvious impacts and effects caused by eutrophication, more subtle effects on water quality, such as changes in oxygen loadings and turbidity, have the potential to disrupt marine biodiversity. From an economic perspective, this includes the viability and recoverability of commercially-exploited species of fish and overarching issues of ecosystem productivity, structure and function.

The Water Framework Directive is a major and welcome development to address these and other related issues out to the boundary of coastal waters (defined as 1 nautical mile from baseline in England and Wales). Further effort is required to support the effective implementation of this Directive, which aims to provide an integrated approach to the management of water and seeks benefits for the wider marine environment. Previous European legislation has generally focussed on reducing point source inputs; more effort will now be required on tackling diffuse sources. The Water Framework Directive provides the driver for developing tools to assess risk and impact at the "water body" scale, based on the definitions of ‘good ecological status’. There is a need to extend the suite of tools to accommodate assessment of risks and impacts at other relevant spatial scales.

7.3 Improving social coherence

As a top recreational destination the seaside plays an important role in our overall quality of life.
Dan Laffoley/English Nature

Over the last decade the UK, along with many other European countries, has seen a marked rise in the interest and involvement of a range of stakeholders in marine and coastal matters. In part this has been the result of initiatives led by the European Commission, such as the Common Fisheries Policy and the introduction of the Habitats and Birds Directives. There have also been wider changes in society that mean people want 'to have their say' in the environmental issues that affect them. This is associated with an increasing realisation of the vital role that good environmental conditions play in supporting human health, quality of life, and economic security.

Recent international commitments promote stakeholder participation in environmental decisions and the need for social equity for all sectors of society:

- The Aarhus Convention grants the public the right to participate in environmental decisions, to have access to environmental information and access to legal redress on environmental matters.
- Under the CBD, parties are urged to '...foster stakeholder participation in biodiversity conservation and sustainable use'.
- Ramsar Convention objectives include '...participatory multi-stakeholder wetland management'.

An early learning opportunity at the seashore.
Emily Strong

The social dimension of sustainable development has two core aspects:

- **Social choice:** it is a fundamental principle of the Ecosystem Approach that people should be able to contribute fully to the decisions that help shape their own lives, and the futures of their children and grandchildren. The factors affecting the quality of people's lives are numerous and include: educational and employment opportunities, the maintenance of social community and support, opportunities for leisure, maintaining clean and pleasant living conditions and aesthetically pleasing environments. The importance of social values is not confined to those who benefit from the use of marine resources.

- **Equality and justice:** Social choice needs to be linked with the 'fair and equitable sharing of benefits'; the social pillar of sustainable development that seeks to ensure that those who live within an area are able to share in the benefits (economic, social and environmental) that result from the use made of its resources. Incorporated within this is the principle of social justice that seeks to ensure that the adverse impacts of management decisions do not bear disproportionately on those already disadvantaged or marginalised, and that, conversely, the benefits from actions aimed at maintaining and restoring environmental quality reach those who need them most. This is the EU objective of 'social cohesion' or 'social inclusion'. A growing body of research on 'social and environmental justice' is confirming that socio-economically deprived groups tend to be concentrated in areas with the worst environmental conditions, and are least protected from environmental risks.

Stakeholder participation is accordingly an essential part of the Ecosystem Approach. It promotes the development of trust and social capital, based on decision-making processes that are open, transparent and accessible. In the past, the main approach to environmental decisions has been 'decide, announce, defend'. This is when power holders make the decisions, announce what they have decided, which in turn requires effort to defend proposals and persuade others to agree. This can dis-empower stakeholders and lead to mistrust. It can also lead to the deliberate withholding of accurate information, as with capture fisheries, hampering accurate decision-making. It can also lead to implementation and enforcement problems when stakeholders who feel excluded and ignored, evade or resist management measures.

Over the last 10 years, stakeholder participation has developed as a field of research and expertise in its own right. This includes a focus on developing good practice. Appropriate expertise is required within public bodies to ensure stakeholder participation is effective. Existing mechanisms require review, and where they do not provide sufficient opportunity for stakeholder involvement, will need to be reformed. An important part of this will be streamlining to ensure that stakeholders do not waste time in processes that have significant overlap in objectives and outcomes, or that are disconnected from the real decision-making.

Priority 1: Increase stakeholder participation and improve transparency in decision-making.

Although there is some regulation, the seas are viewed as a common resource so it is vital that a wide spectrum of interests participate in management decisions. Drawing together knowledge in this way helps to minimise the risk of unexpected or unforeseen effects. Wide involvement also means that decisions have the support, or at least acceptance, of a wide range of stakeholders. Decision-making should accordingly be open to stakeholders wherever possible. This will improve the information

The Thanet Coast European Marine site – from conflict to co-operation

The Thanet Coast around the eastern-most side of Kent, in southeast England is a Natura 2000 site forming part of a network of sites established under the EU Habitats Directive. It consists of 12 miles (approx. 19 km) of chalk reef coastline with sea caves and wintering birds. The coast also has intense human pressure with a resident population of 130,000 and two million visitors annually. It is a priority area for economic regeneration within Europe.

The local authority initially believed that the proposed Natura 2000 site would hinder economic growth and therefore submitted an objection to its designation. They proposed to go to the European Courts to test the two European agendas against each other: economic regeneration versus wildlife. The local English Nature Conservation Officer proposed a consensus-building process that went beyond the concerns of wildlife management, to include recreation management and ideas that could contribute to economic regeneration; both issues of local concern. The local authority agreed to take part.

An independent third party was brought in to design the process and facilitate workshops. Four successive workshops were held with over 100 stakeholders representing a wide range of interests. Everyone helped to identify issues, share information and agree acceptable solutions.

As a result the local authority started to see the surrounding maritime habitats and wildlife as an asset for tourism. They helped set up a new coastal wildlife project with English Nature to implement many of the stakeholders' ideas. This project worked with recreation users to agree codes of conduct so that activities have less impact on each other and on wildlife. As a result there has been a 40% reduction in disturbance to birds and the birds have greater body mass, are healthier and better able to migrate.

The new atmosphere of co-operation between authorities led to jointly funded research and better management of activities. It also led to open-minded consideration and co-operative problem solving of potentially controversial new proposals. Other stakeholders continue to be involved by helping to review progress and influencing the next steps.

Thanet stakeholders agreeing the future. Diana Pound

The marine environment offers opportunities to enjoy leisure pursuits such as yacht racing. Pentewan, Cornwall. Paul Gilliland

used to make decisions, improve the accountability of experts and authorities, reduce mistrust in how decisions are reached and enable stakeholders to work together and find acceptable solutions. It will also improve ownership and ease of implementation.

Priority 2: Ensure decision-making processes are well planned, timely, and undertaken at meaningful spatial scales.

Stakeholders should be involved in the most effective and appropriate ways, and at the right spatial scales. They can then share knowledge and information and contribute to the delivery of the Ecosystem Approach. Well-planned and well-designed processes make the best use of stakeholder time, and avoid consultation overload and duplication of effort. Stakeholders should be involved at an early stage when options are open and their input can make a real difference. Reform of many decision-making processes will be necessary to achieve this. This should include the way in which many environmental professionals relate to other stakeholders.

Where stakeholders have already been involved in marine decision-making it is usually to meet specific and often sectoral needs. In the UK many existing groups have focused on inshore estuarine and coastal habitats. Whilst the Ecosystem Approach is relevant at this scale, there is an obvious mismatch between such groups and the scale of regional seas management. Implementation of the Ecosystem Approach requires greater

Examples of the reform required in environmental management practice to better embrace social inclusiveness

From:	To:
Focus on scientific and technical knowledge	Many forms of knowledge are needed and used
Seeing other stakeholders and users as the problem	Realising we are all part of the problem AND all part of the solution
Seeing other stakeholders as a distraction and drain on resources	Realising they are a resource of information, ideas and endeavour
Telling others what to do	Listening with an open mind
Pushing others to change	Working with others to agree change
Behaving as experts	Behaving as partners
Formal approaches	Informal and interactive approaches
Our ideas and solutions	The best ideas and solutions

thought as to how stakeholders can be involved at various spatial scales. A nested system with good communication links between adjacent communities, as well as dialogue up and down the spatial scales, is required.

Priority 3: Ensure that all relevant stakeholders have opportunities to participate effectively, including disadvantaged or marginalised groups or communities.

Different stakeholder groups will be relevant at different levels: at national, regional or international level, it is organisations representing the interests of different sectors who should be engaged. At local level, it is vital to open up information and participation to community groups and individuals. This should be done in an equitable and inclusive way that actively seeks to engage 'hard to reach' groups and interests by using appropriate participation methods. Processes that are planned to reach and make participation easy for disadvantaged groups will also be clear and simple for all other groups.

Priority 4: Introduce initiatives to build understanding and ownership of the benefits provided by the marine and coastal environment.

Delivering sustainable development should contribute to the quality of life of local communities. The Ecosystem Approach promotes working with other stakeholders, and through them with communities, to develop a broad consensus on the full range of benefits that marine and coastal biodiversity provides. Marine and coastal biodiversity has intrinsic value and provides many different benefits for human health, wealth and well-being. It is only with a thorough exploration of what is valued now, and how it is threatened, that decision makers, stakeholders and communities will understand current risks and future opportunities. This discussion must go beyond scientific and economic values and include social and cultural meanings and value too.

Initiatives should be introduced to develop a common understanding of these benefits both now and in the future. This will help support better decision-making and ensure that a 'social deficit' does not exist between decision makers and stakeholder representatives, and society more generally. For decision-making at the local level, community members are a repository of local and traditional knowledge, and often individuals have a keen interest in being guardians of their local environment. Decision and management processes that support this sense of community ownership are a key part of delivering the Ecosystem Approach.

The iridescent spines of the 15 cm long sea mouse *Aphrodita aculeata* have special properties that are informing the development of new optical technologies. Keith Hiscock/*MarLIN*

HRH Prince of Wales chats to skippers at the launch of *Invest in Fish SW* in April 2004. *Invest in Fish SW*.

Invest in Fish South West: Building understanding and ownership of the benefits provided by marine and coastal biodiversity

Fish and the South West of England go hand in hand: fishing and fish-related industries form an integral part of the economy, communities, the natural environment, and their image to the outside world. Yet the state of many fish stocks could be improved. The South West fishing industry is worth £165 million a year and accounts directly for 1,800 jobs, and indirectly for a further 1,900. When combined with other activities that depend on fish and a high quality marine environment, its real worth may be far greater.

The aims of *Invest in Fish SW* are to maximize the potential of fish resources by rebuilding the fishing industry, communities and the marine environment. This will be through investing in:

- **People** – bringing together those with an interest in the management of fisheries and the marine environment.
- **Knowledge** – providing these stakeholders with the best scientific and economic information to identify opportunities for improving management.
- **Best practice** – identifying the management option that best balances economic, social and environmental benefits in a truly transparent and innovative way.

Invest in Fish SW includes those that have an interest in the future of fisheries in the South West, including: fishermen, processors, merchants, retailers, sport fishing industry, governmental and non-governmental environmental organisations, and restauranteurs. The project will run from January 2004 to October 2006 and is supported by £1.6 million of funding which has been drawn from a range of public and private sector organisations, research trusts, and grant-awarding bodies. It is hoped that the project will provide an example to be followed elsewhere in the UK and Europe.

With an emphasis on people, *Invest in Fish SW* has recently completed the first stages of public consultation. This has unearthed significant levels of consensus about the priorities for the future of fishing and the marine environment. There is universal agreement that 'something must be done' and consensus on a range of issues. These include developing options which:

- Involve all relevant stakeholders to ensure ownership of proposed solutions.
- Have a regional focus and be able to respond to regional issues.
- Consider the fishing industry in the broad context of the marine environment and the wider economic situation.
- Address problems inherent in operating under the current quota system and deal with the issue of discards.
- Place a strong emphasis on education and communication.

Sources: WWF – UK (http://www.wwf.org.uk/investinfish/investinfish.pdf) and Opinion Leader Research, 2004.

7.4 Improving spatial coherence

Marine and coastal ecosystems encompass a continuum from small-scale features within habitats to oceans and the wider sea. Applying the Ecosystem Approach in marine and coastal environments requires recognition of the need to operate across such a range of spatial scales. This has to be turned into a practical reality. Definitions of scale for management purposes are necessary, but should be viewed as ecologically artificial. This is because human activities need to be managed in the context of functioning ecosystems at the appropriate spatial scale. The scales may vary, depending on the nature of the activity or indeed with the nature of an institutional regulatory process.

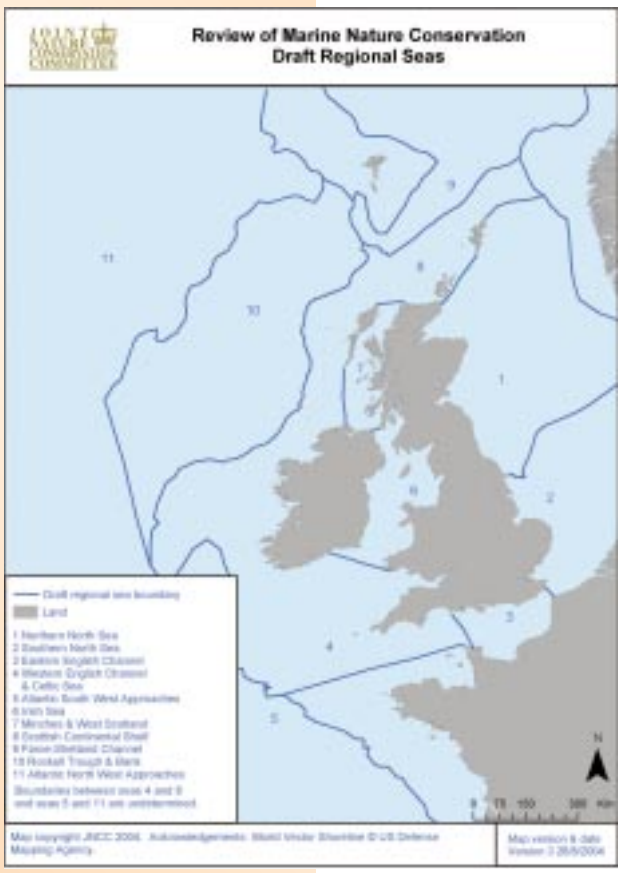
Within this context, a series of conceptual 'nested' scales can provide a useful framework within which to structure management measures. These nested scales relate to the wider sea, regional seas, the component landscape scale, and the more detailed scale of habitats. Links will also need to be made to terrestrial environments, especially coastal areas and river catchments.

Priority 1: Provide a spatial framework to support management measures taken under the European Marine Strategy.

In the marine environment, many sectors have their own frameworks for managing and regulating activities. These have been devised over time to meet their needs and frequently do not relate to the frameworks being used in other sectors, especially in terms of scale or detail. For example, the OSPAR Convention operates over the North-east Atlantic, a larger area than that over which the European Union and Member States have jurisdiction. At a regional sea scale, whilst there is general agreement over the delineation of partly enclosed marine water bodies, there is a far wider discrepancy over where the framework operates for regional sea boundaries in the open sea. In addition, the European Marine Strategy may be implemented across regional seas through co-operation with neighbouring non-Member State countries.

A common map, incorporating meaningful spatial areas for the wider sea and regional seas should be defined as an essential spatial framework through which to implement the European Marine Strategy and other relevant Community policies (e.g. Common Fisheries Policy). It should also be used to establish more detailed stakeholder and spatial management arrangements. Guidance on the appropriate spatial scale for the various types of management decisions that need to be taken is also required.

A proposed regional seas framework around the UK, devised by taking account of geophysical information, hydrographical factors and extant broad scale administrative units (JNCC, 2004)



Priority 2: Implement a spatial planning framework at regional sea scales and country levels.

A spatially-based planning system is required through which marine and coastal sectors can integrate and deliver improved management. Spatial planning is a way of ensuring that space is made available for industry, wildlife and healthy ecosystems. To be effective in delivering sustainable development marine spatial planning should be: led by a clear strategic vision and objectives; be a statutory system with a statutory purpose; embrace all marine uses; incorporate visually-explicit zoning arrangements; and be operated through an open, transparent and inclusive participative process. Sufficient flexibility needs to be available in the planning system to respond to broad-scale environmental changes, including shifts in species boundaries, resulting from climate change.

A hierarchy of scales will be needed, ranging from a national level planning framework, co-ordination at a regional seas level, through to the flexibility to produce local plans where required. The role of coastal administrative bodies in developing coastal plans will need careful consideration, as will the extent to which such potential plans could integrate or apply to sea planning systems. The case for the introduction of marine spatial planning should be made on social, economic and environmental criteria, underpinned by the framework provided by the Ecosystem Approach, and not solely on the basis of an economic-sector-only cost-benefit argument.

Priority 3: Improve understanding of the spatial regulation and management of the resource.

The need to bring together information on management regimes in a spatially explicit manner at local and regional scales will help improve the management of the environmental resource. This should parallel, rather than replace, the current reliance on multiple sources of text-based information, from many individual Acts of Parliament, through to lists of byelaws. Broad-scale maps, visualising the existing management of the resource should be developed in order to help to address landscape management issues. The full range of environmental legislation and regulation should be compiled into an information base that can be used openly with stakeholders to discuss sea-use management.

Empty shells of the common mussel *Mytilus edulis*.
Dan Laffoley/English Nature

Improving understanding of the spatial regulation and management of the resource: a Management Information Chart for the Solent in southern England

A key challenge in improving the management of marine resources is communicating the regulation and management regime to a wide and non-technical audience. On land the usual way of informing people about management arrangements is to advertise and distribute reports, leaflets and management plans. On-site promotion often involves the use of interpretation panels and, in some cases, posting of byelaws on notice boards. Rarely, if ever, are the public and users expected to read the actual legislation and work out for themselves what they can and cannot do.

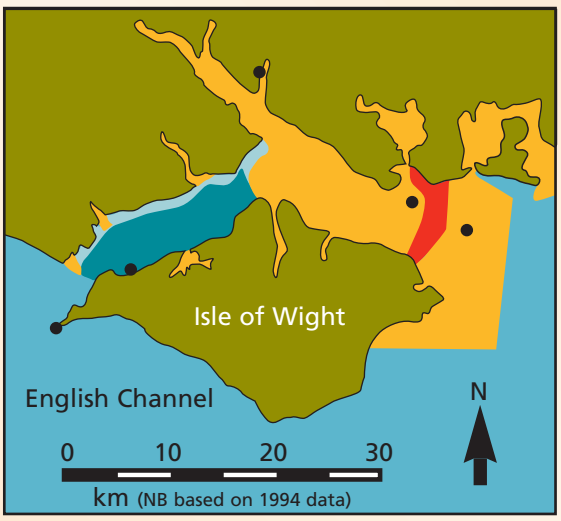
In the marine environment there are no landowners to speak of and all generally view the resource as a 'commons' for use and enjoyment. As on land, however, regulations and legislation exist to manage access, use and impacts. Around the world zoning schemes are used to communicate such measures to users of marine protected areas. The best-known examples are probably from the Great Barrier Reef Marine Park in Australia. Two European examples are the scheme used in the Danish sector of the Wadden Sea and, on a more local scale, the Lundy Island Marine Nature Reserve off the South West coast of England.

In 1994, a study was conducted to see if such approaches could be applied more widely to the seas around the UK. The heavily used area around the Solent was chosen. To get a comprehensive picture of legal controls in the area it was necessary to be aware of both national legislation and local byelaws. Overcoming the difficulty of finding all the relevant legislation, in 1994 (excluding local byelaws) a minimum of 42 regulations had to be consulted to get an overview of the environmental controls in the region, together with additional information provided by 50 individuals familiar with the various management arrangements. Zones were then devised to best represent this information in a clear, spatial manner on a single map, and relate this to 13 marine activities that did or might occur in the area.

The trial was successful in that it showed it was possible to prepare a management information chart for the region and communicate the results to a wide audience. The approach seriously challenges how sectors work together with their legislation to provide integrated and transparent management arrangements for stakeholders. The limitations to the approach are that it can only provide a broad overview and can only communicate area-based restrictions. This is to be expected from any document that summarises information and serves to emphasise that such charts could have considerable potential but should not be used in isolation.

Levels of use allowed

Activity	General use zone	Recreation zone	Harbour zone	Refuge zone	Protected zone
Fisheries					
Potting	Yes	Limited	Limited	Limited	No
Beam trawling	Yes	Limited	Limited	Limited	No
Dredging	Yes	Limited	Limited	Limited	No
Recreation					
Waterskiing	Yes	Yes	Limited	Limited	No
Jet-skiing	Yes	Yes	Limited	Limited	No
Sub-aqua	Yes	Yes	Limited	Limited	No
Windsurfing	Yes	Yes	Limited	Limited	No
Sailing	Yes	Yes	Yes	Yes	Limited
Industry					
Aggregate extraction	Yes	Yes	Yes	Yes	No
Dredge spoil disposal	Yes	Yes	Yes	Yes	No
Oil and gas extraction	Yes	Yes	Yes	Yes	Limited
Research	Yes	Yes	Yes	Yes	Permit
Military	Yes	Yes	Yes	Yes	Yes



Source: Gubbay & Laffoley, 1996.

Priority 4: Improve understanding of the spatial distribution of the environmental 'resource'.

The strong spatial scaling requirements of the Ecosystem Approach require the environmental sector to display information on the resource in a spatially explicit manner. This will mean shifting from lists of habitats and species, and point source information, to maps where surrogate data on biotic factors is used to represent the broad spatial extent of the resource. Broad-scale maps of the environmental resource using existing biological and geophysical data should be produced. These will address landscape dimensions, underpin regional management strategies, support a fully representative conservation approach, and put existing conservation measures in perspective. This priority is strongly linked to the need to work with surrogate information on the environment *in lieu* of more detailed information, as set out earlier in this report on page 28.

Sea rocket *Cakile maritima*, Holkham, North Norfolk Heritage Coast. Dan Laffoley/English Nature

Priority 5: Provide a free-of-charge basic coastline and bathymetry data set.

A significant impediment to bringing together stakeholder knowledge and expertise in the UK, and perhaps elsewhere in Europe, is the lack of freely-available standardised data about the coastline and seabed. This information would provide the basis for presenting marine and coastal data and facilitating its integration, as part of developing our overall understanding of this environment. This should be provided free-of-charge to all who have an interest, ideally via the Internet. The provision of these fundamental data sets, free of change, would encourage coherence, whilst promoting and protecting the ongoing revenue-generating activities required by national data suppliers.

7.5 Improving temporal coherence

Coastal processes eroding soft cliffs nears Benacre in Suffolk. Dan Laffoley/English Nature

The impact of past human activity, combined with the effects of climate change, means that ambitious decisions will be needed if management measures are to have a meaningful influence. In addition, there is a need to address the length of time it may take for ecosystems to respond, show signs of recovery and provide enhanced benefits. Many of the current decisions being taken need significantly more ambition. Much longer timescales need to be considered if management is to make a difference in the face of such changes.

The actual ambition required to effectively implement the Ecosystem Approach is equivalent to that now being shown, in the energy sector, to meet the carbon dioxide emission targets set under the Kyoto Protocol.

Priority 1: Ensure that the sum of management measures taken is not already negated in the future by forthcoming climate changes that are already 'locked' into the environment.

In using the Ecosystem Approach it is important to take into account the changes that are already 'locked-in' to the environment as a result of past human impacts. These range from the issue of genetic viability and recoverability of commercially-exploited species, through to broader-scale issues such as increasingly-elevated sea water temperatures and changes in productivity resulting from climate change and shifts in ecosystem state. These issues need to be understood and built into future processes. They can then inform the level of ambition required to address social, economic and environmental concerns through management actions and other routes. As climate change intensifies, there will be a need for more resilient ecosystems, and a far greater ambition to bring about change in favour of societal values. Mechanisms still need to be found to address such issues adequately.

Priority 2: Ensure that any measures are taken in the context of the scale of past changes to marine and coastal ecosystems.

There is a need to set proposed management measures within the context of how ecosystems have been changed in the past. Human influences on marine and coastal ecosystems have occurred in Europe since the earliest days of human settlement along the coast. Ecosystems have been shaped by such uses, and understanding how and when such changes have occurred provides an insight into the ways in which ecosystems may respond in the future. Such perspectives need to go far wider than simply understanding past trends in stocks of commercially-exploited species of fish.

A key issue is overcoming the concept of 'shifting baselines' where managers and decision-makers fail to see the scale of changes that have occurred, and the timescale over which this has happened. The result is remedial actions that lack the ambition to succeed and have unrealistic indicators of success, set against timescales that are far too short. This priority may be addressed in part by decision-makers and policy advisors being made aware of the issue of 'shifting baselines'. It may also be addressed by capturing information on past ecosystem states as part of the process of defining the outcomes required for the environment as part of sustainable development.

Chalk Cliff.
Dan Laffoley/English Nature

Delivering management of our coasts and seas in a changing world

Future management regimes will need to take into account 'locked-in' changes that will result from the ongoing consequences of the impact of human activities over previous decades and centuries. These include:

- A decline in the Gulf Stream that warms the seas around the UK, by as much as 25%, is possible by 2100. This is unlikely to result in a cooling of UK climate, due to predicted steady increases in air temperature due to other effects.
- Sea surface temperatures may rise by up to 3°C in the UK's shallowest seas by the 2080s, and even more in semi-enclosed areas, as a result of 'global warming'. This will change the mixture, distribution and abundance of marine wildlife including commercially important fish species.
- Habitat loss is occurring in many areas on the south and east coasts of England. There is evidence in Essex that at least 40 hectares of saltmarsh are lost each year. This is partly attributable to the combination of hard coastal defences and rising sea levels, and will increase in the longer term if steps are not taken now.
- The need to change coastal defence options means that a substantial number of internationally designated sites with freshwater habitats directly behind seawalls will be affected by either managed realignment or removal of seawall maintenance by 2050. As a result, re-creation of key freshwater features at locations inland will be required.
- There may be an increase in the risk of severe flooding events in some eastern England locations by as much as 90% in any one year by the 2080s due to climate change.
- Changes in the productivity of some regional seas could have significant effects on the character and types of species that occur around the UK and the quantity of wildlife they can support. Subtle changes in oxygen and turbidity loadings in seawater can make environmental factors less favourable to some species. The southern North Sea and western English Channel are beginning to show some characteristics more similar to the Mediterranean.
- The acidity of seawater has been predicted to increase by 0.7 pH units in the next 50 years, thereby affecting the ability of the sea to absorb carbon dioxide and regulate climate.
- There is a reduced and impaired ability for commercial fish stocks to recover, due to historic and on-going over-exploitation of stocks. There is a concurrent loss of rare 'adaptive' genes from populations, and an increase in selective, possibly inheritable traits for species to mature at small size with reduced reproductive capacity. This is combined with possible loss of 'taught' behavioural characteristics from populations as all old mature individuals are killed.

Source: Adapted and expanded from English Nature, 2004

Recovery of marine ecosystems: timescales and long-term political commitment

Recovering the benefits that marine ecosystems can offer society will take more time than most people think, and it is therefore essential to have long-term political will to make this happen. Long-term commitment, supported by legislation is needed because of a number of factors: the consequences of our long history of impact on the seas; limits on the speed with which ecosystems can recover from our impacts; and the temptation in the future for narrow sectors of society to remove any newly acquired benefits for short-term economic gain.

Reflecting on history provides a sobering perspective. Within the UK, as long ago as the 14th century there were already concerns about fishing effects, and by the 18th century there were attempts to control mesh and landing sizes, and stiff penalties for those who contravened them. Set within an historical context these first concerns arose over 250 years before the Dutch explorer, Abel Tasman, 'discovered' New Zealand.

Given such pressures, it is naïve to think that ecosystems will recover in just a few years once the 'right' management choices are made. Just like humans, species that live in the sea often take many years to reach sexual maturity and even longer to reach adult-hood. Some, such as cold-water coral reefs, may out-live humans by up to 4,500 years. In addition, species need a natural habitat to flourish. Where this has been damaged by human actions, the 'complexity' of habitats may take a long time to recover, usually in ways we fail to accurately predict. More dynamic sandy habitats may recover faster, but some, such as 'living' reefs of mussels may be lost forever. Studies from some Marine Reserves around the world are showing that after 29 years of excluding all extractive pressures from humans, significant and extensive changes are still occurring to rocky seabed habitats as food chains continue to recover.

Sources: MacGarvin & Jones, 2000, *MarLIN*, Shears & Babcock, 2003.

Leigh Marine Reserve in New Zealand, where habitat changes are still occurring 29 years after its closure to fishing and other extractive uses.
Dan Laffoley/English Nature

Priority 3: Sustain the long-term political support required to deliver sustainable development.

The rate and scale of change exhibited by ecosystems can vary considerably from very short term, to changes that only become apparent over many decades. What is evident, from practical experience, is that changes in ecosystem health and quality are difficult to predict. Given these limits in our knowledge, ecosystems often 'do the unexpected'. It is only with adaptive management that experience will be gained on how marine ecosystems around Europe perform under different management regimes.

It is likely that some of the anticipated benefits of applying the Ecosystem Approach will only become apparent a decade or more after significant effort has been directed towards implementing it. Given the particular difficulty for many citizens to see below the surface of the seas and to judge the benefits for themselves, governments and authorities have a critical role to play on behalf of society. This raises the priority to be placed on maintaining strong political commitment to a long-term process. A legal framework is the only way to deliver this, as a voluntary approach will be too susceptible to changes in political priorities, taking short-term gains at the expense of longer-term and wider benefits.

Regular monitoring of fish in the English Channel, using a standard approach, reveals a reduction in fish size, with the sharpest declines seen in large species such as sharks, skates and brill. Marine Biological Association of the United Kingdom.

October 1963

November 2001

Tracking changes in marine ecosystems: the marine trophic index

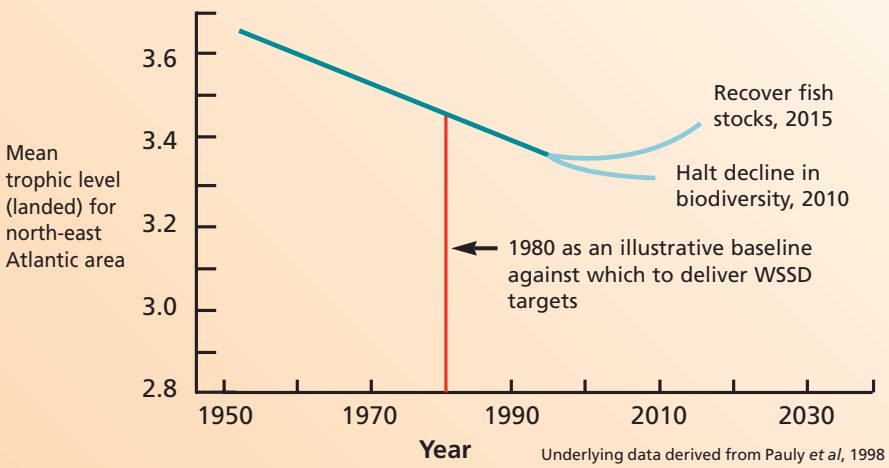
Detailed indicators reveal just part of the picture needed to assess progress towards delivery of sustainable development. High level, ecosystem state indicators are also needed. This is to contribute essential knowledge about long-term trends, reflecting overall changes in food chains and ecosystem structure and function. For example, on land an index of the abundance of farmland birds is already used in the UK to help track the overall impact of agricultural practices on the environment.

In 2004, the Convention on Biological Diversity (decision VII/30) adopted a framework to help assess progress towards the 2010 target of significantly reducing the current rate of loss of biodiversity. The marine trophic index is one of eight indicators agreed for immediate testing. This index could be derived from the effects commercial fishing has on fish stocks and the environment. The 'trophic level' of a species expresses its relative position in the food chain. This ranges from 1 in plants, to 4 or 5 in large predators. In the sea, the zooplankton that eat the microscopic plants in the plankton have a level of 2. Small fish, which feed on them, have a level of around 3 and we generally eat the larger fish at level 4 that feed on those smaller fish. This scale resembles the Richter scale for the magnitude of earthquakes, where a level 5 is 10 times stronger than level 4. This scaling reflects changes in biological productivity between trophic levels.

The effects of fishing selectively capture and remove the predatory species higher up the food chain, simplifying marine food webs – effectively 'fishing down marine food webs'. By understanding the position of fish species in the food chain and analysing the composition of the species that are landed it is possible to analyse the effects of fishing. Because of the close relationship between trophic level and size (big fish eat small ones), mean trophic levels reflect changes in both size composition and position in the food chain, and hence ecological roles. Developing the marine trophic index will require further definition of the methodology to reduce sources of error. This will need to include agreeing data capture techniques, its application on a regional seas basis and standardising the trophic index for selected commercial species at that scale.

Source: Pauly & Maclean, 2003.

The marine trophic index and the delivery of related WSSD targets



Underlying data derived from Pauly *et al*, 1998

Inshore fishing sustains local employment: Caister-on-Sea, Norfolk. Dan Laffoley/English Nature

Priority 4: Ensure that the suite of indicators used to monitor progress is meaningful and responsive.

In tracking the success of using the Ecosystem Approach, increased attention and prioritisation will need to be placed on the range of indicators that are selected to monitor aspects of marine and coastal ecosystem health. The current attention on very selective attributes, which are strongly linked to manageable activities, is only part of the set of indicators required. Longer-term indicators (EcoQOs: see also page 19) will be needed to track changes in overall ecosystem state using attributes that may only be responsive on 5, 10 or 20-year timescales. Ecosystem state indicators, such as the trophic structure of landed/caught fish fall within this category. The recent decision within the CBD to adopt a marine trophic index should stimulate thinking in this area. Alongside this work is a need to understand which biological trends, and their associated indicators, could serve as an early warning of risks to ecosystem resilience, functionality and/or integrity.

Further work is needed to develop indicators that reflect all aspects of ecosystem state and temporal perspectives, and to focus funding in order to deliver the long-term programmes that are required.

Priority 5: Establish appropriate timetables to deliver regional sea management plans.

There is a need to separate out the timescales within which management measures should be decided, from the longer and more uncertain timeframes within which ecosystems may respond and provide enhanced benefits. There is thus a need to develop management measures, such as regional sea management plans, within a relatively short period of time. This will ensure that ecosystems can deliver enhanced benefits as quickly as possible. Given experience from other countries in developing regional sea-scale management plans, a period of four years for delivery of the first plans (which could then be revised on a periodic basis), is realistic.

The raw power of the sea can sometimes overcome coastal protection structures.
Dan Laffoley/English Nature

7.6 Improving scientific coherence

"You think of all the things we have learned about the ocean in the 20th century, what is the most important? Well I think the most significant thing we've learned, is that the ocean is the cornerstone of what makes the planet work."

Sylvia Earle, 2003,
Conservation International

In Europe we undertake world-class scientific research into marine and coastal ecosystems, from 'blue skies' work through to practical underpinning of science programmes. There is, however, far greater value in this research than is presently being realised. There is a variety of ways in which the 'hidden' value of this research may be more effectively used.

Priority 1: Better align science to support society in delivering sustainable development.

Delivering sustainable development raises many questions about the state, structure, function, processes and management responses of ecosystems. Over time, science has generated its own priorities, both with an eye to the needs of society but also with a view to addressing the curiosity of the human mind. The state of the environment, the need to halt the decline in the biodiversity of our coasts and seas and to deliver sustainable development, raise critical issues about the focus of science and where the expenditure of scarce financial resources should now be directed.

There will always be a need to innovate, and novel solutions can be part of the answer to environmental concerns. Equally, there is a need to ensure that science is appropriately aligned to support society in delivering sustainable development. This balance and focus may be addressed though a variety of means, from audits of science programmes for sustainable development 'compliance', through to opening up the development of new science programmes to stakeholder involvement and comment.

Priority 2: Develop and support co-ordinated and strategic research programmes to bring together science and technology in an effective manner, particularly at the regional seas scale.

Whilst the format of regional sea management plans may not yet be known, the regional dimension is becoming an increasingly important scale through which to work. Delivering science at regional spatial scales will be important to the future success of decentralised management. This will mean forging new institutional relationships and instigating new lines of research. Previous general assumptions made at ocean basin scales will require further analysis to make them applicable across all regional seas. This will place new demands on the science community, some of which will be addressed through current marine research. Consideration should now be given as to how such scientific advice may be best generated and shared to support these new regional requirements.

Dissemination of the results of long-term marine monitoring programmes, Plymouth University Conference Centre, 2004. Dan Laffoley/English Nature

Dan Laffoley/English Nature

Priority 3: Improve access to data by introducing measures to ensure that publicly funded data is made available and to a minimum acceptable standard at the end of each project.

A significant amount of public money is currently spent each year on attempting to access data already collected through other publicly-funded work. No standards exist to enable such information to be effectively archived 'in the national interest'. This is acting as a barrier to 'mining' these data, developing knowledge about trends, and maximising the contribution this public investment can make to support the delivery of sustainable development. A requirement should be placed, ideally through contractual mechanisms, to ensure that all publicly-funded data are made available to a minimum acceptable standard and within a minimum timescale. A system should be put in place to provide an effective archiving system. This will not resolve the past problems on data, but will lead to an improvement in data access and expenditure savings. The costs of delivering and co-ordinating this priority action would more than offset the sums of public money currently spent on trying to gain access to previous publicly-funded work.

Priority 4: Widen the scope of the scientific advice provided to policy advisors and decision-makers so that it better reflects ecosystem processes as well as sectoral concerns.

The value of existing research can be enhanced by ensuring that information is provided to policy advisors in a more integrated manner. A key example is the advice provided by the International Council for the Exploration of the Seas (ICES) to the European Commission. This could usefully be re-oriented to marine ecosystem advice thus setting the current advice, on commercial fisheries issues within a broader context. Similar examples may exist elsewhere in Europe and at national levels.

Priority 5: Support greater ownership and use of scientific advice by policy advisors and end-users.

Opportunities for dialogue and greater transparency should be introduced within research programmes and projects to further enhance the quality of the science and its application. Strongly linked to social inclusiveness is the need to build opportunities for greater exchanges to take place between scientists, policy advisors and end-users. This important education process should occur at all stages in the development and implementation of science projects and programmes. An adequate two-way flow of information is needed to ensure a good take up of science in policy decisions and to enable science to be conducted with due regard for the requirements of the policy advisors and end-users. Good practice is emerging on these aspects through a variety of initiatives, including the concept of Reference User Groups, established for the EU funded COST-IMPACT programme, and now being more widely adopted by the European Commission. Such best practice needs to be adopted widely through the science and policy community.

COST-IMPACT: an example of close interaction between policy advisors and the science community

The European Union currently faces potentially conflicting objectives in its use of European waters. It must deliver sustainable fisheries with all the economic benefits afforded to the community through the fishing industry. At the same time the European Union must recover and maintain biodiversity and avoid further negative effects on the environment.

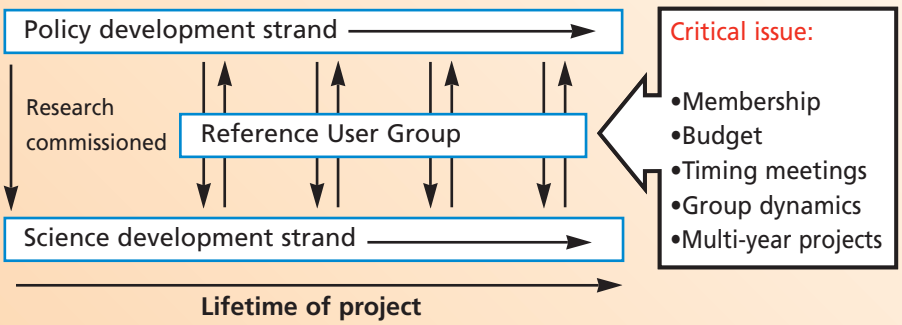
The objectives of the EU project COST-IMPACT are to provide advice to decision-makers on:

- how demersal fishing impacts the biodiversity of the marine benthos and the associated goods and services, such as nutrient cycling, that it provides.
- how these impacts influence other marine ecosystem processes.
- what the likely values of marine ecosystem goods and services are and how these values are affected by fishing.

The key outputs from this work will be to help managers integrate fishing policy with environmental policy and to provide some new tools for the management of fishing effort. It has therefore been particularly important to work in close partnership with those involved to ensure that the end results are appropriate and applicable to decision-makers' needs. This partnership approach has been facilitated by the formation of a Reference User Group comprising relevant stakeholders to provide advice throughout the life of the project. This approach has provided a number of benefits:

- scientists and policy advisors have maintained contact
- policy advisors felt informed and could promote the project's work
- ownership and involvement has been encouraged
- continual information exchange has occurred
- perspectives have been changed
- dissemination plans have been discussed during the research phase

The COST-IMPACT process: better policy-science links



Some species living in sandy and muddy seabeds are an essential part of the powerhouse of the seas, recycling critical nutrients back into foods chains. Easily damaged and widely depleted by fishing trawls running across the seabed, these large, long-lived species include burrowing shrimps, such as *Calocaris macandreae* (above) and *Upogebia deltaura*, and the heart urchins *Brissopsis lyrifera* (below) and *Echinocardium chordatum*. Susanne Erikson/KMF and http://www.biltek.tubitak.gov.

Priority 6: Improve the synthesis of existing blue skies, social and practical sciences, by encouraging integrated multi-disciplinary research.

There is a critical need to maintain the collection of new data and long-term studies of marine and coastal ecosystems.

Equally much valuable information and knowledge exists, which would help develop better policies and decisions to support sustainable development. The reasons for this are varied, but may include a lack of enthusiasm from funding bodies to 'go back' and look at existing data, or a lack of frameworks to involve the appropriate range of disciplines to achieve this. Ecologists, ecosystem modellers, fisheries scientists, oceanographers and economists should synthesise and develop available knowledge, shifting the agenda from 'what is there?' towards 'what does it do?' A key part of achieving such a shift will be through the use of strategic workshops to scope users' needs in setting up new research programmes building on existing data and information sources.

Major infrastructural developments are often located by the sea, such as Ramsgate port.
Dan Laffoley/English Nature

7.7 Improving institutional coherence

The Houses of Parliament, London.
Dan Laffoley/English Nature

"On the marine environment, I believe that there are strong arguments for a new approach to managing our seas."

Tony Blair, 2004

The structure and nature of institutional arrangements are important in delivering sustainable development. Current institutional arrangements have arisen over many years, often devised to meet the demands of the time, rather than to fulfil long-term objectives. Reform of sectoral and institutional arrangements through prioritised and targeted actions needs consideration to meet current demands better and support future delivery requirements for sustainable development. Improved institutional coherence should lead to improved spending efficiency, better lines of communication, less confusion amongst stakeholders and stronger ownership of the problems and potential solutions. A key issue will be providing adequate time within the work programmes of relevant staff to bring this about. It is important to afford this area equal importance alongside the day-to-day priorities of each delivery organisation.

Whilst there are many ways in which improved institutional coherence could be achieved, three areas are identified below. These areas have strong links to the priorities identified for improving social coherence.

Priority 1: Reform institutional arrangements to support action on delivering sustainable development.

Often institutional arrangements at European or national levels are focussed on a particular sector - whilst this can be appropriate it is vital to ensure coherence through proper co-ordination and linkages across sectors. Furthermore, artificial administrative boundaries are often created to deal separately with marine and land issues at the coast. This can lead to inflexible, overly complicated, and uncertain systems of administration and control. These complex arrangements can also be characterised by high levels of inertia, causing a lack of responsiveness to stakeholder views or new evidence on the state of the resource and improved management practices. All institutions operating at or across the land/sea boundary need to have regard to the effects of their operations, both directly and on adjacent ecosystems. Innovating approaches will be needed to enhance the effectiveness of the sectoral approach, which may involve optimising:

- professional support that can be provided to stakeholders, streamlined and focussed on their needs.
- funding arrangements to be adequate, rational, clear, simple, responsive, long-term and targeted.
- linkages that can be made across the land/sea divide.
- mechanisms for policy development, delivery of management and enforcement, so that responsibilities are clear and accountable.
- organisational streamlining, so as to provide coherence and effective environmental management and enforcement outcomes.
- delivery and targeting of priorities at the local and regional seas scales, whilst being held accountable to national standards.

The European Parliament, Brussels.
Dan Laffoley/English Nature

Alongside such reforms, the use of the Ecosystem Approach as the key tool to support delivery of sustainable development should be mainstreamed into policy. Delivery organisations normally have a primary economic, social or environmental remit as this provides focus and helps avoid confusion and overlap. However, improved institutional coherence will occur if all delivery bodies seek to work in partnership to achieve sustainable outcomes for our coasts and seas. In the UK, for example, Government Offices, with their cross-cutting leadership and brokerage role, have a key part to play by sustainable development 'proofing' any new arrangements, and by ensuring that processes and programmes are coherent and co-ordinated within an overall sustainable development framework.

Priority 2: Provide high-level European Commission and Government support and co-ordination.

Current actions alone will not result in sufficient political will to deliver the institutional coherence required to deliver sustainable development. High-level European Commission and Government scrutiny will be required to oversee the process and ensure that barriers that have previously acted against fully co-operative working are removed. Scrutiny is also needed to maintain momentum, thus optimising conditions for the delivery of sustainable development. In addition it will have a critical role to play in ensuring that a more appropriate balance is struck across social, economic and environmental boundaries.

Priority 3: Provide adequate support for more coherent action at the local level.

The Ecosystem Approach has a strong emphasis on understanding societal values, choices and needs, and on achieving societal involvement. A key route to deliver this is through stakeholder engagement at local community levels. This may take the form of participation in developing management plans for particular areas, or projects addressing certain environmental concerns. Sometimes it may take the shape of fora, which act as a framework for seeking views and capturing the knowledge and advice held in local communities. Frequently such initiatives are supported by *ad hoc*, short-term or piecemeal funding arrangements, which wax and wane depending on chance events or political trends. As a consequence, genuine stakeholder involvement struggles to survive. Given that we treat the seas, and to some degree the coasts, as 'commons', and given that the knowledge base from which to make decisions about sustainable development is dispersed through society, it is important to secure coherence at local levels. It will be important to ensure that adequate, structured and long-term support, including funding, is provided to help shape and inform sustainable development solutions.

8 The next steps

"Behaviourally modern humans have been around for no more than about 0.0001 per cent of the Earth's history….We are really at the beginning of it all. The trick, of course, is to make sure we never find the end. And that, almost certainly, will require a lot more than lucky breaks."

Bill Bryson, 2003

The framework in this report offers a mechanism for decision-makers and policy advisors to engage with the broad range of organisations and stakeholders who have an interest or involvement in our coasts and seas. This new framework could be used to take the application of the Ecosystem Approach forward. The priorities identified are examples of the core elements of the programmes and projects where countries need to make practical progress, now and in the future. There will be other actions needed alongside those that have been given, so the next stage could be discussion and debate leading to the development or enhancement of 'sustainable development' action plans. Such plans would enable countries or entire regions to identify common priorities and needs, and share subsequent costs. These practical plans should have at their core an overall objective for delivering sustainable development.

In addition to this general perspective, there are specific ways in which this report may assist those with an interest in the coasts and seas to deliver sustainable development. At a global scale, it could provide a guide to support the plan of implementation from WSSD. The framework could help further elaborate the advice already provided by the CBD. It may also form a useful basis to support the development of the Convention's forthcoming 'sourcebook'. This 'sourcebook' will provide authorities with additional advice to take the Ecosystem Approach forward at a practical level. The areas of coherence form a readily recognisable framework to bridge the gap between the Convention's broad concepts and principles, and the priorities to support practical application at regional sea or national levels.

The coherence framework and priority actions support and complement the work currently being undertaken on the European Marine Strategy by the European Commission, Member States and others. The framework in this report could support the broad-scale implementation guidelines being developed by the Commission. In particular it can inform the level of ambition and the focus for practical actions that will be needed within a clearly-structured approach. It could also help support the work of the Regional Seas Conventions in implementing the Ecosystem Approach, as well as contributing towards meeting the EU Gothenburg 2010 target. Within the UK, it is recommended that this report be considered in the light of the outcomes of current Government consultations and independent reviews of maritime and coastal affairs. It can help provide a checklist against which to evaluate the measures needed for a fit-for-purpose sustainable development strategy for the UK's marine and coastal environment. In so doing it should be recognised that this report is not exhaustive and that further detail may be needed on some aspects.

Finally, the framework may have value at more local levels for the development of community initiatives and for individual organisations that have an involvement with relevant processes. It could help provide a structure around which to discuss the de-centralisation of government policy. It may also provide organisations charged with implementing sustainable development with the basis of an audit to improve their performance and relationships with key partners and stakeholders, whilst enhancing their own role in the process.

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An educational opportunity using inflatable models to learn about whales and dolphins. Karen Hall/SNH

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Beacon Cove, Cornwall. Chris Pater/English Nature

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Diana Pound is head of *'dialogue matters"* which she set up to facilitate and advise on stakeholder participation in ecological and environmental decisions. She is regularly invited to contribute to European forums considering conflict and change management in biodiversity conservation and sustainable development. She has just been invited to become a member of the IUCN's Commission on Education and Communication. She is currently developing ways of working with stakeholders that will help deliver the Ecosystem Approach.

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