

# Securing a healthy natural environment:

An action plan for embedding an ecosystems approach



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This Action Plan, along with further information on our research programme, is available online at <http://www.defra.gov.uk/wildlife-countryside/natres/eco-actionp.htm>

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The natural environment is vitally important, both for its intrinsic value and for the wide range of benefits it provides to people and society. It provides us with the essentials for life and underpins our health, wellbeing and prosperity. It is inextricably linked with climate change and can play a key role in both mitigation and adaptation.

The importance of the natural environment is reflected in the shape of a new cross-government Public Service Agreement announced as part of the 2007 Comprehensive Spending Review. The PSA sets out the Government's vision for a diverse, healthy and resilient natural environment. Within my own Department, we have also identified securing a healthy natural environment as one of Defra's two high-level goals, alongside tackling climate change.

If we are to secure a healthy natural environment, we need to strive constantly to be more effective in delivering the outcomes we want to see. We must stop taking the natural environment for granted and ensure the value of the services it provides is fully taken into account in decision-making.

Defra is therefore committed to developing a more strategic framework for policy-making and delivery on the natural environment, based on the principles of an ecosystems approach. This is an exciting and progressive agenda. It takes forward some of the key recommendations of the Millennium Ecosystem Assessment and reflects the latest thinking internationally about how best to protect our natural assets.

This Action Plan sets out an ambitious programme of work to deliver a decisive shift towards an ecosystems approach in our policy-making and delivery. It aims to demonstrate the benefits of taking an ecosystems approach; to embed this in policy-making and delivery; to develop better ways to value the natural environment in decision-making; and to develop our strategic evidence base.

Embedding an ecosystems approach will require changes to the way we think and work, and these changes will take time. This Action Plan is intended to build on existing best practice and extend this across policy-making and delivery. Defra and the Defra network must lead the way, but the Action Plan also provides a basis for securing wider engagement across Government and a broad range of partners and stakeholders – recognising that we will all need to work together if we are to secure a healthy natural environment.

A handwritten signature in black ink that reads "Joan Ruddock". The signature is fluid and cursive, with a horizontal line underneath the name.

Joan Ruddock MP

Minister for Climate Change, Biodiversity and Waste

## Executive Summary

The natural environment provides a wide range of goods and services – ‘ecosystem services’ – that underpin human health, wellbeing and prosperity. In order to improve our effectiveness at securing a healthy natural environment, Defra is committed to developing a more strategic approach and a more integrated framework for policy-making and delivery. The new natural environment Public Service Agreement sets out a clear vision and, for the first time, recognises that this is a shared responsibility across Government. To help us deliver the Public Service Agreement, we are now taking further steps to embed an ecosystems approach in policy-making and delivery, based on a number of core principles:

- taking a more holistic approach to policy-making and delivery, with the focus on maintaining healthy ecosystems and ecosystem services
- ensuring that the value of ecosystem services is fully reflected in decision-making
- ensuring environmental limits are respected in the context of sustainable development, taking into account ecosystem functioning
- taking decisions at the appropriate spatial scale while recognising the cumulative impacts of decisions
- promoting adaptive management of the natural environment to respond to changing pressures, including climate change.

Moving towards an ecosystems approach will deliver a number of important benefits:

- more effective delivery of our environmental outcomes
- better-informed decisions that take full account of environmental impacts, helping us to achieve sustainable development
- better prioritisation and more efficient use of our resources
- more effective communications and greater awareness of the value of the natural environment and ecosystem services.

Defra has worked with many of our key partners and stakeholders, including Natural England and the Environment Agency, to agree this Action Plan to drive the adoption of an ecosystems approach. The Action Plan identifies 37 actions (listed in Annex 1) that will be delivered mainly over the next two years and which represent an ambitious and wide-ranging agenda for Defra, the Defra network and our partners. As part of this agenda, we have identified a number of clear **priority areas for action** that will be fundamental to our success and to securing wider engagement at the national, regional and local levels:

### **Priority area 1: Promoting joined-up working within Defra and the Defra network to deliver environmental outcomes more effectively**

- Defra will embed the principles of an ecosystems approach in its standard policy-making procedures **[A1]**.
- Natural England, the Environment Agency, the Forestry Commission and the Government Offices will work together to influence regional strategies, including by baselining key pressures **[A11]**.



## **Priority area 2: Identifying opportunities for mainstreaming an ecosystems approach**

- Defra will review the scope for adapting existing policy and project appraisal tools to incorporate principles of an ecosystems approach **[A10]**.
- The Department for Communities and Local Government and Defra will work together to influence the design of eco-towns to maximise delivery of ecosystem services **[A17]**.

## **Priority area 3: Using case studies that demonstrate the benefits of taking an ecosystems approach**

- A project to look at the wider benefits of peat conservation **[A4c]**.
- A review of the air quality policy on ammonia **[A4a]**.
- A scoping study to identify the wider benefits of Environmental Stewardship **[A4b]**.

## **Priority area 4: Developing ways of valuing ecosystem services**

- Defra and the Defra network will pilot the valuation of ecosystem services in a range of policy areas, including valuing the benefits of the UK Biodiversity Action Plan and impact assessment for the Marine Bill. **[A15]**.
- The Department for Transport will work with Defra on a long-term strategy for the development of environmental valuation in transport appraisal, including the valuation of ecosystem services **[A16]**.
- Defra and the Defra network will develop a benefits transfer strategy to facilitate the valuation of ecosystem services **[A18]**.

## **Priority area 5: Developing a robust evidence base**

- Defra and the Defra network will further articulate the evidence needs for an ecosystems approach, identify priorities and improve the strategic co-ordination of research and development **[A27]**.
- Defra and the Defra network will develop a strategy for the convergence of indicators and targets, consistent with an ecosystems approach **[A21]**.

The Action Plan is structured around a number of themes that set out the background to the approach and the rationale for the suggested actions. It is intended to provide policy-makers, economists and scientists with a clear overview of the principles and benefits of an ecosystems approach and to show how key players will work together to take this agenda forward.

# 1 Introduction

The natural environment is a precious resource. It provides not only the essentials of life – air, water, food and fuel – but underpins our health, wellbeing and prosperity. By protecting and enhancing the natural environment, we can also significantly improve our quality of life. That is why securing a healthy natural environment is one of Defra’s two high-level goals, alongside tackling dangerous climate change. Its importance is also reflected in the new Public Service Agreement (PSA) framework announced as part of the Comprehensive Spending Review (CSR) 2007, in the shape of a new cross-Government PSA to ‘secure a healthy natural environment for today and the future’.<sup>1</sup>

For the first time, the PSA sets out the Government’s clear vision for the natural environment:

*‘To secure a diverse, healthy and resilient natural environment, which provides the basis for everyone’s well-being, health and prosperity now and in the future; and where the value of the services provided by the natural environment are reflected in decision-making:*

- *The air that we breathe free from harmful levels of pollutants*
- *Sustainable water use which balances water quality, environment, supply and demand*
- *Land and soils managed sustainably*
- *Biodiversity valued, safeguarded and enhanced*
- *Sustainable, living landscapes with best features conserved*
- *Clean, healthy, safe, productive and biologically diverse oceans and seas*
- *People to enjoy, understand and care for the natural environment.’*

Over the years, we have made significant progress in tackling environmental pollution and degradation in this country. We have seen real improvements in air and water quality, halted the decline in farmland birds and improved the condition of many of our nationally important wildlife sites. We have provided more opportunities for people to enjoy the natural environment, through the creation of National Parks and Areas of Outstanding Natural Beauty (AONBs), and improved access to the countryside. Internationally, the UK is seen as a world leader on issues such as wildlife conservation, where we have contributed significantly to measures to protect species such as the tiger and the great apes.

But there are still many pressures on the natural environment, and the challenges we face are becoming more complex (see Box 1.1). Many of our most acute environmental problems are now caused by diffuse pollution and the cumulative impacts of development, and these problems are exacerbated by climate change.

In the past, the policy framework for dealing with these issues has been complex and fragmented, which has made it difficult to tackle them in the most efficient way and to reconcile conflicting priorities. If we are to achieve the vision set out in the natural environment PSA, we need to constantly strive to improve the effectiveness of our policy-making and delivery. It is in this context that this Action Plan has been developed, fulfilling a commitment in the UK Sustainable Development Strategy. It is intended to form the basis for a more strategic approach to policy-making and delivery on the natural environment, reflecting the latest thinking among scientists and policy-makers, both domestically and internationally.

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1. [http://www.hm-treasury.gov.uk/media/1/3/pbr\\_csr07\\_psa28.pdf](http://www.hm-treasury.gov.uk/media/1/3/pbr_csr07_psa28.pdf)



## Box 1.1 – Some important challenges

- Air pollution is estimated to reduce the life expectancy of every person in the UK by an average of 7–8 months, with estimated annual health costs of £20 billion.<sup>2</sup>
- Most rivers and lakes in England are at risk of failing to meet the requirements of the Water Framework Directive (WFD).
- Thirty-nine per cent of priority habitats and 27% of priority species are still in decline in England.<sup>3</sup>
- Marine ecosystems continue to deteriorate and many fish species are at low levels.
- Over a fifth of land in England is at high risk of soil erosion, threatening the health and viability of our land.
- The world's population has grown by 34% to 6.7 billion in 20 years;<sup>4</sup> the UK population is projected to increase by 4.4 million by 2016.<sup>5</sup>

Defra has worked with many of our key partners and stakeholders, including Natural England (NE) and the Environment Agency (EA), to identify and agree a number of actions to help us move collectively towards an **ecosystems approach** to conserving, managing and enhancing the natural environment in England.<sup>6</sup> Essentially, this is about adopting a new way of thinking and working, by:

- shifting the focus of our policy-making and delivery away from looking at natural environment policies in separate 'silos' – e.g. air, water, soil, biodiversity – and towards a more holistic or integrated approach based on whole ecosystems; and
- seeking to ensure that the value of ecosystem services is fully reflected in policy- and decision-making in Defra and across Government at all levels.

The Action Plan has been developed through extensive discussions and informal consultations, including a series of stakeholder seminars on some of the main issues, which helped us to build awareness and understanding of this agenda and to identify many of the actions included here. The actions are identified by theme in the text and listed by organisation in Annex 1.

The Action Plan is a first decisive step towards embedding an ecosystems approach. This is an ambitious and long-term agenda that will require us to overcome many challenges – institutional, political, methodological and scientific. Defra cannot deliver this alone, only by working closely with our delivery partners, other government Departments, regional and local government, farmers and land managers, Non-Governmental Organisations (NGOs) and the research community.

Adopting an ecosystems approach is a means to an end rather than an end in itself, and it is not a panacea. It is intended to help us deliver our natural environment outcomes more effectively and more efficiently, and to help us make better-informed decisions about how to balance economic, environmental and social objectives in pursuit of our ultimate goal: development that is truly sustainable.

2 <http://www.defra.gov.uk/environment/airquality/pdf/strategy/pdf/airqualitystrategy-vol1.pdf>

3 From the UK Biodiversity Action Plan 2005 reporting round, see England Biodiversity Strategy, Volume 2: <http://www.defra.gov.uk/wildlife-countryside/biodiversity/biostrat/index.htm>

4 The Global Environment Outlook: GEO-4: <http://www.grid.unep.ch/activities/assessment/geo/geo4.php>

5 The Office for National Statistics: <http://www.statistics.gov.uk/>

6 Responsibility for the environment and sustainable development is a devolved function, although Defra has worked with the devolved administrations on the research and development agenda, as agreed in One Future – Different Paths: The UK's shared framework for sustainable development: <http://www.sustainable-development.gov.uk/publications/uk-strategy/framework-for-sd.htm>

## 2 What is an Ecosystems Approach?

This section seeks to explain what we mean by an ecosystems approach for the purposes of this Action Plan, based on a set of core principles that can be applied in a range of different policy- and decision-making contexts.

### 2.1 What are ecosystems and ecosystem services?

An **ecosystem** can be defined at the most basic level as a natural unit of living things (animals, including humans; plants; and micro-organisms) and their physical environment. The living and non-living elements function together as an interdependent system – if one part is damaged, it can have an impact on the whole system.

Ecosystems can be terrestrial or marine, inland or coastal, rural or urban. They can also vary in scale from the global to the local. At the international level, examples include rainforests, deserts and coral reefs. Closer to home, we might think more in terms of different types of habitats (e.g. woodlands, grassland, marshes, heathland, rivers, peat bogs, rocky shores), though this can also extend to the urban environment (e.g. parks and gardens, rivers and streams). In many cases, ecosystems overlap and interact.

**Ecosystem services** are the wide range of valuable benefits that a healthy natural environment provides for people, either directly or indirectly. The benefits range from the essentials for life, including clean air and water, food and fuel, to things that improve our quality of life and wellbeing, such as recreation and beautiful landscapes. But they also include natural processes, such as climate and flood regulation, that we often take for granted – and as we have seen with climate change, we damage these natural processes at our peril.

There is no single agreed way of describing ecosystem services, but the most widely recognised framework is probably that provided by the Millennium Ecosystem Assessment (MA)<sup>7</sup> (see Box. 2.1), which suggested four broad categories:

- **provisioning services** – the products obtained from ecosystems, including fresh water, food, fibre (e.g. timber, cotton, wood fuel), genetic resources, biochemicals, natural medicines and pharmaceuticals
- **regulating services** – the benefits obtained from the regulation of natural processes, including air quality regulation, climate regulation, water/flood regulation, erosion regulation, water purification, disease and pest control, pollination, buffering pollution
- **cultural services** – the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic enjoyment
- **supporting services** – the services that are necessary for the production of all other ecosystem services, including soil formation, photosynthesis, primary production, nutrient cycling and water cycling.

The full typology of ecosystem services as set out in the MA is detailed in Annex 3. These ecosystem services in turn provide a range of benefits that support human health, wellbeing and prosperity (Figure 2.1).

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<sup>7</sup> <http://www.maweb.org>

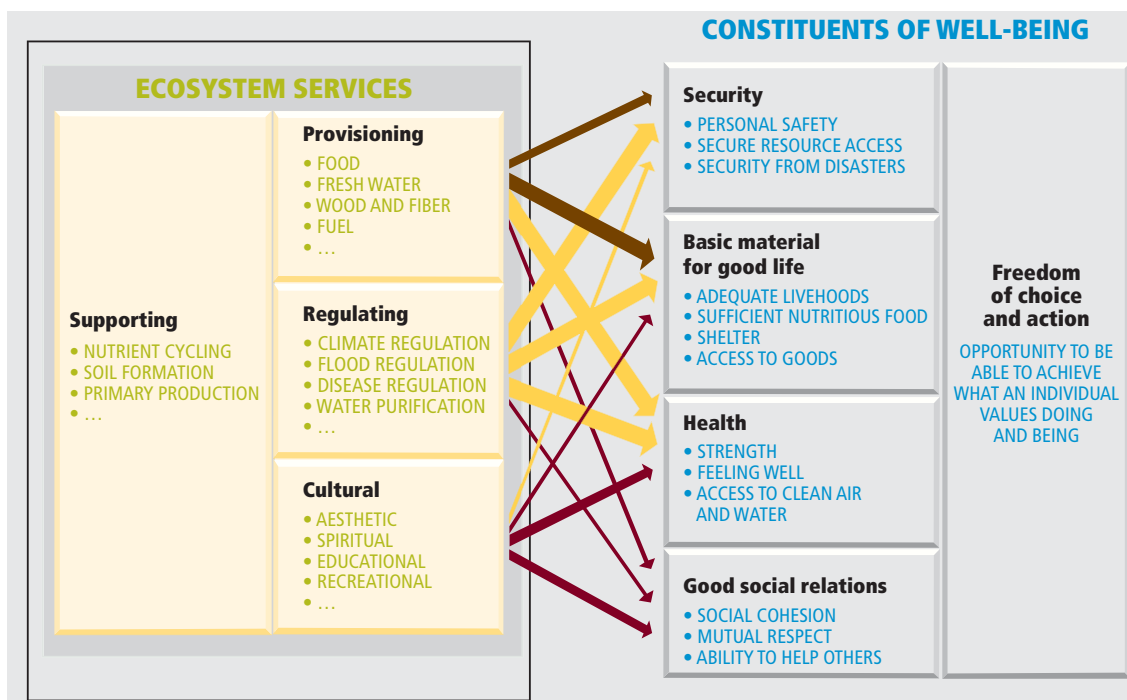
## Box 2.1 – The Millennium Ecosystem Assessment (MA)

In 2000, the United Nations Secretary-General, Kofi Annan, called for the first comprehensive assessment of the state of the global environment. Involving over 1,300 scientists, their findings, contained in five technical volumes and six synthesis reports, provided an appraisal of the state of the world's ecosystems and ecosystem services, and policy options to restore, conserve or enhance ecosystems. Its main findings included:

- Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history. This has contributed to substantial net gains in human wellbeing and economic development but at a growing cost in terms of the degradation of many ecosystem services. Two-thirds of ecosystem services were found to be in decline globally or managed unsustainably.
- The degradation of ecosystem services could grow significantly worse during the first half of this century and is a barrier to achieving the Millennium Development Goals.
- The challenge of reversing the degradation of ecosystems while meeting increasing demands for their services will require significant changes in policies, institutions and practices.

The MA identified a number of steps that governments can take to address environmental degradation, as noted in Annex 2. Taken together, they are consistent with many of the things the Government is already committed to by means of the UK Sustainable Development Strategy.

Figure 2.1: Ecosystem services and their benefits – adapted from the MA<sup>8</sup>



The concept of ecosystem services is therefore helpful because it reminds us that we should not just care about the natural environment for its own sake – its ‘intrinsic value’ – important though this is. It makes it clear that **people** all over the world depend on ecosystem services for their health, wellbeing and prosperity. People in developing countries are often directly dependent on ecosystem services for their survival, which means that they are particularly vulnerable to environmental degradation. And while city dwellers often tend to feel disconnected from the natural environment, the reality is that they are just as dependent on ecosystem services as anyone else. It is therefore vital that human activities in both developed and developing countries are managed in a way that maintains healthy ecosystems and the services they provide.

We have used the MA typology as the basis for this Action Plan. As we go forward, we may find that it needs to be adapted and simplified if we are to mainstream ecosystems thinking in domestic decision-making.

### Box 2.2 – Wellbeing and the natural environment

‘Wellbeing’ is receiving much attention from policy-makers in the UK and abroad. The consultation on the UK 2005 Sustainable Development Strategy, *Securing the Future*, revealed concern that government policy placed too great an emphasis on increasing gross domestic product and neglected wider ‘quality of life’ issues. The Strategy identifies a need to ensure that wellbeing issues are being tackled consistently and in the right way, and that Government is genuinely making a difference to people’s lives. A number of studies on the impact of the natural environment on elements of wellbeing, such as health, indicate that it provides people with synergistic physical, mental and social benefits.

The wealth of material exploring the beneficial wellbeing impact of green spaces, for example, suggests that a positive impact results from interacting with the natural environment. An increasing number of studies have shown that engaging in physical activities has positive mental wellbeing impacts and that these are further enhanced if they are carried out in green spaces.<sup>9</sup> There is also a large body of research that explores the role that nature plays in the personal development of children. Environmental quality is known to affect children’s overall wellbeing through its influence on food quality, air quality and opportunities for them to play in outdoor spaces.<sup>10</sup>

## 2.2 What do we mean by an ecosystems approach?

The ecosystems approach has been defined in various ways, but the core of the approach lies in integrating and managing the range of demands placed on the natural environment in such a way that it can indefinitely support essential services and provide benefits for all.

The Convention on Biological Diversity (CBD) has defined its Ecosystem Approach as ‘a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way’.<sup>11</sup> The Ecosystem Approach is considered by the parties to the CBD as the primary framework for achieving sustainable development, based on maintaining fully functioning ecosystems. The CBD has recommended 12 principles to guide the practical application of the Ecosystem Approach, noting that such an approach is not a formula to be applied but a framework that can be adapted to suit all issues and situations.

9 Sustainable Development Commission (2007), The natural environment, health and wellbeing. *Healthy Futures No. 6*, (SDC: London).

10 Huby M and Bradshaw J (2006). A Review of the Environmental Dimension of Children and Young People’s Well-being (report prepared for the Sustainable Development Commission).

11 <http://www.cbd.int/ecosystem/default.shtml>

Safeguarding Our Seas,<sup>12</sup> the UK Government's strategy for the conservation and sustainable development of the marine environment, also proposed seven principles for an ecosystem-based approach to marine management.

This Action Plan does not seek to impose a single, rigid definition of an ecosystems approach. Rather, our intention is to promote a **generic** ecosystems approach that can be applied in a wide range of policy areas and decision-making contexts, based on a number of core principles:

- taking a more holistic approach to policy-making and delivery, with the focus on maintaining healthy ecosystems and ecosystem services
- ensuring that the value of ecosystem services is fully reflected in decision-making
- ensuring environmental limits are respected in the context of sustainable development, taking into account ecosystem functioning
- taking decisions at the appropriate spatial scale while recognising the cumulative impacts of decisions
- promoting adaptive management of the natural environment to respond to changing pressures, including climate change.

Not all of these principles will be relevant in all contexts and to all stakeholders, but where they are relevant they should be observed. For example, partners whose main focus is managing the natural environment (e.g. conservation interests, land managers) will want to have regard to all the principles, whereas those who have a broader agenda (e.g. other government Departments, local and regional government, planners) will, in many cases, be mainly interested in how to value ecosystem services and respect environmental limits.

## 2.3 The benefits of an ecosystems approach

If we are successful in embedding an ecosystems approach in policy- and decision-making, we anticipate that this will deliver a number of important benefits:

- more effective delivery of our environmental outcomes
- better-informed decisions that take full account of environmental impacts, helping us to achieve sustainable development
- better prioritisation and more efficient use of our resources
- more effective communications and greater awareness of the value of the natural environment and ecosystem services.

To some extent, the only way we can demonstrate the benefits of taking an ecosystems approach is by actually putting it into practice. There are already good examples of an ecosystems approach being embedded within Defra, including in the biodiversity strategy for England,<sup>13</sup> the implementation of the WFD and our long-term vision for fisheries.<sup>14</sup> Through this Action Plan, we are committed to building on existing best practice and driving this further and deeper.

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12 Safeguarding Our Seas: A strategy for the conservation and sustainable development of our marine environment: <http://www.defra.gov.uk/environment/water/marine/uk/stewardship/index.htm>

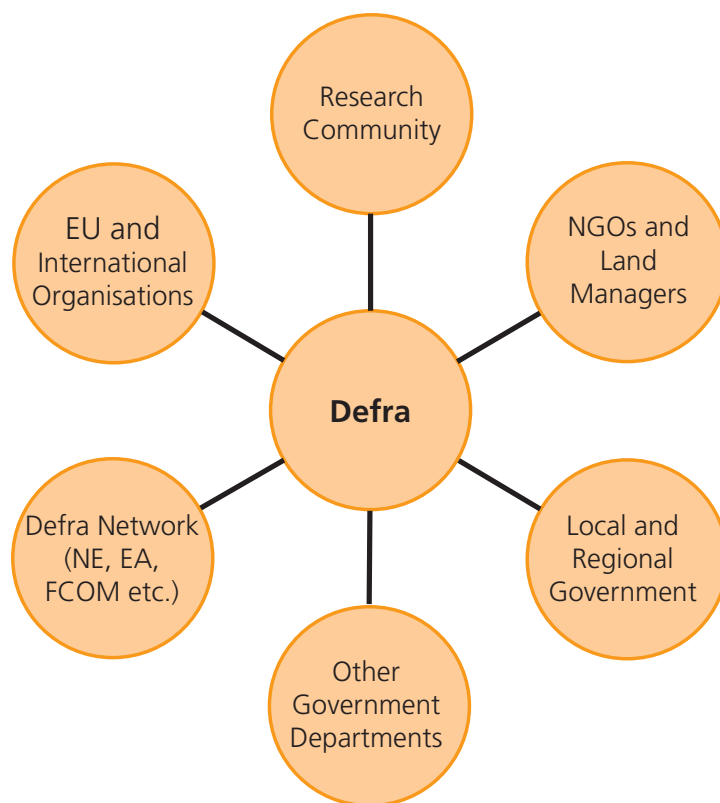
13 Working With the Grain of Nature: A biodiversity strategy for England, Defra: <http://www.defra.gov.uk/wildlife-countryside/biodiversity/biostrat/index.htm>

14 Fisheries 2027 <http://www.defra.gov.uk/marine/pdf/fisheries2027vision.pdf>

## 2.4 Who do we need to engage?

If we are to embed an ecosystems approach, we will need to continue to engage a wide range of partners and stakeholders. We will need to work across traditional policy and institutional boundaries to raise awareness of the value of ecosystem services and to promote the design and implementation of policies that deliver the fullest possible range of environmental, social and economic benefits. Figure 2.2 identifies the key players. Defra and the Defra network have a lead role to play in this agenda, but we will need to work closely with many others.

**Figure 2.2: Key partners and stakeholders**



## 2.5 Monitoring and evaluation

Defra's Natural Environment Strategic Unit will monitor and evaluate the delivery of all the actions set out in this document, and will report on progress by the end of 2009.



## 3 Mainstreaming an Ecosystems Approach

This section discusses what we need to do to mainstream an ecosystems approach in policy- and decision-making at the international, national, regional and local levels. At every level, we will need to raise awareness, overcome resistance to change, promote more joined-up working between key partners and stakeholders, embed ecosystems thinking in standard procedures and build capacity to ensure people have the right skills and tools.

### 3.1 International context

Government has international commitments to develop and implement an ecosystems approach. For example, the MA calls on countries to develop this approach and, under the CBD, signatory states are committed to developing and applying the CBD's Ecosystem Approach. Therefore, although this Action Plan focuses on the implementation of an ecosystems approach in England, it also has an international dimension and we hope that domestic application of an ecosystems approach could serve as a model that other countries can adopt and build on. Defra, working with partners such as the **Joint Nature Conservation Committee** (JNCC), will disseminate its work through channels such as the CBD's and the UK's Clearing House Mechanisms, at international meetings (including Conferences of Parties) and in reports to Multilateral Environmental Agreements.

Defra will also work with other government Departments such as the **Department for International Development** (DFID) to help mainstream an ecosystems approach in areas such as the Environmental Transformation Fund, the joint research programme on ecosystem services and poverty alleviation<sup>15</sup> and through Defra's contribution to PSA 29 on poverty reduction and progress towards meeting the Millennium Development Goals.<sup>16</sup> Defra will also support and promote an ecosystems approach within the European Union (EU) (see Box 3.1).

#### Box 3.1 – EU Marine Strategy Framework Directive

The draft EU Marine Strategy Framework Directive uses an ecosystems approach designed to restore the ecological health of Europe's oceans and seas by defining, achieving and maintaining their 'Good Environmental Status' by 2021. Given the diverse conditions and problems of the marine environment in the EU, the proposal establishes European Marine Regions on the basis of geographical and environmental criteria. The Directive will provide an integrated policy framework that takes into account all pressures and impacts and sets clear actions in order to maintain marine ecosystem integrity. Defra will deliver these outcomes for the UK, including through the UK Marine Bill.

<sup>15</sup> <http://www.nerc.ac.uk/research/programmes/espa/>

<sup>16</sup> [http://www.hm-treasury.gov.uk/media/E/4/pbr\\_csr07\\_psa29.pdf](http://www.hm-treasury.gov.uk/media/E/4/pbr_csr07_psa29.pdf)

## 3.2 National level

**Defra** is committed to taking the lead in developing and applying an ecosystems approach and demonstrating its benefits to key partners and stakeholders.

We plan to do this by ensuring that the principles of an ecosystems approach are embedded in our own standard policy-making procedures and by putting these into practice. There are already a number of good examples of best practice in policy-making that are broadly consistent with an ecosystems approach and from which we can learn:

- The **Water Framework Directive** takes a broader catchment-based approach to setting ecological objectives for water bodies based on river basin districts. The framework laid down by the Directive requires the actions we take to be integrated into plans and packages of measures tailored to individual river basins and drawn up with the active involvement of interested parties, such as participants from NGOs, farming and business and the local community.
- New measures for agriculture under the WFD's River Basin Management Plans have to be operational by 2012. To ensure early action to tackle diffuse water pollution from agriculture and its ecosystem impacts, Defra has put in place the **England Catchment Sensitive Farming Delivery Initiative**.<sup>17</sup> The primary aim of this initiative is to change, through advice and incentives, practices that have an adverse impact on water quality and related ecosystem benefits in 40 priority catchments, covering a third of the agricultural area of England.
- The **Marine Bill White Paper**, *A Sea Change*,<sup>18</sup> published in March 2007, sets out the UK Government's plans to introduce marine planning through a new Marine Act. The new planning system will move us away from the traditional system of separately regulating sectors of activity and will ensure instead that we implement a holistic ecosystems approach to management of the seas.
- The new cross-cutting **Peat Project** is taking an ecosystems approach to protecting and enhancing peat soils and the habitats they support. The project recognises that peat provides a range of important ecosystem services (e.g. carbon storage/climate regulation, water-flow regulation and quality, biodiversity, recreation). It is bringing together a wide variety of partners and stakeholders and will contribute to a set of environmental outcomes and targets on soil protection, biodiversity, climate change, flood management and water quality.
- **Making Space for Water**<sup>19</sup> is the Government's strategy for flood and coastal erosion risk management in England. It takes a holistic and integrated approach to flood and coastal erosion risk management at a whole-catchment or shoreline level, including working with natural processes to ensure adaptability to climate change. The aim is to manage risk by employing an integrated portfolio of approaches that reflect both national and regional priorities.
- In October 2007, the UK Biodiversity Partnership published a new strategic framework, **Conserving Biodiversity: The UK approach**,<sup>20</sup> which promotes an approach to biodiversity conservation that is designed not only to meet the commitment to halt the loss of biodiversity by 2010, but to guide action well into the second decade of the 21st century. This includes a new vision placing ecosystems at the heart of the strategy. The framework embedded the CBD's Ecosystem Approach as one of the guiding principles underpinning the work towards this vision, recognising that the conservation of ecosystem structure and functioning is fundamental to species conservation.

17 <http://www.defra.gov.uk/farm/environment/water/csf/delivery-initiative.htm>

18 <http://www.defra.gov.uk/corporate/consult/marinebill-whitepaper07/index.htm>

19 <http://www.defra.gov.uk/environ/fcd/policy/strategy.htm>

20 <http://www.defra.gov.uk/wildlife-countryside/pdfs/biodiversity/ConBioUK-Oct2007.pdf>

To successfully embed this more integrated approach, we will need to ensure that policy-makers in Defra:

- understand the principles and benefits of an ecosystems approach
- think consistently in terms of whole ecosystems and the need to maintain ecosystem services when defining policy outcomes
- take full account of the value of ecosystem services when assessing policy options or undertaking impact assessments.<sup>21</sup>

We will also work to ensure that key messages about the wider benefits provided by ecosystem services are reflected in Defra's internal and external communications, tailoring the language to our audience.

The **Defra Network** – including **Natural England**, the **Environment Agency** and the **Forestry Commission** (FCOM) – has a leading role to play too. There are, similarly, some good examples of an ecosystems approach within the Defra network:

- NE's **Multiple Objectives** (NEMO) pilots aim to explore how to increase the effectiveness and efficiency of delivering multiple objectives through area-based working and landscape-scale delivery, working with a range of partners. For example, in the South Pennines, a multi-functional partnership has been established, in which NE is heavily involved, that facilitates delivery across landscape-scale geographical areas.
- EA and NE are working together with major landowners to deliver a programme of remedial work that helps to improve the condition of **Sites of Special Scientific Interest** (SSSIs) owned and managed by these landowners in order to contribute to the delivery of the SSSI PSA Target under the 2004 Spending Review.<sup>22</sup>

This will be achieved by tackling pollution, grazing management, abstraction and flood management problems to improve a range of habitats.

- The **Community Forest Programme** has developed and delivered effective models for multi-function community forestry delivering a wide range of ecosystem services and incorporating economic regeneration, rural development, recreation, access and conservation into their work.<sup>23</sup> The programme was initiated in 1990 and is now supported by FCOM, NE, 58 local authorities and a range of other voluntary, public and private organisations.

NE, EA and FCOM have agreed a Memorandum of Understanding (MoU)<sup>24</sup> that seeks to encourage partnership working in areas of shared responsibility such as development of the evidence base, integrated catchment management and resilience of the natural environment to climate change, while respecting their distinctive roles and accountabilities.

In order to further embed an ecosystems approach, NE, EA and FCOM will need to ensure that its principles are clearly reflected in their corporate plans, strategies and delivery plans and that the approach is then effectively operationalised at all levels within their organisations. They will also need to build on the existing MoU to deliver more joined-up working on a whole-ecosystems basis.

A number of government Departments' policies have a significant impact on the natural environment, whether direct or indirect. The **Department for Communities and Local Government** (CLG) has a major role to play in view of its responsibilities for housing, land use and planning (see Box 3.2). We will work with the **Department for Transport** (DfT) to improve the environmental performance of transport and minimise the negative environmental impacts of

<sup>21</sup> This is discussed further in Section 4.

<sup>22</sup> Defra PSA 3: Bring into favourable condition by 2010 95% of all nationally important wildlife sites.

<sup>23</sup> [http://www.communityforest.org.uk/resources/ECF\\_GI\\_Report.pdf](http://www.communityforest.org.uk/resources/ECF_GI_Report.pdf)

<sup>24</sup> <http://www.naturalengland.org.uk/about/board/oct07/101007-NEBP0726.pdf>

transport; with **HM Treasury** to mainstream the valuation of ecosystem services in policy appraisal across Government; and with the **Department for Business, Enterprise and Regulatory Reform** (BERR) to help business minimise negative impacts on the natural environment. The **Department of Health** (DoH) has a key interest in the health benefits of the natural environment. And we are already working, as mentioned above, with **DFID** on initiatives such as their joint research programme on ecosystem services and poverty alleviation.<sup>25</sup>

The new Natural Environment PSA offers us an opportunity to develop closer co-operation across Government on environmental issues and to promote the principles of an ecosystems approach. This PSA is shared across Whitehall, with CLG and DfT signed up as formal delivery partners and a number of other Departments contributing. The governance and reporting arrangements for the PSA will include CLG, DfT and BERR, as well as NE and EA. As we go forward, we are keen to work with key Departments to promote an ecosystems approach, with a view to ensuring that policy-makers across Government:

- recognise that securing a healthy natural environment is a shared priority across Government
- understand that a healthy natural environment delivers a wide range of ecosystem services that contribute to their Departmental strategic objectives
- have the tools they need to value ecosystem services in policy appraisal.

We plan to work with a number of Departments on specific case studies to help us test an ecosystems approach in different decision-making contexts.

### Box 3.2 – Land use and planning

The planning system plays a vital role in the protection and enhancement of the natural environment. Embedding the principles of an ecosystems approach in the planning system will help it achieve its over-arching goal of sustainable development by:

- ensuring that the positive and negative impacts of development on ecosystem services are reflected in sustainability appraisals
- enabling planners to more effectively integrate environmental, social and economic objectives
- improving the information available to planners in the decision-making process.

The Planning White Paper<sup>26</sup> (published in May 2007) responded to the recommendations in the Barker Report on Planning. It included commitments to develop national policy statements for major infrastructure and to review existing national planning policy statements and guidance with the aim of substantially reducing them in volume. A streamlined set of planning policy statements will set out the required environmental outcomes, principles and actions, supplemented where necessary by guidance on delivery. Defra will be looking to ensure that these new planning policy statements clearly reflect the principles of an ecosystems approach.

Defra's Land Use Project is also looking to develop a long-term vision for land use in England that is consistent with an ecosystems approach. The aim is to ensure that decisions on land use at the national, regional and local levels are proofed against a vision of land use for 2050 and deliver a sustainable legacy, with enhanced social wellbeing, environmental health and economic prosperity. This will be done through a Foresight<sup>27</sup> project to look at the future of land use, and through learning lessons from current land use and land management projects.

25 <http://www.nerc.ac.uk/research/programmes/espa/>

26 <http://www.communities.gov.uk/publications/planningandbuilding/planningsustainablefuture>

27 The Foresight programme aims to provide challenging visions of the future, to ensure effective strategies now. It does this by providing a core of skills in science-based futures projects and unequalled access to leaders in government, business and science: <http://www.foresight.gov.uk/>

## Actions to mainstream an ecosystems approach at the national level

- A1** **Defra** to embed the principles of an ecosystems approach in its new standard policy-making procedures, which are being developed in the context of the Renew Defra programme
- A2** **Defra** to embed key 'ecosystems approach' messages in its strategic communications on the natural environment
- A3** **Defra's** Land Use Project to explore the benefits of an ecosystems approach, drawing on the lessons learned from land management projects where this approach is being applied
- A4** **Defra** to develop further case studies to demonstrate the benefits of an ecosystems approach in policy-making:
  - A4a** Scoping study on implementing an ecosystems approach to air quality policy on ammonia
  - A4b** Scoping analysis of the full range of benefits of Environmental Stewardship in terms of impacts on ecosystem services
  - A4c** Development of a framework of action for the management and restoration of peat soils based on the delivery of ecosystem services
- A5** **Defra** to work with other government Departments and the Devolved Administrations to introduce a new system of marine planning that embeds an ecosystems approach in marine management and integrates effectively with other management processes in coastal areas
- A6** **Defra** to embed the principles of an ecosystems approach in its new policy appraisal guidance for flood and coastal erosion risk management
- A7** **Defra** to embed the principles of an ecosystems approach in its forthcoming Water Strategy
- A8** **Defra** to fund the extension of the England Catchment Sensitive Farming Delivery Initiative through the CSR 07 cycle
- A9** **Defra** to work with **Natural England**, the **Environment Agency** and the **Forestry Commission** to explore how the principles of an ecosystems approach can be embedded in their corporate plans and strategies and to identify potential barriers
- A10** **Defra** to review existing policy and project appraisal tools to explore how the principles of an ecosystems approach, including the valuation of ecosystem services, could be incorporated

### 3.3 Regional level

Key delivery partners at the regional level are the Government Offices (GOs), Regional Assemblies (RAs) and Regional Development Agencies (RDAs). These bodies currently hold many levers for securing a healthy natural environment, in particular Regional Spatial Strategies (RSSs) and Regional Economic Strategies (RESs), both led by RDAs. GOs play an important role in joining up policy across different Departmental agendas and enabling delivery by working in partnership with other important regional players. In addition, the EA and NE have strong regional presences and play a vital role in advising on and delivering regional environmental priorities.

The Review of Sub-National Economic Development and Regeneration<sup>28</sup> proposes a single integrated regional strategy, led by RDAs. This strategy will replace the RESs and RSSs and expands RDAs' functions to include regional planning. It will be important to ensure that environmental sustainability remains a priority in this new regional landscape.

28 [http://www.englishrdas.com/filestore/pdf/17\\_7\\_07%20SNR%20FINAL%20REPORT.pdf](http://www.englishrdas.com/filestore/pdf/17_7_07%20SNR%20FINAL%20REPORT.pdf)

We need to work with and through these regional players to embed an ecosystems approach in regional policy and delivery, making full use of the levers at their disposal and building on existing successful partnerships. There are many good examples of integrated and partnership working at the regional level (see Box 3.3). However, there are a number of barriers to successful integration that need to be overcome, such as:

- **lack of clear leadership.** There is currently no focal point for taking the lead on environmental issues or even co-ordinating views on strategic priorities.
- **organisational barriers.** Organisations have different objectives and priorities and it can be difficult to integrate and accommodate a variety of interests.
- **capacity and capability issues.** We need to build awareness and understanding of an ecosystems approach among regional decision-makers and ensure they have the guidance and tools they need.
- **timing issues.** Opportunities to influence regional strategies are limited as they are only reviewed every few years. This becomes yet more problematic when coupled with the 'short-termism' of regional political and budgetary cycles.

One of our main aims is to include ecosystem services in sustainability appraisals and strategic environmental assessments at the regional level, so as to ensure that they genuinely inform decisions about how best to deliver sustainable development. It will be important to identify the ecosystem services that can be most effectively addressed at the regional level on the basis of the available evidence at this scale and the appropriate regional interventions.

### Box 3.3 – Regional case study: Black Country Living Landscape

The Black Country Living Landscape project aims to place biodiversity and the enhancement of urban habitats at the heart of regeneration priorities. It is run as a partnership by the Birmingham and Black Country Wildlife Trust, the four unitary authorities, government agencies, business, and other voluntary sector partners. The project aims to transform the Black Country by taking an ecosystems approach in order to:

- achieve fundamental improvements to biodiversity, air, soil and water quality
- drive forward the protection and enhancement of natural and historic assets
- develop new and enhanced places and spaces through high-quality urban design.

It will achieve this by preparing and implementing a joint Black Country Landscape Action Plan. This was set out in the partial review of the RSS and will define and deliver an integrated network of open spaces and habitat (Green Infrastructure).

In achieving the aims given above, the project will increase the ability of people to benefit from the environment through increased opportunities for recreation (improving physical and mental health), tourism, and out-of-school learning. The project will also help the area ensure a long-term supply of ecosystem services by encouraging people to see the benefits of a high quality environment and training local people to work in environmental management.

The project includes large national flagship projects as well as smaller local actions engaging the local community, meaning that the area, as a whole, benefits from the cumulative effect of small and large improvements to the local natural environment.



### 3.4 Local level

Local government has an important role to play in delivering a healthy natural environment through local plans and strategies, including local development plans. The Local Government White Paper<sup>29</sup> places further emphasis on devolving decision-making to the local level. Levers include Local Area Agreements (LAAs), which set priorities for local areas; Local Strategic Partnerships (LSPs); Sustainable Community Strategies; Local Development Frameworks; local networks and partnerships; statutory duties; and funding and incentives. The new Local Government Performance Framework includes indicators on air quality, biodiversity and flood risk and coastal erosion, and will also have a significant impact on the shaping of local priorities and how these are delivered.

We face a number of challenges in helping local authorities to focus on the importance of maintaining a healthy natural environment and the value of ecosystem services as, inevitably, they have to balance many different priorities and objectives. There is a risk that priorities will tend to focus on areas where financial incentives are strongest, such as waste. 'Door step' issues such as local environmental quality (e.g. litter, graffiti) are often given more prominence at the local level, particularly within urban areas. And with climate change dominating the environmental agenda, it is difficult to get decision-makers to focus on the natural environment agenda. As at the regional level, there are often capacity/capability issues and a lack of clear leadership.

Local partnerships involving a wide range of interests, including local authorities, NGOs, business and local communities, are often very successful at delivering protection and enhancement of the natural environment at the local level. Projects can be led by one or more partners, reflecting their relative interest, capacity, experience and enthusiasm. There are many excellent examples of local projects that demonstrate an ecosystems approach and that represent best practice in terms of delivering multiple environmental, social and economic benefits for the local community (see Box 3.4). In the marine environment, Defra is working to reform Sea Fisheries Committees (which manage inshore fisheries) through the Marine Bill to give them a clear purpose to adopt an ecosystems approach to inshore fisheries management.



However, overall, the approach to natural environment issues tends to be patchy at the local level and varies considerably from one area to another. It is important to continue to identify and disseminate examples of best practice, where an ecosystems approach has been effective at the local level.

<sup>29</sup> <http://communities.gov.uk/index.asp?id=1503999>

### Box 3.4 – Local case study: Wicken Fen

The Wicken Fen Nature Reserve is one of the most important wetland habitats in Europe and has been in the care of the National Trust since 1899. One of only four extant 'wild' fens that still survive in the enormous Great Fen Basin, its viability as a long-term habitat is dependent on it increasing in size.

Therefore, the National Trust is leading a partnership to improve the management of Wicken Fen and extend its area, managing the land to protect its nature conservation value (including as a habitat for rare species), protecting depleted peat soils and ensuring sufficient water resources, and providing opportunities for local involvement with, and enjoyment of, the natural environment. The project will help the local area to adapt to climate change, for example, by providing options for flood management and by offsetting some of the potential loss of coastal habitats.

As part of the project, the Trust has engaged with more 'unusual' partners – such as research and business stakeholders – and has found that their different take on the project has helped articulate its wider benefits. This has helped ensure that the project has really taken a holistic view, looking not only at the impacts and potential benefits for the natural environment itself, but also for the people and communities around it.

### Actions to mainstream an ecosystems approach at the regional and local levels

- A11** The **Environment Agency, Natural England** and the **Forestry Commission** to work together with the **Government Offices** to ensure that environmental priorities are addressed in regional and sub-regional strategies/plans and their delivery, including by baselining environmental pressures in each region
- A12** **Defra** to work with the **Government Office** network to build awareness of the benefits of an ecosystems approach in the English regions
- A13** **Defra** to work with **local government** to build awareness of the benefits of an ecosystems approach at the local level, including identifying and disseminating examples of best practice
- A14** **Natural England** and the **Environment Agency** to consider how they can build their capacity at the local level to work with local authorities as local strategic partners

## 4 Valuing Ecosystem Services in Decision-Making

This section discusses the rationale for valuing ecosystem services in policy and project appraisal and how this relates to existing approaches to environmental valuation. It proposes that Defra should work with its partners to develop and test ways of valuing ecosystem services and to address some of the salient methodological issues.

### 4.1 Environmental valuation

Environmental valuation is not new, and considerable progress has been made over the last 10–15 years to develop practical methodologies for use in decision-making. For example, valuation has been used to calculate:

- the social cost of climate change e.g. damage from increased extreme weather events
- the impacts of air pollution e.g. health impacts including reduced life expectancy
- the costs of poor water quality e.g. the costs of removing pollutants
- environmental impacts of transport e.g. the effects of traffic noise on house prices.

However, while techniques have been developed for valuing some environmental impacts, we still lack a systematic and comprehensive way of ensuring that the positive and negative impacts of development on the natural environment are fully taken into account in decision-making. Ecosystem services have often been regarded as ‘free goods’, particularly those for which there is no market. In many cases, this has led to over-exploitation of the natural environment and is a barrier to sustainable development. We therefore need to better account for the value of our natural assets in policy- and decision-making, not only to conserve and enhance our natural environment, but to support economic and social development.

In addition, valuation of ecosystem services could play a significant role in the development of market mechanisms for delivering environmental benefits and dealing with environmental externalities.

#### 4.1.1 Applying valuation methodologies to ecosystem services

Although using an ecosystem services framework may be a new approach, it builds effectively on existing environmental valuation methodologies and applies them to a much wider range of potential environmental impacts. These methodologies fall into two broad categories: economic and non-economic valuation.

**Economic valuation** attempts to quantify changes in the state of the environment in monetary terms. Examples include techniques that calculate the input of the natural environment to agricultural production; the effects of environmental amenity (e.g. proximity to green space) on house prices; factors (e.g. travel costs) affecting the choices people make between recreational sites; and asking people to choose between different environmental options with different price tags (‘willingness to pay’).

**Non-economic valuation** methods explore how opinions are formed or preferences expressed in ways other than with money. These may use ‘deliberative’ or ‘participatory’ processes, such as discussion groups, where members of the public are presented with expert opinion and asked to consider a verdict; or they may use ways of synthesising expert opinion on particular subjects.

For the purposes of valuing ecosystem services, it will be necessary to use a combination of economic and non-economic methodologies. For some services, market values can be used but, for others, economic valuation techniques as well as deliberative or participatory processes will be required to capture non-market values. Some examples are included in Box 4.1.

It will also be important to take into account equity issues e.g. whether some sectors of society will be more affected than others by the degradation of ecosystem services.

In many cases, a **marginal valuation** approach will be most useful for decision-making. This is where we value the change in ecosystem provision as a result of a policy intervention.

### Box 4.1 – Examples of possible valuation techniques for selected ecosystem services<sup>30</sup>

#### Provisioning services

Food	Market values (gross value added)
Game	Market values (gross value added) and willingness to pay for recreational values

#### Regulating services

Water purification	Avoided costs of water treatment
Carbon sequestration	Social costs of carbon
Improvements in air quality	Avoided costs of health treatment

#### Cultural services

Recreation	Revealed preferences e.g. travel costs, entry fees to nature reserves
Cultural heritage values	Stated preference surveys to elicit both use and non-use values

In order to help us develop and test this approach in a decision-making context, Defra has developed an **Introductory Guide to Valuing Ecosystem Services**.<sup>31</sup> This is aimed both at policy-makers and economists and includes a checklist of ecosystem services and suggested ways of assessing their value. Defra plans to test this guidance by applying it to a number of ‘live’ policy appraisals, as well as working on similar case studies with NE, EA and relevant Departments. In this way, we plan to ‘learn by doing’ with a view to further developing the guidance. If we can demonstrate that valuing ecosystem services is both practical and useful, in the longer term our aim would be to mainstream this approach in existing policy and project appraisal tools (see Box 4.2).

### Box 4.2 – Policy and project appraisal tools

- All new government policies require an **Impact Assessment** (IA – formerly known as a Regulatory Impact Assessment), which must include an assessment of environmental impacts.
- A **Strategic Environmental Assessment** (SEA) is required for new public programmes and major plans.
- At the project level, **Environmental Impact Assessments** (EIAs) have to be undertaken for all projects with environmental impacts.
- A **Sustainability Appraisal** is mandatory under the Planning and Compulsory Purchase Act 2004. Its purpose is to promote sustainable development through the integration of social, environmental and economic considerations into the preparation of revisions of RSSs and Local Development Plans.

<sup>30</sup> From Jacobs (2007), Valuation of England’s Terrestrial Ecosystem Services. Stage 1, (unpublished report)

<sup>31</sup> <http://www.defra.gov.uk/wildlife-countryside/natres/eco-value.htm>

As part of our ecosystems approach research programme, Defra has also commissioned a number of case studies that will explore the extent to which valuation of ecosystem services could be integrated into existing decision-making processes and the advantages this might bring. These include an EIA case study (in relation to the M6–Heysham link road) and another that will look at sustainability appraisal in planning (for the Thames Gateway Green Grids). Further details of the research programme are given in Annex 7. We also plan to commission a review of existing appraisal tools to explore how they could be adapted to incorporate the valuation of ecosystem services.

### Actions towards the practical application of ecosystem services valuation

- A15** Defra, the **Environment Agency**, **Natural England** and the **Forestry Commission** to pilot practical application of ecosystem services valuation in specific policy areas, including:
  - A15a** Valuation of the benefits from the implementation of the UK Biodiversity Action Plan
  - A15b** Impact Assessment for the Marine Bill
  - A15c** Development of a vision and action plan for the uplands environment based on the delivery of ecosystems benefits
  - A 15d** Valuation of the benefits from the English Woodland Grants Scheme
- A16** The **Department for Transport** to work with Defra on a long-term strategy for the development of environmental valuation in transport appraisal, including the valuation of ecosystem services
- A17** The **Department for Communities and Local Government** and Defra to work together to influence the design of eco-towns to maximise delivery of ecosystem services

### Box 4.3 – Wareham managed realignment case study

This case study was undertaken by EA and applied an ecosystem services framework to the appraisal of a flood and coastal erosion risk management scheme to address changing pressures on the area. It looked at the effect of including estimates of the economic value of changes in ecosystem services under the scheme options considered, including maintenance of the existing flood defences and managed realignment of the coastline.

The study considered a range of ecosystem services, including the value of habitat creation and examples of provisioning services (fisheries), regulating services (nutrient cycling and carbon storage) and cultural services (e.g. recreation) to take into account the impacts of options on the whole ecosystem.

The case study showed that there are uncertainties surrounding the value of the ecosystem services (resulting from uncertainty about the physical changes in ecosystem services) and therefore in relation to the appropriate monetary values to be applied. But it also demonstrated how using an ecosystem services framework can inform appraisals, leading to improved decision-making where there is potential for significant impact on the natural environment.

## Box 4.4 – Natural Economy Northwest

Natural Economy Northwest<sup>32</sup> is a £2.8 million programme to nurture natural environment projects that, with the right investment, can deliver social and economic benefits across the North West. It is led by NE, the North West Regional Development Agency and the SITA Trust, and pulls together tourism, business development and environmental sector specialists to deliver projects that support economic development.

The programme is working to map the economic benefits that the natural environment provides and to create methodologies for quantifying and reporting these benefits. This includes looking at the benefits of environmental investment across sectors alongside interests as diverse as job creation, raising land and property values, attracting inward investment, re-use of derelict land, improvements to health and wellbeing, and addressing the impacts of climate change. This work will help ensure that the value of the environment is fully taken into account in investment and development decisions in the North West.

## 4.2 Methodological challenges

If, in due course, we are to mainstream the valuation of ecosystem services in decision-making across Government, there are a number of methodological issues that will need to be addressed:

- There remain challenges in identifying appropriate **methodologies for valuing different ecosystem services**. For example, it is much easier to value provisioning services (e.g. agricultural production) than supporting services (e.g. photosynthesis), which are fundamental aspects of ecosystem functioning. A current Defra research project is exploring how to value England's terrestrial ecosystem services.<sup>33</sup> Key outputs from this study will include a typology of ecosystem services and the most appropriate methodologies for their valuation; an investigation of methodologies for combining and aggregating values based on different valuation techniques; and an assessment of the suitability of existing studies for benefits transfer.
- In many cases, there will be insufficient time or money available to perform a 'primary' valuation of ecosystem services when making decisions. **Benefits transfer** is a process whereby values from previous valuation studies are used to calculate approximate values in a new context. This provides a quick way of making a broad assessment of environmental costs and benefits to inform the decision-making process. However, there are important issues to be resolved in terms of the appropriateness and accuracy of the transfer of values from one context to another.
- Decisions (i.e. on which ecosystem services should be valued) need to be made at appropriate **spatial scales**, taking into account impacts of decisions on adjacent ecosystems (e.g. impacts of land use in river catchments on water quality downstream) and the national and global significance of ecosystem services provision (e.g. carbon sequestration and wildlife conservation have global benefits).
- There remain some significant gaps in our understanding of **ecosystem functioning** and how this relates to ecosystem services. To apply the valuation of ecosystem services in a particular decision-making context, it will be necessary to understand how ecosystems respond to change and the consequent impact on the provision of ecosystem services.

<sup>32</sup> <http://www.naturaleconomynorthwest.co.uk/>

<sup>33</sup> <http://www.defra.gov.uk/wildlife-countryside/natres/research.htm>



- The involvement of the public and stakeholders in decision-making on the natural environment is already required on a statutory basis and integrated into existing decision-making mechanisms. However, in order to value ecosystem services, we will need to continue to develop our **public and stakeholder engagement** to ensure decisions are informed by views on how best to deliver environmental, economic and social objectives; how people relate to and identify with their environment; and how changes in ecosystem services impact on human wellbeing.

There is also a real need to encourage more **interdisciplinary working** between natural scientists and social scientists (including economists), so that knowledge across the board can inform valuation methodologies.

These challenges highlight some significant evidence needs. Work to identify and prioritise these needs, including the need for new valuations studies and development of methodologies, will be included in Defra's developing evidence strategy. This is considered further in Section 7. However, from our discussions with partners and stakeholders, it is clear that there is a broad consensus that we already know enough about how to value ecosystem services to begin to operationalise this approach in a policy-making context.

### Actions towards practical application of ecosystem services valuation

- A18** Defra, in partnership with the **Environment Agency, Natural England** and the **Forestry Commission**, to develop a benefits transfer strategy for use in valuing ecosystem services
- A19** Defra to promote the development of the existing Environmental Valuation Reference Inventory (EVRI) database<sup>34</sup> to ensure that it captures studies on the valuation of ecosystem services most useful and relevant for benefits transfer, including from Defra-funded studies
- A20** Defra to review work on non-economic and participatory valuation methodologies and produce guidelines on their use alongside economic valuation methodologies

<sup>34</sup> <http://www.evri.ca/english/default.htm>

## 5 Environmental Limits, Indicators and Targets

The UK Sustainable Development Strategy identified 'living within environmental limits' as one of its five principles. This section discusses how taking an ecosystems approach can help operationalise this principle, informed both by our understanding of ecosystem functioning and by the values people attach to ecosystem services. It also explores the related question of how to select appropriate indicators and targets on an ecosystems basis to inform and drive policy- and decision-making, enabling us to assess the health of ecosystems and delivery of ecosystem services while respecting environmental limits.

### 5.1 Environmental limits

External pressures such as pollution, over-exploitation of natural resources and climate change will impact on the functioning of ecosystems and on the provision of ecosystem services. Ecosystems respond to these pressures in different ways. Some may exhibit a rapid decline or even a sudden collapse – the point at which this happens may indicate an 'environmental threshold' or 'tipping point'. Examples of such tipping points include the collapse in marine fisheries as a result of over-exploitation and the decline in water quality in lake systems impacted on by nutrient input. The rapid collapse in the early 1990s of the Newfoundland cod fisheries, previously one of the world's most abundant populations of cod, is an often quoted example (see Box 5.1).

But the extent to which ecosystems exhibit distinct thresholds is uncertain. In many cases – particularly in the context of England's natural environment – we are more likely to see a gradual degradation of ecosystems and a reduction of ecosystem services rather than a sudden collapse. However, it is also the case that we often do not know where thresholds lie until they are crossed.

In this context, the concept of **environmental limits** can also help us to think about how to make 'trade-offs', including with regard to how much degradation society is willing to tolerate or accept as the price for economic and social development, and between alternatives that might be beneficial to some sectors while being detrimental to others. In this sense, environmental limits can be defined as 'the point or range of conditions beyond which the benefits derived from natural resources systems are judged unacceptable or insufficient'<sup>35</sup> and can be applied to protect against sudden ecosystem collapses as well as more gradual declines. So while, to some extent, environmental limits may be defined on the basis of the biophysical properties of a natural ecosystem, limits are also defined by the way that people value environmental benefits or ecosystem services. These two perspectives will need to be reconciled in decision-making.

In practice, we may wish to set limits and targets above threshold levels to allow ecosystems to be **resilient** to external shocks such as extreme weather, disease outbreaks etc. in addition to human pressures. Since ecosystems exhibit different types of limits and we often may not know whether and where thresholds exist, we need to apply a precautionary approach, based on the best evidence and analysis available, when setting limits and targets.

35 Haines-Young R, Potschin M and Cheshire D (2006), Defining and Identifying Environmental Limits for Sustainable Development (NR0102): <http://www.defra.gov.uk/wildlife-countryside/natres/nr0102.htm>

### Box 5.1 – The costs of exceeding environmental limits

**The collapse of the Newfoundland cod fisheries.** One of the world's most abundant populations of cod suddenly collapsed in the early 1990s, leading to a total fishing moratorium and the loss of about 40,000 jobs. Over \$2 billion (Canadian) in losses were estimated from unemployment benefit and retraining, in addition to the economic losses from the fisheries themselves. Although the local economy has now diversified into new activities, this illustrates starkly how unsustainable management of natural resources can lead to an unforeseen and catastrophic collapse.

**Degradation of peat land.** Peat soils represent Britain's most significant carbon store and underpin the delivery of a range of other ecosystem services, including water purification, water storage and flood control. These functions have been compromised by a range of factors in the past few hundred years, including the impacts of air pollution, the draining and cutting of peat, overgrazing and, more recently, climate change. Peat erosion leads to increased carbon dioxide (CO<sub>2</sub>) release into the atmosphere and higher organic matter content in water, increasing the costs of water treatment and increasing water flow across the land.

**Freshwater eutrophication.** The damage costs of freshwater eutrophication (an increase in nutrients in freshwater ecosystems due to pollution) in England and Wales was estimated to be between £75 million and £114.3 million per year in the 1990s, with an additional £54.8 million per year being spent to address this damage.<sup>36</sup>

Adopting an ecosystems approach in policy- and decision-making can help us to operationalise the principle of living within environmental limits. Making decisions that respect environmental limits will require improved understanding of ecosystem functioning and the provision of ecosystem services and how they are, or are likely to be, impacted on by change. Valuing ecosystem services, using both economic and non-economic methods, will also help to inform decisions about how to define environmental limits.

## 5.2 Indicators and targets

A wide range of indicators and targets are currently used to inform and drive policy-making and delivery on the natural environment, from the international to the local level. These include indicators and targets in specific policy areas (e.g. for biodiversity, water, air, soil) as well as those in cross-cutting policies and strategies (e.g. sustainable food and farming, the UK Sustainable Development Strategy).

**Indicators** are measurable attributes (e.g. of the state of various components and processes of the natural environment) chosen to evaluate the performance and effectiveness of policy for conserving and enhancing a healthy environment. They can serve a variety of purposes, including reporting (assessing progress towards stated objectives), communication (e.g. to highlight an issue of particular public interest), and management (to help managers of ecosystems understand changes and to intervene).

<sup>36</sup> Pretty J, Mason C, Nedwell D and Hine R (2002) A Preliminary Assessment of the Environmental Costs of the Eutrophication of Fresh Waters in England and Wales, University of Essex for the Environment Agency: <http://www.essex.ac.uk/ces/esu/occasionalpapers/EAEutrophReport.pdf>

**Targets** are the objectives or standards we set for delivery on the natural environment and include 'aspirational' or 'political' targets, targets relating to critical loads and thresholds in the natural environment, and those for public service delivery. They may be set on a precautionary basis, where the aim is to deliver environmental protection, or they may be more ambitious in order to achieve environmental enhancement. Targets may be attached to particular indicators or ecosystem components, or may be framed as broad over-arching objectives.

While the current indicators and targets used by Defra and others have not been established with an ecosystems approach in mind, many do in fact relate to ecosystem services (see Annex 5 for a list of relevant existing indicators and targets). In addition, there are a number of interdisciplinary indicators of ecosystem health, including the Holistic Ecosystem Health Indicator (HEHI)<sup>37</sup> and Monitoring Ecosystem Health through Trends Analysis (MEHTA)<sup>38</sup> (see Box 5.2).

More work will be needed to identify the ecological, environmental and social indicators that will allow the routine assessment of ecosystem health and the status of ecosystem services. A current Defra research project<sup>39</sup> has allowed an initial exploration of criteria that would need to be used for indicator selection, including:

- **interdisciplinary indicators.** Ecological indicators will be important but it will also be necessary to monitor the causes of change e.g. *pressures* such as waste emissions; and *drivers* such as human population and market forces. This will require an interdisciplinary approach, drawing on ecological and socioeconomic data.
- **relating indicators to ecosystem functions.** Indicators measuring the quantity of direct benefits (e.g. timber) produced by an ecosystem will be useful, but we will also need indicators relating to ecosystem function, particularly as some benefits are underpinned by a combination of different functions.
- **reference values for societal choice.** 'Biophysical measures' are important in establishing the limits of ecosystem function, but we will also need to know what the public and stakeholders seek from ecosystems.
- **the ability to adapt to spatial scales of assessment.** Many services influencing the output of goods do not occur locally e.g. water filtration could be due to a woodland located many kilometres upstream from where the local benefit is felt. We will therefore need to understand the spatial scales on which services operate in order to capture all the important services.
- **sensitivity to change.** Indicators of ecosystem health need to have explicit links to drivers of change for us to be able to identify the cause of the degradation of a benefit or a service, and we would need to identify output measures that change when there is a problem.
- **cost.** The cost of data collection and analysis cannot be prohibitive if the indicators are to be monitored regularly on a large scale.
- **comprehensibility, measurability and data availability.** Indicators need to be unambiguous and easy to measure, and relevant data must be readily available.

37 Aguilar BJ (1999), Applications of ecosystem health for the sustainability of managed systems in Costa Rica. *Ecosystem Health*, 5, 1–13.

38 Raffaelli D, White P, Perrings C, Smart J and Renwick A (2004), The Future of Healthy Ecosystems. Defra Horizon Scanning Project, Project Code SD0306.

39 Raffaelli D et. al. (2007), Assessing and Monitoring the Provision of Ecosystem Services by Ecosystems. Unpublished review paper for England's Terrestrial Ecosystem Services and the Rationale for an Ecosystem-Based Approach (NR0107): <http://www.defra.gov.uk/wildlife-countryside/natres/nr0107.htm>

### Box 5.2 – Holistic indicators of ecosystem health

The **Holistic Ecosystem Health Indicator** incorporates interacting ecological and social indicators to provide a comprehensive assessment of ecosystem health. These indicators quantify relationships between people and the ecosystem, as well as the effectiveness of regulatory agencies in implementing legislation and community perceptions, awareness of and involvement in management decisions. This approach is a simple and cost-effective approach that allows managers and policy-makers to focus their resources on the weakest aspects of ecosystem health.

The **Monitoring Ecosystem Health through Trends Analysis** approach uses indicators of the status of the environmental, ecological, financial, human and social capital 'stocks' associated with the ecosystem relative to 'critical thresholds' for these stocks that are necessary to the delivery of desired products or benefits. Weightings are applied to each indicator to produce an overall assessment of ecosystem health and these are adjusted to take into account values and aspirations of society (e.g. local stakeholders). When this approach was applied to the North York Moors National Park, the following capital stocks were seen as providing the most important benefits to the local community:

- **environmental capital** – water purification capacity in river catchments
- **ecological capital** – biodiversity-supporting ecosystem services such as soil fertility, natural pest control and pollination (in turn underpinning the delivery of agricultural and forestry crops), and maintenance of landscape features attracting visitors to the park
- **financial capital** – financial reserves for land management businesses within the national park
- **social capital** – the connections between social networks, 'community spirit' and trust between individuals, governments and organisations
- **human capital** – the skills, knowledge and qualifications of people in the park.

A logical first step in establishing indicators and targets as part of an ecosystems approach is to explore which current indicators of ecosystem health (relevant to the supply of goods and services) it would be most appropriate or useful to set targets for. To do this, we need to know which are the most 'important' ecosystem services in terms of how the public uses and values them, and the level of threat to ecosystems and their services. We need to consider what we know about environmental limits and adopt a precautionary approach. Ecological data on the state and trends of ecosystems will be vital for this, but we may also require more deliberative forms of decision-making to set targets in the context of societal choice.

Selecting indicators and setting targets on a 'whole ecosystems' basis will not only help us to improve our effectiveness at delivering natural environment outcomes, it should also reduce the overall number of environmental targets and therefore the associated reporting burden. As a first step, Defra has commissioned a short study to review existing indicators and targets relating to the natural environment and assess how well they capture ecosystem health and the state of ecosystem services. In the light of this study, we plan to work with NE and EA to develop a strategy for convergence between the indicators and targets used in different policy areas that is consistent with an ecosystems approach. If necessary, new, alternative indicators and targets will be proposed.

### Actions towards setting targets and indicators on an ecosystems basis

- A21** Defra, the **Environment Agency**, **Natural England** and the **Forestry Commission** to develop a strategy for convergence between indicators and targets used in different policy areas to be consistent with an ecosystems approach
- A22** Defra to work with the **Department for Business**, the **Enterprise and Regulatory Reform** to ensure that the ecosystem services framework is given appropriate consideration in the development of environment-adjusted productivity indicators.



## 6 Ecosystems and Climate Change

This section discusses the relationship between ecosystems and climate change. Human-induced climate change is one of the biggest pressures on the natural environment and is exacerbating the effects of other pressures (e.g. transport and housing). One of the main reasons we are concerned about climate change is its impacts on the natural environment and the consequent effects of those impacts on people. Healthy ecosystems can make a significant contribution to climate change mitigation and adaptation, so we need to ensure that the value of climate regulation as a key ecosystem service is fully recognised in decision-making. We also need to ensure that our adaptation strategies recognise the importance of a healthy and resilient natural environment as healthy ecosystems will be more resilient to the unavoidable impacts of climate change and will have greater adaptive capacity.

### 6.1 Climate change mitigation

The way we manage the natural environment can make a significant contribution to mitigating climate change, in a number of important ways:

#### 6.1.1 Carbon sinks

Healthy ecosystems play a crucial role in regulating the climate through the natural carbon cycle as plants, trees and plankton absorb carbon from and release it to the atmosphere. Human-generated greenhouse gas emissions have disrupted the natural carbon cycle, resulting in dangerous climate change. Approximately half the CO<sub>2</sub> emitted since the industrial revolution has been locked up in the world's seas and plant life. **Climate regulation** is therefore a critical ecosystem service but one that has often been overlooked or undervalued in decision-making. Alongside action to reduce emissions, the way we manage our natural environment can make a significant contribution to climate change mitigation. In particular, we can maximise the potential of our terrestrial and marine ecosystems as **carbon sinks** (see Box 6.1).





## Box 6.1 – Terrestrial and marine ecosystems as carbon sinks

**Woodland.** Woodlands in the UK represent both an important store and sink for carbon. They are estimated to remove 4 million tonnes carbon (MtC) annually from the atmosphere and store a total of 150 MtC. When woodlands are managed sustainably, their contribution to greenhouse gas mitigation through the direct and indirect substitution of fossil fuels, through use as wood fuel and timber products, can be much larger than that associated with carbon sequestration in growing biomass. As part of the UK Biodiversity Action Plan, Ministers have endorsed a target to expand the native woodland resource in England by 53,000 hectares by 2015.

**Peat land.** Although the rate of carbon uptake is slow, peat accumulations have developed over thousands of years and represent a large carbon store. Peat contains the equivalent of approximately two-thirds of all carbon in the atmosphere and carbon equivalent to all terrestrial biomass on the earth. Other soils types also store carbon but not to the same degree as peat. Defra is intending to consult on the new Soil Strategy for England<sup>40</sup> in December 2007, which will set out proposals for the sustainable management of England's peat lands to prevent the release of carbon to water and the atmosphere, as well as protecting the full range of ecosystem services provided by peat. As part of the UK Biodiversity Action Plan, Ministers have endorsed a target to restore 1,000 hectares of lowland raised bog in England by 2015.

**Oceans.** The world's oceans absorb a significant amount of CO<sub>2</sub> from the atmosphere; the growth of algae alone accounts for one-third of absorption by plants. Absorption by the surface waters is also a significant sink for CO<sub>2</sub>, but this leads to 'acidification', which is detrimental to some ocean life including the world's coral reefs. The Marine Bill placed a significant economic value on the climate regulatory function of the world's seas of up to £8.5 billion (an underestimate).

### 6.1.2 Renewable energy

The UK Biomass Strategy,<sup>41</sup> published in May 2007 alongside the Government's Energy White Paper,<sup>42</sup> acknowledges the importance of fuels sourced from biomass in meeting the UK's climate change commitments, with biomass playing a key role in meeting the EU target of 20% renewable energy by 2020. The Strategy also explores how the UK can meet 60% cuts in CO<sub>2</sub> emissions by 2050 (as set out in the Climate Change Bill, March 2007<sup>43</sup>), but also acknowledges the need to take account of impacts of land-use change on ecosystems and biodiversity and the ability of natural ecosystems to adapt to climate change.

### 6.1.3 Land management

Environmental Stewardship is Defra's flagship agri-environment scheme, delivered by NE. Under the Rural Development Programme for England (RDPE) 2007–2013, about £2.9 billion is expected to be spent under the ES scheme to reward farmers for delivering environmental benefits. Environmental Stewardship was launched in March 2005, and is currently undergoing a review of progress, due to be completed in early 2008. The review is looking at how to maximise the contribution Environmental Stewardship can make to climate change mitigation as well as adaptation.

40 <http://www.defra.gov.uk/Environment/land/soil/index.htm>

41 <http://www.defra.gov.uk/environment/climatechange/uk/energy/renewablefuel/pdf/ukbiomassstrategy-0507.pdf>

42 <http://www.dti.gov.uk/energy/whitepaper/>

43 <http://services.parliament.uk/bills/2007-08/climatechange1.html>

## 6.2 Climate change adaptation

We need a more dynamic approach to our management of the natural environment for enhanced resilience under climate change so that ecosystems provide the fullest range of benefits. We need to manage the natural environment to enhance its resilience to climate change, managing a process of ecosystem adaptation or change to ensure continued provision of ecosystem services (see Box 6.2). An **adaptive approach** to managing the natural environment is one of the principles of an ecosystems approach and will be crucial to addressing this issue.

The natural environment can also help people and society adapt to climate change, for e.g., through:

- provision of urban green space, with benefits of cooling and protection against storm floods etc.
- coastal realignment and creation of natural wetlands can provide natural buffering against flooding and coastal erosion, carbon sequestration in sediment and a range of valuable benefits such as new fisheries, absorption of pollutants and the creation of new wildlife habitats.

The importance of adaptation is reflected in the development of a strategic approach to adaptation. There are two main strands to this – the legislative framework provided through the Climate Change Bill, published in November 2007, which will set out a strong and sustainable approach to adaptation; and the adaptation framework, which will provide a national context for adaptation, setting out a vision of a UK that is adapting well and highlighting areas where action needs to be taken. The adaptation framework will be published in spring 2008.

At the local and regional level, we need to make sure that the synergies between enhancing the natural environment and adapting to climate change are realised and identify exemplary case studies to show what this means in practical terms. In May 2007, Defra, on behalf of the UK Biodiversity Partnership, published guidance for conservation managers setting out principles for climate change adaptation.<sup>44</sup>

### Box 6.2 – Helping the natural environment adapt to climate change

The priorities and targets identified in the **UK Biodiversity Action Plan**<sup>45</sup> (UK BAP) will need to be reviewed periodically to ensure they continue to be relevant and achievable. Imaginative approaches, such as those promoted by the climate change adaptation work stream of the England Biodiversity Strategy<sup>46</sup> are needed to ensure that adaptations in other sectors (e.g. agriculture, forestry, water management and energy) also contribute to biodiversity objectives.

The Government launched a new **Strategy for England's Trees, Woods and Forests** in June 2007. One of the Strategy's five core aims is to ensure that existing and newly planted trees, woods and forests are resilient to the impacts of climate change and also contribute to the way in which biodiversity and natural resources adjust to a changing climate. The focus of the Strategy is 'the right tree in the right place'. That means choosing trees that will have the best chance of delivering public benefits both now and as the climate changes.

NE is working in **four pilot Joint Character Areas (JCAs) to construct assessments of projected climate change impacts and appropriate response strategies**. These JCAs are in four contrasting parts of England, and the strategies will focus on key environmental assets i.e. biodiversity, landscape and access attributes. These response strategies will be as geographically explicit as possible in order to provide a focus on the necessary action to enable the natural environment to adapt to inevitable climate change.

44 <http://www.ukbap.org.uk/Library/BRIG/CBCCGuidance.pdf>

45 <http://www.defra.gov.uk/wildlife-countryside/biodiversity/ukbap/index.htm>

46 <http://www.defra.gov.uk/wildlife-countryside/biodiversity/biostrat/index.htm>

## 6.3 Priorities for the future

In managing the natural environment in the context of climate change, we must:

- manage on an adaptive basis so that natural ecosystems are able to deliver the full range of benefits while adapting to inevitable change and mitigating further climate change
- better recognise points where climate change will drive natural ecosystems towards critical thresholds – for example, as seasonal timing of food availability and species breeding patterns go out of synch
- ensure that climate change measures in other sectors do not negatively impact on biodiversity and natural ecosystems and win/win solutions are sought wherever possible
- ensure that adaptation strategies reflect the opportunity provided by natural ecosystems to provide additional benefits (i.e. new wetlands that act as natural flood barriers can provide a range of other recreational and biodiversity benefits).

Top priorities include:

- establishing effective monitoring systems to detect and improve our understanding of the impacts of climate change on the natural environment, particularly regarding the most vulnerable ecosystems
- taking action on the ecosystems that are most vulnerable to the impacts of climate change on the provision of ecosystem services
- ensuring that other sectoral policies and strategies on climate change adaptation and mitigation also take into account the impacts of action on the natural environment, including biofuels
- incorporating a long-term view into the management of the natural environment – there is a need to consider the predicted climate in 50–100 years time and its associated uncertainty when making long-term decisions
- using and integrating the UK Climate Impacts Programme (UKCIP) 2008 probabilistic models with models of ecosystem functioning to better determine critical points in climate–ecosystem interactions and establish how best to direct management activities to improve resilience and adaptive capacity
- improving our general awareness and understanding of the dynamic responses of ecosystems to climate change and providing reliable sources of information about mitigation and adaptation.

### Actions to embed an ecosystems approach in climate change policy

- A23** **Defra** to ensure that principles of an ecosystems approach are reflected in the UK climate change adaptation framework
- A24** **Research councils** and other partners in the **Living with Environmental Change Programme** (LWEC) to work together to produce predictions of ecosystem impacts based on a range of climate change scenarios (such as those produced by UKCIP)
- A25** **Defra** to ensure that, as part of implementing the England Biodiversity Strategy, effective action is taken to identify the ecosystems most vulnerable to climate change and provide guidance for adaptation through managing for inevitable change
- A26** **Defra** to ensure that the programme of response to the Climate Change Bill Risk Assessment addresses the impacts of adaptation in other sectors on ecosystem health

## 7 Developing the Evidence Base

This section discusses the importance of developing the strategic evidence base to support an ecosystems approach. It identifies a range of evidence needs and some cross-cutting issues and explores how these might be addressed through domestic and international research programmes.

### 7.1 Identifying the evidence needs

Relevant evidence needs in support of an ecosystems approach have been identified through our own consultations with stakeholders and a number of other initiatives.<sup>47</sup> These needs include:

- **How are ecosystem services provided?**
  - Improved information on the relationships between biodiversity, ecosystem functioning and the supply of ecosystem services
- **What is the state of service provision?**
  - Information on the state of and trends in ecosystems and ecosystem services and ways to monitor this over time
- **What will happen in the future?**
  - Better understanding of the influence of drivers of and pressures on ecosystems and ecosystem services, including improved forecasting of trends and scenarios
- **Does this matter?**
  - Improved understanding of the impacts of ecosystem change on human wellbeing and ways to establish public preferences and values
  - Building the evidence base on environmental limits and how to define them
- **What can we do about it?**
  - Improved methodologies for valuing ecosystem services in decision-making
  - Improved understanding of policy options for responding to future change.

A more detailed description of these evidence needs can be found in Annex 6. Further work will be required to develop and refine these broad evidence needs in the context of Defra's Evidence and Innovation Strategy.

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<sup>47</sup> Including:

- Defra's Evidence and Innovation Strategy: <http://www.defra.gov.uk/science/how/part2.htm>
- Robson J (ed.) (2006), A UK BRAG Research Strategy: The role of biodiversity in ecosystem functioning. Report on behalf of BRAG Biodiversity and Ecosystems sub-group: <http://www.jncc.gov.uk/page-4006>
- GBSC (Biodiversity sub-group to the UK Global Environmental Change Committee)/Royal Society, Evaluating the Millennium Ecosystem Assessment: Messages, knowledge gaps and policy implications. Report on Workshop Feb 2006: [http://www.ukgecc.org/dvl\\_Biodiversity\\_MEA.htm](http://www.ukgecc.org/dvl_Biodiversity_MEA.htm)
- European Platform for Biodiversity Research Strategy (EPBRS). Notes of the German meeting, Leipzig 4–7 May 2007: <http://www.epbrs.org>
- Defra-commissioned scoping studies <http://www.defra.gov.uk/wildlife-countryside/natres/research.htm>

There are also some cross-cutting evidence challenges – which are not exclusive to an ecosystems approach – that need to be addressed:

- **interdisciplinary co-operation.** Embedding an ecosystems approach will require more interdisciplinary working across the natural and social sciences. We need to integrate our knowledge of the interactions between ecosystem functioning and the provision of ecosystem goods and services; the way people interact with and use these benefits; and ways to value changes in ecosystem services provision. Defra and its delivery partners will need to identify relevant research needs across the disciplines and ensure research requirements are framed in an interdisciplinary way.
- **improved communication between policy-makers and the research community.** Clear two-way communication and mutual understanding is needed between the research and policy communities so that policy-makers are better able to articulate evidence needs for an ecosystem approach and the research community has a clearer idea of research needs in order to address these policy challenges.
- **improved accessibility of publicly available data.** One of the biggest frustrations expressed by stakeholders in the research community is that it is often difficult to access data that is already in the public domain.
- **improved public participation.** We need to improve public participation both in environmental decision-making and in producing the evidence that is used to inform decisions. This can be achieved through a range of methods, including deliberative techniques.

## 7.2 Addressing the evidence needs

Ensuring a coherent and robust response to the evidence needs for an ecosystems approach will require strategic co-ordination both within and beyond the Defra network so that we have a shared understanding of evidence needs, appropriate priorities are integrated into relevant research programmes and outputs of research are shared and promoted.

Collaboration in research fields and across disciplines will help speed up the pace of development in this field. Broader engagement with other UK, EU and international research programmes will help to influence these programmes to ensure they are as relevant as possible for policy application, and to lever funding.

### 7.2.1 Defra's ecosystems approach research programme

Defra has a small dedicated research programme that aims to synthesise existing research relevant to an ecosystems approach, identify cross-cutting issues and gaps in the evidence base, and demonstrate how an ecosystems approach can be applied in practical terms through a series of case studies.

In its first phase, this programme funded a series of scoping studies to provide contextual analysis of the natural environment policy framework, review the state of current knowledge on some of the key issues, and identify further research needs. A second phase of research has built on these studies and aims to provide an improved understanding of:

- data sources relevant to adopting an ecosystems approach
- the status of and trends in England's ecosystems and ecosystem services
- the rationale for applying an ecosystems approach in different contexts
- how to value ecosystem services.

The latest projects, commissioned in 2007, will review natural environment targets and indicators for implementing an ecosystems approach and explore the scope for a comprehensive 'MA-type' assessment of England's ecosystems and ecosystem services.

Further details of this research programme can be found in Annex 7.

### Actions to identify and address evidence needs

- A27** Defra to work with partners, including the **Environment Agency, Natural England** and the **Forestry Commission**, to further articulate relevant evidence needs, identify priorities and co-ordinate future investment in research
- A28** Defra and the **Environmental Research Funders' Forum** to review ways of improving the integration of and access to publicly available data on the state of England's ecosystems and ecosystem services by the research community and decision-makers
- A29** The **Environmental Research Funders' Forum** to articulate monitoring requirements associated with an ecosystems approach and to propose a strategy for meeting these in the Environmental Observation Framework high-level vision and plan
- A30** Defra to assess the state of our seas and establish their quality status by June 2010 in order to provide a basis for marine ecosystem management (in compliance with the Marine Directive)
- A31** Defra to publish a review of the potential benefits and scope of a comprehensive 'MA-type' ecosystem assessment for England
- A32** The **Natural Environment Research Council** and the **Economic and Social Research Council** to lead the response of the research councils to evidence needs through LWEC, which will include a proposal for research on ecosystem services early in the programme
- A33** Defra, the **research councils** and the **Environmental Research Funders' Forum** to work in partnership to promote and co-ordinate relevant research and, in particular, to develop the role of LWEC in this regard
- A34** The **Department for International Development**, the **Natural Environment Research Council** and the **Economic and Social Research Council** to explore the links between healthy ecosystems and poverty alleviation and identify future research priorities through the joint Ecosystem Services and Poverty Alleviation research programme
- A35** Defra to ensure that relevant research priorities are addressed in the influencing strategy for calls under the EU Research Framework Programme FP7 and, in due course, for the development of FP8
- A36** Defra to contribute to the forthcoming BioDIVERSA research call on ecosystem functioning and ecosystem services and to engage closely with this programme to ensure its outputs address current and future policy challenges
- A37** Defra to contribute to a global study analysing the global economic benefit of biological diversity and the costs of the loss of biodiversity as part of the Potsdam Initiative agreed at the G8+5 Environment Ministers' meeting (i.e. Stern-type study for biodiversity and ecosystem services)



## 7.2.2 Other Defra and Defra network research programmes

Defra's research priorities are currently set out in its Evidence and Innovation Strategy 2005–2008.<sup>48</sup> It aims to deliver a coherent and 'fit for purpose' set of evidence and innovation activities to support the delivery of Defra's strategic outcomes, as well as setting the longer-term strategic direction, and includes a number of relevant priorities under its natural resources protection theme. Research funded by NE, EA and FCOM also offers considerable scope to address the evidence needs we have identified.

This research agenda is very broad, and much of the work that the Defra network commissions across scientific disciplines and fields will be relevant to an ecosystems approach. In addition, policy-makers in a number of policy areas are starting to think about the impacts of their policies on the delivery of ecosystem goods and services and have commissioned more specific research in this area (see examples in Annex 8). The challenge, however, is in co-ordinating this research, ensuring we can set joint priorities and share information. As a first step, an evidence working group has been established within Defra to act as a steering group for the ecosystems approach research programme to ensure that the programme is fully linked with other research in the Defra network and beyond and to advise on how an ecosystems approach could be embedded in evidence programmes more broadly.

## 7.3 Influencing wider UK and international research

It will also be important to influence and engage with relevant research initiatives in the UK and internationally:

- **LWEC** is a new ten-year research programme across the research councils (the Natural Environment Research Council (NERC), the Economic and Social Research Council (ESRC), the Biotechnology and Biological Sciences Research Council (BBSRC), that aims, with **other partners in Government and the stakeholder community**, to provide decision-makers with the best information to manage and protect vital ecosystem services; and to improve the tools and knowledge needed to build resilience, mitigate problems and adapt to environmental change. Defra is actively engaged in the development of this programme.
- The **Environmental Research Funders' Forum** (ERFF) is currently carrying out a review of environmental monitoring across the UK. The review builds on a baseline study of monitoring initiatives and aims to take a strategic review of monitoring and what information is required from it; and to develop an Environmental Observation framework under which future monitoring can be managed and which addresses the issues associated with the provision of long-term data for UK requirements. Defra will be working to articulate the monitoring needs on ecosystem health and the provision of ecosystem services to ensure these are included in the review.
- NERC, ESRC and DFID are jointly funding the **Ecosystem Services and Poverty Alleviation programme** – a multi-disciplinary research programme that will address how to achieve sustainably managed ecosystems and the delivery of ecosystem services to reduce poverty and improve wellbeing in developing countries. Defra is represented on the steering group for this programme and is working closely with the programme partners on developing a marine component.

<sup>48</sup> <http://www.defra.gov.uk/science/how/part2.htm>

- The **EU's Research Framework Programme** is already funding a range of relevant projects. There will be further opportunities to promote the evidence needs for an ecosystems approach in the current programme (FP7) and to ensure relevant priorities are adopted in FP8.
- The **European Environment Agency EUREKA** (European Millennium Assessment) programme will take a case-study approach to the analysis of ecosystem services in particular areas, underpinned by environmental accounting.
- **BioDIVERSA**, the Biodiversa European Research Area Network (ERA-Net) project (which includes 19 partners from 14 countries, including Defra and NERC), will launch a joint call for research on biodiversity linking scientific advancement to policy and practice. The three broad science themes included in the call are global change and biodiversity dynamics; ecosystem functioning; and ecosystem services.
- The **European Platform for Biodiversity Research Strategy** (EPBRS) is a forum where natural and social scientists, policy-makers and other stakeholders can identify and promote research that is essential to the sustainable use of components of biodiversity, to the maintenance of ecosystem functions that provide goods and services, and to the conservation, protection and restoration of the natural world.
- Discussions are now under way within the CBD on a **follow-up to the MA**, including whether or not a further global assessment should be undertaken.



# Annex 1 – List of actions, by Organisation

List of actions, by organisation			
No	Action	Target date	Action owner
<b>Defra</b>			
1	<b>Defra</b> to embed the principles of an ecosystems approach in its new standard policy-making procedures, which are being developed in the context of the Renew Defra programme	September 2008	Chief Economist, Defra
2	<b>Defra</b> to embed key 'ecosystems approach' messages in its strategic communications on the natural environment	End 2009	Director of Communications, Defra
3	<b>Defra's</b> Land Use Project to explore the benefits of an ecosystems approach, drawing on lessons learned from land management projects where this approach is being applied	End 2009	Director, Rural Landscape and Adaptation, Defra
4	<b>Defra</b> to develop further case studies to demonstrate the benefits of an ecosystems approach in policy-making:		
4a	Scoping study on implementing an ecosystems approach to air quality policy on ammonia	March 2008	Director, International Climate, Air and Analysis, Defra
4b	Scoping analysis of the full range of benefits of Environmental Stewardship in terms of impacts on ecosystem services	March 2008	Director, Wildlife and Countryside, Defra
4c	Development of a framework of action for management and restoration of peat soils based on the delivery of ecosystem services benefits	End 2009	Director, Wildlife and Countryside, Defra
5	<b>Defra</b> to work with other Government Departments and the Devolved Administrations to introduce a new system of marine planning that embeds an ecosystems approach into marine management, and integrates effectively with other management processes in coastal areas.	Subject to passage of Marine Bill	Director, Marine and Fisheries, Defra
6	<b>Defra</b> to embed the principles of an ecosystems approach in its new policy appraisal guidance for flood and coastal erosion risk management	September 2008	Director of Water, Defra
7	<b>Defra</b> to embed the principles of an ecosystems approach in its forthcoming Water Strategy	Early 2008	Director of Water, Defra

No	Action	Target date	Action owner
<b>Defra cont ...</b>			
8	<b>Defra</b> to fund extension of England the Catchment Sensitive Farming Delivery Initiative through the CSR 07 cycle.	March 2008	Director of Water, Defra
10	<b>Defra</b> to review existing policy and project appraisal tools to explore how the principles of an ecosystems approach, including the valuation of ecosystem services, could be incorporated	End 2008	Chief Economist, Defra
15 (R)	<b>Defra</b> , the <b>Environment Agency</b> , <b>Natural England</b> and the <b>Forestry Commission</b> to pilot practical application of ecosystem services valuation in specific policy areas, including:		
15a	Valuation of the benefits from the implementation of the UK Biodiversity Action Plan	End 2008	Director, Wildlife and Countryside, Defra
15b	Impact assessment for the Marine Bill	End 2008	Director, Marine and Fisheries, Defra
18 (R)	<b>Defra</b> , in partnership with the <b>Environment Agency</b> , <b>Natural England</b> and the <b>Forestry Commission</b> to develop a benefits transfer strategy for use in valuing ecosystem services	End 2008	Chief Economist, Defra
19	<b>Defra</b> to promote the development of the existing Environmental Valuation Reference Inventory (EVRI) database to ensure that it captures studies on the valuation of ecosystem services most useful and relevant for benefits transfer, including from Defra-funded studies	Ongoing	Chief Economist, Defra
20	<b>Defra</b> to review work on non-economic and participatory valuation methodologies and produce guidelines on their use alongside economic valuation methodologies	September 2008	Chief Economist, Defra
21 (R)	<b>Defra</b> , the <b>Environment Agency</b> , <b>Natural England</b> and the <b>Forestry Commission</b> to develop a strategy for convergence between indicators and targets used in different policy areas to be consistent with an ecosystems approach	End 2008	Director, Wildlife and Countryside, Defra
23	<b>Defra</b> to ensure that principles of an ecosystems approach are reflected in the UK climate change adaptation framework	Mid-2008	Director, Rural Landscapes and Adaptation, Defra

No	Action	Target date	Action owner
<b>Defra cont ...</b>			
25	<b>Defra</b> to ensure that, as part of implementing the England Biodiversity Strategy, effective action is taken to identify the ecosystems most vulnerable to climate change, and provide guidance for adaptation through managing for inevitable change	End 2008	Director, Wildlife and Countryside, Defra
26	<b>Defra</b> to ensure that the programme of response to the Climate Change, Bill Risk Assessment addresses the impacts of adaptation in other sectors on ecosystem health	2011	Director, Rural landscape and adaptation, Defra
27	<b>Defra</b> to work with partners including the Environment Agency, Natural England and the Forestry Commission to further articulate relevant evidence needs, identify priorities and to co-ordinate future investment in research	End 2008	Director, Head of Science Directorate, Defra Chief Economist, Defra
28	<b>Defra</b> and <b>Environmental Research Funders' Forum</b> to review ways of improving the integration of and access to publicly available evidence on the state of England's ecosystems and ecosystems services by the research community and decision-makers	End 2008	Director, Head of Science Directorate, Defra
30	<b>Defra</b> to assess the state of our seas and establish their quality status by June 2010 in order to provide a basis for marine ecosystem management (in compliance with the Marine Directive)	June 2010	Director, Marine and Fisheries, Defra
31	<b>Defra</b> to publish a review of the potential benefits and scope of a comprehensive 'MA-style' ecosystem assessment for England	End March 2008	Director, Wildlife and Countryside, Defra
33 (R)	<b>Defra</b> the <b>research councils</b> and <b>Environmental Research Funders' Forum</b> to work in partnership to promote and co-ordinate relevant research and, in particular, to develop the role of Living With Environmental Change in this regard	End 2008	Director, Head of Science Directorate, Defra
35	<b>Defra</b> to ensure that relevant research priorities are addressed in the influencing strategy for calls under the EU Research Framework Programme FP7 and, in due course, for the development of FP8	Ongoing	Director, Head of Science Directorate, Defra
36	<b>Defra</b> to contribute to the forthcoming BioDIVERSA research call on ecosystem functioning and ecosystem services and to engage closely with this programme to ensure its outputs address current and future policy challenges	April 2008 to end March 2012	Director, Wildlife and Countryside, Defra
37	<b>Defra</b> to contribute to a global study analysing the global economic benefit of biological diversity and the costs of the loss of biodiversity as part of the Potsdam Initiative agreed at the G8+5 Environment Ministers' meeting (i.e. Stern-type study for biodiversity and ecosystems services)	End 2008	Director, Wildlife and Countryside, Defra

No	Action	Target date	Action owner
<b>Defra Network</b>			
9	<b>Defra</b> to work with <b>Natural England</b> , the <b>Environment Agency</b> and the <b>Forestry Commission</b> to explore how the principles of an ecosystems approach can be embedded in their corporate plans and strategies and to identify potential barriers	End 2009	Executive Director, Strategy and Performance, Natural England Head of Wildlife, Recreation and Marine, Environment Agency Director, Forestry Commission England
11 (R)	The <b>Environment Agency</b> , <b>Natural England</b> and the <b>Forestry Commission</b> to work together with the Government Offices to ensure that environmental priorities are addressed in regional and sub-regional strategies/plans and their delivery, including by baselining environmental pressures in each region	End 2008 (to inform Regional Strategies in 2009)	Head of Wildlife, Recreation and Marine, Environment Agency Executive Director, Strategy and Performance, Natural England Director, Forestry Commission England
14	<b>Natural England</b> and the <b>Environment Agency</b> to consider how they can build their capacity at the local level to work with local authorities as local strategic partners	End March, 2008	Executive Director, Strategy and Performance, Natural England Head of Wildlife, Recreation and Marine, Environment Agency Director, Forestry Commission England
15 (R)	<b>Defra</b> , the <b>Environment Agency</b> , <b>Natural England</b> and the <b>Forestry Commission</b> to pilot practical application of ecosystem services valuation in specific policy areas, including:		
15c	Development of a vision and action plan for the uplands environment based on the delivery of ecosystems benefits		Executive Director, Strategy and Performance, Natural England
15d	Valuation of benefits from the England Woodland Grant Scheme		Head of Programmes, Forestry Commission



No	Action	Target date	Action owner
<b>Defra Network cont ...</b>			
18 (R)	<b>Defra</b> , in partnership with the <b>Environment Agency, Natural England</b> and the <b>Forestry Commission</b> to develop a benefits transfer strategy for use in valuing ecosystem services	End 2008	Executive Director, Strategy and Performance, Natural England  Head of Wildlife, Recreation and Marine, Environment Agency  Director, Forestry Commission England
21 (R)	<b>Defra</b> to work with the <b>Environment Agency, Natural England</b> and the <b>Forestry Commission</b> to develop a benefits transfer strategy for convergence between indicators and targets used in different policy areas to be consistent with an ecosystems approach	End 2008	Executive Director, Strategy and Performance, Natural England  Head of Wildlife, Recreation and Marine, Environment Agency  Director, Forestry Commission England
<b>Other Government Departments</b>			
16	The <b>Department for Transport</b> to work with Defra on a long-term strategy for the development of environmental valuation in transport appraisal, including the valuation of ecosystem services	End June 2008	Director, Transport Analysis and Economics, DfT
17	The <b>Department for Communities and Local Government</b> and Defra to work together to influence the design of eco-towns to maximise delivery of ecosystem services	End 2008	Director of New Homes and Sustainable Development, CLG  Director, Wildlife and Countryside, Defra
22	Defra to work with the <b>Department for Business, Enterprise and Regulatory Reform</b> to ensure that the ecosystem services framework is given appropriate consideration in the development of environment-adjusted productivity indicators	March 2008	Director, Sustainable Development and Regulation Directorate, BERR  Director, Sustainable Consumption and Production and Waste, Defra
34	The <b>Department for International Development</b> , the <b>Natural Environment Research Council</b> and the <b>Economic and Social Research Council</b> to explore the links between healthy ecosystems and poverty alleviation and identify future research priorities through the joint 'Ecosystem Services and Poverty Alleviation' research programme	End 2009	Director, Policy and Research, DFID  Director, Wildlife and Countryside, Defra

No	Action	Target date	Action owner
<b>Regional and Local Government</b>			
11 (R)	The Environment Agency, Natural England and the Forestry Commission to work together with the <b>Government Offices</b> to ensure that environmental priorities are addressed in regional and sub-regional strategies/plans and their delivery, including by baselining environmental pressures in each region	End 2008	Deputy Regional Director, Environment, Resilience & Rural, GONW
12	<b>Defra</b> to work with the <b>Government Office</b> network to build awareness of the benefits of an ecosystems approach in the English Regions	End 2009	Deputy Regional Director Environment, Resilience & Rural, GONW  Director, Wildlife and Countryside, Defra
13	<b>Defra</b> to work with <b>local government</b> to build awareness of the benefits of an ecosystems approach at the local level, including identifying and disseminating examples of best practice	End 2008	Director, Wildlife and Countryside, Defra  Director, Strategy and Sustainable Development
<b>Research Organisations</b>			
24	<b>Research councils</b> and other partners in the <b>Living With Environmental Change (LWEC) Programme</b> to work together to produce predictions of ecosystem impacts based on a range of climate change scenarios (such as those produced by UKCIP)	End 2009	Deputy Director, Science and Innovation, NERC
29	The <b>Environment Research Funders' Forum</b> to articulate monitoring requirements associated with an ecosystems approach and to propose a strategy for meeting these and in the Environmental Observation Framework high-level vision and plan	End 2008	Chair, ERFF
32	<b>Natural Environment Research Council</b> and the <b>Environmental and Social Research Council</b> to lead response of research councils to evidence needs through LWEC which will include a proposal for research on ecosystem services early in the programme	Mid 2008	Deputy Director, Science and Innovation, NERC  Associate Director for Research (Environment, Education and Governance), ESRC
33 (R)	<b>Defra</b> , the <b>research councils</b> and the <b>Environmental Funders' Forum</b> to work in partnership to promote and co-ordinate relevant research and, in particular, to develop the role of LWEC in this regard	End 2008	Deputy Director, Science and Innovation, NERC  Chair, ERFF
34 (R)	The <b>Department for International Development</b> , the <b>Natural Environment Research Council</b> and the <b>Economic and Social Research Council</b> to explore the links between healthy ecosystems and poverty alleviation and identify future research priorities through the joint 'Ecosystem Services and Poverty Alleviation' research programme	End 2009	Deputy Director, Science and Innovation, NERC  Associate Director for Research (International Relations and Development), ESRC

## Annex 2: MA – Key Steps to Reduce the Degradation of Ecosystem Services

### **Change the economic background to decision-making**

- Make sure the value of all ecosystem services, not just those bought and sold in the market, are taken into account when making decisions.
- Remove subsidies to agriculture, fisheries and energy that cause harm to people and the environment.
- Introduce payments to landowners in return for managing their lands in ways that protect ecosystem services, such as water quality and carbon storage, that are of value to society.
- Establish market mechanisms to reduce nutrient releases and carbon emissions in the most cost-effective way.

### **Improve policy, planning and management**

- Integrate decision-making between different Departments and sectors, as well as international institutions, to ensure that policies are focused on protection of ecosystems.
- Include sound management of ecosystem services in all regional planning decisions and in the poverty reduction strategies being prepared by many developing countries.
- Empower marginalised groups to influence decisions affecting ecosystem services and recognise in law local communities' ownership of natural resources.
- Establish additional protected areas, particularly in marine systems, and provide greater financial and management support to those that already exist.
- Use all relevant forms of knowledge and information about ecosystems in decision-making, including the knowledge of local and indigenous groups.

### **Influence individual behaviour**

- Provide public education on why and how to reduce consumption of threatened ecosystem services.
- Establish reliable certification systems to give people the choice to buy sustainably harvested products.
- Give people access to information about ecosystems and decisions affecting their services.

### **Develop and use environment-friendly technology**

- Invest in agricultural science and technology aimed at increasing food production with minimal harmful trade-offs.
- Restore degraded ecosystems.
- Promote technologies to increase energy efficiency and reduce greenhouse gas emissions.

## Annex 3: MA Typology of Ecosystem Services

Ecosystem services are the benefits people obtain from ecosystems. These include provisioning, regulating and cultural services that directly affect people and the supporting services needed to maintain other services. Many of the services listed here are highly interlinked (primary production, photosynthesis, nutrient cycling and water cycling, for example, all involve different aspects of the same biological processes).

**Provisioning services.** These are the products obtained from ecosystems, including:

- **food.** This encompasses the vast range of food products derived from plants, animals and microbes.
- **fibre.** This is derived from materials such as wood, jute, cotton, hemp, silk and wool.
- **fuel.** Wood, dung and other biological materials serve as sources of energy.
- **genetic resources.** This covers the genes and genetic information used for animal and plant breeding and biotechnology.
- **biochemicals, natural medicines, and pharmaceuticals.** Many medicines, biocides, food additives such as alginates and biological materials are derived from ecosystems.
- **ornamental resources.** Animal and plant products, such as skins, shells and flowers are used as ornaments, and whole plants are used for landscaping and as ornaments.
- **fresh water.** People obtain freshwater from ecosystems and therefore the supply of freshwater can be considered a provisioning service. Fresh water in rivers is also a source of energy. Because water is required for other life to exist, however, it could also be considered a supporting service.

**Regulating services.** These are the benefits obtained from the regulation of ecosystem processes, including:

- **air quality regulation.** Ecosystems both contribute chemicals to and extract chemicals from the atmosphere, influencing many aspects of air quality.
- **climate regulation.** Ecosystems influence climate both locally and globally. For example, at the local level, changes in land cover can affect both temperature and precipitation. At the global level, ecosystems play an important role in climate by either sequestering or emitting greenhouse gases.
- **water regulation.** The timing and magnitude of run-off, flooding and aquifer recharge can be strongly influenced by changes in land cover, including, in particular, alterations that change the water-storage potential of the system such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas.
- **erosion regulation.** Vegetative cover plays an important role in soil retention and the prevention of landslides.
- **water purification and waste treatment.** Ecosystems can be a source of impurities (e.g. in fresh water). However, they can help in the filtering out and decomposition of organic wastes introduced into inland waters and coastal and marine ecosystems and can also assimilate and detoxify compounds through soil and sub-soil processes.
- **disease regulation.** Changes in ecosystems can directly change the abundance of human pathogens, such as cholera, and can alter the abundance of disease vectors, such as mosquitoes.
- **pest regulation.** Ecosystem changes affect the prevalence of crop and livestock pests and diseases.
- **pollination.** Ecosystem changes affect the distribution, abundance and effectiveness of pollinators.
- **natural hazard regulation.** The presence of coastal ecosystems such as mangroves and coral reefs can reduce the damage caused by hurricanes or large waves.

**Cultural services.** These are the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences, including:

- **cultural diversity.** The diversity of ecosystems is one factor influencing the diversity of cultures.
- **spiritual and religious values.** Many religions attach spiritual and religious values to ecosystems or their components.
- **knowledge systems (traditional and formal).** Ecosystems influence the types of knowledge systems developed by different cultures.
- **educational values.** Ecosystems and their components and processes provide the basis for both formal and informal education in many societies.
- **inspiration.** Ecosystems provide a rich source of inspiration for art, folklore, national symbols, architecture and advertising.
- **aesthetic values.** Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks and scenic drives and in the selection of housing locations.
- **social relations.** Ecosystems influence the types of social relations that are established in particular cultures. Fishing societies, for example, differ in many respects in their social relations from nomadic herding or agricultural societies.
- **sense of place.** Many people value the 'sense of place' that is associated with recognised features of their environment, including aspects of the ecosystem.
- **cultural heritage values.** Many societies place high value on the maintenance of either historically important landscapes ('cultural landscapes') or culturally significant species.
- **recreation and ecotourism.** People often choose where to spend their leisure time based, in part, on the characteristics of the natural or cultivated landscapes in a particular area.

**Supporting services.** Supporting services are those that are necessary for the production of all other ecosystem services. They differ from provisioning, regulating and cultural services in that their impacts on people are often indirect or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on people. (Some services, like erosion regulation, can be categorised as both a supporting and a regulating service, depending on the timescale and immediacy of their impact on people.)

- **soil formation.** Because many provisioning services depend on soil fertility, the rate of soil formation influences human wellbeing in many ways.
- **photosynthesis.** This process produces oxygen, which is necessary for most living organisms.
- **primary production.** The assimilation or accumulation of energy and nutrients by organisms.
- **nutrient cycling.** Approximately 20 nutrients essential for life, including nitrogen and phosphorus, cycle through ecosystems and are maintained at different concentrations in different parts of ecosystems.
- **water cycling.** Water cycles through ecosystems and is essential for living organisms.

Source: Adapted from *Millennium Ecosystem Assessment Ecosystems and Human Wellbeing: General Synthesis*

# Annex 4: Organisations that Participated in Defra's Ecosystems Approach Seminar Series

## **Defra – core**

Defra – Climate Change Group  
Defra – Food and Farming Group  
Defra – Natural Environment Group  
Defra – Service Transformation Group  
Defra – Strategy and Evidence Group

## **Defra – network**

EA  
FCOM – (England)  
NE

## **Other government organisations and bodies**

CLG  
DfT  
ESRC  
Highways Agency  
HM Treasury  
JNCC  
NERC  
SDC

## **Regional and local government**

GO (South-West)  
RA – East of England  
RA – Yorkshire and Humber  
RDAs – National Secretariat

## **UK devolved administrations**

Countryside Council for Wales  
Northern Ireland – Department of Environment  
Scottish Environment LINK  
Scottish Government  
Welsh Assembly Government



## Other organisations

ADAS  
British Ecological Society  
British Trust for Ornithology  
Campaign to Protect Rural England  
Centre for Ecology and Hydrology  
Collingwood Environmental Planning  
Country, Land and Business Association  
Earthwatch Institute  
Environmental Futures Ltd  
Institute for European Environmental Policy  
Institute of Ecology and Environmental Management  
Jacobs  
Landscape Institute  
Landuse Consultants  
London School of Economics and Political Science  
National Farmers' Union  
National Federation of Fishermen's Organisations  
National Trust  
Plantlife International  
Plymouth Marine Laboratory  
Reading Agricultural Consultants  
Rothamsted Research  
Royal Society for the Protection of Birds  
Royal Town Planning Institute  
Soil Association  
Somerset Environmental Records Centre  
UN Environment Programme – World Conservation Monitoring Centre  
University – Birmingham  
University – Cranfield  
University – Cranfield (National Soil Resources Institute)  
University – East Anglia  
University – Gloucester (Countryside and Community Research Institute)  
University – Imperial College  
University – Liverpool (SWIMMER)  
University – Nottingham  
University – Oxford (Environmental Change Institute)  
University – Sheffield  
University – Wales (Aberystwyth)  
University – Warwick (HRI)  
Wildfowl and Wetlands Trust  
Wildlife and Countryside Link  
Wildlife Trusts  
Zoological Society of London

## Annex 5: Some Existing Indicators and Targets Relevant to Ecosystem Function and the Delivery of Goods and Services

The **Natural Environment PSA** includes five indicators that capture the health of some of the main components of a natural environment, i.e. air and water quality, biodiversity, the health of the marine environment, and the impacts of agricultural land management. However, it recognises that these indicators only provide a narrow snapshot of how well we are doing and needs to be supported by a much broader set of indicators and targets in other policies and programmes.

The **UK Sustainable Development Strategy** includes a range of state indicators that cover wild birds, fish stocks and native forest cover; pressures such as water abstractions and inputs of fertilizers; and drivers such as agricultural employment.

The **UK air quality standards** include limit values, as set by the European Air Quality Directive, with regard to levels of oxides of nitrogen and sulphur dioxides to prevent damage to vegetation and ecosystems. The limit values relate to levels below which damage to most plant species is preventable.

The **international biodiversity target** to 'achieve by 2010 a significant reduction of the current rate of biodiversity loss', was set under the CBD and adopted by the World Summit on Sustainable Development in 1992. This is underpinned by a framework of sub-targets and indicators that include the maintenance of ecosystem integrity and the provision of goods and services in support of human wellbeing. The EU has adopted a target to 'protect and restore habitats and natural systems and halt the loss of biodiversity by 2010' under the EU Sustainable Development Strategy.

The **UK Biodiversity Action Plan (UK BAP) targets for priority habitats and species** specify the extent and condition of habitats to be maintained, restored or created, and the size or range of species populations to be attained. **UK biodiversity indicators** have been set to assess progress in six focal areas: status of and trends in components of biodiversity; sustainable use; ecosystem integrity and ecosystem goods and services; status of resource transfers and use; public awareness and participation. In a review of UK BAP targets in 2006, attempts were made to develop more holistic targets that would reflect the connectivity of the range of habitats across whole landscapes. This proved challenging, but work is being taken forward in a research project supported by Defra.

A set of national indicators of the quality (physical, chemical and biological), extent and diversity of **soil** is under development.

Natural environment indicators on local biodiversity, air quality, and flood and coastal erosion risk management have been included in the new **local government performance framework**.

Defra's **Sustainable Farming and Food Strategy** indicators cover the economic, environmental and social aspects of sustainability in agriculture and the food chain.

The **Countryside Survey** monitors a range of indicators concerned with the state of ecosystems. A new work programme will be exploring how the survey results can be used to assess ecosystem health and the provision of ecosystem services.

The **Countryside Quality Counts** establish a framework against which countryside change can be judged using landscape character.

The development of indicators is underway for **Fisheries 2027** and the UK Marine Monitoring and Assessment Strategy is preparing suitable indicators for the planned 'state of the seas' report – **Charting Progress II** – in 2010. This will be a precursor to the monitoring regime that will be put in place to evaluate progress towards the 'Good Environmental Status' anticipated by the EU Marine Strategy Directive.

## Annex 6: Evidence Needs for an Ecosystems Approach

### **Improved information on ecosystem functioning and its relationship with the supply of ecosystem goods and services**

- Understanding the relationship between biodiversity and ecosystem functioning
- Better understanding and evaluation of the response of ecosystem function to environmental change
- Better understanding of the contribution of ecosystem function in delivering ecosystem services
- Understanding complex dynamics, non-linear responses and abrupt or irreversible shifts in ecosystems
- Building the evidence base on environmental limits as they relate to ecosystem functioning and provision of goods and services
- Assessment of which ecosystems have goods and services that are most under threat

### **Information on the state of and trends in ecosystems and ecosystem services, and ways to monitor this over time**

- Assessment of the current status of ecosystems in terms of their capacity to deliver goods and services
- Understanding the impacts of drivers and pressures on the capacity of ecosystems to deliver goods and services
- Data integration and development of interdisciplinary indicators for ecosystem functions and ecosystem services at appropriate scales
- Developing concepts of resource accounts for ecosystem services to support ecosystem assessment and management
- Development of multi-scale assessment methodologies
- Development of methodologies to assess multi-functionality of ecosystem services
- Development of spatially explicit frameworks and tools for assessing the capacity of ecosystems to deliver ecosystem goods and services

### **Impacts of ecosystem change on human wellbeing and public participation**

- Understanding the socioeconomic impacts of changes in ecosystem function and ecosystem services provision
- Finding ways of elucidating stakeholder (including public) preferences and values to set objectives for delivery of ecosystem goods and services (e.g. through deliberative decision-making processes).

### **Improved methodologies for valuing ecosystem services and application of ecosystem services valuations in decision-making**

- Improved knowledge of and methodologies for valuation of ecosystem services
- Best-practice case studies for application of ecosystem services valuations in policy and project appraisal (marginal valuations)
- Improved techniques for using valuations out of the original context and for designing valuation studies to take into account needs for application elsewhere (benefits transfer)
- Contribution of natural capital and ecosystem services to sustainable economies

## **Understanding the decision-making context and appraising response options**

- Establishing ways to test and appraise options for response to ecosystem degradation, as well as potential and cumulative impacts of other policies and decisions on the supply of ecosystem goods and services
- Improved knowledge of how the assessment of ecosystems and goods and services could be built into existing decision-making frameworks at the regional and local levels (SEAs, EIAs, planning etc.)
- Exploring accessibility to utilisation of data
- Development and testing of adaptive management strategies

## **Global impacts of UK activity**

- Further research on global impacts of UK activity and consumption.

## Annex 7: Ecosystems Approach Research Programme – Current and Completed Projects

Further details on all these projects can be found at <http://www.defra.gov.uk/wildlife-countryside/natres/research.htm>

### Completed projects

#### **Inventory and assessment of existing resources (NR0101)**

This project provided a high-level review and assessment of the means by which the quantity and quality of components of the natural environment in the UK are identified, monitored and assessed, with particular reference to the delivery of economic functions or ecosystem services.

#### **Defining and identifying environmental limits (NR0102)**

This study collated existing knowledge on environmental limits/thresholds and recommended how Defra should define and apply environmental limits and thresholds.

#### **Collating and evaluating research on the value of the environment (NR0103)**

This study reviewed both economic and non-economic methodologies for how we value the natural environment.

#### **Identification and characterisation of pressures on natural resources, including the effects of cumulative pressures (NR0104)**

The purpose of this study was to identify and organise pressure and impact categories in a useful way for policy.

#### **Characterising the policy framework (NR0105)**

The purpose of this study was to develop understanding on how the current policy framework delivers our vision for the natural environment.

#### **Public understanding of the concepts and language around ecosystem services and the natural environment (NR0115)**

This research aimed to establish the extent to which citizens understand the concept of ecosystem services and to define the language, technology and information required to best convey these concepts.

#### **Future trends (SD0314)**

Defra contributed to this report, which presents the outputs of a future trends study conducted by Fast Future. The primary objective of the study was to identify and analyse trends and driving forces that may affect the natural environment from now to 2050.

## Ongoing projects

### **Inventory study on natural environment data 2 (NR0106)**

This project will, with a focus on social sciences (including economics), review quantitative and qualitative data sources relevant to adopting an ecosystems approach for England's terrestrial ecosystems.

### **England's terrestrial ecosystem services and the rationale for an ecosystem-based approach (NR0107)**

This project will review evidence on the state of, and trends in, England's terrestrial ecosystems and recommend whether there is sufficient evidence base and analytical capability to determine trends in England's ecosystems and the ecosystem services they provide.

### **An assessment of the economic value of England's terrestrial ecosystem services (NR0108)**

This project will provide an economic valuation of England's terrestrial ecosystem services encompassing the goods, services and non-use values it provides, demonstrating examples of the multi-functional values of ecosystems.

### **Case studies to develop tools and methodologies to deliver an ecosystems approach**

These projects use current understanding of ecosystem services and environmental limits in development of retrospective or current case studies to demonstrate an ecosystems approach.

- **Guiding development in the Kent Thameside development area (NR0109)**
- **Selection of the M6–Heysham link road route, Lancashire (NR0110)**
- **Management of the Parrett Catchment, Somerset (NR0111)**
- **Management of the Otmoor protected area, Oxfordshire (NR0112)**

### **Scoping the potential benefits of undertaking a comprehensive ecosystem assessment for England (NR0118)**

This project will review the benefits of undertaking an 'MA-style' ecosystem assessment for England and recommend options through which this could be achieved.

### **Reviewing targets and indicators for an ecosystems approach (NR0119)**

This project will review current indicators and targets to determine their consistency with an ecosystems approach and recommend how future indicators and targets could be devised on a whole-ecosystem basis.



## Annex 8: Examples of Defra Network R&D Programmes Embedding an Ecosystems Approach

examples of defra network R&D programmes embedding an ecosystems approach	
Defra R&D programmes or project areas	Example
Sustainable Food and Farming	Research into the impacts of biomass production on biodiversity and landscape; proposed research on potential for land managers to deliver ecosystem services for adaptation to climate change
Environmental Stewardship	Understanding how to maximise the environmental benefits from investment in agri-environment schemes
Sustainable Consumption and Production	Proposals to include investigating the impacts on ecosystem services in product chains
Marine and fisheries	A number of projects have been funded to underpin the development of an ecosystems approach to fisheries and marine management. A pilot project is under way to trial an ecosystems approach to fisheries management in the English Channel. A process is under way to ensure that an ecosystems approach is embedded in all marine R&D contracts
Sustainable Development	Investigating the relationship between the natural environment and wellbeing
Flood management	Benefits from managed realignment; social justice and 'who benefits' from flood management policy
Air quality	Eutrophication and acidification of terrestrial ecosystems; proposed research into the impacts of ammonia on ecosystems and ecosystem services
Wildlife and Countryside	Understanding the importance of biodiversity in ecosystem functioning
International Biodiversity	Developing and applying an ecosystems approach for the conservation of biodiversity globally
Other R&D programmes	
Integrated Catchment Science Programme (EA)	Research covers understanding aquatic ecosystems; managing soils and sediments; identifying and understanding catchment pressures; restoring habitats/ecosystems and remediating historical pollution; socioeconomic considerations; knowledge transfer; and pilots and demonstrations of catchment management
Flood Risk Management Programme (EA)	Includes research in methodologies for assessing and quantifying the benefits from managed realignment strategies
UK Collaborative Research Programme on River Basin Management Planning	Six sequential projects focused on assessing the costs and benefits of measures in river basin management
National Biodiversity Network and Development of Local Record Centres (Defra, NE and EA)	New phases for both programmes will explore public participation and provision of data about biodiversity for improving decision-making, especially at local levels
Rural Economy and Land Use Programme (Defra central science budget contributes to this research council-led programme)	This programme aims to deliver interdisciplinary research to advance understanding of the social, economic, environmental and technological challenges faced by rural areas and the relationship between them. There is a range of projects relevant to an ecosystems approach

## Annex 9: Glossary of Acronyms and Abbreviations

Glossary of Acronyms and Abbreviations	
Acronym	Definition
<b>AONB</b>	Area of Outstanding Natural Beauty
<b>BERR</b>	Department for Business, Enterprise and Regulatory Reform
<b>CBD</b>	Convention on Biological Diversity
<b>CLG</b>	Department for Communities and Local Government
<b>CSR</b>	Comprehensive Spending Review
<b>Defra</b>	Department for Environment Food and Rural Affairs
<b>DFID</b>	Department for International Development
<b>DfT</b>	Department for Transport
<b>DoH</b>	Department of Health
<b>EA</b>	Environment Agency
<b>EIA</b>	Environmental Impact Assessment
<b>EPBRS</b>	European Platform for Biodiversity Research Strategy
<b>ERFF</b>	Environmental Research Funders' Forum
<b>ES</b>	Environmental Stewardship
<b>ESRC</b>	Economic and Social Research Council
<b>EU</b>	European Union
<b>FCOM</b>	Forestry Commission
<b>GO</b>	Government Offices for the Regions in England
<b>HEHI</b>	Holistic Ecosystem Health Indicator
<b>IA</b>	Impact Assessment
<b>JCA</b>	Joint Character Area
<b>JNCC</b>	Joint Nature Conservation Committee
<b>LAA</b>	Local Area Agreement
<b>LSP</b>	Local Strategic Partnership
<b>LWEC</b>	Living With Environmental Change Programme
<b>MA</b>	Millennium Ecosystem Assessment
<b>MEHTA</b>	Monitoring Ecosystem Health through Trends Analysis
<b>MoD</b>	Ministry of Defence
<b>MoU</b>	Memorandum of Understanding
<b>NE</b>	Natural England
<b>NEMO</b>	Natural England Multiple Objectives
<b>NERC</b>	Natural Environment Research Council
<b>NGO</b>	Non-Governmental Organisation
<b>PSA</b>	Public Service Agreement
<b>RA</b>	Regional Assembly
<b>R&amp;D</b>	Research and Development
<b>RDA</b>	Regional Development Agency
<b>RDPE</b>	Rural Development Programme for England
<b>RES</b>	Regional Economic Strategy
<b>RSS</b>	Regional Spatial Strategy
<b>SEA</b>	Strategic Environmental Assessment
<b>SSSI</b>	Site of Special Scientific Interest
<b>UK BAP</b>	UK Biodiversity Action Plan
<b>UKCIP</b>	UK Climate Impacts Programme
<b>WFD</b>	Water Framework Directive



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