

***England's Terrestrial Ecosystem Services and
the Rationale for an Ecosystem Approach***

***Overview Report
to Defra
(Project Code NR0107)***

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Notes:

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This is an overview report only. The full technical report (plus excel spread sheet with literature review and habitat x service inventory) can be downloaded from the project or Defra's homepage.



www.ecosystems-services.org.uk

Non-technical executive Summary

Aims of the Study

This report considers two important ideas currently being discussed in the research and policy literatures that may help people manage and use ecological resources sustainably. The first is the 'Ecosystem Approach', which is an evolving framework of ideas, designed to help decision makers take full account of ecological systems and their associated biodiversity. The second is the concept of 'ecosystem services', an idea that is currently being widely promoted to emphasise the benefits that ecological systems provide for people, and the importance that systems based on biological diversity have in maintaining human existence and the quality of people's lives. The purpose of this work is to understand better the relevance of the Ecosystem Approach to policy making in England, and to examine how we might use it to manage and understand better the benefits that our major terrestrial ecosystems generate.

This study has examined whether it is possible to make an assessment of the state and trends in England's major terrestrial and freshwater ecosystem services on the basis of the evidence currently available. The task is a challenging one because the methods used to make such an assessment are still developing. We also have to be sure how such assessments can be designed to provide information that is useful to decision makers.

The need to refine assessment methods and ensure that they can be used effectively in decision making required us to consider the merits of the **Ecosystem Approach (EsA)** that has been promoted through the Convention for Biological Diversity (CDB). It is an internationally accepted framework designed to help decision makers take full account of ecological systems and their associated biodiversity. It has also been proposed as a useful framework for thinking about ecosystem services. Since Defra currently consider the EsA as potentially helping deliver their current vision for the natural environment, as part of this study, we have gone on to examine critically the rationale for using it in the English context.

Key Findings

A first key objective of the study was to make a critical review of the case for using the Ecosystem Approach for policy development and evaluation at national levels.

Our review suggested that it is an appropriate framework for Defra and its partners to use for assessing ecosystem services, in that it helps with the task of identifying what constitutes an ecosystem service and how such services may be valued. It also promotes the type of inclusive, cross-sectoral decision making needed for effective management of natural resources. We found that the principles underpinning the EsA are consistent with the current UK Strategy for Sustainable Development, and we have shown how it may be developed operationally in this context. Promoting the EsA principles through the Sustainable Development Strategy will, we suggest, encourage people to think about the state and trends of ecosystem services and to use this information for developing policy and management responses across a number of different policy sectors.

The second key objective for this work was to explore the extent to which an assessment of the state and trends of England's major terrestrial ecosystem services could be made using the evidence currently available. Several different approaches to the problem of assessment were considered.

We made an assessment of changes in stock and ecological condition of the Biodiversity Action Plan Broad and Priority Habitats using existing monitoring data. Out of the 19 Broad Habitats (not including urban) considered, there was evidence that nine may be experiencing changes that could impact on service provision, particularly in the area of genetic resources; the evidence was strongest for Acid Grassland, Bog, and Calcareous Grassland. One Broad Habitat, Broadleaved, Mixed and Yew, showed evidence of change that was possibly enhancing services, particularly the cultural ones linked to recreation and landscape.

A second approach to the problem of assessment looked at a number of services directly. Out of the eight services examined, there was evidence of declining or impaired service output for five of them. The areas of concern were related to the regulation of water quantity and quality, pollination, and the provisioning of genetic resources, and possibly climate regulation. The recreational service is probably enhancing, and there may be potential for deriving additional benefits from ecosystems in the area of assimilation and purification.

On the basis of the strengths and weaknesses of these different assessment approaches we concluded that future studies might benefit by taking a more 'place-based' approach. The constraint of thinking about ecosystem services in a specific geographical area seemed to overcome many of the problems that surround defining what an ecosystem is, and how problems relating to the multi-functional characteristics of systems might be handled. It also helped address the identification of any trade-offs that might arise in the evaluation of any management or policy strategy. We have suggested a set of specific questions that could be used to frame the assessment of ecosystem services in a specific geographical locality that could be used by Defra to encourage people to take up the philosophy embedded in the Ecosystem Approach.

Key Conclusions and Recommendations

Our review of the case for Defra promoting an Ecosystems Approach suggests that in the context of securing the supply of ecosystem services, it is a valuable approach to decision making. Its holistic character means that it can help address the many of the cross-cutting issues affecting ecosystem services that, historically, have often been ignored or left unresolved. **We suggest that to take the EsA forward, Defra, it should review the consistency of its activities (and potentially those of other Government Departments) with the principles of the EsA.** Such a review would help make the case that, at the operational level, current approaches to decision making were limited, and that these deficiencies could be overcome by application of the concepts and methods embodied in the Ecosystem Approach.

The assessments of ecosystem services made here are necessarily provisional, and the robustness of the analysis should be tested by more broadly-based consultation. We therefore suggest:

- A more detailed place-based assessment of ecosystem services initially at the level of the Government Office Regions in England, and subsequently at more local scales. Such work could form a component for a national assessment of ecosystem services in England, following the model of the global Millennium Ecosystem Assessment.
- The development of a common set of guidelines and data resources to ensure a flexible but unified approach across the different assessment units is possible.
- A review of how, through the concept of making a place-based assessment of ecosystem services, the principles of the EsA can be incorporated in the current procedures used at regional scales to implement the UK Sustainable Development Strategy. Since the burden of delivery lies with Local Authorities, the review should pay particular attention to the ways in which a place-based approach can be translated from regional down to local scales. The EsA could be developed and promoted as one way in which this might be achieved.

Such an initiative should, we suggest, form part of Defra's future strategy for ensuring that the principles underpinning the Ecosystem Approach are understood and used more widely in decision making. The work could also contribute to a potential UK and European assessment of ecosystem services.

Part 1: Ecosystems, Policy and Ecosystem Services

1.1 Contexts

The idea that human well-being is dependent on the integrity of environmental systems is not a new one. Perhaps only in developed societies, where most people are no longer working directly with the resources provided by the land, sea and air, do we need to be reminded of the importance of the benefits that nature provides.

This report considers two important ideas currently being discussed in the research and policy literatures that may help people manage and use ecological resources sustainably. The first is the 'Ecosystem Approach', which is an evolving framework of ideas, designed to help decision makers take full account of ecological systems and their associated biodiversity¹. The second is the concept of 'ecosystem services', an idea that is currently being widely promoted to emphasise the benefits that ecological systems provide for people, and the importance that systems based on biological diversity have in maintaining human existence and the quality of people's lives. The purpose of this work is to understand better the relevance of the Ecosystem Approach to policy making in England, and to examine how we might use it to manage and understand better the benefits that our major terrestrial ecosystems² generate.

The publication of the Millennium Ecosystem Assessment (MA)³ has stimulated widespread, international debate about the importance of the links between ecosystems and human well-being. The MA found that at global scales, 60% of the ecosystem services on which people depend were being damaged through human action or mismanagement. As a result there is now considerable interest in finding out what is happening at regional and national scales.

This study has examined whether it is possible to make an assessment of the state and trends in England's major terrestrial and freshwater ecosystem services on the basis of the evidence currently available. The task is a challenging one because the methods used to make such an assessment are still developing. We also have to be sure how such assessments can be designed to provide information that is useful to decision makers.

The need to refine assessment methods and ensure that they can be used effectively in decision making required us to consider the merits of the **Ecosystem Approach (EsA)**⁴ that has been promoted through the Convention for Biological Diversity (CDB). It is an internationally accepted framework designed to help decision makers take full account of ecological systems and their associated biodiversity. It has also been proposed as a useful framework for thinking about ecosystem services. Since Defra currently consider the EsA as potentially helping deliver their current vision for the natural environment, as part of this study, we have gone on to examine critically the rationale for using it in the English context.

This study complements a series of parallel projects funded under Defra's **Phase I and Phase II Programme** (see Defra homepage for details)⁵.

¹ The literature contains a number of variations in terminology designed to emphasise different aspects of the idea. For example, one may find reference to an 'ecosystem-based approach', a term used mainly to promote holistic thinking in the design of management strategies for natural resource systems. Defra, in recent publications (e.g. Defra, 2007), refers to an 'Ecosystems Approach', using the plural to emphasise that no prescriptive methodology is implied. In this report we employ the more widely used 'Ecosystem Approach'. However, we accept that the concept may need to be adapted in the context of specific applications, but there seems little merit in multiplying the terminology in what is an already confusing field.

² In this report when referring to terrestrial ecosystems we include freshwater or aquatic systems – marine systems (including coastal, offshore) are outside the scope of this project.

³ MA (2003) and Book Series (MA, 2005), <http://www.millenniumassessment.org/>

⁴ As the EA is already used as an abbreviation for other idioms such as "Environmental Assessment" but also for the "Environment Agency" the authors have decided to use EsA as the abbreviation for Ecosystem Approach in accordance with IUCN Commission on Ecosystem Management (personal communication, email Pat Hawes, secretariat IUCN-CEM, 14 December 2007).

⁵ <http://www.defra.gov.uk/wildlife-countryside/natres/research.htm>

1.2 Objectives of this study

The objectives set for this study were to:

- *establish and agree what an Ecosystem Approach involves and how it can be used to make an assessment of the outputs of ecosystem services at national, regional and local scales; and,*
- *understand how the principles of the Ecosystem Approach and the assessment of ecosystem services can be used in decision making at national, regional and local scales.*

In order to achieve these objectives we have:

- *considered different methodologies for the classification of England's terrestrial ecosystems, and how they can be developed to measure the capacity of ecosystems to deliver the services described in the Millennium Ecosystem Assessment;*
- *reviewed the existing data and evidence on the state and trends of the terrestrial natural environment in England; and,*
- *used these methodologies to provide an initial analysis of the state and trends of services associated with England's major terrestrial ecosystems.*

1.3 Structure of the Report

Parts 2 and 3 of this Report have been designed to achieve a better understanding of the Ecosystem Approach and ecosystem services. In Part 2 we discuss what the Ecosystem Approach involves and what kind of case could be made by Defra for adopting it as the basis for implementing its vision. Part 3 builds on this material and considers how it can be used conceptually as a framework for assessing the supply of ecosystem services.

Both objectives make reference to decision making at local, regional and national scales. Although discussion of scale issues is included in Parts 2 and 3, they are considered largely from a theoretical perspective. In order to ground our analysis on empirical evidence, and identify how these scale issues translate into the English policy context, Parts 4 and 5 of the report review information on ecosystem services currently available for our national Biodiversity Action Plan (BAP) Broad and Priority Habitats, and for services at national scales. These sections help in identifying what is currently known about the state and trends in ecosystem services, what knowledge gaps exist, and what kinds of challenge we face in making decisions about using these resources more sustainably. In Part 6, we consider how a place-based perspective might help to making such an assessment. Part 7 summarises the outcomes of the study and the conclusions that can be drawn about how the principles of the Ecosystem Approach can be used in decision making at national, regional and local scales.

In order to place this study in context it must be viewed as part of an on-going programme of research initiated by Defra, which is looking at how decision making across all sectors of society can be encouraged to take environmental issues fully into account. An overview of this programme is provided in the recently published *Action Plan* (Defra, 2007). An important goal is to develop ways of properly valuing natural resources so that the costs and benefits of different policy options can be compared. This study should therefore be seen as one of several parallel streams of work. Although it is not concerned with valuation issues *per se*⁶, it seeks to complement such work by exploring the conceptual underpinnings of current approaches to the problem of understanding the links between ecological systems and human well-being, and the limits of ecosystem functioning.

The aim of this Report is to provide an overview of what was achieved by the study. A more detailed account of the work and the analysis that underpins our recommendations can be found in the Full Technical Report that is available alongside it.

⁶ "An assessment of the economic value of England's terrestrial ecosystem services" (Defra Project code NR0108)

Part 2: Developing an Ecosystem Approach

2.1 Introduction

The Ecosystem Approach emerged as a topic of discussion in the late 1980s and early 1990s amongst the research and policy communities concerned with the management of biodiversity and natural resources (Hartje et al., 2003). It was argued that a new focus was required to achieve robust and sustainable management and policy outcomes. An Ecosystem Approach, it was suggested, would deliver more integrated policy and management at a landscape-scale and be more firmly directed towards the needs of people.

Much of the recent interest in the EsA can, however, be traced to the influence of the Convention for Biological Diversity (CBD), which in 1995 adopted it as the 'primary framework' for action (IUCN, 2004). Under the convention, the approach is the basis for considering all the goods and services provided to people by biodiversity and ecosystems (Secretariat of the Convention for Biological Diversity, 2000).

According to the CBD, the EsA:

“...places human needs at the centre of biodiversity management. It aims to manage the ecosystem, based on the multiple functions that ecosystems perform and the multiple uses that are made of these functions. The ecosystem approach does not aim for short-term economic gains, but aims to optimize the use of an ecosystem without damaging it “⁷

It also embodies a core set of management principles⁸, which seek, for example, to promote an integrated approach to management that operates across both natural and social systems, and between different ecosystems. An understanding of the way in which natural and social systems are coupled is seen as particularly important because, it is argued, management decisions have to be seen in their economic and social context, i.e. people are an integral part of ecosystems. The principles proposed by the CBD cover the conservation and sustainable use of resources, and the sharing of benefits derived from natural resources throughout society. This concept also resonates with ideas about 'environmental justice', which is a key component of creating more sustainable communities (SDRN, 2007).

While decisions about policy and management are essentially a matter of societal choice, the principles proposed by the CBD also recognise that decisions have to be grounded on a scientific understanding of biophysical limits that constrain ecological processes and the spatial and temporal scales at which they operate. From the more scientific perspective, the EsA recognises the inherently dynamic nature of ecosystems and the uncertainties involved in any attempt to manage them. Thus the principles seek to promote a holistic, adaptive and flexible approach to natural resource management. It thus helps focus decision makers on longer-term, more sustainable perspectives rather than on short-term fixes that may ultimately fail to deliver lasting, cost-effective socio-economic and environmental benefits.

2.2 Implementing the EsA

The principles that make up the Ecosystem Approach are not unique to the CBD. Indeed, just as the Convention sought to capture and represent a range of concerns around the sustainable use of ecosystems that were being voiced at the time of its drafting, others have subsequently interpreted, extended and emphasised the ideas in a number of different ways. While some have proposed that the EsA principles need to be revised and clarified to make them more useful operationally (e.g. Korn, 2006; Müller, 2006), the key

⁷ <http://www.iucn.org/themes/CEM/ourwork/ecapproach/index.html>

⁸ For more extensive documentation see <https://www.biodiv.org/programmes/cross-cutting/ecosystem/sourcebook/advanced-guide.shtml?approach>

point that emerges from recent debates is that there is probably no final definition of the concept, and that its meaning is likely to develop as it is applied and shortcomings detected. Indeed, as a number of commentators have observed, (Maltby, 2000; Smith and Maltby, 2003; Hartje et al., 2003), the fluidity of the EsA concept is a virtue, because the principles that underpin it are not equally applicable in all circumstances. Solutions have therefore to be tailored to meet the requirements of the problem in hand. Despite its critics, the EsA continues to provide a strong conceptual basis for policy and management decisions.

In the work leading up to this Report we concluded that Defra should consider developing its vision using a language and terminology that is appropriate to the audiences being targeted. On the basis of the analysis of the relationship between the EsA principles and the SD Strategy, it was clear that Defra's broad strategic objectives could easily be re-cast in terms of the EsA, but that there was scope for them to be more focused in the way they are presented. We argued that the EsA principles could be regrouped and restated more simply, in terms that better reflect Defra's needs⁹.

Although Defra's recently published Action Plan (Defra, 2007) now presents the EsA principles in a more generic way, the summary-nature of the document meant that the rationale for simplifying and regrouping them could not be set out in detail. In the Full Technical Report we have therefore presented what we consider to be the case for adopting such the 'tailored' approach to be.

On the basis of our review, we concluded that accepting the EsA amounts to seeking an ***inclusive, cross-sectoral decision making at appropriate spatial and temporal scales so that proper account is taken of the value of environmental systems for the well-being of people***. This formulation of the EsA, we suggest, combines the four key themes¹⁰ included in the EsA which are particularly relevant to Defra's current priorities, namely:

- 1. Inclusive Decision Making:** As the EsA emphasises, the management of environmental resources is a matter of *societal choice*, and so we need to ensure that the views and understandings of different people and organisations are taken into account (Potschin & Haines-Young, 2006). These views include the values and priorities people have in relation to the management of environmental resources, and their knowledge about the systems being managed. The involvement of different groups will help ensure that the costs and benefits of decisions are shared appropriately, and that in the long term management of ecosystems is likely to be more sustainable.
- 2. Proper Accounting for the Environment:** The management of our environment needs to be set in and integrated with wider social and economic contexts. Thus following the EsA principles we need to be sure that the *costs and benefits* associated with protecting it or using the resources it provides are fully taken into account, so that they can be considered alongside other societal issues within appropriate timeframes (see 3 below).
- 3. Appropriate geographical and time perspectives:** Due to the complex ways environmental, social and economic systems interact, decision making about environmental resources will need to take place at a number of different levels and geographical scales. However, for management to be effective, those responsible for making decisions must work at a spatial and temporal scale that will allow them *to use knowledge about environmental limits* to act effectively to sustain the resource or to mitigate or modify the pressures that are acting upon it.
- 4. Joined-up policies:** The complex ways that environmental systems are linked to each other and to other social and economic systems means that the broad implications of

⁹ See also attempts to cluster EsA principles: www.iucn.org/themes/CEM/ourwork/ecapproach/index.html

¹⁰ The Action Plan sets out the same ideas in five generic principles – but they are broadly the same as those presented here.

decision making needs to be considered by all sectors of society. Thus we need to ensure that in the design and appraisal of policy, or the evaluation of management decisions or development plans, the implications of proposals are considered in an *integrated way* so that the integrity of environmental systems is not undermined and change is managed sustainably.

2.3 Embedding the EsA

The case for adopting an Ecosystem Approach cannot be made in terms of ‘principles’ alone, however. Operational matters also have to be considered. At the practical level we still need to examine the extent to which current practice falls short of what might be expected or identify how it could be improved by using some set of guidance based on the EsA. If the EsA is accepted as a way of working, then it potentially provides a framework for reviewing and auditing current initiatives and programmes. **A review of the consistency of all Defra’s activities and areas of concern with EsA principles is, therefore, one potential next step that could be recommended on the basis of this study.** Such a review would provide the evidence necessary to make the case that at the operational level, deficiencies were apparent, and that these could be overcome by application of the concepts and methods embodied in the Ecosystem Approach. The review might then be extended to environmental issues linked to the work of other Government departments^{11, 12}.

Such a wide ranging review of indicators and policy is outside the scope of the current project. However, as a first step towards evaluating the contribution that the EsA might make at an operational level, we focused specifically on the issue of ecosystem services. The sustainable management of ecosystem services is a key area highlighted in Defra’s current Action Plan. The importance of ecosystem services is also specifically acknowledged in the EsA.

To explore the case for the EsA further, in the remaining parts of this explores what current evidence exists about the state and trends of the services associated with England’s major terrestrial ecosystems. In particular we examine the extent to which current policies or management frameworks are consistent with the thinking embodied in the EsA, or what more might be done to ensure that better strategies for sustaining these services can be devised. Part 3 sets out the conceptual framework, and Parts 4 and 5 then consider the evidence empirically.

Box 2.1: Key messages from Part 2

- *The Ecosystem Approach (EsA) provides a strong conceptual basis for making policy and management decisions. It may best be considered as an evolution of other approaches from the specific position of ecosystems. It is largely consistent with – and could be a more explicit part of – the broader approach offered by the sustainable development agenda.*
- *As an integrative and holistic framework, the EsA provides an attractive and relatively consistent conceptual approach to addressing cross-cutting issues and externalities that, historically, have often been ignored. Much of its value is as a conceptual tool that allows for (and places at its centre) real environmental value that has traditionally been ignored in economic valuations.*
- *The EsA is best promoted by tailoring its key ideas to current strategic needs and priorities, and by finding ways of using the principles to shape the actions of decision makers in other Government departments or in Society more generally.*
- *The EsA principles can be used as a way of auditing current and future policy initiatives, and the extent to which they are consistent with ‘whole-systems’ thinking.*

¹¹ Defra’s current Action Plan (Defra, 2007) now sets out actions to ‘mainstream’ the EsA at national level which could be used to monitor success, and these could be a starting point for such a review.

¹² Defra has commissioned a project on “Reviewing targets and indicators for the ecosystem approach” (project code NR0119). For aims, objectives and contractor consult Defra homepage: <http://www.defra.gov.uk/wildlife-countryside/natres/research.htm>.

Part 3: Understanding Ecosystem Services

3.1 Introduction

The operational issues that follow from adopting an Ecosystem Approach to decision-making are complex and wide ranging. In this part of our Report we consider what they might involve in the context of assessing the state and trends of ecosystem services. Clearly, if the EsA is found to be essential in helping decision-makers think about ecosystem services and link issues across the environmental, social and economic domains, then the case for proposing it as an overarching philosophy would be much stronger. In the Full Technical report we therefore examine current thinking about ecosystem services, and specifically how the EsA helps in managing them sustainably.

3.2 What is an Ecosystem Service?

According to the Millennium Ecosystem Assessment (MA) (2003 Ch 2, p.53) ecosystem services are the benefits people obtain from ecosystems. On the basis of this definition the MA provided a simple typology of services that has since been widely taken-up in the international research and policy literatures. Four broad types of service identified are:

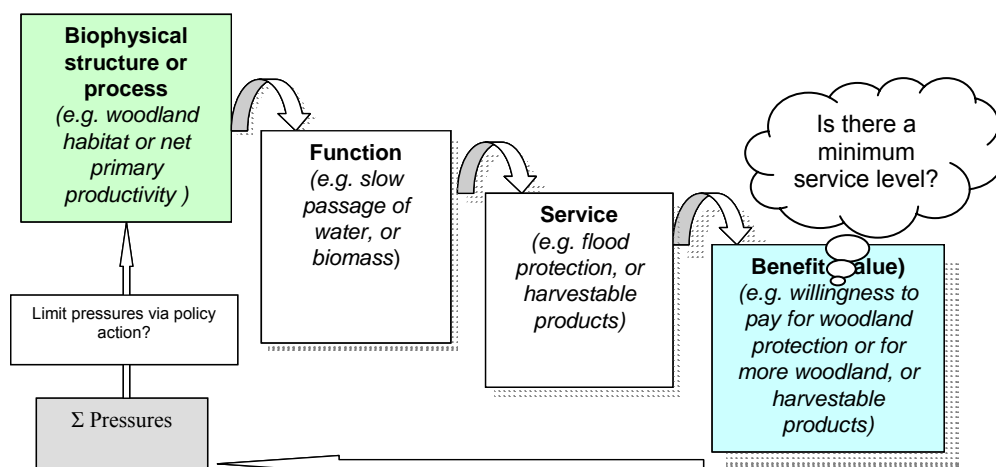
- **Provisioning services** which are represented by the output of products such as food, fresh water, fuel, fibre, biochemicals and genetic resources;
- **Regulating services** which cover the mediating role that ecological systems have in affecting climate, the incidence of disease, water quality and quantity, and pollination processes;
- **Cultural services** which include the non-material benefits ecological systems can provide in terms of their spiritual or religious significance, recreation and tourism, aesthetics, educational and scientific value and cultural significance; and,
- **Supporting services** which are the processes that underpin all the other services, such as soil formation, nutrient cycling and primary production.

Although the MA typology has been accepted widely, it has some limitations for those interested in operationalising the concepts. A number of problems are evident. The list of services is by no means complete, for example, and other more extensive and detailed categorisations have been provided (e.g. Bastian and Schreiber, 1999; de Groot et al., 2002). In addition there are logical inconsistencies within the scheme: food and fresh water are placed under provisioning services, but clean air is not. Also, while 'educational' and 'ecotourism' feature, there is no mention of other job opportunities that arise from services. As pointed out by the authors of the MA, categories may overlap and some services underpin others, but they nevertheless sit next to each other in the table, such as climate regulation and food, or climate regulation and disease regulation. Finally, if we follow the MA definition that 'services are the benefits people obtain' then we should only focus on the things that are directly used or consumed by Society. The placement of supporting services is problematic because they may lead to 'double counting' in valuation studies. Thus despite its influence, the 'service typology' of the MA, though useful, clearly demands elaboration and refinement.

3.3 Linking Ecosystem Services and the EsA

Figure 3.1 summarises the logic that underpins the concept of ecosystem services. Using this idea of a cascade from ecological structures and process through to the benefits people enjoy, we considered different approaches to the problem of making an assessment of the state and trend in ecosystem services. In particular the work examined how an ecosystem service unit might be defined. Our review enabled us to identify three distinct, but complementary perspectives on the problem of making an assessment of England's terrestrial and freshwater ecosystem services, namely:

Figure 3.1: An Ecosystem Service cascade - The logic underlying the ecosystem services paradigm (after Haines-Young et al., 2006)



Note: The present study (NR0107) "only" deals with the first three steps. The Benefits/Valuation step is part of another project commissioned by Defra (NR0108).

- **'Habitats perspective'** which considered habitat units such as the UK Biodiversity Action Plan Broad and Priority habitats as potential service providing units;
- **'Service perspective'** which attempted to focus directly on services themselves, and only consider habitats if they were appropriate for understanding the processes that gave rise to them; and,
- **'Place-based perspective'**, which examined the merits of a spatially explicit approach, which sought to identify all the services in a defined geographical area, and the relationships between them.

In the remaining parts of the report we examine the strengths and weaknesses of these approaches, and the extent to which they could be used in the English context, given the data currently available.

Box 3.1: Key messages from Part 3

- *The Millennium Ecosystem Assessment (MA) and other initiatives have been useful in moving the debate forward in terms of understanding the link between ecological systems and human well-being.*
- *However, frameworks used to define ecosystem services tend to conflate processes and outputs, functions and services, making it difficult to operationalise. The MA service typology is best regarded as a set of themes that must be refined and expanded in the context of any particular study, and further work is needed to examine how this can best be done in different situations.*
- *The difficulty of defining the bounds of ecosystems makes it hard to define units for assessing ecosystem services. Further work is needed on the definition of ecosystem service units. However, three distinct but complementary approaches can be identified that take a habitat, service or place-based perspective on the problem.*
- *Encouraging people to think about ecosystem services might be the best way of leading them to apply 'EsA thinking', particularly in the context of developing sustainable development*

Part 4: Ecosystem Services - Taking a Habitats Perspective

4.1 Introduction

In the UK we are particularly well-placed to explore the merits of a 'habitats perspective' to the assessment of ecosystem services, because of the wide acceptance by different organisations of the Biodiversity Action Plan (BAP) 'Broad' and 'Priority Habitats' (see Jackson, 2000). A clear advantage of using these habitats is that as distinct ecological units they could be seen in terms of the 'bundles' of services that they can deliver. As a result, the importance that they have as elements of 'natural capital' can be more properly assessed, and any trade-offs between ecosystem services implied by current or future management choices can be better understood. In short, people already make decisions about Broad and Priority Habitats, and if thinking can be extended to take in issues relating to the maintenance of ecosystem services, then this might be one way of initially testing and eventually promoting the principles underpinning the Ecosystem Approach.

4.2 Constructing the Evidence Base

Our literature review suggested that evidence about the association of ecosystem services and the BAP Broad and Priority Habitats was limited, and so we devised a questionnaire which was sent to people involved in the recent revision of conservation targets for each Priority Habitat. We asked respondents to consider the wider benefits that these habitats might provide and what might be achieved by the revision of the target in terms of securing or enhancing the output of ecosystem services. The ecosystem service typology of the MA was used to prompt those surveyed about the potential services or benefits that might be associated with each habitat. Respondents were also asked if the service-benefit identified was associated only with the Priority Habitat or could be attributed to the wider, Broad Habitat. Altogether 33 experts completed the questionnaire, and information on 16 Priority Habitats and information on 15 Broad Habitats was collected by this means.

The completeness of the information from the questionnaire was cross-checked in two ways: by a literature review using the Broad and Priority Habitat names as the key search terms, and via a series of workshops. Four workshops consisting of between 4-7 experts from ADAS and other institutions were organised, so that the Broad and Priority Habitats could be considered in related groups. In addition, in an attempt to explore the issues surrounding the woodland Broad Habitat in greater detail, a further workshop with external experts was organised. The questionnaire responses, literature review and the workshop discussions produced a database containing 640 'habitat-service' records. Table 4.1 provides a summary.

Information about the status and trends of the Broad and Priority Habitats and the pressures upon them was assembled from a number of sources including Countryside Survey 2000, the SSSI condition monitoring data published by Natural England, the status and trends assessment included in the 2005 review of BAP Targets, and the change indicator for each Broad Habitat published in the New Plant Atlas of GB (Preston et al., 2002). The conclusions that may be drawn from these has been summarised in Tables 4.1 and 4.2. The lower half of Table 4.1 provides an overview of the information about the pressures impacting on each habitat. In Table 4.2 we attempt to consider both state and trends and their implications for the important services identified for each Broad Habitat.

4.3 Implications of Habitat Change for Ecosystem Services

Although we can build up a relatively good general understanding of the state and trends on the Broad and Priority Habitats from the monitoring and assessment data available, it is difficult to make a direct assessment of the implications for the ecosystem services associated with them. The main issue is that the evidence describing the relationships between habitat stock and condition and the output of different services is limited.

Table 4.1: Association between ecosystem services and the BAP Broad Habitats in England, and the potential pressures upon them.

		Broad Habitat																			
		Acid Grassland	Arable & Horticulture	Bogs	Boundary & Linear Features	Bracken	Broadleaved & Yew Woodland	Calcareous Grassland	Coniferous Woodland	Dwarf Shrub & Heath	Fen, Marsh & Swamp	Improved Grassland	Inland Rock	Montane Habitat	Neutral Grassland	Rivers & Streams	Standing Open Water & Canals	Supralittoral Rock	Supralittoral Sediments	URBAN & Builtup	
Service-themes	C: Aesthetic																				
	C: Heritage																				
	C: Jobs																				
	C: Recreation																				
	C: Scientific																				
	C: Spiritual																				
	P: Fibre																				
	P: Food																				
	P: Freshwater																				
	P: Genetic																				
	P: Medicinal																				
	P: Other																				
	R: Air quality																				
	R: Buffer																				
	R: Climate																				
	R: Disease (F?)																				
	R: Erosion																				
	R: Fire																				
	R: Natural hazard																				
	R: Other																				
	R: Pest (F?)																				
	R: Pollination (F?)																				
	R: Water flow regulation (F?)																				
	R: Water quality regulation (F?)																				
	S: Nutrient cycling (F?)																				
	S: Primary productivity (F?)																				
	S: Sediment																				
	S: Soil formation (F?)																				
	Number of services		18	17	19	16	9	22	16	15	22	18	15	5	12	20	20	16	1	20	11
	Pressures	Agricultural expansion/intensification (crop regime=c, grassland=g)		c		c															
Atmospheric pollution/Diffuse pollution/Critical load exceedance																					
Climate change																					
Decline of woodland coppicing/pollarding																					
Effluent, pollution-freshwater																					
Erosion																					
Eutrophication/pollution (soil=s water=w)			s		s	sw		s	s		s	s	sw			s	s	s			
Flood/coastal protection defences												cf				f			c		
Habitat loss (h=trows=h, field margins=m, trees=t, fwater=f)												f				m				t	
Human disturbance (eg tourism)														t							
Inappropriate grazing regimes (overgrazing/undergrazing)			iou					ou	iou		iu	iou				ioui				u	
Infrastructure/Mineral Extraction/landfill																					
Invasive species (competition=c, disease=d, predation=p)																					
Lack of dead wood																					
Land drainage (for: agri.=a, infrastructure=i, flood defence=f)																					
Management (lack of inappropriate, incl. land abandonment)																					
Natural disasters																					
Natural succession																					
Replanting woodland with inappropriate tree species																					
Urban development																					
Water abstraction (ground=g, surface=s)																					
Woodland/forestry planting																					

- 2005 BAP Review Lead Partner Responses
- Not analyzed by BAP Review Lead Partner
- Additional pressures as identified by Forestry Commission
- Additional pressures as identified by project team and/or workshop participants
- Additional pressures on SSSI

Notes: The cross tabulation is based on questionnaire survey results, literature review and expert workshop assessments. The services are separated and colour-coded into Cultural (C), Production (P), Regulating (R) and Supporting (S) groups, and association are indicated by the appropriate colour tone; the cross-hatched cells are those identified in the workshops as probably the most important for each Broad Habitat. Service marked with an F? indicate where some of those consulted argued that the themes represent ecological functions rather than services – but we have retained the MA typology as the basis of this Table. The pressures were identified from the source shown by colour coding, although similar types of pressure were grouped. The Table indicates specific pressure subtypes using letter codes defined in the row title for each pressure.

Table 4.2: Summary of changes in stock and condition by broad habitat, impact on services and knowledge gaps

Broad Habitat	Assessment		Sensitivities and long term trends	Potential impact on services	Comments on evidence base
	Stock	Condition			
Acid Grassland	▼	▼	<ul style="list-style-type: none"> • Sensitive to pressures related to land management and diffuse pollution • Medium vulnerability to climate change esp. for Lowland Dry Acid Grassland • Small increase in area of Lowland Dry Acid Grassland Priority Habitat planned under 2005 BAP Review 	<ul style="list-style-type: none"> • Possible loss of genetic services • Importance of impact on cultural and regulating services associated with Broad Habitat unknown since habitats replacing Acid Grassland may have similar service associations 	<ul style="list-style-type: none"> • More information needed on relationship between ecological condition and the output of cultural, and regulating services • Improved monitoring of changes in stock and condition at Priority Habitat level
Arable & Horticulture	≈	▼?	<ul style="list-style-type: none"> • Sensitive to changes in market conditions and regulatory environments • Probably can adapt to changing climate conditions assuming appropriate management and policy interventions • Marked increase in area of Cereal Field Margins planned under 2005 BAP Review 	<ul style="list-style-type: none"> • Potential impact on genetic services associated with Broad Habitat which are not used directly in provisioning activities • Impacts of emissions on other habitats potentially significant – externalities need better accounting frameworks 	<ul style="list-style-type: none"> • More information needed on output of non-market services associated with this Broad Habitat, especially extent of landscape and amenity and species protection • More information needed on quantifying the service benefits associated with targets for expansion of extent of field margins • More information needed on extent to which agricultural system can generate additional benefits through assimilation of organic wastes etc.
Bogs	≈	▼	<ul style="list-style-type: none"> • Sensitive to pressures related to land management (esp. drainage) and diffuse pollution • Lowland raised bogs have high potential vulnerability to climate change scenarios • Substantial increase in area of Broad Habitat in favourable condition planned under 2005 BAP Review 	<ul style="list-style-type: none"> • Marked impact on regulation services for water quantity and quality 	<ul style="list-style-type: none"> • Better information needed on extent of Broad Habitat and variations in condition • Better inventory information needed to document different categories of bog and its potential for restoring different ecosystem services • A better understanding is needed about the way the overall functionality of the ecosystem is reflected in the current criteria used to assess conservation status • More research on extent to which restoration methods will restore or secure ecosystem services associated with Broad Habitat

Key ▼= declining; ▼? Possibly declining; ≈ Stable; ≈? Possibly stable; ▲=Increasing; ▲? Possibly increasing; !=Unknown; Climate change assessment from Hossell et al. (2000)

Table 4.2, cont.:

Broad Habitat	Assessment		Sensitivities and long term trends	Potential impact on services	Comments on evidence base
	Stock	Condition			
Boundary & linear features	≈?▲	≈	<ul style="list-style-type: none"> • Sensitive to changes in land management and especially agri-environmental support • Vulnerability to climate change uncertain • Substantial increase in extent and proportion of Broad Habitat in favourable condition planned under 2005 BAP Review 	<ul style="list-style-type: none"> • Past changes have impacted on ability to deliver genetic and landscape resources 	<ul style="list-style-type: none"> • Better inventory information on stock and condition is needed at local scales, together with information on hedgerow trees • More research is needed into the wider service characteristics of hedgerows, in terms of regulatory functions
Bracken	≈	≈	<ul style="list-style-type: none"> • Sensitive to changes in land management • Low vulnerability to climate change 	<ul style="list-style-type: none"> • Services associated with this habitat are currently not highly valued, although Broad Habitat does have some significance for BAP species, and for landscape • Liabilities associated with habitat often emphasised more than benefits 	<ul style="list-style-type: none"> • Better information is needed to understand the costs and benefits associated with control of bracken in different types of location, especially in terms of nutrient and carbon fluxes
Broadleaved, Mixed & Yew	▲	▲	<ul style="list-style-type: none"> • Sensitive to changes in land management and support through planting and management grants • Probably can adapt to changing climate conditions assuming appropriate management and policy interventions, although effects are likely to vary geographically • Substantial increase in extent and proportion of Broad Habitat in favourable condition planned under 2005 BAP Review 	<ul style="list-style-type: none"> • Non-market benefits associated with this habitat appear to have expanded significantly, and are probably valued more highly • Services associated with some Priority Habitats (Traditional Orchards, and Wood Pasture) may be at risk 	<ul style="list-style-type: none"> • Better inventory information on changes in stock, condition and management status is needed, both for important woodland habitats recognised by the BAP framework, and in terms of woodlands generally (e.g. NIWT) • Publicly available information on woodland stock and condition should be linked to information on the location and purposes of woodland grant scheme agreements, and locations and circumstances where felling licences are granted

Key ▼= declining; ▼? Possibly declining; ≈ Stable; ≈? Possibly stable; ▲=Increasing; ▲? Possibly increasing; !=Unknown; Climate change assessment from Hossell et al. (2000)

Table 4.2, cont.:

Broad Habitat	Assessment		Sensitivities and long term trends	Potential impact on services	Comments on evidence base
	Stock	Condition			
Calcareous Grassland	▼?≈	▼	<ul style="list-style-type: none"> • Sensitive to changes in land management in areas marginal for farming, and impact of diffuse pollution • Probably at medium to high risk under climate change scenarios • Substantial increase in extent and proportion of Broad Habitat in favourable condition planned under 2005 BAP Review 	<ul style="list-style-type: none"> • Possible loss of genetic services, and aesthetic properties of landscape where scrub invasion has occurred • Habitat possibly important for pollinators and for water quality/quantity regulation 	<ul style="list-style-type: none"> • Better stock and change data needed; CS2000 estimates are unreliable • Impacts of restoration measures on services other than those related to conservation value need to be investigated
Coniferous woodland	▼	≈	<ul style="list-style-type: none"> • Sensitive to changes in forest and conservation policy, which currently aims to replace stock with native tree species • Sensitive to change in market conditions • Potentially at medium to high risk under climate change scenarios 	<ul style="list-style-type: none"> • Services associated with this habitat are currently not highly valued 	<ul style="list-style-type: none"> • Further information is needed about the effectiveness of restoring coniferous woodland to other habitat types and the costs and benefits involved – other than those associated with the conservation case • The potential benefits of maintaining some old-growth coniferous stands should be investigated
Dwarf Shrub Heath	≈	▼?≈	<ul style="list-style-type: none"> • Sensitive to changes in land management and development pressure in lowland situations. • Possibly at medium levels of vulnerability in terms of climate change • Substantial increase in extent and proportion of Broad Habitat in favourable condition planned under 2005 BAP Review 	<ul style="list-style-type: none"> • Past losses have depleted the provisioning (genetic), cultural (landscape) and regulating services associated with this habitat 	<ul style="list-style-type: none"> • Significant knowledge gaps exist in terms of assessing the extent and condition of the Dwarf Shrub Heath resource outside of SSSIs, and therefore of monitoring progress on the BAP Targets • The extent to which the functioning of heathlands can be restored is also uncertain

Key ▼= declining; ▼? Possibly declining; ≈ Stable; ?≈ Possibly stable; ▲=Increasing; ▲? Possibly increasing; !=Unknown; Climate change assessment from Hossell et al. (2000)

Cont./

Table 4.2, cont.:

Broad Habitat	Assessment		Sensitivities and long term trends	Potential impact on services	Comments on evidence base
	Stock	Condition			
Fen, Marsh & Swamp	▲	≈? ▼	<ul style="list-style-type: none"> • Sensitive to changes in land management, diffuse pollution, agri-environmental initiatives, and levels of support for restoration of wetlands • Priority Habitats possibly at medium to low risk in relation to climate change • Substantial increase in extent and proportion of wetland habitats in favourable condition planned under 2005 BAP Review 	<ul style="list-style-type: none"> • Past losses have depleted the provisioning (genetic), cultural (landscape) and regulating services associated with this habitat for water quantity and quality • The expansion of Fen, Marsh Swamp may have mainly been due to the increased area of rush dominated pastures and so may have had limited positive impact on the services expected to be associated with this habitat (esp. those related to the wetland types of priority habitat) 	<ul style="list-style-type: none"> • Improved systems are needed for monitoring the extent and condition of both wetlands, and upland communities • There is considerable interest in the restoration of wetlands at the landscape scale. More research is needed to understand the extent to which wetland restoration can restore the full range of ecosystem services, and to understand how conservation status maps onto underpinning ecological functions • Further work is required to understand how improved grazing management can restore Purple-moor Grass and Rush Pasture
Improved Grassland	≈	≈	<ul style="list-style-type: none"> • Sensitive to changes in market conditions and regulatory environments • Probably can adapt to changing climate conditions assuming appropriate management and policy interventions; Grazing marshes may be more vulnerable 	<ul style="list-style-type: none"> • Potential impact on genetic services associated with Broad Habitat which are not used directly in provisioning activities • Impacts of emissions on other habitats potentially significant – externalities need better accounting frameworks 	<ul style="list-style-type: none"> • More information needed on output of non-market services associated with this Broad Habitat, especially extent of landscape and amenity, species protection and water storage • Better systems needed for the surveillance and monitoring of grazing marshes • Further work is needed to develop indices of quality that take all the component interests of grazing marshes into account, including invertebrates, birds, aquatic macrophytes, wet grassland and fen plant species

Key ▼= declining; ▼? Possibly declining; ≈ Stable; ≈? Possibly stable; ▲=Increasing; ▲? Possibly increasing; !=Unknown; Climate change assessment from Hossell et al. (2000)

Cont./

Table 4.2, cont.:

Broad Habitat	Assessment		Sensitivities and long term trends	Potential impact on services	Comments on evidence base
	Stock	Condition			
Inland Rock	!	≈	<ul style="list-style-type: none"> • Unknown 	<ul style="list-style-type: none"> • The service characteristics of this Broad Habitat are uncertain – although they clearly play a role in both landscape and recreational services 	<ul style="list-style-type: none"> • Further work is needed to identify the service associations of this Broad Habitat
Montane Habitats	!	▼	<ul style="list-style-type: none"> • Unknown 	<ul style="list-style-type: none"> • The service characteristics of this Broad Habitat are uncertain – although they clearly play a role in both landscape and recreational services 	<ul style="list-style-type: none"> • Further work is needed to identify the service associations of this Broad Habitat
Neutral Grassland	▲	≈? ▼	<ul style="list-style-type: none"> • Sensitive to changes in land management and level of agri-environmental support and diffuse atmospheric pollution • Lowland Meadow Priority Habitat possibly at medium risk in relation to climate change • Substantial increase in extent and proportion of Broad Habitat in favourable condition planned under 2005 BAP Review 	<ul style="list-style-type: none"> • Increases in stock possibly beneficial impact on services associated with this habitat, although lower intensity of agricultural inputs to pastures systems is generally beneficial • Expansion of Lowland Meadow Priority Habitat have possibly benefited genetic provisioning services 	<ul style="list-style-type: none"> • Further work is needed to support the conservation studies on scarce animal and plant taxa associated with unimproved neutral grasslands, and to understand the assess the effect of atmospheric nutrient deposition and climate change on community composition, and commission research as appropriate • Better surveillance and monitoring programmes are needed to support action plan targets

Key ▼= declining; ▼? Possibly declining; ≈ Stable; ≈? Possibly stable; ▲=Increasing; ▲? Possibly increasing; !=Unknown; Climate change assessment from Hossell et al. (2000)

Cont./

Table 4.2, cont.:

Broad Habitat	Assessment		Sensitivities and long term trends	Potential impact on services	Comments on evidence base
	Stock	Condition			
Rivers & Streams	≈	▲	<ul style="list-style-type: none"> • Sensitive to changes in land management and diffuse agricultural pollution • Sensitive to water regulation strategies in surrounding catchments, and water abstraction levels • Chalk Rivers possibly at high risk in relation to climate change 	<ul style="list-style-type: none"> • General improvement in water quality throughout England, although resource remains vulnerable to agricultural runoff • Water (flow) regulation service impaired in some areas by engineering – more sustainable management strategies are being promoted 	<ul style="list-style-type: none"> • In the light of the Water Framework Directive, a better understanding of catchment hydrology, nutrient budgets and loads, and the costs and benefits occurred in relation to delivering the services associated with this Broad Habitat is needed • More research is needed into the limits of tolerable eutrophication and the costs and benefits of different mitigation strategies in different locations, and in particular the effects of eutrophication on recreation and tourism and on the lives of those living and working by affected water courses • Better information is needed on the extent of ecological and social damage brought about by poor water quality and flow regulation, and on the costs of in-water preventative and remedial measures
Standing open water & canals	≈	≈? ▼	<ul style="list-style-type: none"> • Sensitive to changes in land management and diffuse agricultural pollution. • Sensitive to water regulation strategies in surrounding catchments, and water abstraction levels • Vulnerability of Mesotrophic Lakes to climate change is probably medium, but is lower for Eutrophic Lakes. Vulnerability of Aquifer Fed Waterbodies is uncertain 	<ul style="list-style-type: none"> • General improvement in water quality throughout England, although resource remains vulnerable to agricultural runoff 	<ul style="list-style-type: none"> • In the light of the Water Framework Directive, a better understanding of catchment hydrology, nutrient budgets and loads, and the costs and benefits occurred in relation to delivering the services associated with this Broad Habitat is needed • More research is needed into the limits of tolerable eutrophication and the costs and benefits of different mitigation strategies in different locations, and in particular the effects of eutrophication on recreation and tourism and on the lives of those living and working by affected water courses • Better information is needed on the stock and condition of the Eutrophic and Mesotrophic Priority Habitats

Key ▼ = declining; ▼? Possibly declining; ≈ Stable; ≈? Possibly stable; ▲ = Increasing; ▲? Possibly increasing; ! = Unknown; Climate change assessment from Hossell et al. (2000)

Cont./

Table 4.2, cont.:

Broad Habitat	Assessment		Sensitivities and long term trends	Potential impact on services	Comments on evidence base
	Stock	Condition			
Supralittoral rock	!	≈	<ul style="list-style-type: none"> • Sensitive to coastal pollution, unmanaged recreational access, sand and shingle extraction • Vulnerability to sea level change and erosion ('coastal squeeze') puts habitat at medium to high risk in relation to climate change 	<ul style="list-style-type: none"> • Limited evidence available 	<ul style="list-style-type: none"> • Better monitoring and surveillance data are needed • Further work needed to identify how integrated coastal management plans, water quality objectives, and pollution control and avoidance measures can be integrated to enhance the services associated with this Broad Habitat
Supralittoral sediment	!	≈	<ul style="list-style-type: none"> • Sensitive to coastal pollution, unmanaged recreational access, sand and shingle extraction. • Vulnerability to sea level change and erosion ('coastal squeeze') puts habitat at medium to high risk in relation to climate change. • BAP Targets uncertain, although some expansion of saltmarsh is planned under BAP 	<ul style="list-style-type: none"> • Limited evidence available 	<ul style="list-style-type: none"> • Better monitoring and surveillance data are needed • Further work needed to identify how integrated coastal management plans, water quality objectives, and pollution control and avoidance measures can be integrated to enhance the services associated with this Broad Habitat
Urban (including build up areas and gardens)	▲	!	N/A	<ul style="list-style-type: none"> • Poor urban design has limited on the capacity of these designed ecosystems to deliver non-market services to people, and has impacted upon surrounding habitats 	<ul style="list-style-type: none"> • More research is needed into how better urban design could enhance or expand the provision of non-market environmental services to people, and minimise the impacts of urban living on surrounding habitats

Key ▼= declining; ▼? Possibly declining; ≈ Stable; ?≈ Possibly stable; ▲=Increasing; ▲? Possibly increasing; !=Unknown; Climate change assessment from Hossell et al. (2000)

Nevertheless, in general terms the analysis presented in Table 4.1 and 4.2 suggests that at national scales at the individual habitat level, the services associated with the Acid Grassland, Arable and Horticulture, Bog, Calcareous Grasslands, Coniferous Woodlands, Dwarf Shrub Heath, Montane and Standing Waters and Canals and possibly Fen, Marsh Swamp, show evidence of decline, whereas those associated with Broadleaved and Mixed Woodlands, Rivers and Streams are possibly stable or increasing.

At this stage, however, we cannot draw any firm conclusions about the overall significance of these changes for individual services, or even what importance to attach to them at the individual habitat level. The analysis of the pressures upon each Broad Habitat shown in Table 4.1 suggest that the main causes of change are related to urban expansion, woodland planting, habitat replacement in the farmed landscape and natural succession brought about by changes in land management.

Four key points emerge from attempting to view the state and trends of services from a habitats perspective:

1. Some changes in stock are the deliberate result of public policy, and are not necessarily 'undesirable'. For example, the expansion of Broadleaved and Mixed Woodlands has in many areas been undertaken at the expense of Coniferous Woodlands or one of the intensively managed agricultural Broad habitats, given the policy decision to promote and re-establish native woodlands in England. The BAP Broad and Priority Habitats already have a number of societal values built in.
2. Some stock trends appear to partially offset each other in terms of the overall output of services. The case of Acid Grasslands, which shows a 15% reduction in stock for England between 1990 and 1998, is particularly interesting. The evidence from CS2000 suggests that the losses in stock of Acid Grasslands have mainly been to Improved Grassland, and to a smaller extent Bracken, Bog and Fen, Marsh and Swamp. While these changes might have considerable implications in terms of the genetic resources associated with each habitat, it is not clear that the overall level of, for example, the landscape and recreational service would be changed, or how services associated with water regulation might be modified.
3. A number of the BAP targets set in the 2005 Review involved significant increases in the stock of certain Priority Habitats (e.g. Lowland Calcareous Grassland, Lowland Dry Acid Grasslands, Lowland Heath, Lowland Dry Acid Grassland, and Native Broadleaved Woodlands). The review materials are unclear, however, about wider benefits such expansion would have – other than securing the conservation value of these habitats.
4. Part of the problem we face in understanding the implications of changes in habitat condition for service output is that most of the measures of condition relate to some aspect of conservation status or biodiversity, and cannot easily be used to assess what this might mean for the output of other services. Moreover, we cannot assume that changes in condition would affect all the services associated with a given habitat equally. The extent of the evidence available is variable, and much more is known about some habitats than others. **Further work is needed to develop new condition measures for our Biodiversity Action Plan (BAP) habitats that help people understand their importance for ecosystem services and subsequently, for quality of life and human well-being.**

4.4 The Habitats Perspective – An Assessment

In the UK, the BAP Broad and Priority Habitats clearly represent convenient framework thinking about ecosystem services. They also have strong policy relevance, in that they have been used to identify many of the conservation issues facing ecological systems at national scales, and are the focus for a broad range of initiatives aimed at sustaining many of our most important ecological assets. However, a habitats perspective does not offer a complete framework for looking at the state and trends of ecosystem services.

It seems clear, for example, that while distinct habitat-service associations might be identified, changes in habitat stock are not a simple indicator of changes in a given service. Current evidence does not allow us to predict what the consequences of changes in the extent of a given habitat might have. Moreover, since changes in stock generally involve the exchange of land area with other types of habitat, the overall implications of change probably have to be looked at in a wider context, as envisaged by the EsA.

It is also apparent that current understandings of the ecological condition of habitats are limited in terms of predicting the consequences for the services associated with them. **We recommend that future research is needed to expand the concept of 'favourable conservation status' to cover what changes in condition mean for the output of at least the most important services associated with each habitat.** As with arguments for increases in the stock of Priority Habitats, the case for restoring their conservation status would be strengthened if the additional benefits gained by enhancing or securing the output of ecosystem services associated with them could be demonstrated. Such research would need to take account of the limits of ecosystem function, so that a better assessment of the pressures acting upon them could be made.

The analysis based on a 'habitats perspective' suggests that while the focus on habitat service associations is useful, it is probably quite narrow as a way of promoting an Ecosystem Approach. On the one hand, it would probably be difficult to address or mitigate the pressures on services by working at the individual habitat level, because they are generally of a more wide-ranging character. On the other, the relationships between habitats, and in particular the different values we place on the services associated with them, need to be considered if an overall assessment of changes in stock and condition are to be made. While the BAP Habitats may be a useful framework for the conservation of biodiversity, other areas of public policy are more concerned with balancing the benefits and liabilities associated with different kinds of habitat against each other. These cross-habitat assessments cannot easily be made if we restrict ourselves to thinking about services to the individual habitat level.

Box 4.1: Key messages from Part 4

- *The BAP Habitats provide a valuable framework in which to think about ecosystem services and the pressures upon them. It also provides a framework in which a large body of information on the state and trends of these 'ecosystem service units' can be brought together.*
- *Further research is needed to establish how changes in the extent and condition of these habitats affect the output of services potentially associated with them. The evidence available mostly relates to their conservation value, rather than the other cultural, provisioning and regulating services linked to them. The conservation case for the BAP habitats would be considerably strengthened if the implications of changes in stock and condition for ecosystem services could more clearly be set out.*
- *Further work is also needed to document the liabilities (dis-benefits) associated with particular habitats so that more balanced ecosystem assessments can be made.*
- *Although the study of services by habitats may be useful in terms of understanding how ecological structures and processes give rise to particular benefits, a 'habitats perspective' on services is limited in terms of promoting an Ecosystem Approach. A more integrated view of services is needed if an overall assessment of the impact of habitat change on service output is to be made, or the impacts of pressures on these services are to be mitigated.*

Part 5: Taking a Service Perspective

5.1 Introduction

To what extent is it possible to take the matrix of habitats and services shown in Table 4.1, and make an analysis of each service on the basis of the individual habitats that potentially contribute to it? The simple answer is that given the current state of knowledge it is difficult. Three issues need to be considered:

1. We would have to assume that the identification of services and their relative importance shown in Table 4.1 was comprehensive and that it really did identify those habitats contributing to a given service. Unfortunately, the matrix was put together on the basis of 'best available information', and only gives a picture of the link suggested by different commentators. The lack of an association between a habitat and a service may simply mean that there is currently no literature on it, or that those consulted did not feel it was important compared to the other habitat-service associations identified.
2. Even if the matrix of associations between services and habitats shown in Table 4.1 was comprehensive, then we would still need some way of weighting the contribution each habitat to overall service output. To some extent this weighting would have to reflect the extent or quantity of each habitat unit, as well as its capacity to provide that service. As Part 4 suggested, there is little information on the relative importance of different habitats for a given service.
3. Faced with the task of making an assessment of the state and trends of a service, it may not be appropriate to view it as some aggregation of contributions made by these habitat units at all. The ecological mechanisms that underpin some services (e.g. flood protection) may operate across habitats or depend more on their combinations and patterns, than on the state and dynamics of individual habitats.

As a result it seems unlikely that we can presently use a framework like Table 4.1 in a straight-forward way to make a direct assessment of the service themes on an all England basis, even knowing what to do about the state and trends of individual habitats.

In order to identify what can be achieved, the study considered each service themes in turn and examined what analytical opportunities existed, and how potential analytical barriers might be overcome. In view of the number of service themes identified in Part 4 it was impossible to review them all, however. Thus we focused only on those where we felt progress could be made, or where particular analytical issues arose. The aim of the assessment was not however, to make a final judgement about the state and trends of the services, but to investigate the merits of an explicitly 'service-orientated' approach to the problem.

5.2 Service trends

Out of the eight services examined there was evidence of declining or impaired service output for five of them (Table 5.1). Supporting services, which include primary productivity and nutrient cycling, were not considered. These services are problematic within the MA typology, because they underpin the other themes, and therefore do not by definition, directly contribute to human well-being. In other words, they do not give rise to the 'final quantities' that we need to identify in any assessment study. In our analysis we have considered them when dealing with the processes that generate the other types of services.

5.2.1 Cultural Services

Within the cultural services group, recreation has probably been enhanced at national scales, largely as a result of changes in land management (particularly in relation to woodlands) and new access arrangements brought about by such initiatives as the Countryside and Rights of Way Act (CROW) 2000, and initiatives such as the establishment of the New Forest National Park. Given the type of spatially referenced

Table 5.1: Preliminary assessment of trends for selected service themes associated with England's terrestrial ecosystems.

Service group	Service theme	Assessment	Comment
Cultural	<i>Recreation</i>	▲	Recreational provision has improved as a result of forest policy and extension of access rights.
	<i>Aesthetic</i>	?	Unknown, the conceptual frameworks used to assess the aesthetic contribution of landscape service is presently limited.
Provisioning	<i>Food and fibre</i>	►◄	While the integrity of provisioning services seems stable, the impact of activities associated with the exploitation of this service has major impacts on other ecosystems.
	<i>Genetic</i>	▼	Probably declining.
Regulating	<i>Water quantity (flow regulation)</i>	▼	Probably declining but more slowly than in the past. Land cover change is an important driver.
	<i>Water quality</i>	▼	Probably declining but more slowly than in the past; diffuse pollution is a major driver.
	<i>Pollination</i>	▼	Probably declining possibly as the result of loss of food plants
	<i>Climate</i>	?▼	Although opportunities for increased carbon sequestration, the past loss or damage to blanket peat deposits and losses in soil organic carbon suggests that the service have been impaired.
	<i>Assimilation and purification</i>	P▲	There is the potential to increase the use of this service especially for the assimilation of organic materials.

Note: Supporting services were not formally included in the assessment to avoid the problem of 'double counting'; the assessment made here takes account of changes in any underlying ecological structures, processes or functions.

Key to symbols: ▲ service probably showing a positive trend; ▼ service probably showing a declining trend; ►◄ service provision probably stable; ? some uncertainty associated with the assessment; P there is potential to expand this service.

data on tranquillity and access that are now available at national scales, there is the prospect that in the future recreational opportunities can be modelled in detail for habitats (sites) and whole landscapes so that improved assessments can potentially be made.

No assessment could be made for the 'aesthetic' service associated with landscape because current conceptual frameworks are limited. We suggest that it is probably unhelpful to think of the landscape service as being associated with individual habitats at all, but rather to approach the problem at the level of the mosaic of habitats found in an area, and try to understand how the marginal values might change if their relative abundance and spatial patterns are transformed in some way. Our review points to the need for much further work to be undertaken in this area.

5.2.2 Provisioning Services

The production of food and fibre was looked at as a provisioning service, and was found that there is little evidence to indicate significant reductions in the productivity of agricultural or forest ecosystems as a result of biophysical changes. Thus they have provisionally been assessed as stable. However, the review suggested that in relation to these services for which a clear market existed, the main interest was perhaps not so much output levels, but the environmental costs of such provisioning systems for other kinds of ecosystem service, especially those relating to the provision of genetic resources, and the regulation of different aspects of environmental quality.

Our review suggest that that in the long term a more comprehensive accounting model for the provisioning services related to the agricultural and forest sectors is needed. Such a model look at services from an integrated or 'whole-systems' perspective, and as such be a valuable one for demonstrating the merits of the Ecosystem Approach in an operational sense. Our review did not consider food and fibre output related to the more informal harvest of biological materials, which in a developed economy such as ours may only be important in some local situations.

5.2.3. Regulation Services

The main areas of concern arising from the analysis related to the group of regulation services, especially those for water quantity and quality, pollination, and possibly climate. The output of all of these services appears to have been impaired. The major drivers of change identified were inappropriate land management and cross-sectoral impacts such as those arising from diffuse pollution. As a result, the development of strategies for the mitigation of these pressures and is clearly an area in which the principles of the Ecosystem Approach could be applied. In this context, the experience that is being gained through initiatives linked to the Catchment Sensitive Farming Programme, and new methods for Integrated River Basin Management will be invaluable in terms of understanding better what barriers exist hinder application of the Ecosystem Approach.

While there is some evidence of damage to the soil resource through loss of soil carbon, with the negative implications that follow in terms of climate regulation and greater vulnerability to erosion, there is possibly considerable potential for deriving additional benefits from soil ecosystems in the area of assimilation and purification. Providing future strategies take account of the biophysical limits of ecosystem function and the risks associated with any new technologies, there are opportunities to develop new uses for the assimilative services associated with soils, particularly for the treatment of organic wastes.

In the US Swinton et al. (2006) have emphasised that despite artificiality of agro-ecosystems they have great potential to expand the supply of ecosystem services compared to semi-natural systems. They argue that this is because much more is known about the biophysical relationships within them and we already have precedents for ways to intervene via markets or regulatory mechanisms exist. They also suggest that on grounds of past performance, agricultural systems have the capacity to respond to such external drivers. A similar argument probably exists for agricultural landscapes in England. The greater use of the assimilative capacity of soils may be one area in which this can occur.

5.3 The Service Perspective – An Assessment

The assessment of the selected services is necessarily preliminary. On the one hand, we have considered only a subset of themes covered by the MA typology. On the other, the analysis probably glosses over many qualifications that need to be made about reliability and coverage of the evidence and the way it should be interpreted. In particular, some consensus needs to be achieved for the period over which the assessment should be made, and the work needs to be extended by looking at possible future trends via a set of agreed scenarios relevant to the English situation.

Clearly the robustness of the analysis made would benefit from a more broadly based consultation across the different topic areas. This kind of process lay outside the brief for this study, and could perhaps only be achieved if a full 'MA style' assessment was made at national level. In the context of the present work, the main interest in the analysis represented by Table 5.1 is not, we suggest, primarily the conclusions about the particular service trends, but rather the issues that arose in the attempt to make the assessment. These can be summarised as follows:

1. Many of the services, especially the cultural ones, cannot be considered only from the biophysical perspective. The analysis of services such as recreation, for example, are contingent upon an understanding of peoples needs and preferences, and can only be undertaken if approached in an integrated way.
2. The exploitation of many services, especially the provisioning capacity of ecosystems, has both costs and benefits for society. Thus any assessment of ecosystem services within an EsA framework would have to look at the balance of costs and benefits probably through some kind of ecosystem accounting framework.

3. Of the selected themes, the group of regulating services are those which appear to be most affected by human activities. Some current initiatives to mitigate past damage and restore capacity, particularly in the area of managing water flow and quality, demonstrate the advantages of adopting an Ecosystem Approach, and could be used to identify best practice and operational guidelines.
4. The assessment of services can be used to identify both where human action has adversely impacted on a service and where intervention might give rise to additional or new benefits, as in the case of the assimilation of organic wastes, where there is the possibility to exploit ecosystem processes more fully, providing risks are managed appropriately.

The service-based perspective is therefore one which can be used to frame an assessment of the benefits that ecosystems can provide.

Our review suggests that the main short-coming of the service-based perspective is that by taking each service in turn, the links or interactions between services might be overlooked or difficult to handle. The approach, unlike the one built around habitats, might therefore not allow the multi-functional characteristics of ecosystems to be fully considered. In the final sections of this Report, we therefore investigate what strategies exist that allow the insights provided by the two conceptual frameworks to be brought together, so that their strengths can be combined and used most effectively to support decision making.

Box 5.1: Key Messages from Part 5

- *Although it is difficult to aggregate up from individual BAP Broad Habitats to make an assessment of the status and trends of ecosystem services, an understanding of habitat-service relationships was useful in developing assessment approaches.*
- *In some topic areas, especially those relating to the cultural services (e.g. aesthetics-landscape), further work is needed to develop a conceptual framework that would enable an assessment to be made.*
- *A more balanced assessment of provisioning services consistent with the EsA could be made by adopting an environmental accounting framework, within which the costs and benefits of management activities and their impacts can be assessed, and the inter-ecosystem consequences of exploiting the service can be considered.*
- *Current initiatives to manage human impacts on a number of services, especially those relating to the regulation of water quality and quantity, demonstrate the merits of adopting an EsA, and could be used to illustrate the kinds of integrated approach needed for the management of other types of service.*
- *In making an assessment of ecosystem services, the identification of future potential uses should be considered alongside an analysis of the extent to which current services have been impaired or damaged by human impact or environmental change.*

Part 6: Taking a Place-Based Perspective

6.1 Introduction

In this final part of our Report we examine a third approach to the task of assessing ecosystem services, which takes a 'place-based perspective'. A geographical or spatial approach seems to preserve strengths of each of the other perspectives and the opportunity to develop an integrated view of ecosystem services. Since people tend to make decisions about specific places, a spatial approach may also be a useful way of making the principles underlying the EsA operational.

6.2 Context, Scale and Pattern

The primary motive for suggesting a place-based approach is that our review suggests that the assessment of ecosystem services is often context dependent. This can be demonstrated in a number of ways. For example, a small % increase in woodland stock in an area of low forest cover will have different implications for landscape compared to the same increase in a well-wooded location. Alternatively, particular combinations of habitats may enhance the output of a service over and above that which might be expected if we made an assessment on an individual habitat basis. Finally, particular groupings of habitats may mean that the output of a service is buffered, or is more resilient, to change. In the uplands of England, landscape quality may have been hardly affected by the loss of Acid Grasslands and the expansion of other types of semi-natural habitat, because all the habitats concerned have similar capacities to generate this particular service. The context or location in which change occurs therefore matters.

Understanding the geographical patterns associated with ecosystem services is also important because change is often uneven. A gain or loss in the output of a service, or a change in the threats or pressures that act on them, may be concentrated in certain places. Thus decision makers will have to make a judgement about the scale and significance of such patterns if they are to make a balanced assessment of the situation. Ultimately the need to adopt a place-based perspective arises because assessments made about the importance of changes in the output of an ecosystem service are also dependent upon the geographical scale at which people ask their questions. Issues that are significant locally may not be important nationally. Moreover, the services themselves might have different geographical 'footprints'. This is frequently seen with many of the regulating services. While the capacities of ecosystems to regulate soil erosion and climate are both significant, the former is probably of most interest at regional and local scales. In the case of the erosion risk to peat areas in England, the causes of vegetation change and the consequences of vegetation loss are usually concentrated spatially, and so local assessments may be appropriate. By contrast, in the case of climate regulation, the significance of any release of the carbon stored in the peat has consequences far beyond the locality in which any damage to the resource occurs.

The Ecosystem Approach recognises that spatial context matters; the principles set out the proposition that systems have to be viewed and managed at 'appropriate' geographical scales. However, while this is undoubtedly the case, the idea poses considerable operational difficulties. Most administrative or decision making frameworks have been drawn up according to other criteria, and their proponents could equally suggest that they are 'appropriate' given the social, economic and political systems that they are dealing with. Even if an Ecosystem Approach was accepted, it is difficult to imagine how decision making could be co-ordinated across a series of different biophysical frameworks, each of which might be appropriate for the service being considered, but which may bear little conceptual or physical relationship to each other.

Since the places people make decisions about are also a matter of 'social choice', it would be misguided to apply the EsA too strictly, and be prescriptive about what kinds of spatial framework are to be preferred. In the review that follows we have therefore

considered that types of spatial framework that could be useful for assessing the state and trends of ecosystem services, the data resources that underpin them, and how they could be used flexibly in decision making at national, regional and local scales.

6.3 The Spatial Data Resource

A pre-requisite for implementing a place-based approach to assessing ecosystem services is the availability of good map information. Despite the fact that England has some of the best and most comprehensive environmental data in the world, it is still difficult to answer some of the basic questions needed to build up a geography of ecosystem services. Habitat and land cover information, for example, have been gathered for many purposes and through a variety of different survey methods and classifications, and it is not always easy to integrate these data and build the kind of robust evidence base that decision makers require.

A comprehensive review of the adequacy of different spatial databases for assessing ecosystem services is outside the brief for this study. These issues have already been partly covered as a result of other work commissioned by Defra¹³. **However, the experience gained through this review suggests that while the range of spatial information available allows particular aspects of ecosystem services to be explored, the data resource is fragmented and there is at present little incentive to bring the different elements together to construct an integrated data architecture.**

For example, while the Natural England habitat inventories provide the most detailed coverage of the extent and distribution of Priority Habitats that is currently available, in their present state they do not provide much information on change in stock or habitat quality. Although they are widely used, it is unclear how representative, accurate or comprehensive they are. Moreover, since a proportion of the inventory sites lies outside the SSSI network, there is no requirement to monitor their condition, even in a modified or simplified way. Unfortunately the monitoring gap cannot be filled by an initiative like Countryside Survey, whose sample-based structure produces results are at too coarse a thematic scale to give information at the Priority Habitat level. Similar problems of integration exist when we consider using the different inventory data alongside more comprehensive mapping products such as Land Cover Map 2000. Information about the location of the inventory sites and SSSIs, like those of other habitat features, such as the woodland parcels mapped in the Forestry Commissions' National Inventory of Woodlands and Trees, was not used to assist in the construction of LCM2000, nor do the parcels subsequently mapped in the LCM2000 product relate at all well to the boundaries found in the different inventories.

The advent of digital mapping has done much to improve the range and quality of information available, but the data resources remain embedded in different institutional silos and their thematic structure and content reflects different operational and scientific concerns. **If an Ecosystem Approach is ever to be made fully operational, then a much more integrated or flexible spatial data infrastructure is required than presently exists.** Our assessment of the extent to which current data resources can be used to build a geography of different ecosystem services is that while they are adequate, there are considerable opportunities for improving the range and quality of data resources available to researchers and decision-makers.

The range of mapping techniques now available means that flexible approaches to the definition of spatial frameworks can be adopted. For example, Natural England have partially developed a nested system of 'landscape description units', that might be developed to further examine how to map services or underlying functions at different spatial scales¹⁴. If structured appropriately, spatial databases can rapidly be used to construct and transform different views of the same underlying data, so that we do not

¹³ See NR0101 and NR0106 ("data projects" commissioned by Defra)

¹⁴ There is a national landscape typology at level 1, and a more detailed level 2 classification for parts of England.

need to confine ourselves to using one spatial framework at the expense of all others. **In designing the type of integrated spatial data infrastructure that is needed to support an Ecosystem Approach, we suggest that a key requirement is that it should allow the hierarchical relationships between different types of spatial unit to be built.** In this way, the place-based approach might be used for any spatial unit we care to define.

6.4 Making Decisions about Services

In the US context, Heal et al. (2003) has argued that ecosystem services might be best understood and protected by defining 'ecosystem service districts'. They base their argument on the success of soil conservation and flood control districts, which have enabled a range of resources to be managed sustainably at local scales. While the formal designation of service districts may not be appropriate in England, by encouraging people to think about the services associated with the areas they are making decisions about might achieve similar results.

In order to highlight the kinds of issue that need to be resolved generally, and to promote the EsA operationally so that people take account of the links between ecosystem services and human well-being, **we suggest that the following questions should be used as a starting point for any assessment:**

1. What are the ecosystem services associated with this place that matter to people's well-being?
2. How are these services generated? Do they arise locally or are they generated outside the place or area being considered?
3. How important is each of these services, to which individuals or groups, and for what reasons? Do people outside the area also depend on these services?
4. How can the importance of these services be prioritised or valued? Do we expect to have enough of each of these services either here or elsewhere in the future? What, if anything, could replace or substitute for each of the benefits obtained from these services, either here or elsewhere?
5. What kinds of management or policy actions are needed to protect or enhance these services and in particular how might actions directed towards one service impact or enhance another?

We have based these questions on a set initially suggested by the *Quality of Life Capital Project*¹⁵. However, we have revised and extended them, to make the connection to ecosystem services explicit and the link to the Ecosystem Approach clear. If, as we argued in Part 2, the Ecosystem Approach is seen as promoting '***inclusive, cross-sectoral decision making at appropriate spatial and temporal scales so that a proper account is taken of the value of environmental systems for the well-being of people***', then we suggest that by answering them the key themes that the Approach seeks to promote can be pursued. The issue of inclusiveness is covered principally by question 3, while the notion of taking proper account of the value of services is covered mainly in 4. Questions 1 and 2 have been included to help people scope the assessment exercise, and to explore the extent to which it is at an appropriate spatial and temporal scale – or at least to identify what scale issues need to be considered. The importance of cross-sectoral links is covered in question 5.

We accept that the language in which these questions are set may need to be simplified, and that some support might be needed to help people answer them. Nevertheless, we suggest that such a place-based framework could be used to encourage people to work through the sorts of issues that need to be considered in relation to ecosystem services when confronted with tasks such as EIA and SIA, or when they come to draw up Local Area Agreements or more generally when they need to assess specific policy or

¹⁵ <http://www.countryside.gov.uk/LAR/archive/Quality/index.asp>

management proposals. With all these tasks, there is probably no 'best' geographical scale for assessments and there will always be hierarchical relationships that have to be taken into account. However, we suggest that the questions cause people to look at these issues critically, and potentially identify how new and more effective decision making structures can be created. Thus there should be scope to include these sorts of questions within the evolving 'neighbourhoods' agenda under development by government and others as part of the new 'localism'.

In Part 3 it was argued that one of the strengths of the EsA is that it encourages those concerned with policy or management to take a broader perspective by considering the implications of setting or pursuing multiple objectives. In the real world the application of the policy or management is often constrained by narrow organisational responsibilities and institutional structures that limit the capacity to work together. Perspectives are also often constrained by the shortness of political or institutional time-frames and the difficulties of resolving the local and global aspects of problems. **We suggest that the questions outlined above can be used both to help people explore the service characteristics of particular places, and put in place the whole-systems thinking that is needed to implement strategies for sustainable development.**

In terms of taking an assessment of ecosystem services associated with England's major terrestrial ecosystems forward, we suggest that the spatial framework provided by the Government Office Regions is probably the one that is most appropriate. These geographical scales are more suited to the types of data resources that are currently available. More importantly, there are already institutional mechanisms in place within the Regions for looking at the implications of the UK Sustainable Development Strategy at local scales. With appropriate advice and guidance current approaches could be refined to cover issues linking ecosystem services and human well-being both across and within them.

Box 6.1: Key Messages from Part 6

- *Although the 'habitat' and 'service' perspective are useful frameworks for assessing ecosystem services, decision making is generally focused on specific geographical areas. Thus a place-based approach to assessing and managing ecosystem services is also valuable.*
- *The range of spatial mapping data that is currently available is probably sufficient for an initial assessment to be made at regional scales. However, for the future, better systems for linking information on habitat, land cover, management and monitoring are probably required.*
- *A place-based perspective on ecosystem services may be an effective way of making the Ecosystem Approach operational. It can encourage people to think about cross-sectoral issues, the appropriate geographical scales for analysis, and the way the values and priorities of different stakeholder groups can be included in decision making.*

Part 7: Conclusions and Recommendations

7.1 Introduction

In this final Part of our Report we will provide an overview of the conclusions and recommendations that we have made. In particular, we have sought to identify where further work is needed to fill any gaps in the evidence base, and where a more holistic, 'whole ecosystem', approach could be beneficial for the management of ecosystems and the services associated with them.

7.2 The Ecosystem Approach

We found that the Ecosystem Approach (EsA) is an appropriate one to use for assessing ecosystem services. It is valuable because it promotes the kinds of inclusive, cross-sectoral decision making that is needed when we consider what constitutes an ecosystem service and how such services might be valued. It also stimulates debate about what the right spatial and temporal scales are for securing the future supply of ecosystem services.

Our review showed that while the principles underpinning the EsA are consistent with, and support the current UK Strategy for Sustainable Development, Defra's current Action Plan did not, we feel, show clearly how it could be used operationally. We have suggested one way to promote the EsA is to encourage people to think about the state and trends of ecosystem services and to use this information to develop effective policy and management responses.

We have recommended (Part 2) that, while all the principles that underpin the Ecosystem Approach described in the Convention for Biological Diversity are relevant, the way they are expressed in Defra's current vision for the natural environment should be simplified. In particular they should be focused around the ways it can best deliver the goals of the UK Strategy for Sustainable Development.

The challenge that now confronts Defra, in terms of promoting the principles that underpin the EsA, is to describe them to people in a non-technical way that encourages them to use them as part of their decision making. **A potential next step is a review of the consistency of all Defra's activities and areas of concern using EsA principles.** Such a review would provide the evidence necessary to make the case that at the operational level, deficiencies were apparent that could be overcome by application of the concepts and methods embodied in the Ecosystem Approach.

7.3 Assessment Methodologies and Evidence Gaps

7.3.1 Service Typologies

The task of making an assessment of England's major terrestrial ecosystem services is a challenging one because the methods used to make such an assessment are still developing.

Part 3 of this report reviewed current scientific approaches to the problem of understanding and describing ecosystem services. **We found that despite its influence the typology provided by the Millennium Ecosystem Assessment (MA) was problematic, in that many of the service categories were inconsistent, tended to overlap, and did not clearly distinguish between the capacity of ecosystems to deliver a service and the benefit that people might subsequently derive.** As a way forward we suggested that analyses should focus on the idea of 'ecosystem service cascades' which document how biophysical structures and processes give rise to ecological functions that in turn provides a service that potentially can be quantified in terms of a benefit to people.

The cascade model seemed to resolve the problematic nature of the supporting services defined by the MA that potentially introduce problems of 'double counting' in valuation studies. It also helps make clear the ways that the identification of a service may be contingent on human values or preferences, and the ways in which notions of

environmental limits can be used in making judgements about the limits of ecosystem functioning. **It is proposed that the MA service typology is best viewed as a checklist of themes that should be refined, expanded and analysed through such a model.**

7.3.2 Assessment Perspectives

A key problem that arises in the context of using the Ecosystem Approach, and in assessing ecosystem services, is to define what an ecosystem actually is in operational terms. In our review of the scientific literature we have considered what constitutes an ecosystem service unit, and concluded that currently there are some differences in opinion about how this can best be done.

In order to make progress, this Study considered three distinctive, but complementary perspectives on the problem of making an assessment of England's terrestrial ecosystem services. The work examined their strengths and weaknesses, and the extent to which they could be used given the data currently available.

(a) The 'habitats perspective'

The habitats perspective was found to be particularly valuable because it had clear policy relevance by linking the assessment of ecosystem services to the Biodiversity Action Plan process. **Despite the shortcomings of a habitat-based methodology for assessing services, we recommend that it is one that should be taken further because it would make the BAP conservation case even stronger.** In order to take this forward we suggest:

- Those involved in the BAP process and the review of targets should be encouraged to make the link between the habitats and species they prioritise and ecosystem services. Such an initiative would be particularly useful at Local BAP level, by involving decision-making bodies like Local Strategic Partnerships and related community groups, and establishing clearer links between the ecosystem services associated with each habitat and benefits local communities and businesses derive from them.
- Those involved in monitoring the status of BAP Habitats should be encouraged to extend the range of condition measures employed to include indicators that would trace the impacts of changes for the important ecosystem services associated with each of them, and how they link to socio-economic drivers at different scales.
- That a more systematic and consistent typology of pressures impacting on habitats and potentially the services associated with them should be developed.
- The quality and coverage of stock and change data needs to be improved, and in particular the problems of inconsistency between different sources (e.g. Countryside Survey, SSSI and EN Habitat inventories, BAP Review Materials) should be resolved.

In reviewing the state and trends of the BAP Habitats it was noted that many of them were vulnerable to changes in land management and that their dynamics were often linked to each other. Thus, a future BAP Targets Review might benefit by being undertaken in the holistic context of the Ecosystem Approach, linking state and trends far more directly to socio-economic drivers.

(b) The 'service perspective'

The service perspective was found to be effective in making an assessment of some services at the national scale, given the evidence currently available. However, in terms of its contribution to a decision making context, the approach tended to obscure the linkages between services. The multi-functional characteristics of ecosystems could not so easily be identified by adopting this perspective. Nevertheless, the service perspective was found to be particularly valuable because it clearly linked the notion of services to the problems and opportunities that confront people. Moreover, particularly for the regulation of water quality and quantity, there were good examples of how the ideas that are implicit in the Ecosystem Approach could be used applied. **We recommend therefore that the focus on services is one that should be taken further, particularly in the context of**

River Basin Planning and management under the Water Framework Directive. In doing so the following issues should be noted:

- The major limitation of the analysis was that on the basis of current knowledge, it was not possible to make an assessment of the aesthetic service because there is little agreement as to how the landscape resource should be conceptualised. Further work is needed to develop better methods for analysis and assessment in the area of cultural services.
- The output of some services, particularly those associated with the highly artificial, 'social ecosystems' associated with agriculture, gave rise to both benefits and liabilities (dis-benefits). Further work is needed to bring the assessment of ecosystem services within a robust environmental accounting framework.

(c) A 'place-based' perspective

The constraint of thinking about ecosystem services in a specific geographical area seemed to overcome many of the problems that surround defining what an ecosystem is. While it may draw upon many of the same data sources used to support the other two perspectives considered, by focusing discussion on a specific area, a simple set of guidelines for analysis can be devised. **We have suggested (section 6.4) a set of specific questions that could be used to frame the assessment of ecosystem services in a specific geographical locality that could be used by Defra to encourage people to take up the philosophy embedded in the Ecosystem Approach.**

On the basis of the quality of the spatial data and other evidence considered in this Study, we suggest that the spatial framework provided by the Government Office Regions is probably the one that is most appropriate for taking the assessment of ecosystem services forward. While these regions do not represent biophysical units that provide services, they can be used frame a more detailed analysis within them either for specific landscapes or spatial units such as catchments. The advantage of using such administrative regions is that the outcomes would be at the right spatial scales to feed into the strategic spatial planning process. This approach could be particularly important, given that the new Planning White Paper makes little reference regional Sustainable Development frameworks.

7.4 The state and trends of England's terrestrial ecosystem services

The assessments made here are necessarily provisional, and the robustness of the analysis should be tested by more broadly-based consultation in keeping with EsA principles. We therefore recommend that Defra should consider initiating:

- A more detailed place-based assessment of ecosystem services initially at the level of the Government Office Regions in England, and subsequently at more local scales. Such work could form a component for a national assessment of ecosystem services in England, following the model of the global Millennium Ecosystem Assessment.
- The development of a common set of guidelines and data resources to ensure a flexible but unified approach across the different assessment units is possible.
- A review of how, through the concept of making a place-based assessment of ecosystem services, the principles of the EsA can be incorporated in the current procedures used at regional scales to implement the UK Sustainable Development Strategy. Since the burden of delivery lies with Local Authorities, the review should pay particular attention to the ways in which a place-based approach can be translated from regional down to local scales. The EsA could be developed and promoted as one way in which this might be achieved.

Such an initiative should, we suggest, form part of Defra's future strategy for ensuring that the principles underpinning the Ecosystem Approach are understood and used more widely in decision making. The work could also contribute to a potential UK and European assessment of ecosystem services.

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