GHK

Benefits of Sites of Special Scientific Interest

Final Report

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Benefits of Sites of Special Scientific Interest

Defra

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1 Executive Summary

1.1 Introduction

This report presents the findings of a study of the benefits of Sites of Special Scientific Interest in England and Wales.

Sites of Special Scientific Interest (SSSIs) represent the principal national designation for places of importance for biodiversity and geodiversity in Great Britain. They are protected by law, and effort and resources are devoted to achieve sympathetic management to maintain their conservation interest.

Defra commissioned the research in order to inform future policy for SSSIs. The objectives of the research were:

- To estimate all **benefits to society of SSSIs**, where possible quantified and monetised.
- To estimate the **added value of SSSI notification** to the wider biodiversity value of the sites.
- To ascertain whether there is added value in SSSIs also being afforded **other designations** (e.g. Ramsar sites, Natura 2000 sites or National Nature Reserves).
- To assess, both quantitatively and qualitatively, the contribution that SSSIs make to the **delivery of ecosystem goods and services** both on the site and within the context of the wider landscape.

There are 5,000 SSSIs in England and Wales covering a wide range of habitats and geological features. SSSIs cover around 8% of the land area of England and 12% of Wales. More than 1,000 SSSIs in England and nearly 500 in Wales are also subject to higher national and international designations.

In recent years, increasing emphasis has been given to improving the condition of SSSIs in order to achieve their conservation objectives. As a result, more than 96% of SSSI area in England was in favourable or recovering condition by the end of 2010. Public expenditure on SSSIs has grown in response to this challenge and now totals £101 million annually in England and £10 million annually in Wales.

Government recently indicated that it will now focus on bringing an increasing proportion of sites into favourable condition, whilst maintaining the 95% of English SSSI land already in 'favourable' or 'recovering' condition. The remaining 5% will be reviewed on a site by site basis to establish where and how condition could be improved.

1.2 Methodology

The study examined the benefits of SSSIs in terms of:

- The core **conservation benefits** of SSSIs – in terms of their role in conserving habitats, species and geodiversity. These are the main reason for notifying the site as a SSSI and can be regarded as the "intrinsic benefits" of SSSIs;
- The benefits of SSSIs in providing **ecosystem services**. By contributing to the maintenance of healthy ecosystems, SSSIs can be expected to deliver a variety of services to society, which can be assessed qualitatively and quantitatively; and
- The **economic value** of the benefits delivered – which are assessed in terms of the value of services delivered by particular sites as well as the public's overall willingness to pay for SSSI policy.

The study examined the benefits of SSSIs under hypothetical policy scenarios involving different levels of future funding:

a. *Future funding is maintained at levels sufficient to maintain current levels of SSSI condition ("Maintain funding" scenario).*

b. *Increased future funding leads to achieving favourable condition on all sites ("Increase funding" scenario)*

c. *Future funding is removed, leading to a gradual decline in the proportion of sites in favourable condition ("Remove funding" scenario).*

The work involved the following research tasks:

- A **literature review** on SSSIs and their benefits;
- 20 **case studies** examining the benefits of individual SSSIs across England and Wales;
- Four **workshops** involving experts and stakeholders with an interest in SSSIs;
- Completion of a **weighting matrix**, in which expert participants were asked to assess the delivery of different ecosystem services by different habitats within SSSIs;
- Ten **focus groups**, which explored public knowledge and attitudes to SSSIs and involved a **choice experiment** to elicit participants' willingness to pay for SSSI policy;
- **Economic analysis** to estimate the value of the benefits delivered by SSSI policy, based on estimates of willingness to pay for SSSI ecosystem services from the choice experiment, and assessment of the added value of conservation activities from the weighting matrix.

1.3 Conservation Benefits of SSSIs

SSSIs play an important role in the conservation of the most important species, habitats and geological sites in England and Wales.

SSSIs protect a large proportion of species in England and Wales, including most rare species. Although there are some gaps, they are seen to be representative of our biodiversity as a whole. SSSIs have helped to protect some species in England and Wales which would otherwise be at risk of extinction nationally.

SSSIs protect the majority of semi-natural habitats in England and Wales and have been effective in preventing further habitat loss. Coverage varies by habitat, and some agricultural and brownfield habitats are under-represented by the series. However, for other semi-natural habitats, a very small proportion of remaining area survives outside SSSIs, demonstrating the effectiveness of SSSIs in conserving them.

SSSIs provide effective protection for the most important geological features in England and Wales.

SSSIs provide conservation benefits by protecting sites and their species, habitats and geological features from development and adverse pressures, and by promoting sympathetic management to maintain and enhance their condition. However, achieving favourable condition is a long term process and many sites therefore currently do not meet their full potential.

SSSIs are not in themselves seen to provide an effective ecological network, as many are small, fragmented and insufficiently connected, and many habitats lie outside them. SSSIs have a role to play at the core of an ecological network, but the need for nature conservation policy to look beyond them is recognised.

1.4 Ecosystem Services Delivered by SSSIs

SSSIs deliver a range of provisioning, regulating and cultural services. It is difficult to assess the overall contribution of SSSIs in delivering ecosystem services, because most of the information is site-specific and quantitative evidence is limited.

SSSIs deliver important cultural services to society and are widely used and appreciated by people. SSSIs support recreation and tourism, provide a resource for scientific research and education regarding biodiversity and geodiversity, and contribute to cultural landscapes and sense of place. People benefit from the knowledge that SSSIs conserve our rarest and most threatened wildlife, habitats and geology for the benefit of society as a whole and for future generations. There are many positive examples although evidence suggests that the overall number of users per hectare is not greater than for the countryside as a whole.

SSSIs deliver regulating services such as water purification and regulation of climate, water and natural hazards by protecting ecosystems and enhancing their functioning, though little quantitative evidence is available. At some sites, unfavourable condition has led to a reduction in the delivery of regulating services such as the ability to store carbon and regulate water flows. Action to achieve favourable condition should help to improve the benefits of these sites over time.

SSSIs contribute to a range of provisioning services, though some such as food production may be reduced by SSSI management practices. SSSIs contribute to the conservation of genetic resources by conserving crop wild relatives and using rare livestock breeds.

An overall quantitative assessment of the contribution of SSSIs and their habitats to ecosystem service delivery was made using the "Weighting Matrix". This found that the levels of service vary widely by habitat but that SSSI designation enhances most ecosystem services delivered by most habitats. This is especially true for cultural services associated with species conservation and sense of place. SSSIs are also estimated to enhance regulating services for most habitats. However, food provision is estimated to decline for grassland habitats.

1.5 Economic Value of SSSI Benefits

Estimates from this and other studies show that the economic value of the benefits delivered by SSSIs is substantial and significantly exceeds the costs of the policy.

Existing evidence of the value of these benefits is available for a small but increasing number of sites. A variety of studies also show that management of SSSIs and spending by visitors has significant positive impacts on local economies.

Most evidence is available for the value of cultural services, with studies demonstrating that the public is willing to pay to visit and conserve individual SSSIs. Some studies find that the majority of these values are derived from the existence of these sites and their biodiversity rather than people's use of SSSIs.

The value of provisioning services is relatively easily measured and is significant for some SSSIs but may be reduced by conservation management.

Few studies have valued the regulating services delivered by SSSIs but there is evidence that these values can be significant for particular sites.

The choice experiment valuation for this study estimated that the public is willing to pay £956 million annually to secure the levels of services and benefits currently delivered by SSSI conservation activities in England and Wales, and a further £769 million to secure the benefits that would be delivered if SSSIs were all in favourable condition.

Based on the areas of different habitats in England and Wales, it is estimated that the public is willing to pay £827m for the benefits currently provided by SSSIs in England and £128m for those provided by sites in Wales. The benefits of increasing funding to enable all sites to

reach favourable condition are estimated at £666 million in England and £103 million in Wales.

These benefit estimates significantly exceed the annual public cost of the policy of £101 million in England and £10 million in Wales.

Caution is needed in interpreting estimates of the economic value of the benefits of SSSIs, given limitations in available data on ecosystem services and their value, the complexity of the scenarios being assessed and the methodological challenges inherent in the valuation methods used. This study estimated the value of the benefits of ecosystem services based on people's willingness to pay, and adjusted for the added ecosystem services provided under SSSI status, and different policy scenarios, which involved some reasoned assumptions. The choice experiment focused on certain major ecosystem services only, not the full range of services potentially delivered by SSSIs, while the weighting matrix employed conservative assumptions in assessing the added value of SSSI management. The results are therefore not absolute or comprehensive values, but estimates.

SSSIs also result in some disbenefits by:

- Restricting opportunities for development and land use change. It is unlikely that SSSIs reduce the overall level of development nationally – they are instead likely to displace development to alternative locations. However, this may restrict economic opportunities at the local level and may impose additional costs on society as a result of a need to build on alternative and potentially less attractive sites.
- Restricting agricultural and forestry production by limiting the land management practices that can be undertaken. There may therefore be a trade-off between the value of provisioning services and other ecosystem services at some sites. Where evidence is available, it suggests that negative effects may be outweighed by increases in other services.

1.6 The Added Value of SSSI Designation

From the perspective of society as a whole, the SSSI designation adds value to sites and enhances the benefits they deliver. It does this by:

- **Protecting them from development and land use change**. Without SSSI status many of our species, habitats and geological features would have been lost over time;
- **Focusing effort and resources on SSSI conservation activities**. The focus in recent years in restoring sites to favourable condition has the potential to greatly enhance the benefits that these sites deliver, although achieving favourable condition is a long term process;
- **Providing a focus for education, scientific research and public access**. While the overall use of SSSIs does not exceed that of the countryside as a whole, sites provide a focus for scientific study and educational visits, and are seen by the public as offering a special experience compared to the wider countryside.

As a result of this, evidence demonstrates that SSSI designation enhances the benefits that the sites deliver. In particular, SSSIs:

- Protect important concentrations of species, habitats and geodiversity, and deliver strong **conservation benefits** relative to undesignated sites. Available evidence demonstrates that SSSI habitats are in better condition than the wider countryside.
- **Deliver higher levels of most ecosystem services as a result of designation**, and in response to conservation activity enhancing ecosystem functioning. It should be noted however that changes in ecosystem services as a result of SSSI restoration activity may

take many decades to be realised. Some provisioning services may be reduced as a result of designation.

- **Enhance the value of the services that sites deliver to society**. There are particular examples of SSSIs and activities to conserve them enhancing the delivery of certain ecosystem services, as well as more general evidence of the public's willingness to pay for the range of services that SSSI conservation delivers. Evidence from the choice experiment suggests that this added value greatly exceeds the costs of SSSI policy.

1.7 Added Value of Higher Level Designations

Higher level designations provide additional benefits compared to SSSIs. 25% of SSSIs in England and 48% in Wales by number are also protected by higher level designations (Natura 2000, Ramsar sites and NNRs). These designations apply particularly to larger sites and cover 79% of SSSI land area in England and 72% in Wales.

SSSIs which do not have higher levels of designation therefore play a distinctive role in protecting a relatively larger number of relatively small sites.

Higher level designations have added value relative to SSSI status, through:

- **Higher levels of protection from development** and land use change afforded to Natura 2000 sites in particular;
- **Some additional access to resources**, especially EU funding for Natura 2000 sites;
- **A higher profile than SSSIs**. Evidence suggests that National Nature Reserves in particular attract greater public recognition as well as providing an added focus for education and scientific research.

This enhances the conservation benefits and ecosystem services that these sites deliver. In addition, because sites with higher level designations tend to be much larger than average SSSIs, they can be expected to benefit from greater ecological coherence and connectivity due to their extent. This in turn should enhance their capacity to deliver ecosystem services.

Though higher level designations provide added benefits, SSSI status does provide a high level of protection, while differences in management are insignificant for the majority of sites, particularly following the major recent focus in enhancing SSSI condition.

1.8 Benefits of SSSIs under Different Funding Scenarios

The level of funding for SSSIs is an important determinant of the benefits they deliver. A summary of the likely effects of different funding scenarios for SSSIs on the benefits and values of SSSIs is given in Table 1.1 below.

It was found that the benefits of SSSIs, in terms of their conservation benefits, ecosystem service delivery and the economic values, are sensitive to the level of funding of SSSI conservation activity:

- Current policy for SSSIs delivers substantial conservation benefits, as summarised above. It delivers important ecosystem services to society, with cultural services being especially significant. The value of the benefits of the existing policy are estimated at £956 million annually, almost 9 times as high as the £111 million annual public cost of the policy;
- Achieving favourable condition for all SSSIs would enhance the conservation benefits of SSSIs and the ecosystem services they deliver. The delivery of regulating services would be expected to increase as sites achieve favourable condition, though this would be a long term process. Cultural services would increase, both as a result of the

benefits people derive from the existence of biodiversity and the enhanced experience that sites offer to people. The value of the additional benefits is estimated at £769 million annually;

- Removing funding for SSSIs would lead to a decline in their condition with a substantial reduction in the conservation benefits and ecosystem services they provide. There would be a decline in regulating and cultural services, though removing the focus on conservation management might allow food and timber production to increase at some sites. The value of the benefits currently delivered by SSSIs would decline gradually over time.

1.9 Needs for Future Research

The study found that there are significant gaps in our knowledge about the benefits of SSSIs, particularly relating to the measurement and valuation of ecosystem services. While this research has helped to address some of these gaps, various needs for future research were identified.

These research needs are to strengthen the evidence base regarding the measurement of i) the ecosystem services delivered by SSSIs, ii) the effects of management strategies on the levels of service delivery, and iii) the economic and social benefits of SSSIs. More detailed assessment of the benefits and services delivered by individual sites would be beneficial, and would provide a stronger evidence base on which to develop economic valuation work in future.

Table 1.1 Implications of Different Policy Scenarios for SSSIs

	Effects on:			
Scenario	**Conservation Benefits of SSSIs**	**Ecosystem services**	**Economic value of services**	**Costs**
Maintain funding at sufficient level to maintain current SSSI condition	Although 96% of SSSI area in England was in favourable or recovering condition by end of 2010, less than 40% was in favourable condition. For these sites conservation benefits are not maximised.	Sites deliver a wide range of ecosystem services, especially important cultural services. Because many sites remain in unfavourable condition service delivery is not maximised, particularly for some regulating services (e.g. climate regulation, water regulation and purification by bogs)	The services provided by SSSIs are highly valued by people. Based on willingness to pay estimates, this study values the benefits of current policy at £956 million annually	At or below current level (£110 million p.a.)
Increase funding to secure favourable condition for all sites	All sites reach favourable condition, maximising conservation benefits in terms of	Achieving favourable condition would enhance the delivery of most services,	The additional services delivered have economic value. Based on willingness to	Significant increase in costs, particularly to deal with impacts from other sites – e.g. diffuse water

	habitats, species and geodiversity	especially regulating services. Some provisioning services might be reduced.	pay estimates, this study estimates the additional benefits at £769 million annually	pollution. Problems in achieving favourable condition at difficult sites could increase the costs of the policy disproportionately.
Remove funding	Increasing proportion of sites move to unfavourable condition, with negative effects on species, habitats and geological features.	Decline in wide range of services, especially regulating but also cultural and some provisioning services (e.g. fresh water and genetic resources)	Gradual decline over time in the estimated £956 million annual benefit of SSSI conservation activity	Cost saving of up to £110 million annually

2 Introduction

- This report presents the findings of a study of the benefits of Sites of Special Scientific Interest in England and Wales.
- SSSIs represent the principal national designation for places of importance for biodiversity and geodiversity. They are protected by law, and effort and resources are devoted to achieve sympathetic management to maintain their conservation interest.
- The objectives of the research were:
  - To estimate all benefits to society of SSSIs, where possible quantified and monetised.
  - To estimate the added value of SSSI notification to the wider biodiversity value of the sites.
  - To ascertain whether there is added value in SSSIs also being afforded other designations.
  - To assess, both quantitatively and qualitatively, the contribution that SSSIs make to the delivery of ecosystem goods and services both on the site and within the context of the wider landscape.
- There are 5,000 SSSIs in England and Wales, covering 8% of the land area of England and 12% of that of Wales.
- Public expenditure on SSSIs has grown in line with efforts to improve their condition, and now totals £111 million annually in England and Wales.

2.1 Aims and Objectives

This report presents the findings of a study of the benefits of Sites of Special Scientific Interest (SSSIs) in England and Wales.

SSSIs represent the principal national designation for places of importance for biodiversity and geodiversity in Great Britain[1].

They are protected by law, and effort and resources are devoted to achieve sympathetic management to maintain their conservation interest.

The objectives of the research were:

- To estimate all **benefits to society of SSSIs**, where possible quantified and monetised.
- To estimate the **added value of SSSI notification** to the wider biodiversity value of the sites.
- To ascertain whether there is **added value in SSSIs also being afforded other designations** (e.g. Ramsar sites, Natura 2000 sites or National Nature Reserves).
- To assess, both quantitatively and qualitatively, the **contribution that SSSIs make to the delivery of ecosystem goods and services** both on the site and within the context of the wider landscape.

The study combined **a review of existing evidence** of the benefits and values of SSSIs with **new research** to assess the benefits of particular sites, examine delivery of ecosystem services and explore the public's perceptions of SSSIs and its willingness to pay to protect them.

This Final Report presents the findings of the study.

[1] The focus of the report is on England and Wales. SSSIs are also designated in Scotland, while Northern Ireland has Areas of Special Scientific Interest (ASSIs). While the analysis focuses on England and Wales, a few examples are given of the benefits of SSSIs and protected areas elsewhere, where these provide useful insights.

Section 2 provides a brief introduction to SSSI policy and the SSSI network in England and Wales. The methodology employed in the study is set out in Section 3. Sections 4-6 present the study findings, by examining first the conservation benefits of SSSIs, then assessing their contribution to the delivery of ecosystem services, and presenting evidence of the value of these services. The conclusions from the research are presented in Section 7. The Annexes give further details of the individual research tasks.

2.2 SSSI Policy

SSSIs conserve the most important sites for biodiversity and geodiversity nationally. SSSI policy dates back to the 1949 National Parks and Access to the Countryside Act and has been developed through subsequent legislation[2].

The purpose of SSSIs is "**to safeguard, for present and future generations, the diversity and geographic range of habitats, species, and geological and physiographical features, including the full range of natural and semi-natural ecosystems and of important geological and physiographical phenomena**." (Defra, 2003b).

Natural England and the Countryside Council for Wales[3] have a duty to notify SSSIs when they are of the opinion that an area of land is of special interest on account of these features. This opinion is based on the exercise of specialist judgement which is informed by scientific guidelines. The two agencies have responsibility for protection of sites and for promoting positive management actions, working in co-operation with site owners, managers and other stakeholders. Where damaging activities take place on a SSSI, enforcement measures can be used. These measures range from site notices and warning letters to prosecutions and fines (CCW, 2006).

There are two main types of SSSIs: **biological SSSIs** and geological/geomorphological SSSIs (henceforth referred to as "**geological SSSIs**"), although some sites, often more extensive ones, are notified for both biological and geological interests.

In the last 10 years there has been increased emphasis on **improving and maintaining the condition of SSSIs** in England and Wales. In 2000, Defra agreed a target to ensure that 95% of the SSSI land area in England was in favourable or unfavourable recovering condition by 2010, while the Environment Strategy for Wales gave a commitment that 95% of Welsh SSSIs will be in favourable condition by 2015 and that all sites will be in favourable condition by 2026.

Government recently indicated that it will now focus on bringing an increasing proportion of sites into favourable condition, whilst maintaining the 95% of English SSSI land already in 'favourable' or 'recovering' condition. The remaining 5% will be reviewed on a site by site basis to establish where and how condition could be improved.

2.3 SSSIs in England and Wales

In England, there are more than 4,000 SSSIs, covering around 8% of the total area (Natural England, 2008) and there are **more than 1,000 SSSIs in Wales**, covering around 12% of the total area (CCW, 2006).

More than 1,000 SSSIs in England and nearly 500 in Wales are also subject to **higher national and international designations** such as Special Protection Areas and Special Areas of Conservation (together known as Natura 2000 sites), National Nature Reserves (NNRs) and Ramsar sites (Natural England, 2007; CCW, 2006). In addition, about half of SSSIs in Wales are within areas also designated as National Parks and Areas of Outstanding Natural Beauty (AONB; CCW, 2006). In England 7% of SSSIs are within areas designated as National Park and 15% within an AONB (Natural England, 2007).

[2] Further details of the policy are given in Section 2 of the Literature Review (Annex 1)

[3] Scottish Natural Heritage has this responsibility in Scotland.

SSSIs cover a wide range of habitats. Many of the largest sites are in upland and coastal areas, where semi-natural habitats survive as uninterrupted expanses. In contrast, many lowland habitats including meadows, heaths and woodlands, are often represented by small, fragmented sites. SSSIs protect a large proportion of the national area of some habitats, such as intertidal mudflats and saltmarsh; fen, marsh and swamp; sand dunes and shingle. In both England and Wales, **more than half of the total area of SSSIs is within the uplands** (CCW, 2006; Natural England, 2009c).

There are more than 1,200 SSSIs notified for geological interest in England and 300 in Wales. Geological SSSIs can be classified according to:

- The specialist scientific interest for which they were selected. The Geological Conservation Review identifies nationally important features of geological interest. These can be assigned to seven main categories – Geomorphology; Igneous petrology; Mineralogy; Palaeontology; Quaternary geology and geomorphology; Stratigraphy; and Structural and metamorphic geology.
- The physical type of site. There are three broad site categories: finite sites, integrity sites and exposure sites[4]. Within these broad categories there are more specific types such as buried interest, caves, karst, disused quarries, road and rail cuttings, etc. (Prosser *et al*., 2006).

SSSIs vary greatly in size – some are very large but numerically most are smaller than 100 hectares. The majority are privately owned, with the land primarily managed for agricultural, forestry or other purposes, rather than for wildlife conservation, although conservation organisations such as the National Trust, Wildlife Trusts and RSPB own and/or manage a significant portion of the network. There are more than 30,000 SSSI owners in England alone (Kirby *et al.*, 2010). SSSIs are often owned by more than one individual or organisation, particularly the larger sites. The land may be used and managed by the owner(s) themselves and/or tenants, as well as by third parties who may hold rights to graze, fish, shoot or exploit other resources, including on the large area of Common Land notified as SSSI.

2.4 SSSI Condition

In recent years, increasing emphasis has been given to improving the condition of SSSIs in order to achieve their conservation objectives.

The condition of SSSIs in the UK is monitored under a Common Standards Monitoring (CSM) framework (JNCC, 1998), which is based on the site-specific Conservation Objectives for the Interest Feature(s) for which the site was notified.

[4] Exposure sites are those whose scientific or educational values are within geological features of rocks or sediments which are relatively extensive beneath the surface, and are the more common site type in Britain. Finite sites are those whose values are within geological features that are limited in extent so that removal of material may cause depletion of the resource. Integrity sites are those whose values are contained within finite and limited deposits or landforms that are irreplaceable if destroyed.

Box 2.1 Definition of different types of site condition

Favourable condition means that the SSSI land is being adequately conserved and is meeting its 'conservation objectives'; however, there is scope for the enhancement of these sites.

Unfavourable recovering condition is often known simply as 'recovering'. SSSI units are not yet fully conserved but all the necessary management measures are in place. Provided that the recovery work is sustained, the SSSI will reach favourable condition in time. In many cases, restoration takes time. Woodland that has been neglected for 50 years will take many years to bring back into a working coppice cycle. A drained peat bog might need 15-20 years to restore a reasonable coverage of sphagnum.

Unfavourable no change condition means the special interest of the SSSI unit is not being conserved and will not reach favourable condition unless there are changes to the site management or external pressures. The longer the SSSI unit remains in this poor condition, the more difficult it will be, in general, to achieve recovery.

Unfavourable declining condition means that the special interest of the SSSI unit is not being conserved and will not reach favourable condition unless there are changes to site management or external pressures. The site condition is becoming progressively worse.

Part destroyed means that lasting damage has occurred to part of the special conservation interest of a SSSI unit such that it has been irretrievably lost and will never recover. Conservation work may be needed on the residual interest of the land.

Destroyed means that lasting damage has occurred to all the special conservation interest of the SSSI unit such that it has been irretrievably lost. This land will never recover.

Source: Natural England (undated) Online SSSI Glossary

In England, the proportion of SSSI area in favourable or unfavourable recovering condition increased from 57% in 2003 to 96% by the end of 2010. SSSI condition varies between habitats. Kirby *et al.* (2010) observed contrasts in SSSI condition between the uplands and lowlands of England. A high proportion of upland sites are in recovering condition, whilst in the lowlands, the majority are favourable. However, a significantly greater area of lowland SSSI habitats remain in unfavourable no change or declining condition compared with the uplands, reflecting the complexity of adverse factors operating in the lowlands, and the multitude of small sites. A 2008 review found that the only habitats with less than 50% of their area in favourable or recovering condition were rivers and streams and canals. The habitats with the greatest area in unfavourable condition were bogs, heathlands, and intertidal mudflats and saltmarsh, though large areas of these habitats have been improving in condition. The proportion of geological SSSIs in favourable condition was higher than that of biological SSSIs (Natural England, 2008).

In Wales, the most recent data is available for 2006, when 32% of sites were judged to be in favourable condition and 68% in unfavourable condition (CCW, 2006). Of the individual features for which SSSIs were designated, 47% were judged to be in favourable condition. A higher proportion of species features (53%) were considered to be in favourable condition than habitat features (29%), because the requirements of certain species within sites can be delivered more easily than overall habitat improvements. Condition of habitat features could reflect long-standing issues of site management. Cliff and inter-tidal habitats for example were in more favourable condition as they are relatively unaffected by intensive land management, whereas grasslands, heathlands and bogs were more often in unfavourable condition. In the case of bogs, this reflects the dual pressures of overgrazing and burning in the uplands, and drainage and land claim in the lowlands. Most sand dunes were in poor

condition as a result of lack of grazing, sediment starvation, and atmospheric deposition. 72% of geological features were judged to be in favourable condition.

2.5 Public Expenditure on SSSIs

Public expenditure on SSSIs totals £111 million annually in England and Wales.

Achieving favourable condition of SSSIs is dependent on the development and implementation of appropriate management strategies. These have been backed by **significant increases in public expenditures, which are currently estimated to total £101 million in England and £10 million in Wales annually**. This amounts to an average of approximately £85 per hectare of SSSI per year. A breakdown of the main public expenditures in England is given in Table 2.1.

Table 2.1 Estimated Public expenditures on SSSIs, England, 2010/11

Cost Item	Estimated Expenditure (2010/11, £k)	Estimated Expenditure (2000/01 to 2010/11, £k)
Incentives	26,947	225,878
Advocacy/Advice	13,920	101,640
Project/Programme Management	1,260	12,315
Direct Management	25,900	170,105
Regulation	3,230	28,510
UK Exchequer Cost	***71,257***	***538,448***
EU Co-Funding	30,204	156,119
Total Public Cost	**101,461**	**694,567**

Source: Defra data (unpublished)

SSSIs have benefited greatly from agri-environment and other land management schemes.

Maintaining resourcing of SSSI management is a key element of policy, as without sufficient resourcing of management activity the condition of SSSIs would be expected to decline over time. The funding of SSSIs was therefore the key variable used in this study to assess the benefits of SSSIs relative to the counterfactual "remove funding" scenario (see Section 3).

No breakdown is available for the relative amounts spent on biological and geological SSSIs; however, the latter are believed to account for only a small proportion of the total, and in general are not covered by agri-environment schemes.

The figures above relate to the cost of SSSIs to the public sector. Private landowners and managers also incur costs in site management, although these are typically reimbursed by the Government through management agreements, and should not therefore be double counted. However at many sites there is additional investment, including time of volunteers, by conservation NGOs, such as the National Trust, Wildlife Trusts and RSPB, which are major owners and/or managers of SSSIs. Landowners also incur **opportunity costs** as a result of the policy, since **SSSIs restrict opportunities for development and land use change**. This may limit the economic opportunities of the land developed potentially depress land prices. However, the only available evidence of the impact of SSSI designation on land values was a study in Scotland which found no significant statistical influence on land prices across Scottish SSSIs (Roberts *et al.*, 2001).

2.6 Other Conservation Policies

SSSI policy needs to be examined in the light of more recent policies for biodiversity and ecosystems. SSSIs remain the principal designation for special sites for biodiversity and geodiversity in England and Wales. Since they were introduced, there have been a number of subsequent policy developments, notably:

- **The EU Birds and Habitats Directives**, which established a European network of protected areas (**Natura 2000**), giving added protection to the most important sites at EU level, designated according to set criteria. Parallel designation as SSSI is the principal instrument for protecting these sites on land in England and Wales (i.e. Natura 2000 sites are a subset of SSSIs). The Directives also introduced requirements relating to the protection of species and habitats in the wider countryside.
- **The UK Biodiversity Action Plan**, which set out a national strategy for the conservation of biodiversity, in response to the international Convention on Biological Diversity. The UKBAP introduced a series of plans and targets for the conservation of priority species and habitats. SSSIs are important for the conservation of most of these species and habitats, though their role varies – for example they protect only a relatively small proportion of agricultural habitats such as hedgerows and species of farmland birds – which require action in the wider countryside beyond site boundaries.
- **The Ecosystem Approach** – which looks beyond particular sites and sectoral policies and stresses the importance of maintaining healthy ecosystems and the multiple services that they provide to society. This has been adopted by the UK Government and Defra published an action plan in 2007 for embedding it into policy. This follows the Millennium Ecosystem Assessment, a global appraisal of ecosystems and ecosystem services. While SSSI policy was established to protect biodiversity and geodiversity, there is increasing interest in the role of sites in maintaining healthy ecosystems and the services that they provide to society.

These different developments have each brought expectations regarding the role of SSSIs, while at the same time the focus of conservation efforts has extended beyond special sites to the wider countryside.

The next section sets out the methodology employed in the study to assess the benefits of SSSIs.

3 Methodology - Assessing the Benefits of SSSI Policy

- The study examined the benefits of SSSIs in terms of:
  - Their core conservation benefits for habitats, species and geodiversity.
  - The benefits of SSSIs in providing ecosystem services; and
  - The economic value of the benefits delivered.
- These benefits were examined under three hypothetical policy scenarios in which:
  - Future funding is maintained at levels sufficient to maintain current levels of SSSI condition ("Maintain funding" scenario).
  - Increased future funding leads to achieving favourable condition on all sites ("Increase funding" scenario)
  - Future funding is removed, leading to a gradual decline in the proportion of sites in favourable condition ("Remove funding" scenario).
- The work involved the following research tasks:
  - A literature review on SSSIs and their benefits;
  - 20 case studies examining the benefits of individual SSSIs across England and Wales;
  - Four workshops involving experts and stakeholders with an interest in SSSIs;
  - Completion of a weighting matrix, in which expert participants were asked to assess the delivery of different ecosystem services by different habitats within SSSIs;
  - Ten focus groups, which explored public knowledge and attitudes to SSSIs and involved a choice experiment to elicit participants' willingness to pay for SSSI policy;
  - Estimation of the economic value of benefits of SSSIs, based on the willingness to pay estimates from the choice experiment and the estimates of SSSI service delivery from the weighting matrix.

3.1 Overview of Methods

SSSIs provide a variety of benefits which can be assessed at different levels. This study examined the benefits of SSSIs in terms of:

- The core **conservation benefits** of SSSIs – in terms of their role in conserving habitats, species and geodiversity. These are the main reason for notifying the site as SSSI (Section 4);
- The benefits of SSSIs in providing **ecosystem services**. By contributing to the maintenance of healthy ecosystems, SSSIs can be expected to deliver a variety of services to society, which can be assessed qualitatively and quantitatively (Section 5); and
- The **economic value** of the benefits delivered – which are assessed in terms of the value of services delivered by particular sites as well as the public's overall willingness to pay for these services under the different SSSI policy scenarios (Section 6).

These different elements fit together as part of an **ecosystem services framework,** as a basis for understanding, quantifying and valuing the benefits of SSSIs to society as a whole. Following the Millennium Ecosystem Assessment (MA)[5], ecosystem services may be grouped into provisioning services (e.g. provision of food and fibre), regulating services (e.g. climate and water regulation) and cultural services (e.g. recreational and existence values). These are underpinned by supporting services (such as soil formation and nutrient cycling)[6].

[5] See http://www.maweb.org/en/Framework.aspx

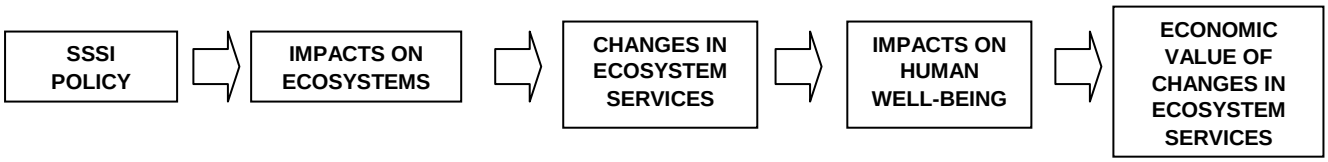
[6] Supporting services are services that underpin other types of ecosystem services rather than providing benefits to people directly; they should therefore be excluded or at least kept separate in the benefits assessment, to avoid double counting.

Defra's ecosystems approach action plan (Defra, 2010) is closely linked to the MA framework.

Ecosystem services emphasise the benefits that ecosystems provide to people. People derive a wide range of goods and services to people, as well as a sense of satisfaction that natural systems exist. However, the MA also recognises that ecosystems have values beyond the services they provide to people, and these "intrinsic values" need to be considered separately. **Therefore it is important to consider the conservation benefits of SSSIs whether or not they result in changes in ecosystem services and benefits to people.**

The overall approach adopted follows Defra (2007) guidance on assessment of ecosystem services, by examining the impact of SSSI policy on ecosystems and the effects of this on changes in ecosystem services and their value (Figure 3.1).

Figure 3.1 Impact Pathway of SSSI Policy



Understanding the benefits of the SSSIs requires an understanding of the scope and effects of the policy at different stages in this value chain. Table 3.1 summarises some of the key aspects of the policy and indicators of its effects that need to be considered and the research tools used by this study to gather the evidence required.

Benefits arising from ecosystems can be described and analysed in **qualitative, quantitative and monetary terms**. Whereas qualitative assessments are often possible, a quantitative analysis is more difficult and therefore quantitative estimates of ecosystem services are rather scarce (TEEB, 2011). Finally, a relatively limited number of benefits can be valued in monetary terms. This is not only because services are difficult to value. Scientific uncertainties often make it difficult to measure services in units to which monetary values can be applied. In order to examine the range of benefits of SSSIs, the study has examined a variety of qualitative, quantitative and monetary evidence.

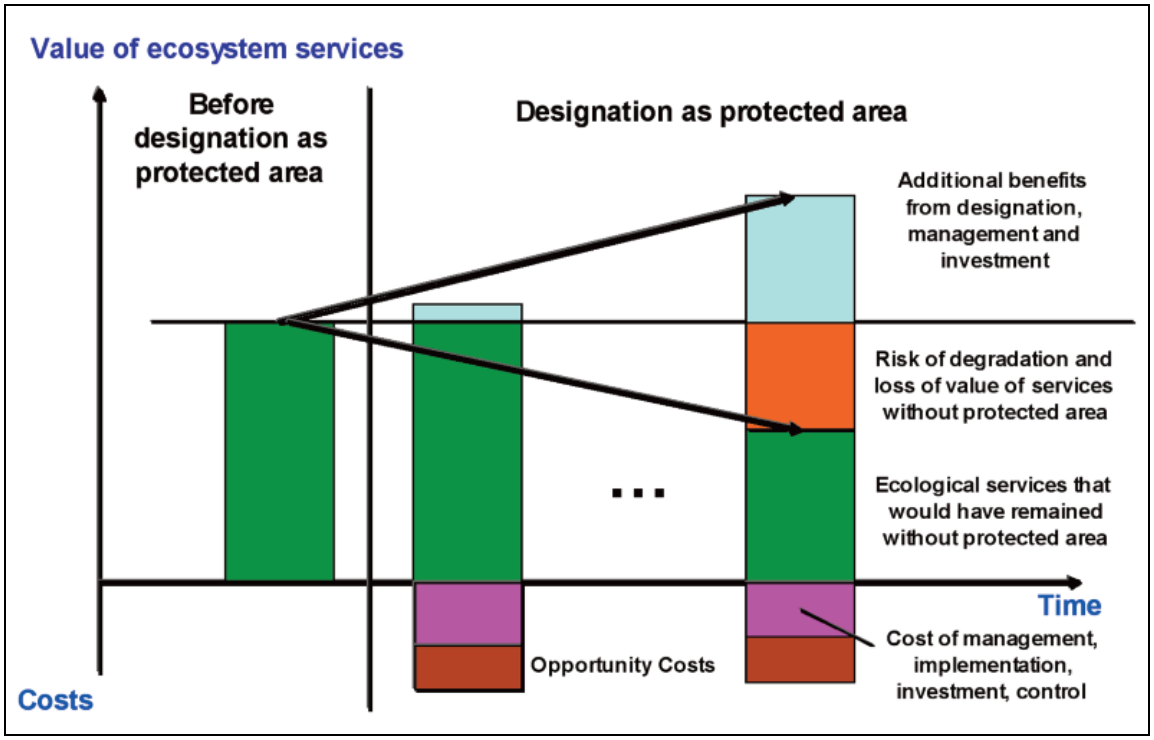
Since many SSSIs also have other designations (as Natura 2000 sites, NNRs and Ramsar sites) a key element of the study was to understand the **added value of these different levels of designations** at each stage in the value chain. It is also recognised that some level of ecosystem services are provided by sites even in the absence of designations, and that it is important to seek to assess the **effect of different levels of designation and conservation status on service delivery**.

Table 3.1 Assessing the Benefits of SSSI Policy

Stage in Impact Pathway	Key Aspects and Indicators	Sources of Information
SSSI Policy	Legal requirements of policy Criteria for designation Policy for improving condition Number and area of sites covered Degree of protection and enforcement Resources provided for site management Effectiveness of monitoring Scope of policy compared to other designations	Literature review Stakeholder consultations
Impacts on Ecosystems (including core conservation benefits)	Number and area of sites protected from development Condition/conservation status of SSSIs Biodiversity supported by SSSIs (species, habitats) Geodiversity supported by SSSIs Ecological functioning of SSSIs	Literature review Stakeholder consultations Stakeholder workshops Case studies
Changes in Ecosystem Services	Changes in: - Provisioning services - Regulating services - Cultural services Qualitative and quantitative assessments of change Net effects taking account of gains and potential losses in some services	Literature review Stakeholder workshops Case studies Weighting matrix
Impacts on Human Well-Being	Use of produce derived from SSSIs Benefits of regulating services (e.g. mitigation of climate change, protection of property from flooding) Public enjoyment of SSSIs Existence values derived from wildlife and habitats of SSSIs	Literature review Case studies Stakeholder workshops Focus groups
Economic Value of Changes in Ecosystem Services	Market value of SSSI products and services Avoided expenditures (e.g. flood protection, water treatment) Willingness to pay for services derived from SSSIs	New evidence of value of SSSIs from choice experiment valuation (public willingness to pay) Existing evidence of value of ecosystem services delivered by SSSIs from: - Literature review - Case studies

An illustration of the possible effects of designation on service delivery is given in Figure 3.2. Designation of SSSIs and other protected areas helps to protect ecosystems and maintain the services they provide, which would otherwise be at risk from degradation caused by development or inappropriate management. Sympathetic management to improve site condition can enhance certain ecosystem services (e.g. regulating services such as water quality). However, certain services may decline as a result of management restrictions (e.g. food production). These are referred to in the diagram as opportunity costs, as they restrict economic opportunity. There are also financial and administrative costs in designating and managing the protected area. An assessment of the net benefits of designation needs to take account of these various costs and benefits (Gantioler *et al*., 2010).

Figure 3.2 Illustration of Possible Effects of Designation on Ecosystem Services



3.2 Defining SSSI Policy Scenarios

The study has examined the benefits of SSSI policy under different future funding scenarios.

A key aspect of the study methodology involved defining the **counterfactual** – the "policy-off" scenario against which the benefits of SSSI policy are compared. In consultation with the project Steering Group, it was agreed that the scenarios to be considered would focus on the levels of resources applied to SSSI policy in future:

Using the current condition of Sites of Special Scientific Interest as a baseline, the project will estimate the benefits of designation in alternative scenarios where:

a. ***Future funding is maintained at levels sufficient to maintain current levels of SSSI condition ("Maintain funding" scenario).***

b. ***Increased future funding leads to achieving favourable condition[7] on all sites ("Increase funding" scenario).***

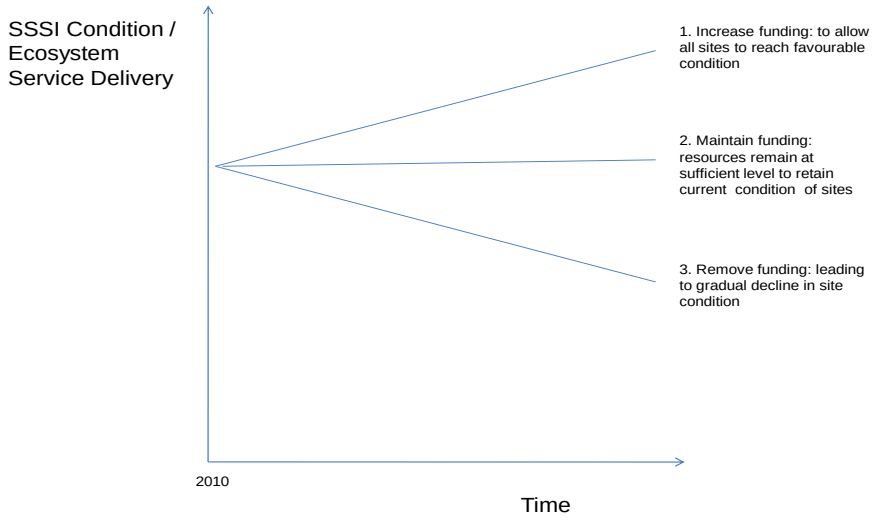
c. ***Future funding is removed, leading to a gradual decline in the proportion of sites in favourable condition ("Remove funding" scenario).***

Figure 3.3 provides an illustration of these hypothetical scenarios and their effects on the condition of sites and hence the conservation benefits and ecosystem services they provide. The effect of these policy scenarios has been examined at each stage in the analysis, and used as a basis for the choice experiment valuation and workshop discussions.

It is also recognised that, in the absence of designation, a significant proportion of SSSIs would have been destroyed by development and land use change. This is evidenced by the volume of historic casework affecting SSSIs, and further illustrated by the literature review and a number of the case studies undertaken. The removal of SSSI designation was not formally included as a policy scenario, although the protection afforded by SSSIs is clearly one of the benefits of the policy.

[7] With the exception of the small proportion of SSSI that have been destroyed

Figure 3.3 Illustration of SSSI Policy Scenarios



3.3 Research Tasks

3.3.1 Overview

A variety of different research methods were used to explore the different benefits of SSSIs in qualitative, quantitative and monetary terms. The study included analysis of existing evidence and new work to examine and as far as possible quantify and value the benefits of SSSIs.

The main research tasks included:

- A **literature review** on SSSIs and their benefits;
- 20 **case studies** examining the benefits of individual SSSIs across England and Wales;
- Four **workshops** involving experts and stakeholders with an interest in SSSIs;
- Completion of a **weighting matrix**, in which expert participants were asked to assess the delivery of different ecosystem services by different habitats within SSSIs;
- Ten **focus groups**, which explored public knowledge and attitudes to SSSIs and involved a **choice experiment** to elicit participants' willingness to pay for SSSI policy;
- **Estimation of the economic value of benefits of SSSIs**, based on the willingness to pay estimates from the choice experiment and the estimates of SSSI service delivery from the weighting matrix.

These tasks were designed collectively to compile evidence of the different benefits, services and values of SSSIs in qualitative, quantitative and monetary terms (Table 3.2).

Table 3.2 Role of the Different Research Methods Employed

Method	Objective	Conservation Benefits	Ecosystem Services	Economic Values
Literature and Data Review	To examine existing evidence of all aspects of SSSIs and their benefits. To avoid duplication of effort and inform study design.	√√	√√	√√
Case Studies	To examine and illustrate the benefits of individual sites, in qualitative, and, where evidence available, quantitative and monetary terms	√√	√√	√
Stakeholder workshops	To draw on the knowledge and experience of stakeholders and experts to assess the benefits and ecosystem services of SSSIs, and to support/ validate the weighting matrix	√	√√	√
Weighting matrix	To quantify in relative terms the ecosystem services delivered by different SSSI habitats and the effects of designation on service delivery	√	√√	
Focus group discussions	To explore public knowledge and perceptions of SSSIs and their benefits	√	√√	
Choice experiment	To assess the value of SSSI policy by eliciting the willingness to pay of focus group participants		√	√√

Full details of the methods employed are given in the respective annexes and are summarised briefly below.

3.3.2 Literature Review

The literature review examined available evidence about SSSIs and their ecological and economic benefits and covered a range of published evidence, grey literature, online resources and data, some of which was provided directly by the statutory nature conservation agencies (Natural England and CCW). An Internet review included detailed examination of the websites and publications lists of Defra, Welsh Assembly, Natural England, CCW, JNCC and the RSPB, as well as an extensive online search[8].

This task examined:

- SSSI policy and the extent and characteristics of SSSIs;
- The benefits of SSSI policy in enhancing ecosystems, biodiversity and geodiversity;
- The effects of SSSIs on the delivery of ecosystem services;

[8] The Internet review used the Google search engine and employed combinations of a variety of key search words including the following: SSSI(s), Site(s) of Special Scientific Interest, Natura 2000, SPA(s), SAC(s), National Nature Reserve(s), NNR(s), Ramsar, protected areas, benefits, ecosystem services, economic benefits, economic value, conservation benefits, species, habitats, ecosystems, biodiversity, geodiversity, England and Wales. More specific searches were conducted for individual ecosystem services, to answer specific questions relating to SSSIs and SSSI policy, and to track down individual references found within the source documents used.

- The effects of these services on human well-being;
- The economic value of these benefits and services.

The review was supplemented by discussions with statutory agencies to obtain relevant datasets required for the research. Key sources are the Natural England SSSI database and SSSI condition reports and the CCW Special Sites and SSSI Features databases.

The results of the literature review are presented in Annex 1.

3.3.3 Case Studies

In consultation with Natural England and CCW, twenty SSSIs were selected with a view to examining the different benefits they provide. 15 sites were individually selected and 5 sites were chosen at random. The selection of the case studies was based on a set of criteria which aimed to ensure that the series of case studies covered the different types, characteristics and locations of SSSIs across England and Wales. The criteria were designed to include sites with a range of regional locations, habitat types, types of other designations and conservation status.

The case study research aimed to combine qualitative and where available, quantitative and monetary information to examine:

- The benefits of SSSI designation for the site and its biodiversity and geodiversity;
- The ecosystem services delivered by the site to a range of stakeholders and extent to which these services are affected by SSSI designation;
- The condition of the site and extent to which this affects its benefits and delivery of different services;
- The links between SSSI designation and other designations and initiatives and relative benefits and added value of each;
- The possible value of the ecosystem services delivered.

The case studies involved site visits, interviews with responsible officers in Natural England/CCW and reviews of relevant documentation. These are presented in Annex 2 and examples are drawn from them throughout this report.

3.3.4 Stakeholder Workshops

Workshops were held in York, Aberystwyth, Peterborough and London. A wide range of stakeholders participated, including representatives from government departments and agencies, NGOs, land managers, utility companies, academics and local authorities. Each workshop comprised four key elements designed to explore the benefits of SSSIs in an interactive way:

- A briefing of the study and its aims;
- Identification of the benefits of SSSIs and other designations by considering a range of specific examples;
- Collective discussion of the range of benefits identified, the effects of different policy scenarios and the implications and lessons arising;
- Quantification of the ecosystem services delivered by different SSSI habitats, reviewing the results of the Weighting Matrix (Section 5.6) and receiving feedback from participants

The findings of the Workshops are presented in Annex 5. These include “mini-case studies” presenting the examples explored.

3.3.5 Weighting Matrix (WM)

Providing an overall quantification of the ecosystem services provided by SSSIs and other sites is hampered by gaps in the available evidence. The weighting matrix (WM) method aims to overcome these evidence gaps by drawing on the knowledge of a number of expert participants to provide a context specific assessment of the ecosystem services delivered.

An important benefit of the WM is that all of the weighting scores are assessed within a single matrix, which helps to ensure that the scores are internally consistent. This enables a direct comparison of weighting scores across the different habitats and services to be made.

The WM is essentially a Microsoft Excel spreadsheet application that guides participants through a series of steps that allow them to provide an assessment of the levels of ecosystem services delivered by different SSSI habitats and geological features. The outputs from the WM are a series of 'weighting scores' which reflect the relative contribution that the different SSSI habitats have for the delivery of a range of ecosystem services. Importantly, these weighting scores are consistent across all habitats and services investigated, thus enabling direct comparison across the entire matrix[9].

The WM comprises seven steps that allow participants to impart their knowledge on the levels of ecosystem services delivered by different SSSI habitats:

Step 1: Participants identified the three SSSI habitats that they were most familiar with (from a list of 17 SSSI habitats). They then focused on only these three habitats for the remainder of the exercise: this helped to ensure that they were reporting on habitats that they were familiar with, as well as reducing potential issues of respondent fatigue.

Steps 2 - 3: The WM utilises a multi-perspective scoring procedure to estimate habitat: ecosystem service 'weighting scores'. First, participants were asked to rate the habitats in terms of their contribution to ecosystem services (a service perspective: Step 2). This was followed by a second rating exercise which asked them to rate the provision of services within each habitat (a habitats perspective: Step 3).

Step 4: The rating scores from Steps 2 and 3 were then averaged to generate a mean weighting score for each SSSI habitat: ecosystem service relationship. These weighting scores could range from '0' = no service provision to '1' = full service provision. In Step 4, these mean weighting scores were presented back to the participants for review, and if necessary they were provided with an opportunity to modify any scores that they were unhappy with. Participants were required to confirm that they were happy with the weighting scores before they could proceed to Step 5.

Step 5: Participants were then asked to consider what impact removing SSSI conservation activities might have on the provision of ecosystem services. This was achieved by measuring the percentage change in service provision from SSSIs being in 'favourable' condition to 'unfavourable' condition.

Step 6: Participants were asked to review their weighting scores from Step 5 and either modify or confirm these scores.

Step 7: In the final step, participants are asked to review the WM as a tool and express their overall level of confidence in their weighting scores.

In this study, 49 participants completed the WM. The weighting scores from all participants were pooled to provide estimates of the average weighting scores for each habitat: ecosystem service combination. To help validate the results from the WM, the stakeholder workshops (Section 3.3.4) reviewed the weighting scores. During these workshops, the participants were asked to review the habitat: ecosystem service weighting scores and confirm which scores they were satisfied with. If participants queried a particular score, they

[9] The concept of the WM was first developed by Christie *et al*. (Forthcoming) in a related Defra study on the value of ecosystem services delivered by the UK Biodiversity Action Plan (UK BAP).

were asked to make appropriate adjustments to that score. Finally, the workshop also asked participants to discuss the overall validity of the WM.

The validity of the weighting scores was assessed through an external review by eight academic experts across the range of ecosystem services examined in the matrix. In the review, the external experts were asked to comment on whether the relative weighting scores for service delivery across habitats were consistent with their expectation for the SSSI funding scenarios. These experts were also asked to provide general comments on their perceived validity of the weighting matrix as an approach to eliciting scientific knowledge on service delivery from SSSIs.

Further details of the WM and the strengths and weaknesses of the methodology are provided in Annex 3.

3.3.6 Public Focus Groups

Ten Focus Groups were completed to examine the public's knowledge and perception of SSSIs and their benefits.

The focus groups were completed in five locations in England and Wales, with two group sessions per evening in each location:

- Wells, Somerset, 7 September 2010
- Carmarthen 8 September 2010
- Southport, 14 September 2010
- Hexham, 15 September 2010
- Ipswich, 21 September 2010.

The focus groups were designed to provide a qualitative discussion of SSSIs and their benefits as well as exploring the economic values that participants placed on these benefits, through a choice experiment valuation.

Each focus group explored people's understanding of and preferences for SSSIs, and, through the choice experiment, their willingness to pay for SSSIs and the benefits they provide.

Each group consisted of between 14 to 17 people, with a total of 154 participants taking part across the ten focus groups. The sample was recruited by the Research Box, a specialist market research company, and stratified to comprise a representative cross section of the general public.

At each location, one 90 minute session was undertaken with an older group (46-75 years), and another with a younger group (18-45 years), drawn from both genders and from a range of the demographic classes AB/C1/C2D.

The focus groups involved:

- A one hour briefing and guidance for participants to undertake the choice experiment;
- A half-hour discussion on people's personal awareness of, use of and concern for SSSIs in the area and its immediate hinterland (a 15 mile radius);
- A discussion on different aspects of the benefits of SSSIs.

The qualitative results of the focus group discussions are summarised in Annex 4.

3.3.7 Choice Experiment

The choice experiment involved 153 people in the focus groups, who were asked to indicate their willingness to pay for the SSSI policy scenarios, in relation to the benefits and

ecosystem services received. The exercise was designed to examine the value to the public of changes in biodiversity and ecosystem services resulting from changes in the overall level of funding provided to SSSIs.

The choice experiment method asks people to express a preference for alternative options within a choice set, each with a set of environmental attributes and a level of payment. Respondents therefore implicitly make trade-offs between the levels of the attributes in the different alternatives presented, enabling their willingness to pay for these to be assessed.

The economic benefits of the alternative SSSI funding scenarios outlined in Section 3.2 were assessed by examining participants' willingness to pay for the services delivered by SSSIs under two funding scenarios, the "Maintain funding" and "Increase funding" scenarios, relative to the counterfactual scenario in which funding for the policy is withdrawn (the "Remove funding" scenario). In line with the different scenarios, participants were told that:

- **Maintain funding** scenario - maintains the current condition of SSSIs but is not sufficient to achieve favourable condition for all sites. This was represented as a situation where 65% of SSSI area achieves favourable condition and a further 30% is in unfavourable recovering condition[10]. As a result ecosystem services are delivered at current levels but are not maximised;
- **Increase funding** scenario - involves growth in expenditure to a level sufficient for all SSSIs to achieve favourable condition, maximising the ecosystem services delivered;
- **Remove funding** scenario **-** leads to a gradual decline in condition such that all sites which are not subject to higher level designations move to unfavourable condition due to a loss of sympathetic management. Further, the conservation interest of a small number of SSSI sites may even be lost altogether due to unsympathetic management or neglect. However, some sites would retain protection under the other conservation policies and these would remain in 'favourable' condition. Thus, the levels of CE ecosystem service attributes will reflect the levels of service delivery if no SSSI conservation activities were undertaken.

To make the exercise manageable and comprehensible to the public, seven groups of ecosystem services and benefits associated with SSSIs were examined in the choice experiment:

Provisioning services:

- **Nature's gifts** (comprising wild food and other items that people might gather or harvest from the countryside);

Regulating services:

- **Climate regulation**;
- **Water regulation**;

Cultural services:

- **Sense of experience** (combining recreation and sense of place);

[10] The "maintain funding" scenario compares with the situation at the end of 2010 where 37% of SSSI land area in England was in favourable condition and a further 59% in unfavourable recovering condition. No up to date figures are available for Wales. The scenarios were defined in consultation with Natural England, and projections were made based on 2006 data (Williams *et al*., 2006) to estimate the area of different habitats reaching favourable condition under current levels of SSSI funding and management. The actual proportion of sites that will reach favourable condition under current funding and management cannot be known, but will be greater than the current proportion and less than 100%. The 65% estimate is a representation based on the available evidence at the time.

- **Research and education**;
- **Charismatic species**; and
- **Non-charismatic species** (the latter two groups examining the conservation benefits of SSSIs and the cultural services people derive from them).

The exercise provided information to participants regarding the relationship between SSSIs, ecosystem services and values, promoting reflective learning. Following some introductory questions and focus group discussions, participants were asked to complete a series of five choice tasks, where each task required respondents to select their preferred 'Option' from a series of three options: Option A, Option B and a Baseline option. Each Option was described in terms of the different levels of the seven ecosystem services that might result, and each involved a different level of payment. The payment was specified as annual increases in taxation of either: £25, £50, £100, £200, £300, or £450 over the next 10 years. The choice tasks were revisited after further discussion and information, and respondents were given an opportunity to revise their choices.

The choice tasks are necessarily a simplification of the levels of different services under the various scenarios, but were designed to capture the likely type and extent of service changes that could be delivered by the different funding scenarios, based on available evidence.

This enabled each participant's willingness to pay for each of the funding scenarios, and for the different ecosystem services within them, to be estimated.

Full details of the survey instruments used and the different scenarios examined by the choice experiment are given in Annex 3.

3.3.8 Valuation of SSSI Services

By combining the results of the choice experiment and weighting matrix, the overall value of the services delivered by SSSIs and their habitats was estimated.

The results from the choice experiment were combined with the findings of the weighting matrix to estimate the marginal 'total economic value' of the ecosystem services delivered as a consequence of SSSI expenditures. This is the value of additional benefits that society gains from the ecosystem services that SSSIs collectively provide.

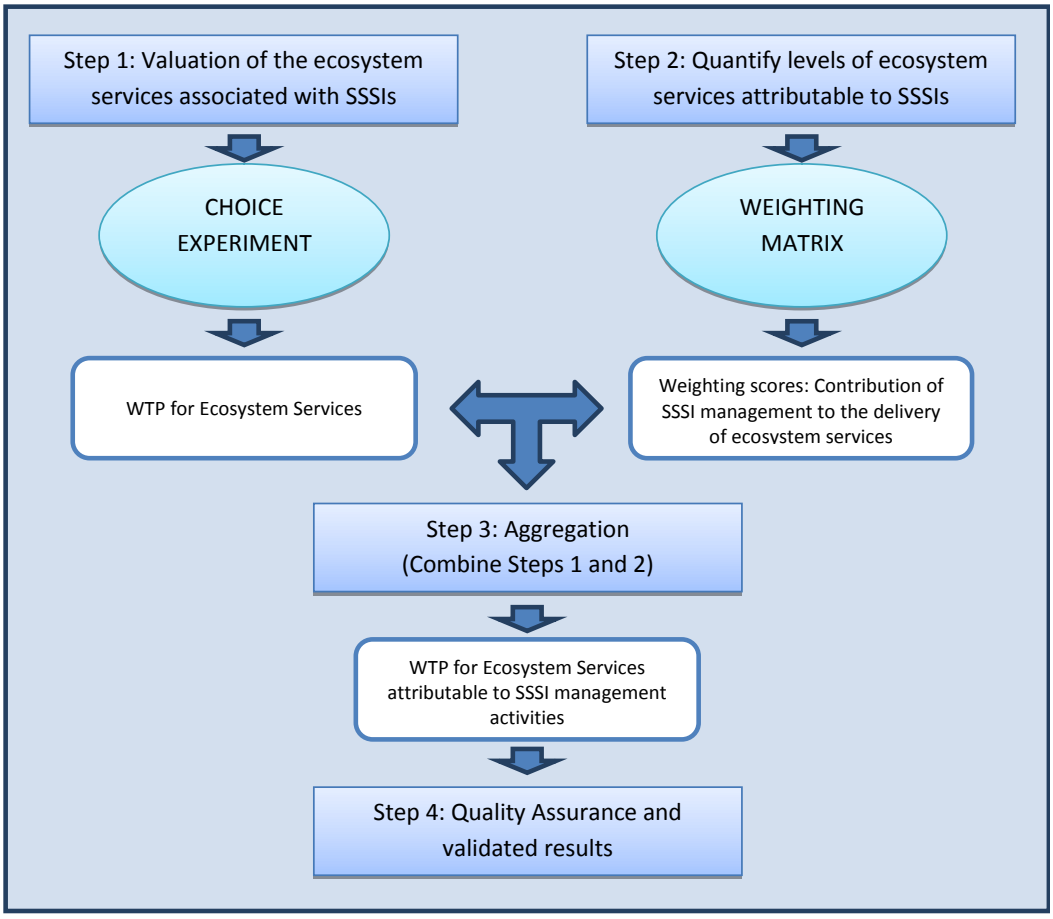
While the choice experiment measured the public's willingness to pay for the services delivered by SSSIs under different funding scenarios, the weighting matrix provided estimates of the relative levels of services provided by different habitats and the added value of SSSI designation for service delivery. Combining the two enabled an assessment of the value of services by habitat and the value added by SSSI designation for each habitat.

This was achieved by multiplying the value estimated for each ecosystem service delivered by SSSI sites in the choice experiment by the relative level of ecosystem services delivered by those habitats from the weighting matrix. This is illustrated in Figure 3.4 below.

The average values per household for each habitat and service were then multiplied by the 22.1 million households in England and Wales to estimate the overall willingness to pay of the population for the services delivered by SSSIs. This gave estimates of the aggregate value of the ecosystem services directly attributed to SSSI spending in England and Wales and for each of the 17 SSSI habitats examined. The assessment of the net benefits of the different funding scenarios took account of the proportion of SSSI land area that is designated Natura 2000, and could therefore be expected to benefit from conservation management even if national funding for SSSIs were removed.

The approach largely follows that utilised in a similar Defra study that valued the ecosystem services associated with the UK Biodiversity Action Plan (Christie *et al.*, 2010). Full details are presented in Annex 3 of this report.

Figure 3.4 Overview of valuation approach



The following sections of the report present evidence collected regarding the conservation benefits of SSSI policy, the effect of these on ecosystem services, and the economic value of these services, each drawing on findings of the different research tasks completed.

4 The Conservation Benefits of SSSIs

- SSSIs play a vital role in the conservation of the most important species, habitats and geological features in England and Wales.
- SSSIs provide good but not comprehensive coverage of our national biodiversity, and some rare species and priority habitats remain outside the SSSI series.
- SSSIs help to protect species that would otherwise be at risk of extinction nationally, and habitats that have largely disappeared from the wider countryside
- SSSIs afford good protection for our most important geological sites.
- SSSI status protects sites from development and damage and in recent years has substantially improved their management and condition.
- SSSIs are particularly important for the conservation of relatively small sites, with many larger sites benefiting also from higher level designations.
- SSSIs are seen as too fragmented to constitute a coherent ecological network.
- Higher level designations provide added benefits as a result of extra protection from development or damaging activities, additional funding opportunities (especially at EU level), greater national and international profile, and enhanced public access and promotion of education and scientific study.
- The conservation benefits of SSSIs are highly dependent on funding for management actions designed to achieve favourable condition, and without funding many of their benefits would decline and the condition of species, habitats and features would deteriorate

4.1 Assessing the Conservation Benefits of SSSIs

This section of the report focuses on the benefits of SSSIs in conserving species, habitats and geodiversity in England and Wales. As these are the features for which SSSIs are designated, this section therefore examines the effectiveness of SSSIs in meeting their core objectives.

These conservation benefits depend on:

- The extent to which the SSSI network covers our most important species, habitats and geodiversity features;
- The degree to which SSSI status furthers the conservation of these biological and geological features, by protecting them from development or other pressures and by facilitating positive management of the sites which support them.

A 2006 workshop of the UK Population Biology Network (Gaston *et al.*, 2006) used two measures to assess the ecological effectiveness of protected areas – measures of inventory (the amount of biodiversity present) and measures of condition or persistence (the status of biodiversity features). Over time, measures of inventory can indirectly give indications of condition or persistence.

The ecological effectiveness of protected areas can be addressed at different spatial levels, examining the effectiveness of individual sites and of portfolios of protected areas (i.e. the combined effectiveness of the SSSI series as a whole). The main issue for ecological effectiveness at the portfolio scale is how well the SSSI series represents the full range and examples of biodiversity features regionally or nationally. Studies looking at the effectiveness of SSSIs at the national scale (e.g. Oldfield *et al.*, 2004; Jackson *et al.*, 2004) have generally concluded that the portfolio does represent the biodiversity features well, but that it could also be improved upon. The location and connectivity of protected areas is also an important factor in determining the effectiveness of ecological networks, since habitat fragmentation is an important concern in relation to maintaining viable species populations.

The following sections assess the conservation benefits of SSSIs, taking account of the various criteria identified above.

4.2 SSSSIs and Species Conservation

SSSIs protect a high proportion of all species found in England and Wales, including many (but not all) rare and endangered species

Designation of SSSIs for species is covered by the Guidelines for the selection of biological SSSIs (NCC, 1989) which provide specific criteria for different species groups (vascular plants, non-vascular plants, mammals, birds, reptiles and amphibians, freshwater and estuarine fish, invertebrates, butterflies and dragonflies). These criteria relate to species diversity, population size and rarity, as well as referring to the international importance of sites for species conservation.

It has been demonstrated that SSSIs support the majority, but not all, of the species found nationally. For example, recent analyses have found that 88% of the UK's vascular plants, 70% of threatened bryophytes and 100% of BAP butterfly species are represented in the SSSI network (Lawton *et al*., 2010).

SSSIs have helped to protect some species in England which would otherwise be at risk of extinction. For example, the United Kingdom has between 25% and 50% of the world's population of bog orchids which are threatened with extinction throughout Europe. All bog orchids in England are protected within SSSI land and plants on such sites depend on the continued management of the habitat (House of Commons Public Accounts Committee, 2009a). Jackson *et al*. (2009) found that a high proportion of Red List plant species occur within protected areas despite the fact that many of these areas were not originally designated for conserving these species. Protected areas are increasingly important, as fragmentation and intense land use continue to restrict ranges. Despite good overall species coverage, protected areas cover less than one third of the total number of occurrence records for Red List plant species, which limits the extent to which there is effective 'risk-spreading'.

Banks *et al.* (1994) found that habitat protection, mainly in the form of SSSI designation, had been effective in safeguarding the natterjack toad (*Bufo calamita*), with safeguarded sites increasing from 60% in 1970 to 83% in 1990. Sites with SSSI or NNR status fared better than sites without any statutory habitat protection, particularly after the Wildlife and Countryside Act came into force.

Overall Defra (2004) found that insufficient data are available on species populations in SSSIs to measure extinction risk but concluded that for species restricted to rare and/or semi- natural habitats, it is likely that SSSIs have made a significant contribution to reducing local extinctions and declines.

Sympathetic management of SSSIs to achieve favourable condition contributes positively to species conservation. For example, Davies *et al.*, (2007) showed that SSSIs are important for threatened species of butterfly and management of SSSIs to achieve favourable condition is important in determining future population levels of these. Population trends of eight threatened butterfly species were found to respond positively to favourable site condition.

Assessment of Breeding Waders of Wet Meadow surveys of 1982 and 2002 revealed a 62% decline in the breeding population of snipe (*Gallinago gallinago*) on lowland wet grassland between these two dates (Wilson *et al.*, 2005). Analyses to relate these changes to site characteristics found that designation as a SSSI or nature reserve was a significant positive predictor of snipe presence, with snipe densities also tending to be significantly higher on SSSIs than other sites.

The case studies conducted as part of this assignment give examples of the importance of individual SSSIs for species conservation, and highlight the importance of SSSI management for these species (Table 4.1). Some sites such as the Humber Estuary and South Pennine Moors support internationally important populations of bird species.

Table 4.1 Examples of Role of Case Study Sites in Species Conservation

Site	Role in Species Conservation
Dark Peak	Nationally important populations of nesting birds including golden plover, dunlin, merlin, short-eared owl and twite
Dyfi	Important populations of waterfowl and wading birds, including nationally important numbers of wintering Greenland white-fronted goose and wigeon. Important plant and invertebrate communities. Populations of a range of species are increasing as a result of efforts to improve the condition of the SSSI habitats.
Holy Island Coast	Coastal cliffs and associated grasslands are of major botanical interest, supporting the endemic South Stack fleawort, rare lichens including ciliate strap-lichen and golden hair lichen, the nationally rare spotted rockrose, a good range of invertebrates including the silver-studded blue butterfly, as well as choughs and a variety of nesting seabirds.
Humber Estuary	Among the ten most important estuaries in Europe, supporting nationally important populations of 22 species of wintering waterfowl and a further 9 species of regularly occurring passage waders, and a nationally important assemblage of breeding birds of lowland open waters and their margins. Nationally important for a breeding colony of grey seals, and for river lamprey and sea lamprey. Conservation of these species needs to be balanced with industrial and commercial activities and populations are carefully monitored.
Lower Usk	Important for otters and fish species (Atlantic salmon, twaite shad and allis shad, sea lamprey and river lamprey, brook lamprey, bullhead) and floating Ranunculus vegetation. Conservation efforts protect the river from development and recreational pressures and safeguard water quality.
North York Moors	Support nationally-important populations of breeding birds, many of high conservation concern, including merlin, golden plover, hen harrier, peregrine falcon, and various waders.
Richmond Park	Veteran trees found throughout the Park support a nationally significant assemblage of invertebrates. One of Britain's prime sites for beetles associated with dead and decaying wood, with over 200 species recorded. These lignicolous species have become restricted to just a few localities in Britain due to the decline in ancient wood and parkland habitats.
South Pennine Moors	Internationally important populations of merlin, golden plover, short-eared owl, common sandpiper, dunlin, twite, snipe, curlew, wheatear, whinchat, redshank, ring ouzel and lapwing. Numbers of golden plover are just under 5% of the British population and are increasing.
Walthamstow Reservoirs	The site supports one of England's five largest heronries and a particularly large concentration of breeding wildfowl of various species.

It is known that some species are not protected in the SSSI series, including some rare species. For example, SSSI guidelines for the selection of grassland fungi were only published in 2009 and there have so far been few sites selected for this group. Guidelines are also lacking for other less well known groups including types of algae and many soil-living organisms. A number of notably rare species lie outside the SSSI series, including the endemic lichen *Lecidea subspeira* which is known globally only from a single churchyard in West Sussex; similarly the only English population of Pyramidal Bugle *Ajuga pyramidalis* is not within a SSSI, nor are the only two sites of the freshwater snail *Sphaerium solidum*. Furthermore, a recent survey of the biodiversity potential of 478 brownfield sites in the Thames Gateway found that of 113 rated 'high' in terms of invertebrate interest, only one

was designated as SSSI (Lawton *et al*., 2010). Jackson *et al.* (2009) found that the SSSI series covered 88% of vascular plant species but that 40 species, some of which are critically endangered, were completely absent from protected areas.

In conclusion, although there are some gaps in the range of species protected by SSSIs, evidence demonstrates that the SSSI series does broadly support the full range of biodiversity in England and Wales.

4.3 SSSIs and Habitat Conservation

SSSIs make an important contribution to the conservation of semi-natural habitats in England and Wales, protecting the majority of our most important habitats.

The Nature Conservancy Council (1989) *Guidelines for selection of biological SSSIs* catalogue the relevant habitats. These include the main priority habitats listed in the UK Biodiversity Action Plan as well as a wider range of more specialist habitats (including, for example, a variety of rare montane and upland habitats).

Most SSSIs in Wales (82%) were notified for habitat features, such as fen, marsh and swamp, dwarf shrub heath and acid grassland (CCW, 2006). SSSIs include habitats and features such as blanket bogs, maritime heathlands and limestone pavements for which the UK hosts a large part of the EU resource.

SSSI contribution to habitat targets under the UK Biodiversity Action Plan is larger for those priority habitats where a high proportion fall within protected areas. CJC Consulting (2004) summarised the contribution of SSSIs to BAP targets for different habitats in England (Table 4.2). The SSSI network includes all examples of one priority habitat - aquifer fed naturally fluctuating water bodies – and a major proportion of others such as lowland wood pasture and parkland, limestone pavement and most coastal habitats. However, it protects only a minor proportion (<10%) of some agricultural habitats such as hedgerows and arable field margins.

Table 4.2 SSSI contribution to BAP targets

Habitats	Contribution of SSSIs to BAP targets
Aquifer fed naturally fluctuating water bodies	Complete (100% of national habitat area)
Lowland wood pasture and parkland, upland hay meadow, lowland calcareous grassland, upland calcareous grassland, lowland dry acid grassland, purple moor grass and rush pasture, upland heathland, lowland heathland, fen, reedbeds, lowland raised bog, blanket bog, chalk rivers, limestone pavement, vegetated shingle, coastal saltmarsh, mudflats, maritime cliff and slope, coastal sand dunes,	Major (50-99% of national habitat area)
Upland oak woodland, lowland beech woodland, upland mixed ashwoods, wet woodlands, coastal floodplain and grazing marsh, lowland meadows, eutrophic standing waters, mesotrophic lakes, littoral and sublittoral chalk	Significant (10-49% of national habitat area)
Hedgerows, cereal field margins, upland calcareous grassland	Insignificant (<10% of national habitat area)

Source: CJC Consulting (2004), Lawton et al. (2010)

Evidence provided by Natural England for the *Making Space for Nature* review found that all types of BAP priority habitats are represented in SSSIs in every English region in which they occur. On average, **71% of the area of BAP priority habitats are protected in SSSIs, although there is a large amount of variation**, with low coverage of some habitats such as coastal and floodplain grazing marsh (18.5%) and broadleaved woodland (24.7%) and

very high representation of others, including reed beds (98.3%) and coastal vegetated shingle sites (93.1%). One of the reasons for the difference in SSSI coverage across habitats is that, for some habitats, SSSIs are selected to provide only an exemplar representation (e.g. more common habitats such as broadleaved woodlands and upland heathland), while for others the SSSI guidelines are to designate all occurrences that are of a minimum standard (including most types of grassland). **There are some recognised gaps in coverage**. These include geographical gaps for certain habitats, such as lowland heathlands in west Cornwall and, perhaps more significantly, there are also some habitat types which are very poorly represented in the SSSI series as a whole. They include some arable habitats of botanical importance, and two recently listed BAP priority habitats, traditional orchards and open mosaic habitats on previously developed land (i.e. brownfield sites), which can host a range of rare species (Lawton *et al*, 2010).

Lawton *et al.* also observed that **most of England's SSSIs are small, with 77% having fewer than 100 hectares.** While SSSIs and other designations protect most of the current extent of BAP priority habitats, the amount of habitat left today is much reduced from what it was less than 100 years ago. **Much of the current extent of BAP priority habitats is now within protected sites because they have largely been lost from everywhere else. This demonstrates the benefits of the SSSI series, without which we would expect the remaining area of habitats to be significantly reduced.**

The case study sites examined for this study protect a variety of priority habitats. Table 4.3 provides examples of the range of habitats represented and how SSSI status helps to conserve them. These include small remnants of once widespread habitats (such as species rich neutral grassland at Stone Field), major areas of scarce habitats representing a substantial proportion of the national resource (such as lowland raised bog at Hatfield Moors), rich mosaics of several priority habitats (such as at Dyfi) and large expanses of upland and coastal habitats (such as Humber Estuary and North York Moors).

Table 4.3 Habitats Protected by Selected Case Study Sites

Name	Size of SSSI (ha)	Types of habitat supported
Dyfi	3,792	Mosaic of special habitats including sand dunes, mudflats, saltmarsh, raised bog, floodplain grasslands
Hatfield Moor	1,400	Second largest remaining area of lowland raised peat bog, unique in having been formed on nutrient deficient gravels. Other habitats include lowland heath, scrub woodland (birch mainly) and medium-sized water bodies
Humber Estuary	3,404	Second-largest coastal plain estuary in the UK, supporting important mudflats and sandflats, saltmarsh, coastal lagoons and sand dunes
North York Moors	18,076	The SSSI contains the largest continuous tract of heather moorland in England. Varied mosaic of habitat types including dry and wet upland heath, blanket bog, acid grassland and native woodland
River Avon	476	Rich and varied chalk river, possessing more than 180 species of aquatic plants, a diversity of fish and a wide range of aquatic invertebrates. Management effort has focused on reducing pressures on water quality and restoration of the river system and bankside habitats.
South Pennine Moors	20,938	Extensive areas of unenclosed heather moorland, blanket bog, acidic flushes and mires underlain by acidic Millstone Grit. These habitats are being restored after a long history of

		pollution, overgrazing, erosion and other pressures.
Stone Field	2.3	Provides a remnant example of species rich neutral grassland, a habitat once widespread but now very rare, with 97% lost across Britain since around 1960 to agricultural change and development.
Sutton Park	866	Complex mosaic of habitats including extensive lowland, wet and dry heathland, acid grassland and oak-holly-rowan woodland, one of only a few which exist in Britain with such an abundance of holly in the understorey.
Wormley Hoddesdonpark Woods	143	Lowland mixed broadleaved and yew woodland, including Danemead nature reserve, one of the two outstanding localities in the UK for oak-hornbeam forest, as well as valley mire, unimproved damp acid grassland, scrub, stream and Hornbeam woodland. The SSSI designation has helped preserve hornbeams, oak trees, ancient pollards and coppice and to maintain a diverse woodland structure.

4.4 SSSIs and Conservation of Geodiversity

SSSIs form the main statutory mechanism for protecting nationally important geological sites in Great Britain and provide a high degree of protection for them.

The selection of these sites is based on clear guidelines published by JNCC (Ellis *et al.*, 1996) in the Geological Conservation Review (GCR). The aim of the GCR programme which began in 1977 was to identify the best, most representative, geological sites in Great Britain, with a view to their long-term conservation. The GCR also re-evaluated sites that were designated SSSIs before 1977. As a result, nearly all of the pre-1977 geological SSSIs were confirmed as retaining their interest, and additional localities also deemed to be of national importance to the study of geology and geomorphology were identified, creating the comprehensive GCR site 'register'.

To be designated as SSSI each site must have a special interest demonstrable at national or international level, either in its own right or by virtue of its contribution to a network of closely related sites. The special interest of the series is interpreted as the minimum number of sites needed to demonstrate our current understanding of the diversity and range of geological features with regard to the following criteria:

- Representativeness
- Exceptional features
- International importance

SSSI designation provides sites with a high degree of protection from damaging activities, although it does not guarantee their long-term conservation, which also requires sympathetic management (Prosser *et al.*, 2006). Geological SSSIs are subject to similar legal protection and procedures for condition assessment as biological SSSIs.

An assessment by Natural England (2008) found that the overall condition of geodiversity SSSIs, as represented by the condition of geo-features, tended to be slightly better than for SSSIs as a whole, with about 86% of geo-features in England in favourable or unfavourable recovering condition at that time. However, there was some variation between sites. A high proportion of coastal and natural inland sites were found to be in favourable condition, with exposures maintained by natural erosion. In comparison, a smaller proportion of mineralogy

sites (which are sensitive to removal of material) and disused quarries and cuttings (whose geological exposures are vulnerable to being obscured by vegetation or scree) were in favourable condition.

The 20 SSSI case studies undertaken for this assignment included two sites designated specifically for their geodiversity (Crime Rigg and Sherburn Hill Quarries, and Wren's Nest) as well as others which protect geodiversity as well as biodiversity. The benefits of these sites for geodiversity conservation are summarised in Box 4.1.

Box 4.1: Examples of geodiversity protected by the case study sites

Crime Rigg and Sherburn Hill Quarries - This 23 hectare geological SSSI sits within a limestone and sand quarry and is one of the most important sites on the Lower Permian Yellow Sands. The formation passes up through Marl Slate Raisby and Ford formations with Lower Magnesian Limestone deposited above. The interdigitating Yellow Sand structures are Seif (sharp-crested) dune deposits and the formation is thought to be from the late Early Permian, approximately 270 million years old. SSSI status means that the exposure is protected – there are plans to move the SSSI to a different part of the quarry, replacing the existing exposure with another elsewhere in the quarry with similar geological features.

Dyfi – as well as being designated for its habitats and species the site provides a detailed record of coastal and environmental changes during the Holocene epoch, while the area at Ynyslas is significant for studying estuarine sedimentation, spit development and sand dune formation and growth.

Holy Island Coast - The site is notable for the recorded history of its geological features, especially its folded Precambrian rock formations which have been visited and studied by generations of geologists and geographers.

South Pennine Moors – The SSSI has three locations of special geological interest including two areas of deltaic sedimentary rocks and a locality for two diagnostic fossils.

Wren's Nest - exceptional paleontological importance, particularly Silurian Limestone from the Wenlock age which has led to the site being renowned internationally for the abundance, variety and well preserved nature of Silurian limestone fossils. The site is one of the most notable geological locations in the British Isles. Over 600 fossil species are known at Wren's Nest, and Dudley was the first place in the world where one-third of these fossils, including the trilobite Calymene blumenbachi (or 'Dudley Bug') were found. Around 80 of the fossils have only ever been found at Wren's Nest. Active management is required to maintain exposure of important geological features including periodic clearance of vegetation and rock debris.

4.5 Conservation Benefits of SSSI Designation

The SSSI designation has played an important role in protecting species, habitats and geodiversity from adverse pressures and in financing the activities needed to achieve favourable condition, though this is a long term process.

SSSI designation has benefited the species, habitats and geological features of sites by:

1. **Protecting sites from development and from other adverse pressures** such as agricultural intensification;
2. **Focusing efforts on achieving favourable condition** of sites, and attracting resources to fund the management required to achieve this.

The act of identifying important wildlife sites and designating them as SSSIs has been important in reducing the loss of semi-natural habitats, particularly since 1981 when the Wildlife and Countryside Act significantly strengthened the protection afforded to them. Until then the emphasis had been on identifying these special sites rather than protecting them, so that many were lost or damaged in the second half of the twentieth century (Lawton *et al*., 2010; Barton and Buckley, 1983). **SSSI designation now offers a high degree of protection**, for example in planning policy, and in the latest data on the

condition of SSSIs only 304 ha (or 0.04%) of the current SSSI network in England is recorded as 'destroyed' or 'part destroyed' (Lawton *et al*., 2010).

In spite of this protection, loss and damage to SSSIs has continued to be documented in assessments since 1981 (e.g. Rowell, 1991; Sheail, 1998), and this has focused attention on management as well as site protection. **Inappropriate management** is most often cited as the reason for unfavourable condition in SSSIs, often as a result of over- or under-grazing, as well as presence of invasive or non-native species (Williams, 2006).

Changes introduced through the Countryside and Rights of Way Act 2000 provided greater powers to secure appropriate management for SSSIs and take action where this is not in place. Lawton *et al.* (2010) found that there has been good progress in improving the management of SSSIs since this Act, in part driven by the former target for SSSI condition backed by its comprehensive programme of condition assessment. **By the end of 2010, more than 96% of England's SSSI area was in favourable or recovering condition, although 59% was in unfavourable recovering and only 37% in favourable condition at that point** (Natural England, 2011). This has been assisted by funding from agri-environment schemes, which now cover 78% of eligible BAP priority habitats within SSSIs (Kirby *et al*., 2010). Inclusion of SSSIs in these schemes has been found to enhance condition significantly through improvements in management (Rural Development Service and English Nature, 2006). In some cases, intensive management measures such as hand pollination, seeding, fencing and wardening of sites has been required to maintain small populations of certain plant species in protected areas (e.g. lady's slipper orchid, Ramsay and Stewart, 1998).

Significantly, many of the causes of unfavourable condition for the remaining SSSIs are due to 'off-site' factors that are often outside the control of the site owners or managers. An example relates to eutrophication, where the use of agricultural fertilisers outside of SSSIs causes pollution of water bodies and soils within SSSIs. Air pollution can also be a cause of unfavourable condition, as in Epping Forest (Kirby *et al.*, 2010).

Because evidence of the condition of habitats across the wider countryside is not widely available in a form comparable to that of the SSSI condition assessments, an evaluation of the exact impact of SSSI designation is difficult. However, comparative surveys of SSSI and non-SSSI lowland grassland and heathland show that **SSSI habitats are in very significantly better condition than non-SSSI habitats** (Natural England, 2008). Natural England concludes in their 2008 report 'State of the Natural Environment' that *"Where comparable evidence has been collected, it demonstrates better condition of habitats under SSSI designation compared to non-designated areas."* For example, a study of a sample of non-SSSI heathland in England found that none was in favourable condition, compared to 17% of UK SSSI heathland assessed by the JNCC (Hewins *et al.,* 2007).

Like biological SSSIs, **many geological sites need management to achieve and maintain favourable condition.** Rocks, fossils and minerals, exposed in artificial situations such as cuttings, or in natural outcrops, require active management to maintain the exposures and physical access to them. Approximately half of all geological SSSIs currently need vegetation or scree clearance, followed by on-going management to maintain exposures in favourable condition (Stace and Larwood, 2006). Geological sites are generally not covered by agri-environment schemes but SSSI status helps them to attract some funding from other programmes. For example, in 2009, Natural England announced a new Conservation Enhancement Scheme designed to fund management of SSSIs that were not eligible for Environmental Stewardship, which include some geological SSSIs. The relatively high proportion of geological SSSIs in favourable condition indicates that the policy has been effective in their conservation. Most geological SSSI are static features and SSSI designation has worked well in protecting them from damage and degradation. Mobile and dynamic features such as eroding coastlines or mobile river features present greater challenges, but overall the SSSI approach is understood to have worked well for geology

and geomorphology, where sufficient resources have been available for site management (Prosser, *pers. comm.*).

The condition of the 20 case study SSSIs examined for this assignment varies widely. Sites can fall into unfavourable condition due to numerous adverse impacts including fertiliser use, overgrazing and under-grazing, air pollution, fire, moor burning, forestry and woodland management, inappropriate ditch management, weed control and public access, and disturbance. SSSI designation, and the goal of achieving favourable condition, has provided an impetus for addressing these issues and providing the conditions for recovery.

The case studies provide numerous examples where **SSSI status has benefited biodiversity and geodiversity by protecting sites from development and other adverse pressures, and by focusing effort and resources on enhancing the condition and conservation interest of sites** (Box 4.2). Improving condition is often a significant and long term task, particularly when a complex range of habitats, interest groups and pressures are involved, as in several of the case studies. However, signs of success are evident at many sites.

Box 4.2: Conservation Benefits of SSSIs – Examples from Case Study Sites

The 20 case study sites together support a wide variety of habitats, species and geological features of national and international importance.

The case study research as a whole has illustrated that SSSI status assigned to these individual sites has helped to conserve the biodiversity and geodiversity of the sites and balance these needs with different pressures and uses. It is likely that, without SSSI status, these benefits would be lost or severely depleted at some sites. This includes not only inappropriate or lack of management, but also complete or partial site destruction by built development or land use change (e.g. commercial forestry; grassland conversion to arable). Examples of sites where SSSI status has helped to protect against or mitigate other pressures include the Lower Usk and Wormley Hoddesdonpark Woods (where designation affords protection against built development); the River Avon System (helping to tackle pollution from agriculture); King's Sedgemoor (maintenance of water levels and appropriate farming systems); Humber Estuary (balancing conservation, river use and port activities); Crime Rigg (maintenance of the quarry exposure, otherwise at risk of neglect or infilling); North York Moors (balancing conservation, farming and grouse interests); and Hatfield Moor (protection from peat extraction and agricultural pollution).

SSSI status has also proved to be a key stimulus in focusing attention on the condition of sites and in facilitating the allocation of resources to improve site condition. This is delivering measurable conservation benefits at some sites, such as Dyfi, where populations of reptiles, amphibians, otter, dormouse and wading bird species are increasing; the South Pennine Moors, where the SSSI is recovering from past habitat degradation, and King's Sedgemoor, which is now all in unfavourable recovering or favourable condition, largely due to recent investments in infrastructure and improved farming practices. Other sites where increasing effort and resources are being channelled into improving condition include Ashdown Forest, Dark Peak, Hatfield Moor, and the North Yorkshire Moors.

4.6 Ecological Coherence of SSSI Series

The SSSI series is too fragmented to constitute a fully effective ecological network.

While the major focus on SSSI condition in recent years has undoubtedly enhanced the conservation of the species, habitats and features for which the sites were designated, **development of our understanding of ecology and conservation has led to increased attention to the role these sites play as an interconnected ecological network** or a component of such a network.

Most SSSIs in Britain are small in size. This creates large edge effects, increased interference from outside activities and a reduced potential for maintaining local populations as well as difficulties with dispersal between local populations (Latham, 2007).

Some other difficulties associated with protected areas include the tendency to treat protected areas as 'islands', and as an alternative to (rather than an element within) a national strategy for conservation (Jackson *et al*., 2009). There may be a failure to integrate protected areas requirements into policies which affect them (e.g. agriculture, tourism, transport) and the needs and interests of local people may not always be fully recognised.

Much important habitat lies outside of SSSIs, e.g. in England: 84% of broadleaved woodlands, 45% of heathlands, 14% of semi-natural grasslands and 26% of mires, bogs and fens lie outside of SSSIs (Catchpole, 2007). Some have argued that physical changes such as those caused by climate change or marine incursion could make protected areas obsolete in the future (Bishop *et al.*, 1995). Others, however, argue that **climate change will intensify the pressures on wildlife and increase the importance of protected areas, as strongholds for wildlife in a changing environment** (RSPB, undated; Hopkins *et al.,* 2007).

Indeed, **the need for nature conservation policy to look beyond SSSIs has been recognised in several recent policy documents**, including the response of Natural England (2009) to the House of Commons Innovation, Universities, Skills and Science Committee report on Sites of Special Scientific Interest, the Public Accounts Committee (2009) report *Natural England's role in improving Sites of Special Scientific Interest*, and the *Making Space for Nature* review (Lawton *et al*., 2010), which concluded that:

*The evidence demonstrates that **the SSSI series, as important as it is, clearly does not in itself comprise a coherent and resilient ecological network**. Perhaps this should not come as a surprise since **SSSIs were not designated with this aim in mind**.... many of England's wildlife sites are too small; losses of certain habitats have been so great that the area remaining is no longer enough to halt additional biodiversity losses without concerted efforts; with the exception of Natura 2000 sites and SSSIs, most of England's semi-natural habitats important for wildlife are generally insufficiently protected and under-managed; many of the natural connections in our countryside have been degraded or lost, leading to isolation of sites; and too few people have easy access to wildlife.*

4.7 Benefits of Higher Level Designations

Those SSSIs which also have higher level designations benefit from extra protection, additional funding opportunities and enhanced public access and profile.

As noted in Section 2, a significant proportion of SSSIs are also subject to higher levels of designation as Natura 2000 sites (SACs and SPAs), Ramsar sites and SSSIs.

These higher designations cover a minority of sites by number, representing collectively 26% of SSSIs in England and 48% in Wales. However, they account for the majority of the SSSI land area. **The Natura 2000 network accounts for 79% of all SSSI land in England** (Lawton *et al*., 2010) and **72% in Wales** (CCW, 2006). This demonstrates the **significantly larger average size** of sites subject to higher designations compared to SSSIs as a whole. Indeed, in England, the figures suggest that **the average size of a Natura 2000 site is ten times greater than that for a site designated as SSSI only**.

These figures highlight the respective roles of the SSSI and Natura 2000 series. With some exceptions, **EU designations cover larger, more extensive sites of greatest importance internationally**. **The SSSI series covers a much larger number of sites of smaller average size.** As noted by the *Making Space for Nature* review, **SSSIs are often isolated fragments of remaining habitats, but their larger number and smaller average size compared to sites with higher designations suggests that they have a distinct conservation role.**

Natura 2000 sites receive the highest level of protection of all conservation designations in England and Wales, with stringent assessments required under Article 6 of the Habitats Directive to prevent damaging activities and a requirement for compensatory

habitat creation to offset any unavoidable damage. SSSIs also benefit from high levels of protection but this is not as stringent as for EU designated sites (Lawton *et al*., 2010).

The Habitats and Species Regulations 2010 make provision for the effective conservation of Natura 2000 sites (Lawton *et al*., 2010). All terrestrial SACs and SPAs are also designated as SSSIs. However, although Natura 2000 status may involve additional management requirements above those required for SSSIs and facilitate access to additional resources, **it is unlikely that EU designations currently make much difference to the management required, given the already strong existing emphasis on achieving favourable condition for SSSIs in England and Wales**. Natural England's website[11] states that:

Designation of an SAC is unlikely to greatly affect the existing management of SSSIs to conserve their biodiversity.

Designation of an SPA is unlikely to have a major affect on how SSSIs are already managed to conserve their biodiversity.

The Natura 2000 network does achieve **greater recognition** at the EU level compared to sites subject only to national designations. This confers advantages to EU designated sites in **securing funding from EU programmes**, such as LIFE+, which has a strong focus on strengthening the Natura 2000 network. However, while important for some sites, LIFE+ provides relatively small levels of funding compared to the agri-environment programme.

Ramsar sites are wetlands of international importance, designated under the Ramsar Convention. As a matter of policy they are also designated as SSSIs. As a result they benefit from high levels of protection. All sites are required to have a management plan that protects and furthers their Ramsar interests.

National Nature Reserves (NNRs) were initially established to protect sensitive features and to provide 'outdoor laboratories' for research. Their purpose has widened to offer opportunities to the public as well as schools and specialist audiences to experience our natural heritage.

Natural England[12] describes NNRs as *being* ***a selection of the very best parts of England's Sites of Special Scientific Interest.*** CCW describes them as *some of the* ***most important places for wildlife in Britain****.... set up to conserve – and to allow people to study - their fauna, flora, or geological features of special interest.*

There are 224 NNRs in England, covering a total area of 94,400 hectares, and 72 in Wales, covering an area of more than 25,000 hectares. The average site size is relatively large at 421 hectares in England and 367 hectares in Wales. Most NNRs also have EU designations.

NNRs can therefore be seen as a selection of the most special SSSIs for which there is added focus on education, access and scientific study. Experience from the case study sites examined in this study suggests that **NNR status has greater resonance with the public and that it can help make sites more accessible** (physically and intellectually) to people.

In summary, therefore, **while SSSI status affords a high level of protection to sites and encourages resources to be allocated to secure their positive management, higher level designations provide added benefits as a result of extra protection from development or damaging activities, additional funding opportunities (especially at EU level), greater national and international profile, and enhanced public access and promotion of education and scientific study.**

These points are illustrated at several of the sites examined as part of this assignment, through the case studies and stakeholder workshops (Box 4.3).

[11] http://www.naturalengland.gov.uk/ourwork/conservation/designatedareas/default.aspx

[12] http://www.naturalengland.gov.uk/ourwork/conservation/designatedareas/nnr/default.aspx

Box 4.3: Benefits of Higher Level Designations – Examples from Different Sites

Many of the case study sites have other designations (especially as SPA, SAC and/or NNR). It is often difficult to assess the relative importance of these designations in contributing to benefits and ecosystem services. This is especially true for the larger and more biodiverse sites, which are more likely to have multiple designations.

It is important to recognise that SSSI status often pre-dates other designations and has played a major role in protecting and maintaining sites which have subsequently received other designations. For example, at South Pennine Moors, it is believed that higher level designations would not have occurred had the site not first benefited from designation as SSSI.

Higher level designations can bring additional benefits to SSSIs. For example, Natura 2000 designations at Hatfield Moor and the Lower Usk are believed to enhance the level of protection from built development and other potentially damaging activities. Natura 2000 status has also helped to attract EU funding to King's Sedgemoor, the Lower Usk, the River Avon System and the South Pennine Moors.

A further benefit from higher level designations can be the greater focus for public access and recreation, especially related to NNR or National Park status. Examples include Wren's Nest NNR, the North York Moors National Park, Richmond Park NNR and Sutton Park NNR. In the latter case NNR status is believed to have led to a changed perception by users, who increasingly appreciate the importance of nature conservation, with a general belief that a National Nature Reserve is more accessible to the public and easier to understand than a site with SSSI status alone.

Sites examined through the stakeholder workshops also demonstrate the benefits of higher level designations:

Barnack Hills and Holes – This is a limestone grassland site in the East Midlands designated as SSSI, SAC and NNR. NNR status has helped to facilitate management activity and provide continuity of management, and to encourage the use of volunteers to help with practical management work. NNR staff have facilitated recreational use of the site. SAC status has enhanced protection of the site and the specialist features relating to the SAC criteria.

Drostre Bank – This SSSI and SAC in South Wales comprises wet woodland, dry broadleaved woodland and *Molinia* meadows. SAC status is believed to provide more stringent protection from development and potentially damaging operations, as well as improved opportunities to harness funds and resources for site management.

Humber Estuary – This 37,000 hectare estuary supports a variety of coastal habitats and has SSSI, SPA, SAC, Ramsar and NNR status. NNR status confers a range of cultural benefits including enhanced facilities and opportunities for education, access, recreation, tourism, with potential for income generation. Natura 2000 and Ramsar status confers a higher level of protection – the requirement for no net loss of intertidal habitats has led to managed realignment initiatives. There is also enhanced potential for funding, including from EU programmes, and greater scientific understanding of pressures on the estuary (including from industry).

Monks Wood – This is an ancient woodland SSSI and NNR in Cambridgeshire. The NNR status provided more stringent protection prior to the 1981 Wildlife & Countryside Act and has enhanced financial resources for access (e.g. signage and path management) and conservation management. It has also provided a focus for scientific research and enhanced confidence that the research will be ongoing and provide a 'recorded history'.

Norbury Park – This is a chalk grassland site designated as SSSI and SAC and set in the Surrey Hills AONB. While in theory SAC status enables access to European LIFE funds, in practice this has been found to be too hard and time consuming to harness. AONB status helps to reinforce the management and protection of the SSSI by providing support for strategic planning and community action, and enhanced funding (including AONB Sustainable Development Fund and LEADER, which have helped to fund a sawmill).

4.8 The Importance of SSSI Condition

The conservation benefits of SSSIs are highly dependent on their condition which in turn is dependent on future funding for SSSI policy.

Experience demonstrates that the protection afforded by SSSI status of itself is not sufficient to maintain their conservation interest. Before the 1990s many SSSIs were inappropriately managed and declined in condition, such that by 2003 only 57% of SSSI area was in favourable or recovering condition. **This had adverse effects on the species, habitats and geological features that SSSIs support** (Defra, 2011).

Restoring the condition of SSSIs has required a significant investment of resources to achieve the required management, and is an ongoing challenge, as some habitats will take many years to achieve favourable condition (see Section 2). While more than 95% of SSSI area in England is now in target (favourable or recovering) condition, **only 37% is currently in favourable condition** and **ongoing efforts are needed to ensure that those that are recovering will continue to do so.** This requires ongoing public funding.

The likely effects of the future funding scenarios investigated for this study are summarised in Table 4.4.

Table 4.4 Effects of Funding Scenarios on Conservation Benefits of SSSIs

Scenario	Effect on Site Condition	Implications for Species, Habitats and Geological Features
Maintain funding - at levels sufficient to maintain current levels of SSSI condition	More than 95% of SSSI area in England is in favourable or recovering condition but only 37% is in favourable condition. The remainder is recovering and achieving favourable condition is a long term process. Uncertainty means that some sites may never achieve favourable condition. A small % of sites are not recovering as challenges such as diffuse water pollution cannot be addressed.	Conservation benefits are not maximised – condition of habitats and species may gradually increase but not achieve full potential at many sites or take many years to achieve this potential. Geological features generally require less funding and management and more will remain in favourable condition.
Increase funding - leads to achieving favourable condition on all sites.	All sites achieve favourable condition.	Conservation benefits of sites would be maximised – populations of species, conditions of habitats and geological features reach their full potential.
Remove funding - leading to a gradual decline in the proportion of sites in favourable condition.	The condition of sites would gradually deteriorate. Most sites would decline in condition and gradually reach unfavourable condition, except for a minority that require no intervention or where appropriate management is undertaken voluntarily. If sites with higher level designations continue to be funded, their condition may be maintained – these account for only 30% of SSSIs by number but almost 80% by area.	The conservation benefits of SSSIs would decline. Sites remain protected but without sympathetic management populations of species for which the sites are designated decline, and habitats and geological features deteriorate. Conservation interest may be maintained at sites which have higher designations, if resources continue to be made available.

5 Ecosystem Services delivered by SSSIs

- SSSIs deliver a variety of cultural, regulating and provisioning services.
- All sites provide ecosystem services to varying degrees but quantitative evidence is often lacking.
- Many services are localised and site specific, making generalised assessments difficult.
- There is strong evidence of the cultural services delivered by SSSIs, though much of it is qualitative.
- SSSIs contribute significantly to the provision of regulating services though these have been quantified at only a few sites.
- SSSIs also deliver provisioning services, though the quantity of these is often reduced by conservation management.
- The "weighting matrix" is an attempt to overcome the lack of quantitative evidence of ecosystem services through expert judgement, and is able to provide quantitative weighting scores for different services and habitats.
- The weighting matrix found that levels of delivery of different ecosystem services vary widely by habitat. Cultural services are delivered consistently by all habitats; provisioning services are delivered especially by and woodland habitats; and regulating services by bogs, woodlands and wetlands.
- The weighting matrix estimated that SSSI conservation activities enhance levels of delivery of most services for most habitats, and especially for bogs and wetlands.
- The public has limited awareness of SSSIs but recognises and appreciates some of the ecosystem services they provide, particularly the cultural services.
- Ecosystem service delivery is strongly linked to funding for SSSI policy, which, if removed, would cause significant declines in many services.

5.1 SSSIs and Ecosystem Services

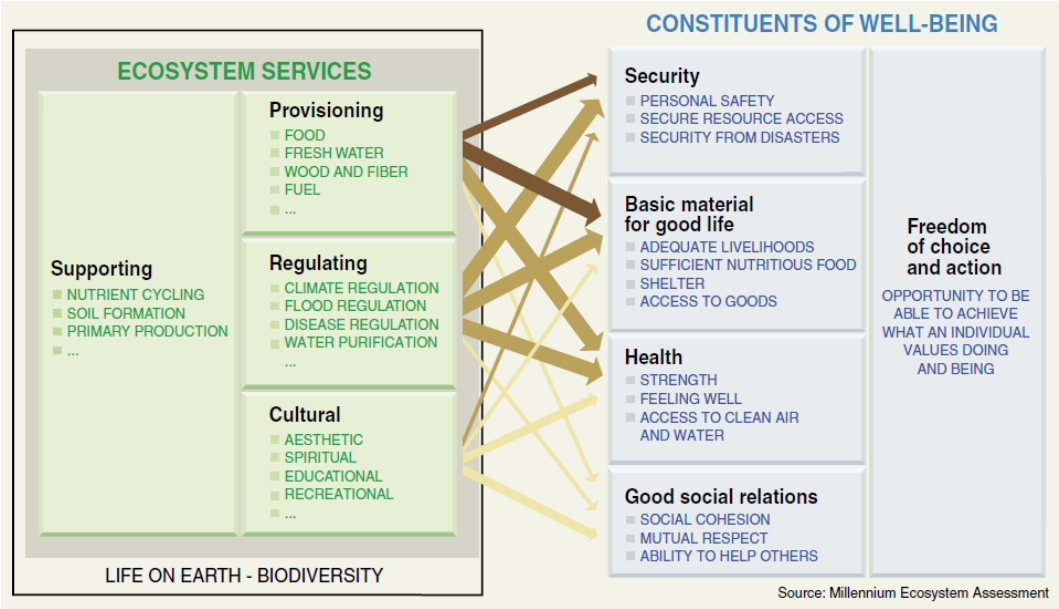
SSSIs and the ecosystems they maintain provide services that contribute to the well-being of people and society as a whole.

The Millennium Ecosystem Assessment (MA) and the UK National Ecosystem Assessment both distinguish between four types of ecosystem services supporting human well-being (Figure 5.1):

- **Supporting services** (e.g. nutrient cycling and habitat provision);
- **Provisioning services** (e.g. food and fuel);
- **Regulating services** (e.g. flood risk regulation); and
- **Cultural services** (e.g. aesthetic and educational).

Supporting services do not provide direct benefits to people but underpin the provisioning, regulating and cultural services delivered by well-functioning ecosystems.

Figure 5.1 Ecosystems deliver important services that support human well-being



While the ecosystem services framework is a useful means of assessing the benefits that SSSIs provide to people, these need to be examined in conjunction with the core conservation benefits examined in Section 4. Participants in the four stakeholder workshops convened for this study stressed that **the primary purpose of SSSIs is to conserve biodiversity and geodiversity itself.** While this should help to secure ecosystem services, it was often argued that these are an additional benefit of designation and should not interfere with the reasoning for designation of SSSIs. **The intrinsic value of biodiversity therefore needs to be recognised alongside the ecosystem services approach.** Both of these two sets of values are important, distinct and complementary.

Participants in the stakeholder workshops also suggested that the ecosystem service approach may fail to capture the benefits of many small, isolated SSSIs which are valuable for the species and habitats they conserve yet have limited capacity to deliver ecosystem services. It was argued that large sites and landscape scale conservation initiatives deliver higher levels of ecosystem services. Participants also stressed that some services such as the role of SSSIs in enhancing people's mental health are difficult to quantify but are significant and need to be fully recognised, where necessary in qualitative terms.

Table 5.1 summarises the key services potentially delivered by SSSIs, considering their effects on human wellbeing and the likely distribution of benefits between sites.

Table 5.1 Main Categories of Ecosystem Services Potentially Delivered by SSSIs

Service	Effect of SSSIs	Benefits for Human Wellbeing	Distribution of Benefits
Provisioning Services			
Food, fibre, fuel	Likely negative net effects as SSSI management reduces agricultural and forest yields; possible increases in quality of produce and wild food	Changes in output of food, fibre, fuel	A wide variety of sites provide these services, either commercially or informally, e.g. grasslands, uplands, woodlands and coastal habitats
Genetic resources	SSSIs have been identified as significant in holding reserves of crop wild relatives. Management of some sites employs rare livestock breeds.	Crop wild relatives and rare breeds could play a significant role in future agricultural production	All sites can be expected to conserve genetic resources in some way, though the benefits are variable and often uncertain. Only certain sites use rare livestock breeds.
Fresh water	Water is abstracted directly from some SSSIs; others play an important role in catchment management	Clean water is essential for human life and many economic activities	Benefits are variable and site specific – some sites are regionally significant, notably large upland sites.
Regulating Services:			
Air quality	Improvements of air quality by natural ecosystems, particularly in or around urban areas	Human health benefits measured in reduced cases of ill health	Benefits are potentially widespread but most significant from woodlands in urban and urban fringe locations.
Climate regulation	Reduced impacts on global climate through carbon sequestration/storage; micro-climate effects through shading and evapotranspiration	Reduced damage costs from climate change	Benefits are widespread, especially from bogs, woodlands and some grasslands; microclimatic effects are local.
Water regulation	Localised effects in reducing flooding through water storage/reduced run-off	Protection of property and infrastructure	Benefits are location specific but likely to be widespread and downstream or downslope of site (e.g. woodlands and grasslands)
Water purification and waste treatment	Woodlands, wetlands and other habitats can filter pollutants and enhance water quality	Enhanced water for human consumption and reduced treatment costs; benefits for fisheries and recreation	Benefits are location specific, but likely to be widespread and apply to a range of habitats (e.g. woodlands, grassland, wetlands)
Pest regulation	Possible positive effects in harbouring predators or negative effects in harbouring pests	Changes in crop yields and timber harvests, or changes in costs of pest control	Effects are uncertain but likely to vary by location and surrounding land use
Pollination	Possible increase in insect pollination	Enhanced crop yields	Benefits vary by location, e.g. flower rich grasslands close to insect pollinated crops
Natural hazard regulation	Possible effects of intertidal	Protection of property and	Benefits may be significant

(coast protection)	and coastal ecosystems in coastal protection	infrastructure	in specific coastal locations
Cultural Services:			
Recreation and ecotourism	Enhanced opportunities for countryside recreation through biodiversity and landscape effects	Increased enjoyment of countryside	Public use of SSSIs is widespread but variable, with a minority of sites attracting large numbers of visitors
Educational and scientific values	Opportunities for education, research, learning and training	Increased education, learning and scientific knowledge	All sites have scientific and potential educational value; the benefits themselves vary according to access and educational/ scientific use
Sense of place, spiritual and existence values	Conservation of species, habitats and geodiversity for benefit of current and future generations; defining sense of place and local identity	Appreciation, inspiration, non-use values	Benefits of individual sites are likely to vary according to their characteristics and their landscape context and biodiversity. The SSSI series has a collective role in provision of these benefits to society.
Supporting Services	Likely to contribute to a range of supporting services (e.g. soil formation and cycling of nutrients and water)	Supporting services benefit people indirectly by supporting the delivery of other services	Depends on distribution of other services.

The delivery of these services depends on the condition of sites and the effective functioning of ecosystems, while the benefits to society depend on the use of these services by people, which in turn is influenced by factors such as the location of the site relative to population and economic activities, the accessibility of the site, the services it provides, and public awareness, perceptions and appreciation (Jacobs, 2004).

Geodiversity, as well as biodiversity, contributes to the delivery of ecosystem services and underpins the delivery of provisioning, regulating, cultural and supporting services. The framework therefore provides a means of assessing many of the benefits of geological SSSIs. However, the Millennium Ecosystem Assessment (2005) acknowledges that it does not fully capture the benefits of geodiversity and that certain abiotic non-renewable goods from the abiotic environment such as fuel (e.g. coal), aggregates and minerals are not considered. These are not regarded as ecosystem services as they are non-renewable.

The 20 case study sites deliver a variety of ecosystem services. The case studies collectively cover a range of provisioning, regulating and cultural services and each contribute to societal wellbeing in the surrounding local areas and in England and Wales as a whole. Cultural services are provided by all 20 sites. Most of the sites also provide regulating services, though these are often poorly understood and can only be quantified in certain cases – the clearest and most widespread evidence relates to climate regulation, water regulation and water purification, and at certain sites air quality regulation and coastal protection. Provisioning services are important at some sites, particularly the provision of fresh water and food. Further examples are given in the sections below. Table 5.2 provides a summary of ecosystem services provided by the case study sites, based on available evidence concerning the sites themselves. It must be noted that some of the case study sites might be expected to deliver other ecosystem services, but these are included in the table only where evidence is available at the site level. Where it is possible that the site

delivers certain types of ecosystem services but there is no evidence of this available from the case study, this has been signified by a '?' instead of a tick.

Table 5.2 Summary Matrix for Ecosystem Services from 20 Case Study SSSIs

	Provisioning Services:				Regulating Services:					Cultural Services:		
Site	**Food, fibre, fuel**	**Genetic resources**	**Fresh water**	**Air quality**	**Climate Regulation**	**Water regulation**	**Water purification and waste treatment**	**Pollination**	**Natural hazard regulation**	**Recreation and ecotourism**	**Research and Education**	**Aesthetic, spiritual & existence values**
Ashdown Forest				√	√					√	√	√
Crime Rigg and Sherburn Hill Quarries											√	√
Dark Peak	√		√		√	?	√			√	√	√
Dyfi	√	?			√	√			√	√	√	√
Hatfield Moors					√	√				√	?	√
Holy Island Coast	√	?							?	√	√	√
Humber Estuary	√	√		√	√	√	√		√	√	√	√
King's Sedgemoor	√	?			√	√		?		√	√	√
Lower Usk	√		√			√	√			√	√	√
Malltreath Marsh	√	?			√	√		√		√	√	√
North York Moors	√				√	√			?	√	√	√
Richmond Park	√		√	√	√	√			√	√	√	√
River Avon System	√	?	√			√				√		√
South Pennine Moors	√		√		√	√	√			√	√	√

	Provisioning Services:				Regulating Services:					Cultural Services:		
Site	**Food, fibre, fuel**	**Genetic resources**	**Fresh water**	**Air quality**	**Climate Regulation**	**Water regulation**	**Water purification and waste treatment**	**Pollination**	**Natural hazard regulation**	**Recreation and ecotourism**	**Research and Education**	**Aesthetic, spiritual & existence values**
Stone Field	√	√			√	?	?	√			√	√
Sutton Park	√			√	√	√			√	√	√	√
Thompson Water, Carr and Common		?			√	?	√			√	√	√
Walthamstow Reservoirs			√			√				√	√	√
Wormley-Hoddesdonpark Woods	√				√	√	?			√	√	√
Wren's Nest				√		?	?			√	√	√

Source: Information provided by Natural England and CCW officers; the absence of a tick may indicate a lack of evidence rather than that the service is not delivered by the site

5.2 Existing Evidence of SSSI Ecosystem Services

Few studies have assessed the overall contribution of SSSIs to the delivery of ecosystem services, though there is more evidence for particular sites and habitats.

A study by Eigenbrod *et al*. (2009) assessed the coincidence of protected areas (including SSSIs, Local Nature Reserves and other nature conservation designations) with biodiversity (as represented by the occurrence of BAP species) and three ecosystem services (carbon storage, recreation and agricultural production). It found that:

- Protected areas are well placed to protect species of conservation concern, capturing 3.3 times as much biodiversity as would be expected from an area outside the SSSI series. This supports the findings from Section 4 regarding the core conservation benefits of SSSIs, and is also indicative of their role in providing cultural services linked to biodiversity [Cultural service];
- Recreation – as measured by the number of leisure day visits - was slightly under-represented in protected areas compared to rural areas as a whole. This is supported by other studies, though evidence is presented below that protected areas can have high qualitative benefits to recreational visitors and close to centres of population may have high recreational usage [Cultural service];
- Carbon storage is also well represented, with protected areas storing 1.8 times as much carbon per hectare as the wider landscape. This reflects the over-representation of the carbon-rich soils in heather moorland and wetland in protected areas [Regulating service];
- Agricultural production was significantly under-represented in protected areas in quantitative terms, reflecting the under-representation of arable farming in these areas [Provisioning service].

The authors noted that care is needed in interpreting these results as the extent to which the observed relationships are causal is unclear. For example, carbon storage and agricultural production are functions of land cover as well as site management. Recreational use tends to be higher in areas close to centres of population, while protected areas tend to be more concentrated in areas of lower population density. They concluded that while conservation strategies may enhance certain ecosystem services as well as biodiversity, some trade-offs (for example between biodiversity and agricultural production) are inevitable, suggesting that there are limits to the multi-functionality of landscapes and that different strategies may be needed to optimise ecosystem service delivery at specific locations.

Other studies have examined overall ecosystem service provision by the natural environment, and given examples of the services delivered by particular protected areas, including SSSIs.

Though not focused specifically on SSSIs, a report by the RSPB (2009a) demonstrates that restoration and positive management of nature sites can contribute to regulatory services such as water regulation, coastal protection and climate regulation, support provision of food through grazing and fisheries management, and enhance opportunities for tourism and regulation. Many of the examples given are SSSIs, and several demonstrate the benefits of higher designations (especially Natura 2000 status) in helping to secure funding for restoration work (Table 5.3).

Table 5.3 Ecosystem services delivered by RSPB SSSIs

Site	Activity	Other designations and associated advantages	Ecosystem services provided
Lake Vyrnwy	Restoration of blanket bog on a landscape scale	Natura 2000 – helped to secure funding for restoration of blanket bog	Provisioning – organic beef and lamb production Regulating – reduction of flood risk from restoration of blanket bog; improved water quality and supply (both from blocking moorland drains to halt habitat degradation) Cultural – education resource; tourist destination
Wallasea Island	Largest coastal wetland restoration project in Britain - restoration of saltmarsh, creeks, and mudflats	Natura 2000 – key driver of project was legal requirement to secure no-net loss of a intertidal area of the Natura 2000 site	Provisioning – livestock (grazing marsh habitats) Regulating – carbon sequestration, nutrient cycling and water quality, flood defence (from the innovative managed re-alignment scheme) Cultural - fishery and recreational opportunities
Freiston Shore	Managed coastal realignment project in Lincolnshire	Natura 2000 and Ramsar – key driver for project is need for compensation for loss of intertidal habitat in the Natura 2000 site	Regulating – flood defence (shown to yield net cost savings compared to engineered flood defences) Cultural –annual recreational visits increased from 11,000 to 60,000)
Ouse Washes	Largest area of washland in the UK	Natura 2000, Ramsar	Provisioning – livestock (provides grazing) Regulating – important flood control service for the East Anglian fens and beyond Cultural - significant numbers of recreational and educational visits
Insh Marshes	Largest floodplain mire in Great Britain	Natura 2000, Ramsar	Provisioning – livestock (marshes support grazing by local agricultural enterprises) Regulating – potential improvements in water quality, and flood defence benefits to Aviemore, and other settlements and farmland downstream (cost savings likely compared with constructing and maintaining engineered flood defences for Aviemore, which could cost more than £83,000 a year) Cultural - recreational and educational visits (attracting 12,000 people annually); fishing on the floodplain and downstream on river Spey

Source: RSPB (2009a) Naturally, at your service: Why it pays to invest in nature

The following sections summarise evidence of the cultural, regulating and provisioning services delivered by SSSIs.

5.3 Cultural Services

SSSIs deliver important cultural services to society and are widely used and appreciated by people. In particular, they:

- Support **recreation and tourism;**
- Provide a resource for scientific **research and education** regarding biodiversity and geodiversity;
- Contribute to **cultural landscapes** and **sense of place;**
- **Conserve our rarest and most threatened wildlife, habitats and geology for the benefit of society as a whole and for future generations**. They therefore have benefits even for people who may not visit or experience them – these benefits are often referred to as "non-use values".

SSSI status protects and maintains the natural assets that provide these services, as well as providing a focus for visitors and helping sites to attract funding for access and visitor facilities. Biological and geological SSSIs provide a focus for scientific research and help to enhance our understanding of geological sciences and our natural history and cultural heritage.

While there is some evidence of the overall cultural services provided by SSSI sites; the added benefits of SSSI designation are incompletely understood. SSSIs provide a natural focus for education and research, although the degree to which designation affects wider recreational use of the sites concerned is often unclear.

Much of the information relating to the cultural services of SSSIs is taken from the case studies, which provide a rich and varied reflection of the types of cultural benefits that SSSIs provide. Examples are given in Table 5.4. These examples focus on the use of SSSIs and are additional to the non-use benefits that people derive from the protection of species, habitats and geodiversity at these sites (summarised in Section 4).

Table 5.4 Cultural Services Delivered by the Case Study Sites

Site	Cultural Services
Ashdown Forest	*Recreation and Tourism* - The site is the largest area of open countryside in South-East England, and its common land is freely open to the public. It attracts 750,000 visitors a year, many of whom are walkers and road cyclists. Its appeal to the public is enhanced by its international reputation as the 'home' of Winnie-the-Pooh. *Education* - activities include school visits and demonstration of conservation management techniques.
Crime Rigg	*Research and Education* - cultural services are expected to increase further through the development of a quarry trail, a permanent viewing area, interpretation and school / university visits.
Dyfi	*Recreation and Tourism* - Ynyslas dunes and Aberdyfi beach and dunes and the estuary are important recreation and tourism areas. Surveys indicate 250,000 visitors are attracted to Ynyslas every year. These range from specialist visitors and bird watchers, to local dog walkers, and holiday makers visiting from well beyond the region. *Research, Education and Sense of Place* - the SSSI has a rich archaeology and cultural history, and is important for education and scientific research. Scientists from 8 UK universities use Cors Fochno for field studies mostly related to carbon cycling. The studies include a UK-wide Defra contract, 5 post-doctorate studies, 3 PhDs, 1 MSc and 4 undergraduate dissertations. The site has inspired art, photography and crafts.
Anglesey Coast	*Recreation* - 180,000 visitors are attracted to South Stack and 120,000 to Breakwater Country Park annually. As well as informal recreational visits, people are attracted by the opportunity to view breeding seabirds, to study geological features and to engage in activities such as rock climbing and coasteering.
Humber Estuary	*Research* - The site has high scientific value due to its high population of rare wintering birds, and provides the ground for research on birds at Hull University's Institute of Estuary and Coastal Studies (IECS) and the University of Leeds.

	Recreation - The estuary is important for a variety of recreational activities, including bird and seal watching, angling, sailing, jet-skiing and paragliding.
Lower Usk	*Recreation* - The river provides high quality recreational fishing and is an important setting for walking and informal recreation for local people, and for visitors within the region and beyond. Some limited boating in dinghies and canoes also occurs.
North York Moors	*Recreation and Education* - The whole site is a well-known and well-visited area, with recreational uses ranging from walking and birdwatching to grouse shooting. These recreational uses are largely based on the expanse of the habitat and its designation as a National Park, with visitor centres and educational facilities throughout.
Richmond Park	*Recreation and Education* - The site receives 3.9 million visitors every year (in addition to the millions who drive through it). Visitor numbers have increased by approximately 50% since 1995. The site provides numerous facilities and opportunities for recreation, and educational facilities such as Holly Lodge Centre.
River Avon System	*Recreation* – The SSSI supports a high value fishery which provides revenue to landowners and fishing syndicates, as well as bank-side footpaths.
South Pennine Moors	*Recreation and tourism* – The site has open access and tourism and recreation are important for the local economy. The most significant recreational activity is walking, while the site also supports horse-riding, cycling, rock climbing, orienteering, water sports, off-road riding, grouse shooting and angling.
Stone Field	*Sense of Place* - The site is part of the local character and history of the area because of its distinct hay meadow character and because of the standing stone which is very evident. *Research* - It is visited by specialist botanical and wildlife groups making field visits to the site to experience it and conduct surveys, research and monitoring work.
Sutton Park	*Recreation* - The site attracts 2.5 million visitors annually, who primarily use the space for walking, but there are also a wide variety of local clubs and societies including golf, sailing, model aircraft flying, kayaking and scouting. Local people receive physical and mental health benefits of accessing a natural environment. *Education* - public guided walks, schools visits, talks and events are led by the site's ranger service, as well as partnership projects including youth intervention work, healthy living, ethnic minority group outreach work and Scout Jamboree Commemorative works.
Wormley Hoddesdonpark Woods	*Recreation* - the SSSI is close to London and attracts at least 110,000 visits annually. Its attractions include its wildlife, landscape and historic features. The woods attract volunteer wardens, scouts, joggers, runners, dog walkers and disabled groups. The woods also host educational and research visits.
Wren's Nest	*Education and Volunteering* – the site attracts approximately 12,000 visitors annually, including around 3,000 school children. The warden service runs a programme of guided walks, slide talks, school visits and special events. The site supports volunteering and work experience placements, including conservation tasks for adults with learning difficulties.

Research and Education

The term "Site of Special Scientific Interest" emphasises the scientific value of the designation and its importance for research and education.

Discussions in the stakeholder workshops stressed the valuable role of SSSIs as places for on-going research, monitoring and education. **Through SSSIs we have an increased knowledge of species, habitats, ecosystems and of management techniques**. The ability of SSSIs to offer learning environments for visitors of all ages was also widely emphasised. Some of the example sites examined in the workshops have a significant 'recorded history', for their particular wildlife or geology, which could be used further as a resource for learning, discovery and research.

Geological SSSIs make an important contribution to human knowledge, helping us to better understand the history of the planet, evolutionary biology, and how the environment around us is changing (Webber *et al*., 2006, Stace and Larwood, 2006; Prosser *et al*., 2006).

Scientific research and education are important at many of the case study sites, with examples including Stone Field, the Humber Estuary, Dyfi and Wren's Nest.

Recreation and ecotourism

Around 50% of SSSIs are open to the public and more than 39,000 hectares of SSSI land are in or close to urban areas. **SSSIs attract around 380 million visits each year** and support more than 40 different types of recreational and educational activities (Public Accounts Committee, 2009). Over 50% of open access land designated under the Countryside and Rights of Way Act is also designated SSSI (Lawton *et al.*, 2010).

The majority of the visits to SSSIs involve walking and running (ca. 65%) and cycling (6%) (CJC Consulting, 2004) but activities also include water sports, angling, horse riding and hunting. A minority of visitors engages in specialist activities linked to the conservation interest of SSSIs, such as bird-watching or fossil collecting, although these can account for large numbers of visitors at particular sites. The 2003 Arkenford report found that visits were concentrated on 'honeypot' sites (76% of visits on 6% of SSSIs), and that the relevance of the SSSI status to the use and enjoyment of the site is uncertain.

Lawton *et al*. (2010) provided further evidence of the benefits of wildlife sites to people, which include:

- Enhanced human health as a result of people being more physically active if they have access to natural environments. Overall levels of physical activity across age groups are positively associated with the proximity and accessibility of green spaces to residential areas, particularly in pre-school children.
- Mental health benefits from increased contact with nature, including reduced stress and symptoms of depression; enhanced concentration and self-discipline (including among children with attention deficit disorder) and reduced levels of admissions for mental illness. Children also often prefer to play in natural or wild places, helping them develop cognitive, physical and social skills.
- Survey evidence that people value wildlife and want accessible places where they can experience the natural environment at first hand.
- Enhanced attitudes to nature as a result of the level of direct contact with it.

However, Lawton *et al.* (2010) stressed that for many people these benefits are limited by the location of wildlife sites and inequalities in access to nature. It cited evidence that those living in inner cities and particularly those from poorer households, lower socio-economic groups and minority ethnic groups have less access to local green space and are less likely to visit the countryside. This can exacerbate other social problems, such as inequalities in health. With the exception of Local Wildlife Sites, the area of wildlife sites within or near urban areas is low, with only 3.6% of SSSI area located in urban areas.

Discussions in the stakeholder workshops also emphasised the recreational benefits of SSSIs. It was argued that while most green spaces have a general recreational value, SSSIs provide a more specialist product and a more unique experience that will still appeal to many.

Most of the 20 case study sites are open to visitors with some providing a very significant resource for recreation and tourism (e.g. Sutton Park, Richmond Park, North Yorks Moors, South Pennine Moors, Dark Peak).

Recreation is not always directly linked to site condition. For example, some sites in unfavourable condition have remained important for recreation and tourism such as Sutton Park and Richmond Park. For other sites dependent on more specialist recreational activities such as angling and birdwatching, recreational demand is more intimately linked to site condition. The Holy Island coast, for example, attracts many visitors specifically to

observe its sea birds, geological features and botanical interest. RSPB staff also mentioned that for some of these visitors, the experience can be unique and may inspire interest in similar environments and wildlife of this type. In other cases, damage to sites (for example due to disturbance, vandalism and anti-social behaviour) may directly affect the site's attractiveness to visitors. Examples where such pressures have had to be addressed include Wormley Hoddesdonpark Woods and Wren's Nest.

It is also important to note that many cultural services relating to recreation and education are often linked to the availability and quality of site facilities and interpretation. SSSI status can provide a focus for opening access and improving interpretation, hence enhancing cultural services. Examples include Wren's Nest, Wormley Hoddesdonpark Woods, Dyfi, Lower Usk, Hatfield Moor and Malltreath Marsh.

Sense of place, aesthetic, spiritual and existence values

Many SSSIs are important in defining sense of place and contributing to our understanding of our natural and cultural history and the inter-relationships between them. They can give rise to aesthetic and spiritual values and provide artistic inspiration. Many people also derive existence values from the role of SSSIs in conserving biodiversity and geodiversity. Studies have suggested that these **existence values may account for a substantial proportion of the overall cultural services people receive from SSSIs** (eftec, 2007, CJC Consulting, 2004).

The case studies help to illustrate these types of benefits. Stone Field SSSI is considered to be part of the local character and history of the area because of its distinct hay meadow character and because of the standing stone, which is very evident. Crime Rigg is important in contributing understanding to cultural history and research occurs here into social history and links with industrial archaeology. Dark Peak is seen as offering opportunities for solitude and tranquillity that surrounding, more inhabited landscapes cannot offer, and these characteristics are highly valued by those who use the site. The North York Moors has a rich and varied landscape and high aesthetic value, as does the River Avon, due to it being a 'natural river system'. Walthamstow Reservoirs provide an important 'green space' in an otherwise industrial area, thus providing some respite and improving the well-being of local residents. These benefits are likely to be applicable to other SSSIs situated within densely populated urban areas. Public perceptions of these services were further explored through the focus group discussions (Section 5.7 below).

Social benefits relating to cultural services

The stakeholder workshops identified examples where these **cultural services give rise to social benefits** (Table 5.5). These examples highlight the importance of some sites for local community activities and their role in training, volunteering and education.

Table 5.5 Cultural Services and related Social Benefits at SSSIs

SSSI	Cultural services and Social Benefits
Barnack Hills and Holes Limestone grassland National Nature Reserve in East Midlands.	Social cohesion, skills and confidence: The site's NNR status has prompted the use of volunteers to help with practical management work. This has helped to create social cohesion, practical skills and personal development amongst the volunteers.
Blo'Norton and Thelnetham Fen Lowland fen in Suffolk.	Inspiration and the arts: The site is referred to in local arts and poetry. Education and learning: The site hosts educational visits from a local and regional catchment
Clemenstone Meadows A small, isolated meadow grassland in South Wales.	Training: The site hosts training courses. This brings in additional resources and allows wider learning and skills development from the wildlife at the site.
Croham Hurst Urban woodland and heathland site in South London.	Community support: 'Friends of Croham Hurst' champions the site and is consulted on management issues by the local authority. Recreation: The site is intensively used for active and passive recreation by people from the large population in surrounding neighbourhoods. Social cohesion and outdoor skills: Young people use the location as an informal meeting place and learn about the outdoor environment.
Monks Wood Woodland and other fringing habitats – a National Nature Reserve in Cambridgeshire.	Outreach and learning: Guided walks and open days are well attended by local and more distant visitors who learn about the wildlife and the history of the site. Research and dissemination: Many researchers have contributed their own time and resources to monitoring, understanding and documenting the wildlife and history of the site and explaining the wider lessons from this research.
Port Eynon A mixed range of coastal habitats, heavily visited, on the Gower coast in South Wales.	Recreation: The site enables people to experience the coastal environment for active and passive recreation and for mental health benefits.
Roydon Woods Ancient woodland, heathland and old meadows in the New Forest.	Outdoor skills and crafts: An annual woodfair event acts as a stimulus for cultural and craft activity associated with the woodland and involving many local volunteers.
Southlake Moor Wet grassland site within the Somerset Levels.	Recreation: The site is used for passive recreation and bird-watching. Wildlife experience and learning: Bird watchers share information and learn together as they observe and monitor the site's wildlife.
Wiveton Downs A remnant esker geological site in Norfolk.	Research and monitoring: Geological researchers study and monitor the site to understand its recorded history and better understand the glacial history and human history that it reveals. Education and learning: School field visits make use of the site from a regional and national catchment to learn about the geological and human history.

5.4 Regulating Services

SSSIs enhance regulating services by protecting ecosystems and enhancing their functioning, though little quantitative evidence is available.

Evidence from the literature review, case studies and stakeholder workshops demonstrates that **SSSIs contribute to a wide range of regulating services** (air quality, climate, water

quality, flood management and coastal protection). Sympathetic management to enhance site condition can influence ecosystem function and delivery of regulating services.

Nearly all of the 20 case study sites provide regulating services to some degree, with the majority contributing to climate regulation and water regulation. It should be noted, however, that much more needs to be learnt about regulating services, which are poorly understood and little studied at most sites.

Similarly, the link between site condition and ecosystem service delivery is not always understood. However, it is clear that at certain sites, unfavourable condition has led to a reduction in the delivery of some regulating services, such as the ability of ecosystems to store carbon and regulate water flows. Action to achieve favourable condition should help to improve the benefits of these sites in mitigating climate change and alleviating flooding. Examples include Dark Peak, Hatfield Moor, Malltreath Marsh and the South Pennine Moors.

Examples of the regulating services delivered by the case study sites are given in Table 5.6.

Participants in the stakeholder workshops saw regulating services as a widespread and readily identifiable role of SSSIs, and one which has come to prominence because of current policy drivers relating to climate and water management. There was a realisation that regulating services were easily cited but more of a challenge to understand and quantify with any confidence. It was argued that studying and modelling service delivery at particular sites may be an important way forward in providing evidence, and that heavily researched sites might provide evidence for wider application.

Air Quality Regulation

Natural vegetation, and especially trees and woodlands, improves air quality through the uptake, transport and assimilation of a wide range of gaseous and particulate air pollutants, thus potentially reducing the incidence of adverse health effects caused by air borne pollutants, especially in urban areas (Forest Research, 2011).

SSSIs which protect and promote the sympathetic management of urban woodlands can play an important role in regulating air quality. Among the case studies, urban fringe sites such as Sutton Park, Wren's Nest and Richmond Park contribute to the improvement of air quality, absorbing atmospheric pollutants and, according to site managers, provide "green lungs" for nearby conurbations.

Climate Regulation

Carbon sinks in soils, vegetation and the oceans play a vital role in regulating climate. SSSIs protect important areas of peatland, woodland and grassland habitats that play a key role in greenhouse gas regulation. For example, it is estimated that peat soils in England store 296 million tonnes of carbon, roughly equivalent to 2 years of total UK carbon emissions. However, degradation of peatlands by drainage, burning, over-grazing and conversion to other land uses has significantly reduced these benefits and many degraded sites contribute to carbon emissions (Natural England, 2009b). SSSIs protect many peatland habitats and restoration to favourable condition is expected to enhance significantly their benefits for climate regulation.

UK woodlands store around 150 million tonnes of carbon and sequestered around 15 million tonnes of carbon dioxide in 2006, reducing the UK's carbon dioxide emissions by 3 per cent (Natural England, 2009b). Sympathetic management of SSSI woodlands contributes to this. Semi-natural habitats can also affect microclimate through shading and evapotranspiration.

Most of the 20 case study sites play a role in climate regulation. However, this role has been adversely affected by the condition of some sites, such as the South Pennine Moors, where restoration of the SSSI aims to enhance the provision of this service.

Table 5.6 Regulating services delivered by case study sites

Site	Type of regulating services provided
Dark Peak	*Climate Regulation* - in favourable condition, blanket bogs contribute significantly to carbon sequestration, although some areas at present may be contributing to net carbon release, having become degraded by previous mismanagement. Restoration should enhance their contribution to climate regulation. *Water Regulation and Purification* - Sphagnum in the blanket bog helps to restore water tables, contributes to flood risk mitigation through affecting the quantity and timing of water discharge,
Dyfi -	*Climate and Water Regulation* - Cors Fochno, the fourth largest lowland raised bog in the UK, is believed to play an important role in carbon sequestration and water regulation, with research ongoing to enhance understanding of these roles. *Natural Hazard Regulation* - The Ynyslas shingle and dune spit, Aberdyfi dunes and intertidal habitats perform important sea defence functions, protecting local settlements. The raised mire is able to store significant quantities of freshwater, reducing flood potential on surrounding land and property.
Humber Estuary	*Natural Hazard and Climate Regulation* – Intertidal habitats play an important role in coastal flood defence and storm protection, as well as contributing to climate regulation by trapping carbon in sediments. *Water Purification* - The sediments of the estuary are also known to capture heavy metal and other pollutants such as phosphorus (produced by local industrial estates), reducing the contamination of water bodies.
King's Sedgemoor	*Climate Regulation* - The peat is an important carbon sink and the water level management regime prevents peat shrinkage and subsequent loss of carbon. *Water Regulation* - The flood plain serves to protect surrounding properties. Annual water level and flood management expenditure in Somerset Levels and Moors is around £7m, with floodplain management helping to limit these costs.
Malltreath Marsh	*Climate Regulation* - the extensive wet soils contribute to carbon absorption *Water Regulation* - The site plays an important role in flood management *Pollination* - the site's floristic value contributes to pollination of nearby crops.
Richmond Park	*Climate Regulation* - The Park contributes to carbon storage and attenuates the heat island effect. *Water Regulation* - Seasonal ponds and restricted water flows in ditches contribute to the ground water resource by retaining and storing water within the Park, and options are being developed for the retention of water to minimise the reliance on mains supply. Urban green spaces are also important in flood regulation by increased infiltration and reduced overland flows.
South Pennine Moors	*Climate Regulation* - In 2008 the Moors were annually leaking as much CO_2 as a town the size of Altrincham due to erosion. Restoration of the peat bogs will help to curb these emissions and re-establish carbon sinks.
Sutton Park	*Climate and Air Quality Regulation* - The park plays a role in reducing the urban heat island effect and acts as a carbon store, as well as absorbing atmospheric pollution. Water regulation is also important.

Water Regulation

Habitats such as woodland, heathland and wetland have the capacity to slow the surface flow of water into rivers and streams, and store water within the habitat, reducing flood risk and the need for engineered flood banks. Restoring green space can increase the infiltration of water into the soil, reducing surface run-off. Restoring more natural rivers with well-vegetated river channels conveys floodwaters more slowly and increases the venting of floodwaters onto the undeveloped floodplains, which avoids flooding in built-up areas. In the past, washlands were created for this purpose (Natural England, 2009b).

Many of the case study SSSIs have a role in water regulation by slowing surface water flows. Floodplain grazing marshes such as King's Sedgemoor and Malltreath Marsh are important in storing floodwaters and protecting nearby property.

Water Purification and Waste Treatment

By maintaining semi-natural vegetation in catchments, SSSIs can improve water quality by reducing the generation of pollution and by assimilating or immobilising pollutants such as nutrients or heavy metals generated by other land uses. Management practices such as drainage, over-grazing and burning of peat moorland can result in damage to surface layers, resulting in increased losses of carbon, phosphorus and nitrogen and causing discolouration of water, resulting in costly treatment processes – efforts to restore SSSIs to achieve favourable condition can therefore enhance service delivery. Projects such as the Moors for the Future Partnership are seeking to restore large areas of upland habitats and ensure favourable land management practices. Peatlands, in good condition, store, filter and regulate water (Natural England, 2009b).

Sites such as Dark Peak and the South Pennine Moors are important water catchments and play a role in water purification.

Regulation of Pests and Diseases

SSSIs could potentially have positive effects in harbouring predators of pest species, or negative effects, in harbouring pests and diseases. However, no evidence was found relating to this service, either in the literature or at the case study sites.

Pollination

SSSIs help to enhance the diversity of pollinators and their food plants in the countryside, with benefits for yields of insect pollinated crops. There was little evidence of the significance of pollination among the case study sites, though this was considered to be a potentially important service at flower rich meadows such as Stone Field and Malltreath Marsh.

Natural Hazard Regulation

Inter-tidal saltmarshes and mudflats, a large proportion of which are protected by SSSIs, provide us with natural defences against storm surges as the storm waves lose energy as they pass across them. Shingle beaches and sand dunes above high water provide a further barrier. However, such habitats are declining due to sea level rise and the supply of sediment to build the inter-tidal habitats is halted by engineered coastal defences. On many low-lying coasts, sea walls have been built to compensate for the loss of these natural defences. In 2006–2007, approximately £358 million was spent on coastal and inland flood defences, but this is not keeping pace with the erosion caused by sea level rise. It has been estimated that an 80m deep zone of inter-tidal habitat fronting sea walls can save £4,600 per m in sea defence costs. An alternative approach to engineering is to restore inter-tidal habitats as coastal defences, so called 'managed re-alignment' (Natural England, 2009b), which can provide similar functions and help to reduce flood defence costs. Protection against storms and coastal flooding is an important service provided by the Humber Estuary and Dyfi SSSIs.

5.5 Provisioning Services

SSSIs contribute to a range of provisioning services, though some of these may be reduced by SSSI management practices.

Provisioning services include the production of food, fibre, fuel, freshwater and genetic resources, including through farming and forestry systems as well as harvesting of wild produce. **Most SSSIs support provisioning services to some degree.** Examples of the provisioning services delivered by the case study sites are given in Table 5.7.

Table 5.7 Provisioning Services Delivered by Case Study Sites

Site	Provisioning Services
Ashdown Forest	*Food Production and Conservation of Genetic Resources* - Management of the SSSI has involved the reintroduction of grazing, with a shepherded flock of Hebridean sheep which has grown to 300 animals. It is hoped that this will generate income through wool, meat, skins and horn, although sales of wool so far have been lower than hoped. When the flock has reached its maximum manageable size, currently estimated to be 500 to 600, there is potential for the sale of animals.
Dark Peak	*Food Production* - The area is important for grazing sheep and beef cattle. Water Supply – The relatively high rainfall and impermeable shale valleys make it ideal for water gathering and an important water catchment area. Many shale valleys in the Peak District have been dammed and flooded to create reservoirs to supply surrounding towns and cities, with these reservoirs producing 450 million litres of water every day.
Dyfi	*Food Production and Conservation of Genetic Resources* - Controlled grazing is carried out across c235ha (580ac.) of secondary and archaic bog, involving 27 rare breed Welsh mountain ponies, c145 cattle and c300 sheep grazed under licence agreements with five local farmers. At least 2 local graziers market Saltmarsh lamb from the SSSI locally. *Fibre Production* - Mown rushes are supplied to a local farm for animal bedding.
King's Sedgemoor	*Food Production* - Nearly all of the land is used for cattle grazing. The grasslands also provide winter fodder. The drainage system provides water for cattle and for irrigation. Ditches also serve to pen in cattle.
Lower Usk	*Fisheries* - The river provides a migration corridor for fish, some of which have a high economic value such as Atlantic salmon. *Fresh Water* – there are two major abstraction locations along the Upper Usk and several smaller abstractions elsewhere on the Upper and Lower Usk.
Malltreath Marsh	*Food Production* - Farm enterprises on site engage in grazing of sheep and cattle. Anglesey Grazing Project is establishing a marketing scheme for meat from conservation grazing. At least two and up to six Malltraeth Marsh graziers will be involved in supplying meat with this premium brand.
North York Moors	*Food production* – Grazing of sheep and cattle, wild produce such as deer, hare, and red grouse. *Fibre Production* - Timber from managed forestry *Fresh Water* - Supply of water for surrounding urban areas
Richmond Park	*Food Production* - around 150-200 deer are culled each year, and the resulting venison is sold to game wholesalers and frequently exported abroad. Fibre Production - The woodlands of the Park represent a significant timber resource - an on-site sawmill cuts and uses timber for a range of in-park uses (tree crates, benches etc).
River Avon System	*Food Production* - The river supports a watercress farm and several fish farms which benefit from good water quality and provide rural employment.
South Pennine Moors	*Food Production* - Sheep and cattle are farmed on the moors, mostly in small holdings with relatively low productivity. *Fresh Water* - The site supplies water to the major regional population centres.
Sutton Park	*Food Production* - Cattle are farmed on site and bees are kept by local apiarists. *Fibre Production* - Timber is produced but its low quality and difficulties of access restrict its use for internal applications such as park furniture, timber fencing and interior gating.

Food, Fibre and Fuel

A large proportion of SSSIs are farmed in some way and/or produce wild food, timber or other materials. **The impact of SSSI designation on provisioning services may be negative** in many cases as SSSI management is likely to reduce agricultural and forestry output, though there can also be increases in the quality of produce e.g. in niche markets for meat reared under environmentally sustainable conditions. SSSI management may contribute to the production and sustainable exploitation of certain wild species harvested for food (e.g. fish and fungi) as well as other products such as reed for thatching and coppice products. While in many cases SSSI management may limit the opportunities for harvesting such produce, management regimes may require sustainable exploitation or there may be benefits where SSSIs serve as nurseries – there is evidence, for example, that saltmarsh conservation can benefit the fisheries sector (Stevenson, 2001).

Food and timber production are important at some of the case study sites examined for this study, though rarely on a very large commercial scale. In some cases (e.g. Humber Estuary), conservation management has reduced the value of provisioning services, whereas in others it has reintroduced traditional production methods such as coppicing and grazing into otherwise unproductive sites, albeit on a small scale. An example is at Ashdown Forest where grazing has been reintroduced to restore the heathland, and is expected to lead to production of meat and wool.

Genetic Resources

Maxted *et al*. (2007) stress the importance of conserving crop wild relatives (CWR) for future agricultural production and highlight the role of SSSIs and other designations in their conservation – **all of the 17 CWR hotspots that would need to be protected to conserve two thirds of CWR species contain significant areas designated SSSI.**

Participants in the stakeholder workshops emphasised that SSSIs conserve genetic resources of lower organisms present in undisturbed soils, from which important pharmaceuticals (e.g. Streptomycin) and other products have been derived, and which may have been severely depleted in the wider landscape. It was further stressed that they create a holding resource for the stock of biodiversity, which has an insurance value in the future in the face of environmental change (Harlow *et al.*, 2010). As we do not know what natural resources and species may be helpful in the future, it is argued that SSSIs are important in maintaining the biodiversity options for the future.

SSSI management often involves grazing with rare or unusual breeds which may contribute to the conservation of genetic resources. This is the case at the SSSI case study sites at Ashdown Forest (Hebridean sheep), Dyfi (rare breed Welsh mountain ponies and Highland cattle) and Thompson Water, Carr and Common (Shetland ponies). However, there is no further evidence available from the case studies as to the level of benefits which sites provide in terms of containing key genetic resources for future plant breeding. For example, it is likely that grassland sites such as King's Sedgemoor host a wide range of CWR species, but no specific detail is available on their significance at the individual sites.

Fresh Water

Many SSSIs protect freshwater resources which play an important role in water supply. Up to 70 per cent of UK water supply is sourced from upland rivers, lakes and reservoirs (Natural England, 2009b)

Several of the case study sites play an important role in the provision of fresh water. An important distinction can be made between upland sites such as Dark Peak and the South Pennine Moors, where the natural ecosystem is important in providing fresh water, and engineered sites such as Walthamstow Reservoirs where construction of water supply infrastructure gave rise to the nature conservation interest.

Minerals

Geodiversity provides products useful to man including building and industrial materials, ornamental resources and energy (through coal, oil, geothermal energy and support for other renewables, Webber *et al.*, 2006, Stace and Larwood, 2006; Prosser *et al.*, 2006). However mineral resources are not renewable and are therefore not normally classified as ecosystem services. Nevertheless, **many geological SSSIs have been shaped by a history of minerals extraction which has exposed their geological interest**.

Two of the case study sites have a history of minerals extraction. At Crime Rigg and Sherburn Hill Quarries, the SSSI is located within an active limestone and sand quarry. Wren's Nest is also a former limestone quarry which in the past provided stone for construction and lime for agriculture.

5.6 Overall Assessment of Ecosystem Services

The sections above demonstrate that **quantitative evidence of the ecosystem services provided by SSSIs is limited** – much of the evidence from the literature review and case studies is qualitative in nature. The "Weighting Matrix" exercise study sought to provide an overall assessment of the relative levels of services provided by different habitats and the added effect of SSSI funding, based on the judgement of conservation experts (but not necessarily experts in ecosystem services). As well as being of interest in their own right, the results of the weighting matrix exercise were combined with the results of the choice experiment (Section 6.6) to assess the value of services delivered by different habitats. The method used is described in Section 3.3.5 and full details are given in Annex 3.

Table 5.8 reports the weighting scores for the 17 SSSI habitats (see first column) and the 10 ecosystem services: see row 2). For each habitat - ecosystem service assessment, three weighting scores were estimated relating to three different scenarios for the future of SSSIs:

- "Fully funded SSSIs" estimates ecosystem services under the "increase funding" policy scenario - i.e. the total level of ecosystem services that would be delivered by a SSSI habitat if SSSI funding was increased to allow all SSSIs to achieve favourable condition;
- "Additional services due to SSSIs" estimates the additional ecosystem services that are delivered as a direct result of the conservation activities associated with SSSIs. This figure is estimated by subtracting the estimated "services without SSSIs" from those for "fully funded SSSIs". It should be noted that these additional services span both the policy change scenarios investigated in the choice experiment, i.e. the combined effects of the "maintain funding" and "increase funding" scenarios compared to the "remove funding" scenario;
- "Services without SSSI" estimates the ecosystem services under the "remove funding" scenario - i.e. the residual level of ecosystem service provision that would be delivered by habitats in the absence of conservation activities associated with SSSIs, i.e. if future funding for SSSIs was withdrawn.

Taking the example of the Broadleaved, mixed and yew woodland – Climate regulation results from Table 5.8, the data suggest that:

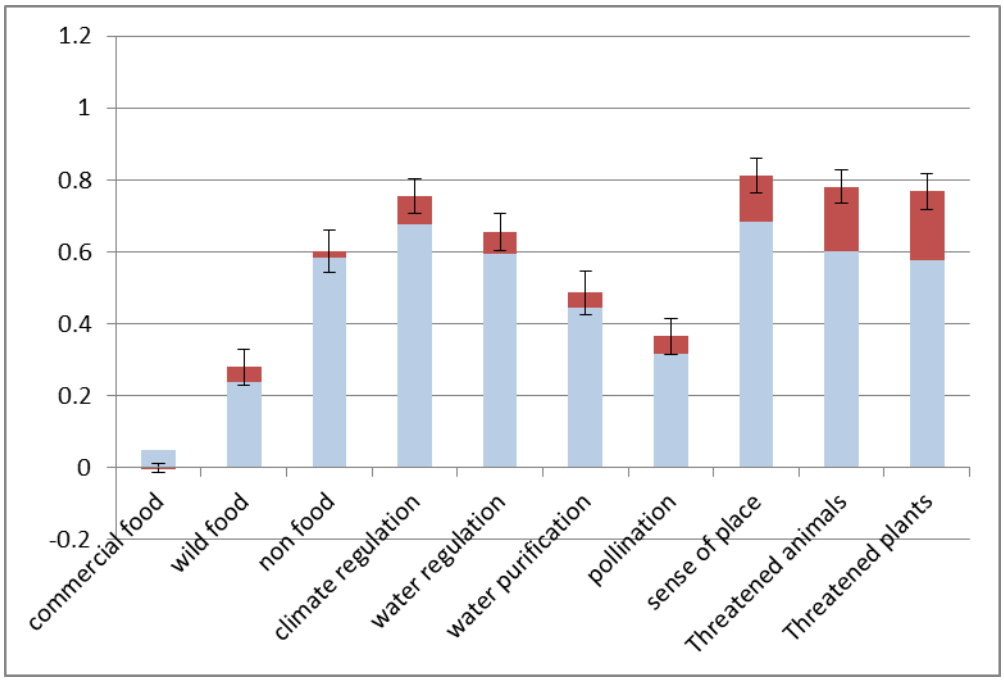
- Under the "increase funding" scenario, which means that SSSIs are fully funded to achieve favourable condition, the climate regulation services delivered by broadleaved, mixed and yew woodland have a relative weighting score of 0.76. This coefficient is interpreted on a relative scale of 0 = no service delivery to 1 = full service delivery. Therefore, a value of 76% suggests that Broadleaved, mixed and yew woodland protected through SSSIs would deliver high levels of climate regulation – indeed the figure is higher than for all other habitats except bogs.

- The second row coefficient for Broadleaved, mixed and yew woodland – Climate regulation relates to the additional ecosystem service that would be delivered by the conservation activities associated with SSSIs. So the SSSIs activities in Broadleaved, mixed and yew woodland are responsible for increasing Climate regulation services by a weighting score of 0.08, i.e. 8 percentage points more than without SSSI status.
- The third row weighting score relates to the level of service provision that would be delivered under the "remove funding" scenario. So for example, even without SSSI conservation management, Broadleaved, mixed and yew woodland are considered to deliver a relative weighting score of 0.68 units of Climate regulation services (on the assumption that they are not destroyed).
- In this research, the most important weighting score is the Additional services due to SSSIs score as this provides an indication of how the conservation activities under SSSIs impact the levels of ecosystem service provision. In the example above, the SSSI conservation activities helped to increase climate regulation services in Broadleaved, mixed and yew woodlands by around 10%.

A graphical illustration of the level of services estimated to be provided by this habitat is given in Figure 5.2. The figure illustrates the high levels of services this habitat is estimated to provide with regard to climate regulation, water regulation, provision of non-food (i.e. timber) products, sense of place, and conservation of threatened plants and animals. The levels of other services (commercial food, wild food and pollination) are estimated to be relatively low. The value added by SSSI investment (i.e. the difference between the estimated level of services if the habitat is managed as a SSSI compared to if it is not) is illustrated in the dark shaded upper portion of the bar chart. It is estimated that SSSI investment **adds substantially** to the level of services related to biodiversity conservation and sense of place, as well as increasing each regulating service. However, it is estimated to result in a net reduction in commercial food production as it prevents conversion of land to commercial agriculture[13].

[13] The weighting matrix estimated the added value of SSSI funding and management, as this was the focus of the policy scenarios addressed in the study. It is recognised that without legal protection, some sites would undergo major land use changes which would have still greater effects on service delivery.

Figure 5.2 Weighting Scores of Services Delivered by Broadleaved, Mixed and Yew Woodland SSSIs



Key:

Total height of bar: Level of ecosystem service provision under "increase funding" scenario (i.e. all SSSIs in favourable condition). Y axis provides a weighting score of up to 1, where 1 = maximum service delivery.

Dark shaded area (top half): Additional services due to SSSI funding

Light shaded area (bottom half): Level of ecosystem service provision under "remove funding" scenario

Error bars: Standard errors of weighting coefficient for "increase funding" scenario

Graphs for other habitats are given in Figures 5.3 to 5.18.

It should be noted that all of the weighting scores reported numerically in Table 5.8 and graphically in Figures 5.3 to 5.18 are relative to and consistent with all habitat - ecosystem service combinations. In other words, the coefficients can be directly compared across the entire matrix.

The estimates indicate that:

- **The levels of delivery of different ecosystem services vary widely by habitat**;
- **Provisioning services** are delivered especially by grassland habitats (commercial food), woodlands (timber) and intertidal mudflats and saltmarsh (fisheries);
- **Regulating services** are provided by all except the rocky habitats, and especially by bogs (climate and water regulation), woodlands (climate and water regulation, water purification), rivers and streams (water regulation and purification), fen marsh and swamp (water regulation and purification, climate regulation) and coastal and floodplain grazing marsh (water regulation).

- **Cultural services are delivered by all habitats**. Estimated service levels are found to be more consistent between habitats than provisioning and regulating services, demonstrating that all habitats are able to contribute to species conservation and sense of place. However, lower values were found for coniferous woodland and for inland rock habitats.
- **SSSI conservation activities are estimated to enhance levels of delivery of most services for most habitats**. This is especially true for cultural services associated with species conservation and sense of place, which are estimated to be between 10% and 25% higher under SSSI conservation management for most habitats. SSSIs are also estimated to enhance regulating services by between 0% and 15% for most habitats. However, food provision is estimated to decline by up to 10% for grassland habitats;
- The additional benefits of SSSI conservation activities are estimated to be particularly high for some habitats (e.g. bogs, rivers and streams and fen, marsh and swamp).

Figures 5.3 to 5.18: Estimated Delivery of Ecosystem Services by SSSI Habitats – Results from the Weighting Matrix

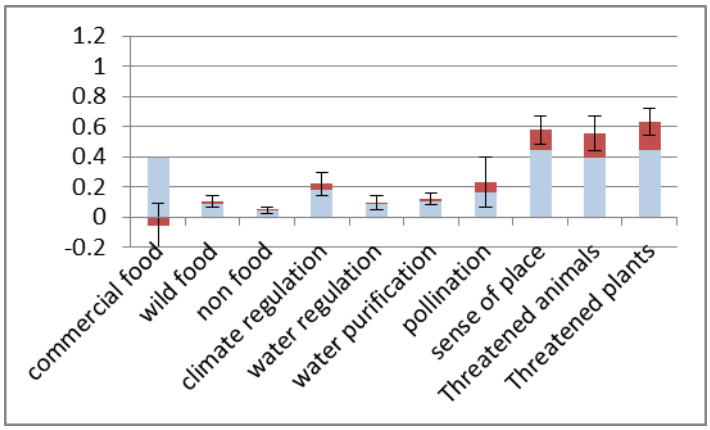


Figure 5.3 Acid grassland

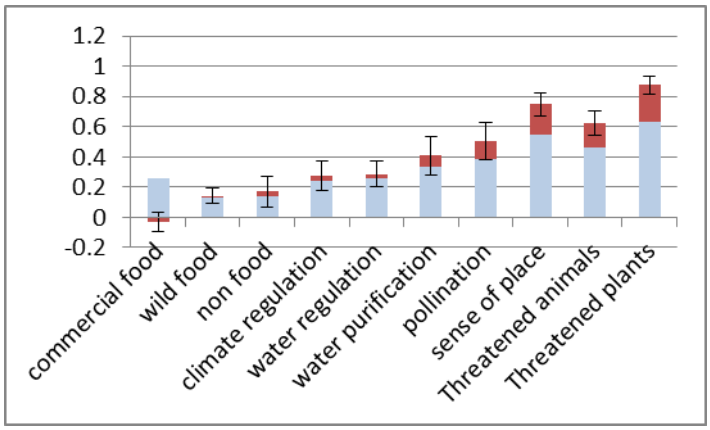


Figure 5.4 Calcareous grassland

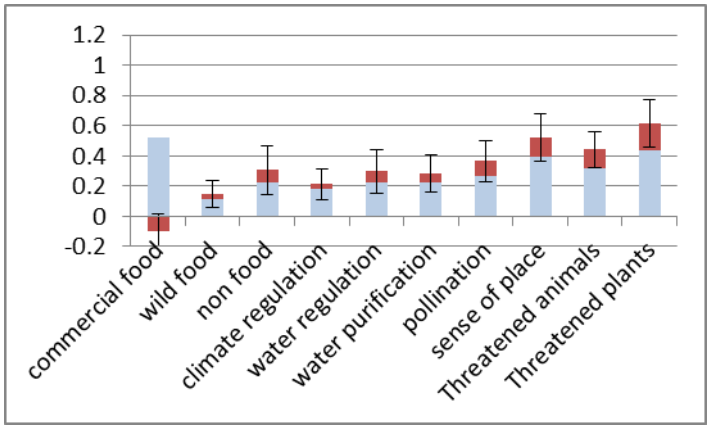


Figure 5.5 Neutral Grassland

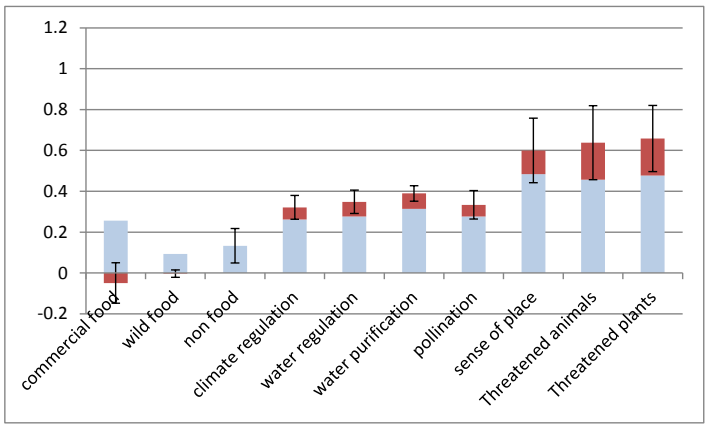


Figure 5.6 Purple moor grass and rush pastures

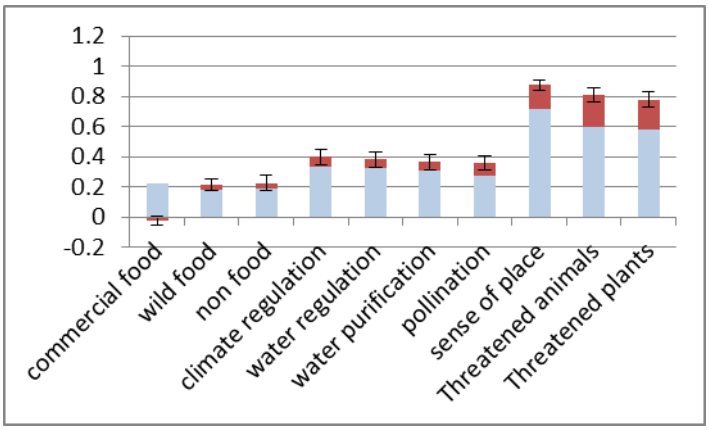


Figure 5.7 Heathland

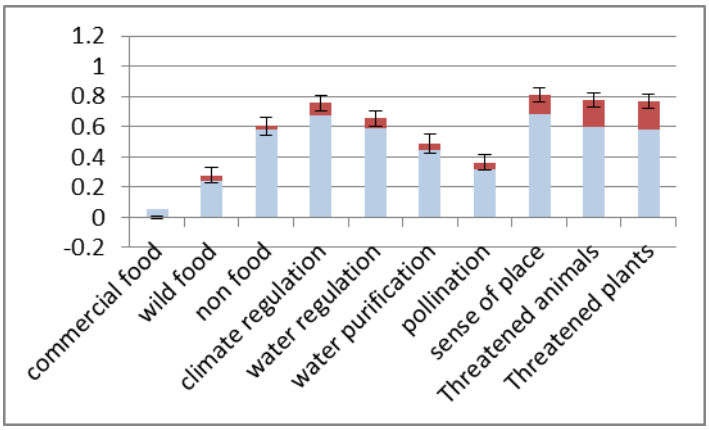


Figure 5.8 Broadleaved, mixed and yew woodland

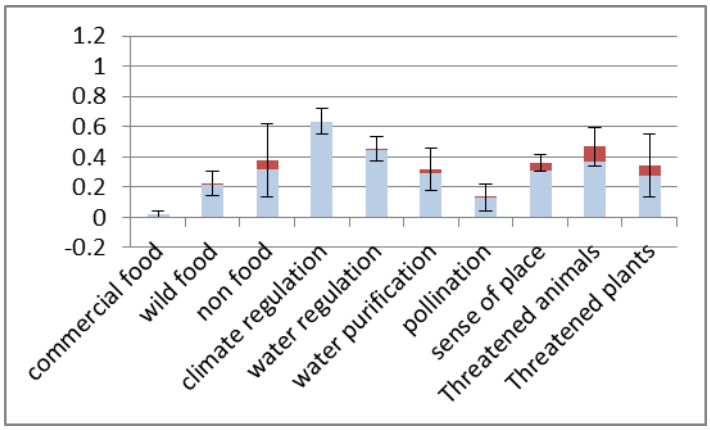


Figure 5.9 Coniferous woodland

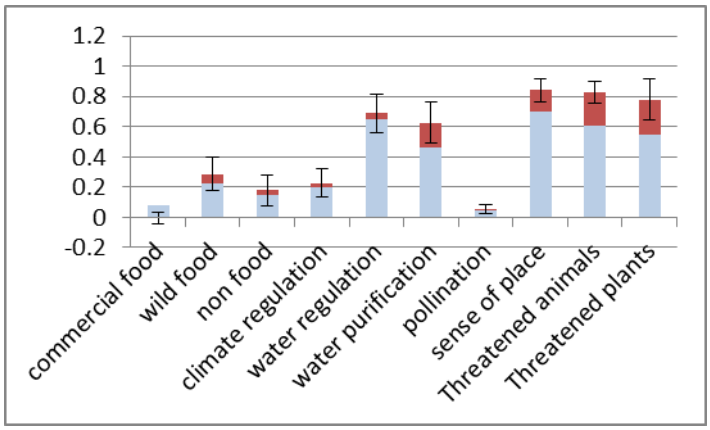


Figure 5.12 Standing waters

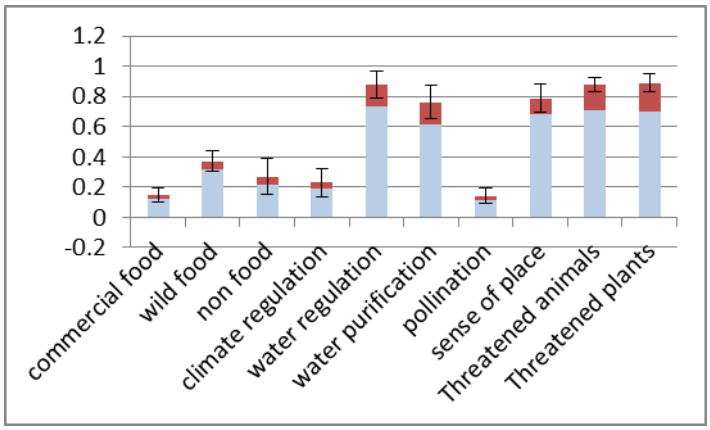


Figure 5.10 Rivers and streams

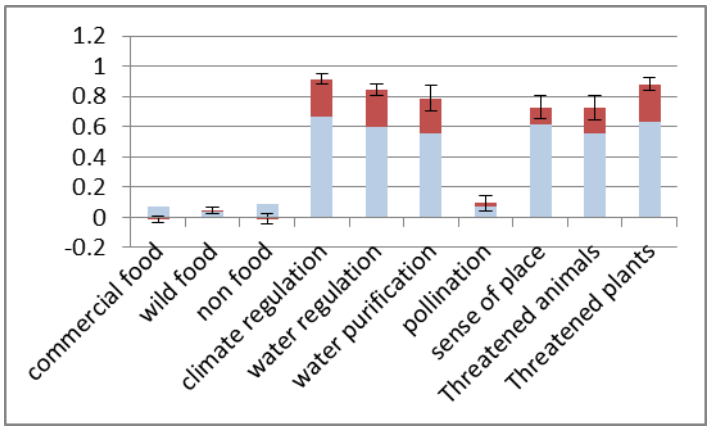


Figure 5.13 Bogs

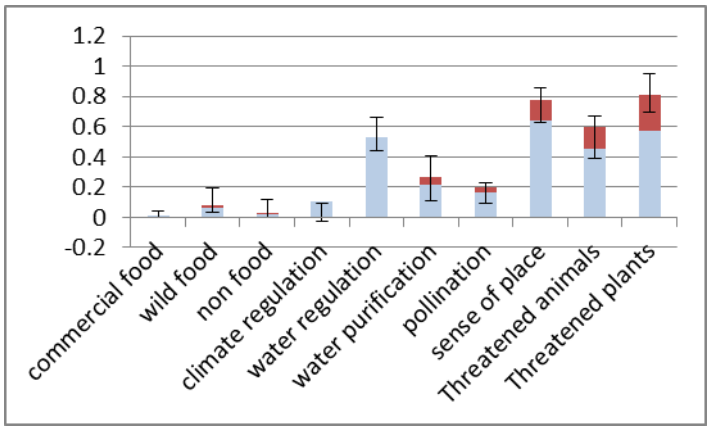


Figure 5.11 Canals

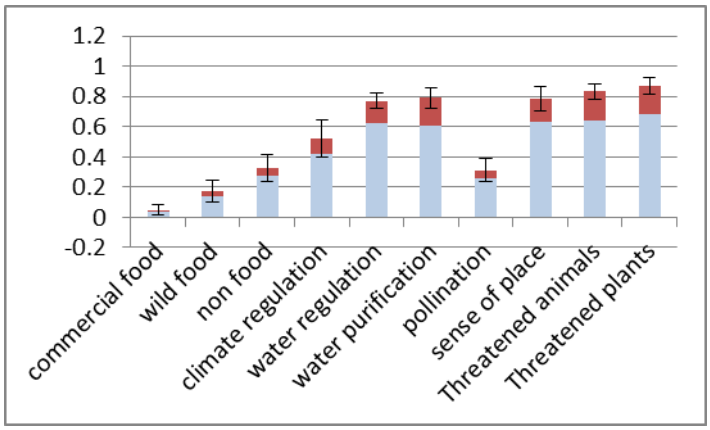


Figure 5.14 Fen, marsh and swamp

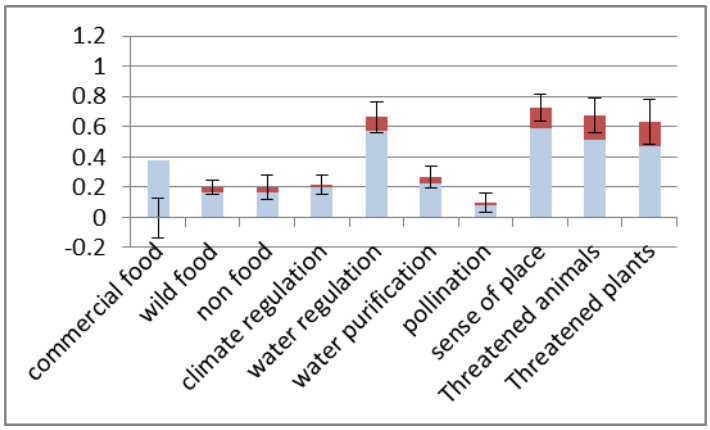


Figure 5.15 Coastal and floodplain grazing marsh

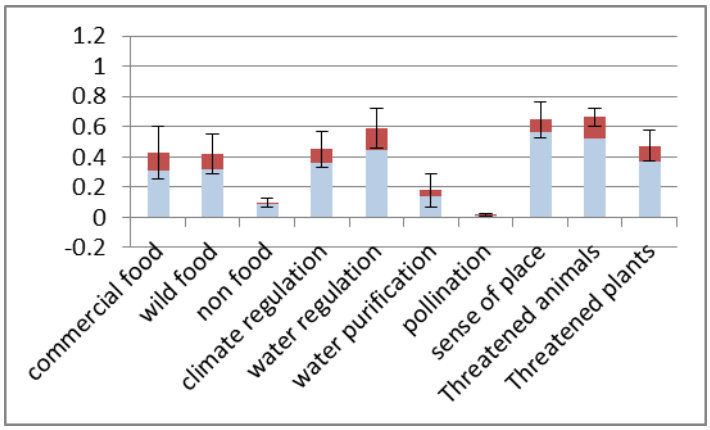


Figure 5.18 Intertidal mudflats and saltmarsh

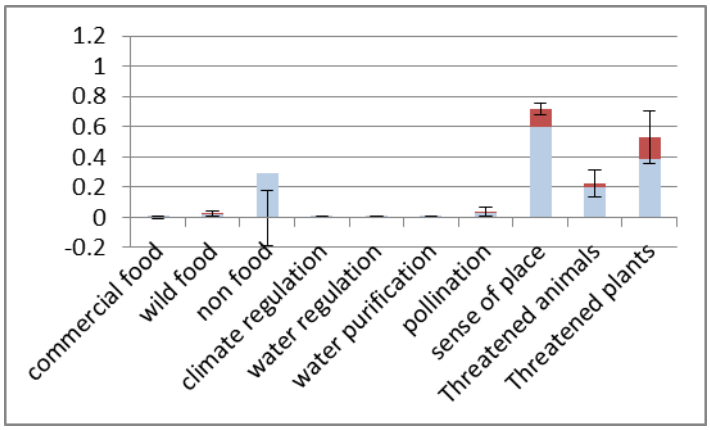


Figure 5.16 Inland Rock

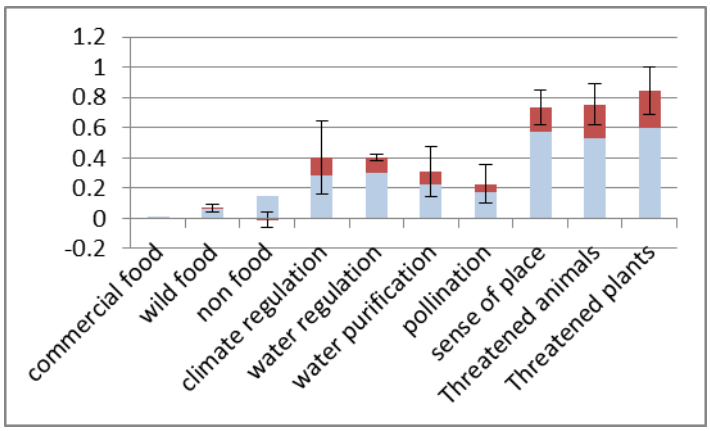


Figure 5.17 Sand dunes and Shingle

Limitations and criticisms of the weighting matrix approach need to be considered in interpreting these results. Annex 3 presents a discussion of the approach, based on the observations of participants, and on the results of a quality assurance exercise by the study team in consultation with external experts.

Some participants raised concerns about the validity of the exercise, particularly in terms of their own ability to derive weighting scores. However, the resultant weighting scores were generally consistent across participants and the range of scores across the different habitats and services generally met the expectations of participants and the external experts consulted as part of the validation exercise. There were specific concerns regarding the weighting scores that were based on fewer than five observations, i.e. Acid grassland, Purple moor grass and rush pastures, Coniferous woodland, Canals and Coastal and floodplain grazing marsh.

An external review of the results by eight academic experts with knowledge of particular ecosystem services provided general endorsement of the approach, as a practical means of overcoming limitations in evidence and of assessing the services delivered by different habitats on a consistent basis. The experts also found that the weighting scores obtained for different habitats met expectations and were consistent with available evidence. However the review also noted the limitations of the method and the difficulty of validating its findings scientifically. Because of these concerns, the results should be regarded as indicative and caution is needed in interpreting individual weighting scores, particularly for those habitats for which there was a small number of assessments.

Table 5.8 Weighting scores for the level of ecosystem services delivered by SSSI habitats.

		Provisioning services						Regulating services								Cultural services					
		Commercial food		Wild food		Non-food		Climate regulation		Water regulation		Water purification		Pollination		Sense of place		Charismatic species		Non-charismatic species	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Acid grassland	Fully funded SSSIs	**0.341**	0.294	**0.103**	0.074	**0.046**	0.043	**0.221**	0.148	**0.095**	0.088	**0.120**	0.081	0.229	0.330	**0.578**	0.192	**0.557**	0.227	**0.630**	0.175
	Additional service due to SSSIs	**-0.053**	0.049	**0.013**	0.009	0.002	0.005	0.036	0.054	**0.005**	0.005	**0.011**	0.012	0.062	0.103	**0.130**	0.075	**0.160**	0.080	**0.189**	0.053
	Services without SSSIs	**0.394**	0.338	**0.091**	0.067	**0.044**	0.039	**0.185**	0.104	**0.090**	0.090	**0.108**	0.083	0.167	0.228	**0.448**	0.168	**0.398**	0.148	**0.441**	0.123
Calcareous grassland	Fully funded SSSIs	**0.224**	0.191	**0.143**	0.160	0.173	0.305	**0.276**	0.288	**0.285**	0.256	**0.385**	0.387	**0.506**	0.370	**0.748**	0.220	**0.624**	0.242	**0.877**	0.181
	Additional service due to SSSIs	-0.033	0.061	0.012	0.041	0.031	0.098	0.036	0.072	0.028	0.074	0.050	0.101	**0.118**	0.101	**0.197**	0.103	**0.162**	0.079	**0.245**	0.084
	Services without SSSIs	**0.257**	0.234	**0.131**	0.158	**0.142**	0.212	**0.241**	0.245	**0.257**	0.206	**0.334**	0.322	**0.387**	0.292	**0.550**	0.138	**0.462**	0.179	**0.632**	0.106
Neutral grassland	Fully funded SSSIs	**0.418**	0.292	0.150	0.218	0.306	0.400	**0.214**	0.252	**0.297**	0.346	**0.282**	0.298	**0.365**	0.337	**0.522**	0.394	**0.441**	0.286	**0.617**	0.380
	Additional service due to SSSIs	**-0.102**	0.115	0.036	0.070	0.082	0.128	0.034	0.090	0.069	0.116	0.061	0.099	**0.095**	0.112	**0.128**	0.134	**0.121**	0.094	**0.178**	0.124
	Services without SSSIs	**0.520**	0.397	**0.115**	0.148	**0.225**	0.273	**0.180**	0.168	**0.228**	0.232	**0.221**	0.202	**0.270**	0.227	**0.393**	0.267	**0.321**	0.193	**0.439**	0.257
Purple moor grass and rush pastures	Fully funded SSSIs	**0.207**	0.197	**0.090**	0.036	0.133	0.168	**0.322**	0.116	**0.348**	0.115	**0.390**	0.076	**0.333**	0.139	**0.600**	0.316	**0.638**	0.362	**0.659**	0.324
	Additional service due to SSSIs	-0.049	0.068	-0.003	0.007	0.000	0.000	**0.059**	0.040	**0.072**	0.034	**0.076**	0.026	**0.057**	0.046	**0.116**	0.108	**0.181**	0.128	**0.181**	0.128
	Services without SSSIs	**0.256**	0.263	**0.093**	0.042	0.133	0.168	**0.262**	0.088	**0.276**	0.090	**0.314**	0.076	**0.276**	0.110	**0.484**	0.234	**0.457**	0.234	**0.477**	0.198
Heathland	Fully funded SSSIs	**0.179**	0.149	**0.219**	0.191	**0.226**	0.260	**0.399**	0.258	**0.383**	0.258	**0.364**	0.267	**0.360**	0.229	**0.878**	0.168	**0.812**	0.231	**0.780**	0.239
	Additional service due to SSSIs	**-0.023**	0.049	**0.037**	0.050	**0.035**	0.080	**0.062**	0.092	**0.055**	0.096	**0.058**	0.093	**0.082**	0.077	**0.159**	0.087	**0.210**	0.097	**0.198**	0.097
	Services without SSSIs	**0.228**	0.206	**0.183**	0.162	**0.191**	0.205	**0.336**	0.199	**0.328**	0.191	**0.306**	0.200	**0.279**	0.169	**0.718**	0.159	**0.602**	0.168	**0.582**	0.166
Broadleaved, mixed and yew woodland	Fully funded SSSIs	**0.050**	0.052	**0.279**	0.216	**0.603**	0.256	**0.756**	0.212	**0.655**	0.226	**0.487**	0.263	**0.365**	0.221	**0.813**	0.208	**0.780**	0.204	**0.767**	0.219
	Additional service due to SSSIs	-0.001	0.007	**0.040**	0.071	0.019	0.095	**0.078**	0.117	**0.062**	0.092	**0.042**	0.085	**0.047**	0.060	**0.129**	0.093	**0.179**	0.076	**0.190**	0.084
	Services without SSSIs	**0.051**	0.052	**0.239**	0.164	**0.585**	0.259	**0.678**	0.216	**0.593**	0.199	**0.445**	0.225	**0.318**	0.191	**0.683**	0.184	**0.601**	0.152	**0.578**	0.164
Coniferous woodland	Fully funded SSSIs	0.021	0.036	**0.226**	0.137	0.376	0.416	**0.634**	0.145	**0.453**	0.145	**0.316**	0.243	0.134	0.154	**0.357**	0.094	**0.468**	0.220	0.340	0.360
	Additional service due to SSSIs	0.000	0.000	0.014	0.026	0.054	0.100	0.000	0.072	0.010	0.017	0.020	0.034	0.003	0.006	**0.051**	0.036	0.096	0.059	0.068	0.072
	Services without SSSIs	0.021	0.036	**0.213**	0.115	0.321	0.318	**0.634**	0.162	**0.443**	0.161	**0.296**	0.209	0.130	0.155	**0.306**	0.058	**0.372**	0.175	0.272	0.288
Rivers and streams	Fully funded SSSIs	**0.145**	0.154	**0.373**	0.227	**0.271**	0.396	**0.229**	0.305	**0.877**	0.302	**0.761**	0.368	**0.141**	0.164	**0.788**	0.310	**0.881**	0.153	**0.890**	0.186
	Additional service due to SSSIs	0.025	0.054	**0.055**	0.071	0.056	0.107	0.038	0.093	**0.145**	0.194	**0.149**	0.168	**0.023**	0.032	**0.107**	0.075	**0.173**	0.184	**0.190**	0.184
	Services without SSSIs	**0.120**	0.107	**0.318**	0.247	**0.215**	0.292	**0.191**	0.225	**0.732**	0.317	**0.611**	0.326	**0.118**	0.134	**0.681**	0.283	**0.708**	0.231	**0.700**	0.249
Canals	Fully funded SSSIs	0.003	0.006	0.079	0.082	0.021	0.036	**0.106**	0.048	**0.534**	0.165	0.270	0.282	0.201	0.193	**0.778**	0.263	**0.597**	0.361	**0.813**	0.206
	Additional service due to SSSIs	0.000	0.000	0.018	0.030	0.004	0.007	-0.002	0.013	0.000	0.000	0.052	0.059	0.033	0.040	**0.139**	0.080	0.147	0.135	**0.244**	0.062
	Services without SSSIs	0.003	0.006	**0.062**	0.052	0.016	0.029	**0.108**	0.058	**0.534**	0.165	0.218	0.224	0.168	0.156	**0.639**	0.184	**0.450**	0.244	**0.569**	0.144
Standing waters	Fully funded SSSIs	0.075	0.106	**0.285**	0.295	0.179	0.268	**0.228**	0.247	**0.688**	0.332	**0.626**	0.365	0.053	0.074	**0.842**	0.208	**0.828**	0.198	**0.777**	0.360
	Additional service due to SSSIs	-0.005	0.027	**0.060**	0.063	0.029	0.056	0.025	0.059	0.038	0.078	**0.163**	0.105	0.005	0.007	**0.139**	0.129	**0.218**	0.102	**0.233**	0.108
	Services without SSSIs	0.079	0.128	**0.225**	0.251	0.150	0.213	**0.203**	0.197	**0.649**	0.324	**0.463**	0.270	0.048	0.066	**0.703**	0.150	**0.610**	0.103	**0.544**	0.252

*Notes: Figures shown in **bold** can be considered to be consistent based on the following criteria (mean / SE)*

		Provisioning services						Regulating services								Cultural services					
		Commercial food		Wild food		Non-food		Climate regulation		Water regulation		Water purification		Pollination		Sense of place		Charismatic		Non-charismatic	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Bogs	Fully funded SSSIs	**0.059**	0.067	**0.046**	0.064	**0.079**	0.116	**0.915**	0.114	**0.844**	0.138	**0.786**	0.291	0.093	0.172	**0.726**	0.265	**0.724**	0.281	**0.881**	0.143
	Additional service due to SSSIs	-0.012	0.022	0.008	0.019	-0.009	0.017	**0.252**	0.055	**0.242**	0.061	**0.229**	0.095	0.020	0.051	**0.110**	0.100	**0.173**	0.116	**0.245**	0.064
	Services without SSSIs	**0.071**	0.086	**0.037**	0.047	**0.089**	0.126	**0.663**	0.087	**0.602**	0.083	**0.558**	0.200	**0.073**	0.123	**0.617**	0.247	**0.552**	0.197	**0.636**	0.096
Fen, marsh and swamp	Fully funded SSSIs	0.048	0.095	**0.175**	0.208	**0.327**	0.242	**0.524**	0.342	**0.770**	0.148	**0.790**	0.181	**0.312**	0.214	**0.785**	0.237	**0.835**	0.145	**0.870**	0.147
	Additional service due to SSSIs	0.008	0.019	**0.033**	0.042	**0.050**	0.072	**0.102**	0.115	**0.149**	0.092	**0.179**	0.118	**0.057**	0.074	**0.149**	0.093	**0.196**	0.091	**0.187**	0.133
	Services without SSSIs	0.040	0.076	**0.142**	0.167	**0.276**	0.188	**0.422**	0.271	**0.621**	0.114	**0.611**	0.103	**0.255**	0.160	**0.636**	0.185	**0.639**	0.063	**0.683**	0.080
Coastal and floodplain grazing marsh	Fully funded SSSIs	**0.379**	0.294	**0.200**	0.100	**0.200**	0.181	**0.215**	0.144	**0.662**	0.233	**0.265**	0.161	0.094	0.142	**0.725**	0.193	**0.673**	0.258	**0.632**	0.324
	Additional service due to SSSIs	-0.001	0.082	0.034	0.053	0.035	0.070	0.018	0.026	**0.088**	0.084	**0.038**	0.026	0.015	0.030	**0.137**	0.111	**0.158**	0.129	**0.158**	0.129
	Services without SSSIs	**0.380**	0.343	**0.167**	0.079	**0.165**	0.113	**0.196**	0.145	**0.574**	0.177	**0.227**	0.149	0.078	0.112	**0.588**	0.103	**0.515**	0.133	**0.473**	0.198
Inland rock	Fully funded SSSIs	0.007	0.011	0.025	0.043	0.287	0.415	0.007	0.011	0.002	0.004	0.002	0.004	0.036	0.069	**0.718**	0.090	**0.227**	0.200	**0.530**	0.389
	Additional service due to SSSIs	0.000	0.001	0.002	0.004	-0.004	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.007	**0.124**	0.093	0.031	0.039	**0.147**	0.123
	Services without SSSIs	0.007	0.011	0.023	0.038	0.291	0.413	0.007	0.011	0.002	0.004	0.002	0.004	0.033	0.062	**0.594**	0.157	**0.197**	0.181	**0.383**	0.269
Maritime cliffs	Fully funded SSSIs	**0.124**	0.127	0.154	0.207	**0.412**	0.436	0.154	0.207	0.036	0.069	0.040	0.060	0.176	0.240	**0.846**	0.267	**0.656**	0.364	**0.649**	0.378
	Additional service due to SSSIs	-0.021	0.048	0.001	0.003	0.000	0.000	0.029	0.065	0.000	0.000	0.000	0.000	0.037	0.064	**0.108**	0.092	**0.134**	0.107	**0.123**	0.115
	Services without SSSIs	**0.145**	0.164	0.152	0.208	**0.412**	0.436	0.124	0.151	0.036	0.069	0.040	0.060	0.140	0.186	**0.739**	0.223	**0.522**	0.286	**0.526**	0.293
Sand dunes and shingle	Fully funded SSSIs	0.002	0.004	**0.067**	0.064	**0.139**	0.108	0.402	0.546	**0.405**	0.046	**0.309**	0.373	0.227	0.287	**0.735**	0.257	**0.752**	0.306	**0.844**	0.350
	Additional service due to SSSIs	-0.001	0.001	**0.007**	0.007	-0.010	0.014	0.120	0.164	**0.102**	0.030	0.088	0.116	0.056	0.089	**0.163**	0.126	**0.226**	0.092	**0.249**	0.115
	Services without SSSIs	0.003	0.006	**0.060**	0.058	**0.149**	0.121	0.282	0.381	**0.303**	0.076	**0.221**	0.257	0.170	0.199	**0.572**	0.147	**0.526**	0.214	**0.595**	0.235
Intertidal mudflats and saltmarsh	Fully funded SSSIs	**0.425**	0.461	**0.416**	0.348	**0.096**	0.087	**0.451**	0.316	**0.590**	0.352	0.180	0.288	0.016	0.024	**0.645**	0.304	**0.663**	0.158	**0.475**	0.263
	Additional service due to SSSIs	**0.112**	0.152	**0.101**	0.118	0.004	0.009	**0.094**	0.081	**0.144**	0.131	0.037	0.087	0.003	0.005	0.082	0.099	**0.144**	0.104	**0.104**	0.093
	Services without SSSIs	**0.313**	0.311	**0.315**	0.234	**0.093**	0.081	**0.357**	0.249	**0.446**	0.242	0.143	0.211	0.013	0.019	**0.563**	0.275	**0.518**	0.094	**0.371**	0.184

*Notes: Figures shown in **bold** can be considered to be consistent based on the following criteria (mean / SE). The estimates are average scores given by participants, based on their individual judgement. Three decimal places are given because of the low absolute values of scores for "additional service due to SSSIs" and should not be taken to imply that the estimates are made with a high degree of precision.*

5.7 Public perceptions of SSSI Services

People's perceptions of SSSIs and their benefits were explored through the public focus groups. These emphasised the significant cultural services that people derive from SSSIs, though their awareness of the policy was limited.

The results of the focus group discussions are summarised here, while the findings of the choice experiment valuation conducted for each focus group are given in Section 6.6. Full details of the context and methods for the focus groups are given in Annex 4.

5.7.1 Awareness of SSSIs

Most focus group participants were aware of some of their local SSSIs, but no one had heard of all of them

All participants were asked about their personal knowledge and use of different named SSSIs locally. The use, knowledge and understanding of the sites varied from non-existent in some cases to relatively frequent in a small number of others (Table 5.9). Most people had a limited experience of engaging with the sites in some way, although some participants had not known of the site being an SSSI until seeing its name on the list in front of them at the event. To these people, the site was a nature reserve or site in the local countryside that they visited, and they were unaware that it had SSSI status.

Table 5.9 Proportion of Focus Group Participants Aware of Local SSSIs

Knowledge of the SSSIs: Do you know of any of these locations?	Older Groups (N=76)	Younger Groups (N=78)	All Participants (N=154)
None	4%	4%	4%
A few	70%	63%	66%
Many	18%	24%	21%
Most	8%	9%	8%
All	0%	0%	0%

Amongst those who were unaware of the sites, some people were frustrated that they had not become aware of the locations through their general life and activities as a citizen in the area, and expressed this in their feedback. These people implied that they felt they had been missing out, and unaware of something relatively important, regardless of whether they would have experienced the sites.

Some differences in usage and awareness of SSSIs were apparent between older participants (over 45 years) and younger participants (under 45 years):

- Amongst older participants, 12% never visit or use a local SSSI, while amongst the younger participants, only 6% never visit or use a local SSSI (Table 5.10);
- Older participants were much more likely to have heard of the term SSSI, with just 42% not knowing or having heard of the term, while 60% of the younger participants were unfamiliar with the term, even though some of them used or visited one or more location that happened to be an SSSI (Table 5.11).

Table 5.10 Proportion of Focus Group Participants Visiting and Using Local SSSIs

Visit and use: Do you visit, use or identify with any of these locations?	Older Groups (N=76)	Younger Groups (N=78)	All Participants (N=154)
Never	12%	6%	9%
Occasionally	30%	32%	31%
Sometimes	33%	35%	34%
Frequently	16%	19%	18%
In the past	7%	4%	5%
Travelling past	3%	4%	3%

Table 5.11 Number of Focus Group Participants who had Previously Heard of the Term SSSI

Had you heard of the term SSSI before?	Older group (N=62)	Younger group (N=63)	All Participants
Not heard of SSSIs before	26 (42%)	38 (60%)	64 (51%)
Heard of SSSIs before	36 (58%)	25 (40%)	61 (49%)

5.7.2 Public Appreciation of SSSIs

Almost all focus group participants felt SSSIs were worthwhile and were supportive of government funding being allocated to them.

Only in one group did one person ask if the public were paying for activities which would happen anyway, and a handful of people across the focus groups expressed disinterest in SSSIs. Otherwise, participants appreciated that SSSIs were a relevant part of government spending, they supported the concept of SSSIs, and many felt pleased to be able to voice an opinion and potentially influence a deserving and meaningful activity of government. Comments to this effect included the following, which were stated in the context of SSSIs:

"A moral obligation to protect habitat and species for future generations" - Carmarthen younger group.

"It would be tragic if these areas and places were lost – wildlife, space and nature benefits would disappear" - Ipswich older group.

"To me, protection of our natural environment ranks extremely highly" - Carmarthen older group.

Only a few focus group participants mentioned specific wildlife benefits of SSSIs.

The specific wildlife present in SSSIs was not especially prominent in people's feedback, mainly because people's comments largely related to the full scope of experience they obtained and perceived from SSSIs, and because the sample was non-specific and contained few people with specialist knowledge or specialist interest in wildlife. Nevertheless,

some specific aspects of nature, relating to the main purposes of SSSIs, certainly did feature and were expressed very positively by people, as illustrated below.

"[If SSSIs were lost..] *my bird watching would be curtailed and my quiet times would deteriorate"* - Wells older group.

"[SSSIs are about] s*eeing things for real, not just in books*" - Carmarthen older group

"*Fresh air, sea birds, wild flowers, lizards, toads*" - Southport older group

"*Nice place to walk and enjoy wildlife. Means badgers and other cool animals get preserved which makes me happy*" - Ipswich younger group

5.7.3 Benefits of Use of SSSIs

Most SSSI visits by focus group participants were for general recreational purposes.

Amongst the groups, the majority of participants who had experience of visiting one or more SSSIs did so because of an amenity or recreational use such as walking of exercising a dog, or for experiencing nature with their family or children. However, also amongst the sample, a few participants had experience of a more functional kind, due to their involvement in farming, field sports, or having undertaken practical work on an SSSI, or because they fished in the local river, which also happened to be an SSSI. Thus there were different user perspectives on SSSIs amongst the sample, although rarely more than two in each group had this more functional perspective on an SSSI.

SSSIs are widely seen to provide mental health benefits.

There was a widespread view that SSSIs offered an important tonic for people, as a place to relax, de-stress, and refresh the mind. This kind of benefit often gets expressed through such terms as thinking time, ability to reflect and contemplate, and ability to escape from daily pressures. Such points were made throughout all groups, and examples included the following:

"*Exercise, relaxation, and thinking time*" - Wells older group.

"*They are places where you can reflect on issues and escape the modern world for an hour or two*" - Southport older group

"*De-stress, relax, sleep better, lifts mood*" - Southport older group.

"*What SSSIs mean to me - Simple. Relaxation. Intellectual. Natural*" - Wells younger group.

Several focus group participants emphasised the social benefits of visiting SSSIs.

The ability to experience SSSIs with family and friends was cited several times in consistent ways. Perhaps partly linked to the above point on mental health benefits, SSSIs clearly provide situations in which families can share experiences amongst each other and between generations.

"*Dog walking; time with family to enjoy our local environment*"- Wells younger group.

"*Family time together. Wonder of God's creation*"- Carmarthen older group.

"*The chance to take grandchildren to see wildlife*"- Hexham older group.

"*Walking with friends and family*" and "Family contact" - Ipswich older group

SSSIs are seen to provide a pleasant and inspiring environment for recreation.

Many respondents made the point that they were undertaking routine activities, such as physical exercise or walking the dog, but elected to do so in a pleasant and stimulating environment provided by an SSSI. In this sense they were enjoying the wildlife as part of the need to exercise a dog or go for a walk, but appreciated the wider benefits of the SSSI, such as its tranquillity, peace, views, and natural sights and sounds. Many participants recognised they could exercise their dog in a local park or similar but emphasised that they preferred to

spend this time in the rich environment provided by an SSSI. Typical of such views are the following:

"*Inspirational walking area*" and "*SSSIs are fantastic areas for inspiration*" - Wells younger group.

"*Walking my dog – plus it's nice and relaxing to walk with a nice view*" - Hexham younger group.

"*Exercise in lovely surroundings*" - Carmarthen older group.

"*Walking, enjoy nature, enjoy the space*" - Ipswich older group.

The educational benefits of SSSIs were emphasised by many focus group participants.

A consistent theme through the focus groups related to the educational role of SSSIs and the importance of children having contact with nature. Thus many participants expressed the importance of SSSIs as places where children could see and experience wildlife. Examples of such views included:

"*I have a young family – it is important to get away from the television and to get them interested in other living things*" - Ipswich younger group.

"*Introducing young children to wildlife*" - Southport older group.

"*I want my children to know nature*" - Southport older group

"*Educational for children spotting different wildlife*"- Hexham younger group

5.7.4 Disbenefits of SSSIs

SSSIs are seen by some to have disbenefits, by constraining development and potentially attracting anti-social behaviour.

In each focus group, amongst the optional questions, participants were invited to identify any disbenefits or disadvantages that local SSSIs might present. A small range of negative points were raised by participants, but with two main types of disbenefits expressed.

First, in several of the groups, one person voiced a concern that SSSIs represented a barrier to 'progress' and 'growth', and felt that the potential constraining role of SSSIs should be recognised. Examples of such views included:

"*Prevents commercial growth and development of transport routes*" - Southport younger group.

"*Restricted development potential making property in 'home' areas costly and out of reach*" - Carmarthen younger group.

Second, the other main type of disadvantage was perceived as SSSIs being potential or actual locations for accumulation of litter, fly tipping, and anti-social behaviour. The challenge here is that avoidance of such undesirable activity might require additional management facilities and/or management staff, which has a resource implication. Specific quotes illustrating such views included:

"*Teen drinking – spoiling area with mess and intimidating behaviour, puts off the vulnerable*" - Ipswich younger group.

"*Litter – some places could do with more care*" - Southport younger group.

5.7.5 Public Perceptions of the term "Site of Special Scientific Interest"

The term "Site of Special Scientific Interest" was seen as off-putting by most focus group participants.

The term 'Site of Special Scientific Interest', or 'SSSI' was a popular talking point within the focus groups. With only a handful of exceptions, there was consistent agreement that the term SSSI, in full or as an acronym, was off-putting for the following main reasons:

- **Unrepresentative**: it was widely felt that the term did not do justice to the range of qualities possessed by SSSIs. People recognised the relevance of the scientific tag but felt that from all that they had heard and discussed in the focus group, SSSIs embraced a wider range of factors. "It doesn't do what it says on the tin".
- **Clumsy**: the term was thought to be convoluted, long winded, and hard to recall.
- **Too scientific and specialist**: the scientific label was felt to be too specialist and too off putting, implying for science specialists only. This view was even voiced by participants who had some knowledge and training in science-based subjects.
- **Too exclusive**: Related to the prevalence of science in the name, people felt the term was too exclusive, and even elitist.

5.7.6 Link between SSSI Characteristics and Benefits

The focus groups highlight that SSSIs provide significant cultural services that contribute to people's welfare.

The discussions demonstrate that some of the main wider characteristics of SSSIs which provide benefits to people include the following:

- the aesthetic interest of many SSSIs
- the sense of wildness which many SSSIs exhibit
- the tranquillity afforded by many SSSIs
- the variety of experiences offered within many SSSIs
- the accessible location, with environmental and amenity interest, offered by an SSSI if it has provision for public access (not all SSSIs have public rights of way or access opportunities).

The above characteristics supplement the benefits which people derive from the specific wildlife and geology of SSSIs. Managing SSSIs to retain or improve these characteristics (such as wildness, tranquillity and aesthetic appeal) is not an explicit policy objective, although some SSSI management plans may allude to such factors or address them to different degrees.

The results are comparable to other recent studies such as the MENE (Monitor of Engagement with the Natural Environment) report (Natural England, 2010c) and the Experiencing Landscape report (Natural England, 2009d), both of which emphasise the cultural and health benefits of informal use of the natural environment.

5.8 Ecosystem Services and SSSI Funding

The ecosystem services delivered by SSSIs depend to a large extent on future funding for SSSI policy.

Evidence with which to assess the effects of SSSI funding and management on ecosystem service delivery is incomplete. However, from the above review, it is clear that:

- **The delivery of many cultural services is enhanced by SSSI condition, although the linkage is not always clear for all services.** For example, evidence suggests that SSSIs do not attract more recreational visitors than non-SSSI sites, and that the link between site condition and numbers of visitors is unclear, but that SSSI status and

condition can add qualitatively to the visitor experience. SSSIs are also a focus for science and education, which are also dependent on site condition as well as resources for access and interpretation. Importantly, the knowledge that biodiversity and geodiversity are protected forms an important component of cultural services and this is closely linked to site condition.

- **There is evidence that regulating services are linked to the condition of SSSIs, though this is not quantified for most sites.** It is widely understood that achieving favourable condition will enhance the ability of SSSIs to store carbon, regulate water quality and water flows, and protect against floods and natural hazards.
- **Provisioning services may be increased or decreased by management designed to enhance SSSI condition.** SSSI management may reduce agricultural output at many sites but enhance other services such as protection of genetic resources, management of fisheries and provision of fresh water.

Section 4.5 above demonstrated that the conservation benefits of SSSIs are closely linked to the level of resources devoted to achieving favourable condition. The analysis above suggests that levels of funding will also influence the delivery of most ecosystem services.

The likely effects of the future funding scenarios investigated for this study are summarised in Table 5.12.

Finally, it can be noted that the removal of protection that SSSIs enjoy from development and changes in land use would result in a more significant decline in ecosystem service delivery. If reduced protection meant that some SSSIs were lost to built development, this would remove most of the provisioning, regulating and cultural services they currently deliver.

Table 5.12 Effects of Funding Scenarios on Ecosystem Services delivered by SSSIs

Scenario	Cultural Services	Regulating Services	Provisioning Services
Maintain funding - at levels sufficient to maintain current levels of SSSI condition	Service delivery remains at current levels. Sites are widely used and appreciated but do not deliver their full potential.	Service delivery remains at current levels. Gradual recovery of site condition may enhance some services but full potential of sites to store carbon, regulate water etc. is not achieved.	Service delivery remains at current levels. Commercial food and timber production remains at current levels but some services (conservation of genetic resources, provision of wild food etc) do not achieve their full potential.
Increase - funding leads to achieving favourable condition on all sites.	Opportunities for scientific study, education and recreation would be maximised although there is not necessarily a significant increase in overall numbers of visitors. Sense of place, aesthetic and spiritual values would also be likely to be enhanced. Existence values related to the conservation benefits of the site would be maximised.	Regulating services such as carbon storage, water regulation and purification, pollination and natural hazard regulation would be maximised.	Commercial production of food and timber might decline at many sites. There might be increased woodfuel production in newly managed woods and small increases in livestock on previously unmanaged grazing lands. Conservation of genetic resources, provision of wild food and fresh water would be enhanced. There could be benefits for fisheries.
Remove funding - leading to a gradual decline in the proportion of sites in favourable condition.	Declining site condition would lead to gradual decline in some qualitative aspects of recreation, loss of educational and scientific opportunities, loss of site character (and sense of place, spiritual and aesthetic values) and a loss of the existence values people derive from biodiversity and geodiversity. Many sites remain widely visited by the public.	Loss of regulating services including carbon storage, water regulation and purification, pollination, natural hazard regulation.	Increases in commercial production of food and fibre at many sites, but a decline at others as traditional management practices (extensive grazing, woodland management) would be withdrawn. Loss of genetic resources and wild food.

6 Economic Value of the Benefits of SSSIs

- Valuing the services that SSSIs deliver is challenging, because of a lack of evidence enabling the quantification of ecosystem services as well as evidence of their value.
- Existing studies demonstrate the substantial value of cultural services delivered by individual SSSIs. Most studies focus on the recreational values of SSSIs, but the limited evidence available suggests that these may be significantly outweighed by non-use values.
- The few studies estimating the value of regulating services delivered by SSSIs demonstrate that these can be significant and that SSSI conservation activities enhance their value.
- Provisioning services are relatively easily valued using market prices but are covered by few existing studies.
- Because existing evidence is fragmented and often site-specific, it does not permit an overall assessment of the value of services delivered by SSSIs.
- An estimate of the public's willingness to pay to support SSSI management was made through a choice experiment for this study. Based on the results and data from the weighting matrix, it was estimated that the public is willing to pay £956 million annually to secure the current benefits delivered by SSSI funding in England and Wales, and an additional £769 million to secure the services delivered if funding was increased to achieve favourable condition for all sites.
- The choice experiment results need to be interpreted with caution but suggest that the benefits could be significantly higher than the current public sector costs of the policy.
- SSSIs also support employment and benefit local economies, both as a result of site management and by attracting visitor expenditures.

6.1 Approach to Economic Valuation

Section 5 demonstrates that SSSIs provide a wide range of services to society. The value of these services can be measured in different ways. For example:

- **Market prices** can be used to measure the value of those services provided by SSSIs that have direct market value, including provision of food and timber. They can also potentially be applied to some regulating services (e.g. to value reductions in damage to property caused by flooding).
- **Avoided costs** can be used to assess the value of some regulating services. Examples include avoided costs of water treatment (due to water purification services) or avoided expenditures on flood defences (due to water regulation services).
- **The travel cost** method is used to value recreational visits to sites, by taking account of the travel time and expense incurred by visitors
- **Stated preference methods** are capable of valuing a wide range of ecosystem services. They involve directly asking members of the public about their willingness to pay to secure an environmental change and the services it delivers. They are the only means of estimating existence values (the benefits that people derive from simply knowing that biodiversity is protected). They include the contingent valuation method (CVM) and the choice experiment method (CEM, used in this study).

Valuing the benefits delivered by SSSIs is challenging. It depends on the ability to quantify the changes in services delivered (such as the impact of a SSSI in reducing the risk of property damage due to flooding) as well as the ability to put values on these services.

Benefits transfer reduces the need for new valuation work by transferring values obtained at studies of other sites to the site in question. However, it is often limited by the availability of relevant evidence and the site specific nature of many of the services. Even if

transferable values can be found, difficulties in quantifying changes in ecosystem service delivery are often a major barrier to valuation.

This study has used two approaches to assess the value of benefits delivered by SSSIs:

- **A review of existing evidence** regarding the value of ecosystem services delivered by particular sites, obtained from the literature review and case studies. This existing evidence is based on a variety of the valuation methods listed above; and
- **A choice experiment study** to provide an overall valuation of the benefits of SSSIs by estimating the public's willingness to pay for the services that SSSIs deliver. The choice experiment was undertaken as part of the ten public focus groups.

This approach enables **an overall assessment of the value of the benefits** provided by SSSIs in England and Wales, as well as an examination of the **value of specific services provided by some individual sites,** as far as the existing evidence permits.

6.2 Existing Evidence

There is some existing evidence of the economic values derived from SSSIs, although this is limited and fragmented. The theoretical benefits flowing from SSSIs are well defined and the economic value of some of these benefits has been calculated. However, there is limited evidence of the contribution that SSSI designation has to this value. Most valuation studies focus on individual habitats or species, particular ecosystem services, or management programmes for areas with multiple designations. A further difficulty is that valuation is often undertaken simply for the value of the current (baseline) condition of a site rather than comparing the value of managing an area towards a policy target against counterfactual conditions. Few comparative studies exist of SSSI and non-SSSI habitats that can be used to determine the impact of SSSI designation.

The 20 case studies completed for this assignment found that **evidence of the value of ecosystem services is lacking for most SSSIs**, and that there is often a lack of quantitative evidence of services on which an economic assessment could be based (Box 6.1). In comparison there is much more information about visitor expenditures and the impacts of sites on local economies (Section 6.7).

Box 6.1: Value of Ecosystem Services – Evidence from the Case Studies

The 20 case studies found that evidence of the value of ecosystem services is available for only a small minority of SSSIs, highlighting the ongoing challenge of assigning economic values to nature and its services. While for some sites there is some evidence helping to quantify ecosystem service delivery that could inform the basis for valuation, at many such information is simply not available. Sites that are smaller in scale or have limited public access are unlikely to have been surveyed or researched in relation to their uses and benefits, and therefore there is little available information on which to base assessments of value.

The case studies found that there is often a greater challenge in quantifying the ecosystem services delivered, than in assigning economic values to these benefits. For example, at no site was evidence available of the effects of the site and its management on flood risk – where such assessments are available, the valuation of benefits (based, for example, on value of property at risk from flooding) would be feasible. The ecosystem services framework provides a good framework for quantification and valuation of benefits, but a lack of scientific evidence is often a constraint, especially where services are very localised or site specific.

The case studies found that the impacts of sites on local economies are much better documented than the value of ecosystem services that sites deliver. Visitor expenditures are relatively easily measured, and methodologies are well established. The availability of evidence may also reflect the level of interest in economic development outcomes among local authorities and regional agencies.

For two of the case study sites, evidence of the value of services is available from existing studies. These are the Humber Estuary, where the value of benefits from managed realignment at Alkborough Flats has been assessed by the Environment Agency (see Box 6.3) and Wren's Nest NNR, where a dedicated valuation study was undertaken in 2006 as part of work commissioned by Natural England on the value of geodiversity (see Box 6.2).

In some cases, there is evidence of the potential value of ecosystem services. For example, at Dark Peak, Yorkshire Water has identified the importance of the site for water purification and its potential role in reducing the need for major investments in water treatment.

6.3 Economic Value of Cultural Services

Evidence valuing the cultural services delivered by SSSIs is available for a wide range of sites and some studies demonstrate that conservation management enhances these values.

The value of cultural services includes the value that people derive from visiting sites (so called **"use values"**) as well as from the knowledge that sites and their biodiversity and geodiversity are protected for the benefit of current and future generations ("**non-use values"**).

SSSI status may enhance the value of recreation by increasing the number of people visiting sites and/or the value obtained from each visit. Recreational values may be assessed using stated preference (e.g. contingent valuation) or revealed preference (e.g. travel cost) methods. It is important to recognise that many visits would take place whether or not the site was a SSSI, so an assessment of the additional benefits of designation is needed.

In addition, it is clear that non-users also benefit from SSSI policy, through the assurance that valuable species and habitats are protected, either for the benefit of society as a whole (existence values), to retain an option to visit the site in future (option value) or to protect it for future generations (bequest value). Stated preference methods such as contingent valuation or choice experiments are needed to estimate non-use values.

In a case study of Ingleborough National Nature Reserve, part of which is SSSI, a study for Natural England valued changes in outdoor recreation (use value) and landscape (non-use value) due to a change from a 'business as usual' baseline to an improved management regime (Natural England, 2009a). Recreational benefits are assumed to accrue to Ingleborough's 100,000 yearly visitors while people across the UK enjoy the site's historic and cultural landscape (in varying degrees). **The increased recreational benefits were estimated to be £3m and the benefit from improvements to the historical and cultural landscape was valued at a further £3m.** This assumed increase entirely relates to an increase in the value per visit, as the numbers of visits are assumed to be constant. Although these findings cannot be extrapolated to other SSSIs, the study highlighted the type of benefits that could follow an improved management regime on SSSIs. The same report included a case study of Bleaklow Plateau which estimated that restoration of an extensive area of SSSI peat bog could deliver non use values of £3.0 million and recreational benefits of £1.5 million (the figures representing the present value of benefits over 50 years).

Early valuation studies estimated that visitors to SSSIs in Upper Teasdale, Skipwith Common and Derwent Ings were willing to pay a total of £150,000, £1.0 million and £520,000 per year respectively at 1990 prices for conservation activities at these sites (eftec, 2007). CJC Consulting (2004) commented that evidence from these studies suggests that **non-use values make the largest contribution to the values estimated** – i.e. a large proportion of the willingness to pay of visitors arose from a general concern to protect the site rather than to visit the site. A similar finding was reached by Jacobs (2004) in a study of the costs and benefits of the Scottish Natura 2000 sites. This estimated that the amount the public was willing to pay to protect these sites was £210 million per year, of which less than

1% was accounted for by the value of using the sites and 99% related to non-use values. Benefits were estimated to outweigh costs by a ratio of 7:1. The Jacobs study suggested that Natura 2000 designations provide additional benefits to SSSI status, relating to enhanced visitor values, marketing opportunities and enhanced leverage of funds invested at the sites, but did not attempt to value these at the margin.

Another early study by Harley and Hanley (1989) of visitors to three RSPB reserves, at Loch Garten and Handa in Scotland and Blacktoft Sands in England, all of which are designated as SSSIs, estimated a mean willingness to pay of between £1.13 and £3.49 per recreational visit.

Crabtree (2004) estimated the overall recreational value of SSSIs by combining estimates of visitor numbers with estimated willingness to pay from previous studies of SSSIs. Based on an estimated total of 370,000 visits to SSSIs annually and an average value of £1 to £3 per visit, **the overall value of recreational visits to SSSIs was roughly estimated at between £370m and £1,110m per year**. However, it was noted that many of these visits would have taken place whether the sites were SSSIs or not, with the author concluding that the additional benefits of SSSI designation could not be estimated.

A study by Willis *et al*. (1996) valued the Pevensey Levels Wildlife Enhancement Scheme (WES), which paid landowners and occupants to develop schemes which enhance SSSI wildlife habitats. This study therefore provides some insights into the benefits of achieving favourable condition. It estimated a mean willingness to pay of £0.41 for non-users and £0.97 to £1.07 for users. Taking account of use values alone, the benefit cost ratio for the Pevensey Levels WES was 0.5; incorporating non-use values increased the benefit/cost ratio to 2.0.

The benefits for physical and mental health related to recreational use of SSSIs are potentially significant. People who live within 500m of accessible green space are 24 per cent more likely to meet recommended levels of physical activity. Reducing the sedentary population by just 1 per cent would reduce morbidity and mortality rates valued at £1.44 billion for the UK (Natural England, 2009). It should be noted, however, that green spaces do not need to be SSSIs to deliver these benefits.

Webber *et al*. (2006) demonstrated that people place significant value on the geodiversity protected by SSSIs (Box 6.2).

Box 6.2: Value of Cultural Services linked to Geodiversity in SSSIs

The social and economic value of geodiversity was explored by Aberystwyth University (Webber *et al.*, 2006) for English Nature, using a variety of methods, including a literature review and new empirical research. In particular, the choice experiments method was used to assess how much people would be willing to pay to protect and enhance two geological sites: Wren's Nest National Nature Reserve (NNR, also SSSI) and the Jurassic Coast World Heritage Site (WHS, which comprises 14 SSSIs). Economic impact analysis was also carried out on the Isle of Wight to determine the size of the local economic impacts that geodiversity brings to the Island.

The value of 'knowledge' of geodiversity was explored by comparing the value of access to different geological sites both with and without the provision of interpretative material.

At Wren's Nest NNR, access to the whole site with educational material was valued at £21.26 per household per year compared to £7.83 per household per year without the provision of educational material. Similarly, access to the geologically-rich Seven Sisters caverns within the NNR with extensive interpretation was valued at £13.95 per household per year compared to £12.22 per household per year without.

Similar findings were also found at the Jurassic Coast WHS where access with extensive interpretative material was valued at £62.35 per household per year compared to a value of £23.69 per household per year for access without educational material.

In all three cases, the provision of educational material on geodiversity (and hence 'knowledge') clearly enhances the value that people attain from visiting a geodiversity site.

The value that people placed on the opportunity to collect fossils was also explored at both case study sites. People expressed a positive willingness to pay to be able to collect fossils, provided that this was accompanied by sufficient protection of rare and important fossils.

Geodiversity was estimated to attract annual visitor expenditures of £11 million to the Isle of Wight economy, generating between £2.6 million and £4.9 million in local income and supporting between 324 and 441 full time equivalent local jobs.

6.4 Economic Value of Provisioning Services

The value of provisioning services is significant for some SSSIs but may be reduced by conservation management.

The impact of SSSI designation on provisioning services is often directly observable and is often the most straightforward ecosystem service to value as market prices are obtainable for most changes in production.

A study of ecosystem services at Otmoor, an 1100 hectare area of wet grassland in Oxfordshire containing a SSSI and RSPB reserve, estimated the value of three ecosystem services of which food production was the most significant, valued at £259 to £355 per hectare per annum. The other values estimated were water purification (£15-20 per hectare per annum) and recreation (£8 to £31 per hectare per annum), giving an estimated total of £282 to £390 per hectare per annum. Flood regulation services could not be quantified or valued. The study did not assess the effect of site designations on the value of these services. A slight increase in these values was predicted under a climate change scenario involving wetter winters (McInnes *et al.*, 2008).

The re-alignment scheme on the Alkborough Flats, part of which is SSSI, resulted in changes in land use. The project led to a net loss of barley straw production and an increase

in the production of other fibres and fuels mainly due to the introduction of sheep. Based on the market values for the barley straw and wool products the net increase in annual fibre and fuel production was calculated at £26,820. However, this was offset by a net decrease in annual food production of £28,075 (Environment Agency, 2009). The net effect of SSSIs on provisioning services is in many cases likely to be negative, as conservation often entails limited use of land for agricultural production.

6.5 Economic Value of Regulating Services

Few studies have valued the regulating services delivered by SSSIs but there is evidence that these values can be significant for particular sites.

The value of regulating services may potentially be assessed using a variety of techniques such as the shadow price of carbon, avoided expenditures on flood defence or water treatment, value of property protected from flooding or natural hazards, market prices for agriculture or forestry output indirectly affected by pollination or air quality, or people's willingness to pay to improve water quality or prevent ill health.

An example of improvements in regulating services due to habitat restoration is the Sustainable Catchment Management Programme (SCaMP) in the Peak District. This project restores degraded moorland in a 20,000ha catchment area, more than 40% of which is SSSI. Around 13,500ha of SSSI land has been restored into favourable or recovering condition, recreating habitats and enhancing biodiversity. As a consequence the moorland's capacity for sequestering carbon has recovered (the moorland previously had a net loss of carbon) and the area is sequestering an estimated 2000t CO_2 per year valued at £0.86m per year over 50 years (Natural England, 2009a). There have also been improvements in water quality in the catchment. The improved management, through a partnership between United Utilities, RSPB, farmers and other local stakeholders, is driven by a variety of objectives, one of which is the SSSI PSA target. Much of the area is also designated as a Natura 2000 site.

Box 6.3 summarises the economic benefits of a managed realignment scheme within the Humber Estuary SSSI, which enhances both regulating and cultural services. The annual value of regulating services was estimated at £401,000 from flood protection and £15,000 from climate regulation.

Box 6.3: Alkborough Flats - Benefits of Managed Realignment

Alkborough Flats comprises 440 ha of low-lying land on the south bank of the Humber estuary which is currently the UK's largest managed re-alignment site. In 2006 a 20m wide breach was cut into the flood defence bank and 170 ha of land was converted to inter-tidal mudflat, saltmarsh and reedbed. The remaining land serves as storage capacity during extreme storm surges. It is calculated that there is an annual flood protection benefit of £400,667.

The area has been lost as arable farmland though there is some income from grazing livestock. The area has become a haven for wildlife with 150 bird species recorded, including thousands of migratory birds such as lapwing and golden plover in winter. The value of wildlife and habitat on the site has been valued at £535,000 per year. The restored intertidal area also plays a role in climate regulation (approximately 539 tonnes per year of carbon are trapped in sediments worth an estimated £14,553 per year), air quality improvement, nutrient and pollutant sequestration, and recreation and tourism. The overall benefit: cost ratio was estimated at 3.2. There are now 23 such coastal re-alignment schemes in England, cost-effectively delivering a wide range of ecosystem services, including commercial fish stock nurseries at other sites.

In a report for Natural England, Eftec undertook a systematic review of qualitative changes in upland ecosystems due to improved woodland cover change, blanket bog restoration, grazing regime changes, burning regime changes, and re-wilding (Natural England, 2009a). Based on the Defra (2007) framework for valuing ecosystem services the study valued six different habitats that experienced improvements in management regimes. The value of reduced carbon losses from the restoration of an SSSI blanket bog at Bleaklow in the Peak

District was estimated at £0.4 million over 50 years. Other regulating services such as water purification, water regulation and wildfire prevention could not be valued but were considered potentially significant.

6.6 Overall Value of SSSI Benefits

Based on research in this study, it is estimated that the public is willing to pay £956 million annually to secure the benefits provided by current levels of SSSI funding.

The evidence from the literature review and the case studies presented in Sections 6.2- 6.5 demonstrates that, while there is evidence of the economic value of the services and benefits delivered by SSSIs, this is somewhat fragmented.

To overcome these gaps in the evidence base, a choice experiment study was undertaken to provide an overall assessment of the public's willingness to pay for SSSI conservation activities in England and Wales.

The choice experiment established the average willingness to pay of focus group participants for the ecosystem services delivered by different levels of SSSI funding. These were multiplied by the number of households in England and Wales to obtain estimates of the overall value of the benefits that society derives from different levels of funding for the policy.

It was estimated that each household is willing to pay an average of **£397 per annum** to secure the ecosystem services currently delivered by SSSIs in England and Wales (Table 6.2). The highest values were derived for *Charismatic species*, followed by *Climate regulation* and *Research and education*. Households were willing to pay an average of **£289 per annum** to achieve the additional services delivered by the "Increase funding" scenario.

Table 6.1 Household willingness to pay for overall ecosystem services associated with SSSIs

Ecosystem service	**Consumer surplus values for policy scenarios (£ / HH / yr)**	
	***Maintain funding* scenario**	***Increase funding* scenario**
Provisioning services:		
Nature's gifts	£6.50	£3.25
Regulating services:		
Climate regulation	£89.00	£89.00
Water regulation	£66.30	£66.30
Cultural services:		
Sense of experience	£29.92	£24.68
Charismatic species	£136.95	£49.80
Non-charismatic species	-	-
Research and education	£68.00	£56.10
Total	**£396.67**	**£289.13**

This can be multiplied by the total number of households in England and Wales to give a total willingness to pay of **£8,774 million per annum** across all of these services. This is an estimate of the **gross value of ecosystem services delivered by SSSI sites**.

However, many of these services would be delivered even if the sites that provided them were not designated as SSSI. It is also important to examine the **net value of the benefits delivered by SSSI policy**, by examining the net effect of SSSI funding and management on the value of ecosystem services delivered.

By taking the estimates of the willingness to pay for SSSI services from the choice experiment, and then applying ratios of the added value of SSSI designation, derived from the weighting matrix, the estimated value of the services that can be directly attributed to SSSI management was estimated. It was also noted that, in the absence of SSSI funding, the UK would have a continuing responsibility to conserve sites designated as Natura 2000. It was therefore assumed that, under the "remove funding scenario", Natura 2000 sites would continue to receive funding for conservation activities, and the estimates were adjusted accordingly[14]. 35% of the SSSI land area comprises Natura 2000 sites in favourable condition, and this area is assumed to remain in favourable condition if SSSI funding is removed. Full details of the methods and results are given in Annex 3.

The estimated overall net value of the ecosystem services directly attributed to SSSI conservation activities in England and Wales are:

- **£956 million per annum** for the ecosystem services provided by the "Maintain funding" scenario; and
- **£769 million per annum** for the additional services that would be provided under the "Increase funding" scenario.

In other words, **it is estimated that the public is willing to pay £956 million per year to secure the levels of services and benefits currently delivered by SSSI conservation activities, and a further £769 million to secure the benefits that would be delivered if SSSIs were all in favourable condition.**

Current levels of public expenditure on SSSIs in England and Wales are estimated at £111 million annually (Section 2.5). **The figures suggest that the benefits of SSSI funding significantly exceed the costs.**

In both the *Maintain funding* and *Increase funding* scenarios, the protection of charismatic species was the most highly valued service (£425m and £188m per annum respectively). Climate regulation (£135m and £182m), research and education (£117m and £124m), and water regulation services (£106m and £154m) were also highly valued. *Nature's gifts* attained the lowest values. Table 6.2 summarises these results.

Based on the areas of different habitats in England and Wales, it is estimated that the public is willing to pay £827m for the benefits currently provided by SSSIs in England and £128m for those provided by sites in Wales. The benefits of increasing funding to enable all sites to reach favourable condition are estimated at £666 million in England and £103 million in Wales.

[14] It is recognised that SSSIs play a key role in the protection, funding and management of Natura 2000 sites and that alternative means of meeting these responsibilities would have to be found if SSSI funding was removed.

Table 6.2 Headline results on the net value of the SSSI management, by ecosystem service

Ecosystem service type	Ecosystem Service	Maintain funding scenario (£m per annum)	Increase funding scenario, compared to maintain funding scenario (£m per annum)
Provisioning	*Nature's gifts*	3	2
Regulating	*Climate regulation*	135	182
	Water regulation	106	154
Cultural	*Sense of place*	81	67
	Charismatic species	425	188
	Non-charismatic species	88	52
	Research and Education	117	124
	Total	**956**	**769**
Of which:	*England*	*827*	*666*
	Wales	*128*	*103*

The habitats estimated to deliver the highest annual value of ecosystem services were heathland (£320 million), bogs (£195 million), fen, marsh and swamp (£101 million) and intertidal mudflats and saltmarsh (£76 million) under the *Maintain funding* scenario (Table 6.3).

These figures reflect the total areas of these habitats covered by SSSIs, as well as the relative levels of services they deliver (as estimated by conservation experts through the weighting matrix) and the values of these services (as estimated by the public's willingness to pay for different services expressed in the choice experiment).

Table 6.3 Headline results of the value of the net value of services delivered by SSSI management, by habitat

SSSI habitat	Maintain funding scenario (£m per annum)	Increase funding scenario (£m per annum)	SSSI habitat	Maintain funding scenario (£m per annum)	Increase funding scenario (£m per annum)
Acid Grassland	54	31	Standing waters	15	12
Lowland calcareous grassland	33	17	Bogs	195	198
Neutral Grassland	12	8	Fen, marsh and swamp	101	83
Purple moor-grass and rush pastures	7	12	Coastal and flood plain grazing marsh	23	24
Heathland	320	156	Inland rock	1	2
Broadleaved, mixed and yew woodland	77	42	Maritime cliffs	5	5
Coniferous woodland	19	19	Sand dunes and shingle	8	9
Rivers and streams	7	4	Intertidal mudflats and saltmarsh	76	147
Canals	0	0	All SSSI habitats	**956**	**768**

The value of services provided per hectare of habitat is given in Table 6.4. This shows that the highest service values per hectare are provided by sand dunes and shingle, heathland, intertidal habitats, bogs, woodlands and fen marsh and swamp, and the lowest by inland rock, coniferous woodland, maritime cliffs and purple moor grass and rush pastures. The differences in the value of services by habitat result from the findings of the Weighting Matrix, regarding the relative levels of service delivery by habitat and the added value of SSSI designation, as well as the willingness to pay for each service as estimated by the Choice Experiment.

Table 6.4 Per hectare values of ecosystem services delivered by SSSI conservation activities by SSSI habitats under SSSI funding scenarios (£ / Ha).

SSSI habitat	Maintain funding scenario (£ / Ha)	Increased funding scenario (£ / Ha)
Sand dunes and shingle	1,377	860
Heathland	1141	556
Intertidal mudflats and saltmarsh	1,035	709
Bogs	1007	1021
Broadleaved, mixed and yew woodland	1002	546
Lowland calcareous grassland	914	469
Rivers and streams	903	568
Fen, marsh and swamp	861	706
Acid Grassland	682	399
Canals	649	339
Neutral Grassland	642	436
Standing waters	622	487
Coastal and flood plain grazing marsh	450	463
Maritime cliffs	344	334
Purple moor-grass and rush pastures	312	522
Coniferous woodland	237	233
Inland rock	200	212

The research therefore provides an analysis of the ecosystem service values associated with a range of SSSI habitats and geological features. Importantly, all the data was collated using a standard research protocol, which means that the data is, at a minimum, internally consistent, thus allowing robust relative comparisons of values across habitats, services and policy scenarios.

When interpreting the findings, a number of caveats need to be considered both with regard to the scope of the study and the robustness of the value estimates. For example:

- The values are based on a limited subset of seven ecosystem services. This was necessary to simplify the valuation exercise for the participants, focusing on those services most likely to be representative and of significant value;
- The scenarios being valued are complex and uncertain and the public's understanding of them is limited. Efforts were made to communicate the implications of the scenarios in a clear and balanced way, and to encourage reflection among participants, although the nature of the exercise inevitably meant that it was a simplification of reality;
- The values are affected by uncertainties regarding the scores derived from the weighting matrix and the limitations of applying expert judgement given incomplete evidence;

- Like other economic valuation techniques, choice experiments are subject to a variety of methodological limitations and concerns, and can give rise to a variety of potential biases, particularly as a result of their hypothetical nature. While efforts were made by the researchers to minimise these, their potential effect on the findings need to be noted.

As a result, **the study results should be interpreted as best estimates of the public's willingness to pay for different levels of SSSI conservation** activities in England and Wales, rather than precise estimates of the value of different ecosystem services delivered by SSSIs.

6.7 SSSIs also support employment and have positive impacts on local economies

The above sections relate to the **economic value of the benefits** provided by SSSIs – i.e. the value of the services that they provide to society. There is also an extensive literature on the **economic impacts** of protected sites and of biodiversity more widely. These economic impacts include the role of sites and the species and habitats they support in supporting employment and incomes, and hence contributing to economic development and regeneration.

For example, a report by the RSPB (Rayment and Dickie, 2001) identifies the following economic development benefits from nature conservation:

- **Direct employment** in the natural environment sector in the UK is estimated to total 18,000 full time equivalent (FTE) jobs;
- **Expenditures** by conservation organisations provide revenues and employment for local suppliers and contractors;
- **Conservation schemes** (such as agri-environment and woodland management initiatives) fund work in the wider countryside, and have been shown to support incomes and employment. The socio-economic benefits of the Environmental Stewardship Scheme have recently been estimated by Defra (2010c);
- The **tourism** sector benefits from conservation activities, as wildlife, habitats and landscapes attract visitors to rural areas, who spend money on local goods and services.

Benefits relating to particular SSSIs, from case studies in the same report, include:

- North Norfolk Coast - A study of visitors to six sites on the Norfolk Coast in 1999 estimated that they spent £21 million per year in the local economy. Visitors attracted to these sites mainly by their birds and wildlife were estimated to have spent a total of £6 million in the area, supporting an estimated 135 FTE jobs. The Norfolk Wildlife Trust's Cley reserve and Titchwell RSPB reserve were estimated to bring extra visitor spending of £2.5 million and £1.8 million respectively into the Norfolk coastal economy in 1999. In addition, work by conservation organisations in managing sites in the Norfolk coast area supports 30 FTE jobs.
- Minsmere RSPB Reserve, Suffolk – the site receives almost 80,000 visitors per year, who were estimated to spend £1.1 million in the local economy in 2000, supporting an estimated 27.5 FTE tourism jobs. Direct employment on the reserve totals 20 FTE jobs.
- Symond's Yat Rock, Forest of Dean - each year, the RSPB and Forestry Commission operate a peregrine falcon nest protection and viewing scheme at Symond's Yat Rock in the Forest of Dean, which attracts 50,000 visitors. A visitor survey estimated that Symond's Yat Rock Peregrine Project attracted extra visitor spending of £551,000 to the Forest of Dean area in 1999, supporting an estimated 18 FTE jobs.

Evidence about visitor expenditures and their economic impacts was found for eight of the 20 case study SSSIs (Box 6.4). This demonstrates that sites can bring significant benefits to their local economies.

Box 6.4: Visitor Expenditures and Economic Impacts – Evidence from the Case Study Sites

Ashdown Forest attracts 750,000 visitors annually and is estimated to bring additional tourism revenues of £2.3 million annually to the local economy

Dark Peak - visitors contribute nearly £225 million directly to the local economy of the Peak District National Park, but it is difficult to distinguish what proportion of this relates to the Dark Peak SSSI.

Dyfi – Ynslas attracts 250,000 visitors annually and was estimated to generate revenues of £2.09 million within the local economy in 1998, supporting an estimated 386 full-time equivalent local jobs (Christie *et al*., 1998).

Holy Island Coast - An RSPB survey estimated that spending by visitors to South Stack in the local area amounted to £223,000 in 2009, and that this supports more than 6 FTE jobs in the area in addition to the six employed on the reserve.

Lower Usk – A survey by the Wye and Usk Foundation found that fisheries use of the two rivers yields revenues of £1.02m to the economy of the local area, but estimated that this could be increased eightfold if salmon numbers could be helped to return to sustainable levels as experienced in former years.

North York Moors – the National Park logs approximately 10 million visitor days per year, from all parts of the country and beyond, bringing in almost £300 million of tourism revenues to the area

South Pennine Moors - Tourism and recreation contribute £268m to the South Pennines Economy but a detailed visitor profile is difficult to ascertain due to the open access to the site.

Sutton Park – The Park attracts 2.5 million visitors annually and 180 are employed in a variety of local businesses situated within it, including a golf club, a charity, and various food and drink businesses.

It should be noted that many of these impacts might occur whether or not the sites were designated as SSSIs. However, SSSI conservation activities enhance the economic impacts of some sites, particularly by attracting visitors with a strong interest in wildlife or geodiversity.

The next section presents the overall conclusions from the study.

7 Conclusions

7.1 Benefits of SSSIs

SSSIs provide substantial benefits for biodiversity, geodiversity and people.

The report examines the benefits of SSSIs in terms of:

- **Conservation benefits** in protecting and enhancing species, habitats and geodiversity. These can be regarded as the **intrinsic benefits** of SSSIs and the delivery of SSSI policy against its core objectives;
- Delivery of **ecosystem services**, including cultural, regulating and provisioning services that provide **benefits to people**;
- The **economic value of these services**, examining existing evidence and assessing the public's willingness to pay for SSSI services under alternative SSSI funding scenarios.

The benefits of SSSIs were assessed qualitatively and, where evidence permits, in quantitative and monetary terms.

7.1.1 Conservation Benefits

SSSIs play an important role in the conservation of the most important species, habitats and geological sites in England and Wales:

- SSSIs protect a large proportion of species in England and Wales, including most rare species, and, though there are some gaps, are seen to be representative of our biodiversity as a whole. SSSIs have helped to protect some species in England and Wales which would otherwise be at risk of extinction nationally.
- SSSIs protect the majority of semi-natural habitats in England and Wales and have been effective in preventing further habitat loss. Coverage varies by habitat, and some agricultural and brownfield habitats are under-represented by the series. However, for other semi-natural habitats, a very small proportion of remaining area survives outside SSSIs, demonstrating the effectiveness of SSSIs in conserving them;
- SSSIs provide effective protection for the most important geological features in England and Wales;
- SSSIs provide conservation benefits by protecting sites and their species, habitats and geological features from development and adverse pressures, and by promoting sympathetic management to maintain and enhance their condition. However, achieving favourable condition is a long term process and many sites therefore currently do not meet their full potential;
- SSSIs are not in themselves seen to provide an effective ecological network, as many are small, fragmented and insufficiently connected, and many habitats lie outside them. SSSIs have a role to play at the core of an ecological network, but the need for nature conservation policy to look beyond them is recognised.

7.1.2 Ecosystem Services

SSSIs deliver a range of provisioning, regulating and cultural services:

- It is difficult to assess the overall contribution of SSSIs in delivering ecosystem services, because most of the information is site specific and quantitative evidence is limited.
- SSSIs deliver important **cultural services** to society and are widely used and appreciated by people. SSSIs support recreation and tourism, provide a resource for scientific research and education regarding biodiversity and geodiversity, and contribute

to cultural landscapes and sense of place. People benefit from the knowledge that SSSIs conserve our rarest and most threatened wildlife, habitats and geology for the benefit of society as a whole and for future generations. There are many positive examples, although evidence suggests that the overall number of users per hectare is not greater than for the countryside as a whole.

- SSSIs deliver **regulating services** such as water purification and regulation of climate, water and natural hazards by protecting ecosystems and enhancing their functioning, though little quantitative evidence of this is available. At some sites, unfavourable condition has led to a reduction in the delivery of regulating services such as the ability to store carbon and regulate water flows. Action to achieve favourable condition should help to improve the benefits of these sites over time.
- SSSIs contribute to a range of **provisioning services**, though some such as food production may be reduced by SSSI management practices. SSSIs contribute to the conservation of genetic resources by conserving crop wild relatives and grazing management by rare livestock breeds.
- An overall quantitative assessment of the contribution of SSSIs and their habitats to ecosystem service delivery was made using the "**Weighting Matrix**". This found that the levels of service vary widely by habitat but that SSSI designation enhances most ecosystem services delivered by most habitats. This is especially true for cultural services associated with species conservation and sense of place. SSSIs are also estimated to enhance regulating services for most habitats. However, food provision is estimated to decline for grassland habitats.

7.1.3 Economic Value of Benefits

Caution is needed in estimating the economic value of the benefits of SSSIs, given limitations in available data on ecosystem services and their value, the complexity of the scenarios being assessed and the methodological challenges inherent in the valuation methods used. This study estimated the value of the benefits of ecosystem services based on people's willingness to pay, and adjusted for the added ecosystem services provided under SSSI status, and different policy scenarios, which involved some reasoned assumptions. The choice experiment focused on certain major ecosystem services only, not the full range of services potentially delivered by SSSIs, while the weighting matrix employed conservative assumptions in assessing the added value of SSSI management. The results are therefore not absolute or comprehensive values, but estimates.

Estimates from this and other studies indicate that the economic value of the benefits delivered by SSSIs is substantial and significantly exceeds the costs of the policy:

- Existing evidence of the value of the benefits of SSSIs is available for a small but increasing number of sites.
- Most evidence is available for the value of **cultural services**, with studies demonstrating that the public is willing to pay to visit and conserve individual SSSIs. Some studies find that the majority of these values are derived from the existence of these sites and their biodiversity rather than the use of SSSIs.
- The value of **provisioning services** is relatively easily measured and is significant for some SSSIs but may be reduced by conservation management.
- Few studies have valued the **regulating services** delivered by SSSIs but there is evidence that these values can be significant for particular sites.
- Based on the results of the choice experiment valuation for this study, adjusted to assess the added benefits of SSSI conservation activities, it is estimated that **the public is willing to pay £956 million annually to secure the levels of services and benefits**

currently delivered by SSSI conservation activities, and a further £769 million to secure the benefits that would be delivered if SSSIs were all in favourable condition.

- These benefit estimates significantly exceed the annual public cost of the policy of £111 million.
- A variety of studies also show that management of SSSIs and spending by visitors has significant positive impacts on local economies.

SSSIs also result in some disbenefits, by:

- **Restricting opportunities for development and land use change**. It is unlikely that SSSIs reduce the overall level of development nationally – they are instead likely to displace development to alternative locations. However, this may restrict economic opportunities at the local level and may impose additional costs on society as a result of a need to build on alternative and potentially less attractive sites.
- **Restricting agricultural and forestry production** by limiting the land management practices that can be undertaken. There may therefore be a trade-off between provisioning services and other ecosystem services at some sites. Where evidence is available, it suggests that negative effects may be outweighed by increases in other services.

7.2 Added Value of SSSI Designation

From the perspective of society as a whole, SSSI status adds value to sites by:

- **Protecting them from development and land use change**. Without SSSI status many of our species, habitats and geological features would have been lost over time, including to built development and other land use change;
- **Focusing effort and resources on SSSI conservation activities**. The focus in recent years in restoring sites to favourable condition has the potential to greatly enhance the benefits that these sites deliver, although achieving favourable condition is a long term process;
- **Providing a focus for education, scientific research and public access**. While the overall use of SSSIs does not exceed that of the countryside as a whole, research carried out here has found that a high proportion of people have visited one or more SSSIs in their local area. Sites provide a focus for scientific study and educational visits, and are seen by the public as offering a special experience compared to the wider countryside.

As a result of this, evidence demonstrates that **SSSI designation enhances the benefits that the sites deliver**. In particular, SSSIs:

- Protect important concentrations of species, habitats and geodiversity, and deliver strong **conservation benefits** relative to undesignated sites. Available evidence demonstrates that SSSI habitats are in better condition and support more biodiversity than the wider countryside.
- **Deliver higher levels of most ecosystem services as a result of designation**, and in response to conservation activity enhancing ecosystem functioning. It should be noted however that changes in ecosystem services as a result of SSSI restoration activity may take many decades to be realised. Some provisioning services may be reduced as a result of designation.
- **Enhance the value of the services that sites deliver to society**. There are particular examples of SSSIs and activities to conserve them enhancing the delivery of certain

ecosystem services, as well as more general evidence of the public's willingness to pay for the range of services that SSSI conservation delivers.

Estimates from the choice experiment suggest that this added value greatly exceeds the costs of SSSI policy.

7.3 Added Value of Higher Level Designations

Higher level designations provide additional benefits compared to SSSIs.

26% of SSSIs in England and 48% in Wales are also protected by higher level designations (Natura 2000, Ramsar sites and NNRs). These designations apply particularly to larger sites and cover 79% of SSSI land area in England and 72% in Wales.

SSSIs which do not have higher levels of designation therefore play a distinctive role in protecting a relatively larger number of relatively small sites.

Higher level designations have added value relative to SSSI status, through:

- **Higher levels of protection from development** and land use change afforded to Natura 2000 sites in particular;
- **Some additional access to resources**, especially EU funding for Natura 2000 sites;
- **A higher profile than SSSIs**. Evidence suggests that National Nature Reserves in particular attract greater public recognition as well as providing an added focus for education and scientific research.

This enhances the conservation benefits and ecosystem services that these sites deliver. In addition, because sites with higher level designations tend to be much larger than average SSSIs, they can be expected to benefit from greater ecological coherence and connectivity as part of larger protected areas. This in turn should enhance their capacity to deliver ecosystem services.

Though higher level designations deliver added benefits, SSSI status does provide a high level of protection, while differences in management are insignificant for the majority of sites, particularly following the major recent focus in enhancing SSSI condition.

7.4 Influence of SSSI Funding on Benefits

The level of funding for SSSIs is an important determinant of the benefits they deliver.

The likely effects of different funding scenarios for SSSIs on the benefits and values of SSSIs are illustrated in Table 7.1.

It is found that the benefits of SSSIs, in terms of their conservation benefits, ecosystem service delivery and the economic values, are sensitive to the level of funding of SSSI conservation activity. With regard to the three SSSI funding scenarios:

- The *Maintain funding* scenario delivers substantial conservation benefits, as summarised above. It delivers important ecosystem services to society, with cultural services being especially significant. The value of these benefits is estimated at £956 million annually, almost 9 times as high as the £111 million annual public cost of the policy;
- The *Increase funding* scenario, achieving favourable condition for all SSSIs, would enhance the conservation benefits of SSSIs and the ecosystem services they deliver. The delivery of regulating services would be expected to increase as sites achieve favourable condition, though this would be a long term process. Cultural services would increase, both as a result of the benefits people derive from the existence of biodiversity and the enhanced experience that sites offer to people. The value of the additional benefits is estimated at £769 million annually;

- The *Remove funding* scenario would lead to a decline in the condition of SSSIs with a substantial reduction in the conservation benefits and ecosystem services they provide. There would be a decline in regulating and cultural services, though removing the focus on conservation management might allow food and timber production to increase at some sites. The value of the benefits currently delivered by SSSIs would decline gradually over time.

Table 7.1 Implications of Different Policy Scenarios for SSSIs

	Effects on:			
Scenario	**Conservation Benefits of SSSIs**	**Ecosystem services**	**Economic value of services**	**Costs**
Maintain funding - at sufficient level to maintain current SSSI condition	Although 96% of SSSI area in England was in favourable or recovering condition by the end of 2010, less than 40% was in favourable condition. For these sites conservation benefits are not maximised and populations of some species remain below optimum levels.	Sites deliver a wide range of ecosystem services, especially important cultural services. Because many sites remain in unfavourable condition service delivery is not maximised, particularly for some regulating services (e.g. climate regulation, water regulation and purification by bogs).	The services provided by SSSIs are highly valued by people. Based on willingness to pay estimates, this study values the benefits of current policy at £956 million annually	At or below current level (£110 million p.a.)
Increase funding - to secure favourable condition for all sites	All sites reach favourable condition, maximising conservation benefits in terms of habitats, species and geodiversity	Achieving favourable condition would enhance the delivery of most services, especially regulating services. Some provisioning services might be reduced.	The additional services delivered have economic value. Based on willingness to pay estimates, this study estimates the additional benefits at £769 million annually	Significant increase in costs, particularly to deal with impacts from other sites – e.g. diffuse water pollution. Problems in achieving favourable condition at difficult sites could increase the costs of the policy disproportionately.
Remove funding	Increasing proportion of sites move to unfavourable condition, with negative effects on species, habitats and geological features.	Decline in wide range of services, especially regulating but also cultural and some provisioning services (e.g. fresh water and genetic resources)	Gradual decline over time in estimated £956 million annual benefit of SSSI conservation activity	Cost saving of up to £110 million annually

7.5 Needs for Future Research

The study revealed various data gaps and future research needs.

The study attempted to complete a comprehensive assessment of the conservation benefits, ecosystem services and economic values delivered by SSSIs in England and Wales. It found that:

- The conservation benefits of SSSIs are relatively well understood, especially following recent work for the *Making Space for Nature* review and SSSI condition assessments;
- Evidence of the ecosystem services delivered by SSSIs is increasing, but there are many gaps and uncertainties;
- There are large gaps in economic valuation evidence, which is lacking for most sites and ecosystem services. The choice experiment valuation for this study has added to the evidence base by providing an overall assessment of public willingness to pay for SSSIs.

Key gaps identified relate to:

- Scientific evidence enabling quantification of the levels of ecosystem services delivered by SSSIs;
- Quantified evidence of the effects of different SSSI management strategies on the levels of service delivery;
- The relationship between the geodiversity protected by SSSIs and the ecosystem services delivered;
- The role of SSSIs in communities and society. The focus groups provided some useful insights about public attitudes and perceptions of SSSIs, which would benefit from further exploration;
- Evidence of the economic value of SSSIs. This is perhaps more a result of the difficulties of quantifying service delivery than a lack of potentially transferable values from other studies.

The case studies conducted for this assignment found that a lack of site-specific evidence - particularly regarding the level of ecosystem services delivered by sites and appropriate metrics to measure them - is a barrier to quantifying and valuing service delivery. More in depth work would be needed at individual sites to strengthen this evidence base.

These gaps could be addressed through further scientific studies of the ecosystem services delivered by particular SSSIs and the effects of management on service delivery. This would provide a stronger evidence base on which to develop economic and other valuation work in future and in turn inform site management which optimised public benefits from the SSSI series.

Glossary

Avoided costs – Method used to assess the value of regulating services, by estimating their effects in reducing other costs which would be incurred if the service did not exist. Examples include avoided costs of water treatment (due to water purification services) or avoided expenditures on flood defences (due to water regulation services).

Benefit: cost ratio – The ratio of the estimated benefits to the estimated costs of an activity or policy change.

Benefits transfer – A method used to estimate the benefits at one site by transferring estimates derived at another. This reduces the need for new benefit assessment and/or valuation work.

Choice Experiment – Method used to value environmental goods and services. It asks people to express a preference for alternative options within a choice set, each with a set of environmental attributes and a level of payment. Respondents therefore implicitly make trade-offs between the levels of the attributes in the different alternatives presented, enabling their willingness to pay for these to be assessed.

Condition - The condition of SSSIs is assessed by Natural England and the Countryside Council for Wales, using categories agreed through the Joint Nature Conservation Committee. There are six reportable condition categories: favourable; unfavourable recovering; unfavourable no change; unfavourable declining; part destroyed and destroyed.

Consumer Surplus – A measure of the welfare that consumers derive from a particular good, and is the difference between the maximum price that they are willing to pay and the price that they do pay. For environmental goods which do not have a price, it is measured by eliciting their willingness to pay for the good.

Contingent Valuation – A survey based method used to estimate people's willingness to pay for an environmental good.

Counterfactual – The "policy-off" scenario against which the benefits of a policy are compared.

Cultural services - The non-material benefits we obtain from ecosystems, for example through spiritual or religious enrichment, cultural heritage, recreation and tourism or aesthetic experience.

Destroyed – A category of SSSI condition where lasting damage has occurred to all of the special conservation interest of the SSSI unit such that it has been irretrievably lost. This land will never recover.

Economic impact – The effect of a site, activity or policy change on economic activity, usually measured through changes in income, output and/or employment.

Existence Values - The value that people place on the existence of an environmental asset, whether or not they intend for themselves or others to use it.

Favourable condition – Where an SSSI is being adequately conserved and is meeting its conservation objectives. However, there is scope for the enhancement of these sites.

Geological Conservation Review (GCR) – A public record of the features of interest and importance at localities already notified or being considered for notification as SSSIs. The selected GCR sites form the basis of statutory geological and geomorphological site conservation in Britain.

Higher Level Designation – Certain higher designations are given to a subset of SSSIs of particular national and international importance – these are National Nature Reserves, Natura 2000 sites and Ramsar sites.

Intrinsic Value – It is recognised that some assets (such as biodiversity) have value in their own right that cannot be estimated by humans. This intrinsic value needs to be considered separately from assessments of ecosystem services, which focus on benefits to people.

LIFE+ - The EU financial instrument for the environment.

Making Space for Nature Review – A review of England's wildlife sites and ecological network, chaired by Professor Sir John Lawton. Its report *Making Space for Nature: A review of England's Wildlife Sites and Ecological Network* was published in 2010.

Millennium Ecosystem Assessment (MA) – An international expert assessment, initiated by the United Nations, of the consequences of ecosystem change for human well-being and the scientific basis for action needed to enhance the conservation and sustainable use of those systems and their contribution to human well-being.

National Nature Reserve (NNR) - A selection of the very best Sites of Special Scientific Interest, representing the most important places for wildlife in Britain, set up to conserve - and to allow people to study - their fauna, flora, or geological features of special interest.

National Ecosystem Assessment - The first analysis of the UK's natural environment in terms of the benefits it provides to society and continuing economic prosperity.

Natura 2000 – An EU wide network of special nature sites, comprising Special Areas of Conservation designated under the Habitats Directive and Special Protection Areas designated under the Birds Directive.

Non Use Values – The values that people derive from an environmental good whether or not they intend to use it. These include the benefits of protecting biodiversity for future generations (bequest values) or simply knowing that it exists (existence values).

Part destroyed – Where lasting damage has occurred to part of the special conservation interest of a SSSI unit such that it has been irretrievably lost and will never recover. Conservation work may be needed on the residual interest of the land.

Provisioning services - The products obtained from ecosystems, including food, fibre, genetic resources and fresh water.

PSA Target - The Government's former Public Service Agreement (PSA) target was to have 95% of the SSSI area in favourable or recovering condition by 2010.

Ramsar Site – Sites designated as Wetlands of International Importance under the Ramsar Convention, an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. The treaty was adopted in the Iranian city of Ramsar in 1971 and the Convention's member countries cover all geographic regions of the planet.

Regulating services - the benefits obtained from the regulation of ecosystem processes, including, for example, the regulation of climate, water, natural hazards and some human diseases.

Stated preference methods – Methods that involve directly asking members of the public about their willingness to pay to secure an environmental change and the services it delivers. They include the contingent valuation method (CVM) and the choice experiment method (CEM, used in this study).

Special Area of Conservation (SAC) – Site designated under the EU Habitats Directive, which, together with SPAs, make up the Natura 2000 network.

Special Protection Area (SPA) - Site designated under the EU Birds Directive, which, together with SACs, make up the Natura 2000 network.

Supporting services - Ecosystem functions that are necessary for the production of all other ecosystem services such as soil formation and the cycling of nutrients and water.

Travel cost method - Method used to value recreational visits to sites, by taking account of the travel time and expense incurred by visitors.

Unfavourable declining condition – Where the special interest of the SSSI unit is not being conserved and will not reach favourable condition unless there are changes to site management or external pressures. The site condition is becoming progressively worse.

Unfavourable no change condition – Where the special interest of the SSSI unit is not being conserved and will not reach favourable condition unless there are changes to the site management or external pressures. The longer the SSSI unit remains in this poor condition, the more difficult it will be, in general, to achieve recovery.

Unfavourable recovering condition - Often known as 'recovering' – where SSSI units are not yet fully conserved but all the necessary management measures are in place. Provided that the recovery work is sustained, the SSSI will reach favourable condition in time.

Use Values – The values that people derive from the use of a particular site or environmental good.

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