Sites of Special Scientific Interest (SSSIs) in England:

their historical development and prospects in a changing environment

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Sites of Special Scientific Interest (SSSIs) in England: their historical development and prospects in a changing environment

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Further information

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Executive summary

This think-piece has been commissioned by Natural England to consider the effectiveness of the current system of SSSIs, and to propose additional actions for the conservation for species, habitats, and ecosystems in light of the increasing impacts from climate change.

We have addressed the issue from two perspectives.

The first, addressed in Part A, is a historical review of the genesis, evolution, and performance of the current SSSI system in England. This also assesses the performance of the network and considers those aspects of the system where there is scope for improvement.

The second perspective in Part B looks to the future, in the context of current and developing challenges posed to biodiversity and geological interests by climate change. Responding to such future dynamism will require a range of adaptation responses.

Part A History and evaluation of SSSIs:

Site protection

Site protection – that is the ability to manage human activities on particular areas, including the direction of management to maintain desirable habitat states – is a fundamental tool in the conservation 'tool-box'. In England, protected areas have a nearly thousand-year pedigree.

The objective the 1949 National Parks and Access to the Countryside Act, which legislatively created the SSSI mechanism, was that the designation should address both geological and biological conservation. For example, the original purpose of the SSSI mechanism was:

"The biological SSSI series is intended to form a national network of areas representing in total those parts of Great Britain in which the features of nature, and especially those of greatest value to wildlife conservation are most highly concentrated or of highest quality".

The SSSI system became further embedded as a key element of statutory nature conservation in England, Scotland, and Wales in 1981. This followed the major environmental changes to the countryside in the 1960s and 1970s highlighting the need for clearer and more extensive conservation action than had occurred in previous decades including through an enhanced ability to conserve areas.

In particular, the SSSI system was intended to protect a "representative sample" of species and habitats across the country (see below). The system was never intended to be a comprehensive or holistic nature conservation mechanism, with other additional mechanisms required to ensure that species and habitats survived and thrived across the country.

Geological conservation

The history of geological conservation in Britain, including the role of geological SSSIs, has been documented elsewhere. Of particular note in the current context has been the hugely important role of the *Geological Conservation Review* which, as did the *Nature Conservation Review* for biodiversity, established an underpinning conceptual framework for geological SSSIs, placing each within a national series. Indeed, many of the founding concepts relating to the SSSI designation were first explored in relation to the conservation of geological interests across the country.

The wider countryside

Intensification of farming progressed rapidly in post-war decades, but especially with the advent of chemical-intensive (pesticides and artificial fertilisers) farming in the lowlands, and subsidised over-stocking of sheep and incentive-led afforestation in the uplands.

Public interest

Alongside the creation and implementation of the SSSI network has been a growing increase in public interest and concern in the “state of nature”, and consequent desire to see damage to the environment reduced. Government has responded to this concern in a variety of ways and for SSSIs this has resulted in the development of a series of targets for action related to the management of SSSIs, and latterly moving towards targets related to the condition of the species, habitats, and geological features present.

Evaluation of SSSIs

In summary, without the SSSI system, then the biodiversity and geomorphological resource of England would have been very significantly more impoverished than it now is. Our judgement is that when viewed against the original purpose of SSSIs, namely, to notify a representative sample of areas holding important species and habitats across England, then the system has worked reasonably well. This success is, however, patchy and the portfolio of sites seems more substantive for some species and for some habitats than others. Key gaps are clearly in lowland habitats.

What was unpredictable in the 1940s and 1950s however, was the sheer scale of environmental change to the wider, unprotected countryside – for some habitats amounting to almost total extirpation. In hindsight, and given the extent of these losses, an approach that sought to protect a small sample of ‘best’ sites may not have been optimal.

Areas of current concern relate also to the intensity of implementation of monitoring and to the control of damaging activities on sites (including from external factors). A clear priority stressed in consultation meetings with NE staff and external stakeholders has been the need for effective, and responsive monitoring in future with clear feedback to the management of each site, thus supporting progressive improvements in site condition.

The key question now is how to adapt the current system to deal with the new challenge of rapid climate change and to consider what role SSSIs could play in a wider adaption strategy for terrestrial and marine environments.

Part B Protected areas and climate change

The SSSI series has been critical in maintaining England's biodiversity and continues to perform such a role. The underpinning concept of the SSSI designation to hold a representative sample of features, was undoubtedly sound when it was created. However, a range of issues have arisen related to implementation over the years, and these, linked to changing expectations regarding the purpose of SSSIs, mean that the current consideration of future options is timely and important.

Nature nuclei

One option for future consideration is as follows:

Accepting that biodiversity is in an emergency situation, and that urgent and widespread action is required, should all existing sites be considered as "Nature nuclei"? I.e. areas that have played, and are still playing a key part in maintaining nature with the potential to form the basis for future conservation action. This includes allowing species to spread to other areas.

This approach would mean that all areas would be valued for their overall biodiversity and for their potential role, as well as for specific features held at any one point in time. They therefore have the potential to become a core part of any nature recovery framework or strategy. Whilst the legally protected "features" on protected areas may change, the multiple wider values of the protected area will remain.

Creating a network of protected areas

We suggest that a vision, echoing the key aspects of the review by Lawton *et al.* in 2010, to guide future SSSI management as part of a wider network of protected areas, to help limit the impact of climate change could be:

The creation of a large and inter-connected network of protected areas that is overseen by an inclusive stakeholder forum, and that is actively monitored and adaptively managed to ensure its effectiveness at conserving biodiversity and geomorphology in the face of dynamic change.

Whilst there are important issues to resolve in the creation of an ecologically linked network of protected areas, we do see its creation as a major step in developing an effective adaption response to climate change. Ideally, sites would be large and with clear ecological linkages to other areas. They would also be surrounded by areas of sympathetically managed land or sea, and with a degree of flexibility and responsiveness to change built into the whole network. This flexibility may manifest itself in the management techniques being deployed, or in the shape and size of the site boundaries. The boundaries are likely to need definition on ecological principles, for instance relating to

hydrological catchments for wetlands. Incorporating such flexibility would be a significant change from current practice, hence the need for much further “real world” exploration of the issues involved.

Management options

Clearly, some difficult management decisions will be required in future, and it is suggested that further work is considered to look in detail at the practicalities and possible trade-offs that may be involved in developing multiple outputs from protected areas.

Having an effective monitoring regime in place is of fundamental importance to being able to manage an adapted, resilient, and responsive network of sites.

The current approach, focussing on existing “features” on sites, along with relatively unchanging site boundaries, means that climate change induced shifts in the distribution of species and habitats will be difficult to accommodate. The development of a network approach, creating new sites to compensate for losses elsewhere, and enlarging the size of existing sites, offers one approach to build flexibility into the system.

In terms of individual protected areas then there are four overarching management options:

Option 1 – **“Do nothing”.** Ecological change would be allowed to happen “naturally” irrespective of its cause, so in this case, climate induced change would be allowed to proceed without interference.

Option 2 – **“Maintain the status quo”.** Sites and other areas would be managed to maintain existing species, habitats, and the wider ecosystems present. Arguably this is close to current conservation practice, where considerable effort is deployed to maintain the status quo, based on the assumption that this state is desirable.

Option 3 – **“Managed change**”. Protected areas would be managed to create a new and more “desirable” mix of species, habitats, and ecosystems. Clearly some conservation practice already takes this approach, for example scrub clearance from heathland, with the underpinning philosophy that the new state for the protected areas is more desirable than at present.

Option 4 **- “Ecological anticipation”.** The scale and nature of climate change impacts on many species and habitats in uncertain, and whilst knowledge about the nature of change remains imperfect, and there will always be some risk in managing protected areas for specific outcomes, decisions will nonetheless need to be made soon to consider the creation of new protected areas (or at least buffer areas of sympathetically managed land and sea) in anticipation of colonisation by desirable species and habitats. Creation of these areas could be used to mitigate losses elsewhere in the network of protected areas. Such ‘ecological anticipation’ is already recognised in some international legislation and in some domestic conservation practice.

Stakeholders

Involving local and national stakeholders in the monitoring and management of SSSIs and other protected areas is a key aspect of any new system that is developed. This involvement is likely to have the added benefit of enhanced advocacy for protected areas and greater appreciation of the value of such areas from those taking part in the work.

Wider countryside policy

Creating and implementing wider nature conservation policy at scale, with regional biodiversity targets, focussed on protected areas and on the remaining areas on semi-natural habitat as well as on the areas surrounding them, is seen as a key step in helping adaptation to climate change. Several existing schemes include elements of this approach, and if implemented fully, have real potential to assist in enhancing the adaptation and resilience of the countryside.

Key actions

Summarising the way forward then we suggest:

1. That a plan is developed to plot the way ahead in terms of adaptation to climate change for SSSIs. We note that other organisations have recently published information on the relative susceptibility of their resources to climate change. For example, the National Trust has developed a map[1] that illustrates the threat climate change poses to some of its most iconic and culturally significant sites and offers some solutions on how to tackle it. This approach could be replicated for SSSIs and other protected areas across England.
2. That a 50-year time horizon is used for planning purposes as this timescale will be required to allow for some key habitat recovery and re-creation. We also note the importance of the anticipated international “30 by 30” target as a key milestone within this overall time horizon highlighting the need for greater ambition in the development of national protected areas, not least through increasing the size of existing sites as appropriate.
3. That known threats to the condition of protected areas should be tackled with vigour now, to help ensure that existing sites are in as good condition as possible and that this should help their resilience to climate change. This is a key step in protecting the existing resource that will in turn act as “Nature nuclei” for the creation of a wider network.

[1] https://www.nationaltrust.org.uk/press-release/national-trust-maps-out-climate-threat-to-coast-countryside-and-historic-places#:~:text=The%20number%20of%20National%20Trust,of%20a%20total%2067%2C426%20sites.

4. That work starts now on developing a wider network of large sites that will, by creating ‘stepping stones’, aid connectivity and that will, progressively assist species and habitats to adapt as their ecological niche or bioclimatic envelope alters as the climate changes.
5. That a pilot scheme be developed to consider the practicalities in developing an expanded network of sites in size and number. For example, test boundary flexibility and “ecological anticipation” on individual sites and consider the legal and ecological issues involved in creating such a network.
6. Investigate further the possibilities of creating a win-win situation where biodiversity is effectively protected and carbon is sequestered on protected areas, by putting in place site management that enhances the conservation of biodiversity.
7. In parallel with the current monitoring of protected areas, consider the issues involved in moving to a “risk-based approach” for monitoring at the network level, with a clear explanation of what this will mean in practice.
8. For wider countryside support policies such as agri-environment measures, consider options for their development to provide maximum support for SSSIs and surrounding areas through the development of buffers of surrounding, sympathetically managed land and sea, as appropriate. This activity should be linked to regional biodiversity targets to help develop planning and delivery at that level. Note that we see real potential here as the existing policy intentions are impressive and integrated delivery on the ground could become a world leading approach.
9. Enhance current monitoring effort and feedback to stakeholders. Develop a renewed relationship with major stakeholders, focussed on the enhancement of the SSSI network. If the network is to be developed with flexibility in the number, location, and extent of sites, alongside flexibility on individual sites in relation to boundaries and to the features each contains, then establishing a consensus with at least the major stakeholders on the process of such an approach is an important prerequisite.
10. Finally, work on SSSIs in England is relevant to protected areas across the UK and indeed internationally. We see it as being important to maintain links to work in other countries and to disseminate the example of what is being done in England to others.

Contents

Foreword

Natural England regularly commissions a range of reports from external contractors to provide evidence and advice to assist in delivering its duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Introduction

This think-piece has been commissioned by Natural England (NE) to consider, firstly the effectiveness of the current system of Sites of Special Scientific Interest (SSSIs) and its operation and then to propose actions for the conservation for species, habitats and ecosystems, based on protected areas that will take into account the ongoing and developing impacts from climate change.

We have addressed the issue from two perspectives.

The first, addressed in Part A, is a historical review of the genesis, evolution, and performance of the current SSSI system in England. This also assesses the performance of the network and considers those aspects of the system where there is scope for improvement.

The second perspective in Part B looks to the future, in the context of current and developing challenges posed to biodiversity and geological interests by climate change. Responding to such future dynamism will require a range of adaptation responses.

We bring together our overall conclusions in the final section (Part C).

In developing our work for the think-piece we have benefitted from discussions with many staff in NE and with external stakeholders (listed in Acknowledgements below) who are involved in management and monitoring of protected areas across England. We thank them all for their valuable insights and suggestions, however, it is important to state at the outset that the ideas and suggestions below represent our personal views and that the document is intended to stimulate further thinking, discussion and action at this key time for nature conservation in England, across the UK and wider.

The think-piece has a focus on protected areas, especially SSSIs and looks at management options for individual sites and for wider areas of conservation practice. It is forward thinking and challenges some aspects of the current situation and is purposely not constrained by existing mechanisms to designate, manage, and monitor sites.

It recognises the scale of the emergency facing biodiversity and adopts a pragmatic approach, stressing the need for action. To use a medical analogy, the patient needs urgent care, hence doing nothing is not an option.

The question is what action to take?

Part A. Review of legislation and its implementation

1. History of the SSSI system in England

1.1 Contexts: the concept of site protection

Site protection – that is the ability to manage human activities on particular areas, including the direction of management to maintain desirable habitat states – is a fundamental tool in the conservation 'tool-box'. In England, protected areas have a nearly thousand-year pedigree, beginning with the declaration of the New Forest as a hunting preserve by William I in c.1079.

The Convention on Biological Diversity (United Nations 1992) states that "the fundamental requirement for the conservation of biological diversity is the *in-situ* conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings." To that end, Article 8 of the Convention requires that its Parties, of which UK is one, shall (*in alia*):

a) "Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity;
b) Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity; …"

There are multiple studies, worldwide, that have documented the inherent value and importance of protected areas[2].

1.2 Development of protected area networks in England up to 1981

In England, the objective of site protection for nature conservation, at national scale and with a systemic basis, was first set out by government in the 1947 *Report of the Wild Life Conservation Special Committee*[3]. This report built formally on the need for the state to address nature conservation, reflecting thinking that had been going on through the 1930s

[2] One among many is the European Environment Agency's comprehensive review of protected areas in Europe (Romão *et al.* 2012).

[3] Ministry of Town and Country Planning 1947

and through the second world war[4] by the professional ecological community, latterly by the Nature Reserves Investigations Committee (see Appendix 1).

That Committee outlined the justifications for nature conservation and made recommendations for a multi-tier approach to site protection, namely a hierarchical system of:

i. National Nature Reserves (NNRs);
ii. Conservation Areas;
iii. National Parks;
iv. Geological Monuments;
v. Local Nature Reserves; and
vi. Local Educational Reserves.

The functions of NNRs were envisaged[5] as: a) Conservation and maintenance; b) Survey and research; c) Experiment; d) Education; and e) Amenities.

Conservation Areas were envisaged as complementary to NNRs:

“Whilst the object of making a National Nature Reserve is primarily scientific, though the reserve may have other uses, the case for designated Conservation Areas rests at least equally on grounds of “amenity” in the widest sense, and it is difficult to divorce this aspect from the scientific ends which are sought”[6].

Given the latter and current centrality of Sites of Special Scientific Interest (SSSI) within British statutory nature conservation, it is curious not to find the concept of the SSSI within the scheme for protected areas at that time, but rather occurring almost as an afterthought. The Report noted[7] that:

“Through the country there are, in addition to the special geological sites just referred to, many hundreds of small sites of conservable biological or other scientific importance, the great majority of which could easily be safeguarded from destruction if their value and interest were but known to the owners and the appropriate authorities. … The existence of a list of such special sites as lie within proposed National Parks and Conservation Areas will be necessary for the proper planning of these areas. In the country at large such lists

[4] Tansley 1945; Sheail 1987

[5] At paragraphs 50-55

[6] At paragraphs 56-76

[7] At paragraphs 71 and 214

should be available to local authorities and private owners for use in relation to planning schemes and proposals for local nature reserves…"

Accordingly, the White Paper recommended[8] that a Schedule of SSSIs be drawn up (by the proposed Biological Service – established as the Nature Conservancy) and disseminated to the then planning ministry and local authorities.

Most of the Recommendations of the 1947 Committee were subsequently enacted by the 1949 National Parks and Access to the Countryside Act.

Following the 1949 Act and the establishment of the Nature Conservancy (NC) in 1949, its initial priority was to establish the network of NNRs, giving protection to these key sites through the only available mechanism of bringing them into state ownership.

Proposed Conservation Areas were more extensive (for example, including the totality of the Cotswolds, Breckland, Chilterns and other landscapes of similar scale). Most of these areas ultimately became Areas of Outstanding Beauty – a designation conceptually close to the original proposed concept of the Conservation Area but providing little or no direct constraints on changes of land-use.

The development of the SSSI network was to develop more slowly, but it especially gained speed through the 1960s[9] once the NNR series was seen as largely in place.

There are multiple narratives of the history of SSSIs from 1949 until the late 1990s[10]. These authors outline both the successes of this designation, but also address the significant limitations that became apparent in the face of huge socio-economic pressures on land, and the multiple attempts to address these. In particular, the major failing, during the period from the 1949 Act until substantively revised legal protection was established by the 1981 Wildlife & Countryside Act, was that the 1949 Act legal procedures addressed perceived threats from planned development, with the county Schedules (*i.e.* lists) of SSSIs specifically addressed to planning authorities. However, the major damage to

[8] At paragraphs 71 and 215

[9] As documented by Moore 1987 and NERC/NC annual reports. SSSI listing had such a low profile compared with NNR acquisition no published accounts notes when the first notification(s) were made.

[10] Important accounts of the history of the implementation of the Great Britain network of SSSIs include: Stamp 1969; Sheail 1976; Lowe *et al*. 1986; Moore 1987; Mackay 1995; Sheail 1998; Marren 2002; Housden 2015; and Thompson *et al*. 2015. Additionally, the annual reports of the Natural Environment Research Council (1967/8 to 1973/4); the 17 annual reports of the Nature Conservancy Council (1973-75 to 1990-91); and the annual reports of English Nature (1991/2 to 2005/6) provide considerable contemporary information.

SSSIs over that time was from unconstrained intensification of agriculture and forestry activities out with the formal planning system[11].

Further, there were no requirements on planning authorities or landowners to have legal regard to SSSIs, far less be legally constrained in their potential actions. It was just assumed that these sites, in some unspecified way, "…could easily be safeguarded from destruction if their value and interest were but known to the owners and the appropriate authorities…[12]" Experience showed that where funding was to be gained, notably from very substantial agricultural subsidies[13], then goodwill was an inadequate constraint on land-use change.

Through the late 1970s, the scale of loss and damage to the SSSI network was becoming increasingly apparent, with the Nature Conservancy Council (NCC) making available in 1980 the results of a 13% sample survey of biological SSSIs which showed that 15% of the sample of 399 sites visited had been lost or damaged in the previous 12 months[14] (Nature Conservancy Council 1981; Moore 1987).

In 1979, the incoming government inherited an embryonic Wildlife Bill. The need for significant new legislation was also being driven by the adoption by the UK of the EEC Directive of the Conservation of Wild Birds in 1979[15]. This gave Member States two years to transpose underpinning regulations into domestic legislation.

1.3 What were/are the objectives of the SSSI network?

It is surprisingly difficult to find an explicit historical statement of the objectives of the SSSI network. The 1947 *Report of the Wild Life Conservation Special Committee* presents SSSIs almost as an afterthought (above) essentially noting that they are all the other sites of interest over and above the core networks of NNRs and Conservation Areas. The objective of their scheduling with planning authorities was simply to protect them from loss.

Legislation never presents objectives, rather just elaborates on new legal processes, so in none of the relevant legislation (Appendix 1) is there a clear objective statement.

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[11] *e.g.* for forestry, see Kirby 2015

[12] Paragraph 214

[13] Body 1984

[14] The planned sample was 15% of all SSSIs (*i.e.* 443) but only 13% (399) could be visited. On the assumption that all of the 2% of sites unvisited were not damaged, the overall proportion damaged in 12 months was then 13.2% + 3.2%.

[15] Housden 2015

However, NCC's 1989 *Guidelines for the Selection of Biological SSSIs* gave a clear exposition of the then purpose of the network, reproduced in full in Appendix 2.

The key purpose was:

"The biological SSSI series is intended to form a national network of areas representing in total those parts of Great Britain in which the features of nature, and especially those of greatest value to wildlife conservation are most highly concentrated or of highest quality"

In summary

The SSSI system was legislatively created in 1949 and became further embedded as a key element of statutory nature conservation in England, Scotland, and Wales in 1981. This landmark change followed the major changes to the countryside in the 1960s and 1970s highlighting the need for clearer and more extensive conservation action than had occurred in previous decades to protect areas.

1.4 Since the 1981 Wildlife and Countryside Act

Public and parliamentary debate on the terms of a Wildlife Bill was intense during the two years leading up the to the final enactment of the Wildlife and Countryside Act (WCA) in 1981. For the first time, the Act put the SSSI designation on a firm legislative basis, addressing many of the problematic procedural issues exposed by previous experience.

Specifically, the SSSI system was intended to protect a "representative sample" of species and habitats across the country (see below). Thus, the system was never intended to be a comprehensive or holistic nature conservation mechanism, with other additional mechanisms required to ensure that species and habitats survived and thrived across the country.

In particular, it:

- required NCC to notify all areas to be protected according to new legal procedures (thus renotifying sites that already had been identified and listed with local authorities), including the requirement to consult with and notify all owners and occupiers of SSSIs[16];
- established a legal requirement on owners and occupiers to consult with NCC before undertaking any potentially damaging operations specified when the site had been notified, triggering a formal three-month consultation period;

[16] Owner/occupier consultation had previously been undertaken on an *ad hoc* basis but had not been a statutory requirement

- gave NCC a statutory obligation to offer a management agreement with appropriate payment to anyone whose application for a farm capital grant relating to a SSSI was refused because of an NCC objection; and
- established, through an associated Government *Code of Guidance for Sites of Special Scientific Interest* "the principle that farmers and others should be compensated for the loss of income or actual expenditure arising from managing their land sympathetically"[17] which extended compensation arrangements to agricultural and forestry operations not covered by the Act.

1.5 Renotification

For the provisions of the 1981 Act to apply on individual sites, each SSSI had to be renotified (or notified in the case of new sites identified through new surveys). This was a huge scientific and administrative task undertaken by NCC's area based and scientific staff through much of the 1980s.

Renotification required face-to-face discussions with owners and occupiers for the first time, although in practice this had been undertaken by NCC staff as much as possible in the 1970s. The realisation by some landowners of future tighter controls on their use of land led, in a few cases, to anticipatory damage to or destruction of some sites, exposing weakness in the legislation. This was later resolved through the enactment of the 1985 Wildlife and Countryside (Amendment) Act.

1.6 Relations with owners and occupiers

Through the 1980s, there had been few positive incentive measures for SSSI managers with many owners and occupiers perceiving more 'stick' than 'carrot'. This had led, in relatively few cases, to poor relations with some SSSI owners but some disagreements were high profile and received a disproportionate amount of national publicity. Four case studies related to moorland preservation in Exmoor; afforestation and SSSI designation of the Berwyn Mountains; wetland reclamation in West Sedgemoor; and the ploughing of the Halvergate Marshes are presented by Lowe *et al*. 1986 (and discussed also by Marren 2002).

Upon the creation of English Nature in 1991, the organisation gave renewed emphasis (through its 1992 *Beyond 2000 Strategy*) to establishing better relations with owners and occupiers. This was undertaken through a number of initiatives, including from autumn 1992, the regular publication of an attractively produced newsletter *'Sitelines'* distributed to all owners and occupiers, whilst in 1995, an annual SSSI Award process was instigated to highlight and celebrate best management practice. These actions were important in

[17] Nature Conservancy Council 1983

building a more positive relationship and the feeling of partnership in the management of these areas.

1.7 Geological SSSIs

The history of geological conservation in Britain, including the role of geological SSSIs, has been documented by Prosser (2008) and Ellis (2008) in particular. Of particular note in the current context has been the hugely important role of the Ge*ological Conservation Review* which, as did the *Nature Conservation Review* (Ratcliffe 1977) for biodiversity, established an underpinning conceptual framework for geological SSSIs, placing each within a national series. Indeed, many of the founding concepts relating to the SSSI designation were first explored in relation to the conservation of geological interests across the country.

1.8 National marine protected areas

SSSIs only extend into the inter-tidal zone and hence the national network, whilst well covering estuaries, does not extend to the marine environment. Marine Nature Reserves were introduced in the UK by the Wildlife and Countryside Act 1981 and were designed to conserve marine life and geological or physiographical features of special interest. They have similar status and protection to NNRs, but were specifically concerned with a marine environment, including both the sea and seabed. In England, the only MNR is Lundy.

Schedule 12 of the Marine and Coastal Access Act 2009 allows the conversion the existing MNRs into the newer designation Marine Conservation Zones (MCZs).

More recently, an impressive network of Marine Protected Areas (MPAs)[18], including in the offshore zone beyond 12 nautical miles from the coast have been established by NE and JNCC. MPAs in England derive from multiple designations including marine Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) under the EU Nature Directives, coastal SSSI and Ramsar Sites, and MCZs designated under the Marine and Coastal Access Act (2009).

As a network of areas managed for its biological and physiographical special interests, the overall MPA network aims to provide functions in the marine environment similar to the SSSI network on land.

[18] https://jncc.gov.uk/our-work/mpa-network-assessments/

1.9 Progressive environmental change

The progressive environmental change outside the SSSI network has been well described elsewhere. Intensification of farming progressed rapidly in post-war decades, but especially with the advent of chemical-intensive (pesticides and artificial fertilisers) farming in the lowlands (Shrubb 2003; Newton 2017), and subsidised over-stocking of sheep and incentive-led afforestation in the uplands (Newton 2020). Such change had long been recognised as a driver to protect the 'best' sites, but progressively recognition has increased that the scale of such change outside of protected areas was influencing the condition of many sites within their borders.

These influences were highlighted in systematic English Nature reviews of the maritime environment (Covey & Laffoley 2002), and lowlands (Townshend *et al.* 2004). The lowland assessment concluded that:

"Lowland SSSIs are coming increasingly isolated from each other through growing agricultural pressures. Without wildlife-friendly wider countryside, there is as risk that inbreeding and local extinctions will lead to a decline in the wildlife interest of many of the SSSIs themselves."[19] "Nature conservation must be achieved through a landscape-scale approach which recognises that the demands of a modern economy will continue to influence land use in the lowlands. Integrated management of the whole landscape and water catchments is essential to facilitate recovery of biodiversity and increase the social and economic benefits that can be obtained through sustainable land use."[20]

The trend of the overall diminishing of environmental condition outside protected areas – and its influence inside protected areas - continues to the present, as documented by the periodic assessments of the *State of Nature* Partnership (Burns *et al.* 2013).

1.10 Assessment of condition

NCC started to regularly report statistics[21] relating to loss and damage of SSSIs in its annual reports to Parliament from 1983/84. However, these represented essentially ad hoc compilations of instances that had come to the attention of staff through the renotification programme and/or casework. This annual loss and damage reporting evolved, especially with respect to allocation of causes.

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[19] English Nature 2004. *Sitelines*. Issue 47. Although presented hypothetically, in reality the decline of condition within many SSSIs from outside influences was already apparent as had been well documented by English Nature's first assessment of the SSSI network the previous year (English Nature 2003).

[20] Townshend *et al.* 2004

[21] At GB scale only

From 1991, English Nature continued to report damage statistics and from 1996/97 started also to report annually on condition, using Commons Standards Monitoring (CSM) assessments that had then been agreed in 1997 through JNCC[22] (Figure 1.1). As outlined by JNCC (1998) “The purpose of site monitoring is essentially to:

- Determine whether the desired condition of the feature(s) of interest for which the site was designated is being achieved. This can enable judgements to be made about whether the management of the site is appropriate, or whether changes are necessary.
- To enable managers and policy makers to determine whether the site series as a whole is achieving the required condition, and the degree to which current legal, administrative and incentive measures are proving effective.”

In 1996/97, EN staff undertook 3,000 visits to 1,714 SSSIs (43.8% of the total) using CSM guidance.

Influenced by the Public Service Agreement target (section 1.12) that 95% of SSSI land, by areas, should be in favourable condition by 2010, as part of a UK exercise, NE undertook a first comprehensive assessment of all English SSSIs between 1997 and 2003. This found that “Currently 58% of SSSI land by area is in favourable or recovering condition, leaving 42% in unfavourable condition. English Nature believes that the target of 95% in favourable condition by 2010 is challenging but achievable” (English Nature 2003).

Figure 1.1. Conceptual summary of Common Standards Monitoring (Williams 2006). © 2006 JNCC. Available under the Open Government Licence 3.0.

English condition statistics were included in a UK overview published by JNCC in 2006 (Williams 2006).

[22] https://data.jncc.gov.uk/data/c493dc31-e910-422a-a148-e43f0a03fc3c/CSM-Statement-1998.pdf

The intention to undertake a second comprehensive UK assessment proved not possible and a revised CSM statement was issued by JNCC in 2019:

“Several developments in UK nature conservation have occurred since the first Statement on Common Standards Monitoring was published in 1998. Foremost of these is a reduction in resources available for protected area monitoring. Among other developments, there have been technological advances in environmental monitoring, and changed thinking about conserving nature at different spatial scales and the dynamic nature of ecosystems. Importantly the UK Country Nature Conservation Bodies now have twenty years practical experience of implementing Common Standards Monitoring.” (JNCC 2019a).

1.11 Performance targets established by government and their assessment

Alongside the creation and implementation of the system of SSSI designation has been an increase in public interest and concern in the “state of nature” and desire to see damage to the environment reduced. Government has responded to this concern in a variety of ways and for SSSIs this resulted in the development of a series of targets for action related to the management of SSSIs (Table 1.1), and latterly moving towards targets related to the “state” of the species, habitats and geological features present.

Table 1.1. Government and statutory agency performance targets related to SSSI condition. There has been a variety of different reporting against these targets.

Year	Target	Set by:
1992	Securing positive action for wildlife and natural features for each site management unit on each SSSI remains a core target. ... We will regularly measure the area of SSSI in favourable status.	English Nature. *Beyond 2000 English Nature’s strategy for improving England’s wildlife and natural features*
2001	Government established Public Service Agreement target to get 95% of all the SSSIs into favourable condition by 2010.	HM Government. Public Service Performance Standard Agreement target[23]
2011	1A. Better wildlife habitats with 90% of priority habitats in favourable or recovering condition and at least 50% of SSSIs in favourable	DEFRA. Biodiversity 2020: A strategy for England’s wildlife

[23] https://www.instituteforgovernment.org.uk/sites/default/files/case%20study%20psas.pdf

Year	Target	Set by:
	condition, while maintaining at least 95% in favourable or recovering condition; 1B. More, bigger and less fragmented areas for wildlife, with no net loss of priority habitat and an increase in the overall extent of priority habitats by at least 200,000 ha; 1C. By 2020, at least 17% of land and inland water, especially areas of particular importance for biodiversity and ecosystem services, conserved through effective, integrated and joined up approaches to safeguard biodiversity and ecosystem services including through management of our existing systems of protected areas and the establishment of nature improvement areas;	and ecosystem services (DEFRA 2011)
2018	"Increasing the proportion of protected and well-managed seas, and better managing existing [marine] protected sites." "Restoring 75% of our one million hectares of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long term."	HM Government. *25 Year Environment Plan* (HM Government 2018)

Alongside the establishment of targets, the National Audit Office has periodically assessed their achievement, either nationally (NAO 2008) or for parts of the SSSI 'estate', for example the holdings of the Ministry of Defence (NAO 2020).

"Since December 2002, the reported condition of SSSIs has improved from 52% by area in target condition to 83% in March 2008. Of the 888,706 hectares in target condition, 45% were in a favourable condition and 38% were in an unfavourable recovering condition. The long-term nature of recovery action means that it may be many years before some sites reach a favourable condition." (NAO 2008).

1.12 Departure from the European Union

The departure from the EU has had, and will have, multiple consequences for UK nature conservation. With respect to protected areas, the significant change is that obligations under the Birds and Habitats Directive in relation to established UK Natura 2000 sites have now been embedded in domestic legislation rather than deriving from EU statute.

The European Union's (EU) 'Nature Directives' (the 1979 Birds Directive and the 1992 Habitats Directive) was the EU's response to the requirements of the Council of Europe's 1979 Convention on the Conservation of European Wildlife and Natural Habitats – more commonly known now as the Bern Convention. That Convention established the basic framework for species protection in Europe, listing of those that should have strict protection, and for others, techniques of killing or capture that are forbidden or should be regulated. Similarly, it established a continental-scale network of internationally important protected areas – the Emerald Network.

So, whilst it is true that the 1981 Wildlife & Countryside Act was UK's means of implementing the Birds Directive, it is equally the case that it was a response to the Bern Convention. Importantly, the Bern Convention will continue to be legally binding and with many of the same general provisions.

1.13 Current policy drivers- nationally and internationally:

1.13.1 Government's *25 Year Environment Plan* for England

The government's *25 Year Environment Plan* outlined its priorities for nature conservation in England. Among its aspirations are:

"We will achieve a growing and resilient network of land, water and sea that is richer in plants and wildlife".[24]

"At sea, we will do this by:

- *Increasing the proportion of protected and well-managed seas, and better managing existing protected sites.*
- *Ensuring seafloor habitats are productive and sufficiently extensive to support healthy, sustainable ecosystems."*

"On land and in freshwaters, we will do this by:

- *Restoring 75% of our one million hectares of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long term.*
- *Creating or restoring 500,000 hectares of wildlife-rich habitat outside the protected site network, focusing on priority habitats as part of a wider set of land management changes providing extensive benefits."*

[24] It is unclear conceptually what a 'network of land, water and sea' actually is. This seems to be an aspiration for better quality nature conservation in some vague sense.

"We will take all possible action to mitigate climate change, while adapting to reduce its impact. We will do this by:

- *…making sure that all policies, programmes and investment decisions take into account the possible extent of climate change this century."*

With respect to English protected areas, the key commitments are:

- *Increasing the extent of the network of marine protected areas;*
- *Ensuring 75% of the protected area network is in favourable condition; and*
- *Ensuring 'all policies and programmes' take account of climate change – inherently for protected areas implying relevant adaptation.*

1.13.2 Environment Act

The 2021 Environment will deliver many of the aspirations within the *25 Year Environment Plan* and includes several elements of either direct or indirect significance for the future development of the SSSI network. These include:

- the establishment of powers for government to set long-term legally binding environmental targets reviewed every five years (including at least one for biodiversity) (under consultation from March to June 2022);
- reform of water abstraction licensing to link it more tightly to the *25 Year Environment Plan* goal of restoring water bodies to as close to natural state as possible;
- creation of new incentives, actions and planning tools to drive further improvements for protected sites and species, in particular establishing a Nature Recovery Network;
- establishing a mandatory requirement for biodiversity net gain in the planning system, ensuring new developments enhance biodiversity;
- development of Local Nature Recovery Strategies across England to support better spatial planning for nature recovery through establishment of priorities for protecting and investing in nature within local areas, and especially by mapping existing protected sites and wildlife-rich habitats and identifying opportunities for their enhancement; and
- strengthening the duty on public authorities through requiring them to enhance, as well as conserve, biodiversity; as well as
- establishing an Environmental Land Management Scheme under the 2020 Agriculture Act.

1.13.3 Post-2020 Global Biodiversity Framework

The Convention on Biological Diversity's (CBD) Conference of Parties has, through Decision 14/34, established a process to develop a 'Post-2020 Global Biodiversity Framework' to guide global actions related to the environment to 2050 (with targets for 2030). CBD Secretariat have issued two 'zero-order drafts' in 2020 and a first draft in 2021.

"The Framework aims to galvanise urgent and transformative action by Governments and all of society, … to contribute to the objectives of the CBD and other biodiversity related multilateral agreements, processes and instruments. … The Framework will be implemented primarily through activities at the national level…"

Negotiations occurred in 2021 and continue in 2022, and it is anticipated (as at June 2022) that the negotiated outcome will be adopted by a CBD Conference of the Parties (COP 15) at the final session of COP15 in December 2022. The Framework, if adopted, will succeed CBD's Strategic Plan for Biodiversity 2011-2020, and its 20 Aichi Targets.

The main themes reflected in 2020 zero order drafts closely related to the previous Aichi Targets, and include the following that are relevant[25]:

a) Reducing threats to biodiversity

1) Spatial planning for land-use and ecosystem restoration

[Target 1. By 2030, [50%] of land and sea areas globally are under spatial planning addressing land/sea use change, retaining most of the existing intact and wilderness areas, and allow to restore [X%] of degraded freshwater, marine and terrestrial natural ecosystems and connectivity among them.]

2) Protected area networks

[Target 2. By 2030, protect and conserve through well connected and effective system of protected areas and other effective area-based conservation measures at least 30 per cent of the planet with the focus on areas particularly important for biodiversity.]

3) Species recovery and conflict resolution

[Target 3. By 2030, ensure active management actions to enable wild species of fauna and flora recovery and conservation, and reduce human-wildlife conflict by [X%].]

7) Climate change adaptation and mitigation

[Target 7. By 2030, increase contributions to climate change mitigation adaption and disaster risk reduction from nature-based solutions and ecosystems-based approaches, ensuring resilience and minimising any negative impacts on biodiversity.]

The potential '30 by (20)30' target for protected areas is likely to be a major policy driver in relation to the conservation of protected areas in England over the coming decade.

[25] Note that all elements of the draft Framework are under negotiation and thus any aspect may change.

2. Evaluation of the SSSI system in England

2.1 Long-term performance of SSSIs in England

2.1.1 Variable success against objectives

The long-term pressures on, and performance of, SSSIs have been reviewed elsewhere and in particular by Lawton *et al.* (2010). We briefly note three types of different outcome:

The intensification of agricultural management on traditional grasslands has been intense, leading to significant huge losses in extent (Blackstock *et al*. 1999; Peterken 2103; Newton 2017). Current UK estimates for the extent of semi-natural meadow are of just 10,500 ha in the lowlands and 900 ha in the uplands[26]. In the face of the trend to near total loss outside protected areas, Natural England have continued a programme of notification of semi-natural grassland SSSIs.

The progressive loss of inter-tidal wetlands to development or agricultural land claim, especially in estuaries, was a major nature conservation concern in the 1960s and 1970s (Prater 1981). Typically, this was through piecemeal losses – "death by a thousand cuts". Whilst many estuaries had had SSSI status since the 1950s, it was the establishment of a comprehensive national network of estuarine protected areas through the 1980s (Stroud *et al*. 1990; Davidson *et al*. 1991) under European legislation, that virtually eliminated further losses of habitats. Indeed, the most recent assessment of pressures and threats to UK's birds under the Birds Directive found no evidence that land claim was a current problem for estuarine birds (JNCC 2019b).

For a species, loss of habitat can come through degradation of quality. A series of national surveys over two decades of waders breeding on lowland wet grasslands (especially Snipe *Gallinago gallinago*, Redshank *Tringa totanus*, Lapwing *Vanellus vanellus* and Curlew *Numenius arquata*) has documented their continuing loss not only from unprotected sites, but also from SSSIs. The most recent national survey (Wilson *et al.* 2005) found that wader populations tended to be higher and declined less in designated areas (Environmentally Sensitive Areas, SSSIs or nature reserves) than in the wider countryside. Yet they found there was *"scant evidence for any direct benefits of SSSI notification for any of these species. It is also difficult to ascertain from our analysis whether SSSIs notified wholly or partly for their breeding wader interest fared better than SSSIs designated for other reasons."* Appropriate management is critical to maintain these species and Smart *et al.* (2014) concluded that "conservation of breeding waders will be most effective when site protection and agri-environment scheme management are combined on the same land.

[26] http://jncc.defra.gov.uk/page-6387

2.1.2 Summary

In summary, without the SSSI system, then the biodiversity and geomorphological resource of England would have been very significantly more impoverished than it now is. . Our judgement is that when viewed against the original purpose of SSSIs, namely, to notify a representative sample of areas holding important species and habitats across England, then the system has worked reasonably well. This success is, however, patchy and the portfolio of sites seems more substantive for some species and for some habitats than others. Key gaps are clearly in lowland habitats. However, what was unpredictable in the 1940s and 1950s was the scale of losses in the wider, unprotected countryside – for some habitats amounting to almost total extirpation. In hindsight, and given the extent of these losses, an approach that sought to protect a small sample of 'best' sites may not have been optimal.

Areas of current concern relate also to the intensity of implementation of monitoring and to the control of damaging activities on sites. A clear priority stressed in consultation meetings with stakeholders has been the need for effective monitoring in future and clear feedback to the management of each site, thus leading to improvements in site condition.

The key question now is how to adapt the current system to deal with the new challenge of rapid climate change and to consider what role SSSIs could play in a wider adaption strategy for terrestrial and marine environments.

The following sections examine the system in detail and then considers examples of site protection from a range of other countries to see if lessons can be learned from this wider experience.

2.2 England in a European context

This section of the think piece examines conservation practice in a number of countries and identifies good practice and innovation that may be applicable in a range of situations.

Protected areas form the core of nature conservation action around the world, with varying levels of protection and a range of legal, policy and practical measures used to ensure their effective conservation management (Lockwood *et al*. 2006). With the onset of rapid climate change, conservationists are increasingly assessing the relationship between protected areas and the wider landscapes in which they occur and looking at how best to adapt the whole inter-linked system to enhance resilience.

One issue in such an exercise is how to ensure like for like comparisons given the huge number of different types of protected areas in other countries. The European Environment Agency's (EEA) Common Database on Designated Areas (CDDA) collates information of designated sites across 39 European countries. As of 2012, the CDDA contains information on 685 different types of designated area (Romão *et al*. 2012).

Some of the variance between protected areas can be removed by considering their status within the IUCN Protected Area Categories System which provides the international standard for categorisation (Table 2.1).

Table 2.1. IUCN Protected Areas Categories System.

IUCN category	Description
Ia Strict Nature Reserve	Strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphologic features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.
Ib Wilderness Area	Usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.
II National Park	Large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities.
III Natural Monument or Feature	Protected areas set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave, or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.
IV Habitat/Species Management Area	Protected areas aiming to protect particular species or habitats, their management reflects this priority. Many Category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.
V Protected Landscape/Seascape	A protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.

IUCN category	Description
VI Protected area with sustainable use of natural resources	Protected areas that conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level nonindustrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

Against this system[27], English SSSIs largely fall within Category IV - Habitat/Species Management Areas, although a few are of Category I – Strict Nature Reserve status (typically some SSSI that are NNRs or NGO nature reserves).

2.2.1 Extent of nationally protected sites

As well as the multiple different types of nationally designated protected area, across Europe, there is huge variation in the size and density of these nationally designated sites as shown in Figure 2.1. Of particular note is:

- the large number and high density of sites in Germany, the Netherlands and Switzerland;
- the large size of sites in France, Germany, and parts of UK (note UK 'National Parks' and AONBs are included here);
- the relative paucity of national protected areas in Portugal, Spain, Cyprus, Finland and much of eastern Europe; and
- the general lack of national marine protected areas other than in the waters of Germany, Italy, Estonia and Greece.

In contrast are the spatial patterns of the Natura 2000 network (EU) and the Emerald Network (Council of Europe's Bern Convention) (Figure 2.2). Both these are internationally derived networks broadly identified according to defined objectives, even if lacking uniform selection criteria. Of note is:

- the large number and density of sites in Spain, Germany and much of eastern Europe;
- significant numbers of marine sites in the waters of Germany, UK, Ireland and France in particular;

[27] Note that Category II – National Park, relates to the internationally accepted definition of the term and not the different concept called by the same name in Britain.

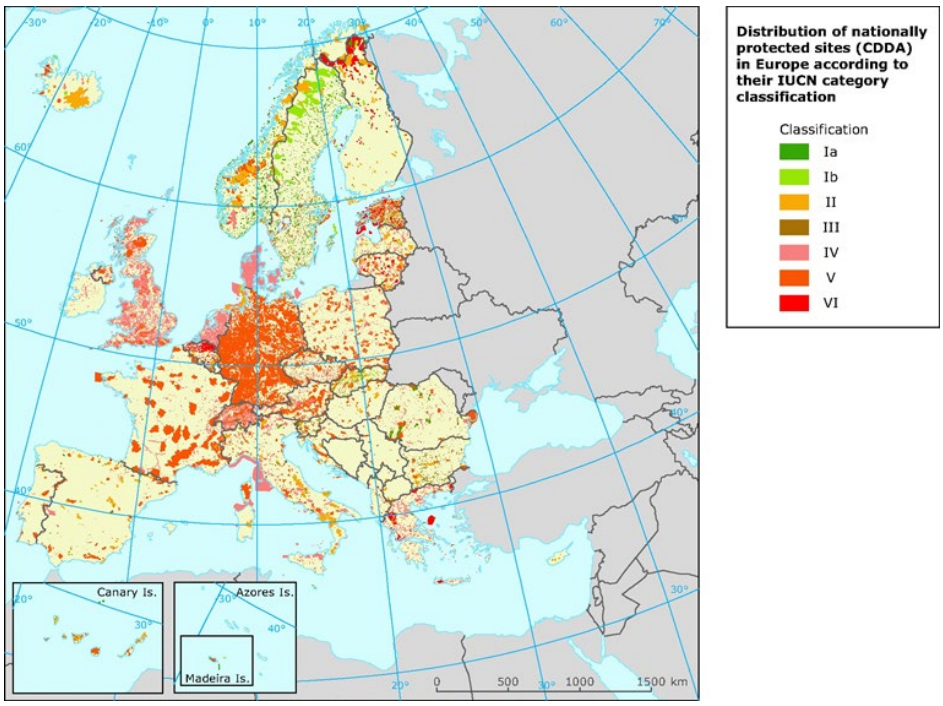


Figure 2.1. Nationally protected areas in Europe (from Romão *et al.* 2012). Available under the © EEA, Copenhagen, 2012. Reproduced under the terms of their copyright notice.

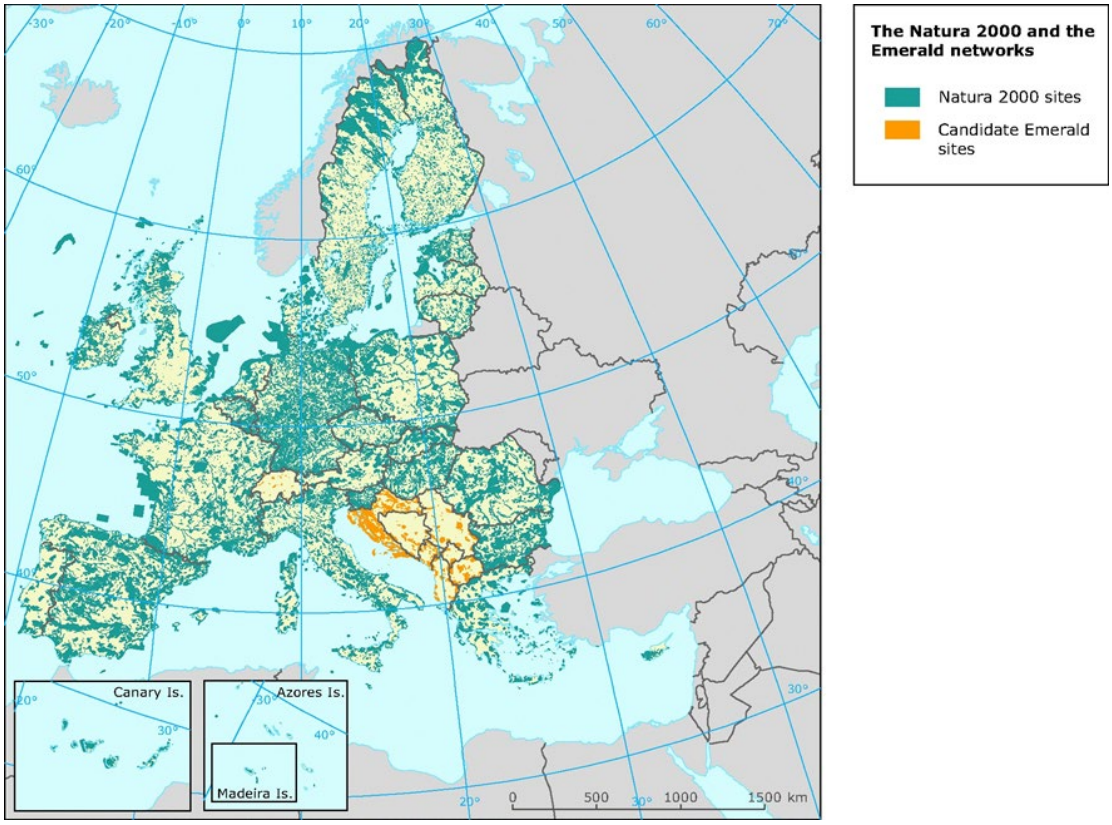
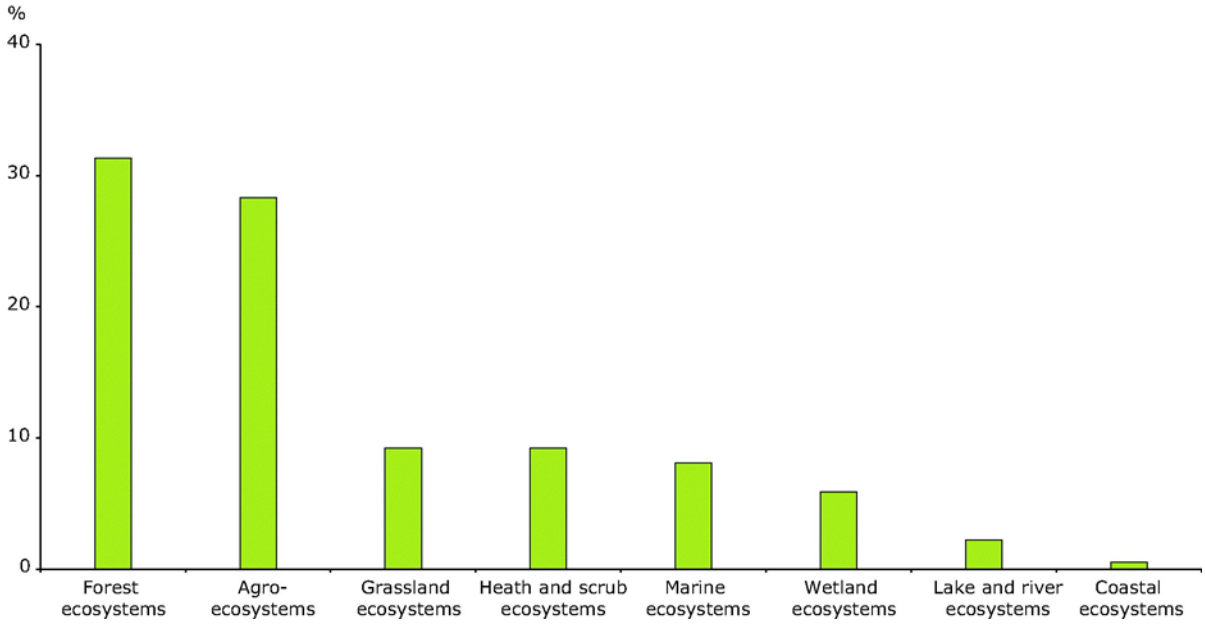


Figure 2.2. Natura 2000 and Emerald Network sites in Europe (from Romão *et al.* 2012). Available under the © EEA, Copenhagen, 2012. Reproduced under the terms of their copyright notice.

- the very small size of sites in Germany and across central Europe generally; and
- the large size of sites especially in ‘wilderness’ areas including northern Scandinavia and mountain regions on eastern Europe.

2.2.2 Ecosystem representation within nationally designated sites

Romão *et al.* (2012) related CORINE Land Cover types (CLC 2006) to the nationally designated sites in EEA’s CDDA (Figure 2.3). This shows that forest (31.3% of land cover in CDDA sites) and agricultural (28.3%) ecosystems are especially highly represented, with very small representation of rivers, lakes and coasts. Note these are not proportions of the land types available to be protected (there are extensive forests and farmland in Europe) but given the long coastline and great extent of lakes and rivers in Europe[28] it is clear that these ecosystem types are disproportionately under-represented in national protected area systems.



Note: These broad ecosystem-types represent different ways of clustering CLC units, so there are overlaps between them. For instance, 'grasslands' and part of 'heaths and scrubs' are included in 'agro-ecosystems'. Similarly, 'lakes and rivers' are included in 'wetlands'. This is why the sum of the ecosystems is over 100%.

Figure 2.3. Proportion of the surface areas of national designated sites in Europe per type of ecosystem (from Romão *et al.* 2012). Available under the © EEA, Copenhagen, 2012. Reproduced under the terms of their copyright notice.

[28] See the most recent MAES analysis for the EU28 (Maes *et al.* 2020)

2.2.3 How effective have European nationally protected areas been?

Fundamentally, it is not possible to answer that question without a detailed understanding of the reasons for designation of each protected area, and the legislative abilities to constrain negative changes or enable positive management, thus allowing an assessment of 'effectiveness'. However, Romão *et al.* 2012 explored patterns of ecosystem change within and outside CDDA national protected areas (Figure 2.4).

They concluded that: "Decreases in agro-ecosystems including grasslands are more limited in protected areas than outside. The amount of land covered by wetlands, forests and coastal ecosystems increased slightly more in protected areas than outside. … The large increase of 'heath and scrub' …, was more pronounced outside than inside protected areas, mainly due to land abandonment (former agriculture areas becoming transitional woodland-shrub areas)."

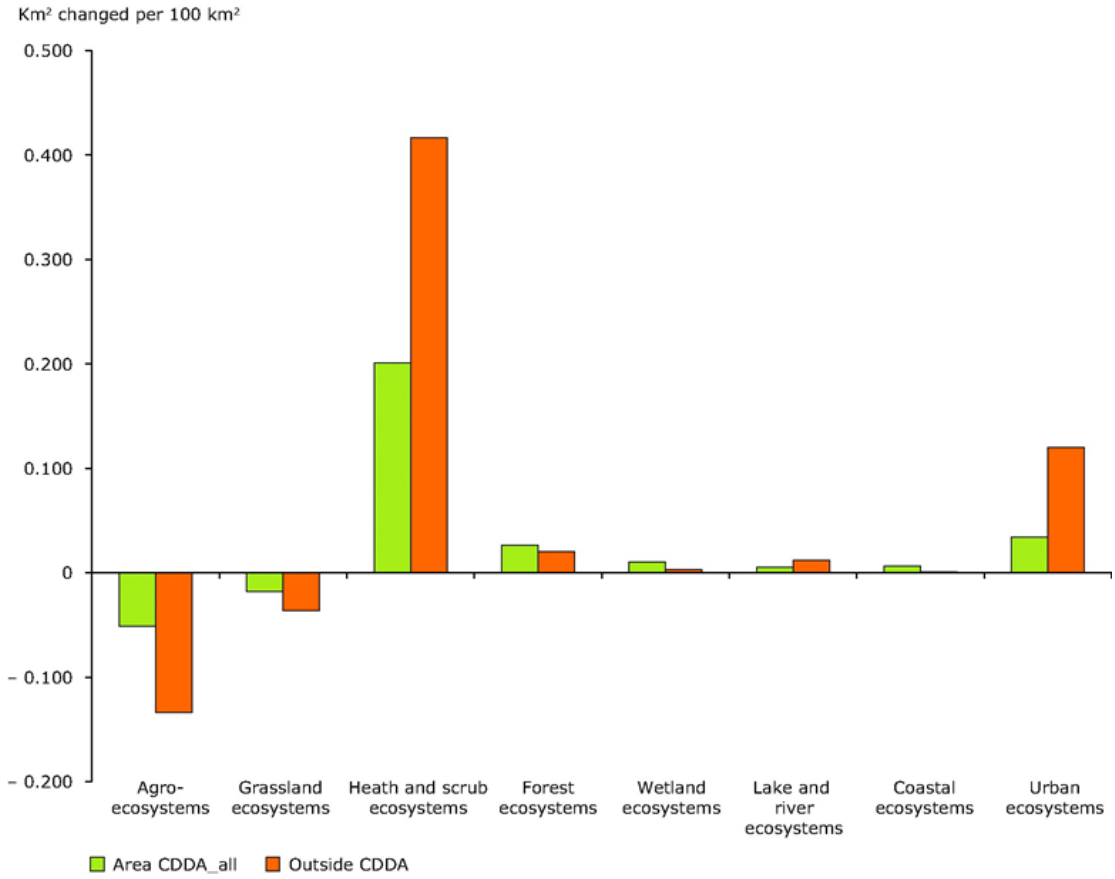


Figure 2.4. Changes in broad ecosystem-types between 2000 and 2006 inside and outside nationally designated areas in Europe (from Romão *et al.* 2012: Sources: CLC 2000, CLC 2006, CDDA June 2011). Available under the © EEA, Copenhagen, 2012. Reproduced under the terms of their copyright notice.

An alternative approach is to consider ultimate conservation outcomes. *If* the objective of nationally protected areas is to sustain the habitats and species for which they are designated, and if they are being effective in that aim, then one should hypothesise that the condition of European habitats should be favourable. However, the results from the 2020 EU *State of Nature report* from the period 2013-2018 (European Environment Agency 2020) for the Birds and Habitats Directive show widespread environmental

degradation in the status of many species and habitats – despite extensive protected areas in Europe. However, targeted analysis demonstrates clear positive effects of some protected area designations, such as SPAs (Sanderson *et al.* 215).

2.3 Different national approaches to habitat protection

The following sections considers conservation practice “on the ground” in a range of countries and draws together some underpinning lessons and principles.

2.3.1 Other national protection systems

New Zealand

Protected areas form around 33% of the total land surface area. Much of this is owned by the state (Department of Conservation) so is under direct government control and management (Wright *et al.* 2020). Overall, large areas of the country are managed for biodiversity, and are made up of natural/semi-natural habitats with very large sites allowing good potential for climate change adaptation and management. There is significant public support for protected area management.

France

Focus is on the classification and management of internationally important nature conservation sites, including Natura 2000 sites, with management of buffer areas around many sites. There is the potential to allow for some change in features within sites and movement into buffer areas, however, the relatively static legal system (EU Directives) may make flexibility in site boundary and change in features somewhat problematic.

Slovenia

Protected areas in Slovenia are implemented through a system of parks operating at different scales and through different government authorities. Essential mechanisms are National, Regional and Landscape Parks with Nature Reserves also, and these may be created and administered by government at either national or local scales (Table 2.2) (Hlad & Skoberne 2001).

Table 2.2. Protected area designations in Slovenia as in 2001 (Hlad & Skoberne 2001).

Protected area category	IUCN category	Number of sites	Area (ha)
Protection at international level			
World Heritage Convention		1	413
Ramsar Convention		2	1,063

Protected area category	IUCN category	Number of sites	Area (ha)
Protection at state level			
National Park	II/V	1	83,807
Regional Park	V/III	2	20,862
Nature Reserve	1/IV	10	120
Landscape Park	V/III	1	650
Protection at local level			
Landscape Park	V	40	47,374
Nature Reserve	1/IV	49	
Natural Monument	III	623	
Monument of 'Designed Nature'		77	
Areas of Natural and Cultural Heritage		10	

2.3.2 Protection through policy

Some countries adopt a policy-led approach to habitat conservation, which provides legislative protection for certain specified habitat types – sometimes above a defined size threshold. Three examples of these are presented by Romão *et al.* (2012):

- In **Croatia**, national legislation requires that all wetland habitats should be preserved in natural or semi-natural conditions. All human activities that could compromise these conditions and/or the biodiversity of these habitats are forbidden[29].

[29] Croatian Parliament 2005. Nature Protection Act, Official Gazette 70/05, 139/08, 57/11.

- In **Denmark**, through national legislation since 1969, basic protection is given to specified protected habitat types that today includes (larger in extent than defined size thresholds): public and private watercourses, natural lakes, peat bogs and marshes, wet meadows, dry grasslands, dry stone walls, heathland, salt meadows, and coastal marshes and meadows. The 1992 Nature Conservation Act imposes a general prohibition on any modification to the state of these natural areas (De Klemm 2000).
- In **Hungary**, all bogs, mires, alkaline lakes, and all caves are given legislative protected.

The situation in Denmark is particularly interesting. In many countries, habitat protection is provided through a hierarchal system of wider countryside policy / locally protected sites / regionally protected sites / nationally protected sites / internationally protected sites. In Denmark, there are no nationally important sites: habitat-based conservation is delivered via internationally designated sites (Natura 2000 and Ramsar Sites[30]) for the most important areas, and the policy-based protection applies across the rest of the landscape.

Whilst such approaches avoid the need for mapping of sites, they do require owners and occupiers of land to be aware of, and be able to identify, for example, an alkaline lake in Hungary or a Danish wet meadow.

When compared to the situation in England and the wider UK it is clear that the legal basis and pattern of land ownership in these other countries could influence the nature of climate change responses. For example, the scale of public ownership of protected areas in New Zealand should facilitate large scale and coordinated action, whilst the Danish streamlined system should allow a greater focus on the management of focal areas set within sympathetically managed landscapes.

In summary, when compared to some other countries, England has a complex mix of protected areas including internationally important sites, (SACs, SPAs, Ramsar Sites, World Heritage Sites), nationally important sites (National Nature Reserves, SSSIs, National Parks), locally designated sites (Local Nature Reserves), and a range of landscape/scenic designations including Areas of Outstanding Natural Beauty (AONB) and Local Landscape designations. Each designation type has a clear boundary, and protection regime defined according to the particular interest it is designed to protect.

Whilst the number of types of designation has been highlighted by some as overly burdensome, each type of protected area has helped to protect an aspect of biodiversity,

[30] Koester (1989) presents a detailed analysis of adoption and implementation of the Convention in Denmark.

geology or landscape that is valued as part of a common heritage, historically evolving to meet particular priority needs at a point in time[31].

One of the key questions for the future is whether the multiple types of protected area will help or hinder the ability of nature conservation managers to put in place effective climate change adaptation strategies across the country.

Reviewing other national practices, what general lessons can be taken in to practice here?

Firstly, scale matters and could add real value in terms of adaptation to climate change and in retaining a greater degree of overall resilience (Schaffer 1990; Lawton *et al.* 2010; Natural England & RSPB 2010). For example, the situation in New Zealand.

Secondly, it is important to develop an approach to protected area management that will be durable and where the policies and practices used will be supported by government in the long-term. Changes to the underpinning approach to protected areas do not occur frequently, so when they are proposed then they need to last.

Thirdly, keep things simple if possible, with good stakeholder support and engagement being an important underpinning principle. The Danish example is interesting in this regard with international sites complemented by sympathetic management across the wider countryside. When this approach is at maximum effectiveness, then theoretically the boundaries between any protected area and surrounding countryside could be made more 'fuzzy', with a gradient of sympathetically managed land as a buffer around the core protected area. As discussed below, this could have real value in terms of adaptation.

2.4 How well does the current system work in England?

We next evaluate the present SSSI system against its strengths, weaknesses, opportunities and threats. We draw particularly on the in-depth '*Making space for nature'* review (Lawton *et al.* 2010) which remains very highly relevant and whose recommendation are given in full in Appendix 2. We have also received input from many NE current and former staff members as well as representative of several major landowners some of which are also other statutory bodies, and the following sections summarise their views. Whilst there was broad consensus on many of the issues, the interpretation and emphasis below is our own.

2.4.1 Inherent strength of the existing system

England's natural heritage would have immeasurably reduced without the SSSI network. SSSIs have previously and continue to fulfil a critical role in conserving England's biodiversity and geomorphological resource. SSSIs have maintained many species and

[31] For example, Areas of Special Protection were first established by the 1954 Protection of Birds Act (and carried forward in the Wildlife & Countryside Act) to protect important waterbird refuges, but this objective is now functionally delivered by SSSIs largely covering the same areas

habitat types which would otherwise have been lost due to land-use changes since the end of the second world war.

The underlying conceptual basis is sound and has stood the test of time, supported by their objective, science-led selection for biological and geological interests. The sheer scale of environmental change and impacts however, including off-site effects in the case of water and atmospheric pollution, and water management issues generally, has impacted the condition of very many sites. What has been achieved has been good but not enough in terms of adapting to climate change.

Specifically, in relation to adaptation to climate change, these sites have the potential to act as a core resource from which natural expansion could be developed. We discuss this in detail later, however, without these sites, adaptation for much of the biodiversity resource in particular would be significantly more problematic.

Since its establishment, although the network has been successful in maintaining the extent of sites, the quality of many has deteriorated (for reasons outlined below).

Current legislation, especially since the extensive reforms in the 2000 Countryside and Rights of Way Act, has been 'debugged' of its initial problems and fit for its purpose.

2.4.2 Profile and awareness

As well as their core function in relation to sustaining the interests for which they have been notified, these protected areas also act as focal points – not only as exemplars of the best English habitats of importance for the public, but also in providing opportunities for commercial and other investments in contributing to maintenance of England's natural heritage.

The current pandemic has generated significant new public environmental awareness typically generated by greater access to nature. There is significant scope to use SSSIs (including within digital education) to raise conservation issues. In this respect, the Wildlife Trust's Wildbelt initiative is potentially useful.

2.4.3 Weaknesses

It is important to identify the nature and cause of any weaknesses in the system, and whilst these are well known and have been identified in past and more recent reviews, solutions to these are generally quite clear.

At its heart, the SSSI system has delivered a great deal and it could be argued that it has been successful according to the original purpose for the designation. Expectation for its delivery and purpose have changed over time, for example, there is now an active discussion about achieving multiple management objectives from these sites that was not part of the 'original specification'.

At the root of most of the SSSI system's weaknesses is a history of inadequate and declining funding to fulfil the originally envisaged functions of monitoring, condition

assessment, reporting, and adaptive management. This has major implications including for landowners and other stakeholder involvement. The following sections identify issues raised and possible solutions.

2.4.4 Scale, size and connectivity

There is wide recognition that the scope of the current SSSI network, amounting to 6.1% of England[32], is inadequate. Its coverage is inconsistent, in part due to different thresholds of selection between habitats in the selection Guidelines. This means it is inherently easier for some habitats to be selected than others. There are also linked geographic disparities, whilst much of the English uplands have SSSI status, in the lowlands SSSI extent is less than 4% (Lawton *et al.* 2010). Thus just 1% of Nottinghamshire has SSSI status although the figure is 20% for Derbyshire.

Generally, existing SSSI are too small (in contrast to National Parks and Areas of Outstanding Natural Beauty for example). Lawton *et al.* (2010) reported that 98% of SSSIs are less than 100 ha in extent. This increases their vulnerability to change from both 'edge effects' arising from surrounding landscapes; increased rates of extinction as a consequence of well understood island biogeographic processes; and the inevitably restricted habitat diversity consequent on limited area – again increasing extinction rates.

However, whilst undoubtedly bigger is better, small sites perform vitally important functions both as repositories of species and habitats (including currently unknown elements of biodiversity such as soil microbiology and for many invertebrate taxa) as well as acting as 'stepping stones' that aid species dispersal across and through often inherently ecologically hostile surrounding landscapes.

It is very important to maintain these small sites rather than presuming their non-viability, expanding them wherever possible.

Boundaries on many sites need to be revised and ideally merged into sympathetically managed landscape surrounding them. Typically, these are drawn too tightly which limits options for management (for example for dynamic coasts and the need for catchment scale hydrological management of wetlands).

2.4.5 Further development of the SSSI network

A range of new policy tools either already exist, or are becoming available, that can improve the quality of land surrounding SSSIs. However, the basic opportunity to enlarge individual sites is one of NE's existing statutory functions and could be readily undertaken.

[32] For biological SSSIs only. From Lawton *et al.* 2010, thus excluding recent notifications.

An enhanced network of SSSIs will provide a critical core of the Nature Recovery Network (NRN). It was the view of very many stakeholders that NRN needs to be driven by top-down policy rather than allowed to self-evolve from local initiatives. This will maximise its value.

There is no published network scale assessment for the coverage of individual species and habitats within SSSIs, although this exists for the subset of sites that are SPAs (Stroud *et al.* 2016) and indeed for that network a formal assessment of sufficiency. Such SSSI sufficiency assessments need to be undertaken and published through a regular process and timescale.

For most species and habitats only a proportion of their national populations or extent are sustained within SSSIs (by original intent it was designed to be a representative sample, rather than provide protection for the complete 'resource'). Given both the scale of change in the countryside since 1949 (section 1.10), and likely international obligations (section 1.14.3) to enhance national ambitions for protected area networks, it seems necessary to revisit this issue and notify significantly more and larger areas to address this shortfall of coverage.

As climate change effects intensify, the ability to manage adaptively for species and habitats within the SSSI network may prove essential to their long-term survival. Especially in the context of climate change adaptation (addressed in Part B) is the issue that SSSIs can only be notified on the basis of their current features. Where future change or interests can be anticipated there is no provision to notify sites that will have future interest but need to be managed now to adapt them into that state. It seems to us that this would not need legislative change but rather revision of JNCC's SSSI Guidelines (JNCC 2013).

Consultees repeatedly highlighted (in various contexts) the importance of regional scales of assessment and planning which seems formally to be missing from the network and should be considered.

2.4.6 Governance issues

There is a widely held view by stakeholders that many aspects of 'governance' of the SSSI network is being performed significantly less well than it could or should be. These issues are for NE to resolve, and touch on many of the issues in this section, including the need for:

- more direction in terms of the purpose and management of SSSIs;
- improved relations with owners and occupiers (especially major landowners who manage a significant proportion of sites and who are enthusiastic about working alongside Natural England;

- better and more enforcement of existing legal powers and regulations[33],[34], including better management and tackling invasive non-native species;
- more joined up thinking;
- less risk-averse organisational responses and the need to test new management ideas on protected areas;
- better application and use of existing policy tools (including guidance within the *SSSI Guidelines*) – which are typically useful but not applied to the extent they could and should be; and
- enhanced willingness to change citations and modify boundaries.

There would be benefit in a more in-depth consideration of processes – involving stakeholders and on a 'no-blame' basis – for the organisation to obtain a more detailed understanding of how the current situation may be enhanced.

Several major landowners highlighted the mutual benefits that would accrue from seconding NE staff members to their organisations to act as focal points for SSSI issues. This would also rebuild more personal relationships with these stakeholders – something we were told that has been lost with the current 'call-centre' mode of working adopted over the last decade and universally regarded as a serious retrograde step in terms of stakeholder buy-in.

2.4.7 Original specification

It is important to be clear what the purpose of these sites should be in future. Clearly, if multiple management outputs become the common expectation, then some re-examination of the core purpose would be required, and how any changes would aid the conservation of biodiversity and geomorphology would be a key aspect to consider.

At the root of most of the SSSI system's weaknesses is inadequate and declining funding to fulfil the originally envisaged functions of monitoring, condition assessment, reporting, and adaptive management. This has had major implications including for landowners and other stakeholder involvement. Specific issues identified include:

2.4.8 Monitoring and condition assessment

Making data and information derived though monitoring, and interpreted through assessment, openly available is fundamental for the management of the SSSI network.

[33] There was a repeated view that environmentally damaging activities on SSSIs (in the uplands in particular) are organisationally tolerated because they are 'traditional', with a failure to research and promote more environmentally acceptable alternatives.

[34] We gather there has been only one use of management notice powers under the 2001 CROW Act in the decade since these became available.

Currently this system seems to have largely broken down in the last decade. Apparently 78% of sites have not been assessed as to their condition in the last six years[35]. It seems fundamental to us that this situation need to be resolved, as resolving nearly all other problems identified here depend, ultimately, on a good understanding of the state of those species and habitats for which the sites are legally protected.

The lack of regular condition assessments on sites is apparently causing several major landowners both to undertake their own assessments and to progress with active management in the absence of regular inputs from Natural England. This means that the management of some areas may be less than optimal as a result. Whilst there is a common reluctance by major landowners to self- assess site condition – seen as 'marking one's own homework' – where such assessments have been made, they suggest significant variance from extant site assessments that are sometimes over a decade old[36].

Whilst past resources have been made available by government to address this situation, there appears to have been no systematic monitoring of the efficacy of their deployment.

Lack of assessment creates real disincentives for positive management. We repeatedly heard from major/statutory landowners of the difficulties in arguing for further resources for management when the positive outcomes of past management are not formally recognised. This lack of apparent progress (and lack of support for major landowners) creates disincentives for continued investment[37].

Many NE staff and major landowners, did however, have positive suggestions as to how the situation could be improved. At its root is that whilst the Common Standards Monitoring methodology is inherently sound, it is resource intensive. Lack of resources has limited Natural England's capacity to deliver this core function. Many suggested that assessments could be undertaken by or sub-contracted to others, although this would necessarily require training and quality assurance processes to be established.

Additionally, there was general consensus from stakeholders that whilst some new technologies, such as remote sensing, may be useful in limited (and simple) circumstances, it should not be given too much emphasis and can be distracting.

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[35] Answer to Parliamentary Question by Rebecca Pow 17 February 2021 https://www.theyworkforyou.com/wrans/?id=2021-02-09.151834.h&s=%27SSSI%27#g151834.r0.

[36] As highlighted in the National Audit Office's environmental sustainability assessment of the Ministry of Defence (NAO 2020).

[37] A related problem is the lack of modification of citations as a consequence of positive management actions – this also discourages engagement from sympathetic landowners.

Ultimately there is no replacement to assessments made by trained ecologists – ‘ecological boots on the ground’.

Given the challenges faced, there was a widespread view that assessment needs to provide more nuanced information on the trajectory of change: not just understanding whether a site is in favourable or unfavourable condition, but how far the site is from these states or ‘end points’. This is especially important in managing for change.

2.4.9 Feature lists and flexibility: better recognising dynamic processes

An essentially static legal process to manage inherently dynamic ecological processes is not a good mixture. Not only is nature dynamic (well recognised for example in the context of coastal geomorphology) but climate change will bring rapid and unpredictable future changes.

Many consultees stressed the need for existing assessment and management processes to better recognise ecological dynamism – avoiding for example, management driven by the need to achieve precise target states. For example, targets could be set with a tolerance zone around the desired target state.

2.4.10 Relationship with surrounding landscapes

protected areas and their ecological processes into the ecological development of adjacent landscapes. This would require the establishment of buffer areas around SSSIs where sympathetic management would be positively encouraged through policy or land management incentives.

We repeatedly heard of the problems SSSI owners/managers have dealing with impacts arising on SSSIs beyond their boundaries. A high proportion of problems relating to poor site management are out with the control of owner/occupiers, such as invasive species, water quality and quantity (levels), abstraction, and air pollution. These are systematic drivers of decline – but there are currently no effective means of addressing them.

2.4.11 Ecosystem services

There was a widespread view among the stakeholder organisations and staff that the concept is not well integrated or understood at present in the context of management decisions concerning individual sites. That is not to say that services such as water provision and carbon capture and storage should not be recognised where they occur, but the challenge is to deliver these services whilst sustaining and enhancing nature.

2.4.12 Planning for the future

Much of what we have heard in our discussions with stakeholders relates to the need for flexibility and to put in place a system of adaptive management where sites are monitored, and the results used to inform management in real time. Historically, whilst this has been the intention, implementation on the ground has been reduced by funding limitations and by uncertainty over what management to put in place. Looking ahead,

many of the objectives in the *25 Year Environment Plan* will undoubtedly require additional funding and focussed effort to deliver all the planned outcomes.

Threats to the natural interest of SSSIs arise from ongoing change processes, in particular from climate change; but also related to processes of atmospheric and water pollution; the consequences of water abstraction; spread of invasive alien species; and for sites with public access, growing impacts from recreational and other use by increasing numbers of people.

There will be a need for long planning horizons – for example, it took 20 years of action to restore the UK population of Bittern *Botaurus stellaris* (Brown *et al.* 2012), a species with inherently simple ecological requirements. Addressing more complex issues needs to be undertaken within longer planning frameworks and will require functional monitoring and assessment to allow adaptive management of sites individually and collectively.

There are significant current opportunities with the recent, or planned, new policy mechanisms especially within Defra's 25 Year Environment Plan; the 2020 Agriculture Act, and current Environment Bill. These include the proposed Net Biodiversity Gain; Local Nature Recovery Strategies; the Nature Recovery Network; and Environmental Land Management Scheme. There is an urgent need to consider how these opportunities can be used synergistically and for NE to plan to that end. There are also a variety of useful further approaches within Part 1 of the *SSSI Guidelines (*JNCC 2013) that are not currently being fully implemented.

Additionally, recommendations made by the Glover Review of National Parks and AONBs in relation to the delivery of national landscapes at scale and better integration of protected landscapes with other protected areas are important and need to be built into planning. However, these recommendations will need i) new powers to influence land-use and ii) resources to deliver. Notwithstanding that, they provide a valuable further opportunity.

2.4.13 Summary

There was a widespread view from stakeholders that the following three issues should be priorities for attention:

1. design the Nature Recovery Network with protected areas at the core;
2. develop a clear, robust plan to address the condition of existing SSSI; and
3. deliver on outstanding tasks that have long been pending and will assist development of the SSSI network nationally:
    - ✦ implement the third SPA Review;

- designate proposed SSSIs[38]; and
- complete and publish the completeness review of the SSSI network.

[38] https://www.gov.uk/government/publications/natural-england-designations-programme-for-areas-sites-and-trails/natural-englands-designations-programme

Part B. Climate change challenges to English protected areas and desirable responses

3. Climate change impacts: key issues for protected areas

This section of the think-piece considers the impact of climate change and how to design a system of protection that enables effective adaptation and that enhances the overall resilience of the protection regime

3.1 The twin emergencies of climate change and biodiversity loss

England, like much of Europe and beyond, is facing the inter-related crises of biodiversity loss and climate change impacts, (*e.g*. EU's Biodiversity Strategy for 2030[39]. IPCC 2018; IPBES 2019). Climate change is already having a profound effect on biodiversity across the country with significant changes in the distribution and abundance of species and habitats, and increasingly variable timing of what were previously predictable annual events.

It has long been recognised that such change will progressively impact on protected areas and that a re-evaluation of nature conservation practices will be required to ensure that they continue to remain effective (*e.g.* Natural England & RSPB 2014; Duffield *et al.* 2021). Such a re-evaluation is timely, especially given the welcome desire by government to tackle these issues as expressed through the *25 Year Environment Plan* (Section 1.14.1 above; HM Government 2019), and to meet UK's international targets for the designation and management of protected areas. Of particular note is the anticipated 30 by 30 target (CBD 2020), which is likely to become a global target to 2030 (Section 1.14.3. above).

In addition to considering climate change and its impact on protected areas, there is a wider need to develop nature-based solutions to climate change, and to do this as a key part of the UN's 2030 Agenda for Sustainable Development[40]. This recognises protected areas as a key element of land (and sea) -scapes, stressing the intertwined nature of conservation management and the need for holistic, long-term management solutions to be developed and agreed across society.

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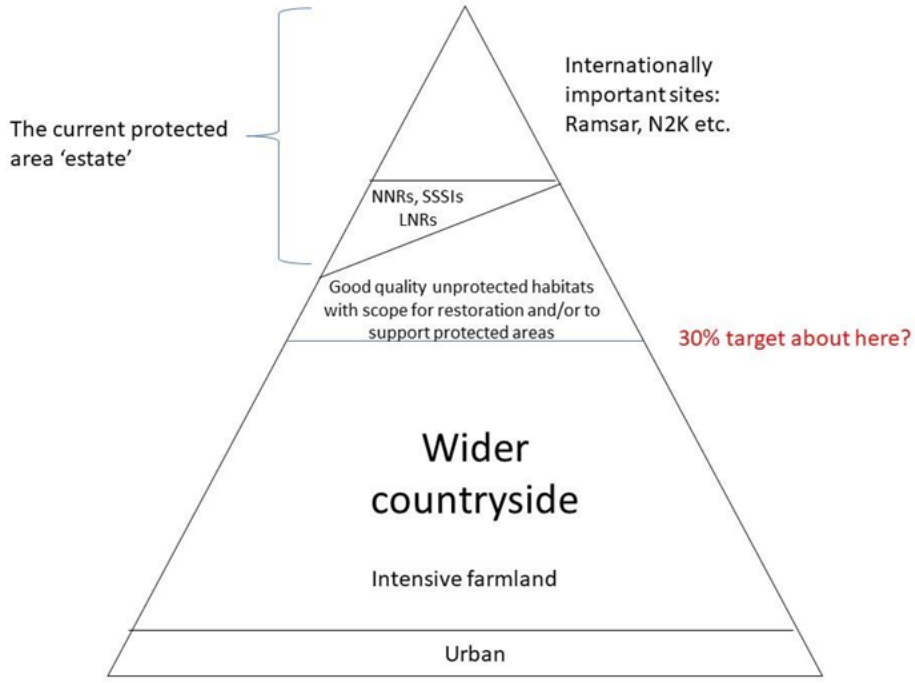
[39] https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en#:~:text=The%20EU's%20biodiversity%20strategy%20for,contains%20specific%20actions%20and%20commitments.

[40] https://www.un.org/sustainabledevelopment/sustainable-development-goals/

Tacking climate change must be more than a responsibility for government and is in fact a responsibility for us all. In that context, the protection and management of the key sites for nature across England is a shared responsibility, albeit that statutory obligations in this regard are for government to deliver.

Figure 3.1 presents the conceptual relationship between protected areas (including SSSIs) and the overall extent of the land in England. However, note that not all NNR or SSSI quality sites have been designated, as these are samples of the total resource only. It makes the important point that if the 30 by 30 target is to be met then management of areas outwith current SSSIs needs to be considered as a matter of urgency to ensure their sympathetic management for biodiversity.

Figure 3.1. Conceptual relationship of protected areas to the 30% by 2030 target.



Perhaps the key challenge for the future is to manage protected areas in an effective, cost-effective, and flexible way in a rapidly changing environment, whilst still maintaining the overall cohesion and resilience of biodiversity in that area. Future management must add value to existing practices and not diminish from them.

3.2 Current extent and nature of protected areas

Whilst this review takes a "zero based" approach to the development of a system of protection, it is important to be aware of the current situation and, as outlined in Part A of this think-piece, to assess what has worked well in the current system and what could be enhanced. Understanding baselines are therefore important in setting the scene for future developments and to begin to consider options for increasing resilience to climate change through adaptation.

Figure 3.2 (JNCC 2020) shows the location and extent of areas, both terrestrial and marine, under some form of national protection. This shows multiple areas and landscapes legislatively protected covering large parts of the English uplands especially, however with significant areas of land between those protected areas. The lowland situation is rather different with smaller protected areas more patchily distributed though the wider landscape, with larger areas in between.

Monitoring has documented the decrease of species and semi-natural habitats across England (*e.g.* summarised by Maclean 2010; Burns 2013 and others). Typically, this has been due to the intensification and simplification of agriculture; but also includes wetland drainage; heathland loss and damage; coastal land claim; and destruction and conversion of ancient woodland. While each reduction is a direct loss for the biodiversity of the area concerned, such losses also reduce the resilience to further climate induced change overall – increasingly fragmenting the extent of remaining habitat and/or populations[41] . We are therefore starting with a more impoverished baseline of habitats than in previous times from which to build resilience. This is an important factor in climate adaptation as every site lost, however small, is a “stepping stone” less for the restoration of nature and makes adaptation that bit harder for the remaining species, habitats and ecosystems.

Whilst there is more to do in the marine environment, very large areas now have some form of designation, ensuring at least a degree of protection from some (although not all) potentially damaging activities. The number and scale of marine protected areas is impressive, especially given that much of the protection of these areas has occurred recently. With the onset of climate change, however, the underpinning intensity of use of the marine environment is still an issue, and the combination of ongoing impacts and future threats could be particularly damaging.

3.3 Extent of semi- natural habitats in Britain.

In considering options for the future, it is important to determine firstly where the remaining areas of semi-natural habitat can be found, as these areas may well form the basis of any framework to enhance the overall resilience of biodiversity across the country. The Office of National Statistics (ONS) has recently published a map (ONS 2021) of semi-natural habitats (Figure 3.3 below) clearly showing that semi-natural habitats remain across the country but, as with protected areas, there is a focus on larger sites in the uplands, mainly heathland scrub, and on various wetland types and especially woodlands in lowlands. Large areas of land surrounding these areas are currently being managed for a range of land-uses, notably of course for agriculture and for urban development.

[41] As shown for example for lowland heaths in Dorset by Moore (1962) and Webb &Haskins (1980).

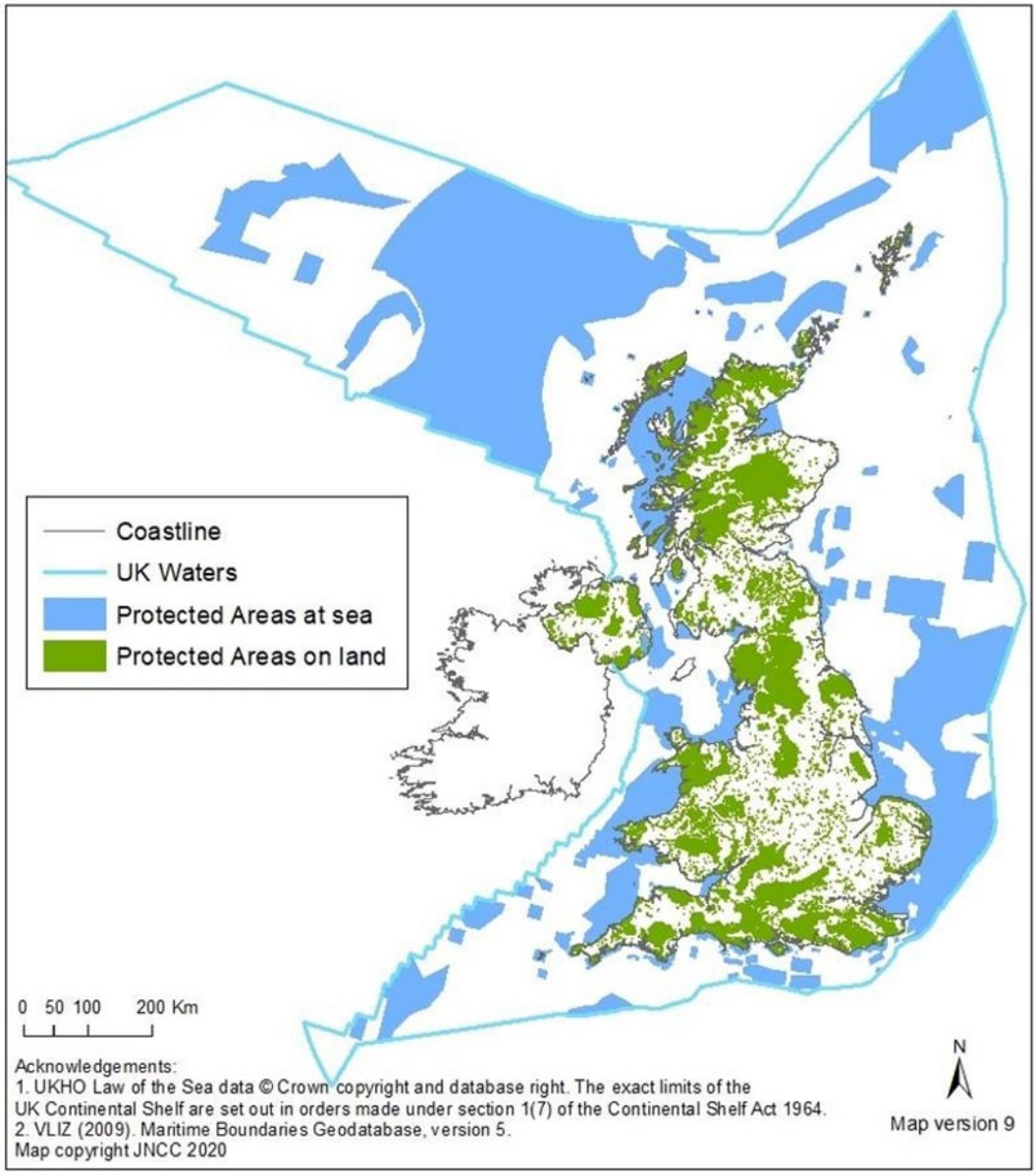


Figure 3.2. Map of UK terrestrial and marine protected areas, as of 25 September 2020.

Source: Joint Nature Conservation Committee (2020) based on its own data and data from Natural England, Natural Resources Wales, Northern Ireland Environment Agency and NatureScot. © JNCC 2020. Reproduced with permission.

Note: Includes the following site designations: Areas of Special Scientific Interest (Northern Ireland), Sites of Special Scientific Interest (England and Scotland), National Nature Reserves, Marine Conservation Zones, Nature Conservation Marine Protected Areas, Ramsar Sites, Special Areas of Conservation (including candidate Special Areas of Conservation and Sites of Community Importance), Special Protection Areas, Areas of Outstanding Natural Beauty, National Scenic Areas and National Parks. Note these designations are dissimilar in their (current) ability to influence land-use and the management of land-use change.

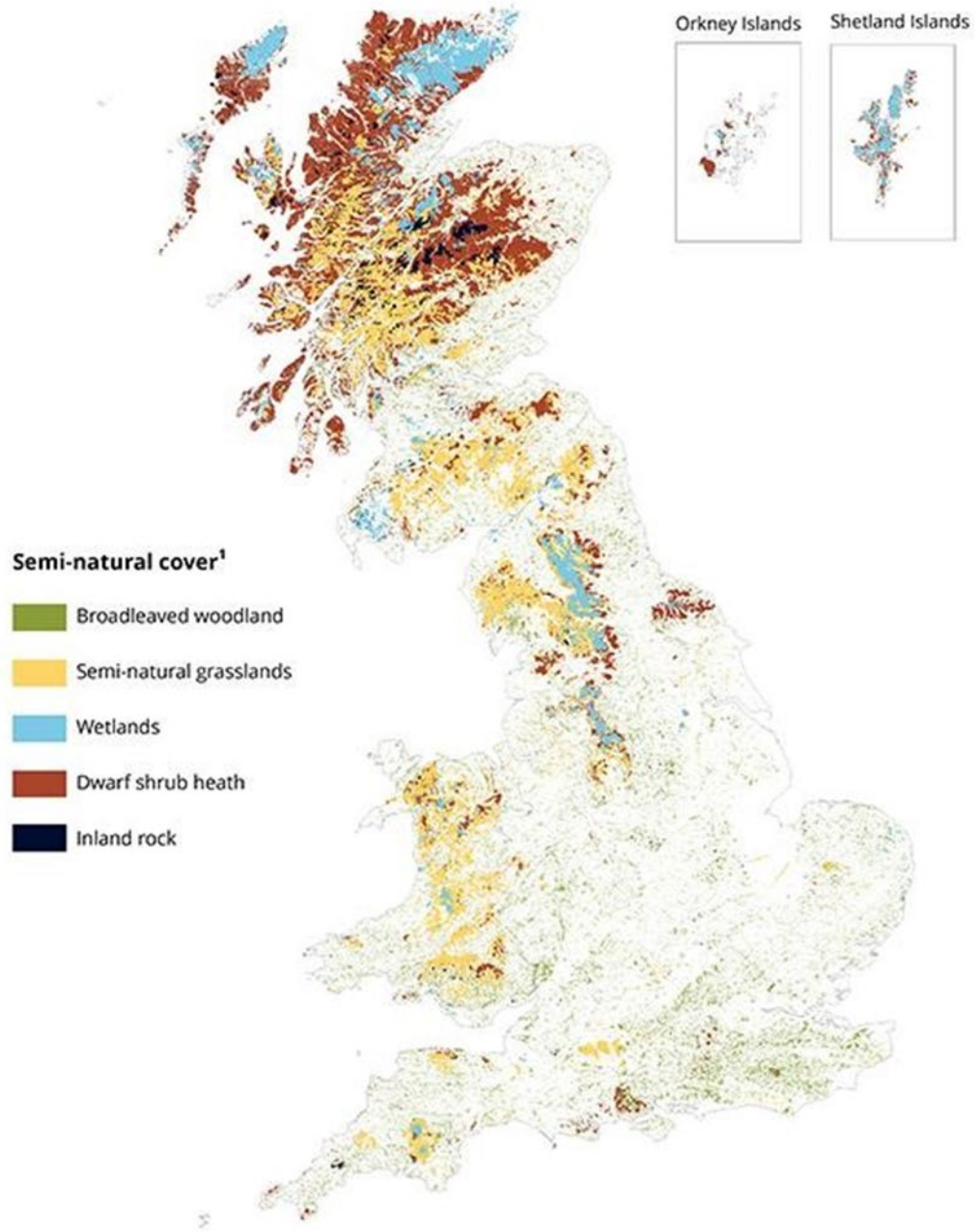


Figure 3.3. Map of inland areas of semi-natural habitat, Great Britain (Office of National Statistics 2021). Available under the Open Government Licence 3.0.

These remaining areas are of considerable value and could form the baseline for a more extensive network in future. A 2021 report from the Office of National Statistics provides an up-to-date assessment of semi-natural habitats across the UK and concludes that:

- *Our most natural areas of the UK, semi-natural habitats, occupy 32.6% of the land area of the UK with 8.02 million hectares.*
- *The annual value of services from the UK's semi-natural habitats is estimated at £7.0 billion in 2018.*
- *There were an estimated 1.7 billion hours spent on recreation in semi-natural habitats in 2018.*
- *The removal of air pollution by semi-natural habitats in the UK equated to an estimated saving of £634.1 million in health costs in 2018.*

- *The asset value of UK semi-natural habitats was estimated at £269.8 billion in 2018.*

Clearly these semi-natural habitats are of enormous value to the country and provide core elements on which to base the creation of a network of protected areas that could maximise resilience to climate change and directly contribute to the post-covid "green recovery".

Drawing examples from the global perspective:

- If networks of mangrove swamps can protect tropical coastal areas, then can saltmarsh do the same for England's' coasts?
- If tropical rainforest locks up huge amounts of carbon can native woodland do the same here? and,
- If tundra peatlands are a global reservoir of carbon-rich peat, then so too is the peat within English uplands and in lowland peat soils.

The occurrence of each of these semi-natural ecosystems in England provides an opportunity to build on their current extent and quality, and to demonstrate good management throughout. They also provide opportunities to demonstrate that society has the desire to manage such areas in sustainable and innovative ways to adapt to climate change, and that this approach, if undertaken correctly, can be used internationally as a model.

4. Key questions and towards solutions

This section of this think-piece seeks to answer the key underlying question:

"If we were to arrange the protection and conservation of important habitats, species, and geological features in 2021 from scratch, what should we create in the face of climate change"?

The following section identifies the central issues in adapting to climate change, and which formed the basis for discussions with stakeholders (see also Appendix 4).

Issue 1 How can we develop a vision to guide future SSSI management?

Developing such a vision will be complex and will require significant and continuing consultation with multiple stakeholders (especially the major statutory and other landowners, and conservation NGOs) if it is to be adopted and implemented nationally. This needs to be an iterative learning process for all concerned (see section 2.4).

There are several underpinning options that could guide the vision and the management that stems from it, namely:

4.1.1 Overarching management options

Option 1 – **"Do nothing".** Ecological change would be allowed to happen "naturally" irrespective of its cause, so in this case, climate induced change would be allowed to proceed without interference.

Option 2 – **"Maintain the status quo".** Sites and other areas would be managed to maintain existing species, habitats, and the wider ecosystems present. Arguably this is close to current conservation practice, where considerable effort is deployed to maintain the *status quo*, based on the assumption that this state is desirable.

Option 3 – **"Managed change".** Protected areas would be managed to create a new and more "desirable" mix of species, habitats, and ecosystems. Clearly some conservation practice already takes this approach, for example scrub clearance from heathland, with the underpinning philosophy that the new state for the protected areas is more desirable than at present.

Option 4 **"Ecological anticipation".** The scale and nature of climate change impacts on many species and habitats suggests a range of scenarios that could occur (Johnson *et al.* 2013; Natural England & RSPB 2020). Whilst knowledge about the nature of change remains imperfect, and there will always be some risk in managing protected areas for specific outcomes, decisions will nonetheless need to be made soon to consider the creation of new protected areas (or at least buffer areas of sympathetically managed land and sea) in anticipation of colonisation by desirable species and habitats. Creation of these areas could be used to mitigate losses elsewhere in the network of protected areas. Such 'ecological anticipation' is already recognised in international decisions[42] and in some domestic conservation practice but has, as yet rarely been applied in practice[43].

In all four options, it is important to have an effective monitoring system in place with clear and simple feedback to ongoing management, so that any changes detected can be considered in future management plans.

[42] *E.g.* Convention on Migratory Species 2017. Resolution 12.21. Climate change and migratory species.

[43] However, the creation of multiple inland reed-beds since the 1990s in response to the realisation that the major extent of habitat for Bittern *Botaurus stellaris* on English coastal reedbeds was under long-term threat from saline intrusion and sea-level rise, is a successful example. This has resulted in major expansion of Bittern distribution (and numbers) and has significantly reduced dependency on coastal reed-beds.

4.1.2 Scale of management

Future choices about how to manage protected areas are profound and considering these issues at the appropriate scale will be important. The context for decisions could be significant and differ at different scales:

> **1. Individual sites.** Where protected areas are considered only in their own right, such that every site would be managed without direct reference to management occurring elsewhere. This approach is similar to management of the current SSSI system where sites are selected in "Areas of Search" across the country (NCC 1989) but with individual sites managed for (only) their own interests.
>
> **2. Portfolio**. Where protected areas are considered as part of a "portfolio" of sites with a number of areas holding a similar assemblage of species, habitats and ecosystems managed in a coordinated way, with similar outcomes expected. This shows some characteristics of the current SSSIs system, where sites are selected to be part of a number of sites that provide a "representative sample" of the features being protected, however, making management decisions at the portfolio level is rare.
>
> **3. Networks.** Where protected areas are managed as an ecologically inter-connected network and where the level of management objectives is set at network level with monitoring geared to address "change" at that scale. In this model, and given the observed rate of change, then it is conceivable that parts of a network may change considerably whilst other parts may not. Developing adaptive management to deal with this network level variability will be critical.

The characteristics of each site has been shown to influence how effective it is at sustaining a significant biodiversity resource overall (Lawton *et al.* 2010; Crick *et al.* 2020), with larger and more connected sites anticipated as being more resilient to change and species loss (Schaffer 1990; Lawton *et al.* 2010). It is clear from this that managing at "scale" may have benefits in terms of adaptation and retention of the interest on sites.

A key future issue is how to evaluate change and how, in practice, to measure 'resilience'. From this there will need to be some measure of levels of "acceptable" change (noting that climate change effects are now unavoidable, IPCC 2018), and what is an unacceptable level or rate of change. So, in terms of future action:

- consider how to evaluate change; perhaps measured against the current distribution of species and habitats on a protected area. consider how to measure resilience; noting that this will be difficult to do, with further work needed to consider ecosystem processes as well as work to provide the wider ecological context for a range of species and habitats by learning from other areas. For example, do similar species and habitat assemblages occurs elsewhere and how have they dealt with climate change in more extreme locations?
- evaluate levels of acceptable and unacceptable change; requiring further work with stakeholders to provide some metrics here, and
- agree the "outcomes" expected over an agreed timescale.

Whilst these aspects may seem theoretical, they are fundamental to developing an effective response to climate induced and other causes of change.

In terms of future management objectives in practice then previous work remains relevant as a key aid to management of sites in practice. For example, see Table 4.1.

In addition, Crick *et al.* 2020 stressed several key aspects to consider in the future design and management of networks of sites.

"To make core wildlife sites 'Better' is to make them 'Big Enough, Messy, Complex and Dynamic'. Restoring natural ecosystem function is the best means of achieving this.

- *'Big enough': Core sites need to be big enough to be able to function well ecologically, with natural hydrological processes and rich food webs, so that they are more resilient.*
- *'Messy': sites that are physically messy, with mosaics of habitat, and a diverse structure that provides more niches for species and refuges in times of environmental stress (*e.g. *drought).*
- *'Complex': sites with a complex and rich biodiversity and full food webs, as these will be more resilient to external shocks and environmental stresses.*
- *'Dynamic': well-functioning ecological networks are dynamic and may involve shifting mosaics of habitat types at a range of spatial scales. In addition;*
- *Climate change refugia should form key parts of ecological networks as they are likely to improve resilience for species within landscapes.*
- *Rare, long-distance dispersal events are likely to be important for many species, so receptor site quality and quantity is therefore very important".*

We suggest that a vision to guide future SSSI management could be:

The creation of a large and inter-connected network of protected areas that is overseen by an inclusive stakeholder forum, and that is actively monitored and adaptively managed to ensure its effectiveness at conserving biodiversity and geomorphology in the face of dynamic change.

Stakeholder question – Does this vision effectively describe how you see the SSSI series developing in future?

Table 4.1. Rules of thumb for the design of nature networks, building on the principles of Lawton *et al.* 2010. From Crick *et al.* 2020.

Better site quality	> Bigger sites	> More sites	> Stepping stones & permeable matrix	> Corridors
Encourage natural processes Encourage habitat mosaics Create more niches for more species – use 'ecosystem engineers' and welcome ecological disturbance Increase messiness (variation of physical structure within sites) Restore missing biodiversity by increasing niches or by reintroduction Maintain rare species	Big enough to encourage natural processes – include sufficient area to ensure functioning ecosystems Provide space for ecosystem dynamism, supporting mosaics and to encourage succession Reduce edge effects by decreasing the edge : area ratio Join habitat fragments; choose the ones that will create the biggest site Restore degraded habitat surrounding the site	Add larger sites in preference to many smaller sites Target areas of unprotected irreplaceable habitat or with a long ecological continuity of unintensive land management Target areas with complex or additional topography & geomorphology and with a potential to be climate change refugia Target areas of important habitat potential in the surrounding area. Target degraded areas with potential for high ecosystem service delivery. Ensure connectivity is good for new sites	For poorly dispersing species, sites should be < 1 km from each other and < 200 m apart for highly specialised species within a habitat Expand sites towards existing habitat to reduce space between patches. Increase the cover of seminatural habitat in landscape to at least 20% Reduce the intensity and increase the diversity of land use in the surrounding countryside Stepping stones should provide appropriate resources to avoid becoming ecological traps	Natural corridors are better than human designed corridors Use linear landscape features Ensure corridor habitat matches that in core sites Minimum width of corridors = 100 m, preferably wider

Better site quality	> Bigger sites	> More sites	> Stepping stones & permeable matrix	> Corridors
Encourage climate colonists Reduce edge effects by buffering sites and encouraging graded ecotones to 'soften the edge' Buffer sites with at least a 50-100 m buffer strip, possibly up to 500 m wide Maintain ecological continuity of management to protect soils	Enlarge sites to >40 ha (or >100 ha for wide-ranging species			

Issue 2. How could stakeholder/community involvement in monitoring and management of protected areas be enhanced?

4.2.1 Involving stakeholders in the management of protected areas

Tackling the twin emergencies of climate change impact and biodiversity loss will increasingly need to become a national effort, involving government and the public, in combination with the protected areas stakeholder and land management community. Developing systems to ensure that stakeholders and managers are integral to future management and monitoring should be a key aim of any initiative involving protected areas.

National responses to other aspects of climate change interacts with, and will be relevant to, the nature conservation agenda. Thus, for example, greater rainfall will result in greater flood risks nationally, with relevant flood risk management likely to result in more managed flooding (temporary water impoundment) in inland areas. This will create both opportunities and problems for protected areas on river flood plains and the development of catchment management plans in this example is a very welcome step forward. Tackling such issues at scale and in a holistic manner, involving stakeholders from the outset, seems to be the most productive approach.

Other parts of the UK are already considering the development of a pilot study to trial innovative ways to involve local communities and land management stakeholders in the identification of the management objectives for protected areas, thereby increasing their involvement in the active management and monitoring of these areas. In that case getting dialogue started about management across a number of protected areas will probably need to involve the establishment of a series of local fora to enable collective dialogue, hopefully leading to agreement on the way forward.

In terms of direct involvement in the management of protected areas, then a shift to paying managers for nature conservation outcomes as proposed in recent government policy and legislation (Agriculture Act; Environment Bill; *25 Year Environment Plan*), rather than simply paying for undertaking activity or processes, is likely to pay dividends in terms of future delivery. This approach, linked to the development of regional level biodiversity targets, set across protected areas and their surrounding landscapes, could ensure that planning “at scale” begins to be seen as a fundamental part of how these areas are managed. This approach would require:

- The establishment of fora to enable discussion and agreement on management objectives, and on monitoring. Whilst it is clearly important to limit the bureaucracy of such a scheme, some level of governance is essential for its success.
- The identification of an appropriate scale for landscape planning for nature conservation across England.
- The development of regional nature conservation targets. This would require further scientific analysis on how to develop multi-species, habitat and ecosystem level targets across England that take account of likely climate induced change.

Targets could involve the assessment of species and habitat type across the country to develop a series of ecosystem complexes (species and habitat assemblage “weather maps” of the countryside indicating what is, or should be, present across England) to allow greater targeting of effort in future. This has the potential to encapsulate the concept of “ecological anticipation” as outlined in section 4.1.1 above, where regional plans are used to facilitate the overall resilience and adaptation of the countryside.

- The development of a funding scheme where land managers are rewarded not simply for actions on their own land but where rewards can be “topped up” if regional targets are delivered (in effect rewarding good delivery at a wider scale). A combination of local and regional stakeholders could therefore be involved in the overall delivery of such a scheme.

4.2.2 National level stakeholders

It is important to note that national level stakeholders are an important part of the overall approach to site management and monitoring. There is a range of nationally coordinated monitoring schemes that have important data and information collected on protected areas. This data and information, along with other locally collected information, should form the basis for monitoring the overall “health” of protected areas. It may be necessary in some cases to re-orient some data collection effort to ensure that protected areas are adequately monitored. The development of a risk-based approach to monitoring where sensitive and fragile sites, prone to climate induced change or with dynamic management challenges, are monitored more frequently than other areas seems the right way to take this forward, ensuring that national stakeholders are a key part of the process in future.

In summary, involving local and national stakeholders in the monitoring of protected areas is an important aspect of any new system that is developed. This involvement is important to obtain data and information but is likely to have the added benefit of enhanced advocacy for protected areas and greater appreciation of the value of such areas from those taking part in the work.

Stakeholder question – Are there other, additional approaches that could be used to involve stakeholders in the future management and monitoring of SSSIs as the need for adaptation due to climate change develops?

Issue 3. How can we create the wider policy environment (at multiple scales) that needs to be developed to maintain and ensure the greater effectiveness of protected areas in future?

4.3.1 Future nature conservation practice

Conservation policy and practice on protected areas tends to be driven by the need to implement legislation at the international, national and local levels. Whilst management action by individual stakeholders is of course important, getting the underpinning legislative and policy framework right is a key step in the initiation and delivery of an effective network of protected areas. We have seen earlier that international treaties and

national conservation guidance can be framed to anticipate climate induced change to biodiversity. Whilst scientific work in relation to adaptation in both the terrestrial and marine environments is developing rapidly, getting the principle of designating or at least managing areas of land and sea in anticipation of the highly likely change in the distribution of species and habitats, has yet to be fully embedded in legislation and/or in nature conservation policies, so is a clear action for the future.

4.3.2 Scale

The scale of consideration and planning is a key issue to address for the future. It has been observed by some that all conservation action happens locally and whilst this is true, such action is driven by legislation and policy focussed at the regional, national, and international level. For example, conservation action to protect a local wetland will take place within regional planning policy, national wildlife legislation and the principles of management should accord with international conservation action under the Ramsar Convention.

The fundamental point to be agreed at the outset is the appropriate scale of planning and delivery. We advocate that planning is considered at a larger scale than in the past, and that a regional level of planning is worthy of further consideration. Planning at this landscape scale (large ecology scale) allows consideration of protected areas in the context of the wider landscape in which they sit, making a holistic assessment of the situation possible.

4.3.3 Regional biodiversity targets

As mentioned previously, explicitly linking action under the various existing and future agricultural support policies and other incentive schemes to regional biodiversity targets has the potential to create a win-win outcome for climate adaptation and for nature. For example, linking agriculture policy and support scheme outcomes, flooding policy and practice, coastal management and other land management incentives to a series of wider biodiversity targets that had protected areas at their core would be innovative, and need not in itself to be more costly than at present.

Developing such a series of target or focal species, habitats and ecosystems across England could be based on existing work by Natural England and need not be an overly difficult or prolonged scientific exercise. The development of regional targets could begin by considering the key interests in protected areas in a particular region, set within an analysis of regional biodiversity. For example, a region holding several grassland SSSIs could have a regional target to expand that interest, especially around existing sites, and a wider target to enhance grassland habitat, invertebrates, and bird interest across the region. The detail of the particular habitat and species assemblage that formed the target would vary across the country, but the principle of regional targeting would be consistent.

4.3.4 Sympathetic management surrounding protected areas

Using support policies to ensure that protected areas are surrounded by areas of sympathetically managed habitat (on land and in the marine ecosystem, as appropriate), seems to be an obvious policy aim, and could be a key step in linking existing sites and in creating a climate-adapted network. Such an approach is encouraged in several international Conventions and two examples from global conservation action are particularly relevant here, both providing useful models for further consideration in terms of any future approach to develop a network of sites. Both the Ramsar Convention and World Heritage Convention advocate the creation and maintenance of “buffer zones” of sympathetically managed land around core protected areas. In the context of this think-piece, the creation of buffer areas, created and managed explicitly to anticipate and facilitate climate induced change, seems an approach worth further consideration as part of any new countryside management or support scheme that might be introduced. Indeed, some existing initiatives could easily be linked to such an approach – see below.

4.3.5 Current policy initiatives

In developing this think-piece, and in discussion with stakeholders, it has become apparent that several of the policy building blocks needed to create a more nature-friendly landscape and a future network of sites are already in place. This is encouraging, as is the clear common direction of travel across government, Natural England and in various stakeholder bodies and in the non-government community.

For example, the *25 Year Environment Plan* contains innovative approaches and large-scale recovery targets (HM Government 2020); the Nature Recovery Network being taken forward by Natural England provides a major focus on connecting existing protected areas and the new Environment Land Management Scheme (ELMS), has the reduction of, and adaptation to, climate change as one of its key objectives. Importantly, the scheme includes an on the ground pilot that will provide an opportunity to test and improve the scheme design before its full roll-out in late 2024.

The national pilot of ELMS will be a mix of large and small pilots, to help test different approaches. These pilots will mainly test:

- how best to construct different types of ELM agreements at different scales
- how to target ELM incentives to provide specific environmental outcomes in specific areas
- underlying scheme mechanics – for example, applications and payments approach and the use of advisers.

In addition to these schemes, a range of stakeholders are putting in place work on the ground to complement these government funded schemes. For example, the Wildlife Trusts are developing the concept of a “Wildbelt”, that would put nature at the heart of planning and protect land in recovery for nature from development.

In developing this think-piece we have been struck by the enthusiasm of the various stakeholders to implement a variety of policies and schemes on the ground in

coordination with Natural England and whilst this represents a real opportunity, the challenge is to make sure all these initiatives work together to maximise their collective positive outcome for biodiversity in the years ahead.

In summary, creating and implementing wider nature conservation policy at scale, with regional biodiversity targets, focussed on protected areas and on the remaining areas on seminatural habitat as well as on the areas surrounding them, is seen as a key step in helping adaptation to climate change. Several existing schemes include elements of this approach, and if implemented fully, have real potential to assist in enhancing the adaptation and resilience of the countryside.

Stakeholder question: Does this adequately sum up the situation or can you suggest additional actions that might be required to produce a policy landscape that could enhance the effectiveness of protected areas in future?

Issue 4 What are the merits (and challenges) of developing an ecologically linked network of protected areas across England?

There is a significant body of evidence to suggest that protected areas that are large and that are connected to other similar areas tend to hold more biodiversity and that such areas may be more resilient to change (Lawton *et al.* 2010).

There is considerable merit in developing an ecologically linked network of protected areas, both on land and in the marine environment, that fits within a wider climate change adaptation framework for England and that anticipates and reacts to changes rather than simply being a static system. Actively managing such a network is likely to be key to its long-term success. The challenge is how to achieve this, and the following lists some of the issues that are likely to be involved in its creation:

- It is important at the outset to be clear what is being linked and why. In summary, ecological linkage for what? Which features, species, habitats and ecosystems are to be linked?
- How would the protected areas forming the network be selected? Would every site have to qualify above a particular threshold of interest, or would the assessment be at the network scale only? There is a significant difference in the two approaches, hence the need for a clear decision-making process as part of any initiative to create a network.
- Would sites be selected for particular features, as now, or for their “whole biodiversity” or for the ecosystem processes they contain or support?
- How would network scale decisions be taken? Currently management decisions are taken on a site-by-site basis, governed largely by current legislation that focusses on maintaining particular “features” on sites as the rationale for the protection of individual sites.
- How would adaptation to climate change be built into the network in terms of size, number of sites and how these are managed?

- How would the regional nature of biodiversity across England be accounted for in any network? Could local priorities for conservation action be included to enhance the direct link to local communities and to help ensure their engagement? Setting regional targets as part of the country-wide network has the potential to deliver real benefit locally; for example, larger areas of good moorland habitat in Yorkshire and the Peak District – larger and better-connected native woodland in lowland areas, and managed retreat for coasts.
- How could national legislation be adapted or interpreted to allow the creation of a network and how would this ensure its effective protection going forwards?

Whilst much further work is required to evaluate exactly how best to develop such a network, there are some general approaches that provide useful insight on how this might be done. Box 4.1 below provides an example from the work of the Bern Convention, that seem particularly relevant here. For further information see: Recommendation No. 206 (2019) of the Standing Committee, to the Bern Convention adopted on 6 December 2019, on nature-based solutions and management of protected areas in the face of climate change.

Box 4.1 Text from Recommendation No. 206 (2019) of the Standing Committee of the Bern Convention, adopted on 6 December 2019, on nature-based solutions and management of protected areas in the face of climate change.

Expand existing protected areas and ecological networks to achieve win-win measures for adapting sites, habitats and species to climate change and for developing nature-based solutions to mitigate climate change and disaster risk reduction;

Seek to engage wider land management, beyond Emerald and Natura 2000 sites and other protected areas' boundaries, to adapt to climate change in ways that support biodiversity and habitats condition both in sites and in the wider countryside;

Promote climate change adaptation, climate mitigation and biodiversity conservation in agricultural and other relevant land management policies, thus enabling win-win measures and practices;

Analyse national protected areas and ecological networks to assess how they contribute to adaptation and mitigation challenges of climate change, including the reduction of disaster risks;

Develop strategic spatial planning for nature-based solutions/ecosystem-based approaches to climate change mitigation, adaptation and disaster risk reduction and green infrastructure implementation, thereby supporting and encouraging land managers to implement them;

Step up awareness-raising on the benefits of biodiversity and nature-based solutions in the context of climate change and disaster-risk reduction, aiming at closing the communication gap between scientists and conservation practitioners, policymakers, relevant sectors and businesses as well as contributing to multiple SDGs simultaneously;

Develop communication plans, including cooperation with media, social networks and other communication channels, to raise the awareness of the public and to draw the attention of decision makers on the importance of nature-based solutions, of considering local knowledge in disaster risk reduction strategies and in improving the prevention of natural hazards;

Promote formal and vocational education programmes for practitioners and managers which include climate adaptation management, both in and beyond Emerald and Natura 2000 Network sites and protected areas in general;

In summary, whilst there are several important issues to resolve in the creation of an ecologically linked network of protected areas, we do see its creation as a major step in developing an effective approach to adapt to climate change. Ideally, sites would be large and with clear links to other areas, surrounded by areas of sympathetically managed land or sea, and with a degree of flexibility and responsiveness to change built into the whole network. This flexibility may manifest itself in the management techniques being deployed, or in the exact shape and size of the site boundaries. Incorporating such flexibility would be a significant change from current practice, hence the need for much further "real world" exploration of the issues involved.

Stakeholder question: Do you agree that the creation of a network as outlined here is desirable and would your organisation be willing to take part in its development?

We suggest that a relatively short-term pilot project is considered (short-term so that there is no undue delaying in the wider development of a network), to explore the issues

involved in the creation of a network further. It is important to note also that the creation of a responsive and adaptive network is likely to be easier to achieve with effective stakeholder engagement and involvement. Ensuring that stakeholders are aware of the significance of the challenge and the key role that they could play is important.

Issue 5 How could protected areas be managed and monitored to maximise their resilience to climate change and what part do they play in helping mitigate climate change effects though carbon sequestration and storage?

4.5.1 Management choices for now and for the future

Learning lessons from the management and monitoring of protected areas is of fundamental importance in underpinning the development of a flexible and effective system of protection for species, habitats and ecosystems, that is resilient and that adapts as far as possible to climate change. Further consideration is needed in terms of the planning timescales required to create such a network, and it is immensely difficult to predict the exact nature of the climate related impacts that are likely to be seen over the longer period. We do, however, suggest that a fifty year forward look is both necessary and practical in terms of planning for the longer term; for example, for woodland management or other habitat regeneration. Clearly, many habitat management schemes will show real benefit in a much more rapid timescale, for example wetland creation may be relatively fast, but unless a longer time horizon is considered some opportunities and potential schemes may not seem viable and consequently may not get started. In summary, let us not miss opportunities to put things right over the long-term by only taking a short-term view.

Adopting such a timescale could be useful also in that it would see the implementation of two twenty-five-year Environment Plans, provide a structure for monitoring long-term change and could be linked to formal reviews of the situation and of progress, say every ten years.

A theme underpinning this think-piece is to suggest that effort should be directed to maintain and enhance the resilience of protected areas now to attempt to “smooth out” any change and give biodiversity time to adapt. This may or may not prove to be possible given the rate of change already being seen but it is an important underpinning principal for action. The implication of this approach is that known threats should be the focus of renewed activity now, supported by professional judgement on the practicality of any management put in place.

The immediate challenge is to minimise threats to existing protected areas and to other seminatural habitats, to maximise resilience, so that species and habitats can adapt at a pace that still allows their overall survival. This is a fundamental challenge at the core of tackling the “biodiversity emergency”, however, tackling existing, known threats should not come at the expense of wider consideration of the need to create a network of protected areas across the country. It is important, therefore, to be clear what the management goals are for each protected area, how they relate to the known threats to

that area, and to any wider, national, adaptation strategy for the species, habitats and ecosystems concerned.

Recent debate has focussed on the option of getting multiple management outputs from protected areas, including especially their role in carbon sequestration. In terms of the overall management of protected areas it seems that there are options to manage for:

- Features as per the current legal focus only, or legal features alongside:
- Whole of biodiversity or
- Whole of biodiversity, carbon sequestration and storage, or
- Whole of biodiversity, carbon sequestration and storage, climate change adaptation plus other economic interests.

Clearly, some difficult management decisions will be required in future, and again it is suggested that further work is considered to look in detail at the practicalities and trade-offs involved in developing multiple outputs from protected areas. See section 5.3 below.

Further work is also required to develop a biodiversity metric to measure the “whole of biodiversity” as suggested above. Clearly this could focus of the assemblage of species and habitats and species present (both above and below ground) on sites but the challenge will be to develop a system of measurement that is both scientifically meaningful and that is cost-effective to deploy in the field.

4.5.2 Linking monitoring to management action

Developing an actively managed network will require that the “state” of the resource is known and that changes are tracked over time. Having a clear feedback loop from monitoring to management is a prerequisite for the development and effective management of a network of protected areas. As climate change progressively impacts then local management will probably have to change and it will be increasingly important to be clear about what is happening and what management measures are needed.

One aspect that has come up as a recurring theme from those stakeholder organisations that we discussed the development of this think-piece with has been the importance they attach to monitoring of protected areas. Organisations have committed significant resources to the management of protected areas that they own or manage, and they need to know whether their investment is or is not being successful and cost effective overall. Providing feedback on the results of monitoring to stakeholders is important to ensure their continued support and investment in the future management of protected areas.

Looking forward, it is important to consider how management information will be used at the outset of any monitoring scheme as this can influence how the monitoring programme itself is framed. Alongside this, consideration of how decisions about management will be made and what range of stakeholders need to be involved in this process will be important. Having such a process in place will avoid *ad hoc* management actions and will progressively systematise the use of monitoring to underpin management action.

Ecological monitoring is of course an expensive practice and it is important to determine the scale of consideration and what aspects of protected areas are to be monitored across the network in future. Options are to monitor:

a. Particular features (only) within a site.
b. Whole sites (all features).
c. A portfolio of sites (a number of areas holding similar features but not necessarily ecologically connected).
d. A network of sites (a number of ecologically linked areas).

Additionally, there are judgements to be made about the intensity of monitoring required in each case; so how often or at what level of detail is data required, and with what certainty of detecting specified change? This may of course be guided by the questions being asked to inform management; by the relative fragility of the area, and by what rate of ecological change is already being observed. It may also be informed by the degree of threat any area is under, so for example it may be desirable to monitor a fragile and threatened habitat, or rare and ecologically sensitive species, more frequently and in greater detail than a habitat or species that is known to be stable and not threatened.

Implementing a tiered approach based on “risk” to inform monitoring is underway and including vulnerability to climate change as a key “risk factor” in future will help ensure that a more holistic approach is adopted. Developing a risk assessment for protected areas in relation to climate change to inform monitoring activity undoubtedly merits further consideration, as does further examination of how best to measure the ecosystem processes that underpin protected areas.

There are further judgements to be taken about the level of risk that is acceptable in not having accurate and timely information about the status of any area. This may vary depending on the focus of the monitoring programme; so, for a network, then a “risk-based approach” could mean that only a proportion of the areas involved may be monitored, or monitored on variable schedules, with assumptions made about how the results from this activity may relate to other areas in the network. How acceptable this will be to land managers and other decision makers has yet to be fully tested.

4.5.3 Managing for carbon and other ecosystem services

The Millennium Ecosystem Assessment (Millennium Ecosystem Assessment 2005) was a key, global assessment, demonstrating the nature and value of ecosystems around the world. It stressed the inter-relatedness of ecosystem services and the link to biodiversity as the “glue” that holds it all together. Managing for biodiversity, and maintaining overall ecological coherence, is the basis of having the ecosystem services that we all depend on.

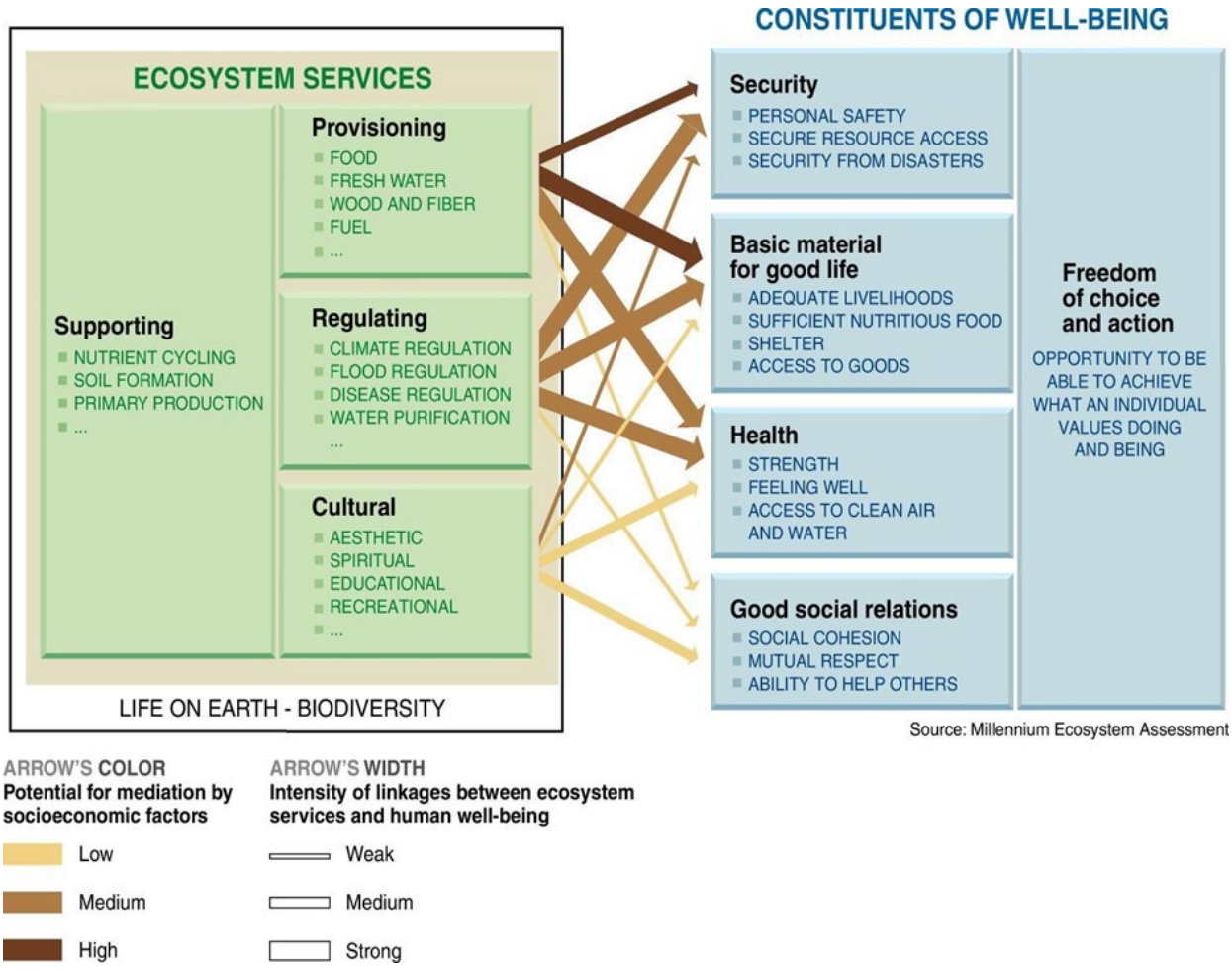


Figure 4.1. Managing for carbon and other ecosystem services**.** Source: Millennium Ecosystem Assessment 2005. Reproduced under their terms of use for graphic resources.

When considering individual protected areas then the ideal management regime will maintain and enhance biodiversity and a range of ecosystem services. In the context of climate change, clearly the ability of protected areas to sequester carbon is an important factor, however, there is a need to consider this aspect alongside the other ecosystem services provided so that a balanced approach that sustains biodiversity (the glue holding ecosystems together) is put in place. Whilst such an approach is probably achievable, it would be useful to work through some real-world examples, with relevant stakeholders to determine the practicalities involved on the ground, including examining the economics of various multioutput scenarios. For example, moorlands in the English uplands sequesters carbon but are also important in the provision of water, flood mitigation, aesthetic

services and for biodiversity hence achieving a truly sustainable approach to their management is important.

The question for the future is, could an ecologically linked network of protected areas be managed in a way that has multiple management targets and if so, how can this be created? The prospect of such a network is indeed attractive, and we have previously stressed the importance of such an approach where biodiversity is helped to adapt to climate change and natural vegetation is used as a carbon sink. “Natural carbon sequestration” that combines the conservation of biodiversity and carbon management is a win-win outcome to strive for. As with previous issues, it is clear that further work is required here to provide greater insight into the potential for multiple ecosystem outputs from a network of protected areas.

In summary, it is important to be clear about the management objectives for any site and for the network. Managing for multiple ecosystem outcomes may be possible but further work is required to clarify the options here. Having an effective monitoring regime in place is of fundamental importance to being able to manage an adapted, resilient, and responsive network of sites.

Stakeholder question: Do you agree with this analysis and how important to you is achieving multiple ecosystem outcomes?

Issue 6. How should the management and monitoring of new and existing protected areas be implemented, especially where current legally defined features are declining in extent or in number, and (in extreme cases) already absent due to climatic effects?

4.6.1 Current management

Site-based nature conservation practice over recent decades has been framed by legislation that requires the identification of clear and fixed boundaries for protected areas, within which management has focussed on maintaining the status of particular features. The selection of protected areas (e.g. SSSIs and Natura 2000 sites) has broadly followed a two-part process, firstly identification and quantification of the particular feature in need of protection, followed by the identification of appropriate boundaries for the site, drawn to encompass the area judged to be required for the long-term survival of the feature concerned. Changes to the boundary of any site can be made only after a formal, legal process has been completed, with this normally taking some considerable time and expense.

The onset of climate change has thrown into sharp focus two weaknesses in current practice, namely the requirement for fixed boundaries around protected areas and the requirement to designate sites only for features that are present there at the time of legal designation. The combination of these approaches makes building flexibility into the system and “ecological anticipation”; having protected areas for new colonising species or for habitats that are spreading into new areas, difficult.

Two examples do, however, serve as possible ways to develop flexibility; firstly, the selection guidelines for some features on SSSIs do now contain the ability to include areas where, with reasonable scientific judgement, particular features (species) will be found in the near future based on their present distribution, with examples of these species already nearby. Secondly, the international Convention on Migratory Species (CMS) now includes the ability of countries around the world to take measures in anticipation of species arriving within their territory, again based on scientific judgement of the likelihood of such colonisation. Whilst these two examples are encouraging, they are rare examples of such flexibility helping overall adaptation and resilience. In this context the assessment of Favourable Conservation Status (FCS) may need to be more flexible to accommodate the changing distribution of species and habitats, however, climate change impacts should not in themselves be used as a justification for not trying to attain FCS on protected areas.

4.6.2 Future choices

Looking specifically at the management of sites and their boundaries, and building on the issues discussed in section 4.1.1, there are some difficult choices to be made soon concerning the aims of management on each protected area as follows:

1. **Maintaining the status quo**: manage for the legally defined features as now and try to arrest any ecological change - keep things as they are now as far as possible.
2. **Progressive change**: manage the legally defined features but allow them to change over time, for example in some case by reducing the overall intensity on management.
3. **Natural processes:** manage on a "whole site" basis using the existing boundaries of the protected area and considering the total biodiversity resource (see section 4.5.1 for a discussion on measuring biodiversity), held on the site. The assumption here is that the whole site is of importance and that overall resilience is important.[44] Note that management objectives can of course be expressed in a range from highly prescriptive to more accommodating and flexible.
4. **Boundary flex:** Develop a system of boundary change and flexibility for the protected area that ensures the overall maintenance of the feature/site set within a larger sympathetically managed landscape. This would progressively allow the existing boundaries of a site to be "blurred" by making the surrounding landscape more resilient.
5. **The wider network:** Consider existing sites as nodes in a wider ecological/geological network and evaluate 'condition' and management objectives in the broader context of the whole network. Potentially add new sites to the

[44] Such an option could include forms of 'rewilding' where natural processes are allowed to dominate.

network to compensate for losses elsewhere. An important issue to resolve here is how to assess the condition of the network in future and to decide whether "features" would still need to be the key determinant of condition or whether moving to measure the state of the "whole of biodiversity" or of "ecosystems services" is feasible and is cost effective.

Options 1-5 above may not be entirely mutually exclusive of course, but difficult choices will have to be made and it is generally better to be proactive rather than to have reactive and ad hoc decision on a case-by-case basis. Further work is required on how best to approach these decisions and to consider what action is possible for a range of species and habitats on protected areas. The situation does seem similar to a medical triage to "save what is saveable", but this approach would probably be conceptually difficult for parts of the conservation community to accept, as it implies letting some protected areas change to the extent that existing features disappear. Features may, of course, disappear anyway given the extent of climate change, and hard choices in the use of resources will need to be made about site management and monitoring in future.

The question that follows from the five options above is how to decide on what management option to deploy and what monitoring regime to put in place. In a somewhat contradictory way, making choices about management and monitoring is day to day business for the conservation community and for land managers. However, this level of decision making at the strategic level could be said to be new territory for some, and taking such decisions during climate and biodiversity emergencies could be problematic. None the less, we would encourage radical decisions to be taken and management options tested on the ground, as "doing nothing" will almost certainly lead to the slow decline of existing protected areas; to a loss of resilience and to a failure to adapt that will be particularly damaging. Again, further work is required, probably involving testing a range of management options in practice over the coming years.

Consideration is needed also into the mechanisms to be used to ensure that decisions are taken, as far as possible, with stakeholders fully engaged in the process.

In one important study for example, Johnston *et al.* (2013) assessed the potential impacts of climate change on the UK SPA network by linking distributions of SPA qualifying species to current climate models and then running these forwards to 2050. Broadly, their findings[45] were that:

- in 2050 every SPA still ends up as internationally important for one or more species; but

45 https://www.bto.org/sites/default/files/u4/CHAINSPAN%20FINAL%20REPORT%20POLICY%20SUMMARY.pdf

- these were largely not their current feature list as species distributions moved considerably. Thus, the national SPA network could potentially act as just that – a network of good semi-natural habitat 'nodes'[46].

This result might imply that some combination of options 2-5 above is likely to result in valuable sites for biodiversity being maintained within a more resilient network of protected areas overall. This is, however, at variance with future site management focussed just on existing qualifying species or habitats – option 1 above.

In summary, hard management choices will be required in future as the current legal systems' focus on existing "features" on sites, along with relatively static site boundaries, means that climate change induced shifts in the distribution of species and habitats will be difficult to accommodate under the present approach. The development of a network approach, creating new sites to compensate for losses elsewhere, offers one approach to build flexibility into the system.

Stakeholder question: Does this effectively describe the challenges you are facing in managing your sites and do you have real examples of the choices you are having to make?

[46] Whilst the Johnston *et al.* study involved predictive modelling, a recent continental-scale analysis of non-breeding waterbird distribution demonstrated that such redistribution within a protected area network is currently happening. Smew *Mergus albellus* are abandoning SPAs in central and southern Europe and occupying SPAs classified for other species in northern Europe (Pavón-Jordán *et al.* 2015)

Part C. Summary and conclusions

5. Moving forward

This think-piece has explored a range of issues related to the effectiveness of protected areas in England over recent decades, focussing on the SSSI system. It has considered the ever-increasing effect of climate change and addressed some of the key questions in relation to developing a robust approach to the role that protected areas can play in the overall conservation of species, habitats and ecosystems across the country.

This final section outlines a series of actions that could be put in place to progressively increase the overall resilience of the protected area system to the impacts of climate change. It is important to note, however, that even the following actions cannot stop the series of changes to the ecology of the countryside that are now more or less inevitable in the medium term at least due to 'locked in' climate change (IPCC 2018). It is known that the climate is warming, that severe weather events are increasing and that impacts are getting progressively more severe.

In summary, the SSSI series has been critical in maintaining England's biodiversity and continues to perform such a role. As noted previously, the underpinning concept of the SSSI designation to hold a representative sample of features, was undoubtedly sound when it was created, however, a range of issues have arisen related to implementation over the years, and these, linked to changing expectations regarding the purpose of SSSIs, means that the current consideration of future options is timely and important.

The SSSI series and associated processes have faced multiple challenges since its inception in the later 1940s, namely:

- its limited statutory basis prior to 1981;
- the long process to develop formal selection guidelines;
- legal 'loop-holes' in the 1981 designation process subsequently resolved through later legislation;
- its early lack of focus on positive management needs and limited ability to deliver these;
- the consequences for biodiversity of extreme land-use change, especially the intensification and industrialisation of management processes in surrounding land- (and seascapes);
- the lack of scope to protect the marine environment until more recent marine protected area legislation;
- the adverse consequences of historic reductions in governmental resources, limiting scope for management and monitoring, resulting in multiple failures to achieve targets related to the favourable condition of the network; and

- current challenges in addressing the implications of dynamic climate change across an inherent static network of sites, with fixed boundaries and relatively inflexible legal processes.

A number of previous reviews of the SSSI series have been undertaken in recent years, most recently that of Lawton *et al.* 2010 (Appendix 3). Although many of their recommendations remain unimplemented, they are nonetheless of continuing relevance and should be addressed.

Taking all the previous points into consideration, the following measures are suggested as “ecological common sense” in ensuring the sustainability of SSSIs into the future, with the aim of creating a sustainable, resilient network of protected areas, surrounded by a wildlife friendly landscape and seascape.

5.1 Fundamental choices

We have seen that there are fundamental choices in relation to the existing protected areas across England. One option could be to “let it happen”. In essence, to continue current management practices under the present legal framework and monitor the changes as they happen. Alternatively, an active management approach could be developed that aims to enhance resilience as much as possible, accepting that there is a cost-benefit trade off in all such management. We are firmly of the opinion that the latter approach is the better option for biodiversity and geological interests across England. This does, of course, imply that a wider climate change adaptation plan is developed in due course within which the work on sites could sit.

5.2 Scale

A key part of developing a new approach is to consider the scale of action needed. We advocate a “landscape or large ecology” scale approach where a holistic view of issues is developed. One of the primary decisions to consider is whether to continue to view the total protected areas resource as a series of sites chosen individually to be representative of particular habitats or species groups across the country; or to view them as a wider portfolio of sites with a range of common features; or, as we suggest, to develop a network of ecologically linked protected areas across the country. The scale of selection, monitoring and management would therefore shift progressively to the network level, thereby enhancing flexibility and hopefully also overall resilience. Such a network probably also needs to be larger and more joined up in terms of the number of protected areas it holds and in overall extent. To achieve this, additional measures may be required, as it will not be enough simply to have existing sites in good health, and lowland areas in particular should be a more nature rich ecosystem.

5.3 Existing sites

The existing protected areas are the product of many decades of investment from government, government agencies and a wide range of landowners, managers and

stakeholders. They are an invaluable resource for the country, and we have seen just how much people value access to open areas and the role that "green" areas can play in the overall health of the nation during the ongoing Coronavirus pandemic. That said, the true value of many areas is not yet appreciated and there is more to do to engage and involve stakeholders and local communities in their future. This is not an issue particular to England and is true for protected areas in most countries.

Climate change is, however, already altering the state of protected areas and the distribution of species and habitats is changing. In addition, and perhaps less noticeable, but as profound a change is occurring to overall ecosystem processes in terms of the timing of annual events, (flowering, species migration, the frequency of pest outbreaks etc.) In combination all these changes may lead to some protected areas losing their current legally defined and protected "features". This level of profound change raises several important questions.

- Firstly, if the features are lost from a particular protected area is the area still legally protected?
- Secondly, from an ecological perspective, should we try to stop the disappearance of features, so that it is maintained as part of the protected area?
- Thirdly, if the feature does disappear from a particular protected area, should greater efforts be made to ensure its presence elsewhere on the network of protected areas overall?
- Fourthly, if the feature disappears, does that particular protected area still have a residual value for other biodiversity or for important ecosystem processes and how will any monitoring regime need to adapt to these changes?

As climate change continues, it seems inevitable that hard choices will have to be made, not just about how to manage sites from a day-to-day perspective, but whether some sites are viable and whether some other sites should be expanded to compensate for any losses. It seems inevitable that some form of "Triage" decision making process as noted above will need to be adopted for the management of protected areas in future, and that it is important to invest time now in considering what such a system might look like in practice.

One option, and one that we consider to be worthy of further consideration, is as follows:

> *"Accepting that biodiversity is in an emergency situation, and that urgent and widespread action is required, should all existing sites be considered as* ***"Nature nuclei"*** *– areas that have played, and are still playing a key part in maintaining nature, and that they have the potential to form the basis for future conservation action and to spread to other areas".*

This approach would mean that all areas would be valued for their overall biodiversity and for their potential role, as well as for specific features hold at one point in time. They therefore have the potential to become a core part of any nature recovery framework or strategy. So, for example, features may change, as indeed we are already witnessing in many coastal sites, but the multiple values of the protected area remain. Could a similar

approach be adopted for other sites holding different assemblages of species and habitats?

5.4 Timescale and key actions

Summarising the way forward then we suggest:

1. That a plan is developed to plot the way ahead in terms of adaptation to climate change for SSSIs. We note that other organisations have recently published information on the relative susceptibility of their resources to climate change. For example, the National Trust has developed a map[47] that illustrates the threat climate change poses to some of its most iconic and culturally significant sites and offers some solutions on how to tackle it. This approach could be replicated for SSSIs and other protected areas across England.
2. That a 50-year time horizon is used for planning purposes as this timescale will be required to allow for some key habitat recovery and re-creation. We also note the importance of the anticipated international “30 by 30” target as a key milestone within this overall time horizon highlighting the need for greater ambition in the development of national protected areas, not least through increasing the size of existing sites as appropriate.
3. That known threats to the condition of protected areas should be tackled with vigour now, to help ensure that existing sites are in as good condition as possible and that this should help their resilience to climate change. This is a key step in protecting the existing resource that will in turn act as “Nature nuclei” for the creation of a wider network.
4. That work starts now on developing a wider network of large sites that will, by creating ‘stepping stones’ aid connectivity and that will, progressively assist species and habitats to adapt as their ecological niche or bioclimatic envelope alters as the climate changes.
5. Develop a pilot scheme to consider the practicalities in developing an expanded network of sites in size and number. For example, test boundary flexibility and “ecological anticipation” on individual sites and consider the legal and ecological issues involved in creating such a network.
6. Investigate further the possibilities of creating a win-win situation where biodiversity is effectively protected and carbon is sequestered on protected areas, by putting in place site management that enhances the conservation of biodiversity.

[47] https://www.nationaltrust.org.uk/press-release/national-trust-maps-out-climate-threat-to-coast-countryside-and-historic-places#:~:text=The%20number%20of%20National%20Trust,of%20a%20total%2067%2C426%20sites

7. In parallel with the current monitoring of protected areas, consider the issues involved in moving to a “risk-based approach” for monitoring at the network level, with a clear explanation of what this will mean in practice.
8. For wider countryside support policies such as agri-environment measures, consider options for their development to provide maximum support for SSSIs and surrounding areas through the development of buffers of surrounding, sympathetically managed land and sea, as appropriate. This activity should be linked to regional biodiversity targets to help develop planning and delivery at that level. Note that we see real potential here as the existing policy intentions are impressive and integrated delivery on the ground could become a world leading approach.
9. Enhance current monitoring effort and feedback to stakeholders. Develop a renewed relationship with major stakeholders, focussed on the enhancement of the SSSI network. If the network is to be developed with flexibility in the number, location, and extent of sites, alongside flexibility on individual sites in relation to boundaries and to the features each contains, then establishing a consensus with at least the major stakeholders on the process of such an approach is an important prerequisite.
10. Finally, work on SSSIs in England is relevant to protected areas across the UK and indeed internationally. We see it as being important to maintain links to work in other countries and to disseminate the example of what is being done in England to others.

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Appendices

1. Chronological review of SSSI network development in England

Date	Event	Cause or consequence of event
1915	Hon. Charles Rothschild publishes comprehensive list of proposed nature reserves in Britain	Rothschild & Marren (1997)
1941	Society for the Promotion of Nature Reserves convenes conference to consider Nature Preservation in Post-War Reconstruction	
1942	Nature Reserves Investigations Committee instigated by Ministers and publishes draft list of nature reserves	
1943	British Ecological Society issues report on *Nature Conservation and Nature Reserves*	
1947	First Government White Paper on nature conservation: *Conservation of Nature in England and Wales. Report of the Wild Life Conservation Special Committee*[49] (section 1.2) Equivalent paper published for Scotland[49]	
1949	National Parks and Access to the Countryside Act (section 1.2)	Establishment of a statutory basis for nature conservation in Great Britain
1964	Private Members Bill – Sir Marcus Kimball	
1968	Passage of Countryside Act. Section 15 established powers for NERC (*i.e*. NC) to "…enter into an agreement with the owners, lessees and occupiers of any such land [SSSIs] which imposes restrictions on the exercise of rights over land…."	New powers were fixed at £1/acre – consequently no agreements were ever agreed (Sheail 1998).
1973	Removal of financial limit on management agreements (Sheail 1998)	
1975-1979	Development of SSSI selection guidelines by Norman Moore and other NCC colleagues	
1977	Establishment of the *Geological Conservation Review*	Initiation of a robust, science-based approach to the statutory basis for geoconservation (Ellis 2008)
1977-1987	Amberley Wild Brooks case	

Date	Event	Cause or consequence of event
1979-1981	Public and parliamentary debates on Wildlife and Countryside Bill	
1980	8% of all biological SSSIs in England and Wales lost or damaged in the previous 12 months[50]	
1981	Passage of Wildlife and Countryside Act (section 1.5)	Sections 28-32 address SSSIs
1982	NCC publish explanatory booklet *The selection of Sites of Scientific Interest*	
1983	First use of a Section 29 Order at Baddersley Common SSSI	
1985	Passage of Wildlife and Countryside (Service of Notices) Act	
1985	Wildlife and Countryside (Amendment) Act 1985	*Inter alia*, amendment of sections 28 & 42 of W&CA: constraining damaging operations during the legal notification period
1988	NCC publish elaborated booklet on *SSSIs – what you should know about Sites of Special Scientific Interest*	
1989	NCC publish *Guidelines for selection of biological SSSIs* (NCC 1989)	Draft guidance had been in development within NCC since 1975
1990	Environmental Protection Act	NCC split into three country agencies
1991	Responsibility for SSSIs in England passes to newly established English Nature	
1991	Publication of *SSSIs: A Health Check* (Rowell 1991)	
1992	First issue of English Nature's *Sitelines* – a newsletter for all SSSI owners and occupiers	
1992	Publication of *Beyond 2000 English Nature's strategy for improving England's wildlife and natural features* – with actions and priorities for SSSIs including that: "Securing positive action for wildlife and natural features for each site management unit on each SSSI remains a core target. ... We will regularly measure the area of SSSI in favourable status"	
1994	Draft Wildlife Bill launched	

Date	Event	Cause or consequence of event
1994	Wildlife Enhancement Scheme	Introduced payments for positive SSSI management, including land adjacent to SSSIs
1995	Launch of SSSI Awards by English Nature	
1997	First publication of Common Standards for Monitoring Designated Sites by JNCC	
1998	Publication of Common Standards for Monitoring by JNCC (section 1.11)	Establishment of the first GB-wide common standard for the assessment and monitoring of national and international protected areas
1999	Decision by JNCC and the country agencies to implement the monitoring programme for designated nature conservation sites in 1999 and report on the condition of the whole site series in 2005	
2000	Countryside and Rights of Way Act	Placed increased emphasis on supporting SSSI owners and occupiers in managing, rather than just safeguarding important features within their SSSIs. Presumption in favour of conserving SSSIs. New powers to address neglect of sites. Requirement on public bodies to conserve and enhance SSSIs. Created offence *for anyone* (*i.e.* not just owner or occupier) to knowingly or recklessly damage an SSSI.
2000	English Nature publish revised position statement on SSSIs	
2001	Publication of *The Future of Sites of Special Scientific Interest (SSSIs)* by the Royal Society	Multiple recommendations, especially concerned with the role of SSSIs in research on the natural environment, many still relevant.
2001	Government established Public Service Agreement target to get 95% of all the SSSIs into favourable condition by 2010	
2002	Launch of EN's Wildlife Enhancement Scheme – a voluntary and new approach to the establishment on management agreements on SSSIs	
2002	English Nature's *Maritime State of Nature* report published (Covey & Laffoley 2002)	Major impacts, *inter alia,* on coastal SSSIs

Date	Event	Cause or consequence of event
2003	English Nature's first condition assessment of SSSIs published (English Nature 2003)	All SSSIs visited in previous six years: 42% in unfavourable condition
2004	English Nature's *Lowlands State of Nature* report published (Townshend *et al.* 2004)	Major impacts on lowland SSSIs especially from agricultural influences
2004	EN give evidence on SSSIs to Select Committee on Environment, Food and Rural Affairs	"PSA target of 95% of SSSI land in favourable or recovering condition by 2010 is very challenging but, given appropriate resources, some policy changes and joined-up working across Government, achievable."
2005	Planning Policy Statement 9: Biodiversity and Geological Conservation	Described as government's policy on conservation of biodiversity and geological/geomorphological features in England through the use of the planning system.
2005	Environmental Stewardship	Comprehensive national scheme with two tiers: i) Higher Level Stewardship (HLS) including SSSI land; and ii) Entry Level Stewardship (ELS) 'broad & shallow'
2006	Establishment of Natural England and transfer of responsibilities for SSSIs from English Nature	
2006	Publication of the first Common Standards Monitoring Report for designated sites by JNCC (Williams 2006; section 1.11)	
2008	Publication of DEFRA's Climate Change Adaptation Principles - Conserving biodiversity in a changing climate	First government guidance to address climate change adaptation including on protected areas
2008	Conservation and Enhancement Scheme	For management of SSSIs and other land where Environmental Stewardship is not appropriate
2008	Publication of NAO's assessment of *Natural England's role in improving Sites of Special Scientific Interest*	Appendix 4
2010	Lawton *et al.* (2010) Review: *Making Space for Nature: a review of* *England's wildlife sites and ecological network* [Appendix 3]	Major review of England's protected area network

Date	Event	Cause or consequence of event
2011	Government publishes *Biodiversity 2020: A strategy for England's wildlife and ecosystem services* with targets to achieve: "1A. Better wildlife habitats with 90% of priority habitats in favourable or recovering condition and at least 50% of SSSIs in favourable condition, while maintaining at least 95% in favourable or recovering condition; "1B. More, bigger and less fragmented areas for wildlife, with no net loss of priority habitat and an increase in the overall extent of priority habitats by at least 200,000 ha; "1C. By 2020, at least 17% of land and inland water, especially areas of particular importance for biodiversity and ecosystem services, conserved through effective, integrated and joined up approaches to safeguard biodiversity and ecosystem services including through management of our existing systems of protected areas and the establishment of nature improvement areas;"	
2018	Government publishes *25 Year Environment Plan* for England (section 1.14.1)	
2019	Revised Common Standards Monitoring Statement published by JNCC (section 1.11)	Downscales expectations as to the scope and frequency of monitoring of SSSIs as a consequence of resource constraints
2020	National Audit Office publishes MOD Environmental Sustainability Overview	Assessment of performance with respect to SSSI condition
2021	Environment Bill before Parliament (section 1.14.2)	Includes establishment of Nature Recovery Network and Environmental Land management Scheme

[48] Ministry of Town and Country Planning 1947

[49] Cmd 7235

[50] Nature Conservancy Council 1981; Moore 1987, pp. 60-64. Statistic based on 15% sample

2. The objective of the SSSI system within an overall nature conservation strategy

Reproduced from NCC 1989, Part A, section 2

2.1 *Nature conservation in Great Britain* (NCGB) (Nature Conservancy Council 1984) stated (paragraph 15.1): "The primary objective of nature conservation is to ensure that the national heritage of wild flora and fauna and geological and physiographic features remains as large and diverse as possible, so that society may use and appreciate its value to the fullest extent." Site safeguard, that is the protection and management of the most important areas for wild flora and fauna and their habitat, is regarded as the cornerstone of conservation practice and, within this, SSSI notification is now the principle statutory means of achieving this goal.

2.2. …

2.3 The biological SSSI series is intended to form a national network of areas representing in total those parts of Great Britain in which the features of nature, and especially those of greatest value to wildlife conservation are most highly concentrated or of highest quality. The further intention is that the interest of this site network will be safeguarded under the provisions of section 28 and 29 of the Wildlife and Countryside Act 1981.

Each site represents a significant fragment of the much-depleted resource of wild nature now remaining in this country. The much large area of Britain outside the SSSIs contains a considerably greater proportion of the commoner habitats and species than the special sites; its total wildlife importance is thus very high, but tends to be more thinly dispersed. Nature conservation is no less essential there than in the SSSIs, bit it will have to be fostered by a non-statutory and less direct approach of advice, education and persuasion.

Species protection legislation and measures for safeguarding scenic beauty and landscape amenity also complement the conservation both of SSSIs and the wider countryside outside them. The ecological interdependence of the SSSIs and this wider environment is crucial; and while designation necessitates drawing clear boundaries, it is important to integrate as far as possible the conservation measures for both elements in a total approach.

2.4 NCGB also stated (paragraph 15.2.4): "Collectively, the national total of protected areas should be large and varied enough to guarantee the survival of a necessary minimum of Britain's wildlife and physical features." It is appropriate that the total area of habitats and the total size of species populations identified as having special interest should correspond to this "necessary minimum" of the national resource of wildlife.

Many nature conservationists believe that the losses of wildlife and habitat in Britain have already gone so far that, in the developed lowlands at least, all remaining natural and semi-natural habitat has special interest. As a general principle, the rarer the habitat or more threatened the remainder, the higher is the nature conservation value of what is left. And for the larger expanses of undeveloped habitat, in the uplands and on some parts of the coast, it is important that the proportion of the total area selected for SSSI designation is sufficient to represent the complete field of biological interest, in the event tat all the rest should change or disappear.

2.5 While there is no target area, the total extent of SSSI land will reflect the consistent application of these principles, selection procedures and standards countrywide. About 7% of Great Britain is already designated as SSSIs, with geological and physiographical sites contributing to this total. Allowance then has to be made for the known number of impending new SSSI designations, for the discovery of yet others of requisite quality in areas so far unsurveyed, and for the eventual representation of neglected groups of flora and fauna (mainly lower plants and animals) in the choice of sites. Present indications are that the total area of SSSIs will cover at least 8% of Britain. The extent of SSSI land will continue to vary geographically, according to the wide regional differences in extent of natural and semi-natural habitat within which the choice is made. The present range is from 22% in Orkney to 0.2% in West Yorkshire.

2.6 It would be inappropriate and undesirable to prescribe a definite limit to the total number and area of special sites which should be designated as SSSIs. “Special interest” in the features of nature is not fixed in time. It is a combination of the intrinsic attributes of nature and the values that people place on these; and both these parameters are prone to change in time.

Particular examples of habitats may lose value through deterioration, but the type in general may become more important through its increased rarity. Some species may become more common and less threatened, whilst others decline and assume increased value. The numbers of people interested in a particular feature of nature may also increase or decrease, or their interests show a shift in perspective, so that the kind and weight of public interest are also subject to change. The rest of this introduction will examine the underlying basis of the rationale for the identification of SSSIs.

3. Lawton Review recommendations

5.4 Conclusions

To make space for nature we need more, bigger, better and joined up sites to create a sustainable, resilient and more effective ecological network for England. Practically this requires actions under five headings, all of which we currently do to a greater or lesser extent. So we need to do more to:

- Improve the quality of current sites by better habitat management.
- Increase the size of current wildlife sites.
- Enhance connections between, or join up, sites, either through physical corridors, or through ‘stepping stones’.
- Create new sites.
- Reduce the pressures on wildlife by improving the wider environment, including through buffering wildlife sites.

These actions will help to establish an ecological network that meets the needs for wildlife and people today, and one that is more resilient to the future. There are trade-offs between these actions: the more we do to improve the quality of existing sites or to enhance the wider environment, the less we will need to do to create new sites. Our actions need to be adaptive, adjusting to what works as we progress.

6 Establishing a coherent and resilient ecological network

6.2 Identifying and protecting England’s ecological network

6.2.1 Planning a coherent and resilient network

Recommendation 1. Local authorities should ensure that ecological networks, including areas for restoration, are identified and protected through local planning. Government should support local authorities in this role by clarifying that their biodiversity duty includes planning coherent and resilient ecological networks.

Recommendation 2. Planning policy and practice should:

- continue to provide the strongest protection to internationally important sites and strong protection from inappropriate development to SSSIs.
- provide greater protection to other priority habitats and features that form part of ecological networks, particularly Local Wildlife Sites, ancient woodland and other priority BAP habitats.

6.2.2 Ecological Restoration Zones

Recommendation 3. Ecological Restoration Zones (ERZs) need to be established that operate over large, discrete areas within which significant enhancements of ecological networks are achieved, by enhancing existing wildlife sites, improving ecological connections and restoring ecological processes. We further recommend:

- ERZs should be proposed and implemented by consortia of local authorities, local communities and landowners, the private sector and voluntary conservation organisations, supported by national agencies.
- To start and support this process, and recognising current financial constraints, we also recommend resources be provided, which can be accessed through a competition, to implement 12 ERZs in the next three years.

Comment
Undertaken as Nature Improvement Areas. Also: https://www.ecos.org.uk/wpcontent/uploads/2015/05/ECOS-33-3-4-13-Large-scale-conservation-in-GreatBritain.pdf.

6.2.3 Identifying and protecting ecosystem services

Space for water

Recommendation 4. Public bodies and statutory undertakers planning the management of water resources should:

- make space for water and wildlife along rivers and around wetlands;
- restore natural processes in river catchments, including in ways that support climate change adaptation and mitigation; and
- accelerate the programme to reduce nutrient overload, particularly from diffuse pollution.

Comment
Unclear the extent to which this has actually happened.

Space for dynamic coasts

Recommendation 5. Authorities responsible for measures to reduce the risks from coastal erosion and flooding should do so in ways that enhance ecological networks where possible. This can be achieved by taking full account of the natural dynamism and functioning of the coast, thereby allowing wildlife and habitats to move and evolve.

Comment
Environment Agency seem to be holding firm on letting coasts retreat as policy.

Space for carbon storage

Recommendation 6. Government should produce a strategy to ensure that we protect and secure multiple benefits from our carbon-rich soils and peatlands, and maximise their contribution to ecological networks.

Comment
Reflected in the *25 Year Environment Plan*. Secretary of State Gove announced a review of what to do with peat-based soils in East Anglia in 2020 which is now operational.

Natural spaces for people

Recommendation 7. Responsible authorities should take greater steps to reconnect people to nature by enhancing ecological networks within urban environments, including wildlife-friendly management of green spaces, and by embedding biodiversity considerations in the need to adapt to climate change.

Comment
Even more strongly reinforced by Covid-19 lockdowns *etc.*

6.2.4 Protecting and managing elements of the network in public ownership

Recommendation 8. Public bodies owning land which includes components of England's current or future ecological network should do more to realise its potential, in line with their biodiversity duty. Further, before disposal of any public land, the impact on the ecological network should be fully evaluated. Where such land is identified as having high wildlife value (existing or potential) it should not be disposed of unless its wildlife value is secured for the future.

Comment
Still highly relevant.

6.2.5 Protection through designation or purchase

Recommendation 9. The government should ensure that the remaining areas of high conservation value that currently are not well protected are effectively safeguarded.

Comment
Remains highly relevant but needs to be supported by survey and mapping.

Recommendation 10. When determining the boundaries of designated sites, responsible authorities should take better account of the need to support underpinning ecological processes and of anticipated environmental change.

Comment
Very highly relevant.

6.3 Managing components of the ecological network

6.3.1 Managing designated wildlife sites

Recommendation 11. The recent progress in improving the management of SSSIs must be sustained, with the aim of moving the condition of sites from 'recovering' to 'favourable'. Investment in the management of the SSSI series must be maintained.

Comment
Remains highly relevant.

Recommendation 12. Local authorities should take responsibility for the identification and monitoring of Local Wildlife Sites and the management of LWS must be improved.

Comment
Unrealistic without central government funding to that end specifically.

Recommendation 13. Responsible bodies should revise conservation objectives for SSSIs and other wildlife sites to respond to the effects of climate change - in particular by aiming to enhance habitat diversity and support underpinning ecological processes, whilst taking account of the requirements of current species and habitats.

Comment
Central element is "aiming to enhance habitat diversity and support underpinning ecological processes" Critical need.

6.3.2 Managing protected landscapes

Recommendation 14. In view of the opportunity presented by their existing statutory remits, in National Parks and AONBs:

a) favourable condition of SSSIs should be achieved as quickly as possible;

b) non-SSSI semi-natural habitat should be brought under management equivalent to SSSI standards; and

c) other land should be managed so as to enhance connectivity.

Comment
Highly relevant. 'Low-hanging fruit'.

6.3.3 Managing ecological networks through incentive schemes

Recommendation 15. The Higher Level Scheme of Environmental Stewardship must be retained and properly resourced as the single most important tool for maintaining and

expanding the most significant areas of priority habitat and populations of priority species. Consideration should be given to improving the quality of advice and putting longer term agreements in place to ensure sustained ecological benefits, while retaining the buy-in of land managers.

Comment

Higher Level Stewardship will be transferred into Environmental Land Management Scheme.

Recommendation 16. A new type of Environmental Stewardship scheme is needed, particularly to help buffer sites and establish stepping stones and ecological corridors. This should be simple to administer, be available in key areas, and provide support for high cost but relatively simple management measures.

Comment

Implemented, in principle at least, via the Environmental Land Management Scheme and Nature Recovery Network.

6.3.4 Habitat management and enhancements through payment for ecosystem services

Recommendation 17. The government should promote economic approaches that will favour conservation management by stimulating the creation of new markets and payment for ecosystem services, to ensure that the values of a wider range of ecosystem services are taken into account in decisions that affect the management and use of the natural environment.

Comment

HM Government's (2020) *25 Year Environment Plan* committed that:

"We will also set gold standards in protecting and growing natural capital – leading the world in using this approach as a tool in decision-making. We will take into account the often hidden additional benefits in every aspect of the environment for national wellbeing, health and economic prosperity, with scientific and economic evidence to the fore.

6.3.5 Providing integrated advice and support for management of the network

Recommendation 18. Government needs to establish a consistent, integrated and long-term expectation of land managers to deliver parts of the ecological network. In doing so, consideration should be given to:

- providing more readily available, high quality advice; and
- developing the Defra Whole Farm Approach to provide an opportunity for those managing land to enter into a 'Whole Farm Plan' which integrates all aspects of a farm's environmental and productive potential, simplifies regulation, increases transparency and gives long term commitments to both farmer and the public.

Comment

In part being taken forward by shift to 'public money for public goods' philosophy, and delivered through Environmental Land Management Scheme.

6.4 Establishing new components of the ecological network

6.4.1 Establishing new wildlife sites through habitat creation and restoration

Recommendation 19. Habitat creation by government and its agencies, grant-giving trusts, businesses and the voluntary sector requires greater focus on the needs of ecological networks, in particular the need to contribute to Ecological Restoration Zones.

Comment
In general, this remains a need, but it is unclear what the precise action is.

Recommendation 20. Government should consider extending tax incentives to encourage landowners to make long-term commitments to the creation of new wildlife habitats that benefit ecological networks.

Comment
Remains a need.

6.4.2 Improving connections for wildlife

Recommendation 21. Public bodies and other authorities responsible for canals, railways, roads, cycle ways and other linear features in the landscape, should ensure that they better achieve their potential to be wildlife corridors, thereby enhancing the connectivity of ecological networks, and improving opportunities for people to enjoy wildlife.

Comment
This seems to remain unimplemented as a single initiative, although it is unclear what mechanism(s) could be used to promote this.

6.4.3 Biodiversity offsetting and developer contributions

Recommendation 22. If a formal system of biodiversity offsets is to be introduced, pilot schemes should be established to test and refine its operation, to ensure it meets the conditions we have set out for a safe and effective system.

Comment
Defra and Natural England ran six biodiversity offsetting pilot areas from 2012 to 2014. https://www.gov.uk/government/collections/biodiversity-offsetting

6.5 Improving the countryside

6.5.1 Entry Level Stewardship

Recommendation 23. The design and delivery of the Entry Level Scheme of Environmental Stewardship needs to be improved, in particular to ensure key options are taken up in appropriate combinations over a sufficient area. Delivering a more effective ecological network may require refinements to the schemes, such as rewarding farmers who act cooperatively.

Comment
To be replaced by the Environmental Land Management Scheme.

6.6 Monitoring and evaluation

Recommendation 24. The Secretary of State for the Environment, Food and Rural Affairs should be advised on progress against recommendations in this report after two years, with a full evaluation of the outcomes for England's ecological network after five years.

Comment
Unclear whether a formal review has been undertaken. If not, it should be.

4. Recommendations by National Audit Office (2008)

Recommendations

Progress toward meeting the PSA Target

a. **Some 60 per cent of sites were first recognised as important between 20 and 60 years ago. Some may no longer retain the features they were established to conserve, or may contain new interest features which are not recorded.** Natural England should periodically review and update as appropriate the current suite of SSSIs. The amendments should include new notifications, renotifications as well as denotifications.

b. **Around 35 per cent of SSSIs do not have written descriptions of the monitoring requirements for the special features that they were notified to conserve, nor the specific conservation actions that are necessary to provide this protection.** As the final piece of national guidance on monitoring was published in March 2008. Natural England should complete the conservation objectives for all interest features of SSSIs**.**

c. **Around a quarter of SSSIs have not had a condition assessment in the past six years, as recommended by national guidelines.** Natural England should assess all sites within the recommended timescales.

d. **There is no consistent approach to record-keeping. Some advisers maintained comprehensive records for their SSSIs, and others did not. Natural England's database does not record whether national guidelines on assessment of the condition of a SSSI have been followed.** Natural England should record the date of field visits, compliance checks, contact with landowners/occupiers and the extent and location of all features on SSSIs on its electronic database. It should introduce quality assurance to provide consistency in the judgement of condition and compliance with national guidelines.

Managing relationships

e. **Natural England has used its statutory powers to deal with damage to sites, but only once taken steps to enforce positive management practices by landowners/occupiers.** Natural England should use its enforcement powers within a

reasonable timescale where landowners/occupiers persistently refuse to manage land in a way which conserves the SSSI.

f. **Financial incentives paid to landowners are accompanied by a management agreement; but for some units in recovering condition there was not a written description of the improvements expected over time.** Natural England should specify for all incentives paid the expected timescales and milestones against which to measure progress.

Making better use of resources

g. **Until 2007, the Department had a limited understanding of the cost of delivering the target. It has now estimated the funding required to deliver the target by 2010, but this estimate is subject to change**. The Department should regularly review these estimates and work with other members of the Major Landowners Group to validate these estimates.

h. **Some regions have allocated dedicated teams to specific projects to address backlogs of work, which has resulted in more efficient working practices.** Natural England should apply these practices nationally to realise efficiencies across all regions.

i. **The public are not fully aware of the wider benefits of SSSIs.** Natural England should quantify the benefits of SSSIs and promote these to the public and businesses to encourage greater support for SSSIs.

j. **Private sector funding has been leveraged in to help with the costs of maintaining SSSIs; but this practice is not widespread.** Natural England should explore the opportunities for further sources of funding from the private sector: in particular the scope offered by SSSIs for carbon offsetting and other forms of corporate sponsorship.

k. **Natural England has outsourced condition assessments and drawing up of conservation objectives for some SSSIs, but has not established whether the results represent value for money compared to a more efficient use of internal resources.** Natural England should assess the cost effectiveness of contracting out work by benchmarking the costs of the different types of assessments carried out by consultants and comparing these to the cost of carrying out condition assessments in-house.

5. Stakeholder conversations key questions

The following short note suggests some key questions that could form the basis of our conversation. The questions will hopefully take us through the key aspects to consider in relation to protected areas in England.

Part 1 The first part of our work will include an evaluation of the present system in practice and consideration of what has worked and what could be improved.

Question 1. What do you see as the Strengths, Weaknesses, Opportunities and Threats in the present system of protected areas generally?

Question 2. What has worked within the SSSI system and what has not? Consider this question across a range of species, habitat types and ecosystems (terrestrial and marine ecosystems)?

Question 3. Considering the last couple of decades, do you think the protected area system has been effective in sustaining England's habitats and species?

Question 4. Can you suggest those aspects of the statutory bases for SSSI's that may need to evolve to protect features and enable adaptation to climate change?

Part 2 takes a forward look, summarised as:

"If we were to arrange the protection and conservation of important habitats, species, and geological features in 2021 from scratch, what should we create in the face of climate change"?

As climate change continues to impact on Protected Areas around the world, long-standing management practices in these areas will need to adapt to the changing environmental conditions through policies that reflect an inherently dynamic *status quo*.

Question 5. How can we develop a vision for the future to guide future SSSI management, identifying key themes for further discussion with stakeholders?

Question 6. How could stakeholder/community involvement in the monitoring and management of protected areas be enhanced?

Question 7. How can we create the wider policy environment (at multiple scales) that needs to be developed to maintain and ensure the greater effectiveness of to protected areas in future?

Question 8. What are the merits (and challenges) of developing an ecologically linked network of protected areas across England?

Question 9. How could protected areas be managed and monitored to maximise their resilience to climate change and to consider what part they may play in helping mitigate the effects of climate change though carbon sequestration and storage?

Question 10. How should the management and monitoring of new and existing protected areas, be taken forward, especially where current legally defined features may be declining in extent or in number, and that in extreme cases may already be absent due to climatic effects?

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