From: [redacted]
To: Cleve Hill Solar Park
Subject: Additional Evidence for Noise impacts on birds; Land Use and effects on Carbon; the Benefits of Nature;
Date: 24 August 2019 17:23:19
Attachments: [redacted]

From CHRIS LOWE Interested Party, reference: 20022096

Dear Examiners,

1 Background Noise adversely affects Birds
New evidence shows that human generated noise masks communication of crucial information between birds, which can therefore affect bird reproduction and so adversely affect survival of bird species.

The attached provide summaries of the research, which is restricted access document.

For Cleve Hill Solar, the constant background from the inverters, transformers and other equipment, would have this effect.

What is unknown, as I believe that wind noise has not been modelled, is the increase in wind noise from the panels, fencing and all the associated infrastructure.

So the actual noise impact may be much greater than expected, and hence the impact on birds, and indeed humans, may be a lot worse.

So the Applicant needs to provide detailed modelling of all these noise impacts.

2 Land Use and effects on Carbon
A recent article by George Monbiot relating to the carbon impact of land use, refers to a Nature paper which shows how that farming has a much higher carbon cost than natural ecosystems: Nature estimates that natural ecosystems can store 9 tonnes of carbon more per person than farming would.

He notes the article says that beef has a carbon cost of 643 kg, while lamb 749 kg. As Cleve Hill propose to graze sheep, this would add to the loss of carbon sequestration because of covering the area with PV panels, thus making a huge carbon cost.

He says that "some people try to argue that extensive farming systems – particularly grazing livestock – “mimic nature”. While some livestock farms are much better than others, there are none in this country that look like natural ecosystems”.
In other words the proposals have a large carbon impact.

I attach the original article, with the Nature Abstract, and this also has references for “Does landscape-scale conservation management enhance the provision of ecosystem services? Kathy H. Hodder, Adrian C. Newton, Elena Cantarello & Lorretta Perrella”, and “Investing in nature could boost UK economy www.ceh.ac.uk/news-and-media/news/investing-nature-could-boost-uk-economy ” which refers to: “**Trends in Natural Capital, Ecosystem Services and Economic Development in Dorset Valuing Nature Research Project Report**”, attached below.

So this new information shows that the Applicant’s proposals would have severe repercussions on carbon, nature and the economy.

Further evidence of the carbon sequestration of land is shown in “Wilding” by Isabella Tree
(21/03/2019, *Publisher: Pan Macmillan*
ISBN: 9781509805105), which reports (page 287) that Graham Harvey found ‘Glomalin’ is a key part of the sequestration process, and it also helps the vital mycorrhizae which are essential for a healthy soil.
As the soil is the key to life itself, the construction of the power station and its coverage of a huge area of soil

would cause immense damage and reduce carbon sequestration and the life within and above the soil.

2 Benefits of Nature

As well as the reference above ("Investing in nature could boost UK economy www.ceh.ac.uk/news-and-media/news/investing-nature-could-boost-uk-economy submitted by Simon Williams"),the Executive Summary of "The Natural Choice" DEFRA's publication of 2011, (attached below) which is still current,shows an earlier recognition of the value of nature, It includes (with my emphasis):

"1. Nature is sometimes taken for granted and undervalued. But **people cannot flourish without**

the benefits and services our natural environment provides. Nature is a complex, interconnected system. **A healthy, properly functioning natural environment**

is the foundation of sustained economic growth, prospering communities and personal wellbeing.

2.The Government wants this to be the first generation to leave the natural environment of England in a better state than it inherited. To achieve so much means taking action across sectors rather than treating environmental concerns in isolation.

It requires us all to put the value of nature at the heart of our decision-making – in Government, local communities and businesses.

9. **The Economics of Ecosystems and Biodiversity study shows that protected natural areas can yield returns many times higher than the cost of their protection.** There are multi-million pound opportunities available from greener goods and services, and from markets that protect nature's services.

13. The NEA and the Marmot Review, *Fair Society, Healthy Lives*, demonstrate the positive impact that nature has on mental and physical health. High-quality natural environments foster healthy neighbourhoods; green spaces encourage social activity and reduce crime. The natural environment can help children's learning.

15. We need to make enhancing nature a central goal of social action across the country. We want to make it easier for people to do the right thing, with action in the health and education systems and in our communities."

The website: https://valuing-nature.net/ provides a lot of more recent evidence of the benefits of nature.

Item 13, quoted above, has been supported by a lot of evidence since 2011 - recent research shows that a two-hour "dose" of nature a week significantly boosts health and wellbeing, research suggests, even if you simply sit and enjoy the peace. see:

"www.theguardian.com/environment/2019/jun/13/two-hour-dose-nature-weekly-boosts-health-study-finds

This says: "The physical and mental health benefits of time spent in parks, woods or the beach are well known, but the new research is the first major study into how long is needed to produce the effect. If confirmed by future research, two hours in nature could join five a day of fruit and veg and 150 minutes of exercise a week as official health advice.

The finding is based on interviews with 20,000 people in England about their activity in the previous week. Of those who spent little or no time in nature, a quarter reported poor health and almost half said they were not satisfied with their life, a standard measure of wellbeing. In contrast, just one-seventh of those who spent at least two hours in nature said their health was poor, while a third were not satisfied with their life."

Hence this means that Nature must take priority over the proposed Solar Power Station.

Thank you,

Best wishes

Chris Lowe

Signal complexity communicates aggressive intent during contests, but the process is disrupted by noise

Original report, with restricted access, on:

https://royalsocietypublishing.org/doi/pdf/10.1098/rsbl.2018.0841

Contestants use displays to signal their aggressive intent and settle disputes before they escalate. For birds, this is often in the form of song, which can vary in structural complexity. The role of song complexity in signalling aggressive intent has not been fully established, and its efficacy could be influenced by background noise levels. Using playback experiments, we found that in European robins, *Erithacus rubecula*, song complexity signalled sender aggression and affected receiver response. However, increased noise impacted the ability of contestants to adjust response based on opponent song complexity. These findings provide new evidence regarding the use of acoustic signal complexity for assessing opponent aggression and that noise can influence contest behaviour by interrupting this process, which could impose fitness consequences.

Summary from the Guardian

www.theguardian.com/environment/2019/jun/20/twitter-storm-noise-pollution-creates-havoc-for-birds-study-shows

Human activities could be affecting reproduction and even normal social behaviour

Fiona Harvey Environment correspondent

A Belfast university study found human noise pollution directly influenced robins' ability to communicate with each other.

Birds are even more disrupted by their noisy neighbours than had been thought previously, researchers have found. And human activities could be preventing birds from reproducing and even developing normal social behaviour and keeping the peace.

A study by Queen's University Belfast found that when European robins were subjected to human produced noises their behaviour changed. Background noise appeared to mask the communication of crucial information between birds.

While aggressive communication is common and birds respond to it, interference through noise can lead to the birds mistaking the signals.

Gareth Arnott, senior lecturer and researcher from the Institute for Global Food Security at Queen's University Belfast, said: "We found that bird song structure can communicate aggressive intent, enabling birds to assess their opponent. But human-made noise can disrupt this crucial information passed between them, by masking the complexity of their songs used for acquiring resources, such as territory and space for nesting."

Birds can end up in situations all too familiar to humans. "The birds receive incomplete information on their opponent's intent and do not appropriately adjust their response," explained Arnott. "Where song is disguised by background noise, in some cases the male ends up fighting more vigorously than he should, but at other times gives in too easily."

This is the first time it has been shown that aggressive communication is being disrupted by noise.

Arnott said the purpose of birdsong was twofold – to attract mates and defend territory.

Birds already face an array of human-made dangers, from pesticides and intensive farming to shooting and poisoning. But noise had often been overlooked, the paper in Biology Letters found.

A spokesperson for the RSPB said: "Everyone is becoming increasingly concerned that nature is in crisis in the UK, with one in 10 of our wildlife species at threat of extinction. Many of our birds' populations are already facing a serious crisis as a result of habitat loss, climate change and other human activities.

“This report is a good reminder that the way we live and our lifestyle has an impact on our natural world, and that we need to protect our natural world if we want to let nature sing.”

The research does not have clear implications for human health, although excessive noise can damage children’s ability to learn and causes stress among adults.

For birds, the extra burden of noise pollution adds to extraordinary decline in species, including among once common birds, in recent decades due to such activities as agricultural practice and pesticide use.

In the experiment the team used playbacks of robin song to stimulate responses from birds who were territory holders. Simple or complex songs were used in either the presence or absence of noise.

The researchers found that song complexity was used as a signal of aggressive intent; birds demonstrated higher aggressive intent towards complex rather than simple song. This process was disrupted by the presence of added noise.

Arnott said: “The study is evidence that human-made noise pollution impacts animal habitats and directly influences their ability to communicate properly, which may have implications for survival and population numbers for birds.”

Summary from 'the print' on 21 June, 2019:
theprint.in/science/human-noises-create-havoc-for-birds-even-prevent-them-from-reproducing-says-new-study/252550/

A new study has found that human noises can prevent birds from reproducing or even developing normal social behaviour.

Conducted by researchers of Queen’s University Belfast, UK, the study was published in the journal *Biology Letters,* 19 June, 2019. Researchers said the study has also established for the first time a link between human-induced noise pollution and decline of bird population.

To understand the effect of human noises in birds, researchers studied bird songs and their responses. Birds use their songs for various reasons. The most well-known reason is, of course, for attracting mates. But, the ability to compose sounds with structural complexity allows birds to use songs to give other signals as well such as for claiming new territories for nesting or breeding purposes.

Birds also communicate aggression through songs, and often settle disputes by effectively arguing melodiously with each other.

One way to understand bird songs is by recording a song, then playing it back in a controlled environment and then observing behaviour of other birds.

The study

The researchers had first recorded songs of European robins. Then they played the songs back to the birds in a controlled environment and checked their reactions.

They first discovered that complexities of the songs signalled a level of aggressive intent of the birds and affected the response of other birds. The more complex a song was, the more aggressive the reaction was from other birds.

When the researchers introduced human noises in the environment, they noticed that the birds’ responses were dampened and they did not react with the kind of urgency required despite increasingly complex and aggressive songs being played in the environment. At times, the birds even misjudged the complexities and reacted more aggressively than was required.

“The birds receive incomplete information on their opponents’ intent and do not appropriately adjust their response,” said Gareth Arnott, principal investigator of the study, in a statement.

“Where song is disguised by background noise, in some cases the male ends up fighting more vigorously than he should, but at other times gives in too easily,” he added.

‘Human-made noise impacts both animals and birds’

The new study raises concerns over birds’ ability to develop social behaviour, compete for resources, breed and live safely, and most importantly, reproduce.

Birds, like most other life on Earth, have already been affected by human activities such as habitat loss to farming, climate change and residential and commercial development, expansion of cities, among others.

This is also the first time that a link between noise produced by humans and decline of bird population has been established by a study.

“The study shows that human-made noise pollution impacts animal habitats and directly influences their ability to communicate properly, which may have implications for their survival, and on population of birds,” said Arnott.

VALUING NATURE RESEARCH

Trends in Natural Capital, Ecosystem Services and Economic Development in Dorset

Valuing Nature Research Project Report

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NATURAL ENVIRONMENT RESEARCH COUNCIL

Trends in Natural Capital, Ecosystem Services and Economic Development in Dorset

Valuing Nature Research Project Report

Suggested citation: Newton, A.C., Watson, S.C.L., Evans, P., Ridding, L., McCracken, M., Anger-Kraavi, A., and Bullock, J. (2019). Trends in natural capital, ecosystem services and economic development in Dorset. Bournemouth University, Poole, UK.

Contents

Cover image:
Chapmans Pool © Roger Holman

Wimborne Minster River © David Jeffrey Morgan

Summary

How does environmental degradation affect economic development and employment? This report presents the results of research that addressed this question. The research was conducted by the project *Tipping Points in Lowland Agricultural Landscapes (TPAL)*, which forms part of the Valuing Nature Programme. The research focused on the county of Dorset, situated on the south coast of England. Land use in Dorset is dominated by agriculture, yet the county is also of high value for wildlife, and has a burgeoning green economy. It therefore provides a valuable example of the potential synergies and conflicts between wildlife conservation, economic growth and development.

Specifically this research aimed to find out:

- **How has the environment of Dorset changed in the recent past?**
- **How might it change in the near future?**
- **What are the implications of such change for human society, and specifically for economic growth and employment?**

Three main approaches were employed to address these questions:

(i) in the past, using analysis of historical and time-series data;

(ii) in the present, using assessments of gradients in the field; and

(iii) in the future, using scenario-building and modelling approaches.

Key results are summarized below:

- Dorset's environment has been seriously degraded over the past 80 years. Measures of biodiversity value have undergone a substantial decline in this period, as illustrated by the 97% loss of neutral grassland and 70% loss of calcareous grassland. The condition of remaining semi-natural habitats has been reduced by nitrogen deposition and habitat fragmentation; for example the mean area of heathland patches has declined by 29% since 1978. These trends are primarily attributable to agricultural intensification and changing farming practices.

- Provision of most ecosystem services, or the benefits provided by ecosytems to people, has declined significantly since the 1930s. Some services, such as soil quality and carbon storage, have declined continuously over this interval, with no sign of recovery. Others, such as mitigation of flood risk, have increased in recent years owing to changing land use, particularly the transition from arable to livestock farming that occurred over large areas after the 1950s.

- The provision of ecosystem services is important to local businesses. Overall, 47% of the Dorset businesses surveyed stated that they were at least somewhat dependent on service flows. Economic sectors that were highly dependent on ecosystem services included tourism and travel, manufacturing, education and agriculture. The most important services to businesses were provision of freshwater, waste and water treatment, microclimate regulation, water quality and carbon storage.

- Economic analyses indicate that the further expansion of agriculture would provide limited benefits to the local economy. Even if all remaining land in Dorset that is suitable for agriculture were converted to farmland, Gross Value-Added (GVA) would increase by ≤ 0.3%. However, investment in natural capital, aiming to improve the extent and condition of semi-natural ecosystems, could have a much greater impact on the economy, with GVA increases of up to 5% in the scenarios explored. Such investment could deliver an £0.8 billion increase in GVA and create more than 25,000 jobs.

- Rural land use can significantly affect the wider economy by influencing the provision of ecosystem services to other business sectors. This influence of farming on the wider economy is ignored by conventional approaches to economic forecasting, but can substantially outweigh the value of the agricultural sector itself.

- We detected a number of ecological thresholds in relation to the status of natural capital assets. These suggest that future environmental degradation could lead to relatively abrupt changes in provision of ecosystem services, which could have a significant impact on the local economy and employment. Investment in natural capital could help mitigate these risks.

- Recommendations are provided regarding policy and management options for strengthening natural capital in the region, while supporting incomes to farmers.

Context

We live in an era of unprecedented environmental change. Examples include rapid changes in global climate and land cover, increasing pollution and biodiversity loss, and widespread environmental degradation. These trends are creating major societal challenges owing to declining natural resources, and increasing risks to human health and wellbeing. These challenges are illustrated by the UN's Sustainable Development Goals, more than half of which are explicitly linked to environmental degradation.

Although the importance of environmental change is widely appreciated, its impacts on human society are less well understood. In particular, there is uncertainty regarding how such changes might affect economic development and employment. Is environmental change something that we can readily live with, or adapt to? Or is it something that might threaten our economy, jobs and wellbeing?

This report describes research undertaken to help answer these questions. The project Tipping Points in Lowland Agricultural Landscapes (TPAL) formed part of the Valuing Nature Programme (http://valuing-nature.net/), a multi-disciplinary initiative designed to improve how the natural environment is represented in valuation analyses and decision making.

The research focused on the county of Dorset, which is situated on the south coast of England. Specifically we aimed to find out:

- **How has the environment of Dorset changed in the recent past?**
- **How might it change in the near future?**
- **What are the implications of such change for human society, and specifically for economic growth and employment?**

[1] Ash Futures (2015). *Dorset's Environmental Economy.* Report for Dorset County Council. Ash Futures, Devon.

Poppies Near Fontmell Down © Roger Holman

Dorset is exceptionally important for wildlife. The UK's richest grid squares for vascular plants and mammals are both found in Dorset, leading to its recognition as a "biodiversity hotspot". There are many habitats of international significance for conservation, including important cliff and maritime areas, chalk rivers, lowland heathland, calcareous grasslands and ancient woodlands. Dorset also possesses scenically attractive landscapes and coastline. These attract large numbers of tourists each year, who make a significant contribution to the local economy. Dorset's land use is dominated by agriculture, in a way that is typical of much of lowland north-west Europe.

In recent decades, the landscapes of Dorset have changed markedly in response to shifting patterns of land use. Many habitats that are valuable for wildlife have been lost or degraded, as a result of agricultural intensification and increasing development pressures. Notable species such as tree sparrows, wild asparagus and fan mussel are now close to extinction, whereas other species such as pearl-bordered and high brown fritillary butterflies have been lost altogether.

Do these changes matter? If the environment is deteriorating in this way, what are the implications for society? A recent report[1] attempted to estimate the value of Dorset's environment to the local economy, and found that the environment contributes about £1.5bn of GVA per annum and supports about 30,000 jobs in the county. This represents about 8-10% of total annual economic output and employment in Dorset. The current report aims to build on this analysis by further examining the links between the economy and the environment. Specifically, it explores how these relationships have changed in the past and how they might alter further in the future.

Natural Capital, Ecosystem Services and Tipping Points

Recent efforts to understand the links between the environment and the economy have focused on the concept of *natural capital*. This can be viewed as one of the five types of capital asset that are needed to support the economy, along with social, human, manufactured and financial capital. Natural capital can be defined as the elements of nature that directly and indirectly produce value or benefits to people[2]. Natural capital assets include different components of the environment, including species, ecological communities and ecosystems, and the ecological processes that influence their structure and dynamics.

These natural assets represent natural capital *stocks*. Whereas stocks of financial capital can provide flows of income or expenditure, stocks of natural capital provide flows of benefits to people. These are referred to as *ecosystem services,* and include many benefits on which human lives depend, including clean air and water, food, materials and energy, together with cultural and aesthetic benefits (**Figure 1**). Such ecosystem services can be valued in monetary or non-monetary terms, but they are generally omitted from traditional approaches to economic accounting and planning.

The relationships between natural capital stocks and provision of ecosystem services can change over time and place. In the context of understanding the impacts of environmental change on human society, the relationship between the condition of a natural asset and provision of ecosystem benefits is of particular importance. Environmental degradation may lead to a decline in natural asset status, which could reduce the benefits provided to people[3]. Potentially, this relationship could either be linear, or it could be non-linear (**Figure 2**). However, the form of this relationship is not well understood. One of the main objectives of the research described here was to determine the form of this relationship, as it applies to natural capital assets in Dorset.

[2] Natural Capital Committee (2014). *State of Natural Capital: Restoring Our Natural Assets.* 2nd report. NCC, London

[3] Mace, G.M. *et al.* (2015). *J. Appl. Ecol.* 52, 641-653.

[4] Groffman, P.M. *et al.* (2006). *Ecosystems* 9, 1-13.

[5] Natural Capital Committee (2014). *State of Natural Capital: Restoring Our Natural Assets.* 2nd report. NCC, London

[6] Mace, G.M. *et al.* (2015). *J. Appl. Ecol.* 52, 641-653.

View west from Eggardon Hill © Panglossian

Why is the form of this relationship important? If environmental change causes a decline in the condition of natural capital assets, then this might happen gradually. Alternatively, a small change in natural asset status might lead to a large decline in the flow of ecosystem benefits, which might happen abruptly and unexpectedly. This could occur if the relationship is non-linear, for example if it is characterised by an *ecological threshold*[4].

Some ecological thresholds are driven by positive feedback processes, which can increase the rate of change. An example is provided by the melting of ice caps and glaciers caused by global warming. Loss of ice reduces albedo, which increases the amount of solar energy absorbed, leading to more warming. There is currently great concern that processes such as this could lead to tipping points, or critical thresholds beyond which rapid changes will occur that might be difficult to reverse (**Figure 3**). Melting ice caps provide a powerful example of a tipping point.

Might there be thresholds or tipping points in natural capital? In other words, could environmental change lead to rapid declines in ecosystem service flows? Could the economy suffer as a result? The identification of such thresholds and tipping points, and their potential consequences, was a central objective of the research described here. Three approaches were employed to detect such changes:

(i) **in the *past*, using analysis of historical and time-series data;**

(ii) **in the *present*, using assessments of gradients in the field; and**

(iii) **in the *future*, using scenario-building and modelling approaches.**

Figure 1. Natural capital and provision of ecosystem benefits to people: a framework. (Adapted from the Natural Capital Committee, 2014)[5].

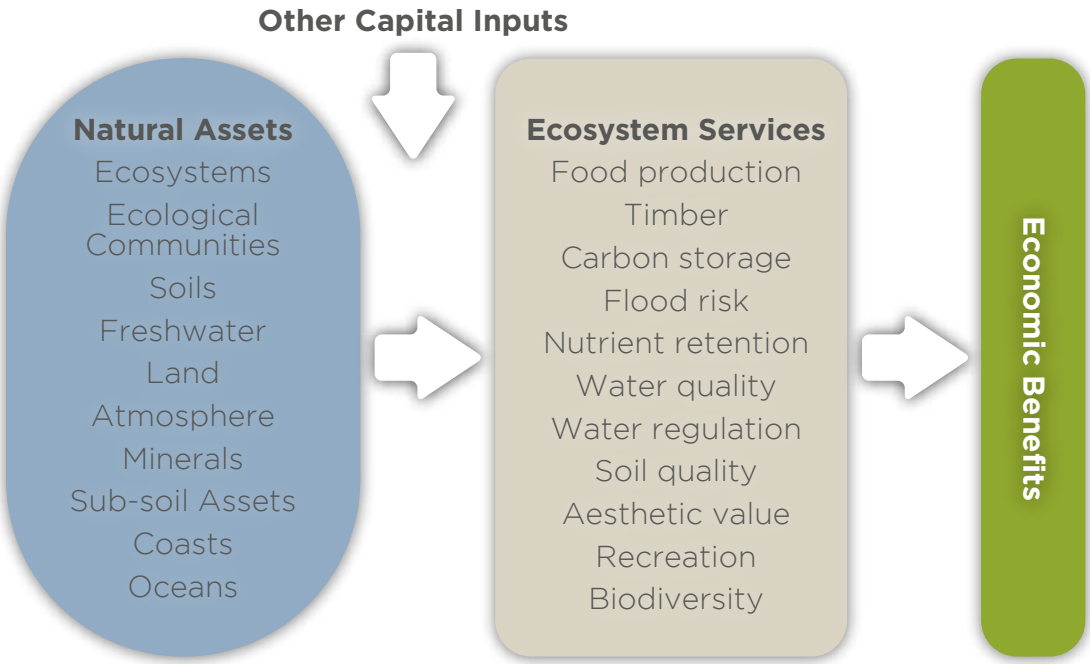


Figure 3. Tipping points in natural capital. Anthropogenic pressures, such as land cover change, pollution or climate change, can lead to a change in the condition or state of an ecosystem. These changes can happen abruptly, representing an ecological threshold. Where such thresholds are caused by a positive feedback mechanism, they are referred to as tipping points.

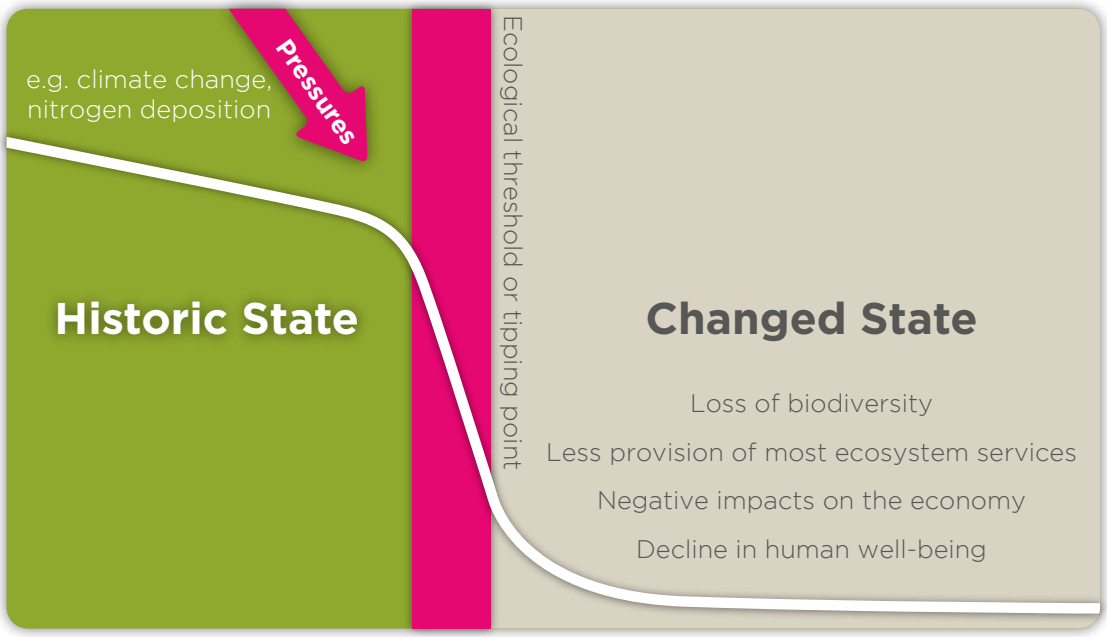


Figure 2. Possible relationships between the status of natural capital assets and the flow of ecosystem benefits[6]. (**2a**) The lines illustrate the how the flow of benefits might change in response to variation in the status or condition of natural assets, which could be caused by environmental degradation. The continuous line shows a threshold response (or tipping point).

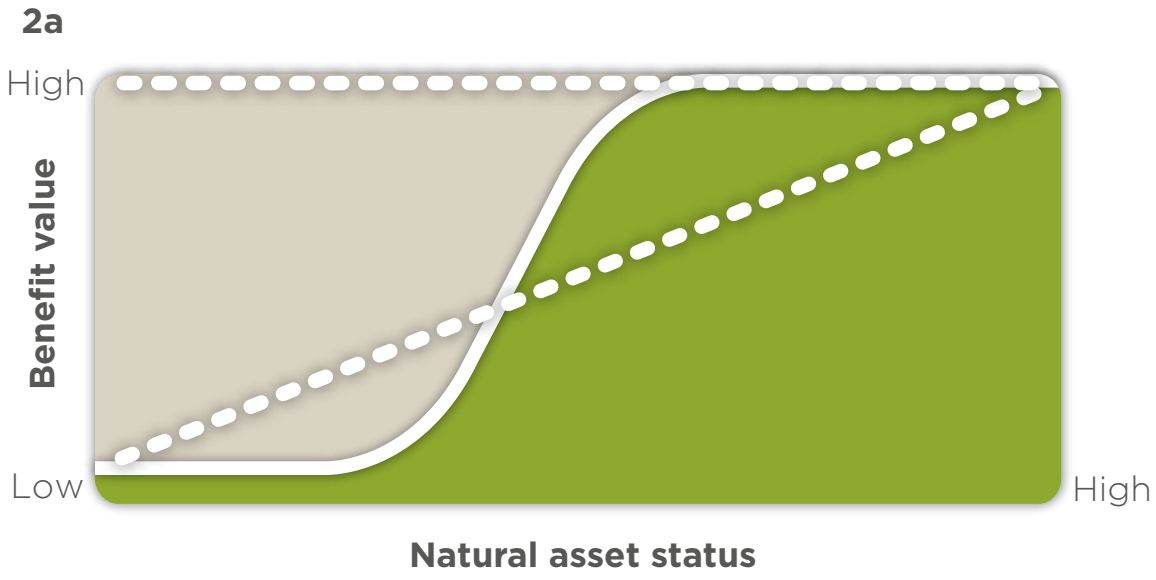
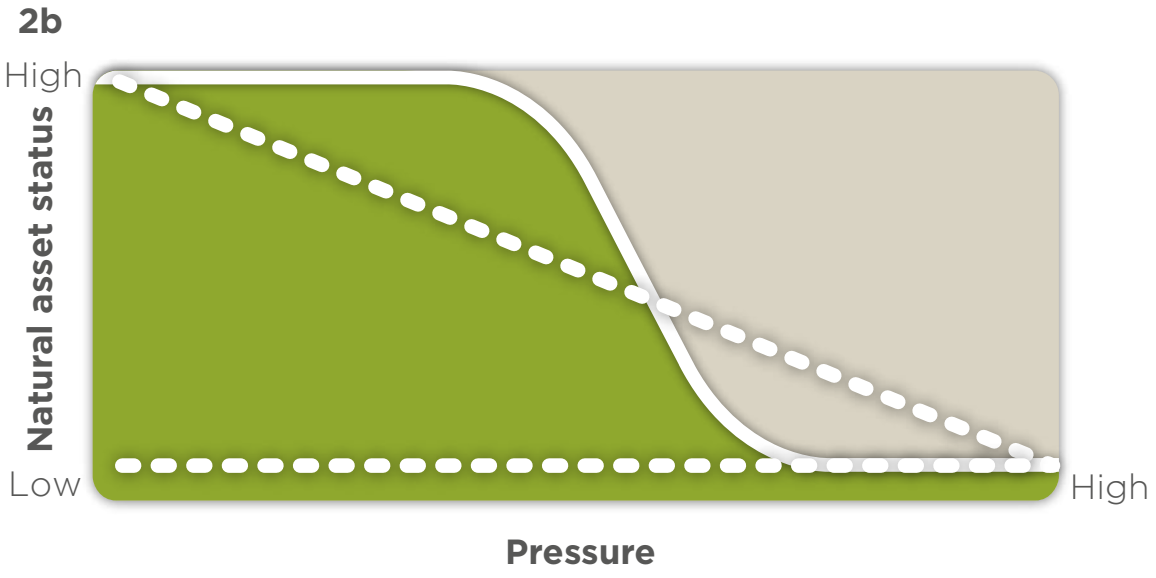


Figure 2. (**2b**) The relationship between anthropogenic pressures and natural capital status may also demonstrate a threshold response (continuous line).



Environmental Change in Dorset

Today, around 75% of Dorset's land area is farmed, of which about a third is arable farmland. In the UK as a whole, agriculture accounts for about 70% of land area, so Dorset can be considered as a fairly typical county in terms of patterns of land use. But how has this pattern changed over time?

To answer this question, we created a series of land cover maps for Dorset (**Figure 4**), which were based on available historical maps and land use data, together with historical vegetation surveys and resurveys. Results indicated that the total proportion of the land cover comprising agricultural land remained roughly constant over the past 80 years. However, there were significant changes in the extent and distribution of different agricultural land use practices. Arable land, for example, increased markedly in extent between 1930 and 1950, but declined steadily thereafter. Conversely, improved grassland remained limited in extent until 1950, but afterwards underwent a substantial increase, reaching a maximum value at the present day. Other vegetation types that increased in area over time included conifer plantations, ranging from a value close to zero in 1930 to 3.4% of land area in 2015.

To illustrate the extent of these changes, by 2015:

- **31% of arable land present in 1930 had been converted to improved grassland;**
- **64% of neutral grassland had been converted to agriculturally improved grassland;**
- **43% of calcareous grassland had been converted to arable, and 47% to improved grassland;**
- **50% of acid grassland had been converted to improved grassland; and**
- **22% of heathland and 17% of broadleaved woodland had been converted to conifer plantations.**

Hambledon Hill © Roger Holman

Land cover change therefore represents the form of environmental change that has affected the natural capital of Dorset most profoundly. However, other types of change have also been influential. Our research into changes in the composition of plant communities in Dorset over the past 80 years[7] has consistently revealed an influence of nutrient enrichment. Even in vegetation that has not been converted to agricultural use, there have been widespread changes in community composition, with plant species favouring higher nutrient availability becoming more abundant over time. Conversely, species favouring low-nutrient conditions have become increasingly rare. This demonstrates how use of fertilizers on farms has negatively affected ecosystems throughout Dorset.

In some plant communities, climate change has also had an impact, with species tolerating higher temperatures becoming more abundant over time. Other changes in Dorset include increasing urbanisation and human population size, increasing pollution and waste, spread of invasive species, and spread of novel diseases of plants and animals. While we have not investigated these factors explicitly, they are all likely to have affected natural capital over the past 80 years. For example, the spread of myxomatosis in the 1950s devastated rabbit populations, and is likely to have had a major impact on grassland habitats in particular.

What has driven these changes? Trends in agricultural land use are largely attributable to the shifting provision of capital grants and subsidies, reflecting changes in government policy. Since 1945, farming practices have become increasingly intensive, leading to an almost fourfold increase in yield. The productivity and efficiency of farming have increased steadily since 1950, in a linear fashion (**Figure 5**). These increases were partly accompanied by increased mechanisation of farming, as illustrated by the number of tractors in use, which increased rapidly after 1945 to reach a peak in the 1980s. Fertilizer use also increased steadily after 1940 to reach a peak in the 1980s, after which it has declined somewhat. Pesticide use was relatively low in the 1970s, but increased markedly after the late 1980s, and is currently near an all-time high. Over time, at the national scale, farms have tended to increase in size and become more specialised; chemical applications have increased massively; around 50% of hedgerows have been removed; and farm labour has decreased by 77%[8].

[7] Keith, S.A. *et al.* (2011) *Oikos* 120(2), 302-331, Keith, S.A. *et al.* (2009) *Proc. Roy. Soc.* 276, 3539-3544, Staley, J.T. *et al.* (2013) *Biol. Cons.* 167, 97-105, Diaz, A. *et al.* (2013) *Biol. Cons.*167, 325-333, Newton, A.C. *et al.* (2012) *J. Ecol.* 100 (1), 196-209.

[8] Robinson, R.A. and Sutherland, W.J. (2002). *J. Appl. Ecol.*, 39, 157-176.

[9] Robinson, R.A. and Sutherland, W.J. (2002). *J. Appl. Ecol.*, 39, 157-176.

Figure 4. Maps illustrating the change in Dorset's land cover over time. The 1930s map was based on Hooftman & Bullock (2012) Biol. Conserv. 145, 30–38. The 2015 map was based on Rowland et al. (2017). Land Cover Map 2015, NERC EIDC. InVEST was used to model the landscapes for 1950 and 1980.

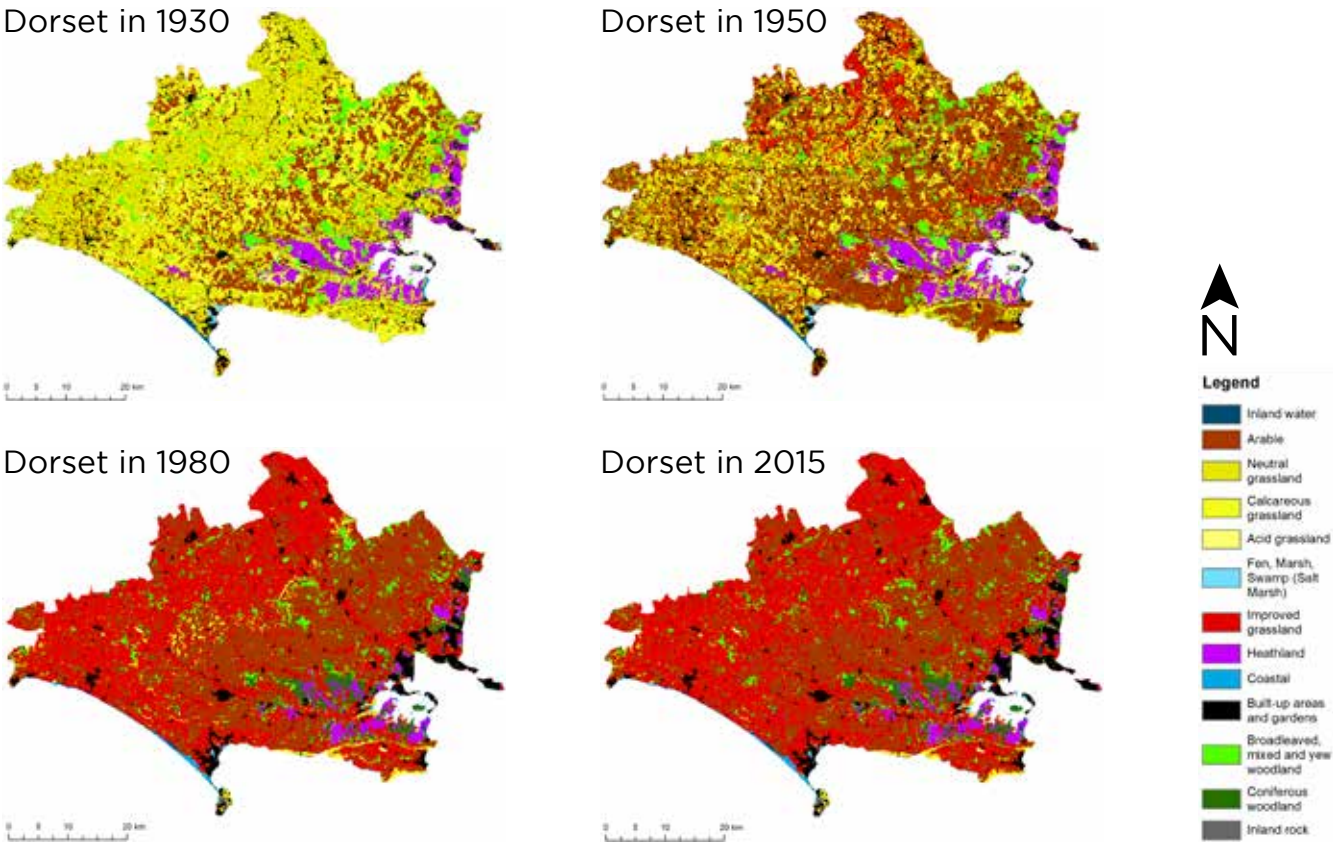
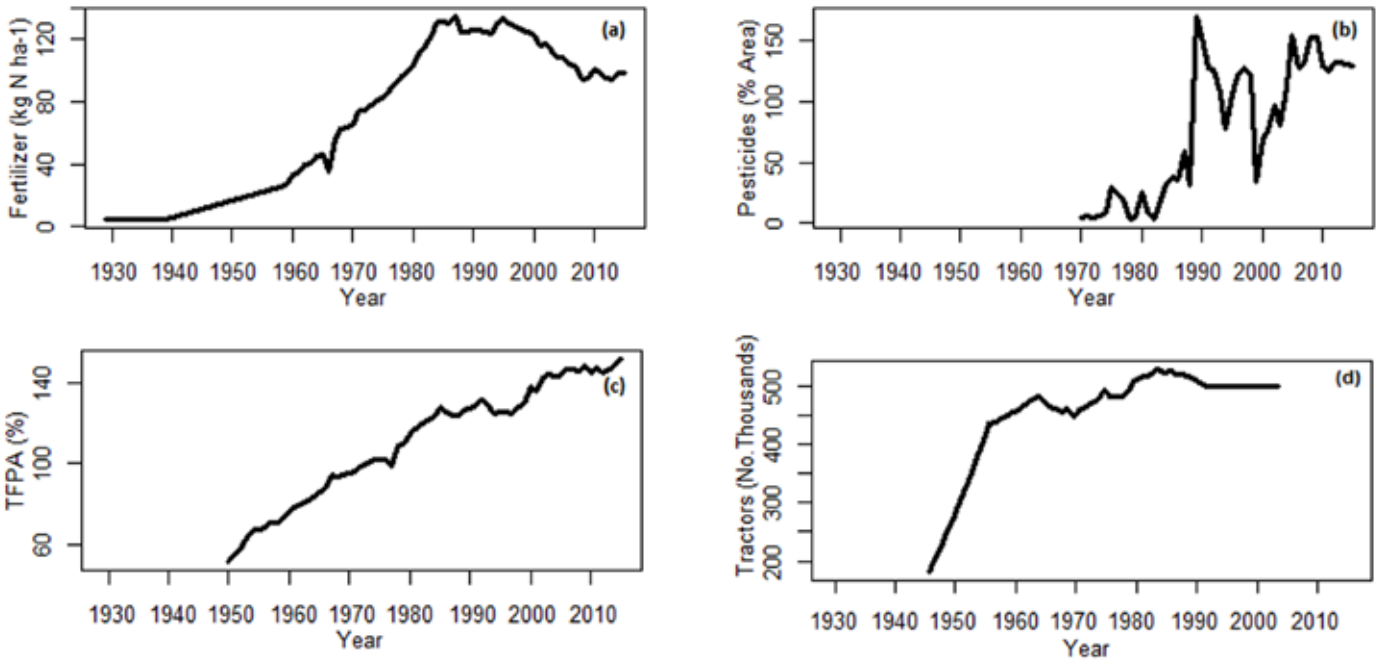


Figure 5. Trends in UK farming metrics over the last 80 years[9]. (a) Total amount of fertilizer applied in Britain, (b) area sprayed with insecticide in the county of Sussex, UK, (c) total factor productivity of UK agriculture (TFPA), (d) numbers of tractors in use in the UK..



Trends in Natural Asset Status: Habitat Area

There are three different aspects of natural capital assets that could potentially vary as a result of environmental change[10]: (i) the *quantity* or area of the asset; (ii) the *quality* or condition of the asset; and (iii) the *spatial configuration* or location and spatial distribution pattern of the asset. Our research examined how each of these three dimensions has changed over time, and how such changes affected flows of ecosystem services to people.

In relation to changes in area, we examined trends in habitats of relatively high biodiversity value. To achieve this, we analysed field survey data in conjunction with the time series of land cover maps. The field data were based on a systematic survey of plant species undertaken in the 1930s by Professor Ronald Good at 7575 sites across Dorset. These "Good sites" were resurveyed in the 1980s by Anne Horsfall, and more recently by the current authors and their colleagues.

Over the last 80 years there has been a considerable loss of semi-natural habitat in Dorset, including calcareous grassland, acid grassland, neutral grassland, wet habitats (fen, marsh swamp), and heathland. Neutral grassland and calcareous grassland have suffered the greatest losses, with declines of 97% and 70% of their initial area, respectively (**Figure 6, 7**). Substantial declines were also recorded in wetland, acid grassland and heathland sites, with losses recorded of 63%, 54% and 57%, respectively. The highest rate of loss of these habitats occurred between the 1950s and 1980s (20% loss), followed by the 1930s to 1950s (14%). Only 1% of semi-natural habitat sites were lost between 1990 and 2015.

Preliminary results from our research show that sites that were protected through designation as a Sites of Special Scientific Interest (SSSI) were more likely to remain as their original habitat, compared to those sites that were not protected (**Figure 8**). These results show that statutory protection has been beneficial in preventing habitat loss, which provides important evidence to policy makers and land managers when undertaking conservation decisions in the future.

[10] Mace, G.M. *et al.* (2015). *J. Appl. Ecol.* 52, 641-653.

Figure 6. The number of sites for each semi-natural habitat (acid grassland, broadleaved woodland, calcareous grassland, heathland, neutral grassland, wet) and land cover type (coniferous woodland, improved grassland, arable, urban) across Dorset in 1930, 1950, 1970, 1990 and 2015.

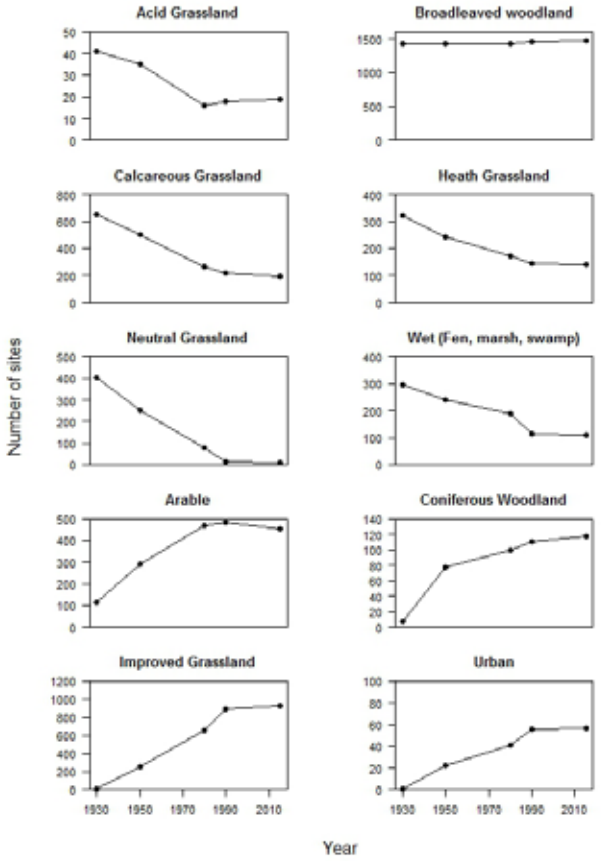


Figure 7. The percentage of neutral grassland, calcareous grassland, wetland habitats, heathland and acid grassland sites that were converted to a more intensively used land cover type (arable, improved grassland, urban, broadleaved, coniferous and other) in Dorset in 1950, 1980, 1990 and 2015.

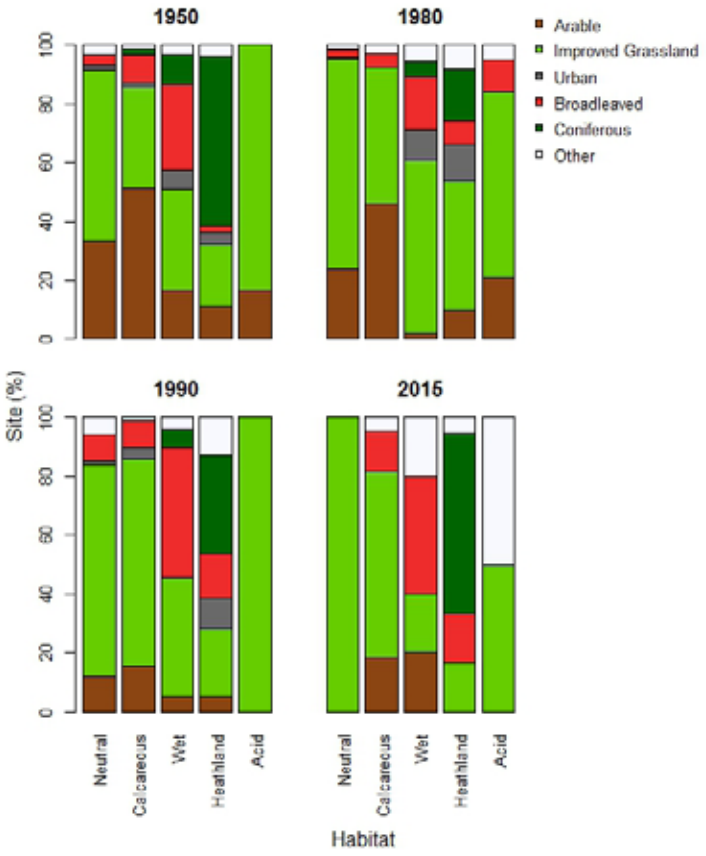
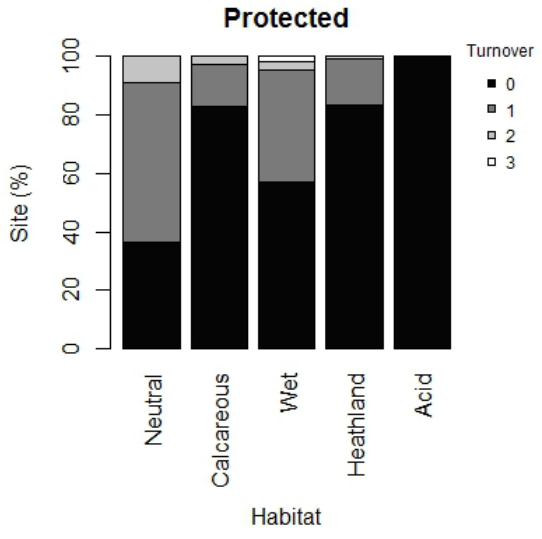
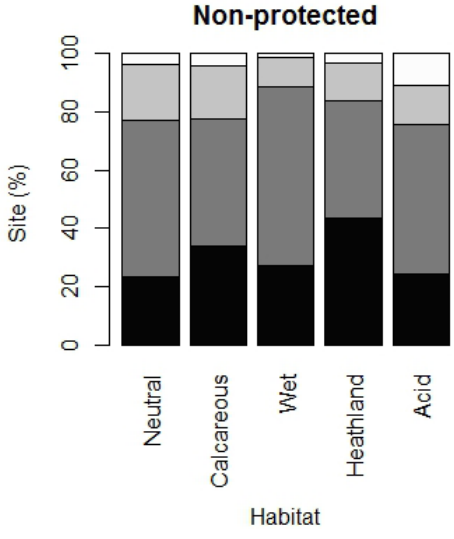


Figure 8. The turnover of protected and non-protected sites across Dorset between 1950 (post protection designations) and 2015 for sites that were neutral grassland, calcareous grassland, wetland habitats, heathland and acid grassland in 1930, where a turnover of 0 indicates that the habitat has not changed and .a turnover of 3 indicates that the habitat changed in each of the time periods assessed post-1930.





Trends in Natural Asset Status: Condition and Fragmentation

In addition to area, our research examined two additional measures of natural asset status: condition and spatial configuration. In this context, condition refers to the functional capacity of a particular ecosystem. Environmental change can affect a variety of ecological processes influencing ecosystem function, including cycling of energy, water, nutrients and other materials. A decline in ecosystem function can reduce the capacity of ecosystems to provide benefits to people.

The relationships between environmental change, ecosystem condition, ecosystem function and benefit flow are not well understood. Here we examined changes in condition by examining two key drivers that have affected ecosystems in Dorset: nitrogen deposition and climate change. To achieve this, we compiled time-series data and associated models.

Nitrogen deposition can have major impacts on the structure and composition of ecosystems; for example, under high nitrogen availability heathlands can be transformed into grasslands. Ecosystem function can also be adversely affected by nitrogen deposition. Results indicated that nitrogen deposition increased steadily since the 1930s, to reach a peak in the 1980s (**Figure 9**). Values of total nitrogen deposition include emissions of oxidised nitrogen from fossil fuel combustion and reduced nitrogen from agricultural sources. Recent trends of declining nitrogen deposition partly reflect declining fertilizer use but are largely attributable to reduced emissions from vehicles and heating sources.

Dorset has also experienced significant climate change over the past 80 years. Mean summer temperatures have increased by about 0.02 °C per year (**Figure 10**). Although total mean annual rainfall has not increased significantly, there have been changes in the pattern of rainfall distribution, with a trend towards wetter winters and drier summers. There has also been an increase in the incidence of drought. While the full impacts of both climate change and nitrogen deposition on the condition of Dorset ecosystems are unknown, there is clear evidence of significant changes in species composition, as revealed by resurveys of vegetation data .

Spatial configuration provides a further measure of natural capital status. Many species are dependent on maintenance of functional links between different patches of habitat, in order to maintain viable populations. Many

[11] Keith, S.A. *et al.* (2011) *Oikos* 120(2), 302-331, Keith, S.A. *et al.* (2009) *Proc. Roy. Soc.* 276, 3539-3544, Staley, J.T. *et al.* (2013) *Biol. Cons.* 167, 97-105, Diaz, A. *et al.* (2013) *Biol. Cons.*167, 325-333, Newton, A.C. *et al.* (2012) *J. Ecol.* 100 (1), 196-209.

[12] McGarigal, K. *et al.* (2012) FRAGSTATS 4. **https://www.umass.edu/landeco/research/fragstats/fragstats.html**

[13] From Cordingley J.E. *et al.* (2015). *PLOS One* 10(6), e0130004.

[14] From Cordingley J.E. *et al.* (2015). *PLOS One* 10(6), e0130004.

[15] Tipping, E. *et al.* (2017). *Sci. Rep.* 7, 1–11.

[16] Martin, P.A. *et al.* (2015). *Forest Ecology and Management* 358, 130-138.

[17] Cordingley, J.E. *et al.* (2015) *Journal of Applied Ecology* 53(1), 96-105.

Summer Landscape Above Bowerchalke © Roger Lane

ecological processes, including the dispersal of organisms and flows of energy and materials, are influenced by the spatial configuration of habitats. The size, density and connectivity of habitat patches are of particular importance in this context. Land cover change can result in increased habitat fragmentation, leading to declining patch size and connectivity. Globally, this has been identified as a major cause of biodiversity loss.

Using the time series of land cover maps of Dorset, we analysed how different habitats have become increasingly fragmented over time. This was achieved using FRAGSTATS, a software program designed to calculate a wide range of landscape pattern metrics . Results showed how key habitats have become progressively more fragmented since 1930, with a decline in mean patch size and an increase in the number of patches observed in many habitats (**Figure 11**, **12**). Patterns of habitat fragmentation in Dorset are illustrated by the example of heathlands, where the mean area of heathland patches has declined by 29% since 1978 (**Figure 13**, T**able 1**). The effects of habitat fragmentation on ecosystem functions and services are not well documented. However in Dorset heathland, we found that decreasing fragment size was found to be associated with a decrease in biodiversity and recreational values, but an increase in relative carbon storage, aesthetic value and timber values. This reflects more rapid ecological succession on smaller heaths.

Table 1. Fragmentation metrics for the Dorset heathlands over four surveys calculated using FRAGSTATS[14].

	Total number of heath fragments	Total number of heath fragments under 10 ha	Mean area (ha)	Maximum area (ha)	Median area (ha)	Mean distance to nearest heath (km)	Median distance to nearest heath (km)
1978	112	31	111	992	30	0.69	0.40
1987	130	45	90	992	22	0.63	0.40
1996	130	47	78	820	18	0.61	0.45
2005	110	35	79	708	20	0.63	0.45

Figure 9. Modelled atmospheric nitrogen deposition totals from all sources (wet, dry, oxidised, reduced) combined, for Dorset (data from CEH, 2019[15]).

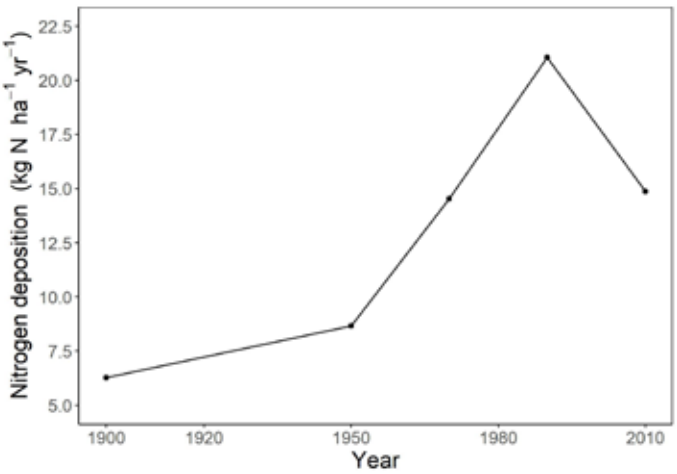


Figure 10. Climate records from 1964 to 2014 showing (a) mean temperature during April–September (b) incidence of drought years. Data taken from the Hurn weather station, Dorset[16].

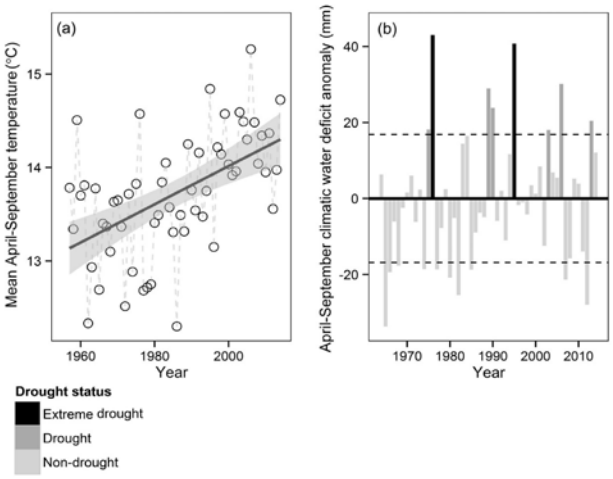
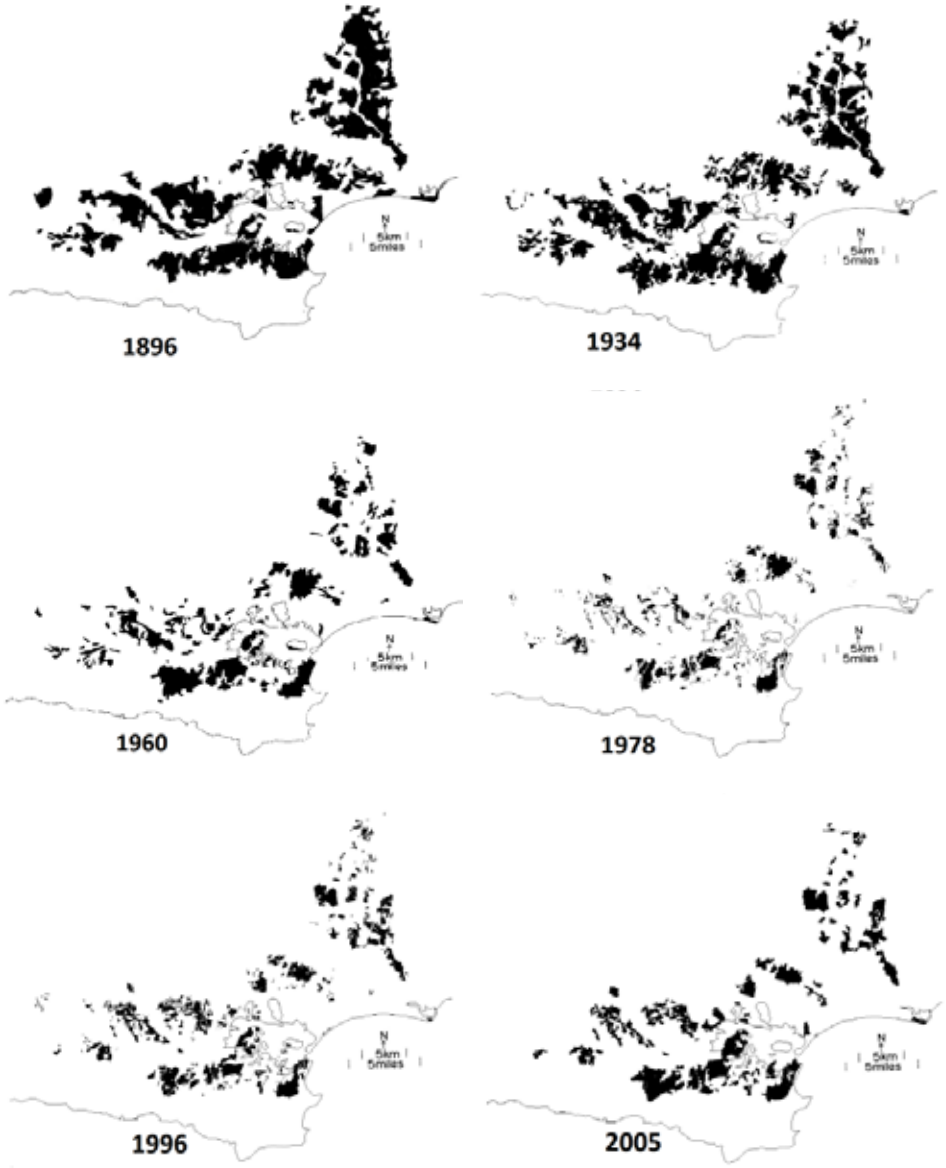


Figure 13. Maps indicating the progressive fragmentation of heathland in Dorset over time[17].



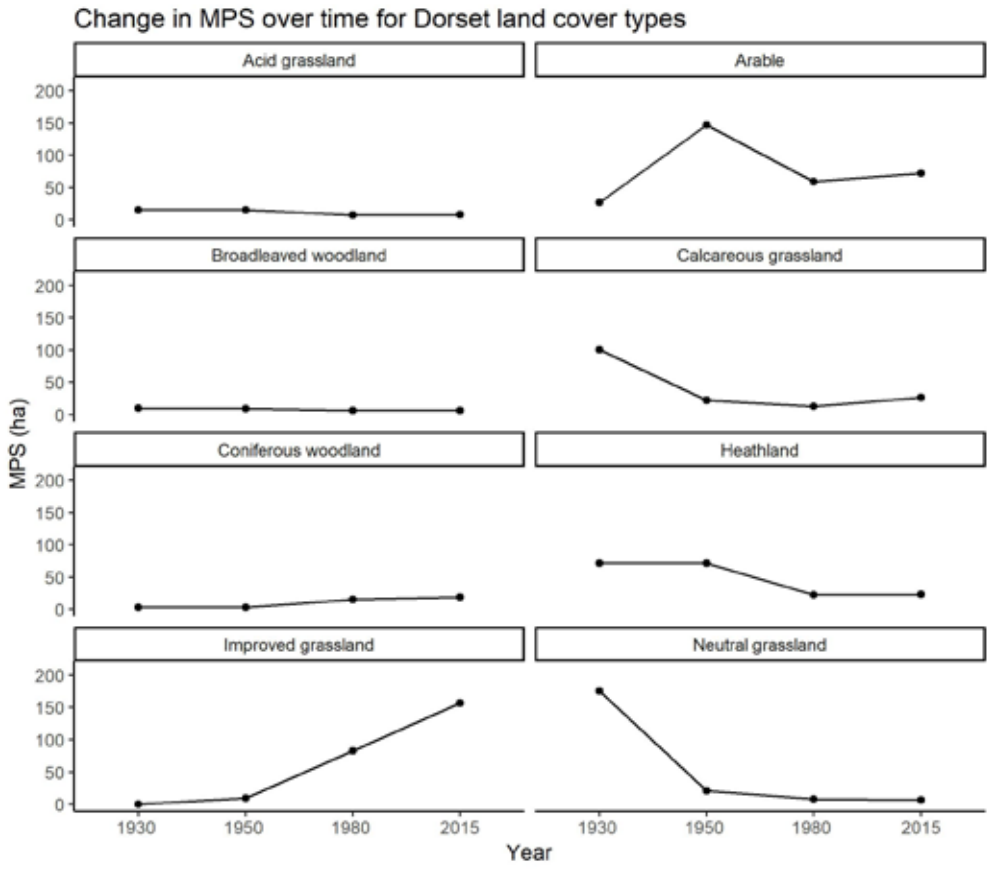


Figure 11. Changes over time in the mean patch size of different land cover types in Dorset, determined using FRAGSTATS.

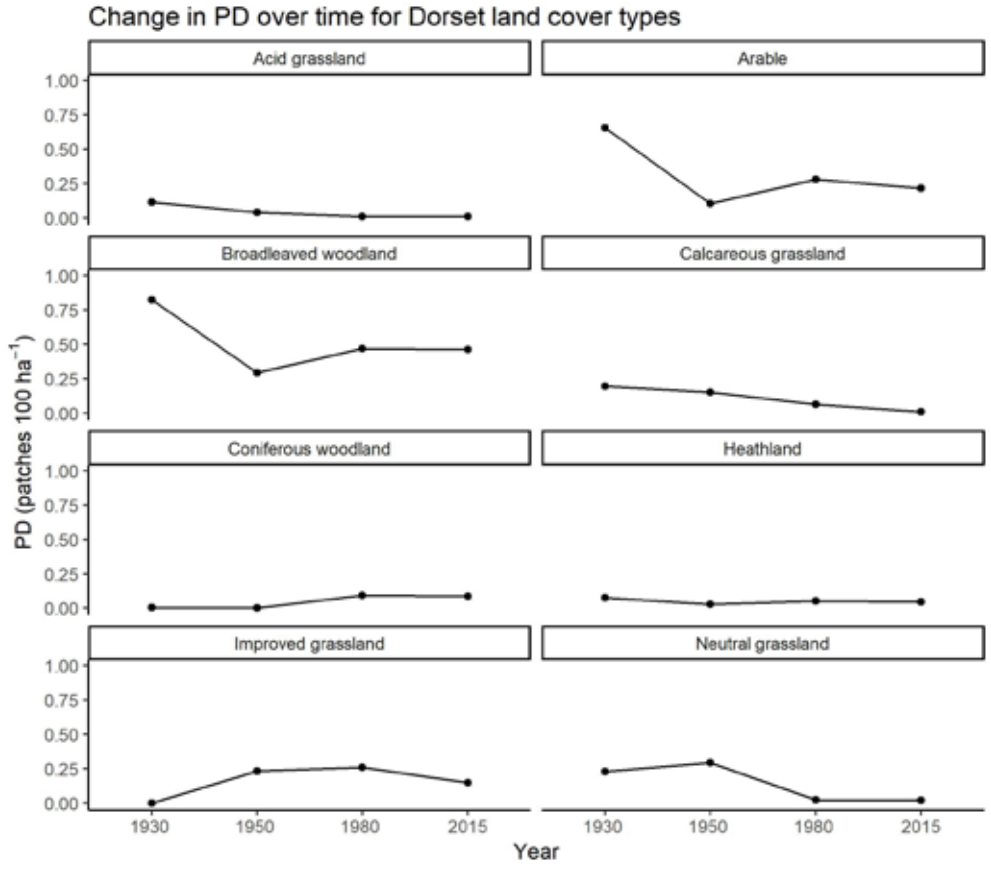


Figure 12. Changes over time in the patch density of different land cover types in Dorset, determined using FRAGSTATS.

Ecosystem Condition and Service Flows

Many human activities can potentially reduce the condition of ecosystems, including pollution, harvesting of plants or animals, and use of livestock or fire. However, the relationships between ecosystem condition and the provision of ecosystem benefits to people are not well understood. Here we examined these relationships by conducting a field survey in Dorset along gradients of ecosystem condition. A range of different variables were measured to provide insights into variation in ecosystem functions and services, including soil carbon and nitrogen content, pollinator abundance, and both aesthetic and recreational value.

Three habitats were selected on the basis of their high ecological value: calcareous grassland, heathland and broadleaved woodland. Only sites that had been identified as these respective habitats by field surveys conducted in the 1930s were selected. Thirteen sites were chosen for each habitat type to provide gradients of decreasing ecosystem condition, representing the common patterns of ecosystem degradation in Dorset. The gradients were as follows:

Calcareous grasslands (SSSI quality) → restoring calcareous grassland → improved grassland

Heathland (SSSI quality) → gorse-covered heathland → coniferous plantation

Ancient woodland (SSSI quality) → broadleaved woodland → coniferous plantation

Measurements were made within 50 x 50 m sample plots located randomly within each site. Analysis of floristic composition enabled each site to be classified according to the National Vegetation Classification (NVC). Ecosystem condition was assessed as the degree of similarity in vegetation composition to that of relatively undisturbed sites, using the NVC classification as a reference.

The majority of ecosystem functions and services displayed linear relationships with ecosystem condition, along the gradients (**Table 2**). Over half of the variables assessed displayed a positive relationship,

[18] **http://www.cldm.ceh.ac.uk/exceedances/maps**

Figure 14. An estimated smoothing curve (solid line) with standard error (blocked grey area) for the model of the carbon content of trees (m^2) across a woodland gradient (a higher NVC fit equates to a better quality site). This is an example of a negative linear relationship (-) in **Table 2.**

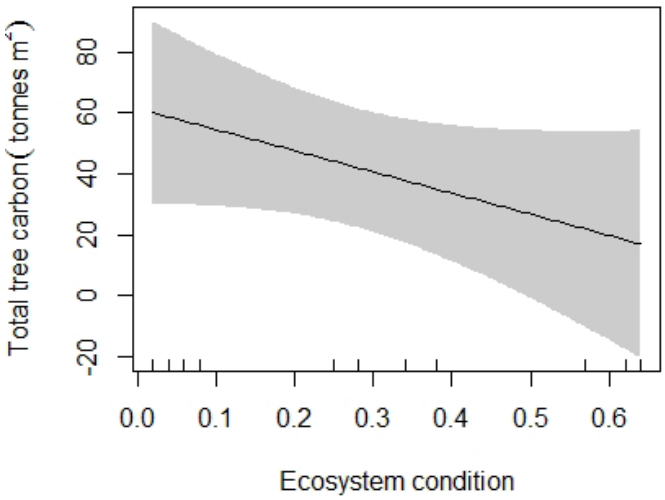
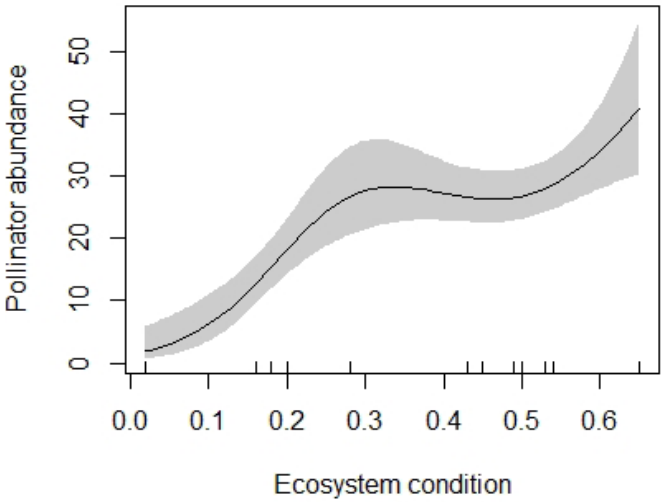


Figure 15. An estimated smoothing curve for the model that contains pollinator (bumblebee, solitary bee and butterfly) abundance with standard error (blocked grey area) across a calcareous grassland gradient. A higher NVC fit equates to a better quality site. This is an example of a non-linear relationship (+/-) in **Table 2**.



increasing with an improvement in site condition, although a fifth of the relationships were negative in trend (**Figure 14**). Some non-linear relationships were also observed (**Figure 15**). Overall, results also showed that ecosystem functions and services may often be less sensitive to environmental change than floristic composition. For example, if an ancient broadleaved woodland were converted into a conifer plantation, species composition might change completely, but the amount of carbon stored in the vegetation might change relatively little.

Another way of considering ecosystem condition in Dorset is to refer to data on critical loads. Internationally agreed critical loads have been defined for the protection of a number of habitats, in relation to different pollutants. Exceedance of these critical loads indicates where there is the potential for harmful effects to occur. Evidence for Dorset indicates that critical loads for nitrogen are currently being exceeded throughout the county, in all habitats, by at least 7 kg N ha^{-1} yr^{-1}.[18] How this is affecting ecosystem service flows is largely unknown.

Table 2. Summary of significant relationships between ecosystem functions and services, and ecosystem condition along gradients. + positive relationship, - negative relationship, +/- non-linear relationship.

	Soil Carbon	Soil Nitrogen	Soil C:N ratio	Vegetation C:N	Pollinator abundance	Aesthetic value	Total tree C
Calcareous Grassland	+/-	+/-	-	+	+	+	n/a
Heathland	+	+	+	+	+/-	+	n/a
Woodland	-	+	-	-	+/-	+	-

Trends in Ecosystem Services

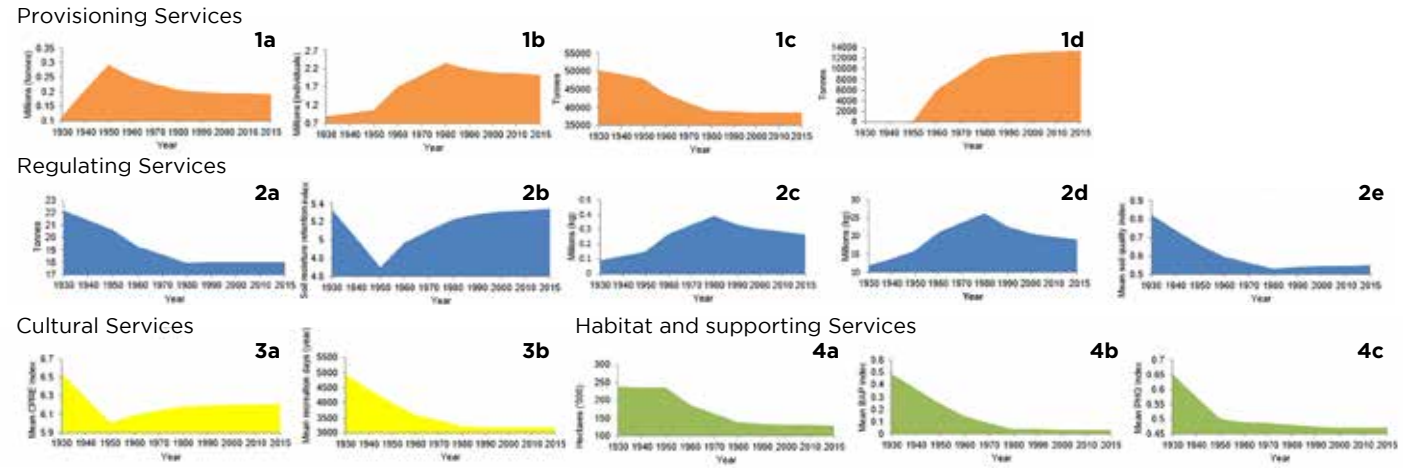
We used the time series of historical land cover maps to estimate how flows of ecosystem services have changed over time. To achieve this, we used the InVEST (Integrated Valuation of Ecosystem Services and Trade-offs) software models[19] for the periods 1930, 1950, 1980 and 2015. Using this approach, we mapped the ecosystem service values of Dorset at a 100 m x 100 m resolution for 12 services, including food production (crops and livestock), timber production, carbon sequestration and storage, flood protection, water purification, soil quality, water regulation, aesthetic value, recreation, habitat quality for pollinators and biodiversity value.

Key results were as follows (**Figures 16, 17**):

- **Measures of biodiversity value have undergone a substantial decline since the 1930s. We mapped the quality of habitat for species of conservation concern (i.e. those listed on the UK's Biodiversity Action Plan (BAP)), using records of field observations. This declined rapidly from 1930-1980, and more gradually thereafter. Habitat quality for pollinating insects also declined rapidly from 1930-1950, and subsequently continued to decline at a lower rate.**
- **Production of arable crops increased rapidly from 1930 to reach a peak around 1950, after which values declined. Livestock production increased rapidly after 1950 to reach a peak in the 1980s.**
- **Timber production from conifer plantations increased substantially after the 1950s, whereas that from broadleaved woodlands declined overall, particularly between 1950 and 1980.**
- **Carbon storage, soil quality and regulation of water flow have declined since the 1930s, although the latter has recovered somewhat since reaching a minimum in the 1980s.**
- **The flow of nitrogen into the wider watershed of the catchment (i.e. 'nitrogen export') increased steadily between 1930 and 1980, declining slightly thereafter. This largely reflects patterns of fertilizer application on farmland.**
- **Mitigation of flood risk demonstrated a more complex pattern, declining rapidly between 1930 and 1950, but thereafter recovering, to reach values similar to those observed at the outset. This pattern partly reflects the increase and subsequent decline of arable land, which promotes high run-off of rainwater.**

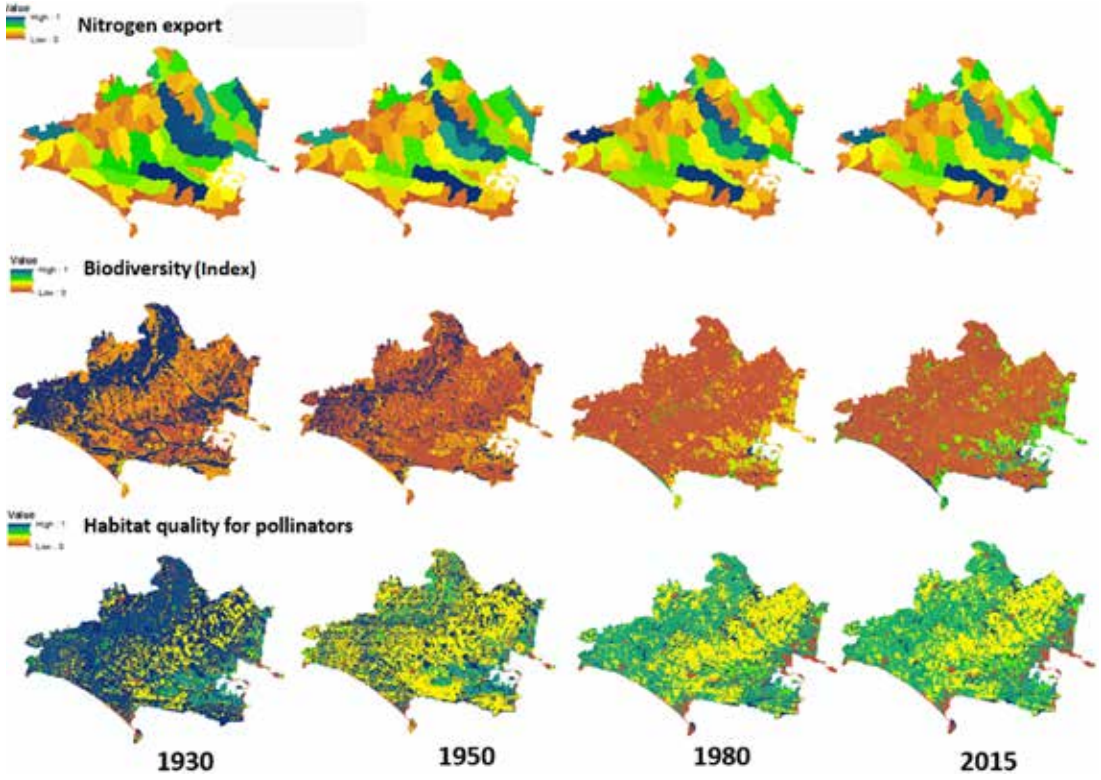
[19] **https://naturalcapitalproject.stanford.edu/invest/**

Figure 16. Trends in ecosystem service provision in Dorset. Values represent annual output of InVEST models and land-use-based proxies for the 1930-2015 period.



1a Food production (crops) **1b** Food production (livestock) **1c** Timber (broadleaved) **1d** Timber (coniferous) **2a** Carbon sequestration and storage **2b** Flood protection **2c** Nutrient export **2d** Nutrient retention **2e** Soil quality **3a** Aesthetic value **3b** Recreation value **4a** Habitat area (BAP species) **4b** Habitat quality (BAP species) **4c** Habitat quality (for pollinators)

Figure 17. Maps of selected ecosystem services, generated using InVEST models, to show changing distributions of service provision in Dorset over time.



Overall, nine of these measures have declined since the 1930s, primarily as a result of the intensification of agricultural and forestry practices. Contrasting dynamics of different services were attributable to shifting patterns of land use over time, particularly the increase in arable crop cultivation after 1945, and the subsequent transition from arable to livestock farming over large parts of Dorset that occurred after the 1950s, reflecting changes in agricultural subsidies. Nutrient export (a major driver of eutrophication) peaked in the 1980s, when use of artificial fertilizers reached a maximum. While some services (such as mitigation of flood risk) have increased in recent years owing to land use changes, others (such as soil quality, carbon storage and biodiversity) have declined continuously over the survey period, with no sign of recovery.

Economic Trends and Environmental Linkages

Dorset has around 30,000 businesses, about 90% of which are relatively small (i.e. fewer than 10 employees). The most important sectors in terms of their contribution to the overall economy are currently the retail trade, construction, financial and insurance, health, and public administration and defence. In terms of employment, the most important sectors are the retail trade, education, health and construction. Currently, agriculture and forestry account for just over 1% of Dorset's economy, and less than 1% of employment. Employment in agriculture has declined by more than half since 1981.

Analysis of official statistics shows that Dorset's economy has grown continuously over the past 50 years, indicated by a seven-fold increase in GVA (**Figure 18**). Employment has also risen, although at a much lower rate (**Figure 19**). These data illustrate how Dorset's economy has developed, even though the environment has deteriorated over the same period, as documented earlier in this report. This raises a pertinent question: do these opposing trends indicate that economic growth has been fuelled by environmental degradation? Or are the environment and economy simply disconnected?

We examined the links between the environment and economic activity by conducting a questionnaire survey of 200 Dorset businesses, drawn from a range of different sectors. We asked them how dependent their business activities were on the provision of different ecosystem services. Overall, 47% of businesses stated that they were at least somewhat dependent on flows of ecosystem services (**Table 3**). Results also showed that:

[20] Watson, S.C.L. and Newton, A.C. (2018). *Sustainability* 10(5), 1368 **https://doi.org/10.3390/su10051368**.

[21] ONS Office for National Statistics (2015).

[22] ONS Office for National Statistics (2015).

[23] Watson, S.C.L. and Newton, A.C. (2018). *Sustainability* 10(5), 1368

Brewery Square, Dorchester © Nigel Jarvis

- **Sectors that were highly dependent on ecosystem service flows included tourism and travel, manufacturing (food and beverages), education and agriculture (Table 3)**
- **The most important services to businesses were provision of freshwater, waste and water treatment, microclimate regulation, water quality and carbon storage (Figure 20).**
- **More than 50% of businesses reported that the quality of the natural environment was one of the main reasons for conducting business in Dorset.**
- **Many businesses placed high importance on locally produced materials and utilities, with >50% of businesses surveyed suggesting locally produced fuel, energy, water (for human consumption and industrial use) and building materials (including timber) were an important factor for locating their businesses in Dorset.**
- **Many businesses indicated little or no dependence on services such as pollination and soil condition, which may reflect a lack of awareness of dependencies occurring upstream of their value chains.**

Our research also showed that Dorset's economy is geographically structured. Most businesses are located in urban areas, which are concentrated in the south-east corner of the county. Yet most ecosystem services are produced in rural parts of the county. This shows that although the direct contribution of agriculture to the economy is low, its indirect impact on the economy is much higher. Many of Dorset's businesses are at least partly dependent on ecosystem service flows from rural areas, which are profoundly affected by the prevailing patterns of land use. How the land is used therefore has a major impact on economic development and employment, beyond the immediate contribution of agriculture as an economic sector.

Table 3. Dependency of Dorset businesses on provision of ecosystem services, averaged by sector. Values were determined by a questionnaire survey. Values presented indicate the percentage of businesses who indicated that their business operations were highly or entirely dependent on ecosystem service flows.[20]

Business Sector	ES Mean Dependency (High or Entirely dependent)	Business Sector	ES Mean Dependency (High or Entirely dependent)
Agriculture and forestry	76%	Retail	34%
Ecological consultancy	74%	Mining and quarrying	32%
Fishing	65%	Private health	31%
Education	62%	Transportation and storage	27%
Tourism and travel	60%	Public health	26%
Charitable trust	54%	Estate agencies	25%
Manufacturing (Food and beverage)	54%	Business services - scientific and technical	22%
Electricity	49%	Manufacturing (Advanced engineering)	19%
Water & sewage and waste	49%	Gas	17%
Food and beverage	43%	Advertising and promotion	13%
Construction	40%	Business services - professional services	12%
Entertainment	38%	Communication	12%
Public administration	35%	Manufacturing (Other)	9%
Wholesale	35%	Financial services	7%

Figure 18. Trends in the economy and employment estimates for Dorset: total industry Gross Value-Added (GVA) for all economic sectors.[21]

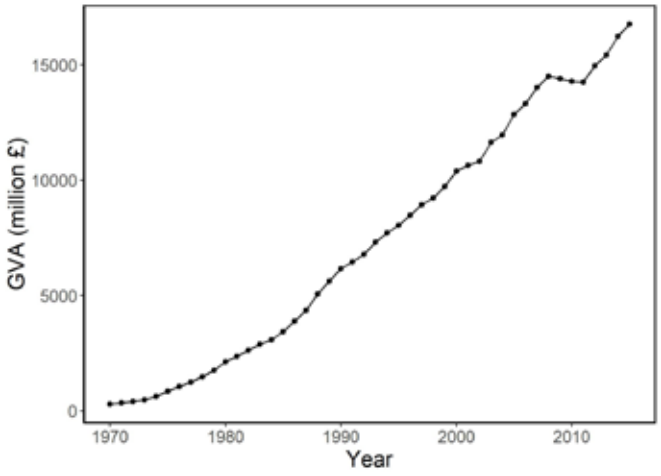


Figure 19. Trends in the economy and employment estimates for Dorset: total employment (FTE).[22]

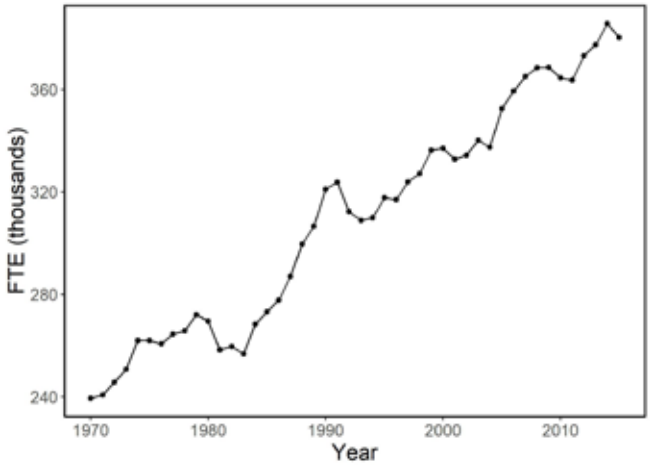
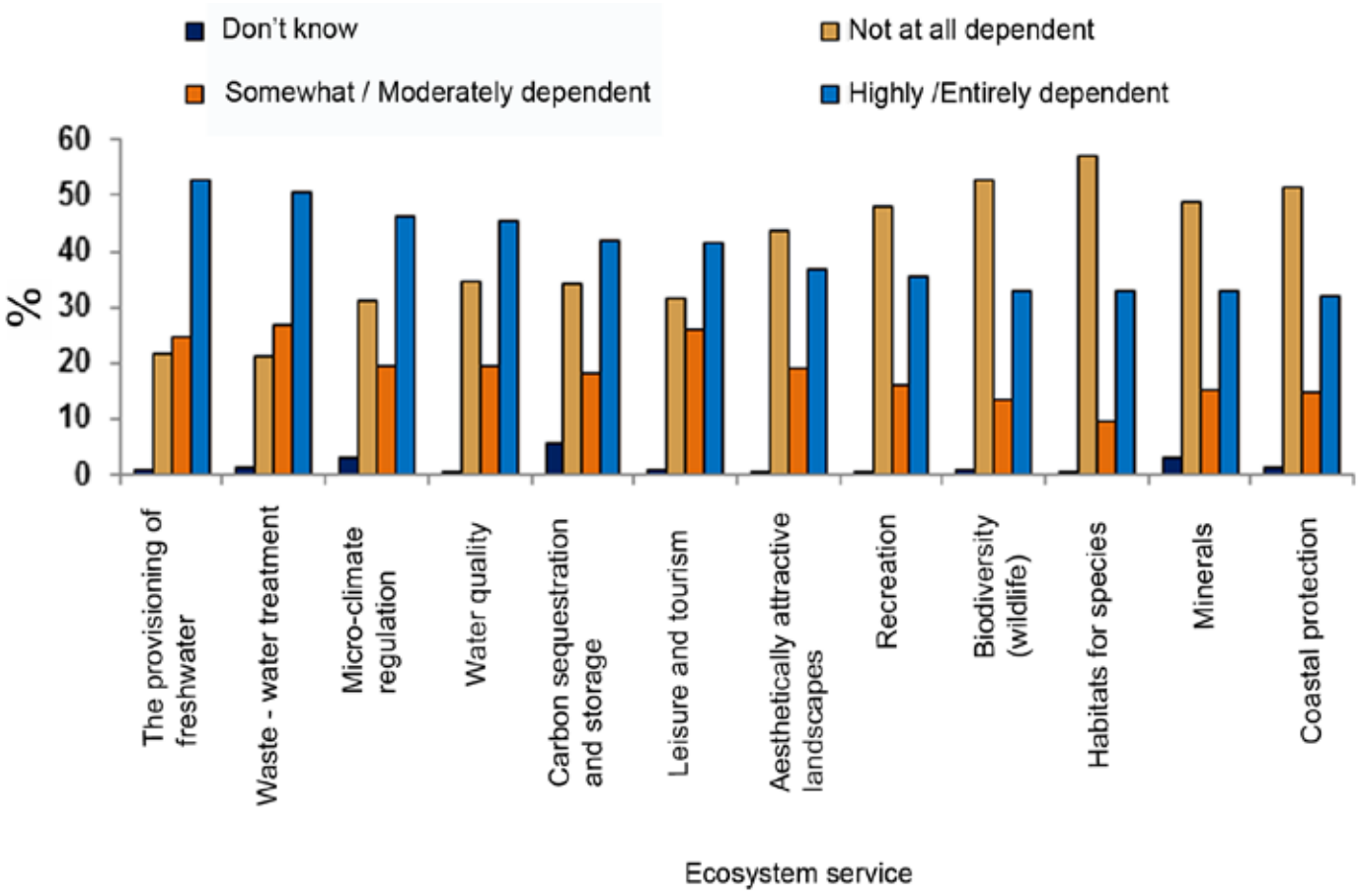


Figure 20. The ecosystem services on which Dorset businesses were most dependent, based on results of a questionnaire survey[23].



Sunseeker assembly facility, Poole Harbour © Sunseeker International

Environmental and Economic Linkages: Poole Harbour as a Case Study

As one of the world's largest natural harbours, Poole Harbour provides an informative example of economic links with the environment. The south side of the harbour is home to extensive areas of semi-natural habitats of high conservation value, including saltmarsh, mudflats, sand dunes and heathland. This contrasts with the high-value residential areas located on the northern side, which neighbour the port and its associated industrial areas. Poole Harbour illustrates some of the many conflicts and challenges that can occur when centres of economic activity are located in places that also have high environmental value.

The environmental value of Poole Harbour is recognised by its designation as a Special Protected Area (SPA) and as a Ramsar site. The area is particularly notable for the large populations of waterbirds that it supports, which feed on the extensive intertidal mud-flats and areas of grazing marsh. One of the main threats affecting the area is increasing nutrient enrichment, which is principally caused by agricultural run-off entering the rivers that flow into the Harbour (**Figure 21**). This contributes to the growth of algal mats, which can restrict the food available for wading birds. In this study we found a direct link between the proliferation of algal mats and decreases in mudflat area, saltmarsh area and populations of overwintering wading birds (**Table 4**).

We also examined dynamics of the Manila clam (*Ruditapes philippinarum*) industry within the Harbour. This fishery developed in the 1980s after the species was first introduced for aquaculture. It then spread and started to reproduce, enabling development of an industry harvesting 'wild' populations, which is currently worth some £1.4 million annually. Analysis of time-series catch data indicated that populations of Manila clam collapsed in 2008, having reached a peak the previous year (**Figure 22**). This decline was partly attributable to illegal fishing pressure, although other factors such as disease also appear to have been influential. Potentially, interactions between climate change, fishing pressure and disease could provide a feedback mechanism leading to a tipping point in the provision of this ecosystem service (**Figure 23**). More recently feral clam stocks of the harbour have recovered, owing to improved management measures taken by the local inshore fisheries and the conservation authority (IFCA). These efforts have recently been recognised by certification by the Marine Stewardship Council (MSC).

[24] Watson, S.C.L. *et al.* (2018). *Estuarine, Coastal and Shelf Science*, 215, 112-123.

[25] Data from the Freshwater Biological Association.

[26] Data from the Southern IFCA.

Table 4. The impact of different pressures (drivers) on the natural capital assets of Poole Harbour. The tick represents a statistically significant negative relationship ($p \leq 0.01$), while the cross represents no effect, as determined by analysis of time-series data[24].

Reported cause (Drivers)	Negative Impact on Natural Capital			
	Manila Clam (*Ruditapes philippinarum*)	Mudflat (Area)	Saltmarsh (Area)	Waders and wildfowl
Macroalgal mats caused by nitrogen inputs	✗	✓	✓	✓
Disease (bacteria)	✓	✗	✗	✗
Illegal fishing	✓	✗	✗	✗
Channel and habitat alterations	✗	✓	✓	✗
Climate change (water temperatures)	✗	✗	✗	✗

Sandbanks ferry in Poole Harbour entrance © Steven Mckell

The five main Islands in Poole Harbour © allou

Figure 21. Normalised time series of nitrogen entering Poole Harbour from the river Frome at East Stoke for the period 1980-2015[25].

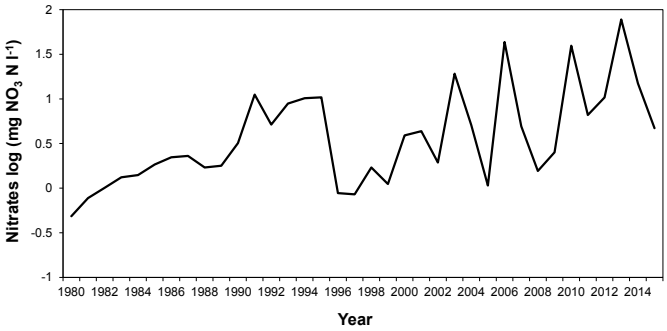
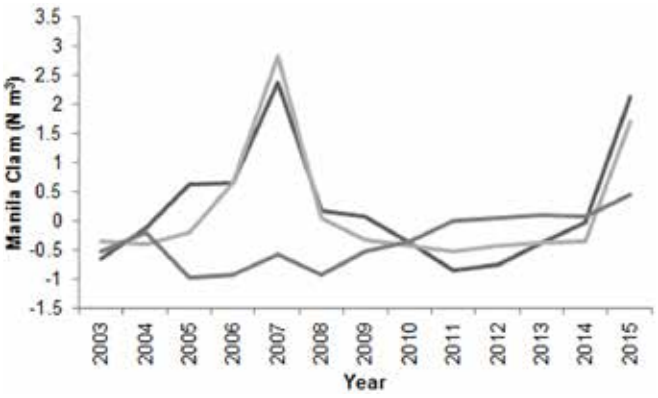


Figure 22. Annual stock surveys for Manila clam obtained for three sites in Poole Harbour: Arne Bay, Seagull Island and Round Island[26].



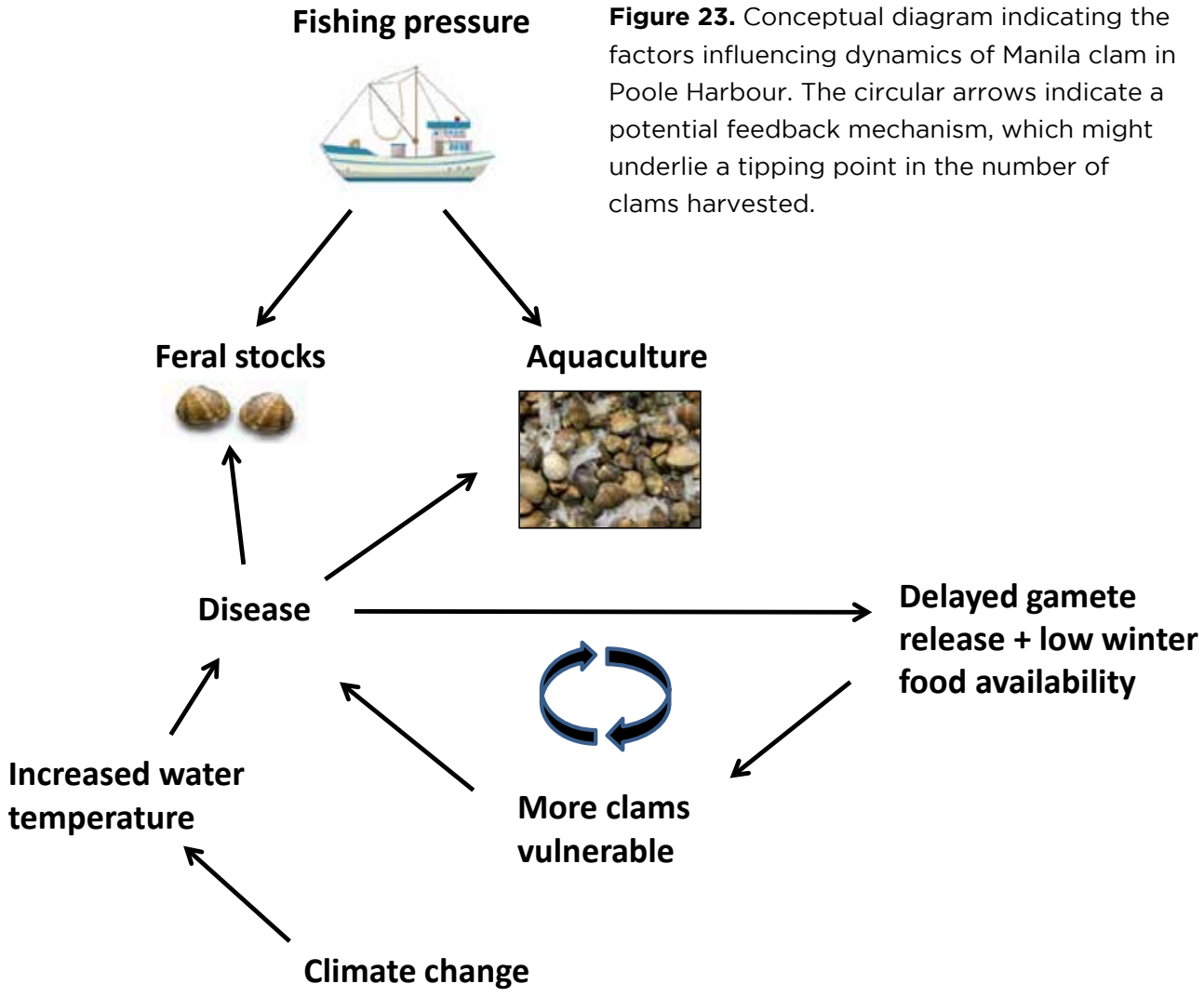


Figure 23. Conceptual diagram indicating the factors influencing dynamics of Manila clam in Poole Harbour. The circular arrows indicate a potential feedback mechanism, which might underlie a tipping point in the number of clams harvested.

Future Trends

How might Dorset's environment and economy change in the future? This is a very pertinent question, given the current political uncertainty surrounding the UK's relationship with the EU. If the UK leaves the EU as planned following the referendum result in 2016, this will have major implications for agriculture. Specifically, Brexit involves departure from the EU's Common Agricultural Policy (CAP) schemes, which are currently an important source of revenue for farmers. While the UK will be able to develop its own agricultural policy to replace the CAP, the details of this have not yet been finalised. It appears that farmers and land managers will likely be able to receive government funds for the provision of environmental services and benefits[27], as well as traditional products such as food and timber. This policy shift might provide economic opportunities for managing the landscapes of Dorset in a profoundly different way.

To explore the potential impacts of possible future trends, we developed scenarios of future land use in collaboration with local stakeholders. Representatives of local businesses, conservation organisations and government agencies were invited to evaluate different land use options at a project workshop. Scenario development was further supported by use of two modelling approaches: (i) an input-output economic model, and (ii) an agent-based model. While input-output models are widely used to support economic planning, they do not explicitly consider links with the environment. For this reason an agent-based model (DONC) was developed that incorporates land cover maps of Dorset, and enables simulation of ecosystem service flows to businesses under different scenarios of environmental change. The two models were used in combination to explore the potential impacts of different scenarios of land cover change.

[27] **https://www.gov.uk/government/publications/the-future-for-food-farming-and-the-environment-policy-statement-2018**

[28] Lawton, J.H. *et al.* (2010). *Making Space for Nature: a review of England's wildlife sites and ecological network.* Report to Defra.

[29] See also the *"Biodiversity 2020"* strategy produced by Defra.

[30] **https://www.gov.uk/government/publications/25-year-environment-plan/25-year-environment-plan-our-targets-at-a-glance**

[31] **http://www.biodiversitysouthwest.org.uk/nmap.html**

Table 5. The extent of land cover change in the different scenarios. BAU: "Business as usual", HIGB "Green Brexit", High Intensity; LIGB "Green Brexit", Low Intensity; HIAB "Agribrexit", High Intensity; LIAB "Agribrexit", Low Intensity.

Land cover type	BAU (%)	HIGB (%)	LIGB (%)	HIAB (%)	LIAB (%)
Inland water	0.28	0.28	0.28	0.28	0.28
Arable	30.04	19.8	24.03	32.34	31.73
Neutral grassland	0.28	3.64	1.74	0	0
Calcareous grassland	0.6	10.41	6.12	0	0
Acid grassland	0.15	0.15	0.15	0	0
Fen, Marsh, Swamp (incl. Saltmarsh)	0.53	2.32	0.85	0.53	0.53
Improved grassland	45.46	24.39	35.84	56.73	50.56
Heathland	2.64	5.18	3.27	0	0
Coastal	1.68	1.68	1.68	1.68	1.68
Built-up areas and gardens	8.14	8.14	8.14	8.14	8.14
Broadleaved, mixed and yew woodland	6.24	20	13.93	0	3.11
Coniferous woodland	3.66	3.66	3.66	0	3.66
Inland rock	0.31	0.37	0.32	0.31	0.31
Agriculture	75.5	44.19	59.87	89.07	82.3

We developed five scenarios for the period 2015-2050, which were designed to cover a wide spectrum of possibilities:

- **"Business as usual" (BAU) – the land cover of Dorset remains unchanged.**
- **"Green Brexit", High Intensity – the area of agricultural land declines by 41.47% over the 35 year interval.**
- **"Green Brexit", Low Intensity – the area of agricultural land declines by 20.7%.**
- **"Agribrexit", Low Intensity – the area of agricultural land increases by 9%.**
- **"Agribrexit", High Intensity – the area of agricultural land increases by 17.9%.**

Here, agricultural land referred to both arable and improved grassland. In the "Green Brexit" scenarios, the area of agricultural land was reduced to enable the large-scale expansion of habitats with high conservation value, such as calcareous grassland and heathland. This is consistent with the ideas presented in the *"Making Space for Nature"* [28] report, which sets out an ambitious vision for creating a resilient ecological network in England through ecological restoration[29]. Similarly, targets for large-scale habitat restoration are included within the UK Government's *25 Year Environment Plan*[30], which aims to restore 500,000 ha of wildlife-rich habitat throughout the UK, and to achieve a 12% increase in woodland cover in England by 2060.

To produce the land cover maps for the "Green Brexit" scenarios, we used the South-West Nature Map[31], which provides an assessment of where habitat restoration might best be undertaken in the region. For the "Agribrexit" scenarios, all of the remaining habitats that are suitable for agriculture were converted to farmland; the type of agriculture in each location was determined by the relative suitability of different soil types. The "low intensity" scenarios implemented half of the land cover change implemented in the "high intensity" scenarios (**Table 5, Figure 24**). Ecosystem services were mapped for each scenario using the InVEST software models.

Results indicated that:

- There is limited scope for further expansion of agricultural land in Dorset; most of the land that is suitable for farming has already been converted to agricultural land use. Even if all land suitable for agriculture were converted, this would only increase the area of farmland by about 18%.

- In addition to increasing their area, the "Green Brexit" scenarios also had a positive impact on the fragmentation of habitats with high conservation value, such as calcareous grassland, broadleaved woodland, heathland and unimproved grassland. This was indicated by increases in mean patch size and patch density (**Figure 25**).

- As expected, the "Green Brexit" scenarios had a positive impact on wildlife, values of the overall biodiversity index and insect pollinator index increasing significantly over 2015 values. However, neither of these indices achieved the values that were present in 1930, indicating that much more extensive habitat restoration measures would be required to return the wildlife value of Dorset to what it was around 80 years ago (**Figure 26**).

- Other ecosystem services that increased under the "Green Brexit" scenarios included carbon storage, soil quality, retention of nitrogen, recreation, aesthetic value and water yield. Only crop yield and livestock production were higher under the "Agribrexit" scenarios.

- Analysis using only the input-output model indicated that the economic impact of the simulated land cover change was very slight, with values of GVA changing by ≤ 0.3% under each scenario. However, when the value of ecosystem service provision was included by using the agent-based model, the overall economic impact was much greater (up to 5%) (**Figure 27**). In addition, the relative impact of the different scenarios was completely reversed: when ecosystem services were considered, the "Green Brexit" scenarios had a positive economic impact, whereas the "Agribrexit" scenarios had a negative economic impact. This demonstrates how rural land use can affect the wider economy by affecting the provision of ecosystem services to other business sectors. This influence of farming on the wider economy is ignored by conventional approaches to economic forecasting.

- Projections of employment mirrored those obtained for economic growth. Changes in employment values obtained with the input-output model were very small, the total number of jobs increasing by 0.25% in the "Agribrexit" High Intensity scenario. Much larger values were obtained using the agent-based model, which incorporated ecosystem service flows. Here, the largest increase (of 8%) was obtained in the "Green Brexit" High Intensity scenario. This demonstrates how investment in natural capital can make a significant contribution to increasing employment.

Figure 24. Land cover maps associated with four scenarios of potential future land use in Dorset. (a) HIGB "Green Brexit", High Intensity; (b) LIGB "Green Brexit", Low Intensity; (c) LIAB "Agribrexit", Low Intensity, (d) HIAB "Agribrexit", High Intensity.

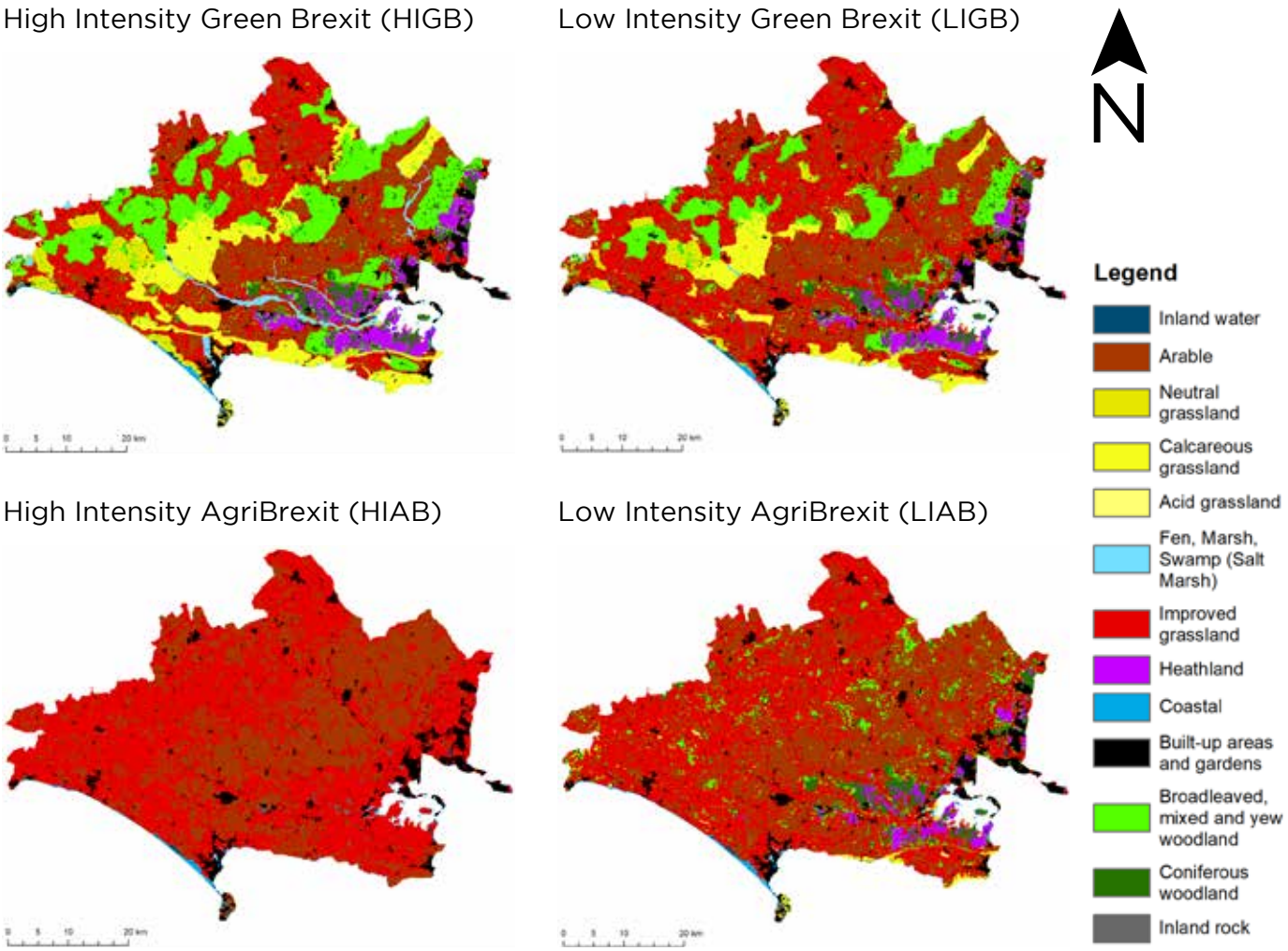


Figure 25. Habitat fragmentation under the four scenarios of future land use in Dorset. (a) mean patch (MPS) size, (b) patch density (PD).

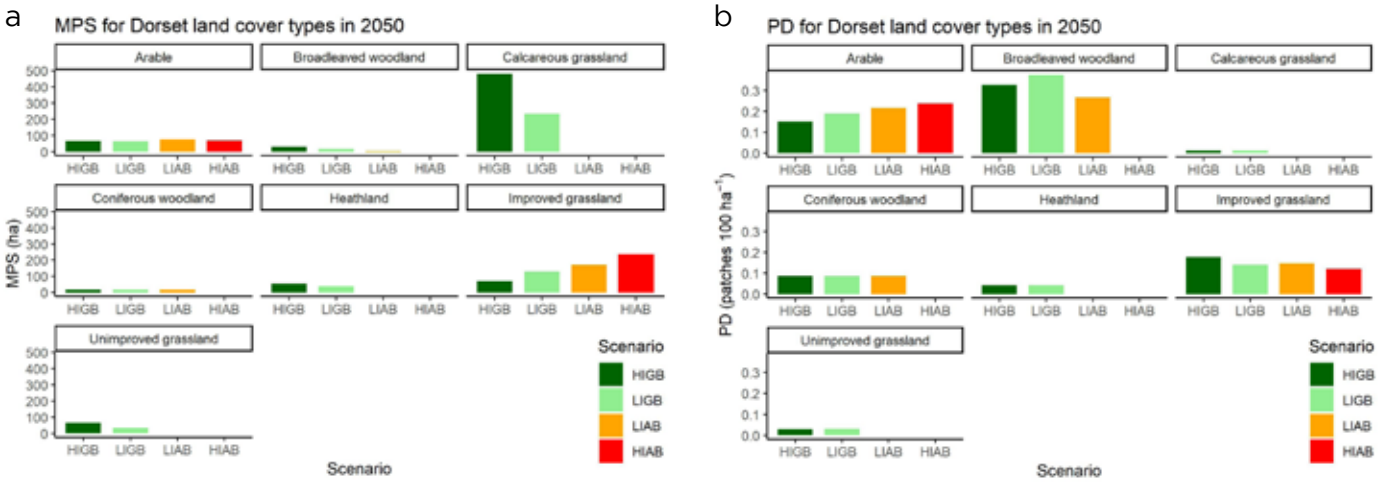


Figure 26. Flows of selected ecosystem services under the scenarios of future land use in Dorset.

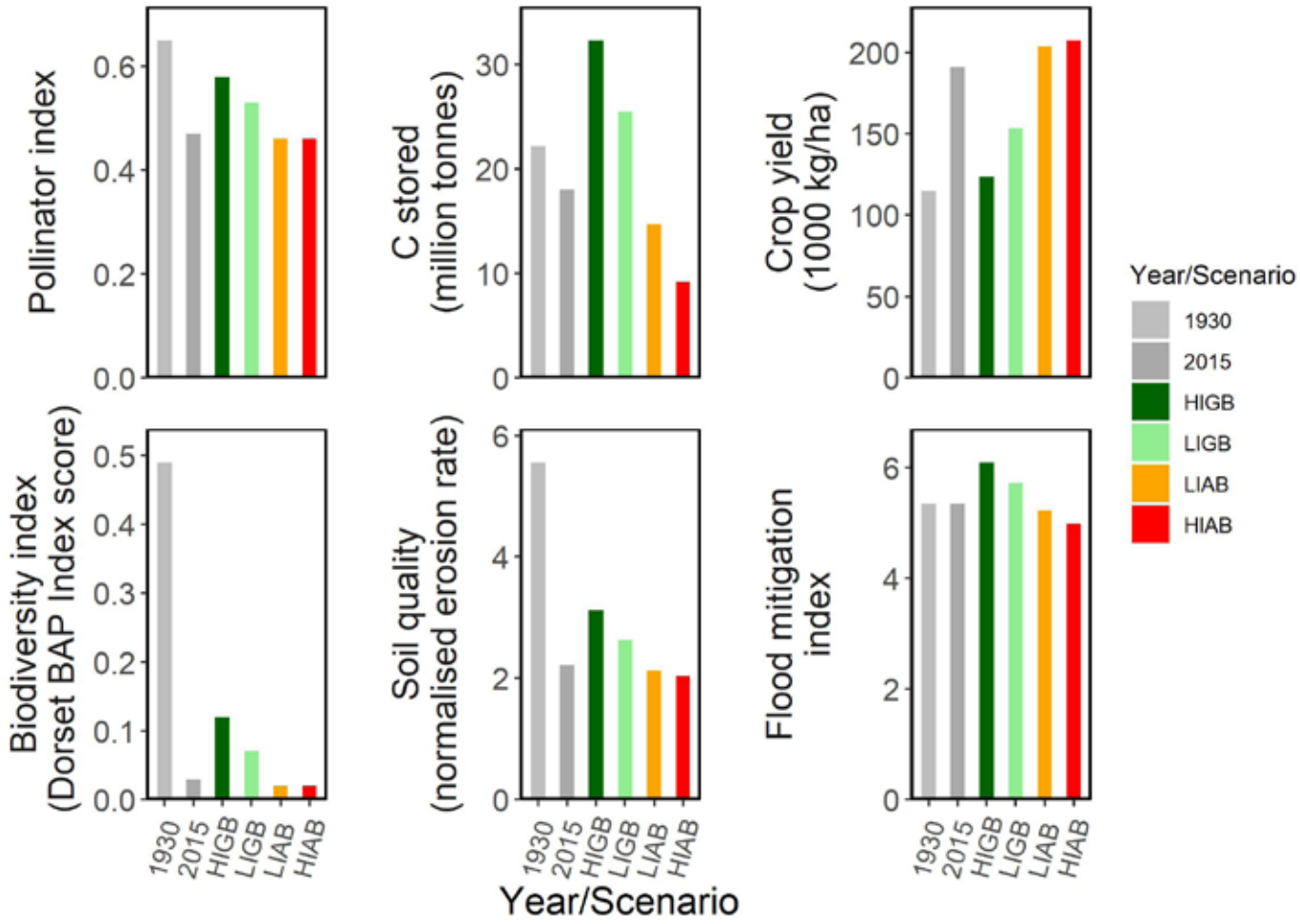
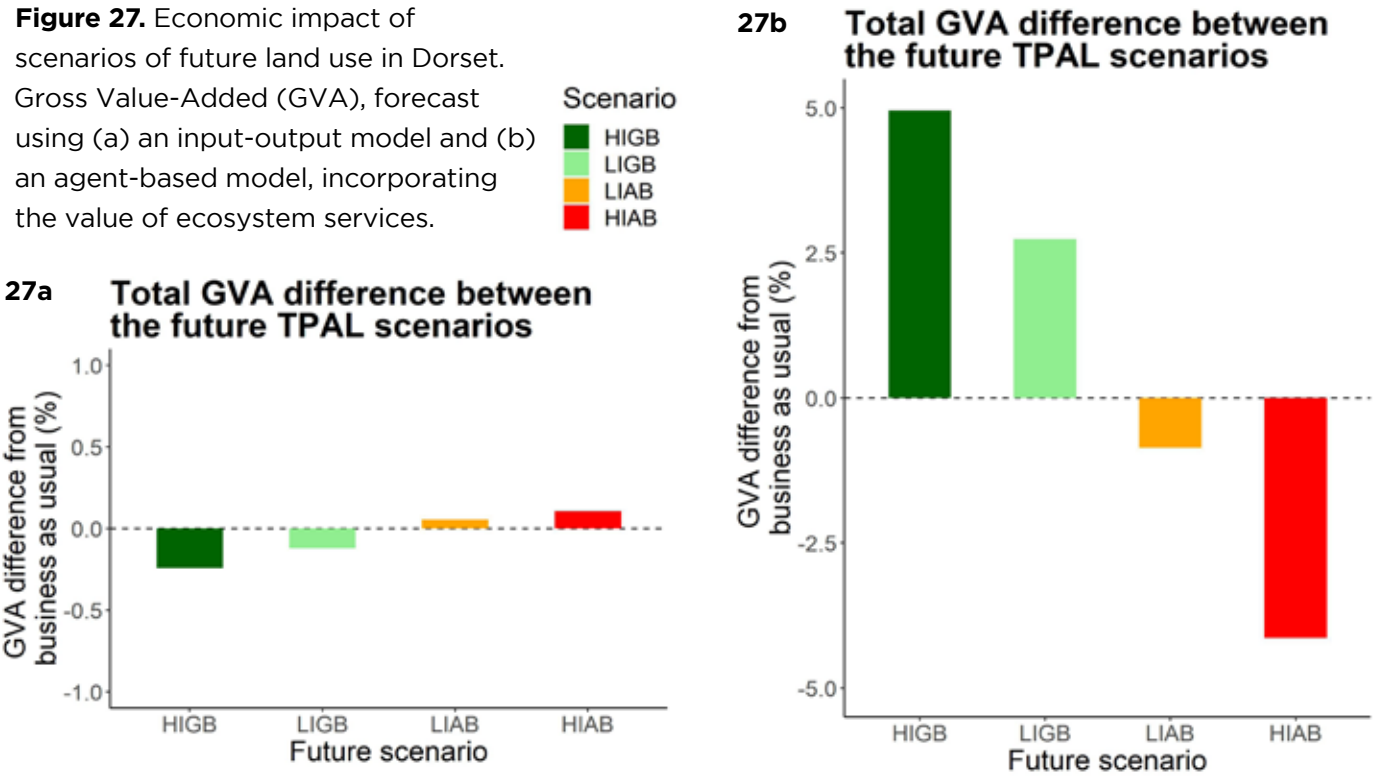
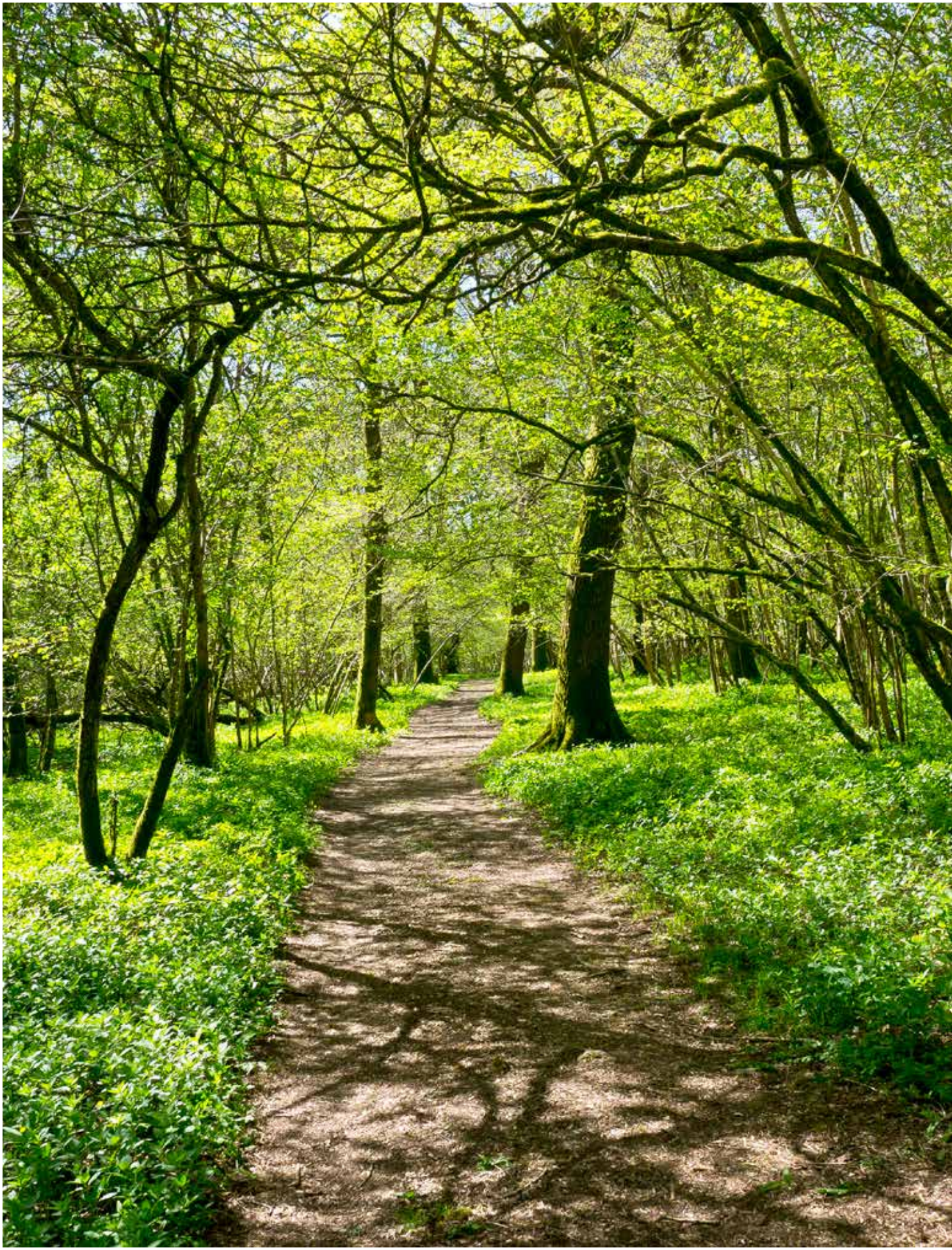


Figure 27. Economic impact of scenarios of future land use in Dorset. Gross Value-Added (GVA), forecast using (a) an input-output model and (b) an agent-based model, incorporating the value of ecosystem services.



Garston Wood © Roger Lane



Conclusions

How degraded are Dorset's ecosystems?

Dorset remains a very important county for wildlife, with extensive areas of semi-natural habitats, high species richness and important populations of many species of conservation concern. However, it is clear from our analyses that Dorset's wildlife value has undergone a substantial decline in the past 80 years, as indicated by the loss and fragmentation of many important habitats, such as calcareous grassland, neutral grassland and heathland. Many of these habitats have lost more than half of the area that was present in 1930. These losses are largely attributable to intensification of agriculture and changing farming practices. Although the rate of habitat loss has slowed in the past three decades, the productivity and efficiency of agriculture continues to increase. This intensification is associated with ongoing losses of biodiversity. All of Dorset's semi-natural ecosystems are receiving nitrogen deposition in exceedance of critical loads, and this is changing the structure and composition of ecological communities. Such trends are apparent throughout Dorset, showing that farming practices are having a significant impact on surrounding habitats. However, trends in ecosystem services reveal a more complex picture. While some services such as carbon storage and soil quality have declined continuously over the past 80 years, others such as mitigation of flood risk have displayed more complex dynamics.

[32] Woodcock, B. A. *et al.* (2017). *Science*, 356, 6345, 1393-1395.

[33] See *Philosophical Transactions of the Royal Society* special issue (2003), vol. 358, issue 1439.

[34] **https://www.metoffice.gov.uk/research/collaboration/ukcp**

Jurassic Coast west of Kimmeridge © Panaglossian

How will Dorset's ecosystems change in the future?

It is difficult to predict what the future holds for Dorset's ecosystems, but this will depend on future trends in the key drivers of change. Based on current trends, the productivity and efficiency of agriculture are likely to continue to increase, perhaps supported by new technological innovations. Such innovations and associated changes in farming practice can often be damaging to wildlife, as demonstrated for example by the use of neonicotinoid pesticides[32] and genetically modified crops[33]. Further biodiversity loss may therefore result from future intensification of agriculture. Patterns of rural land use are likely to depend critically on developments in agricultural policy. In particular, the proposed shift towards providing payments to farmers for provision of environmental services and benefits could have major implications. Potentially this could provide incentives for restoring extensive areas of semi-natural habitats that are of high value for provision of ecosystem services, such as broadleaved woodland, calcareous grassland and heathland. A further key trend is global warming. While climate change has already affected the distribution and abundance of some species within Dorset, such impacts are likely to become much more intense and widespread in future. By 2070, our summers may be as much as 5.8 °C warmer[34], approximating what parts of the Mediterranean experience today. This may result in radical changes to the structure and composition of ecological communities, as well as the provision of benefits to people.

Might Dorset ecosystems be vulnerable to tipping points?

We detected a number of non-linear relationships in our analyses. For example, many of the ecosystem services varied in a non-linear fashion over time, even though agricultural intensification - the main driver of land cover change - increased linearly. Some measures of land cover change, such as the area of arable land, increased non-linearly. We also detected some non-linear relationships along gradients of ecosystem condition in our field surveys. This indicates that the existence of some ecological thresholds in relation to the status of natural capital assets, which could lead to relatively abrupt change in provision of ecosystem services[35]. However, we found little evidence for true "tipping points", which require an underlying feedback mechanism to be identified. This partly reflects the difficulty of identifying such feedback mechanisms. The recent decline of Manila clam in Poole Harbour might provide an example, with a potential feedback mechanism involving bacterial disease, and possible interactions with fishing pressure, climate change and eutrophication.

Currently, there is a lack of understanding of the feedback mechanisms that might cause rapid shifts in Dorset's ecosystems. It is becoming clear, however, that agricultural use of pesticides can cause a massive decline in insect populations[36], which could potentially cause the collapse of food webs and associated extinction cascades. Such processes may account for the 75% decline in biomass of flying insects recently recorded in protected areas in Germany over a period of 27 years[37]. It is possible that similar trends are occurring in Dorset, although appropriate data are currently lacking. However, our analysis of time-series data suggested that profound shifts in Dorset's ecosystems have already happened, because the process of agricultural intensification is now well advanced. For example, the conversion of 97% of neutral grassland and 70% of calcareous grassland over the past 80 years must have been associated with a major loss of functional capacity of these ecosystems, although evidence for this is lacking. Furthermore, the fact that critical loads for nitrogen deposition are being exceeded throughout Dorset implies that an important ecological threshold has been crossed, which may have implications for future provision of ecosystem benefits to people. Climate change and its interaction with other drivers such as nitrogen deposition increase the risk of abrupt changes in ecosystem service provision occurring in the future.

[35] Mace, G.M. *et al.* (2015). *J. Appl. Ecol.* 52, 641-653.

[36] Sánchez-Bayo, F. and Wyckhuys, K.A.G. (2019). *Biological Conservation*, 232, 8–27.

[37] Hallmann, C.A. *et al.* (2017). *PLoS ONE* 12(10), e0185809.

What are the relationships between Dorset's environment and its economy?

One of the most striking results that we obtained was the contrast between environmental and economic trends. Whereas biodiversity and the provision of many ecosystem services has declined over the past 80 years, the economy has grown and employment has risen. This implies that economic development has been achieved through the liquidation of natural assets. However, another feature of these results is the fact that agriculture comprises a very small part of Dorset's economy. This indicates that most economic development has not been driven by direct exploitation of Dorset's natural resources. Conversely, our research has also showed that rural land use has a significant influence on the overall economy in a way that is not captured by traditional approaches to economic analysis. Patterns of rural land use profoundly influence the provision of multiple ecosystem services on which many businesses depend, to varying degrees. Our research also showed that this contribution of rural land use to the economy may be of significantly greater economic value than crop and livestock production. Does this imply that the entire economy of Dorset is vulnerable to environmental degradation? Model simulations suggested that if provision of ecosystem services were to be significantly reduced by future environmental degradation, overall economic activity (as measured by GVA) could decline by more than a third. If employment were also to decline significantly, the economic impacts could be substantially larger. Future environmental trends such as climate change and ongoing agricultural intensification may therefore have significant economic consequences for Dorset, and other comparable areas.

Rewilding at Knepp Estate in West Sussex. © Charlie Burrell

How might future investment in natural capital affect the economy?

Our results suggest that any investment in increasing agricultural productivity or efficiency is unlikely to have a significant impact on the local economy, despite its potential value for improving food sovereignty. However, the scenarios we developed demonstrate how investment in natural capital could potentially strengthen Dorset's economy, by improving provision of ecosystem services on which many businesses depend. For example, according to our simulations, implementation of ecological restoration at the scale described under the "Green Brexit – High Intensity" scenario could potentially deliver an £0.8 billion increase in GVA and create more than 25,000 jobs. How might investment in natural capital be achieved in practice? Many different options have been proposed[38], including development of ecological networks, woodland planting, development of green infrastructure, and creation of wetlands or semi-natural grasslands. Each of these options was rated 'highly' or 'very highly' by more than half of the stakeholders consulted at our project workshop, where different natural capital investment options were explored. Any approach that improves the condition or extent of semi-natural habitats could potentially strengthen the provision of ecosystem services, including wildlife-friendly farming approaches such as organic approaches to pest control and soil improvement, ecological restoration, habitat enhancement schemes and maintenance of habitat diversity.

We examined one particular approach in detail: rewilding. The term "rewilding" refers to a form of ecological restoration that seeks to support the recovery of ecosystems primarily through the action of natural ecological processes. The term has been applied to a wide variety of different conservation practices including species reintroductions (particularly of large vertebrates), taxon substitution, flood pattern restoration and the abandonment of agricultural land. While rewilding is increasingly being explored in many different parts of the world, including the UK, its relevance to lowland agricultural landscapes such as Dorset has been little explored. We therefore examined the potential application of a number of different rewilding approaches[39], involving the consultation of local stakeholders. Survey results showed strong support for rewilding among stakeholders, with the reintroduction of beavers and pine martens being especially popular. Naturalistic grazing and farmland abandonment were also identified as rewilding approaches that have widespread potential across Dorset (**Figure 28**). On the basis of previous research conducted into other rewilding sites in the UK, implementation of such approaches is likely to significantly increase provision of ecosystem services[40]. An example of how rewilding can be successfully implemented in lowland agricultural landscapes is provided by the Knepp Estate in West Sussex (see photo page 40).

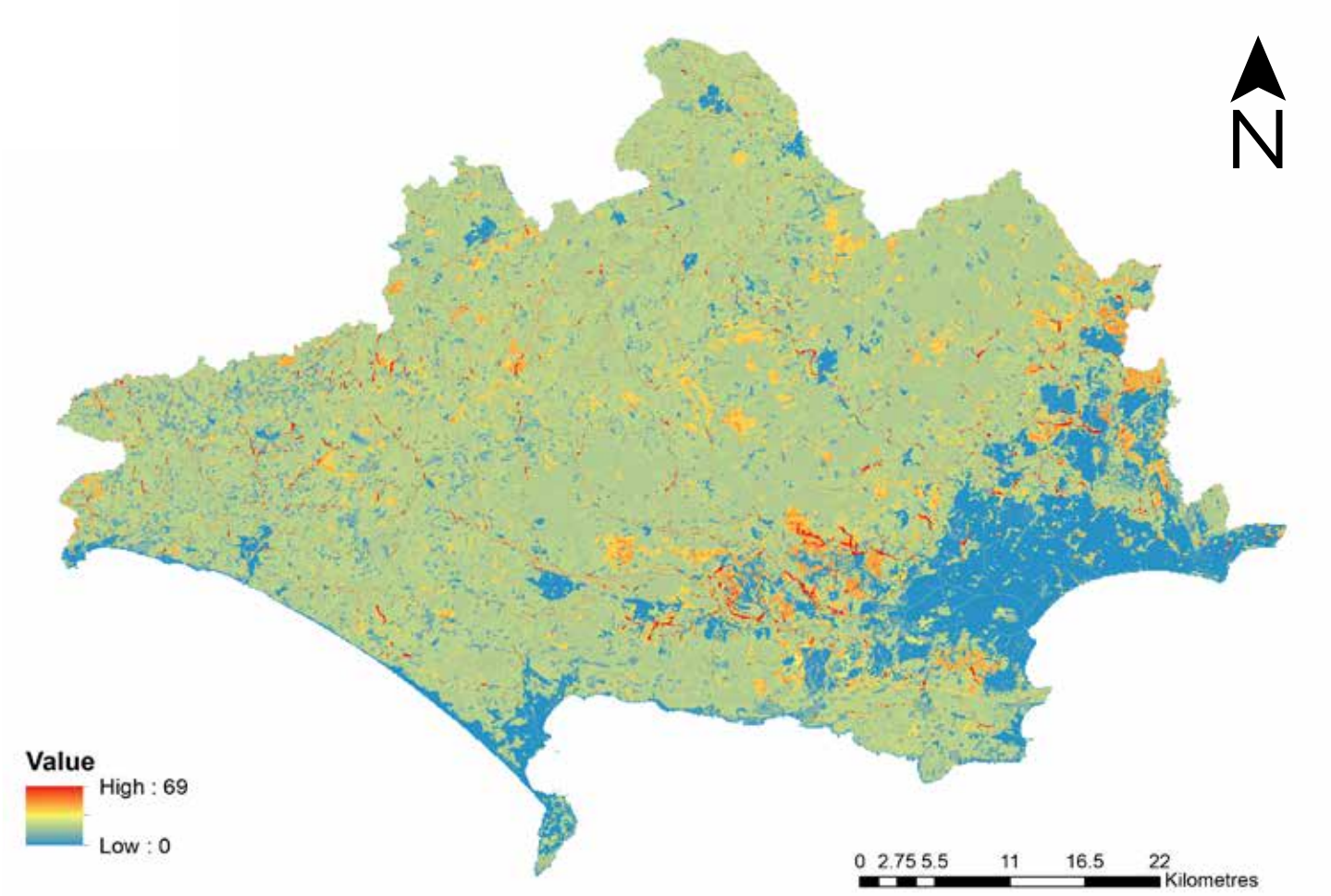
[38] For example, see the reports of the Natural Capital Committee to the UK Government; **https://www.gov.uk/government/groups/natural-capital-committee**

[39] Loth, A.F., and Newton, A.C. (2018). *Journal for Nature Conservation*, 46, 110-120.

[40] Hodder, K.H. et al. (2014). *International Journal of Biodiversity Science, Ecosystem Services and Management.* 10(1). 71-83.

[41] Loth, A.F., and Newton, A.C. (2018). *Journal for Nature Conservation,* 46, 110-120.

Figure 28. Map illustrating the relative suitability of different parts of Dorset for rewilding[41]. This combined map was produced incorporating a range of different rewilding options, including farmland abandonment, naturalistic grazing, beaver or pine marten reintroduction, passive management and river restoration. These analyses were based on results of a stakeholder consultation.



Eurasian beaver © Podolnaya Elena

Recommendations

- Invest in natural capital, by enhancing ecosystem condition and by increasing the area of semi-natural habitats of high conservation value. Such investment would provide direct benefits to businesses, support economic growth and increase employment, while also providing wider benefits to society and to the environment.

- Develop policies aimed at providing incentives for farmers to produce environmental goods and services. Evidence indicates that this would provide greater benefits to the economy than increased production of traditional agricultural products.

- Incorporate the value of ecosystem services provided by rural land use in economic analysis and forecasting approaches. The value of these services to the broader economy can potentially exceed the economic value of the agricultural sector itself.

- Use land use approaches that improve the condition and extent of semi-natural habitats to strengthen the provision of ecosystem services, including wildlife-friendly farming approaches, organic approaches to pest control and soil improvement, ecological restoration, habitat enhancement schemes and maintenance of habitat diversity.

- Reduce nitrogen deposition. There is an urgent need to improve the condition of semi-natural ecosystems in agricultural landscapes such as Dorset. Initiatives designed to help farmers reduce nitrogen applications, such as the ***Code of Good Agricultural Practice for Reducing Ammonia Emissions***[42], should be strongly supported.

- Develop and implement plans for large-scale habitat creation and restoration. Environmental degradation can lead to abrupt changes in the provision of ecosystem services, which could negatively affect the economy and wider society. The risks of such abrupt changes occurring are likely to intensify with increasing climate change. Approaches aiming to increase the extent and condition of semi-natural habitats, such as ecological restoration, rewilding and development of ecological networks, would help mitigate these risks.

[42] **https://www.gov.uk/government/publications/code-of-good-agricultural-practice-for-reducing-ammonia-emissions**

Further information

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Durdle Door at sunrise © Shaun Jacobs

Acknowledgements

Thanks to our partners Nigel Jump (Bournemouth University) and Steven Brand (University of Plymouth) for assistance with economic modelling, and to Rob Robinson (BTO) for agricultural data. Thanks also to Simon Cripps and Maria Clarke from the Dorset Local Nature Partnership (LNP) and Luke Rake from the Dorset Local Enterprise Partnership (LEP) for their advice and assistance with networking. This work is designed to support the work of both the Dorset LNP and LEP in improving the future environment and economy of Dorset. Our hope is that the results will also be of relevance to other lowland agricultural landscapes in the region.

Thank you to Ulrike Dragosits (CEH) for the nitrogen deposition data.

This report was funded by NERC grant reference number: NE/P007716/1 as part of the project *Mechanisms and Consequences of Tipping Points in Lowland Agricultural Landscapes (TPAL)*, which forms part of the Valuing Nature Programme. The Valuing Nature Programme is a 5-year research programme that aims to improve understanding of the value of nature both in economic and non-economic terms, and improve the use of these valuations in decision making. It funds interdisciplinary research and builds links between researchers and people who make decisions that affect nature in business, policy-making and in practice.

The Valuing Nature Programme is funded by the Natural Environment Research Council, the Economic and Social Research Council, the Biotechnology and Biological Sciences Research Council, the Arts and Humanities Research Council, and the Department for Environment, Food and Rural Affairs.

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LAND USE CHANGES

Article: www.theguardian.com/commentisfree/2019/aug/08/ipcc-land-climate-report-carbon-cost-meat-dairy

Article has direct links to references, eg nature with complete original article

We can't keep eating as we are – why isn't the IPCC shouting this from the rooftops?

George Monbiot

In its crucial land and climate report, the IPCC irresponsibly understates the true carbon cost of our meat and dairy habits

@GeorgeMonbiot

Thu 8 Aug 2019 17.22 BST Last modified on Thu 8 Aug 2019 18.56 BST

It's a tragic missed opportunity. The new report on land by the Intergovernmental Panel on Climate Change (IPCC) shies away from the big issues and fails to properly represent the science. As a result, it gives us few clues about how we might survive the century. Has it been nobbled? Was the fear of taking on the farming industry – alongside the oil and coal companies whose paid shills have attacked it so fiercely – too much to bear? At the moment, I have no idea. But what the panel has produced is pathetic.

The problem is that it concentrates on just one of the two ways of counting the carbon costs of farming. The first way – the IPCC's approach – could be described as farming's current account. How much greenhouse gas does driving tractors, spreading fertiliser and raising livestock produce every year? According to the panel's report, the answer is around 23% of the planet-heating gases we currently produce. But this fails miserably to capture the overall impact of food production.

The second accounting method is more important. This could be described as the capital account: how does farming compare to the natural ecosystems that would otherwise have occupied the land? A paper published in Nature last year, but not mentioned by the IPCC, sought to count this cost. Please read these figures carefully. They could change your life.

The official carbon footprint of people in the UK is 5.4 tonnes of carbon dioxide per person per year. But in addition to this, the Nature paper estimates that the total greenhouse gas cost – in terms of lost opportunities for storing carbon that the land would offer were it not being farmed – of an average northern European diet is 9 tonnes a year. In other words, if we counted the "carbon opportunity costs" of our diet, our total footprint would almost triple, to 14.4 tonnes.

Why is this figure so high? Because we eat so much meat and dairy. The Nature paper estimates that the carbon cost of chicken is six times higher than soya, while milk is 15 times higher and beef 73 times. One kilo of beef protein has a carbon opportunity cost of 1,250kg: that, incredibly, is roughly equal to driving a new car for a year, or to one passenger flying from London to New York and back.

These are global average figures, raised by beef production in places like the Amazon basin. But even in the UK, the costs are astonishing. A paper in the journal Food Policy estimates that a kilo of beef protein reared on a British hill farm whose soils are rich in carbon has a cost of 643kg, while a kilo of lamb protein costs 749kg. Research published in April by the Harvard academics Helen Harwatt and Matthew Hayek, also missed by the IPCC, shows that, alongside millions of hectares of pasture land, an astonishing 55% of UK cropping land (land that is ploughed and seeded) is used to grow feed for livestock, rather than food for humans. If our grazing land was allowed to revert to natural ecosystems, and the land currently used to grow feed for livestock was used for grains, beans, fruit, nuts and vegetables for humans, this switch would allow the UK to absorb an astonishing quantity of carbon. This would be equivalent, altogether, the paper estimates, to absorbing nine years of our total current emissions. And farming in this country could then feed everyone, without the need for imports.

A plant-based diet would make the difference between the UK's current failure to meet its international commitments, and success.

Then there are the nature opportunity costs. A famous paper in Science shows that a plant-based diet would release 76% of the land currently used for farming. This land could then be used for the mass restoration of ecosystems and wildlife, pulling the living world back from the brink of ecological collapse and a sixth great extinction.

People tend to make two massive mistakes while trying to minimise the environmental impact of the food they eat. First, they focus on food miles and forget about the other impacts. For some foods, especially those that travel by plane, the carbon costs of transport are very high. But for most bulk commodities – grain, beans, meat

and dairy – the greenhouse gases produced in transporting them are a small fraction of the overall impact. A kilo of soya shipped halfway round the world inflicts much less atmospheric harm than a kilo of chicken or pork reared on the farm down the lane.

The second mistake is to imagine that extensive farming is better for the planet than intensive farming. The current model of intensive farming tends to cause massive environmental damage: pollution, soil erosion and the elimination of wildlife. But extensive farming is worse: by definition, it requires more land to produce the same amount of food. This is land that could otherwise be devoted to ecosystems and wildlife.

Some people try to argue that extensive farming systems – particularly grazing livestock – "mimic nature". While some livestock farms are much better than others, there are none in this country that look like natural ecosystems. Nature has no fences. It has large predators (wolves, lynx and other species that have been eliminated here on behalf of livestock farming) and a wide range of wild herbivores.

In wet temperate nations such as the UK, natural vegetation in most places is dominated by trees. Even the best livestock farms deliver a depleted parody of nature, supporting a small subset of the species that might otherwise occupy the land.

If we want to prevent both climate and ecological catastrophes, the key task is to minimise the amount of land we use to feed ourselves, while changing the way the remaining land is farmed. Instead, governments almost everywhere pour public money into planetary destruction.

Look at the £500m the UK government proposes to spend on buying up beef and lamb that will be unsaleable after a no-deal Brexit. This reproduces the worst and stupidest policy the European Union ever conjured up: the intervention payments that created its notorious butter mountains and wine lakes. Brexit, for all its likely harms, represents an opportunity to pay landowners and tenants to do something completely different, rather than spending yet more public money on trashing our life-support systems.

The IPCC, like our governments, fails to get to grips with these issues. But when you look at the science as a whole, you soon see that we can't keep eating like this. Are we prepared to act on what we know, or will we continue to gorge on the lives of our descendants?

www.nature.com/articles/s41586-018-0757-z

Assessing the efficiency of changes in land use for mitigating climate change

- Timothy D. Searchinger, Stefan Wirsenius, Tim Beringer & Patrice Dumas

*Nature***volume 564**, pages249–253 (2018)

Land-use changes are critical for climate policy because native vegetation and soils store abundant carbon and their losses from agricultural expansion, together with emissions from agricultural production, contribute about 20 to 25 per cent of greenhouse gas emissions1,2. Most climate strategies require maintaining or increasing land-based carbon3 while meeting food demands, which are expected to grow by more than 50 per cent by 20501,2,4. A finite global land area implies that fulfilling these strategies requires increasing global land-use efficiency of both storing carbon and producing food. Yet measuring the efficiency of land-use changes from the perspective of greenhouse gas emissions is challenging, particularly when land outputs change, for example, from one food to another or from food to carbon storage in forests. Intuitively, if a hectare of land produces maize well and forest poorly, maize should be the more efficient use of land, and vice versa. However, quantifying this difference and the yields at which the balance changes requires a common metric that factors in different outputs, emissions from different agricultural inputs (such as fertilizer) and the different productive potentials of land due to physical factors such as rainfall or soils. Here we propose a carbon benefits index that measures how changes in the output types, output quantities and production processes of a hectare of land contribute to the global capacity to store carbon and to reduce total greenhouse gas emissions. This index does not evaluate biodiversity or other ecosystem values, which must be analysed separately. We apply the index to a range of land-use and consumption choices relevant to climate policy, such as reforesting pastures, biofuel production and diet changes. We find that these choices can have much greater implications for the climate than previously understood because standard methods for evaluating the effects of land use4 – 11 on greenhouse gas emissions systematically underestimate the opportunity of land to store carbon if it is not used for agriculture.

SN - 1476-4687

UR - https://doi.org/10.1038/s41586-018-0757-z

DO - 10.1038/s41586-018-0757-z

Does landscape-scale conservation management enhance the provision of ecosystem services?

Kathy H. Hodder, Adrian C. Newton, Elena Cantarello & Lorretta Perrella

To cite this article: Kathy H. Hodder, Adrian C. Newton, Elena Cantarello & Lorretta Perrella (2014) Does landscape-scale conservation management enhance the provision of ecosystem services?, International Journal of Biodiversity Science, Ecosystem Services & Management, 10:1, 71-83, DOI: 10.1080/21513732.2014.883430

www.tandfonline.com/doi/full/10.1080/21513732.2014.883430

Investing in nature could boost UK economy

www.ceh.ac.uk/news-and-media/news/investing-nature-could-boost-uk-economy
Submitted by Simon Williams on Tue, 09/07/2019 - 16:30

The report used Dorset as a case study *Picture: Pixabay*

A new report, which explores land use options post-Brexit, suggests that increasing the area of semi-natural habitats could increase economic growth by up to 5% and employment by up to 8%.

In Dorset alone, investing in habitats such as chalk grassland and heathland could deliver a £0.8 billion boost in the local economy and create more than 25,000 jobs – a substantial increase on the £1.5 billion and 30,000 jobs that the environment is estimated to currently contribute to the county.

In contrast, the expansion of agricultural land would increase economic growth and employment by less than 0.3%, according to the research by Bournemouth University and the Centre for Ecology & Hydrology (CEH).

The findings come as a new Agriculture Bill is passing through the House of Commons, which would provide incentives for different forms of land use after Brexit. This includes payments not just for increasing agricultural productivity, but also protecting and enhancing the environment, which could lead to farmers being paid for improving wildlife and habitats, enhancing air and water quality plus tackling climate change.

The report concludes there is a strong case for investing in natural capital - natural assets such as plants, soil and water that provide benefits for humans, often referred to as ecosystem services. It calls for funding of initiatives such as rewilding and ecological restoration, which are increasing in popularity.

Professor Adrian Newton of Bournemouth University, who led the study, says: “Those farming practices that benefit wildlife and the environment, such as reduced application of fertilisers and pesticides, need supporting much more strongly. Brexit might provide some opportunities for managing rural land in new and creative ways, which could benefit both wildlife and the economy.”

The study focused on Dorset, an area with a high proportion of agricultural land, similar to many other lowland parts of Britain.

> We found that nature-based management will not only benefit people and wildlife, but also the economy
> - **Professor James Bullock**

A survey of local businesses was undertaken to determine the importance of ecosystem services to their commercial activities. Almost half stated they were either moderately or highly dependent on ecosystem services.

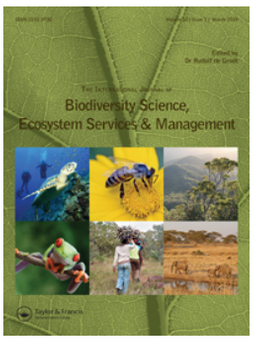
The research – carried out as part of the Government-backed Valuing Nature Programme, which is co-ordinated by CEH - showed that many local businesses rely on having a healthy and attractive local environment. This includes not only tourism, recreation and agriculture, but other businesses such as manufacturing and construction, which require clean water, natural materials and a hazard-free environment. These dependencies of businesses on the environment mean that protecting and restoring ecosystems is likely to boost the economy and lead to job creation.

Professor James Bullock, an ecologist at CEH and one of the authors of the report, says: “We have an opportunity to manage our countryside more sustainably. In this study we found that nature-based management will not only benefit people and wildlife, but also the economy. While this research focused on Dorset, its findings are relevant for the UK as a whole.”

The report, *Trends in Natural Capital, Ecosystem Services and Economic Development in Dorset*, is available on the Valuing Nature Programme website.

Further information

This report was produced as part of *Mechanisms and Consequences of Tipping Points in Lowland Agricultural Landscapes*, a project under the Valuing Nature Programme (VNP). This five-year research programme aims to improve understanding of the value of nature both in economic and non-economic terms, and improve the use of these valuations in decision-making. Co-ordinated by a multidisciplinary team led by the Centre for Ecology & Hydrology, VNP funds research and also support researchers in making links with policymakers, businesses and practitioners through the Valuing Nature Network.
The programme is funded by the Natural Environment Research Council, the Economic and Social Research Council, the Biotechnology and Biological Sciences Research Council, the Arts & Humanities Research Council and Defra.
http://valuing-nature.net/



International Journal of Biodiversity Science, Ecosystem Services & Management

ISSN: 2151-3732 (Print) 2151-3740 (Online) Journal homepage: https://www.tandfonline.com/loi/tbsm21

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International Journal of Biodiversity Science, Ecosystem Services & Management, 2014
Vol. 10, No. 1, 71–83, http://dx.doi.org/10.1080/21513732.2014.883430

Taylor & Francis
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Does landscape-scale conservation management enhance the provision of ecosystem services?

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Biodiversity conservation approaches are increasingly being implemented at the landscape-scale to support the maintenance of metapopulations and metacommunities. However, the impact of such interventions on the provision of ecosystem services is less well defined. Here we examine the potential impacts of landscape-scale conservation initiatives on ecosystem services, through analysis of five case study areas in England and Wales. The provision of multiple ecosystem services was projected according to current management plans and compared with a baseline scenario. Multicriteria analysis indicated that in most cases landscape-scale approaches lead to an overall increase in service provision. Consistent increases were projected in carbon storage, recreation and aesthetic value, as well as biodiversity value. However, most study areas provided evidence of trade-offs, particularly between provisioning services and other types of service. Results differed markedly between study areas, highlighting the importance of local context. These results suggest that landscape-scale conservation approaches are likely to be effective in increasing ecosystem service provision, but also indicate that associated costs can be significant, particularly in lowland areas.

Keywords: landscape-scale; biodiversity conservation; counterfactual scenario; ecosystem service mapping; restoration

1. Introduction

In recent years there has been a shift in emphasis in conservation management, from a focus on managing populations of threatened species at single sites towards landscape-scale management approaches (Lindenmayer et al. 2008; Levi et al. 2009; Jones 2011). This trend has been supported by developments in ecological theory relating to the dynamics of metapopulations (Hanski 1999, 2001) and metacommunities (Leibold et al. 2004), and the development of landscape ecology as a scientific discipline (Turner 2005). Such research has highlighted the importance of maintaining ecological processes at the landscape scale, such as dispersal, colonisation and migration, to ensure the persistence of ecological communities and their component species. Landscape-scale approaches to conservation are also required to address the many causes of biodiversity loss that operate at large spatial scales, such as habitat conversion and fragmentation, over-exploitation and climate change (Jones 2011).

A number of different landscape-scale conservation approaches have been developed, such as metapopulation management (Rouquette & Thompson 2007), trans-frontier conservation landscapes (Smith et al. 2008), ecological networks and 'rewilding'. The development of ecological networks is perhaps the most widespread of these in terms of its practical application, with many countries now incorporating the concept into policy (Jongman & Pungetti 2004; Jones-Walters 2007). More than 42 ecological network initiatives have been established in different parts of Europe, at a variety of scales (Boitani et al. 2007). Ecological networks may be broadly defined as networks of areas that are connected to enhance biodiversity conservation, typically through the establishment of corridors and buffer zones to facilitate the dispersal and migration of species (Boitani et al. 2007).

In contrast, 're-wilding' involves the large-scale (re) introduction of populations of large herbivores that are allowed to roam freely to provide 'naturalistic grazing' (Hodder & Bullock 2009). Such re-wilding approaches are intended to mimic the 'natural' situation that is believed to have prevailed over much of northwest Europe prior to the introduction of agriculture in the Neolithic period (ca. 8000–5000 BP) (Vera 2000). Examples of large-scale naturalistic grazing initiatives include the Oostvaardersplassen and Veluwezoom National Park in the Netherlands (Hodder et al. 2005), and Knepp Estate, Wicken Fen and Ennerdale in the United Kingdom (Taylor 2009). These have parallels in the concept of 'Pleistocene rewilding' currently being explored in both North and South America (Galetti 2004; Rubenstein et al. 2006).

While the potential benefits of implementing biodiversity conservation at a landscape-scale are widely appreciated, impacts on the provision of ecosystem services are much less well understood. Ecosystem services, or the benefits provided by ecosystems to people, have recently become a major focus of environmental policy and practice (Fisher et al. 2008; Balmford et al. 2011; Kareiva et al. 2011). Although a number of recent reviews have highlighted the need for landscape-scale analyses of ecosystem services, to understand spatial variability in their production and flow (Anton et al. 2010; de Groot et al. 2010; Balmford et al. 2011), the spatial analysis of ecosystem services is still at a relatively early stage (Martinez-Harms & Balvanera 2012; Schägner et al. 2013) with a need for

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increased rigour in methodologies (Crossman, Bryan, et al. 2013). Examples of recent studies include analyses of the impacts of land-use change on ecosystem services at national (Eigenbrod et al. 2009), regional (Grêt-Regamey et al. 2008; Li et al. 2010; Liu et al. 2010; Swetnam et al. 2010) and catchment (Martinez et al. 2009) scales, as well as investigations designed to support spatial planning and management decisions both in terrestrial (Egoh et al. 2008; Petz & van Oudenhoven 2012) and marine environments (White et al. 2012). However, few previous studies have explicitly considered the potential impact of landscape-scale approaches to biodiversity conservation on the provision of ecosystem services. Such information is urgently required, given the increasing policy emphasis on landscape-scale approaches to conservation in countries such as the United Kingdom (Lawton et al. 2010).

The objective of this investigation was to determine whether landscape-scale management interventions might increase the provision of ecosystem services. This was achieved through spatial analysis of ecosystem services within five case study areas from the United Kingdom. The research builds on a previous detailed investigation conducted in a single study area, the catchment of the River Frome in Dorset, UK, which examined the cost-effectiveness of establishing ecological networks (Newton et al. 2012). The current analysis extends this approach to consider other forms of landscape-scale intervention, including 'rewilding' and large-scale habitat restoration. The analytical framework adopted here is based on that described by Balmford et al. (2011), which focuses on quantifying the marginal benefits and costs associated with changes in ecosystem services resulting from a policy action, through comparison of counterfactual scenarios. This recognises the need to compare alternative policy actions to provide robust estimates of both benefits and costs (Fisher et al. 2008; Nelson et al. 2009).

2. Methods

Five case study areas were selected that have either implemented or have planned a landscape-scale conservation management approach. A range of landscape types were selected to explore the implications of different environmental contexts. These included upland and lowland farmed landscapes (Table 1) and were situated across several regions of England and Wales (Figure 1). Three (Knepp Castle, Great Fen Project, Wild Ennerdale) were characterised by single ownership or close collaboration between a small number of landowners extending over the entire landscape, whereas the other two (Frome catchment, Pumlumon) involved implementation of management actions in localised patches of the wider landscape, with the aim of increasing inter-patch connectivity and habitat quality.

2.1. *Stakeholder consultation*

In order to evaluate the baseline provision of ecosystem services for each of the study areas and to explore stakeholder perceptions of how this might change as a result of the landscape-scale management interventions, information was elicited from local experts associated with each case study. This was achieved using a questionnaire survey, which asked respondents to assess the relative importance of selected ecosystem services within their respective study areas. In each case, importance was scored on a six-point Likert scale, from 0 (zero) to 5 (very high). Values were requested both for before the implementation of landscape-scale management, and for the year 2060 as the projected result of implementation. The respondents were representatives of each case study area, who were each closely involved with the landscape-scale initiatives, and were either the landowners or managers associated with conservation NGOs (e.g. Wildlife Trusts, National Trust) or representatives of government agencies (e.g. Forestry Commission). The number of respondents depended on the tenure in each case, with 17 stakeholders included overall. The ecosystem services were selected on the basis of an initial scoping study conducted with the same respondents to ensure that all services considered to be of significant importance at either date were included. This resulted in eight services being selected for analysis, namely food (including cultivated crops, livestock, fish, game and other wild foods), fibre/raw materials (including timber, plant fibre, animal skins, wool), energy/fuel (including fuelwood, biofuel crops, hydroelectric energy), freshwater provision (incorporating both water quality and quantity), flood protection (including regulation of surface water run-off), nature-based recreation (including walking, horse-riding, cycling, climbing, swimming, nature-watching, etc.), aesthetic benefits (including spiritual, cultural and heritage values) and carbon storage.

2.2. *Scenarios of land-cover change*

To evaluate the potential impacts of landscape-scale management on ecosystem service provision, counterfactual scenarios of land cover were developed for each study area, for the services identified by the stakeholder survey. In each case, scenarios were developed for (i) a pre-project baseline (PP), representing the situation prior to the management intervention, and (ii) a projected future (LS) showing the expected land cover in 2060, assuming that a timeline of 50 years allows successful implementation of the landscape-scale project (Table 1). Land-cover maps for the future scenarios were developed in collaboration with case study representatives based on the strategies and assumptions of the management vision and associated plans, and guided where possible by local knowledge. The PP scenarios were supported by land-cover maps produced using existing vegetation survey or remotely sensed land cover data, as detailed below.

In Wild Ennerdale, the PP scenario was developed from a vegetation survey undertaken in 2002–2004 at the outset of the project (Jerram 2003a, 2003b, 2004), together with local knowledge and planning documents. This map

Table 1. Characteristics of the case study landscapes.

Name	Area (ha)	Tenure	Pre-project landscape	Landscape vision
Frome catchment, Dorset	48,295	Forestry Commission, Dorset Wildlife Trust, RSPB and many private landowners.	The Frome is a chalk river bordered by grazing marsh and former water meadows with fragments of swamp, fen and wet woodland. The floodplain is bordered by heath, valley mire, semi-natural woodland, grasslands and deciduous and conifer plantations. Agriculture is the predominant land use.	A regional approach to landscape-scale habitat restoration planning known as Living Landscapes developed by the South West Wildlife Trusts. This defines ecologically functional fragments (Strategic Nature Areas, SNAs) for restoration. The SNAs and their land-use type have been identified in a 'Nature Map', designed to inform habitat restoration strategies to create functional habitat networks (Brenman 2005).
Great Fen Project, Cambridgeshire	3700	Bedfordshire, Cambridgeshire, Northamptonshire and Peterborough Wildlife Trusts, Huntingdonshire District Council, Natural England, Environment Agency.	Isolated lowland fens with arable land separating them. Neither of the nature reserve sites are sustainable at their present size, owing to intensive arable cultivation around them and uncontrollable water levels (Great Fen Project 2005).	Restoration of over 3700 ha of fenland from arable land, between Huntingdon and Peterborough. The project will connect Woodwalton Fen National Nature Reserve with Holme Fen National Nature Reserve through land purchase and restoration (Great Fen Project 2005).
Knepp Castle, West Sussex	1400	Knepp Castle Estate.	An arable and livestock farm with some woodland. The main habitats are grassland, woodland, wood pasture/parkland, and scrub.	Implementation of 'rewilding' with minimal management. Grazing by herds of deer, cattle, pigs and horses will occur across the estate. A river restoration project (Janes et al. 2006) and associated land-cover changes is included.
Pumlumon Project, Cambrian Mountains, Mid Wales	40,000	Welsh Wildlife Trusts, Forestry Commission, Countryside Council for Wales, Environment Agency, Powys County Council, Ceredigion County Council, water utilities companies.	A complex mosaic of locally, nationally and internationally important habitats such as dry and wet dwarf-shrub heath, blanket bog, unimproved acid grassland and oligotrophic lakes. Also agriculturally improved grassland, broadleaved woodlands and forestry plantations. Problems with overgrazing.	Landscape solutions through ecosystem management; sustainable farming/management of natural capital; encouraging economic activity through the promotion of enhanced natural assets.
Wild Ennerdale, Lake District	4300	Forestry Commission, National Trust, United Utilities.	Based on management practices prevailing prior to implementation of a rewilding project in 2001. Mountains, rocky outcrops and scree, large, diverse woodlands, rivers, a lake and some of the most highly valued flora and fauna in the country.	Based on the Wild Ennerdale Stewardship Plan. Shift away from economic productivity as the primary output, towards lower input, more sensitive management where natural processes are given a greater hand in determining how the valley will evolve. Initially involved extensive felling of plantation woodland followed by minimum intervention regeneration leading to an increase in broadleaved and mixed woodland in place of plantation conifer.

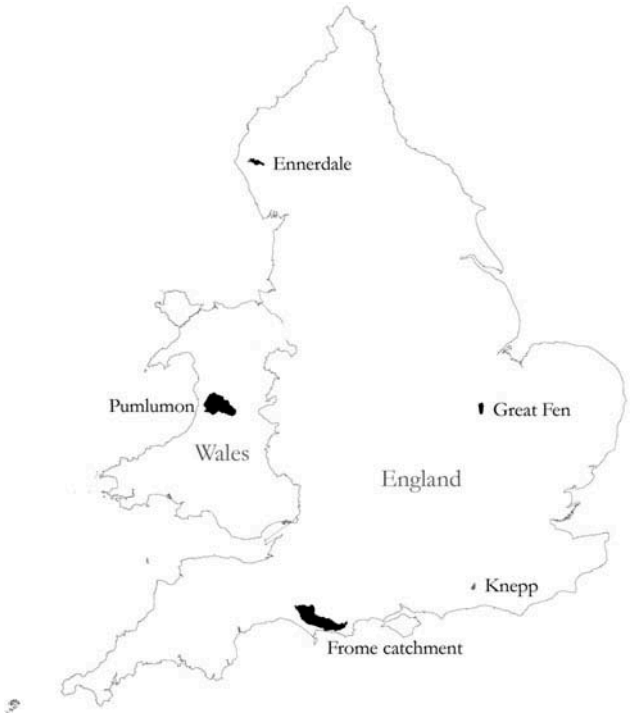

Figure 1. Location of the five case study areas.

was modified by incorporation of forest inventory data (Forestry Commission, UK) to provide greater detail for evaluation of timber production. For the LS scenario, the Wild Ennerdale Stewardship Plan (Wild Ennerdale 2006) was applied with extensive tree felling and minimum intervention regeneration, leading to an increase in broad-leaved and mixed woodland in place of conifer woodland, along with associated habitat changes (Figure 2(a)). In the Great Fen, the PP scenario was based on a national land-cover map (CEH Land Cover Map 2000) (Fuller et al. 2002), which was modified to correct misclassifications (following Mountford et al. 2002). A future habitat scenario developed for the Great Fen project based on LIDAR data, topography and analysis of water levels was used and modified to include the entire project area (scenario 2 in CEH 2006; Figure 2(b)). In Knepp Castle, the PP scenario represented the Estate just prior to the start of the project in 2000. A habitat survey from 2005 (Greenaway 2006) was modified in the light of local knowledge to represent PP conditions. The Estate management plan provided a vision map of the potential land cover in 2060, for the LS scenario (Figure 2(c)). In Pumlumon, a recent habitat survey produced by the project was used for the PP scenario (Figure 2(d)). For the LS scenario, this map was amended using the CCW Upland Strategy mapping methodology (Jones 2007), supported by maps of potential grassland and woodland development produced by the project (Figure 2(d)). For the Frome catchment case study, a PP scenario was generated using the CEH Land Cover Map 2000 (Fuller et al. 2002), whereas the LS scenario was based on the South West Nature Map (Brenman 2005), which identifies areas for habitat restoration with the aim of creating ecological networks. Biodiversity restoration targets of the Strategic Nature Areas (SNAs) incorporated in the South West Nature Map were used to guide simulation of land-cover conversions by extending existing habitat patches in a GIS buffering process (following Newton et al. 2012; Figure 2(e)).

2.3. *Impact of scenarios on provision of ecosystem services*

Ecosystem services were selected for analysis based on scoping of available empirical data, in consultation with representatives of the case study areas. This resulted in exclusion of two of the eight services identified in the stakeholder survey, namely energy/fuel and freshwater provision, owing to a lack of appropriate data. The change in potential ecosystem service provision associated with implementation of landscape-scale management was then estimated for the remaining six services for each of the case study areas.

Provisioning services (food and fibre) were each assessed using market prices, reflecting the fact that they are tangible goods. This approach has been widely adopted in previous research (Chan et al. 2006; Kettunen et al. 2009; Nelson et al. 2009; Pascual et al. 2010). Valuation methods were developed using a combination of site-based, UK standard or generalised data sources. In the case of food, recorded or predicted crop and dairy yields, together with livestock numbers, were sourced. For crops, livestock and dairy products, gross margin values obtained from Nix (2010) were used to convert the production estimates to monetary value. For timber,

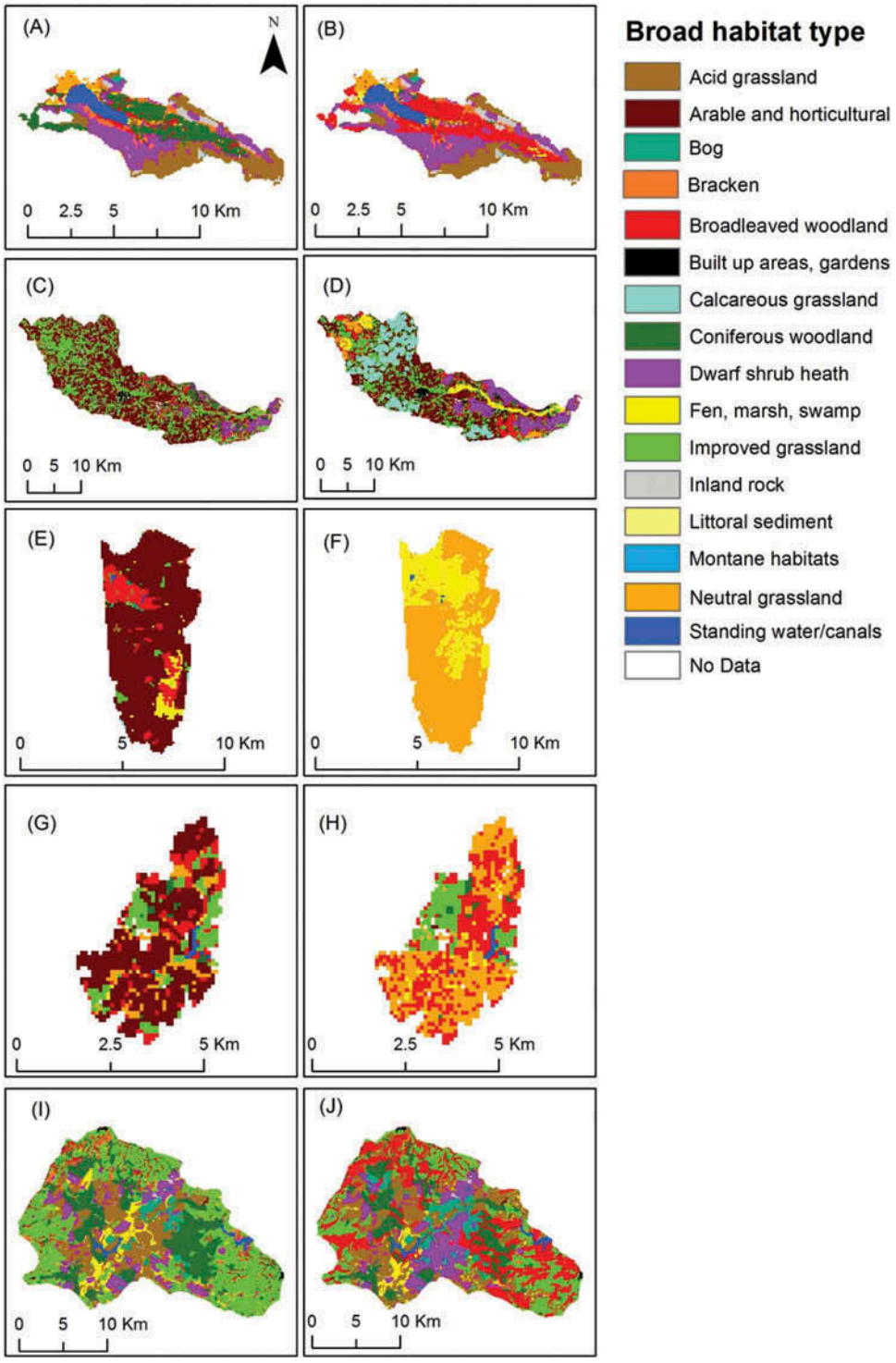

Figure 2. Land-cover maps for the pre-project baseline (left column) and projected scenarios following landscape scale intervention (right column): Ennerdale (A, B); Frome catchment (C,D); Great Fen (E, F); Knepp (G,H); Pumlumon (I,J).

estimates of cumulative timber yield (m^3 ha^{-1}) for generalised broadleaved and conifer forest were derived using the Forestry Commission 'Forest Yield' software, which is based on yield models for forest management (Edwards & Christie 1981). Oak and birch were used to model the broadleaf yields and Sitka spruce was used for conifer timber. This approach takes account of overall extraction throughout the rotation, including the value of timber removed through thinning. The average standing sale price for broadleaved and conifer timber, provided by the UK Forestry Commission, was then used to calculate a monetary value per hectare. This can be interpreted as a net value; although the planting costs were not included, this is generally offset by sale as a standing crop. The

value of reed production was also included in the wetland site (Great Fen), based on estimated productivity of 623 bundles ha^{-1} yr^{-1} (following Sanderson & Prendergast 2002) and the market price given in PACEC (2004).

Carbon storage values for each land-cover type were derived from those presented by Cantarello et al. (2011). In cases where data for land-cover types were not available from this source, mean values from ecologically similar land-cover types were used, following Kettunen et al. (2009). The market value of the carbon was calculated using official values of the UK Government (DECC 2009). Recreation was assessed as market price represented by willingness to pay (WTP). Local WTP studies were not available, so the benefits transfer method was used, following a number of recent studies (e.g. Tinch & Provins 2007; O'Gorman & Bann 2008; Natural England 2009). Where possible, values from sites of comparable character in terms of quality of provision and population size were sought, following EFTEC (2010). For each scenario, the WTP values of different recreational activities were weighted using local knowledge of the popularity of the activity within each case study area, then combined to give an overall value.

Aesthetic value was assessed using scores based on GIS indicators of aesthetic attributes of land-cover types identified from the CPRE Tranquillity Mapping study (Jackson et al. 2008). For compatibility with the habitat data available, the CPRE 'naturalness' values were aligned to CEH Land Cover Map 2000 habitat types. Habitat classifications for each of the case study sites were then aligned to the CEH Land Cover Map 2000 habitat classifications using JNCC (2008). Flood risk mitigation was assessed using the method developed by the Environment Agency (2008), which provides an index of relative change in flood risk depending on land-cover type. This index is based on several factors: the 'sensitivity' of land-cover types and soil types to land-use change and the rainfall and slope characteristics that indicate the likelihood of rapid runoff. It was assumed that soil type, topography and rainfall would remain the same under the scenarios explored here, and therefore any change in flood risk would entirely be the consequence of land-cover change. Each land-cover type was associated with a 'sensitivity index value' derived from Environment Agency (2008), where flood risk is ranked from 1 (lowest) to 4 (highest). These values reflect variation in capacity for run-off generation of different land-cover types. Scores were normalised then inverted (by subtracting each transformed value from 1) so that the maximum value of 1 equates to maximum flood risk mitigation. The scenarios were then compared by analysing the proportion of land cover associated with different flood risk sensitivity scores.

To assess the marginal difference in potential ecosystem service provision, maps were produced for each ecosystem service for both PP and LS, based on the land-cover maps. Values were normalised on a 0–1 scale and reclassified into 10 equal classes, and a mean value per unit area of each land-cover type was then calculated. Total values for each scenario were calculated by multiplying these values by the area of each respective land-cover type, and summing them across the study area.

Multicriteria analysis (MCA) was used to explore the relative effectiveness of the PP and LS scenarios in providing ecosystem services, enabling both economic and non-economic values to be incorporated in the same analysis. The MCA was performed using DEFINITE 3.1.1.7® (Institute for Environmental Studies, Amsterdam, The Netherlands), using a maximum standardisation method. The analysis was performed weighting each of the ecosystem services equally and was then repeated by weighting each criterion according to its current economic value. In the latter case, the three non-market ecosystem services (flood protection, recreation, aesthetic benefits) were each accorded a zero weight. Economic weights for the remaining three services were derived from Newton et al. (2012), namely 51.67, 6.27 and 36.75 for carbon storage, food and fibre, respectively.

2.4. *Biodiversity value*

Two measures were used to assess the impact of landscape-scale interventions on value for biodiversity. First, the PP and LS land-cover maps were used to estimate the current and projected areas of habitats of conservation importance in each of the study areas, focusing on those habitats identified in the UK Biodiversity Action Plan (BAP) (Maddock 2008). This was achieved by aligning the habitat records for each site with BAP and EU habitat types using JNCC (2008), supported by expert consultation with case study representatives. The distinction between 'upland' and 'lowland' BAP habitats, for example, heathland in Pumlumon and Ennerdale, was determined by calculating the area above or below 300 m using a digital terrain model (Maddock 2008). Second, an Ecological Impact Assessment (EcIA) was conducted following Rouquette et al. (2009). This involved scoring habitats present within each study area on a scale of 1–6, reflecting their conservation importance (ranging from being a local to an international priority) and significance (ranging from <1% regional resource of the habitat to >5% national resource, within a case study area). The mean score for all habitats across each site was then calculated, following Rouquette et al. (2009).

2.5. *Estimation of costs*

Estimates of implementation and running costs for the landscape-scale interventions were obtained from each of the case studies by consultation of project representatives, and by reference to available documents, such as business plans. Such data were lacking for Frome, and therefore published data on agri-environment scheme costs were used here instead (Newton et al. 2012).

3. Results

The results of the stakeholder consultation illustrate the impacts of the landscape-scale interventions on ecosystem service provision that are anticipated by the leading actors involved. Results indicate a high degree of variation between the different case studies. Whereas some study areas (e.g. Frome, Great Fen, Knepp) anticipated a major increase in the provision of multiple ecosystem services, others expected much less change (Figure 3). Results also differed between services; while energy provision was expected to increase in all study areas, freshwater provision was expected to increase in none. Very few services were projected to decline in any case study area; the only exception was freshwater in Frome (Figure 3).

Each of the case study areas projected significant changes in land cover as a result of the implementation of the initiatives (Figure 2(a)–(e)). In Ennerdale, the principal projected change was an increase in broadleaved woodland area and an associated reduction in area of conifer plantations, together with an increase in area of dwarf shrub heath. In Frome, substantial declines in agricultural land and conifer woodland were associated with an increase in areas of calcareous grassland, dwarf shrub heath and fen. In Great Fen, the principal changes were a projected increase in the area of neutral grassland and fen, with reductions in arable land and broadleaved woodland. Conversely in Knepp, an increase in woodland and acid grassland was anticipated, with significant reductions in

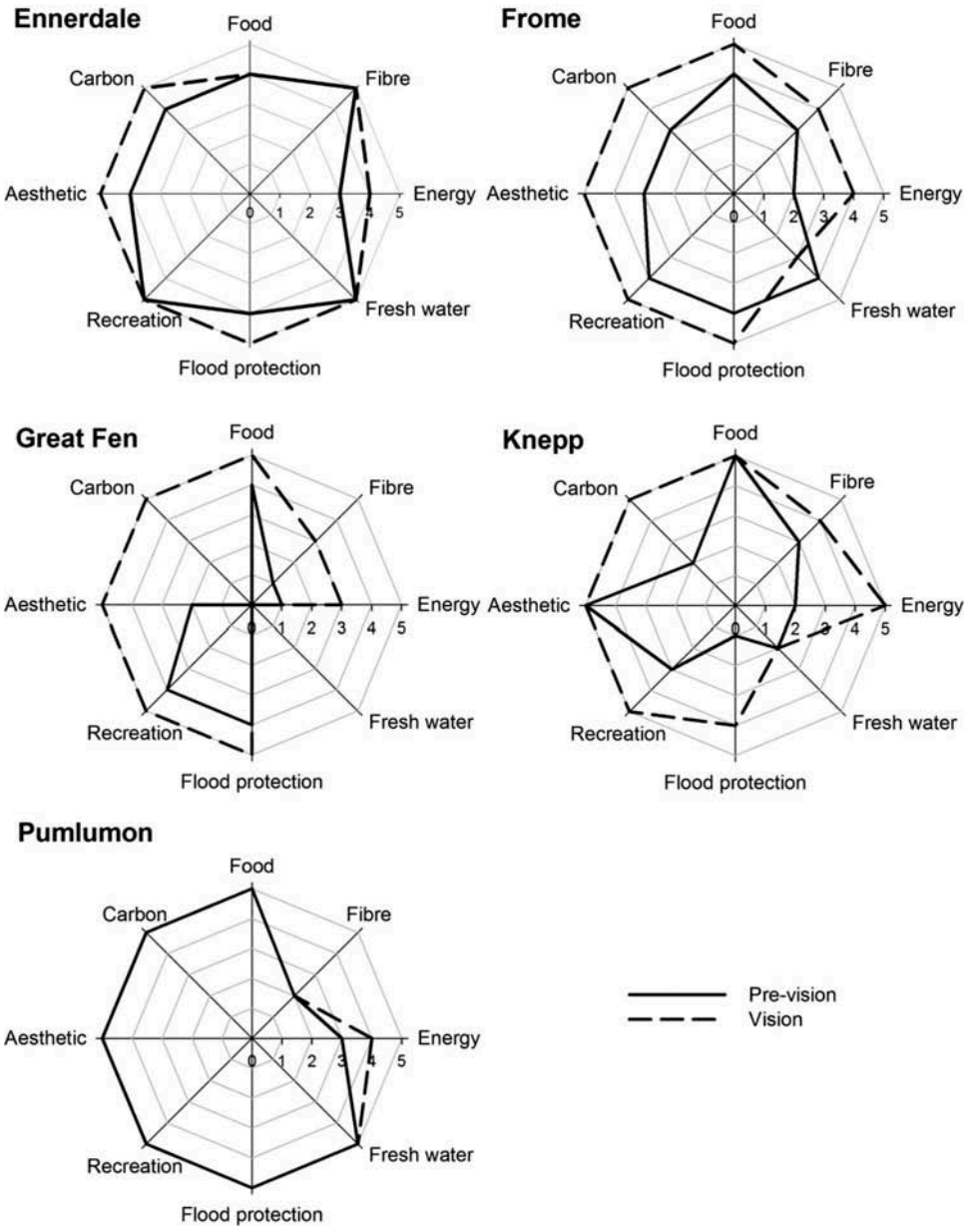

Figure 3. Importance of ecosystem services. The relative importance of ecosystem services within case study areas as estimated by site representatives both for before the implementation of landscape-scale management (pre-vision) and for the year 2060 as the projected result of implementation (vision). Importance is on a six-point scale from 0 (zero) to 5 (very high).

cropland and neutral grassland. In Pumlumon, principal increases were expected in area of bogs, broadleaved woodland, acid grassland and dwarf shrub heath, whereas conifer woodland, improved grassland and fen were projected to decline.

MCA analysis of changes in ecosystem service provision as a result of the projected land-cover changes indicated that landscape-scale interventions are generally projected to have a positive impact on overall provision of the ecosystem services considered here. This is indicated by the fact that the total combined MCA scores were higher for the LS than the PP scenario in four of the five case studies considered, the exception being Ennerdale, where the converse outcome was obtained (Figure 4). MCA scores for the individual ecosystem services showed contrasting responses in the different case studies. For example, while LS scores were higher than PP values for all ecosystem services in Pumlumon, all other case studies indicated lower values for food in LS than PP, and two cases (Ennerdale and Frome) also demonstrated lower values for fibre in LS (Figure 4). Aesthetic value, recreation and carbon storage all consistently showed higher values in LS than PP scenarios, as did flood protection in all cases other than Ennerdale. Similar results were obtained when the ecosystem services were weighted according to their monetary value (data not illustrated). In every case the overall pattern of responses of total MCA scores was identical with or without such weighting, although the magnitude of the difference between LS and PP scenarios differed if weighting was applied.

As expected, implementation of landscape-scale interventions was also projected to have a positive impact on biodiversity value. In every case, LS scenarios were projected to result in an increase in BAP habitat area, by up to 622% in the case of Knepp, although values differed markedly between study areas (Table 2). EcIA scores were also projected to increase in all areas except Pumlumon. The latter result is explicable in terms of trade-offs between habitat types; for example, the planned expansion of woodland in Pumlumon would be associated with a decline in area of other BAP habitats, including upland heathland and acid grassland.

When the monetary value of three ecosystem services was considered (i.e. for carbon storage, fibre and food), a decline in the total value of food production was projected to occur in all study areas, with the exception of Pumlumon. The magnitude of these declines varied strongly between case studies, ranging from £36,380 yr^{-1} in Knepp to £5,193,636 yr^{-1} in Frome. Similarly the marginal value of fibre was projected to decline in two case studies (Ennerdale and Pumlumon), but to increase in a third (Great Fen) as a result of an increase in reed

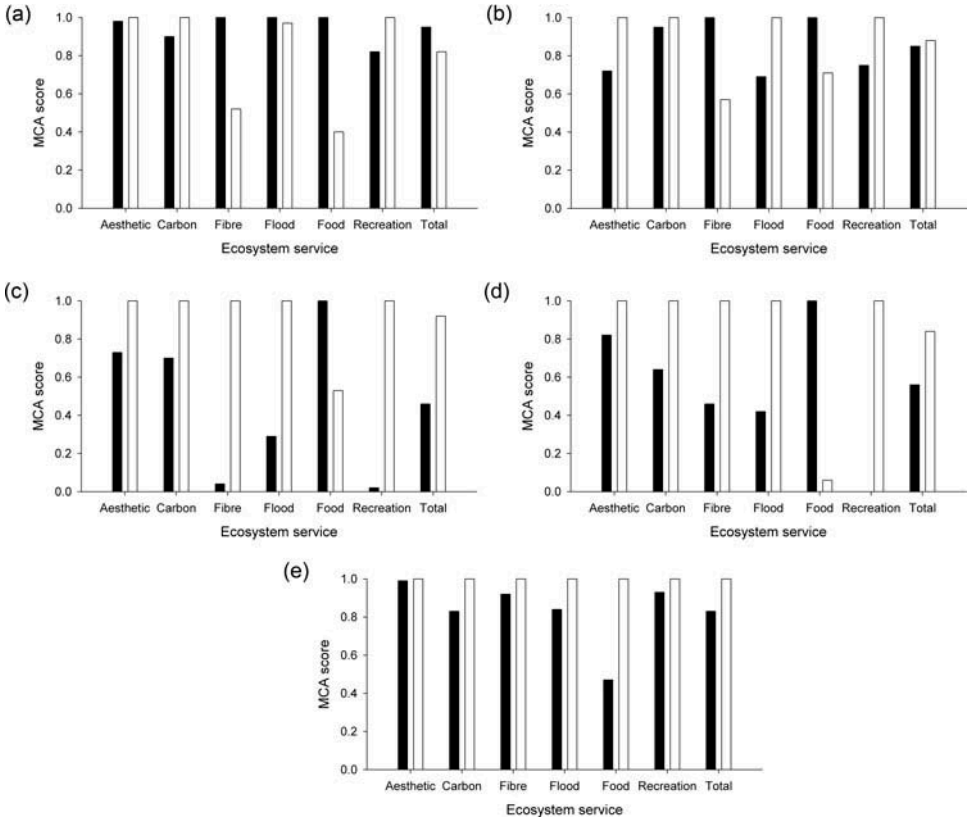

Figure 4. Evaluation of scenarios based on results of MCA, incorporating equal weighting of all services, including those with market and non-market values. Scores presented are the weighted sum of the criteria scores, provided as an output of the MCA. Filled bars indicate the pre-project scenario; empty bars the landscape-scale scenarios. (a) Ennerdale, (b) Frome, (c) Great Fen, (d) Knepp and (e) Pumlumon.

Table 2. Summary of changes in Ecological Impact Assessment (EcIA) score and total area of Biodiversity Action Plan (BAP) habitat between the landscape-scale (LS) and pre-project (PP) scenarios.

Case study site	PP total BAP habitat area (ha)	LS total BAP habitat area (ha)	% change in BAP habitat area	PP EcIA score	LS EcIA score	% change in EcIA score
Ennerdale	1542	1979	28	3.4	3.5	3
Frome	6934	18,554	168	4.3	5.2	21
Great Fen	602	3634	504	2	2.1	5
Knepp	104	751	622	2.8	3.8	48
Pumlumon	9318	14,920	60	4.7	4.3	−9

Notes: The EcIA scores were calculated following Rouquette et al. (2009) using the United Kingdom (rather than England and Wales) as the national resource (see Section 2.4). Percentage change values refer to the difference between LS and PP scenarios, as a percentage of the latter.

Table 3. Estimated marginal costs associated with the landscape-scale projects, derived from representatives of the case study areas and supporting project documentation.

Case study	Area (ha)	Set up cost (£)	Annual running cost (£)
Ennerdale	4300	73,000	20,000
Frome	48,295	7,544,090	3,993,907
Great Fen	3700	50,000,000	154,917
Knepp	1400	1,242,000	209,047
Pumlumon	30,000	253,000	454,918

production. Carbon storage was projected to increase in all study areas, with an increase in marginal value of at least £11 million across the entire landscape, based on the carbon value presented by DECC (2009).

Project costs differed markedly between study areas (Table 3). For example, set-up costs differed by more than three orders of magnitude, with lower values being recorded in upland than in lowland study areas. Annual running costs varied by a factor of 10 when calculated per unit area, varying from approximately £15 ha^{-1} in Pumlumon to almost £150 ha^{-1} in Knepp. Again, running costs were higher in lowland than in upland areas.

4. Discussion

These results provide evidence that landscape-scale conservation management interventions can potentially increase provision of a range of ecosystem services. Although such an outcome has been hypothesised previously (e.g. Lawton et al. 2010), relatively little evidence is available to support this suggestion. This investigation also highlights the value of analysing multiple case studies using comparable approaches to enable the identification of generally applicable results. However, the identification of such generalisation is hindered by the contrasting results obtained in different locations. Previous investigations that have performed comparative spatial analyses of multiple ecosystem services in a range of different landscapes, such as Birch et al. (2010), have similarly identified substantial variation between different case study areas. This emphasises the importance of local context in assessing the provision of ecosystem services, particularly when locally important values are factored into the assessment (Newton et al. 2012). Despite such variation, the current results identified an increase in the overall provision of ecosystem services in four of the five case studies considered.

Clearly, the results obtained will have been influenced by the selection of ecosystem services for analysis; other results might have been achieved had different services been included here. However, some services, such as aesthetic value, recreation and carbon storage, responded consistently across all case studies despite the contrasting environmental contexts and management approaches adopted. While flood risk mitigation was also projected to increase in four of the five case studies in the LS scenario, its projected decline in Ennerdale accounts for the lack of an overall increase in service provision in this case study. This can be attributed to the projected increase in dwarf shrub heath and the associated decline in area of conifer plantations, which would lead to a decline in evaporative water loss (Gilman 2002). A further consistent finding was the decline in food production, projected in four of the five case studies. Trade-offs between production of agricultural crops and biodiversity value have been widely recognised in the literature (e.g. Chan et al. 2006; Nelson et al. 2009; Raudsepp-Hearne et al. 2010), although converse relationships have also been reported (Naidoo et al. 2008). The case of Pumlumon presented here provides an interesting example of such a converse relationship, as a planned increase in livestock production in this case is considered to be consistent with achieving conservation goals.

Interestingly, the decline in food production projected in four case studies did not correspond to the values elicited in the stakeholder consultation. This highlights the value of spatial analysis and the development of scenarios, as recommended by Balmford et al. (2011), to

analyse the potential impact of interventions on ecosystem service provision. Overall, these results suggest that conservation practitioners may have somewhat optimistic beliefs in terms of anticipating positive outcomes of planned interventions on provision of all ecosystem services. One of the principal values of analyses presented here might therefore lie in increasing the recognition among practitioners of potential trade-offs, supporting suggestions made by previous authors (Nelson et al. 2009; Raudsepp-Hearne et al. 2010). However, one of the limitations of the current approach is that it focuses exclusively on changes in land cover and not condition or function (Verburg et al. 2009; Crossman, Bryan, et al. 2013). Conceivably, the management interventions being planned by the initiatives examined here could lead to improvements in the condition of existing habitats, which could be associated with increased provision of services.

Further limitations of this analytical approach arise from the uncertainties associated with scenario development. It is assumed here, for example, that implementation of proposed interventions will lead to the changes in land cover that are projected, and this will in turn lead to increased provision of associated services. The uncertainties associated with using proxies such as benefits transfer methods together with land-cover data for mapping ecosystem services are considered in depth by Eigenbrod et al. (2010). Uncertainties include the assumption that values are constant for a particular land-cover type across the area being mapped, and the error associated with failing to account for the spatial variability in biophysical measurements of ecosystem services. In their analysis undertaken at the scale of an entire country (the United Kingdom), Eigenbrod et al. (2010) found that proxies based on coarse or categorical input data (e.g. broad vegetation types) are likely to provide poor estimates of the distributions of ecosystem services. Comparable analyses of such uncertainties have not been undertaken to date for landscape-scale analyses employing higher resolution data, such as those presented here. In consequence, the results presented here should clearly be interpreted with caution. However, one of the advantages of approach applied here, involving comparison of counterfactual scenarios, is that the overall results are relatively insensitive to uncertainty in the values associated with individual services. This is illustrated by the fact that ranking of the scenarios by MCA scores was unaffected if services were weighted by their monetary values. Ideally, information would be available on the dynamics of processes underpinning service provision, such as nutrient, carbon and water cycling, and their relationship with biodiversity, for each landscape under consideration. Identification of such relationships in real-world landscapes remains a major research challenge (Balvanera et al. 2006; Cardinale et al. 2006; Tylianakis et al. 2008).

In the analytical approach adopted here, land cover was used as a proxy for production of different ecosystem services. While proxy approaches such as this are currently the most widely used method of mapping ecosystem services (Egoh et al. 2012), the approach is subject to a number of limitations (Crossman, Burkhard, et al. 2013). Most importantly, all areas of a given land-cover type are treated as equivalent. In reality, the provision of ecosystem services could potentially vary with ecosystem condition, an area that requires further research. A further limitation is the fact that the ecological processes underlying provision of ecosystem services are stochastic, scale-dependent and often nonlinear; they may also exhibit threshold effects. Such aspects are poorly captured by current approaches to ecosystem service mapping (Nelson & Daily 2010).

Although the current results suggest that landscape-scale conservation approaches are likely to increase provision of ecosystem services, such an outcome is clearly dependent on financial investment. As noted by Balmford et al. (2011), the costs associated with different management interventions are difficult to estimate with precision, and the values presented here should therefore be viewed with caution. The cost estimates used here varied from £8 to £13,513 ha^{-1} for project set-up costs and £4 to £149 ha^{-1} yr^{-1} for recurrent management costs, depending on the case study. These values fall within the range reported for restoration projects in a recent global review (TEEB 2009), but show pronounced variation among case studies.

Few analyses have been undertaken of the cost-effectiveness of landscape-scale conservation actions (Bullock et al. 2011). Analyses undertaken by Birch et al. (2010) of the cost-effectiveness of forest restoration indicated that results are strongly dependent on the restoration methods used. In the case of the Frome case study, a detailed cost–benefit analysis was presented by Newton et al. (2012), who showed that restoration costs consistently exceeded the market value of ecosystem services. However, results were found to be highly dependent on the market value of carbon. Detailed cost–benefit analyses were not performed here because of the high degree of uncertainty around such market values; currently the market price of carbon is highly volatile (Newton et al. 2012). There is also great uncertainty regarding the potential income that landowners might receive in return for carbon storage or for provision of other ecosystem services. However, the decline in food production projected in most of the case studies examined here would undoubtedly represent a significant opportunity cost, in addition to the costs of project inception and implementation.

Despite potential economic constraints, landscape-scale approaches appear to offer potential benefits both to biodiversity conservation and to people. Results suggest that the potential impacts on services such as recreation and aesthetic value could be substantive even if such services are not associated with a significant market value. The wider deployment of such landscape-scale initiatives, and the implementation of associated policies, will likely depend on support from a wide variety of different actors, working in partnership. Success of such projects is likely to depend strongly on public support, and

in this context, the increased provision of non-market benefits could be significant. All of the case studies presented here are projected to increase recreational value for the general public, which could potentially be an important contributor to strengthening such public support in future.

Acknowledgements

This project was funded through the Department for Environment, Food and Rural Affairs Defra Competition Code: WC0758/CR0444. We are indebted to the site representatives. For Ennerdale, Gareth Browning (Forestry Commission), Rachel Oakley (National Trust), Jenny Butler and Simon Webb (Natural England); for Great Fen, Chris Gerrard (The Wildlife Trust for Bedfordshire, Cambridgeshire, Northamptonshire and Peterborough) and Alan Bowley (Natural England); for Knepp, Charlie Burrell (Knepp Castle Estate), Theresa Greenaway (Ecological Consultant) and Henri Brocklebank (Sussex Records Centre); and for Pumlumon, Clive Faulkner, Liz Lewis-Reddy, Estelle Bailey and Stephen Hughes (Montgomeryshire Wildlife Trust); Jerry Pritchard (Forestry Commission), James Harvey (Statkraft Energy Ltd), Carol Fielding (Countryside Council for Wales) and David Webb (West Wales Water). Gwion Aeron (Welsh Assembly Government) provided agri-environment scheme data and Ewan Mackie and Charene Winbow (Forestry Commission) provided standard timber values. For Frome, Andy Pollard (Dorset Wildlife Trust) Johnny O'Brien (Deer Management), Ian Danby, (BASC), Michael Ndeze (Forestry Commission). At Bournemouth University, special thanks go to Sarah Douglas, Chris Moody and Mark Dover. Finally, we would like to thank the Defra project steering group for their guidance. The CEH Land Cover Map 2000 data were used under licence agreement LCM 2010-061.

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HM Government

The Natural Choice: securing the value of nature

The Natural Choice: securing the value of nature

Presented to Parliament by the Secretary of State for Environment, Food and Rural Affairs by Command of Her Majesty

June 2011

CM 8082

£20.50

Any enquiries regarding this document should be sent to us at **naturalenvironment@defra.gsi.gov.uk**.

This document is also available for download at **www.official-documents.gov.uk**

ISBN: 9780101808224

Printed in the UK for The Stationery Office Limited on behalf of the Controller of Her Majesty's Stationery Office

ID 2433258 06/11

Printed on paper containing 75% recycled fibre content minimum.

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Foreword by the Secretary of State for Environment, Food and Rural Affairs

Too often, we take for granted the goods, services and amenity value that nature freely provides us. They risk being lost as a consequence. We can and we must do things differently. With a new way of thinking we can nurture them.

Most people already recognise that nature has an intrinsic value. Over 500 scientists from around the world have now developed a tool by which we can assess more accurately the value of the natural world around us. The National Ecosystem Assessment has given us the evidence to inform our decisions. It makes clear that government and society need to account better for the value of nature, particularly the services and resources it provides.

This White Paper – the first on the natural environment for over 20 years – places the value of nature at the centre of the choices our nation must make: to enhance our environment, economic growth and personal wellbeing. By properly valuing nature today, we can safeguard the natural areas that we all cherish and from which we derive vital services. Everyone can think of places near where they live that languish, neglected and damaged. In many cases, with well-informed intervention, we can make progress towards restoring nature's systems and capacities. We can put right damage done in previous years. This White Paper makes important new proposals for doing just that.

Whether we live in the city or the countryside, natural systems support us. The natural environment becomes degraded when people lose their sense of contact with it. Human health and happiness also suffer. This White Paper aims to strengthen connections between people and nature, to the benefit of both.

As the Government sets about repairing the damage to the economy, we are launching this White Paper to mend the inherited damage in our natural environment. Thousands responded to our recent consultation and told us that they want to safeguard the inheritance of future generations. Valuing nature properly holds the key to a green and growing economy, one which invests in nature – not just for us but for our children's children.

The Rt Hon. Caroline Spelman MP

Executive summary: the natural choice

1. Nature is sometimes taken for granted and undervalued. But people cannot flourish without the benefits and services our natural environment provides. Nature is a complex, interconnected system. A healthy, properly functioning natural environment is the foundation of sustained economic growth, prospering communities and personal wellbeing.

2. This is why we must properly value the economic and social benefits of a healthy natural environment while continuing to recognise nature's intrinsic value. The Government wants this to be the first generation to leave the natural environment of England in a better state than it inherited. To achieve so much means taking action across sectors rather than treating environmental concerns in isolation. It requires us all to put the value of nature at the heart of our decision-making – in Government, local communities and businesses. In this way we will improve the quality and increase the value of the natural environment across England.

3. We will mainstream the value of nature across our society by:

- facilitating greater local action to protect and improve nature;
- creating a green economy, in which economic growth and the health of our natural resources sustain each other, and markets, business and Government better reflect the value of nature;
- strengthening the connections between people and nature to the benefit of both; and
- showing leadership in the European Union and internationally, to protect and enhance natural assets globally.

Protecting and improving our natural environment

4. The National Ecosystem Assessment shows that over 30% of the services provided by our natural environment are in decline. The Lawton Report, *Making Space for Nature*, found that nature in England is highly fragmented and unable to respond effectively to new pressures such as climate and demographic change.

5. Past action has often taken place on too small a scale. We want to promote an ambitious, integrated approach, creating a resilient ecological network across England. We will move from net biodiversity loss to net gain, by supporting healthy, well-functioning ecosystems and coherent ecological networks. We will publish a new Biodiversity Strategy for England, responding to our international commitments and setting a new direction for policy over the next decade.

6. We will establish a clear institutional framework to achieve the recovery of nature:

- We will establish Local Nature Partnerships (LNPs) to strengthen local action. LNPs will enable local leadership and may operate across administrative boundaries. They will raise awareness about the services and benefits of a healthy natural environment. They will contribute to the green economy and complement Local Enterprise Partnerships, with which we are encouraging them to form strong links.
- We will create new Nature Improvement Areas (NIAs) to enhance and reconnect nature on a significant scale, where the opportunities and benefits justify such action. Local partnerships will come together to form NIAs. We will set up a competition to identify 12 initial areas and will provide £7.5 million to support this.
- Through reforms of the planning system, we will take a strategic approach to planning for nature within and across local areas. This approach will guide development to the best locations, encourage greener design and enable development to enhance natural networks. We will retain the protection and improvement of the natural environment as core objectives of the planning system. We will establish a new, voluntary approach to biodiversity offsets and test our approach in pilot areas.

7. More broadly we will achieve a better quality natural environment by taking and promoting concerted action across our farmed land, woodlands and forests, towns and cities, and rivers and water bodies. We will press ahead with our ambitious commitments for the marine environment.

Growing a green economy

8. Economic growth and the natural environment are mutually compatible. Sustainable economic growth relies on services provided by the natural environment, often referred to as 'ecosystem services'. Some of these are provided directly, such as food, timber and energy. Others are indirect, such as climate regulation, water purification and the productivity of soil.

9. The Economics of Ecosystems and Biodiversity study shows that protected natural areas can yield returns many times higher than the cost of their protection. There are multi-million pound opportunities available from greener goods and services, and from markets that protect nature's services.

10. Too many of the benefits we derive from nature are not properly valued. The value of natural capital is not fully captured in the prices customers pay, in the operations of our markets or in the accounts of government or business. When nature is undervalued, bad choices can be made.

11. We will put natural capital at the centre of economic thinking economic thinking and at the heart of the way the way we measure economic progress nationally. We will include natural capital within the UK Environmental Accounts. We will establish an independent Natural Capital Committee to advise the Government on the state of natural capital in England.

12. Government alone cannot create a greener economy. Markets that trade sustainably in natural goods and services are essential. More businesses should benefit from new market opportunities, and from using natural capital more sustainably in their own supply chains. Government and business have a shared interest in protecting natural capital and should work together. Action we are taking includes the following:

- We will publish an action plan to expand markets and schemes in which payments are made by the beneficiary of a natural service to the provider of that service.
- We will set up a business-led Ecosystem Markets Task Force to review the opportunities for UK business from expanding the trade in green goods and the market for sustainable natural services.
- We will publish a review of waste policy later this year.
- We will issue new guidance for businesses by 2012 on how to measure and report corporate environmental impacts.

Reconnecting people and nature

13. The NEA and the Marmot Review, *Fair Society, Healthy Lives*, demonstrate the positive impact that nature has on mental and physical health. High-quality natural environments foster healthy neighbourhoods; green spaces encourage social activity and reduce crime. The natural environment can help children's learning.

14. Human activity can, in return, enrich nature. Voluntary activity to improve wildlife habitats or remove litter increases the value of nature. Well-informed choices made by people in their everyday lives – for example as shoppers, householders and gardeners – also have a positive impact. These connections are good for people and good for nature.

15. We need to make enhancing nature a central goal ofsocial action across the country. We want to make it easier for people to do the right thing, with action in the health and education systems and in our communities. Particular action includes the following:

- To help local authorities use their new duties and powers on public health, Public Health England will publish practical evidence about improving health, including through access to a good natural environment.
- We will remove barriers to learning outdoors and increase schools' abilities to teach outdoors when they wish to do so.
- We will create a new 'Local Green Areas' designation to allow local people to protect the green areas that are important to them.
- We will establish a Green Infrastructure Partnership with civil society to support the development of green infrastructure in England.
- We will launch a new phase of the Muck In4Life campaign, offering volunteering opportunities to improve the quality of life in towns, cities and the countryside.

International and EU leadership

16. We will show environmental leadership internationally and within the EU, to protect and enhance natural assets globally, promoting environmentally and socially sustainable growth. We will advance internationally the approach and principles set out in this White Paper.

17. We will press for effective implementation of the 2010 Nagoya agreement by the parties to the Convention on Biological Diversity. At the UN Conference on Sustainable Development in 2012, we will promote the green economy in the context of sustainable development and poverty eradication.

18. We will improve the quality of the lives of some of the poorest people on the planet by providing £25 million for biodiversity and ecosystem projects through the Darwin Initiative. Through the International Climate Fund, we will support action to prevent dangerous climate change in developing countries and help those affected by the change that is happening. The £2.9 billion of finance we have announced for 2011–15 will include funding to reduce emissions from deforestation and achieve biodiversity benefits.

19. We want the EU to become the world's largest green economy and market for environmentally sustainable goods and services. We will work with our partners to put in place appropriate strategies and sectoral policies, to achieve low-carbon, resource-efficient growth. We are working to achieve:

- greening of the Common Agricultural and Common Fisheries Policies to improve environmental benefits, while achieving our other policy goals;
- implementation of an ambitious new EU Biodiversity Strategy, to put into effect what was agreed at Nagoya;
- a powerful 'EU2020 Strategy' that achieves low-carbon, resource-efficient growth; and
- an effective EU Roadmap for a Resource-Efficient Europe.

Monitoring and reporting

20. We will develop a set of key indicators by spring 2012 to track progress on this White Paper. We will publish periodically a single concise and integrated report about the state of the English environment.

Introduction – the case for a better approach

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"The natural world, its biodiversity and its ecosystems are critically important to our well-being and economic prosperity, but are consistently undervalued in conventional economic analyses and decision making"

UK National Ecosystem Assessment

What we mean by 'natural environment'

In this White Paper, we have given 'natural environment' a broad meaning. It covers living things in all their diversity: wildlife, rivers and streams, lakes and seas, urban green space and open countryside, forests and farmed land. It includes the fundamentals of human survival: our food, fuel, air and water, together with the natural systems that cycle our water, clean out pollutants, produce healthy soil, protect us from floods and regulate our climate. And it embraces our landscapes and our natural heritage, the many types of contact we have with nature in both town and country. In England our natural environment is the result of thousands of years of interaction between people and nature. It continues to be shaped through the care and attention invested by the individuals and organisations who actively manage it.

1.1 Most people rightly believe in the innate value of nature and our strong moral responsibility to protect it. But the value of nature to our economy and society, and to our personal wellbeing, is also clearer than ever. Science, economics and social research have broken new ground, demonstrating that, year by year, the erosion of our natural environment is losing us benefits and generating costs. This knowledge must be the spur for a new policy direction, nationally and internationally.

Assessing our nation's ecosystems: a new understanding

1.2 The last White Paper on the natural environment, in 1990, established the foundation for environmental policies on matters as diverse as pollution and waste, planning and land use, wildlife and protected areas, and climate change. A lot has changed since then. The country has made great progress on some of the big environmental concerns of the time. Improvements have been made to the quality of our air and water, recycling rates, the state of our seas, environmental stewardship of farmland and the condition of our very best wildlife sites.

1.3 But addressing just one issue at a time will only get us so far, because it does not reflect the way that nature works **as a system**. Our natural environment has become increasingly fragmented and fragile. We must rethink our relationship with nature and the way we value the benefits we get from it.

1.4 The innovative UK National Ecosystem Assessment (NEA) was published in June 2011.[1] We are the first country to have undertaken a complete assessment of the benefits that nature provides, how they have changed over the past, the prospects for the future and their value to our society. The results of this research deserve to be widely known; they are the reason for many of the actions proposed in this White Paper.

1.5 The benefits we get from nature are often described as 'ecosystem services'. Natural resources (such as food, timber and water) and functioning natural systems (such as healthy, fertile soils; clean water and air; and a regulated climate) are vital support services for our wellbeing and security, and are themselves sustained by biodiversity. Taking account of all the economic and non-economic benefits we get from these services enables decision-makers to exercise judgement about how we use our environment. Such an approach is often called an 'ecosystems approach'.

1.6 The NEA shows that ecosystems and the ways people benefit from them have changed markedly in the past 60 years, driven by societal changes such as population growth, increased living standards, technological developments and globalised consumption patterns. Our ecosystems are delivering some services well, but others are in decline. Through its analysis of their changing status, the NEA has identified broad habitats and ecosystem services where continuing pressures are causing deterioration in the benefits provided. Of the range of services provided by the eight broad aquatic and terrestrial habitat types in the UK, over 30% have been assessed as declining, often as a consequence of long-term declines in habitat extent or condition.[2]

1.7 The NEA also underlines the importance of managing ecosystems in a more integrated fashion, to achieve a wider range of services and benefits. This means, for example, linking goals on wildlife, water, soil and landscape, and working at a scale that respects natural systems and the natural features supporting such systems. **Chapter 2 of this White Paper sets out measures to protect and improve the health of ecosystems. It promotes an integrated approach to managing the natural environment, particularly at the landscape scale.**

Spot the ecosystem services

Ecosystem Services are the products of natural systems from which people derive benefits, including goods and services, some of which can be valued economically, and others which have a non-economic value.

- **Provisioning services:** We obtain products from ecosystems, such as: food (crops, meat and dairy products, fish and honey); water (from rivers and also groundwater); fibre (timber and wool); and fuel (wood and biofuels).
- **Regulating services:** We benefit from ecosystem processes, such as: pollination (of wild plants and cultivated crops and flowers); water purification (in wetlands and sustainable urban drainage schemes); climate regulation (through local cooling and carbon capture by trees); noise and air pollution reduction (by urban and surrounding vegetation); and flood hazard reduction (by floodplains and sustainable urban drainage).
- **Cultural services:** We gain non-material benefits from ecosystems, for example: through spiritual or religious enrichment, cultural heritage, recreation or aesthetic experience. Accessible green spaces provide recreation, and enhance health and social cohesion.
- **Supporting services:** These are ecosystem functions that are necessary for the production of all other ecosystem services, for example: soil formation (for example, in woodlands or in well managed allotments) and nutrient cycling (for example, soils breaking down animal waste).

All of these roles are underpinned by biodiversity; the level and stability of ecosystem services generally improve with increasing levels of biodiversity.

Making Space for Nature: protecting and enhancing nature

1.8 In 2010, the independent review of England's wildlife sites and ecological network, chaired by Professor Sir John Lawton, concluded unequivocally that England's collection of wildlife areas is fragmented and does not represent a coherent and resilient ecological network capable of responding to the challenges of climate change and other pressures. The review called for 'a step-change in nature conservation [...] a new, restorative approach which rebuilds nature and creates a more resilient natural environment for the benefit of wildlife and ourselves'.[3] The review made 24 recommendations, but summarised what needed to be done in just four words: more, bigger, better and joined. **Chapter 2 sets out a summary of the action that the Government proposes in response to** Making Space for Nature; a response to each of the recommendations is set out at: www.defra.gov.uk

Making Space for Nature – more, bigger, better and joined

The *Making Space for Nature* review of terrestrial wildlife sites argued that we must:

- improve the quality of current wildlife sites by better habitat management;
- increase the size of existing wildlife sites;
- enhance connections between sites, either through physical corridors or through 'stepping stones';
- create new sites; and
- reduce the pressure on wildlife by improving the wider environment.

1.9 The fragmentation of natural environments is driving continuing threats to biodiversity. The previous global target to reduce significantly the rate of loss of biodiversity by 2010 was not met. In England, species and habitats are still declining. In 2008, for example, 18 out of 42 priority habitats and 120 out of 390 priority species were in decline. Biodiversity sustains our natural environment and the many services it provides: bees and other insects pollinate our crops; bogs and forests reduce damaging climate change by 'locking up' carbon; and fish and other animals and plants provide our food. Human health and wellbeing depend on biodiversity; its conservation and enhancement are critical for society and the natural environment alike.

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The role of biodiversity: pollination

- Some 84% of European crops and 80% of wildflowers rely on insect pollination. The value of pollination to UK agriculture is £440 million per year (13% of the total value of agriculture).
- Over the last 20 years, the area of crops dependent on insect pollination has increased by 38%. During the same period, there has been a 54% decline in honey bee colony numbers in England. More than 50% of our landscapes now have fewer species of bees and hoverflies than in 1980. These changes have been driven by habitat loss and farming practices.
- It makes much greater economic sense to protect and conserve pollinators than to adopt alternatives, such as hand pollination. The cost of replacing bee pollination with hand pollination is greater than the total market value of the crops, at over £1.5 billion per year.
- Bees can fly a kilometre or more, foraging for nectar from wildflowers. Creating a patchwork of flower-rich meadows, field edges and flowery road verges, and extending this into urban gardens, parks and open spaces, would assist bumblebees and other pollinating insects. It could reverse the alarming decline in pollinating insects such as bumblebees across England. The measures set out in this White Paper, along with our Bee Health Strategy,[4] will support this.

1.10 Society expects the environment to provide multiple benefits. A growing global population, for example, increases pressure on food production. But food increases must be achieved sustainably in order to protect the ecosystem services (such as pollination and the water cycle) on which food production relies. An increase in the production of

energy crops is also necessary to address dangerous climate change; more woodland cover is required for carbon storage and climate regulation.

1.11 As *Making Space for Nature* suggests, the quality of natural habitats must be improved throughout the countryside, while strategic action must be taken to plug gaps in our ecological network. Special protection of sites that are especially rich in wildlife or particularly fragile must continue. These ambitions impose an overlapping set of demands.

1.12 Ecological fragmentation, reductions in biodiversity and competing demands do not just happen on land. Our seas are also threatened by damage to biodiversity and pollution; fish stocks are under serious pressure. **Chapter 2 summarises the action we propose in order to protect biodiversity, secure multi-functional use of the environment and safeguard important terrestrial and marine habitats.**

Climate change and demographic change

1.13 Climate change is one of the biggest environmental threats facing the world today, and perhaps the greatest economic challenge. Biodiversity will be affected, with species moving or even lost in response to changes in air and sea temperature and water availability. The composition of habitats will change; woodlands will be vulnerable to more frequent storm events. Climate change will increase the severity of flooding and drought in different parts of the country.

1.14 Tackling climate change is essential for maintaining a healthy, resilient natural environment. We are working internationally to agree emission cuts in line with keeping global average temperature rise to two degrees Celsius, so as to avoid the most dangerous effects of climate change. The Climate Change Act 2008 made the UK the first country in the world to set a long-term legally binding framework to cut our emissions by at least 80% by 2050 and by at least 34% by 2020 against 1990 levels. In order to achieve that, the UK needs clean, safe and affordable energy, to heat and power energy-efficient homes and businesses. Our society will have to source, manage and use energy in very different ways.

1.15 A healthy natural environment can offer natural services to help society cope with the impacts of unavoidable climate change. For example, tree-planting can naturally cool the temperature in our towns and cities; in some areas, it can be used to manage increased flood risk, or to retain and recycle water naturally when we most need it. But living with the impacts of climate change will also mean some tough choices about how to protect and enhance nature at the same time as tackling other pressures caused by climate change on our water, food production and the erosion of our soil and land. Our society needs to develop a better understanding about when and where to invest in environmental protection in the face of climate change impacts. **Helping the natural environment to adapt to climate change is a theme that runs throughout this White Paper.**

1.16 Demographic change will also have important environmental impacts. The recent report of the Royal Commission on Environmental Pollution, *Demographic Change and the Environment*, argued that the main environmental challenge is not the total size of the population, but how and where people choose to live. Demographic change is also a factor in water stress and in competition for different types of land use (e.g. for energy, food or development).[5] The Foresight Report, *The Future of Food and Farming: Challenges and choices for global sustainability*,[6] concludes that substantial changes will be required throughout and beyond the food system to provide food security for a predicted 9 billion people. **Chapter 2 of this White Paper sets out action on food and farming, and on competing pressures on land use.**

Growing a green economy

1.17 The Government's priority is to restore sustainable economic prosperity for all. We have taken responsible action to reduce the financial deficit and to promote sustainable growth. In doing so, we reject the outdated idea that environmental action is a barrier to growth or that achieving economic development and a healthy natural environment are incompatible objectives. On the contrary, strong emerging evidence shows that a healthy environment is essential to long-term growth; the economic benefits of protecting biodiversity and ecosystems greatly outweigh the costs of doing so. For example, the recent Economics of Ecosystems and Biodiversity (TEEB) study showed that protected natural areas can deliver economic returns that are 100 times greater than the cost of their protection and maintenance.[7]

1.18 TEEB also highlighted the multi-million pound economic opportunities available from greener goods, services and markets which protect nature's services.[8] Studies such as TEEB and the NEA show how the financial benefits we get from nature – sometimes described as 'natural capital' (see box below) – are often underestimated or overlooked.

> **Natural capital** can be defined as the stock of our physical natural assets (such as soil, forests, water and biodiversity) which provide flows of services that benefit people (such as pollinating crops, natural hazard protection, climate regulation or the mental health benefits of a walk in the park). Natural capital is valuable to our economy. Some marketable products such as timber have a financial value that has been known for centuries. In other cases (e.g. the role of bees in pollinating crops), we are only just beginning to understand their financial value.

1.19 At present, some of the ecosystem services we derive from our natural environment have a financial value in the marketplace, while others – equally vital to our continued wellbeing – do not. Society has traditionally placed a much higher economic value on commodities such as food, fuel or minerals than on other services that are equally essential for economic stability and human wellbeing, such as climate regulation, flood control, water purification and space for relaxation and recreation. This can create an imbalance in the way that decisions are made about how to use the natural environment. It has led historically to a focus on short-term gain and consequent over-exploitation of many natural stocks. The degradation of our natural systems entails not only the loss of precious habitats, wildlife, fish populations, landscapes, clean air and water but also the loss of economic value that we could have gained from more sustainable use of the natural environment. Short-term valuation and, in some cases, the absence of pricing are symptoms of market failure.

1.20 The TEEB study adds to a growing and influential body of international evidence on the need to better account for the value of natural capital. It estimated that if no action is taken to arrest current rates of degradation, the value globally of lost ecosystem services would amount to between $2 trillion and $4.5 trillion per year from deforestation alone[9]. According to its estimates, the loss of land-based ecosystems has already cost around €500 billion over the last ten years. Maintaining nature's capacity to provide the functions upon which we rely is often cheaper than having to replace them by investing in heavy infrastructure or technical solutions.

1.21 The NEA also shows how much we rely on ecosystems abroad to supply goods and services to our economy. Our footprint abroad is large: 80% of our timber and 30% of our food are imported from overseas. Some 66% of our total water use is imported in the form of all the water used to make the goods we buy. **Chapter 3 identifies action to support businesses along the supply chain to understand and manage their global and local environmental impacts. Chapter 5 sets out activity at international level.**

1.22 UK businesses also lose out from degradation of natural capital. Problems with the security of supply – with real shortages in resources and disruption to their availability – may become apparent. Price spikes, increased insurance premiums and reputational issues over environmental damage may arise. There is often a lack of information about impacts on natural capital, such that businesses and consumers are unable to make informed choices. The impacts of supply chains on far-off natural resources are often hidden or ignored. While many businesses understand that

Market failure

'The values of most ecosystem services are currently omitted from national economic frameworks and local decision making. [This] results in less efficient resource allocation.' (NEA)

In the last three decades of the 20th century, high land values and demand for housing to meet the needs of a growing population contributed to declines in the quality and quantity of urban green spaces. For example, communities lost in the region of 10,000 playing fields between 1979 and 1997. Looking forward to 2060, the NEA shows that there is potential to increase the amenity value of urban green space in the UK by some £2 billion–£4 billion every year. However, this value is not effectively reflected within the market for land.

In addition, communities are becoming increasingly aware of the additional value of green space in managing risks such as the urban heat island effect, particulate pollution and surface water flooding.

respecting natural capital makes good business sense, many others have yet to follow their lead.

1.23 One of the main causes for this has been that the full costs and benefits of natural capital have been left off the balance sheet. If businesses do not account for the value of nature, they may only recognise that they are using natural resources beyond their capacity for renewal when they become scarce.
The resulting over-consumption and depletion of natural capital are a form of market failure. Better accounting – by business and by government – would enable better choices, so that society can use natural capital sustainably.

1.24 Sustainable use of natural capital must be a priority. But we can also derive significant economic benefits – for businesses and the UK economy – from actively improving or enhancing capital.
This is particularly true in cases where valuable natural functions have already been degraded or lost, or where natural capital can provide services more cost-effectively than man-made alternatives that need heavy infrastructure. For example, the NEA highlights the value of coastal wetlands at £1.5 billion annually in terms of the role they play in buffering the effects of storms and in controlling flooding. Investing in the creation of new coastal wetland, such as through managed realignment schemes, can be a cost-effective alternative to 'hard' engineering flood defences, as well as providing wider ecosystem services.

1.25 The past and present losses to our economy from environmental degradation are wasteful. Society needs to do more to reflect the economic value of the natural environment in the decisions that each of us – businesses, government and individuals – make. The use of markets and economic incentives is likely to have an increasingly important role to play. **Chapter 3 sets out a series of measures to account for the value of nature, in order to make more balanced decisions about how our society and economy use the natural environment.**

Wellbeing in a healthier environment

1.26 Human wellbeing is intimately connected with our natural environment. Evidence from the NEA supports what many feel instinctively: regular opportunities to experience nature have positive impacts on mental and physical health, learning and

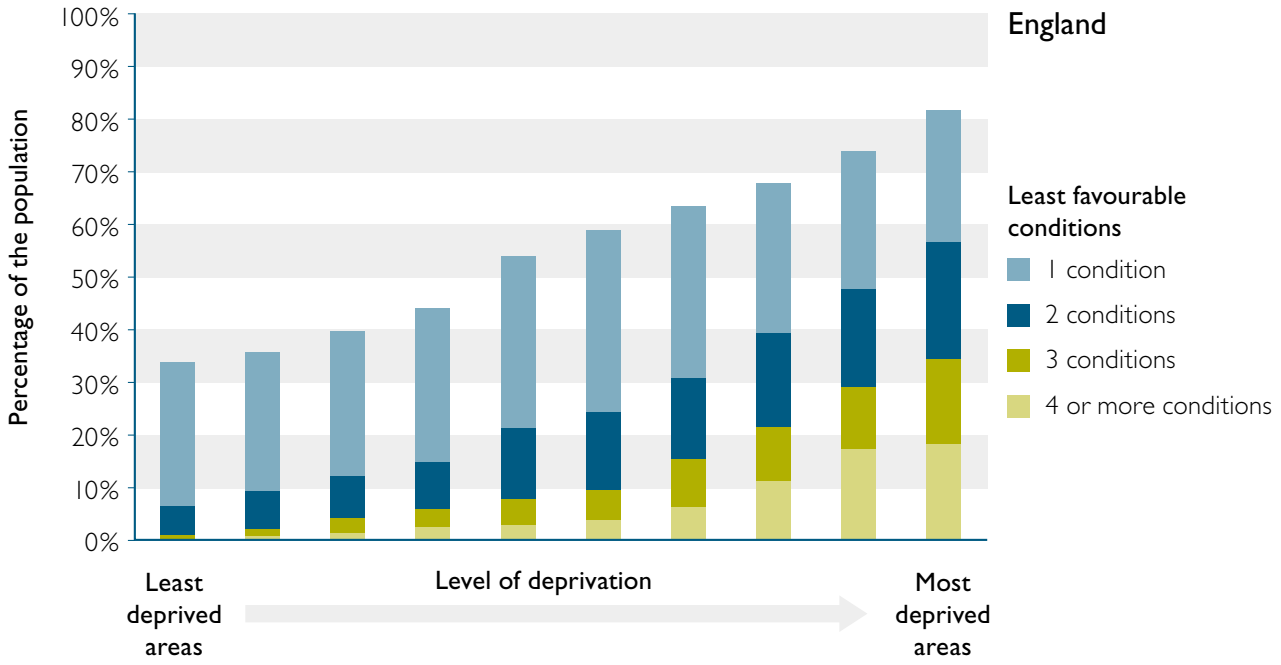
> "Ecosystems can affect both physical and mental health of all social groups, and people's quality of life in general; this evidence often relates to non-specific access to the wider landscape and seascapes, or specific use of urban green space, particularly for leisure in public parks and private gardens.[10]

relationships between neighbours. Nature can benefit us at all stages in our lives:

1.27 Contact with nature can help us to get a better start in life – and to get on in life. There is a wide range of evidence showing that contact with nature enhances children's education, personal and social skills, health and wellbeing, leading to the development of responsible citizens. However, research also shows that the connections between young people and nature are weaker now than in the past. Children are becoming disconnected from the natural environment. They are spending less and less time outdoors. In fact, the likelihood of children visiting any green space at all has halved in a generation. Young people themselves say that outdoor space is one of the things that they need to 'feel good and do well'.[11]

1.28 There is increasing interest in the impact of outdoor environments on health and wellbeing. Several reviews, including Sir Michael Marmot's independent review of health inequalities, *Fair Society, Healthy Lives*,[12] point to the potential of natural environments to improve mental and physical health. A study in the *Lancet* showed that proximity to green spaces was associated with reduced health inequalities.[13] A large-scale study in the Netherlands also found that living close to areas with more green spaces was associated with fewer mental health problems; the relation was stronger for people with a lower socioeconomic status.[14]

1.29 Access to nearby attractive public green space and footpaths is likely to increase levels of walking, one of the simplest forms of physical activity that most can enjoy.[15] Studies show that patients recovering from operations are likely to stay in hospital for less time and need less powerful painkillers if they look out onto a natural scene from their hospital bed.[16]



Note: Level of deprivation is determined by the Index of Multiple of Deprivation. Eleven environmental conditions or characteristics have been included: river water quality, air quality, green space, habitat favourable to biodiversity, flood risk, litter, housing conditions, road accidents, and presence of 'regulated sites' (e.g. waste management, industrial, or landfill sites, or sewage treatment works). For each of these conditions the population living in areas with, in relative terms, the 10 per cent least favourable conditions have been determined. Data range mainly from 2005 to 2008

Source: Defra, Environment Agency, CLG

1.30 Healthy natural environments can also be used as a cost-effective way of regenerating and enhancing our neighbourhoods in both rural and urban areas. The presence of vegetation can halve the incidence of violent and property crimes in otherwise identical social housing. Crime is lower in inner-city areas with more areas of natural vegetation.[17] Green spaces encourage greater social activity and more visitors than barren areas. Residents get to know their neighbours and become more concerned with helping and supporting each other.

1.31 Not everyone has an equal opportunity to access the benefits of a healthy natural environment. While some aspects of environmental quality have improved, it can vary between different areas and communities. People in disadvantaged areas across England experience greater exposure to air pollution, sea flooding, close proximity to large industrial and waste management sites and poor river water quality. Statistics on environmental quality published in 2010 show that the more deprived an area is, the more exposed its residents are to unfavourable environmental conditions.[18] Around 0.2% of people living in the least deprived areas may experience four or more environmental conditions that are 'least favourable'. This rises to around 17% for those people living in the most deprived areas in England.

1.32 These examples of social research place a new responsibility on policy-makers and service providers to redesign policies and services for the natural environment to improve wellbeing. **Chapter 4 proposes measures in our health and education systems, and in our communities.**

2 Protecting and improving our natural environment

Ambition

We want to improve the quality of our natural environment across England, moving to a net gain in the value of nature. We aim to arrest the decline in habitats and species and the degradation of landscapes. We will protect priority habitats and safeguard vulnerable non-renewable resources for future generations. We will support natural systems to function more effectively in town, in the country and at sea. We will achieve this through joined-up action at local and national levels to create an ecological network which is resilient to changing pressures.

The key reforms for protecting and improving our natural environment are:

- **supporting Local Nature Partnerships**, to strengthen local action (paragraphs 2.15–2.26);
- **new Nature Improvement Areas** in response to the recommendations set out in *Making Space for Nature,* to enhance and reconnect nature on a significant scale (paragraphs 2.27–2.32);
- **ecologically coherent planning**, retaining the protection and improvement of the natural environment as core objectives of the planning system (paragraphs 2.33–2.37); and
- **piloting biodiversity offsets**, to make requirements to reduce the impacts of development on biodiversity simpler and more consistent (paragraphs 2.38–2.42).

2.1 The National Ecosystem Assessment (NEA) shows that over 30% of the services we get from our ecosystems are declining. It was once possible to assume that environmental damage was an inevitable impact of social and economic progress. But ground-breaking studies such as the Economics of Ecosystems and Biodiversity (TEEB) study and the NEA have demonstrated that growth and prosperity are compatible with a thriving natural environment. They highlight the social and economic costs of environmental degradation and the significant scale of the opportunities arising from more effective management of our ecosystems in future.

2.2 Through its analysis of their changing status, the NEA has identified habitats and ecosystem services where continuing pressures are causing deterioration in service provision, including marine fisheries, urban ecosystems, wild species diversity, pollination, enclosed farmland and soil quality. The NEA shows that such deterioration has been driven by long-term reductions in the extent and condition of the space available for nature (see the box below).

2.3 This new knowledge demands a clear response. Past environmental action in England has often taken place on too small a scale to achieve overall success and has overlooked crucial links, such as between wildlife sites and the wider countryside, or between rural and urban areas. Policies and practices have too often been conceived and implemented in isolation from each other. Both the NEA and *Making Space for Nature*[19] identify the need for a more coherent approach, working at a larger scale to reflect natural boundaries, joining up across the landscape and encouraging collaboration between sectors.

2.4 In this chapter, we set out our vision for nature, the key measures that will strengthen the institutional framework to achieve this vision, and measures to restore ecosystems across the country.

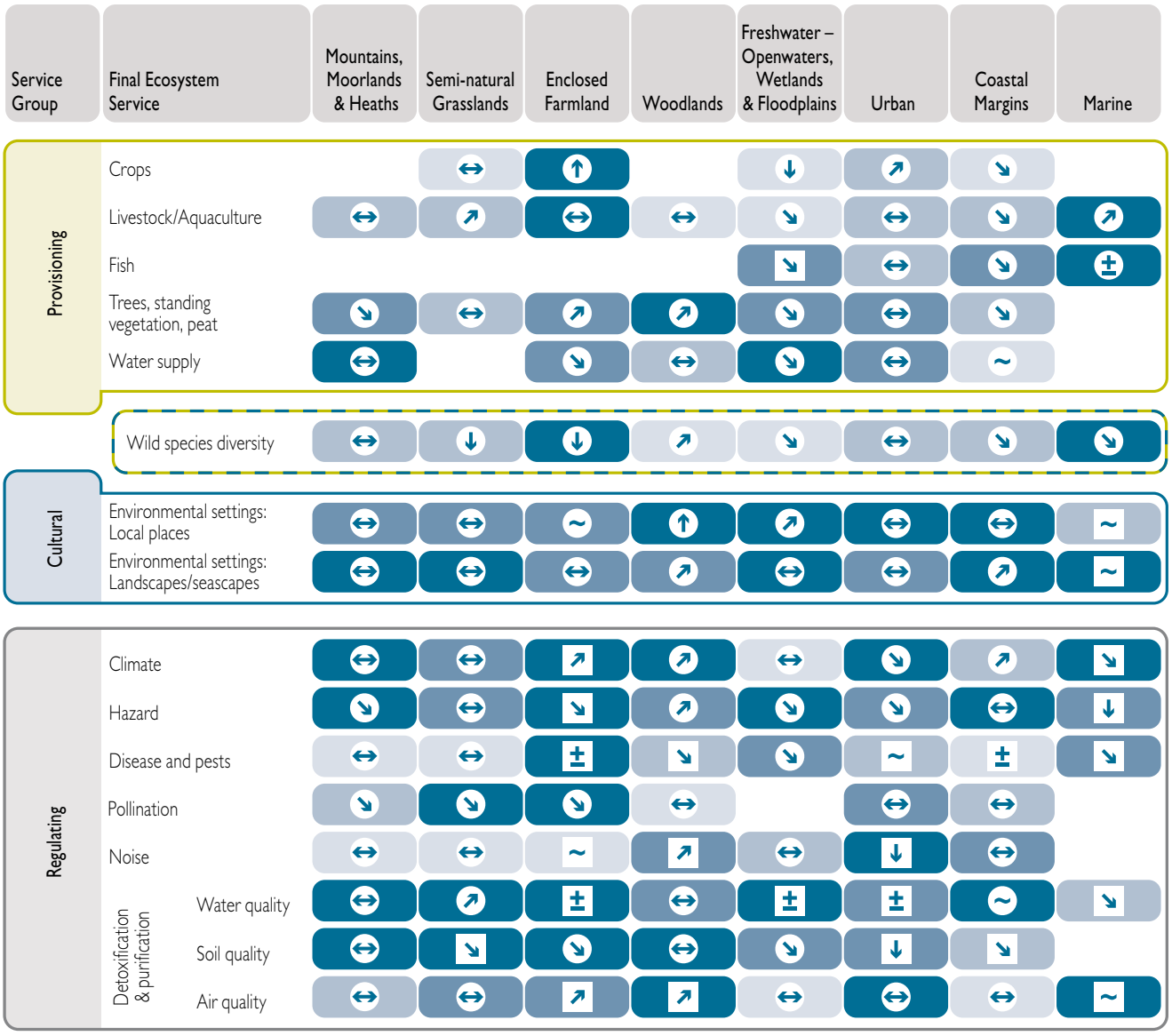
A vision for nature

2.5 Together, our society must act on all the evidence we now have. We must protect the essentials of life: our air, biodiversity, soils and water, so that they can continue to provide us with the services on which we rely. We must repair the damage done to our natural environment by restoring natural connections that have been broken. We must improve the quality and diversity of environments in both town and country, so that they are better able to respond to future pressures. We should set our sights on a vision that inspires us to act now and in the longer term: by 2060, our essential natural assets will be contributing fully to robust and resilient ecosystems, providing a wide range of goods and services so that increasing numbers of people enjoy benefits from a healthier natural environment.

2.6 The NEA has brought new insights; we are committed to growing this knowledge base. **The Government will support a further phase of ground-breaking research. It will investigate the mix of future actions most likely to secure the most benefits for nature and for people from our ecosystems. It will also develop practical tools to assist decision-makers in applying the lessons of the NEA.**

2.7 In 2010, a historic agreement in Nagoya, Japan, set **a new global vision and direction for biodiversity policy**, an acknowledgement that efforts to protect and enhance biodiversity must increase significantly everywhere. As part of that agreement, which is explained more fully in chapter 5, countries must revise their own national strategies and plans for biodiversity to take account of the new global framework. **We will publish a new Biodiversity Strategy for England to follow this White Paper. It will respond to our**

NEA Ecosystems trends since 1990



Relative importance of UK NEA Broad Habitats in delivering ecosystem services and overall direction of change in service flow since 1990. This figure is based on information synthesized from the habitat and ecosystem service chapters of the UK NEA Technical Report (Chapters 5–16), as well as expert opinion. This figure represents a UK-wide overview and will vary nationally, regionally and locally. It will therefore also inevitably include a level of uncertainty; full details can be found in the Technical Report. Arrows in circles represent where there is high evidence for or confidence in the direction of service flow amongst experts; arrows in squares represent where there is less evidence for or confidence in the direction of service flow. Blank cells represent services that are not applicable to a particular Broad Habitat.

Importance of Broad Habitat for delivering the ecosystem service

- High
- Medium – High
- Medium – Low
- Low

Direction of change in the flow of the service

- ↑ Improving
- ↗ Some improvement
- ↔ No net change
- ± Improvement and/or deterioration in different locations
- ↘ Some deterioration
- ↓ Deterioration
- ~ Unknown

international commitments and set a new strategic direction for biodiversity policy in England for the next decade.

Definition of 'biodiversity'

Biodiversity is life. We are part of it and we depend on it for our food, livelihoods and wellbeing. It is the term used to describe the variety of all life on Earth, from the most common of species such as otters, dolphins and bluebells to less well-known and rare species. It includes all species of animals, plants, fungi and even micro-organisms, the places they need in which to live (habitats) and the natural systems that support them.

According to the Convention on Biological Diversity: 'Biological diversity means the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.'

2.8 We will continue to look after and improve our special wildlife areas and take direct action to support our most precious and endangered wildlife. But we must go beyond that, working together to safeguard ecosystem services and restore degraded ecosystems through more cost-effective and integrated approaches. We will move progressively from net biodiversity loss to net gain, by supporting healthy, well-functioning ecosystems and establishing more coherent ecological networks. **Our 2020 mission is to halt overall biodiversity loss, support healthy well-functioning ecosystems and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people.**

2.9 By 2020 we want to achieve an overall improvement in the status of our wildlife. Over time, we plan to have 90% of priority wildlife habitats in recovering or favourable condition.[20] We will work to achieve more, bigger, better and less-fragmented areas for wildlife, including no net loss of priority habitat and an increase of at least 200,000 hectares in the overall extent of priority habitats. At least 50% of Sites of Special Scientific Interest will be in favourable condition, while maintaining at least 95% in favourable or recovering condition. And, in line with commitments made at Nagoya, at least 17% of England will be managed effectively in order to safeguard biodiversity and ecosystem services, and at least 15% of degraded ecosystems that are important for climate change mitigation and adaptation will be restored. Government will play a leading role in delivering these outcomes and will take them forward in a way which is compatible with our other priorities. We do not intend to introduce unnecessary burdens or regulations, rather our aim is for these outcomes to be used as a driver for action by partners under the new Biodiversity Strategy. We want to inspire action at all levels by all partners. Government cannot deliver these outcomes alone and a significant contribution will be required from the wider biodiversity partnership and society in general.

2.10 Public bodies have a statutory duty to take account of conservation of biodiversity. We will provide new tools and guidance for key groups of public bodies, including local authorities, to support local action for nature. We will also raise the profile of this duty among parish councils, to address low awareness of the duty within this group.

Natural networks

The natural environment is sometimes seen as a series of disconnected places: gardens, parks, farmland, forests, coastland, wetlands, rivers and seas. We should be thinking not of isolated spots of green on a map of England but of a thriving green network linking wildlife sites with farmland, forestry and urban parks and gardens across the country.

Making Space for Nature highlighted action to support ecological networks as an effective response to conserve wildlife in environments that have become fragmented by human activities. It stated: 'An ecological network comprises a suite of high quality sites which collectively contain the diversity and area of habitat that are needed to support species and which have ecological connections between them…'[21]

The elements of life – biodiversity, healthy soils, clean air and water, and diverse landscapes – need to be managed in ways which recognise the vital connections between them. Connections can be made over land; through water or by air; or through continuous green corridors or stepping stones, to create a dynamic and resilient landscape.

2.11 *Making Space for Nature* emphasised the need to restore natural networks across the country, working at a range of geographical scales from local networks of small urban parks and green spaces, to major schemes operating over thousands of hectares. There is a growing consensus among conservationists and land

managers that integrated action at a 'landscape scale' is often the best way to achieve multiple benefits.

Working at a 'landscape scale'

There is no single accepted definition of 'landscape scale'; rather, it is a term commonly used to refer to action that covers a large spatial scale, usually addressing a range of ecosystem processes, conservation objectives and land uses.

The 'right scale' might need to take account of the particular interest of those involved locally, aesthetic or cultural characteristics, natural features such as river catchment areas or particular habitats, or recognised areas such as the 159 National Character Areas.

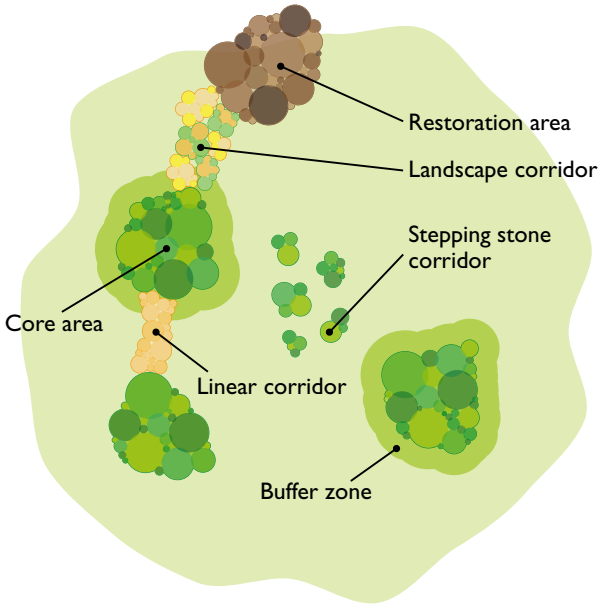
Landscape scale conservation is characterised by the pursuit of multiple benefits across a defined area (e.g. water quality, biodiversity and access). The best examples also make links to wider economic and social priorities, where enhancing nature can provide benefits to the local economy and quality of life.

There are strong links between the landscape scale approach and an 'ecosystems approach', which encourages an integrated approach to land management, considering the costs and benefits of land use decisions, and pursuing those that minimise risks and maximise opportunities for people, for nature and for the economy.

2.12 *Making Space for Nature* set out a practical vision for addressing the fragmentation of our natural environment by restoring ecological networks across the country. The approach is based on five components, to be implemented at a landscape scale working with existing land uses and economic activities:

- **core areas of high nature conservation value** which contain rare or important habitats or ecosystem services. They include protected wildlife sites and other semi-natural areas of high ecological quality;
- **corridors and 'stepping stones'** enabling species to move between core areas. These can be made up of a number of small sites acting as 'stepping stones' or a mosaic of habitats that allows species to move and supports ecosystem functions;
- **restoration areas**, where strategies are put in place to create high-value areas (the 'core areas' of the future) so that ecological functions and wildlife can be restored;
- **buffer zones** that protect core areas, restoration areas and 'stepping stones' from adverse impacts in the wider environment; and
- **sustainable use areas**, focused on the sustainable use of natural resources and appropriate economic activities. Together with the maintenance of ecosystem services, they 'soften' the wider countryside, making it more permeable and less hostile to wildlife.

The components of ecological networks



2.13 A huge amount of work is already under way to restore nature at a landscape scale. The Wildlife Trusts' Living Landscapes, RSPB's Futurescapes, and the eight Integrated Biodiversity Delivery Area pilots are examples of this approach, as are many independent partnerships operating around the country. The England Biodiversity Group has drawn together the lessons learned from examples both in this country and overseas in the *ThinkBIG* report.[22] Published in tandem with this White Paper, *ThinkBIG* suggests ways in which local authorities, communities, businesses, landowners, farmers and government can help ecological restoration at a landscape scale.

Supporting natural networks: a new institutional framework

2.14 We want to create a resilient and coherent ecological network at national and local levels across England. Achieving this will require a fundamental shift in approaches to conservation and land management.

Case Study **Managing Land to Reduce Flood Risk**

On the National Trust's Holnicote Estate on Exmoor, an innovative project is taking place to make the land better at storing water and reduce the risk of flooding in the villages of Allerford and Bossington. The project receives funding from Defra's Multi-Objective Flood Management Demonstration Scheme.

The aim is to change the way the land is managed to allow it to hold more water and change the way that flood waters flow through the catchment. Activities include restoring wetlands and water meadows and creating new woodland. These changes cost relatively little compared to building hard flood defences to protect the villages. As well as reducing flood risks, the project aims to produce multiple environmental benefits including improved habitats, better soil conservation and good carbon stewardship.

The project is led by the National Trust, with support from the Environment Agency and other local partners. The team are working with tenant farmers along the River Aller and Horner Water catchments from source to sea. The results will be relevant to other catchments around the country. Project manager Nigel Hester says: ***"The project presents a great opportunity to help people understand, appreciate and look after our natural resources. We are involving tenants, private residents and other local stakeholders in our long term commitment to this project."***

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To make this happen, the Government will put in place a clear institutional framework to support nature restoration. This means:

- establishing Local Nature Partnerships to strengthen action at the right scale and mirror Local Enterprise Partnerships (LEPs);
- creating new Nature Improvement Areas (NIAs); and
- strengthening support through the planning system, including through biodiversity offsets.

Local Nature Partnerships

2.15 In developing this White Paper, we have received one particularly clear message: effective action to benefit nature, people and the economy locally happens when the right people come together in partnership.

2.16 Some highly effective local partnerships already exist, dealing with matters such as landscape restoration, catchment or coastal management, achievement of Biodiversity Action Plans and provision of green infrastructure. Many already make the important links between action for nature and wider economic and community priorities. We want to see widespread and joined-up partnership action. **We will encourage and support Local Nature Partnerships where local areas wish to establish them. These partnerships will work at a strategic scale to improve the range of benefits and services we get from a healthy natural environment. They will aim to improve the multiple benefits we receive from good management of the land.**

2.17 Such partnerships may cross administrative boundaries, so that they can reflect natural features, systems and landscapes, and work at a scale that has most impact. Where necessary, they may join up on cross-boundary issues, such as landscape scale action for biodiversity, water management, green infrastructure, air quality and ecosystem services more widely. At this strategic level, we envisage that there could be in the order of around 50 partnerships across the country. These would complement the many successful district and neighbourhood groups that are working to achieve positive outcomes at a smaller geographic scale.

2.18 Effective partnerships engage and win the support of local people and communities they serve. They may comprise people from local authorities, businesses, statutory authorities, civil society organisations, land managers and local environmental record centres, as well as people from communities themselves.

2.19 Local Nature Partnerships will demonstrate local leadership, raising awareness about the vital services and benefits that a healthy natural environment brings for people, communities and the local economy. Local Nature Partnerships will contribute to the green economy. In chapter 3 we show the business opportunities available from improving nature and the way our economy is built on the foundations of the natural world. Local Enterprise Partnerships (LEPs) and Local Nature Partnerships therefore have complementary roles both of which will help grow a green economy. We expect them to work in a co-operative and constructive fashion to drive forward green growth locally. Together they can help create the conditions needed for thriving local enterprise, innovation and inward investment – all of which can benefit from and contribute to, a better natural environment. We would encourage LEPs and Local Nature Partnerships to work together to forge strong links that capture the value of nature. LEPs and Local Nature Partnerships may arrange reciprocal representation, but local discretion would apply here.

2.20 Local Nature Partnerships will influence local decisions and promote an ecosystems approach at a local level. They will develop a shared vision for their area and a set of priorities that improve social and economic benefits. This might include measures to establish and improve a local ecological network. Crucially, partnerships can co-ordinate action across individual organisations, aligning efforts and making the best use of available resources to make a difference on the ground. Partnerships will add value to a local area's development through contributing to local authority plans that affect the environment, as well as to local plans and local development frameworks.

2.21 Partnerships that fulfil the broad vision set out above will be recognised by government and its environmental bodies. We will host an annual ministerial event at which partnerships can come together to share best practice, discuss implementation issues and celebrate success. We will maintain a partnership database on the internet.

2.22 Much of this work is already happening but **the Government wants to provide support to both new and existing partnerships wishing to adopt this integrated, landscape scale approach. We will provide a one-off fund in 2011/12 worth £1 million to develop Local Nature Partnerships.**

2.23 We want local authorities to work through partnerships, linking national environmental priorities to local circumstances. Following the Government's arm's-length bodies review, the Environment Agency, Natural England and the Forestry Commission will deliver more joined-up advice and engagement for local areas[23]. Statutory advice to local authorities and developers will be consistent. Where the environmental opportunities and risks are greatest, they will offer local areas streamlined support through the Single Voice initiative. Where appropriate, they will work in partnership with English Heritage, which also has statutory responsibilities for landscape management. Together, they will provide a unified and authoritative source of advice which sets clear objectives and allows partnerships and local authorities the freedom and flexibility to decide how to achieve them.

2.24 In addition, we are supporting the Total Environment initiative. Here, government and self-selected local authorities are working in partnership to find better ways of tackling environmental priorities and removing barriers. Through this scheme, there is an opportunity for local authorities to work with local partnerships as described above.

2.25 The Government's reforms contained in the Localism Bill will further support local authorities and community groups to protect and improve the natural environment. New measures will give local areas greater freedom and renewed responsibilities. Communities will have a greater say about their priorities, including those for the environment. Community consultation on nationally significant infrastructure projects will ensure that the positive and negative impacts of larger developments are considered. A duty to co-operate addresses environmental issues with an impact beyond individual localities and communities.

2.26 The NEA found that the economic and social value of nature is neither understood nor taken into account by decision-makers. Evidence shows that passionate individuals with credibility in their own fields of expertise can help inspire action in others. **We will inaugurate a network of 50 Natural Value Ambassadors to engage key decision-makers and opinion-formers using the latest evidence and materials available.** Local Nature Partnerships will be invited to nominate candidates, as will professional bodies from other sectors such as business, health and education.

Nature Improvement Areas

2.27 *Making Space for Nature* found that there are areas of the country where the opportunities and benefits for the whole ecological network justify focused efforts on a grand scale. The report recommended that large areas should be formally recognised as **Ecological Restoration Zones**. Reflecting this recommendation, **we will enable partnerships of local authorities, local communities and landowners, the private sector and conservation organisations to establish new Nature Improvement Areas (NIAs), based on a local assessment of opportunities for restoring and connecting nature on a significant scale.** We want to see NIAs wherever the opportunities or benefits are greatest, driven by the knowledge and vision of local partners.

2.28 In order to provide inspiration locally and build a practical evidence base, we will fund a competition to illustrate what works. **The Government will support the creation of Nature Improvement Areas. Natural England will set up a competition to identify 12 initial areas. We will provide £7.5 million over the current Spending Review period.** The learning from them will help us to extend this approach.

2.29 Working within the framework of the National Policy Statements and the Government's planning reforms (see below), local authorities will be able to use local planning to support Nature Improvement Areas, including identifying them in their local plans where they choose, while not deterring sustainable development. When planning for development in their areas, they can specify the types of development that may or may not be appropriate in component parts of the NIA (such as existing designated areas), design aspects and how development can contribute to NIA objectives. The planning reforms will help local authorities to plan strategically across boundaries to support ecological networks.

2.30 We will capture the learning from Nature Improvement Areas, and review whether further action is needed in planning policy, regulation or capacity building, to support their development.

2.31 To enable informed decisions about NIAs and the repair of wider ecological networks, farmers, land managers, local authorities, civil society and others need to have easy access to information and advice about the natural environment where they live and work. **The Government's environmental bodies are reforming the way they work together, to provide more coherent advice to local partners. This means sharing information to help practitioners prioritise action based on environmental risks and opportunities.** In support of this, Natural England is producing maps that show how landscape character areas, water catchments and local authority boundaries relate to each other.

2.32 Landscape scale action requires partners to pool resources and get the best possible value from them. Partnerships often draw together funding from National Lottery distributors, and from environmental charities, business, local authorities and communities. Government can provide support where joint priorities have been agreed which meet national and local needs. **We will maximise the contribution which Environmental Stewardship and the Woodland Grant Scheme make towards our over arching objective to promote multiple benefits from ecological restoration at a landscape scale, including through Nature Improvement Areas.**

Protecting natural value through the planning system

2.33 The Government expects the planning system to deliver the homes, business, infrastructure and thriving local places that the country needs, while protecting and enhancing the natural and historic environment. Planning has a key role in securing a sustainable future.

2.34 However, the current system is costly and bureaucratic with excessive central control, preventing local communities from shaping development in their neighbourhoods. It is also failing to achieve the kind of integrated and informed decision-making that is needed to support sustainable land use. We must enable communities to achieve lasting growth in a way that meets all of their needs: economic, social and environmental.

2.35 We need a more strategic and integrated approach to planning for nature within and across local areas, one that guides development to the best locations, encourages greener design and enables development to enhance natural networks for the benefit of people and the environment as part of sustainable development. We will retain protection and improvement of the natural environment as core objectives for local planning and development management. The planning system will continue to facilitate coherent and resilient ecological networks in association with local partners and reflect

the value of natural systems. We want the planning system to contribute to our objective of no net loss of biodiversity; to encourage local authorities to promote multi-functional development so that we get the most from land; and to protect our best and most versatile agricultural land.

2.36 To achieve this, we need more flexible and innovative approaches, including NIAs (set out above) and biodiversity offsetting (see below).

2.37 Central to the Government's planning reforms is the National Planning Policy Framework (NPPF), which will set out our environmental, social and economic objectives for the planning system and explain how they relate to each other, in one succinct document. We have already made clear that our top priority for the NPPF will be to support long-term sustainable economic growth, with a new presumption in favour of sustainable development. The NPPF will provide communities with the tools they need to achieve an improved and healthy natural environment as part of sustainable growth, taking account of the objectives set out in this White Paper. **The Government will consult extensively on a draft of the National Planning Policy Framework later in the summer, and has already invited comments on its content and received responses from a wide range of environmental and other interested groups.**

Offsetting the impacts of development on biodiversity

2.38 The NEA identifies land use change as one of the major impacts on biodiversity in the UK. Development is needed so that communities can grow and expand in a way which suits them and to provide jobs and essential services, but it also has a contribution to make to our overall objective of no net loss of biodiversity.

Definition of 'biodiversity offsets'

Biodiversity offsets are conservation activities designed to deliver biodiversity benefits in compensation for losses in a measurable way.

Good developments incorporate biodiversity considerations in their design but are still likely to result in some biodiversity loss. One way to compensate for this loss is by offsetting: the developer secures compensatory habitat expansion or restoration elsewhere.

2.39 A consistent framework for biodiversity offsetting has the potential to improve the implementation of the requirements of the planning system for biodiversity. It could safeguard biodiversity more effectively, for example, by encouraging the pooling of resources to achieve higher quality compensation. It could also make the process of managing the impacts of development on biodiversity simple for all involved, by providing a straightforward and cost-effective way to assess the impact of a development and to agree the requirements for compensation.

2.40 Biodiversity offsetting should be pursued in line with guiding principles, based on those set out in *Making Space for Nature*. We are clear that offsetting should complement existing habitat designations that are designed to protect our most valuable biodiversity: the current arrangements for managing protected sites remain in place. Offsets should help to expand and restore the ecological network in England. Used in a strategic way they can help to deliver more, better, bigger and joined up networks of habitat.

2.41 Offsetting should be managed locally; the approach taken should be as simple and straightforward as possible. **We will establish a new voluntary approach to offsetting and will test this in a number of pilot areas.** We want local authorities to express an interest in testing this innovative approach. Local authorities in pilot areas will offer developers the option of delivering their biodiversity planning policy requirements through offsetting. We would also like to hear from developers, conservation and community groups and other interested parties who would like to be involved in testing the approach[24].

2.42 We will work with local authorities and others to finalise the details of the test phase, which will start in spring 2012. We will support them through a two-year pilot, until spring 2014. Natural England will work with pilot areas, providing advice, support and quality assurance. The aim is to develop a body of information and evidence, so that the Government can decide whether to support greater use of biodiversity offsetting in England and, if so, how to use it most effectively.

Planning for low-carbon infrastructure

2.43 The new planning system will improve the sustainability of new infrastructure and its capacity to withstand climate change. Through devolved powers, local authorities will be able to work with communities, developers and other stakeholders to judge what fits best in their area, for example rewarding people who generate their own energy.[25]

A sustainable approach to low-carbon energy

The large-scale deployment of a diverse mix of low-carbon energy technologies is crucial for protecting the environment from dangerous climate change. The Government is fully committed to achieving that in line with the projections set out in the energy National Policy Statements and Renewable Energy Roadmap. As well as cutting greenhouse gas emissions, many forms of low-carbon energy can bring additional benefits for the natural environment. Energy from wind, waves, geothermal sources, tides and the sun generally produce very few pollutants compared to fossil fuels. The creation and sustainable management of woodland for energy can provide valuable habitats and suitably located offshore wind farms can offer sanctuaries for some marine species.

Nevertheless, new energy infrastructure (including low and zero-carbon types) of the scale needed has the potential to cause adverse impacts on some aspects of the natural environment, even taking account of appropriate mitigation measures. The Government is committed, therefore, to delivering the level of low-carbon infrastructure needed to cut greenhouse gas emissions, while managing the impacts on the environment. New infrastructure must also be resilient to the impacts of climate change, as outlined in the Government's recent report, *Climate Resilient Infrastructure: Preparing for a changing climate*.[26] The National Policy Statements on energy infrastructure set out the approach for achieving those goals.

In addition, **the Government will work with others to establish a research programme to fill evidence gaps about impacts on the natural environment of the level of infrastructure needed to meet 2050 objectives, in particular with respect to the cumulative and indirect effects**. The research will be used in a strategic way to inform pathways to 2050 and enable informed judgements to be made on the best ways to achieve greenhouse gas benefits, energy security, affordability and protection of the natural environment.

The Government is also introducing sustainability standards for biomass used for heat and electricity to accompany those that apply for transport biofuels. Those standards include protection for designated habitats, highly biodiverse grassland and areas of high carbon stock, such as peatland. We will also introduce emission limits for biomass heat installations to protect air quality. The Government is doing further work to understand more fully the impacts and opportunities from increased demand for bio-energy on the environment, food supply and other sectors that use land and biological material. That evidence will inform a new bio-energy strategy, setting out the role that sustainable bio-energy can play in cutting greenhouse gas emissions and meeting our energy needs.

Restoring the elements of our natural network

2.44 Having set out our vision for nature and our key reforms to the institutional framework, we now turn to improvement of ecosystems across the country. Nature and people thrive where biodiversity flourishes, in living landscapes with healthy soils, water and air. In the following sections, we set out action to create better quality environments through concerted action across our farmed land; woodlands and forests; towns and cities; rivers and water bodies; and at sea.

Getting the best value from agricultural land

2.45 Over 70% of England is farmed. Farmers and land managers play a vital role in achieving society's ambitions for water, wildlife, healthy soil, food production and the management of landscapes. Food security is a long-term challenge; farming needs to be supported in building capacity for sustainable production both in the UK and globally. However, the food chain has major impacts on climate change, biodiversity and the wider environment, which require management.

2.46 The NEA shows that in the past, increases in the productivity of farmed land have resulted in declines in other ecosystem services. One of the major continuing challenges is to increase food production while improving environmental outcomes. Economic and environmental performance presents a mixed picture across many farms, with the potential for significant gains if more land managers bring their performance to the level of the best. We will put in place a clearer and more integrated framework to support farmers to achieve multiple benefits from their land. We need a flourishing natural environment and a competitive, resilient farming and food industry to contribute to global food security. We acknowledge that potential tensions exist

between improving the environment and increasing food production, and this requires all interested parties to work together. **We will bring together government, industry and environmental partners to reconcile how we will achieve our goals of improving the environment and increasing food production. We will publish our conclusions within the next 12 months.**

2.47 In May 2011, the Farming Regulation Task Force published its report. This states clearly that 'maintaining environmental standards is non-negotiable'[27] and identifies that regulation is essential to achieve this. The Task Force made a number of recommendations designed to shift the focus of regulation away from process and towards results. We are considering these recommendations and will publish an interim response in autumn this year, with a final response in early 2012.

2.48 Land managers are often best-placed to identify their own local environmental priorities. The Government is supporting the industry-led Campaign for the Farmed Environment and the Greenhouse Gas Action Plan. Should the goals of the campaign not be achieved, or if progress on the action plan is insufficient, government intervention will be considered instead. **We will use the review in 2012 of both of these voluntary approaches, as well as the evidence from elsewhere such as on pesticides or voluntary action under the EU Water Framework Directive, to assess more generally the effectiveness of this kind of voluntary industry-wide approach.**

2.49 We want land managers to get returns from a range of ecosystem services in addition to those they get from food production. We will work with

Case Study **Environmental Stewardship on Townhill Farm**

Townhill Farm is a 400ha arable farm in west Dorset growing spring barley, and grazed by several hundred sheep and 60 head of cattle. The farm is also home to 40ha of deciduous woodland and a scattering of Roman remains. For the past four years its owner, Hugo James, has had in place a Higher Level Stewardship (HLS) scheme, carrying out initiatives to support native plant and animal life and protect the farm's archaeological sites. The agreement with Natural England is worth £42,500 a year to the farm, but Hugo says his decision to take part in the scheme was more than just an economic one: ***"I felt it would be a good way of securing a core income for the farm but also do some good in the process. The older you get, the more interesting this side of farming becomes."***

One of the main objectives of the stewardship agreement is to encourage wildlife, particularly birds and bats. Hugo has signed up to a number of HLS options aimed at improving habitats for certain species, including the introduction of six-metre-wide margins around most of the farm's arable fields. These are left uncultivated and provide cover and food for birds and small mammals that are hunted by birds of prey. Barn owls are now regularly seen hunting the strips around the edges of the fields.

Elsewhere on the farm, Hugo has introduced a woodland management plan aimed at encouraging the return of native trees such as ash and beech through selective thinning of the invasive sycamores that have taken over many of the copses.

Hugo says the value of HLS for him has been the way in which it has made him more aware of the need to manage his land for the benefit of the flora and fauna found on it: ***"I think it's definitely encouraged me to be more aware of the wildlife on my farm and made me appreciate where I live. When you see a flock of starlings or sparrows get up out of the wild bird strips which were created because of HLS, you think, 'They didn't have that to go to before I made it.'***

the sector to investigate the development of markets for these services. For instance, we will encourage water companies to obtain clean water through working with land managers in their catchments to reduce pollution at source, where it would be more cost-beneficial than procuring or maintaining carbon-intensive treatment infrastructure.

2.50 Public funding must be targeted effectively and efficiently at the provision of public goods. Funding for Higher Level Stewardship (HLS), will grow by over 80% between 2010 and 2014. In addition, we believe that the Entry Level Stewardship (ELS) scheme can yield greater environmental benefits, with better targeted agreements that take advantage of a greater mix of options. **We will work with our delivery partners and stakeholders to develop and pilot an approach to Environmental Stewardship that that increases its focus on outcomes, including the possibility of allowing greater flexibility within agreements in how these outcomes are achieved.** We will also explore how Environmental Stewardship can best contribute to nature restoration through the creation of buffer zones, stepping stones and wildlife corridors as set out in *Making Space for Nature*.

2.51 The Farming Regulation Task Force identified the importance of ensuring that the environmental messages we give to farmers and their advisers are clear and well-prioritised. We have commissioned work to design a more integrated approach to farm advice, and are considering the scope to better integrate the English Woodland Grant Scheme with Environmental Stewardship, to promote a more co-ordinated approach to the provision of financial incentives across our farmland and forests.
In addition, to inform the next period of the Common Agricultural Policy and the next round of catchment delivery plans under the EU Water Framework Directive (2015–21), **we will carry out a full review of how we use advice and incentives for farmers and land managers, to create a more integrated, streamlined and efficient approach that is clearer for farmers and land managers and yields better environmental results.**

2.52 The future role of the Common Agricultural Policy from 2014 to 2020 is key to achieving our ambitions for increasing environmental benefits and food production. More detail is set out in chapter 5.

Protecting and improving our woodland and forests

2.53 Trees, woodlands and forests have a very special place in English culture and have provided us with many of the essentials of life through history. Their health is essential for our wellbeing and prosperity. They shape our landscapes and street scenes. Our choices today will shape our future landscapes, prosperity and wellbeing. Our ambition is for a major increase in the area of woodland in England, better management of existing woodlands and a renewed commitment to conserving and restoring ancient woodlands. Forests and woodlands must play a full part in achieving a resilient and coherent ecological network across England.

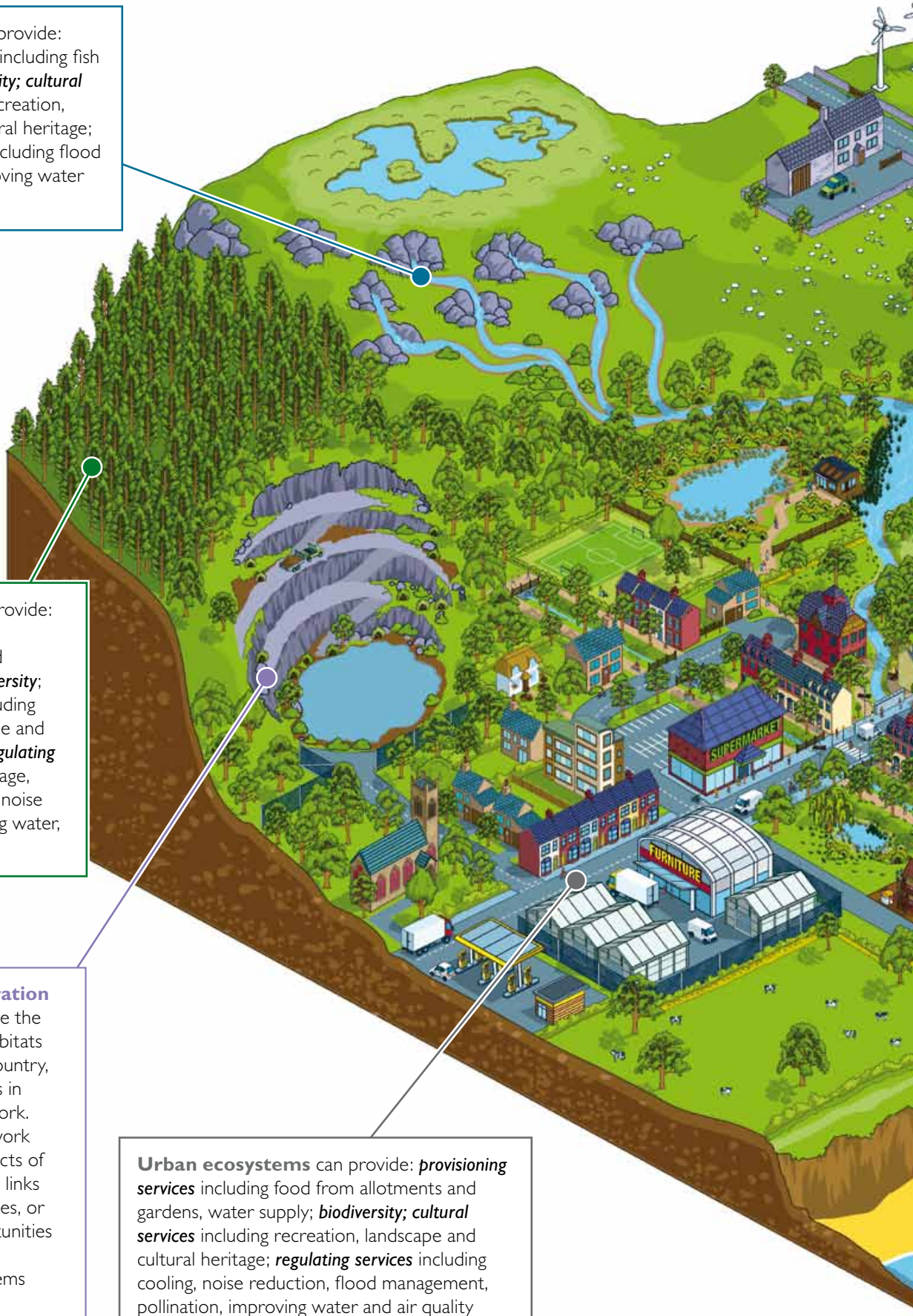
2.54 We want to create more opportunities for planting productive and native woodlands; more trees in our towns, cities and villages; and a much larger proportion of existing woodlands brought into active management. We also want to increase the use of sustainably grown and harvested wood products. Together, this will enhance the wide range of benefits that woodlands provide, including renewable energy and timber, new wildlife habitats and green space for people to use and enjoy, helping us to mitigate and adapt to the future changing climate. It will also increase resilience to climate change, pests and diseases, and help to halt the loss of biodiversity.

2.55 The 2009 "Read Report" [28] identified challenging woodland creation rates of 23,000 hectares per year across the UK. In England this could mean increasing woodland creation rates from 2,300 hectares per year to 10,000 hectares per year over time, with woodland cover increasing from 9% to over 12% by 2060. Since annual planting rates fell between 2004/05 and 2008/09 and government funding is reducing, this would be a significant challenge, requiring new approaches. **The Government welcomes the case that the "Read Report" sets out and has asked the Independent Panel on Forestry**[29] **to provide advice on an appropriate level of ambition for woodland creation and more active management, the mechanisms and market conditions needed and options for ensuring that everyone has the opportunity to experience and enjoy our woodland resource.**

2.56 Approximately one-third of woodland in England is considered 'ancient' (meaning that the land has been wooded for at least 400 years – and probably much longer). Most ancient woods are likely to have been continuously wooded since the Ice Age,

Multiple uses and benefits of the natural environment

Freshwaters can provide: ***provisioning services*** including fish and water; ***biodiversity; cultural services*** including recreation, landscape and cultural heritage; ***regulating services*** including flood management, improving water quality



Woodlands can provide: ***provisioning services*** including timber and water supply; ***biodiversity***; ***cultural services*** including recreation, landscape and cultural heritage; ***regulating services*** carbon storage, flood management, noise reduction, improving water, soil and air quality

Ecological restoration
We need to improve the quality of natural habitats in both town and country, and to plug the gaps in our ecological network. This could involve work to address the impacts of past activities, make links between existing sites, or identify new opportunities to support healthy functioning ecosystems across a landscape.

Urban ecosystems can provide: ***provisioning services*** including food from allotments and gardens, water supply; ***biodiversity; cultural services*** including recreation, landscape and cultural heritage; ***regulating services*** including cooling, noise reduction, flood management, pollination, improving water and air quality

Uplands and grasslands can provide: ***provisioning services*** including energy (in the form of wind power), water supply; ***biodiversity; cultural services*** including recreation, landscape and cultural heritage; ***regulating services*** including carbon storage, flood management, pollination, improving water and soil quality

Farmland can provide: ***provisioning services*** including crops, livestock, energy; ***cultural services*** including recreation, landscape and cultural heritage; ***biodiversity; regulating services*** including carbon storage, flood management, pollination, improving water, soil and air quality

Coasts and seas can provide: ***provisioning services*** including fish; ***biodiversity; cultural services*** including recreation, landscape and cultural heritage; ***regulating services*** including carbon storage, flood management, improving water and air quality

bringing special cultural, heritage and biodiversity value. During the 20th century around one-third of the ancient woodland in England was converted to plantations, but much of the wildlife and many historic features have survived under such crops. Such conversion was stopped in the 1980s and for the last five years there has been a drive to restore plantations on ancient sites to native deciduous species, both on the public forest estate and in woodland owned by others. **The Government is committed to providing appropriate protection to ancient woodlands and to more restoration of plantations on ancient woodland sites (in recognition of their particular value). We have asked the Independent Panel on Forestry for advice on the restoration of open habitats and plantations on ancient woodland sites.**

Diverse and living landscapes

2.57 In England the diversity of our landscapes contributes to our national identity and the distinctive character of our local communities. As our landscapes continue to change to meet the needs of the 21st century they will retain a strong local character across the country. They will reflect the needs and aspirations of local communities, who will have opportunities to shape them through local planning and conservation projects. England's protected landscapes will set the standard for excellence in integrated conservation management. The Government's recently published *Uplands Policy Review* highlighted the great importance of the English uplands for a range of valuable ecosystem services.[30]

2.58 Our landscapes have never been static and they will continue to evolve, reflecting the choices we make as a society. These choices sometimes lead to conflicting demands on our landscapes: for new housing and transport infrastructure, growing food and energy needs, improved flood protection, or increases in forestry. Climate change will also affect how landscapes evolve, both directly and through the land use planning choices we make in response. **We will work with local communities in a number of areas throughout England to support local engagement in landscape planning.**

2.59 We will work with civil society to update and improve the consistency of the national landscape character area profiles and integrate information on the ecosystem goods and services that they provide. Each profile will identify the environmental potential of landscape areas, to inform national policies such as agri-environment schemes and help local communities and planners to make informed decisions about land use.

Safeguarding our soils

2.60 Soil is essential for achieving a range of important ecosystem services and functions, including food production, carbon storage and climate regulation, water filtration, flood management and support for biodiversity and wildlife. Soil degradation as a result of erosion by wind and water, and the loss of soil organic matter and compaction cost the economy at least £150 million–£250 million per year. Soils can degrade relatively rapidly; halting or reversing this degradation or improving the quality of soil is a difficult and lengthy process. A changing climate and our responses to it will magnify these soil degradation threats. Well-managed soils have the potential to capture more carbon in future, and we want to reach a better understanding of this.

2.61 By 2030 we want all of England's soils to be managed sustainably and degradation threats tackled successfully, in order to improve the quality of soils and to safeguard their ability to provide essential ecosystem services and functions for future generations. We are already taking important action, particularly through Environmental Stewardship and through the cross-compliance conditions that claimants of direct payments have to meet under the Common Agricultural Policy.

2.62 However, the relationship between soils and the ecosystem services they provide is hugely complex, and it is often unclear precisely what action is needed to achieve the best results. Consequently, we need to broaden our understanding of soil degradation threats and sustainable management practices by further investing in research and development.

2.63 We will undertake a significant research programme over the next four years to explore how soil degradation can affect the soil's ability to support vital ecosystem services such as flood mitigation, carbon storage and nutrient cycling; and how best to manage our lowland peatlands in a way that supports efforts to tackle climate change. We will use the results of this research to set the direction of future action.

Protecting peat

2.64 In England, horticulture consumes 2.4 million cubic metres of peat each year. Formed over

hundreds of thousands of years, peat is effectively a non-renewable resource. Making the transition to peat-free alternatives would put the industry on a sustainable footing, contributing to our goal of increasing food and other production sustainably and protecting our natural capital. The industry has made progress in reducing peat use in response to a previous voluntary reduction target, but the market is still only 57.5% peat-free. In order to support industry in making increased reductions, we are introducing a new voluntary partnership. The Government is working with industry to unblock barriers to change.

2.65 The long-term aim is for peat use to be reduced to zero. This will contribute to the protection of important lowland peat habitats (both here and overseas) and significant carbon stores, and will promote a shift towards the greater use of waste-derived and by-product materials. Ambitious targets are required to drive action and provide clarity about the long-term direction of policy.

2.66 We want to reduce peat use to zero by 2030, setting the following milestones:

- **a progressive phase-out target of 2015 for government and the public sector on direct procurement of peat in new contracts for plants;**
- **a voluntary phase-out target of 2020 for amateur gardeners; and**
- **a final voluntary phase-out target of 2030 for professional growers of fruit, vegetables and plants;**
- **we will establish a Task Force bringing together representatives from across the supply chain with a clear remit to advise on how best to overcome the barriers to reducing peat use, exploring all the available measures to achieve this goal;**
- **building on the advice of the Task Force, we will review progress towards these targets before the end of 2015 and consider the potential for alternative policy measures if necessary.**

2.67 The support of the retail sector in encouraging consumers to buy peat-free products is essential. We will work closely with the devolved administrations and will push for ambitious but proportionate EU action on peat protection.

Restoring nature in our rivers and water bodies

2.68 A sustainable supply of good-quality freshwater for our economy, society and environment depends on functioning water ecosystems. Rivers, lakes, groundwater, estuaries, wetlands and river corridors provide vital ecosystem services and public benefits. They regulate flooding and local climates, as well as supporting the dispersal of chemicals, energy and organisms between aquatic and terrestrial habitats. Over the longer term, we are faced with increasing challenges as climate change reduces the quantity and increases variability in the quantity and quality of our surface and groundwater, with substantial potential reductions of flows in our rivers in the summer. At the same time, population change and patterns of consumption will lead to rising demands for water.

2.69 By 2050, water bodies in England will be in excellent health, with reduced pollution (nutrients, sediments, chemicals and bacteria). They will sustain rich and abundant wildlife appropriate to their location and will be as resilient as possible to climate change. Water environments will be safe and attractive, supporting a wide range of sustainable uses, including leisure and recreation. Along the way, we aim to increase the proportion of water bodies in good ecological status from 26% now to 32% by 2015; we will then get the majority of our water bodies to GES as soon as possible, and get as many of our water bodies as possible to GES by 2027

2.70 We will reduce the impact of land management on water by ensuring that pollution and flood risk are addressed at source through targeted, risk-based enforcement of existing regulatory instruments and, beyond this, by identifying where land can be managed to deliver multiple benefits, including improving water quality, flood alleviation and biodiversity.

2.71 Agriculture is a significant source of diffuse pollution but it is not the only one; other sources include products used in the home, sewer misconnections and run-off from roads. **We will develop a strategy to identify and address the most significant diffuse sources of water pollution from non-agricultural sources.**

2.72 The Government is committed to protecting water ecosystems to achieve good ecological status through a river basin planning approach under the EU Water Framework Directive. We need to increase the rate of progress towards good ecological status by working at catchment level to involve interested

parties and address the pollution sources that are causing water bodies to fail. Local businesses, citizens and interest groups will play a significant part in determining and implementing the measures needed to achieve long-term improvements.

2.73 We are establishing ten catchment-level partnerships to develop and implement plans for creating and maintaining healthy water bodies. We will also support additional groups who wish to take a lead in trialling a catchment approach. The pilots will establish the right level of spatial targeting to address sources of water pollution and explore the most effective ways to engage partners. The pilots will also aim to establish how best to achieve integrated, multiple environmental outcomes.

2.74 We have announced new funding of £92 million over the next four years to clean up our rivers, including through setting up a dedicated Catchment Restoration Fund from 2012. This will be used to support our objective of coherent and resilient ecological networks through actions to restore habitats tackle diffuse pollution from rural and urban sources, pollution from metal mines and address invasive non-native species. The Environment Agency and Natural England will work in partnership with civil society organisations such as Rivers Trusts. It is expected that over 800 water bodies will be improved and that benefits of around £600 million will be secured.

2.75 We will continue the Catchment Sensitive Farming Initiative, with a programme budget of £18 million for 2011/12. **The Environment Agency and Natural England will work together with farmers to increase the number and appropriate location of Entry Level options under the Environmental Stewardship scheme where there are diffuse pollution problems.** As we learn the lessons from trialling the catchment approach in the pilot areas, we will work with stakeholders to develop new guidance on river basin management planning, setting out the approach to be taken in the second planning cycle from 2015 to 2021.

2.76 Dry spells can lead to low river levels, which can have an impact both on farmers and growers who need to irrigate their crops and on our environment. All water companies are required to plan for secure supplies through their 25-year Water Resources Management Plans and have drought plans that show how they will manage droughts.

2.77 Changes are needed to the water abstraction regime because the current regime is not efficient at protecting the environment and meeting our needs for water. Around 12% of water bodies are unsustainably abstracted, and low water flows are implicated in damaging natural water systems.[31] Without costly action, these impacts will get worse as climate change reduces water availability and population increases drive rising demand for water. **We will reform the abstraction regime. The new regime will provide clearer signals to abstractors to make the necessary investments to meet water needs and protect ecosystem function. We will also take steps to tackle the legacy of unsustainable abstraction more efficiently.** The forthcoming Water White Paper will set out further details.

Ponds and small water bodies

They are often overlooked, but small water bodies such as ponds and ditches play a critical role in supporting ecosystem services (intercepting, storing and routing water and nutrients, transporting and transforming carbon, and supporting biodiversity). Ponds alone support 70% of freshwater biodiversity and more endangered species than lakes, rivers, streams or ditches. Land managers and communities can add diversity to ecological networks in an inexpensive and highly effective way, by creating small clean water bodies across the countryside.

Restoring nature in our towns, cities and villages

2.78 We need urban green infrastructure to complete the links in our national ecological network. Urban green space allows species to move around within, and between, towns and the countryside.

Even small patches of habitat can benefit movement. Urban green infrastructure is also recognised as one of the most effective tools available to us in managing environmental risks such as flooding and heatwaves. It is part of the answer to the challenges posed by a changing climate.

2.79 The NEA highlights reductions in both the quality and the quantity of urban green space over the past half century and identifies the underperformance of urban ecosystems. The benefits of green infrastructure are unevenly distributed throughout society, and one in six urban local authorities says its green spaces are declining.

2.80 We want urban green spaces to be recognised as an essential asset and factored into the development of all our communities. They will be managed to provide diverse functions for the benefit of people and wildlife. They will cool urban areas and reduce flood risk, helping communities to adapt to a changing climate. They will continue to play a key role in regeneration projects throughout England, supporting local economic growth. Greener neighbourhoods and improved access to nature will improve public health and quality of life and reduce environmental inequalities. Urban green spaces will provide varied ecosystem services and will contribute to coherent and resilient ecological networks.

Definition of 'green infrastructure'

Green infrastructure is a term used to refer to the living network of green spaces, water and other environmental features in both urban and rural areas. It is often used in an urban context to cover benefits provided by trees, parks, gardens, road verges, allotments, cemeteries, woodlands, rivers and wetlands.

Green infrastructure is also relevant in a rural context, where it might refer to the use of farmland, woodland, wetlands or other natural features to provide services such as flood protection, carbon storage or water purification. Green infrastructure maintains critical ecological links between town and country.[32]

Around the country local partnerships are seeking to use green infrastructure to drive economic growth and regeneration and improve public health, wellbeing and quality of life. It can also support biodiversity and the functioning of natural systems such as rivers and flood plains and help reduce the negative impacts of climate change.

2.81 Urban green space could be a huge asset both locally and nationally, but is often perceived as a liability, generating concerns about management costs and other risks. There is strong evidence for the economic and social benefits of green infrastructure. To take account of this, appropriate methodologies are needed so that those who may wish to retain or develop green infrastructure locally, such as local authorities, healthcare bodies and businesses, can assess the value for money of local spending on it. In chapter 4 we set out how we will work with civil society organisations, local government and relevant professional bodies to support local areas in planning and developing their green infrastructure.

2.82 Sustainable Drainage Systems (SuDS), which deal with surface water, are designed to mimic natural drainage as closely as possible. They provide an example of green infrastructure and an illustration of opportunities to achieve multiple benefits from the management of land. During the 2007 floods, two-thirds of the homes affected were flooded as a result of surface water. We want to provide opportunities for communities to shape and manage their environment to reduce their exposure to flood risk, release capacity in the sewer and improve water quality. Well-designed systems can increase habitats for biodiversity and provide additional green space for communities to enjoy, as well as increasing the resilience of built areas to a changing environment.

2.83 The Flood and Water Management Act 2010 includes provision to increase the uptake of such systems in new developments and redevelopments. In addition, we want to encourage existing communities to 'retrofit' sustainable drainage in their gardens and neighbourhoods. The creation of public wetlands, rain gardens and community ponds, and the use of permeable paving, which allows water to drain away, can play a role. Properly designed, they can improve neighbourhood amenity and create new wildlife habitats. The Act provides a framework for the management and maintenance of community schemes. The forthcoming Water White Paper will consider mechanisms to encourage the retrofit of SuDS on both community and individual property scales.

2.84 England is a nation of gardeners. It is estimated that 22.7 million households (87% of homes) have access to a garden. Waiting lists for allotments are long and demand continues to grow. Gardens cover up to a quarter of the land surface in our towns and cities (a total area of 432,924 hectares) and contain about 3 million ponds and 28.7 million trees, almost a quarter of all trees outside woodlands.[33] They support

a wide range of plants and animals and support ecosystem processes such as pollination and organic matter recycling in soils. One study identified 2,673 different species in a medium-sized garden.[34]

2.85 Gardeners can do more for nature by adopting environmentally friendly practices, such as switching to alternatives to peat. By co-ordinating gardening efforts to create a network of interlinking habitats across neighbourhoods, biodiversity can be greatly enhanced in towns and cities.[35] Increasing the opportunities for natural drainage in our own back gardens reduces the risk of flooding locally and improves water quality. We want people to have easy access to the information they need in order to garden in a wildlife-friendly way and we want to promote sustainable wildlife-friendly gardening as widely as possible. The Big Wildlife Garden established by Natural England has successfully demonstrated the power of individual action in creating wildlife-friendly gardens. **We will provide funding to support the Big Wildlife Garden scheme. Backed by the Royal Horticultural Society and The Wildlife Trusts, the scheme will support a major national competition for Wildlife Garden of the Year, open to homes, schools and communities. It will also develop a definitive online guide for wildlife gardening, providing advice for gardeners of all levels and abilities.**

2.86 The natural areas at the edges of our strategic roads and railways cover approximately 60,000 hectares. Better management of these green corridors could connect and enhance fragmented habitats. **The Government will work with its transport agencies and key delivery partners to contribute to the creation of coherent and resilient ecological networks, supported, where appropriate, by organisation-specific Biodiversity Action Plans. We will host a forum with environmental stakeholders to inform future priorities for the enhancement of these green corridors.**

Managing our marine environment

2.87 Our seas have shaped our history and form part of our national identity. They provide a wide range of ecosystem services, including the inspiring beauty of our coasts, a wealth of diverse habitats and species, places for recreation and enjoyment, the livelihoods of many communities and a potentially sustainable source of healthy food. We want our seas to be clean, healthy, safe, productive and biologically diverse. Our aim is for resources to be used sustainably and to be able to adapt to dynamic coastal processes. A well-managed network of marine protected areas will be in place, with restored ecosystems. Populations of all commercially exploited fish and shellfish will be within safe biological limits, with age and size characteristics of healthy stocks. Along the way, we will achieve good environmental status for our seas under the Marine Strategy Framework Directive.

2.88 Much has been done in recent years to protect our seas and marine resources, and the state of the UK seas is improving. Through the Marine and Coastal Access Act 2009, our seas have become a global exemplar of marine conservation. We are leading the world in developing a marine planning system and in encouraging socioeconomic activities such as fishing to be seen as part of the solution to the environmental challenges that our seas face. However, there is still much to be done to achieve our vision. **The Government is committed to achieving good environmental status across England's marine area, working in partnership with those who use, enjoy and derive their income from the marine environment.**

2.89 We are committed to an ecosystems approach to management in the marine environment, ensuring that marine resources are used sustainably and are managed in an integrated and holistic way.

The Marine and Coastal Access Act 2009 provides a framework that will enable our seas to be managed sustainably through a marine planning system based on the participation of stakeholders, communities and decision-makers. The Act introduced Marine Conservation Zones to improve protection and conservation of marine biodiversity, forming part of the UK's ecologically coherent network of Marine Protected Areas. The marine nature conservation provisions of the Act are estimated to provide between £749 million and £1.6 billion of annual environmental benefits. Four regional projects, involving national and regional stakeholders, are identifying sites of Marine Conservation Zones using the best available evidence, and an independent Science Advisory Panel has been appointed.

2.90 The Government has set the strategic policy framework through the UK Marine Policy Statement, adopted in March 2011. In England, the Marine Policy Statement will inform the development of ten marine plans covering the English inshore and offshore marine planning regions. Marine plans will integrate economic development, social need and ecosystem management and will guide all decision-makers when making any decision that affects or might affect the marine area. **The first two marine plans to be prepared will be in the East of England inshore and offshore marine plan areas and will be completed by 2013. We will have plans in place for the whole of the English marine area by 2022.**

3 Growing a green economy

Ambition

Our ambition is for a green and growing economy which not only uses natural capital in a responsible and fair way but contributes to improving it. It will properly value the stocks and flows of natural capital. Growth will be green because it is intrinsically linked to the health of the country's natural resources. The economy will capture the value of nature. It will encourage businesses to use natural capital sustainably, protecting and improving it through their day-to-day operations and the management of their supply chains.

The key reforms for growing a green economy are:

- **a new independent Natural Capital Committee**, to put the value of England's natural capital at the heart of our economic thinking (paragraphs 3.10–3.13);
- **inclusion of natural capital in our national accounts**, to capture nature's value in how we measure economic progress (paragraphs 3.7–3.9);
- **actions to support the creation of new markets for green goods and services**, expanding the opportunities for UK business (paragraphs 3.24–3.30); and
- **new support and guidance for businesses**, to promote responsible use of natural capital (paragraphs 3.31–3.39).

3.1 The Government's priority is to restore the economy to strong, sustainable and balanced growth.[36] In the introduction, we highlighted the essential role a healthy natural environment plays in our economy. Businesses and our economy rely on natural capital both directly and indirectly. It directly provides materials and resources such as timber, plant extracts and water. It indirectly provides services and processes which the economy benefits from, such as pollination, natural hazard protection and water purification. Natural capital comes both from within England and overseas. Like any financial asset, it needs to be properly defined, managed and protected in order to continue to provide benefits. Over the past, our natural capital has been depleted; unless action is taken, it is likely to be degraded further in future. The same is true of the global natural capital on which the UK depends.

3.2 The National Ecosystem Assessment (NEA), the Economics of Ecosystems and Biodiversity (TEEB) study and other studies highlight the significant economic and social costs of depleting our natural capital; they also demonstrate the economic benefits of looking after it. In the long term, managing natural capital sustainably leads to higher economic growth. There are unambiguous long-term benefits of green growth. Projections made by the United Nations Environment Programme[37] show that global investment in greening the economy will result in higher growth than an equal amount of 'brown' investment within 5-10 years. Green growth policies seek to maximise growth opportunities as well as minimise any costs to the economy in the short term from adjusting. The move to green growth will result in new green jobs being created, but also in 'brown' jobs being replaced or greened.

3.3 If we protect our natural resources, businesses stand to gain from more secure supplies of natural materials and will save money by using them more efficiently. Our economy will gain from jobs and businesses that are more resilient to pressures on the environment. By properly capturing the value of natural resources, our economy can avoid over-use of those resources and reduce the threat of instability in prices. Nature itself also stands to gain from an economy which better reflects its real value, and from businesses, consumers and investors who have a real incentive to protect and improve the environment. We will create a green economy in which we gain all the economic benefits available from using natural capital sustainably and improving it. We will restore natural capital where it is degraded in order to improve this country's economic wellbeing.

3.4 This is a long-term goal and the transformation cannot be achieved overnight. The Government cannot do this alone; businesses and wider society must also play their part.

3.5 The value of natural capital is often taken for granted; its value is not captured in the prices we pay, in the way goods are bought and sold, or in the accounts of businesses. As a result, natural capital is used without due thought and becomes scarce, depleted or lost altogether. The Government is committed to putting this right. To achieve a green and growing economy, we need to capture the real value of nature. This chapter sets out actions to do that – by putting it at the heart of our economic planning, national economic measures and a greener tax system; by working with business to expand greener markets and support greener action by businesses; and by capturing nature's value in government policy appraisal and operations.

Putting natural capital at the heart of a green economy

3.6 The Government is committed to putting the value of natural capital at the heart of our economic thinking, and the way we measure economic

progress nationally. Such action will be a catalyst for wider change, and put us on a course for a greener economy, with benefits for all.

Capturing the value of nature in our nation's account

3.7 Our economy's GDP only tells part of our economic story . In November 2010 the Prime Minister announced that the Office for National Statistics (ONS) would include wellbeing indicators to help guide national policy. In his speech Mr Cameron talked about a shift to *'measuring our progress as a country not just by how our economy is growing, but by how our lives are improving… not just by our standard of living, but by our quality of life'*. As part of this we must also account nationally for our natural capital. Economic losses and gains resulting from natural capital ought to be properly recorded. This includes changes to the value of physical environmental assets, such as fish stocks or forests, and also to the value of natural services provided by a healthy ecosystem, such as insect-borne pollination of crops. The Government will take action to capture the value of natural capital on the nation's balance sheet. In doing so, we will end the situation where gains and losses in the value of natural capital go unrecorded and unnoticed.

3.8 We will put natural capital at the heart of government accounting. We will work with the Office for National Statistics to fully include natural capital in the UK Environmental Accounts, with early changes by 2013. In 2012 we will publish a roadmap for further improvements up to 2020. Over time, we will move from measuring the value of the physical stocks to systematically valuing the services they provide. Further research will be undertaken to do this, building on the results of the NEA.

3.9 We will also strengthen international efforts to value natural capital, including it in the agreed international standards for producing national accounts. We will contribute to the update of the UN's System of Integrated Environmental and Economic Accounting. We will also support the World Bank's Global Partnership for Wealth Accounting and the Valuation of Ecosystem Services (WAVES), which will look at the feasibility of including changes in the value of ecosystem services in measures of economic performance.

Capturing the value of nature in our economic planning

3.10 Action must now be taken to put natural capital at the heart of economic planning. In moving to a green economy, we must compare and balance the costs and benefits of different actions, just as we are doing in moving to a low carbon economy. Some actions on climate change will save carbon and money at the same time, while others will save large amounts of carbon but come with a large price tag for businesses or our economy. Some actions need to happen now because they take time to establish or because they are cheaper now, while others can be taken on a longer timescale. Tensions sometimes exist between short-term costs and longer-term gains. Choices must be made about the priorities for investment to improve natural capital, based on the best possible returns.

3.11 It is important that our economic policy makes these choices based on strong evidence. Only then can the nation be confident that it is using natural resources sustainably enabling them to grow alongside the economy. **The Government will establish an independent Natural Capital Committee, reporting to the Economic Affairs Cabinet Committee which is chaired by the Chancellor of the Exchequer. The Committee will advise the Government on the state of English natural capital.** Firstly, it will provide advice on when, where and how natural assets are being used unsustainably. Secondly, it will advise the Government on how it should prioritise action to protect and improve natural capital, so that public and private activity is focused where it will have greatest impact on improving wellbeing in our society. Finally, it will advise the Government on research priorities to improve future advice and decisions on protecting and enhancing natural capital.

3.12 Part of this work will be to check which parts of our natural capital are in good condition and which are likely to decline. To support the initial work of the Natural Capital Committee, **the Government will take forward a scoping study in 2011 for a natural capital asset check.** This will build on the NEA and respond to a government economics review which cited this as an important element of assessing the sustainable development implications of individual policies.[38]

3.13 In the transition to a green economy, business requires greater clarity about the Government's longer-term proposals. **Later this year, the Government will publish a 'Roadmap to a Green Economy', to provide business with as much clarity as possible about the future direction of policy.** The roadmap will encourage the right conditions for businesses to become greener, highlighting potential opportunities and challenges for

different sectors. It will promote green innovation and green skills, following up *Skills for Sustainable Growth*, published in November 2010.[39]

Capturing the value of nature in greener taxes

3.14 The potential for greater use of environmental taxes to deliver better environmental and economic outcomes is recognised in the Government's commitment to increase the proportion of revenues accounted for by environmental taxes. Market-based instruments such as taxes and trading systems are an efficient and cost effective way of pricing in the value of environmental resources.

3.15 However, an environmental tax will not be the most appropriate policy instrument in every circumstance. For example, when the environmental risks are large, when options for tackling a problem are limited, or when the problem is fairly specific, direct regulation could be more effective. Taxes will therefore be developed in the context of wider Government levers, such as voluntary agreements and regulations, avoiding overlap of policy instruments. This approach will provide a simple, efficient and cost effective framework to meet environmental objectives while supporting growth and maintaining a sound fiscal position. The Government will use environmental taxes where appropriate to cost effectively deliver improved environmental outcomes. Creating efficient markets and pricing environmental resources correctly is essential for the transition to green growth.

Working with business to capture the value of nature

3.16 Government alone cannot create a greener economy. The right conditions must be created to develop a greener market which trades in natural goods and services sustainably. In addition, the Government has already committed to establish a new Green Investment Bank, which it will capitalise with £3bn funding. This new institution will make a radical contribution to increasing private sector investment in green infrastructure, including from new types of investor. It will need to comply with state aid rules and be approved by the European Commission before it can be established. In order to make rapid progress, from April 2012 the Department for Business, will start to make direct, state-aid compliant investments in green infrastructure projects. Over time, the Government will look to grow the GIB and will enable it to have borrowing powers from 2015-16 and once debt is falling as a percentage of GDP. Once state aid approval is achieved, the Government will move to enshrine the enduring nature of the GIB in legislation. Business has a vital role in seizing new opportunities to trade green goods and services which benefit nature. Businesses can also benefit from using natural capital more sustainably in their supply chain, and protect the natural capital upon which our economy as a whole depends.

Government and business working together in partnership

3.17 Government and business share an interest in protecting and developing natural capital, and must work together. Managing natural capital properly is in the national interest and the country's economic security; it can also lead to better profits for business. Businesses and government each have important responsibilities to address the impacts of economic activity on natural capital. As we develop our understanding of the issues, there are important questions about the balance of the responsibilities between:

- taxpayers and consumers, in paying for the protection of valuable natural capital;
- the role of business in setting and meeting environmental standards for products in their supply chains and the role of government in regulating for product standards; and
- the role of business, government or others in marshalling evidence about how the activities of business supply chains affect natural capital.

3.18 To support a collaborative approach, **we have established a Green Economy Council with leading businesses, which will consider natural capital in its terms of reference**. In addition, **the Government will support a new international coalition of businesses and business organisations to follow up on the *TEEB for Business* report.**[40] **The TEEB for Business coalition will catalyse and co-ordinate action by helping participating businesses from the UK and elsewhere to understand and address their environmental impacts.**[41]

3.19 The new industry Product Research Forum will present a further opportunity to talk to business about its role in protecting natural capital. The forum, which is co-ordinated by the Waste and Resources Action Programme (WRAP), will agree key environmental metrics, establish a methodology and gather data on reducing product-related

Case Study **Business: bringing green infrastructure to the centre of London**

The Victoria Business Improvement District (BID) is a business-led group established to improve the area of SW1. The partnership want to address a range of environmental challenges including surface-water flooding during heavy rainfall, uncomfortably high temperatures during heat waves, and visitor and employee perception of the quality of the area. Their 5-year ambition is to boost the local economy, improve the area for residents, workers and visitors and enrich its sense of place.

The partnership commissioned a study which identified opportunities to introduce green roofs, rain-water gardens, green walls, and trees and plants at street-level. All in all it found potential to create 25 hectares of new green space. Natural England, the Greater London Authority and the Environment Agency are supporting the group's ambitions.

This initiative demonstrates the potential to harness the enthusiasm and dynamism of the private sector, together with the expertise and advice of the public sector, to transform the environmental quality of an area, build its resilience to climate change and deliver benefits for people, business and biodiversity. Ruth Duston, CEO Victoria BID says: *" The increase in green infrastructure will not only benefit the environment but also the workers, residents and visitors that come into Victoria on a daily basis."*

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environmental impacts. It represents an opportunity for government and industry members to collaborate in order to understand and reduce the environmental impacts of grocery and home improvement products.

3.20 Government and industry have been working together for many years to develop and implement voluntary agreements to improve the environment; examples include the Courtauld Commitment. We want to extend this collaborative approach to natural capital. **We will work with business to consider how voluntary approaches could work on key products or natural assets, learning from existing voluntary deals on other environmental issues.**

3.21 At the local level, we are supporting proposals to establish Local Enterprise Partnerships (LEPs). LEPs will provide the vision and strategic leadership to drive sustainable growth, innovation and job creation. As set out in the Local Growth White Paper, they will play diverse roles, reflecting differing local priorities in different areas. LEPs have a key role in securing a green economy locally where economic activity should use natural capital sustainably; local economic growth should be increased by enhancing natural capital. In chapter 2 we highlighted the importance of good local links between LEPs and Local Nature Partnerships.

3.22 High-quality green infrastructure can also drive local economic growth and regeneration. **We will work with local authority partnerships through the Total Environment initiative to identify and address barriers to using green infrastructure to promote sustainable growth, and share the lessons learned.**

3.23 Environmental regulation has an important place in securing long-term economic and social benefits for our economy, by protecting our natural environment. Regulation should only be used where necessary and only where success cannot be achieved by other means. It should be implemented in a proportionate, consistent, transparent and targeted way. It should not impose additional costs on businesses unless a compelling case is made. The Government is running the Red Tape Challenge to harness the experience and ideas of those most affected by regulation.

Growing business opportunities that pay back to nature

3.24 Under Environmental Stewardship schemes, the Government pays farmers on behalf of the public for the benefits that environmentally friendly farming generates. There are now real opportunities for land managers to gain by protecting nature's services, and trading nature's benefits with businesses, civil society and

the wider public sector. Payments for nature's services are also a means of opening up markets and establishing a better market value for ecosystem services. There is potential for significant growth in such markets, including those where demand is driven by environmental targets and regulation (e.g. where business payments to manage forests are being stimulated by the need to meet climate change targets).

3.25 New types of voluntary contract can also benefit business and the environment. For example, a water company might pay a farmer for protecting the ability of uplands to naturally clean and filter water. This provides a cheaper option to the water company and the customer than building an expensive water-cleaning plant downstream. It is a better deal for the business, the customer, the land manager and nature itself.

3.26 The Government has a role here in helping to raise local awareness of opportunities and reducing the costs of putting them into practice. **We will publish an action plan in 2012 to expand schemes in which the provider of nature's services is paid by the beneficiaries, after undertaking a full assessment of the challenges and barriers. We will introduce a new research fund targeted at these schemes and will publish a best practice guide for designing them. We will also encourage pilots to develop across a broad spectrum of nature's services and beneficiaries.** Developing new schemes and pilots will be important to demonstrate 'proof of concept' and help scale up these initiatives. This will complement proposals set out elsewhere in this White Paper on supporting Nature Improvement Areas and catchment water management pilots.

3.27 Potential opportunities for greener markets go beyond local payments for ecosystem services. More customers than ever want to make greener purchases.[42] Globally, markets for nature's services could increase from their current level of around £65 billion annually to over £1,025 billion by 2050.[43] Just as

Case Study **Payments for ecosystems services: improving water quality**

The Sustainable Catchment Management Programme (SCaMP) was devised to ensure the sustainable environmental management of 20,000 ha of water catchment land under United Utilities' ownership in the North West of England.

Much of the land has Site of Special Scientific Interest (SSSI) status but over recent decades industrial pollution, drainage installed in the moorland peat, wildfires and agricultural practices have all had a negative environmental impact, affecting the wildlife value of the site. This has contributed to increased discolouration and pollution of water drawn from the catchment, which has to be removed through treatment processes.

Working in partnership, United Utilities, the Royal Society for the Protection of Birds (RSPB) and local farmers have developed an integrated approach to managing the land in order to improve the quality of the water abstracted for drinking, as well as enhancing biodiversity and providing an enhanced source of income for tenant farmers. In time healthy peat vegetation will absorb and store vast amounts of carbon and help mitigate the impact of climate change.

The programme has been designed to improve the natural environment in catchment areas and

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reduce the need for 'end of pipe' water treatment. Reducing the deterioration of raw water quality at its source could reduce treatment costs and the need for future capital investment by water companies. This could benefit water customers through cheaper bills in the long-term. The cost of the project was split between United Utilities (£8 million) and a government grant (£2.7million).

Bryan Homan, Head of Catchment Operations, United Utilities says: ***"SCaMP is an innovative long-term catchment management scheme that unites both private and public funding. It is showing early signs of success at improving raw water quality whilst providing a multitude of community and environmental benefits."***

we now have a carbon market which rewards people for reducing emissions, there may be opportunities to establish other markets which help manage natural resources or services. Trading those resources could reward those who protect or improve them. As prices and markets increasingly reflect the value of natural capital, investors will look for new opportunities to make a financial return from investing in activities that improve natural services.

3.28 We want to gain the maximum benefit for UK businesses from new market opportunities which protect and improve natural capital. **The Government will set up a business-led Ecosystem Markets Task Force to review the opportunities for UK business from expanding green goods, services, products, investment vehicles and markets which value and protect nature's services. It will report back to government in 2012/13 through the Green Economy Council.**

3.29 The study will look at the drivers and barriers to greener markets' growth in the short to medium term, including expected developments in international and European environmental policy. It will highlight areas of comparative advantage for UK business. It will look at the potential for the financial sector to market new products which invest in natural capital and services to provide a return for investors and nature alike. It will also look at whether markets have the required information to function properly and grow, for example to compare and verify the standard of products provided. **Following the Task Force report we will explore how best to drive forward the potential and help remove barriers to their development.**

3.30 All of these commitments will place the UK at the forefront of other national efforts to expand greener markets benefiting nature's services. They will help UK business make the most of global business opportunities relating to ecosystem markets.

Helping business capture the value of nature through responsible supply chains

3.31 All businesses manage resources and many already fully grasp the environmental and economic benefits of efficiency measures such as saving water. Some are already taking action to manage their resources more efficiently. For example, over the last decade, many businesses made significant progress in measuring their greenhouse gas emissions, partly

Case Study **Environmental Profit and Loss Accounting**

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Puma, a sport and lifestyle company, has worked with a consultancy firm (PricewaterhouseCoopers) and environmental research group (Trucost) to calculate the impact of its business on nature. This has been published as the first results of Puma's 'environmental profit and loss account' which show the monetary value of Puma's impact on the environment in regards to greenhouse gas emissions and water consumption along the entire supply chain. Puma calculates that in 2010 the combined environmental cost of the carbon emitted and the water used - from raw materials production to the shop floor - was £80.9m. The company has a target to reduce its carbon emissions, energy and water use by 25% by 2015. The next phase of this work will examine the impacts of acid rain, waste and land use change, among others.

The company believes that calculating these impacts will help them reduce costs and develop a more sustainable and resilient business model by safeguarding the resources and ecosystems services on which it relies for long term success.

Puma's Chief Executive Jochen Zeitz says of the project: ***"the business implications of failing to address nature in decision making is clear - since ecosystem services are vital to the performance of most companies, integrating the true cost for these services in the future could have significant impacts on corporate bottom lines."***

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Sustainable sourcing: palm oil

Palm oil is the world's cheapest and most consumed vegetable oil and a major global agricultural commodity. It is used in food, in animal feed, as cooking oil and in the production of biodiesel and in cosmetic goods. Supply chains are complex, with palm oil being processed into many different fractions, each of which is used by different manufacturers for different purposes. While palm oil is a valuable resource with a clear economic value, the impacts of the palm oil trade on other natural capital assets such as tropical forests, biodiversity and protected species means that the overall value of this commodity could in fact be negative. This also applies to other commodities such as cotton and soy.

According to research by the UN Environment Programme, the expansion of palm oil production is a significant cause of peatland drainage across Indonesia and tropical forests and wetlands destruction in South East Asia. These are ecosystems of the highest biodiversity value in the world. The palm oil sector is also linked to land conflict as the interests of politicians, plantation companies, indigenous peoples and resettled communities collide. Business has taken action through the Roundtable on Sustainable Palm Oil (RSPO), developing principles and criteria for sustainable palm oil production and beginning a certification process for sustainably produced oil. In addition, leading retailers and buyers have made commitments to source 100% RSPO certified palm oil by 2015. The challenge now is to increase demand for sustainable palm oil.

in response to private initiatives such as the Carbon Disclosure Project.[44] The international scientific community has developed internationally recognised methodologies for measuring emissions in the Greenhouse Gas Protocol.[45] Meanwhile, the Water Disclosure Project found that 60% of firms that responded are setting performance targets on their water use.[46]

3.32 However, there is more to be done. The Government believes there is scope for businesses to improve their performance in relation to managing their impacts on natural capital, following the example of leading businesses that are already doing so. The Government's recent report, The *Further Benefits of Business Resource Efficiency*,[47] concluded that UK businesses could save around £23 billion per year by reducing waste and minimising resource use. These are no-cost or low-cost measures which pay back any investment in less than a year.

3.33 Reducing waste, and managing waste that cannot be prevented more sustainably through increasing levels of reuse and recycling, will also help to reduce our impact on the natural environment whether at home, at work or on the move. By being less wasteful in our use of resources, and managing our waste according to the hierarchy set out in the Waste Framework Directive, we can reduce both our demands on finite virgin materials and our impacts on ecosystem services and carbon. Later this year, the Government will publish its Review of Waste Policy, setting out a long-term direction for waste policy and the key actions needed to move towards a 'zero-waste' economy, in which our resources are fully valued and as little as possible is wasted. Sustainable management of our waste and resources is key to environmental protection, while also saving money for government, households and businesses.

3.34 There are other strong drivers for business action. The use of some natural materials causes serious problems either because of extreme pressure on their availability or because the commodity causes huge environmental damage where it is sourced. The Government's recently published report on resource risks faced by UK businesses highlighted that some natural resources which are important to business will become increasingly scarce.[48] Fish and palm oil are examples of natural capital already under pressure, with major implications for businesses, the economy and nature.

3.35 Businesses will need to measure their environmental impacts in order to compete

successfully in a greener market. For some companies, especially smaller ones, measuring the impacts on natural capital through the supply chain can be difficult. On some issues, the nature of the impact will vary according to local conditions. For example, the natural capital cost of water taken from south-east England during a drought is greater than that for water taken from Northern Scotland in a wet winter. Cotton is a thirsty crop and its natural capital cost depends on the availability of water in the countries where it is grown, as well as on the farming method, such as the levels of pesticides used. Alternative uses for land on which cotton is grown – for example as a habitat for threatened species – must also be taken into account. We will make available the evidence businesses need to understand the impacts of their supply chain on natural capital, so that they can identify priorities for action. **We will develop an agreed approach to water footprinting by December 2012, working through the Product Research Forum.**

3.36 Once businesses have measured their own impacts on natural capital and that of their supply chains, they can take positive action, harnessing their purchasing power to demand higher environmental standards from their suppliers. Many businesses are already doing this and we welcome the leadership they have shown. To support this action **we will update the Business Link website to provide information on natural capital, including guidance on tools and resources businesses can use to assess their dependencies on environmental assets and services and identify growth opportunities**. This builds on an extensive range of resources and tools on natural capital which can help businesses identify key issues and take action where necessary (see the box below). For example, the World Business Council for Sustainable Development has recently published a *Guide to Corporate Ecosystem Valuation* to help companies measure and manage their environmental impacts.[49]

3.37 The Government will publish new guidance for businesses by 2012 on how to measure and report their corporate environmental impacts. This will complement existing government guidance on how to report on greenhouse gas emissions and will follow the same step-by-step approach to ensure consistency and encourage those not already reporting. It will cover key areas such as water use and waste minimisation as well as impacts on natural resources and biodiversity. The guidance will aim to be consistent with international guidance and conventions where these exist.

Existing tools for natural capital

The Corporate Ecosystem Services Review[50] is a list of tools businesses can use to assess their links to ecosystem services. It suggests five steps for performing an ecosystem services review and includes an analytical framework, case examples and suggestions for each step.

CEO Briefing: Demystifying materiality: Hardwiring biodiversity and ecosystem services into finance[51] is a briefing on the links between biodiversity and ecosystem services, risks and financial services. It also discusses business opportunities and gives examples of real cases of embedding biodiversity and ecosystem services in the strategy of financial institutions.

How To: Manage your supply chains responsibly[52] explains why responsible supply chain management is vital for business and provides a step-by-step approach to addressing the economic, environmental and social issues that arise in supply chains.

Mapping of Business Tools and Methodologies for Managing Biodiversity[54] describes tools and methodologies available to businesses to manage their biodiversity impacts using a sector-specific approach.

Measuring Corporate Impact on Ecosystems: A comprehensive review of new tools[55] highlights the importance of integrating new environmental parameters within corporate decision-making and presents a comparative analysis of tools for corporate ecosystem assessment.

Accounting for Sustainability Project and the ***Connected Reporting Framework***[56] aim to develop systems that will help organisations embed sustainability considerations into their decision-making and integrate it effectively into their mainstream external reporting.

The Global Reporting Initiative[57] provides guidance for both public and private sector organisations on reporting on their sustainability performance.

3.38 Products that are manufactured or sold by businesses can have significant impacts on natural capital. Impacts depend on the materials used in the products, and the ways in which the products have been designed, prepared, distributed and disposed of. The Government's source of technical advice and practical expertise on improving resource efficiency in England is the Waste and Resources Action Programme (WRAP). WRAP will continue to advise businesses and government on the efficient and sustainable use of natural resources.

3.39 Environmental and sustainability standards have been developed and publicised for a huge range of products. Some are product-specific, such as those for legal and sustainable timber, fish and palm oil. Some apply across product groups, indicating that they are fairtrade, organic or water or energy-efficient. These types of standards are supported by green product labels which can inform business and government procurement policies and also help shoppers make better decisions on what to buy. The Government has a role in regulating minimum standards which remove the most damaging products from the market. **We will work with the EU Joint Research Council to develop evidence on the environmental impacts of products and their supply chains, and to consider future developments in minimum standards under the EU Ecodesign Directive.**

Government leading by example

3.40 The Government is committed to valuing nature in its policy-making. This is part of our approach to mainstreaming sustainable development across government. The Minister for Government Policy will hold departments to account for mainstreaming sustainable development through the quarterly review of business plans.

3.41 Incorporating the value of nature in policy impact assessments is a key part of this process. Departments must produce impact assessments to assess the need for and likely effects of proposed policy interventions. **As part of our approach to mainstream sustainable development, the Government will fully consider the value of nature in all relevant Impact Assessments.**

3.42 HM Treasury guidance on policy and project appraisal already highlights the importance of aiming to identify all environmental costs and benefits. **Later in 2011, we will publish new supplementary guidance to HM Treasury's Green Book for use by all Government Departments on valuing the natural environment in appraisals.** This will cover techniques for monetary and non-monetary valuation and the need to take into account values from individuals, communities, businesses and other interested parties when undertaking environmental valuation.

3.43 We will meet the new Greening Government commitments replace the Sustainable Operations on the Government Estate targets from 2011/12 and will extend their scope and ambition, making procurement of goods and services more sustainable while continuing to deliver value for money. **The Government will buy products that bring good value for money for the public purse, whilst being more sustainable and efficient. Government will engage with its suppliers to understand and reduce the impacts of its supply chain. We have therefore committed to embed the Government Buying Standards in departmental and centralised procurement contracts.** These standards set out sustainable criteria to be followed when buying priority products and services. We are also committed to publish data on our supply chain impacts, initially focusing on carbon, water and waste and setting baselines for reducing these impacts.

3.44 Our leadership must stretch beyond its headline commitments – extending, for example, to the way we promote and conserve biodiversity on our estate and the standards we set for construction projects. We are committed to promoting good forest management by purchasing only timber and timber products either from independently verified legal and sustainable sources or from a licensed Forest Law Enforcement Governance and Trade partner. **Departments will be open about the steps they are taking to address biodiversity and the needs of the natural environment, including actions to:**

- **promote, conserve and enhance biodiversity; and**
- **reduce the environmental impacts of food and catering services.**

4 Reconnecting people and nature

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Ambition

Our ambition is to strengthen the connections between people and nature. We want more people to enjoy the benefits of nature by giving them freedom to connect with it. Everyone should have fair access to a good-quality natural environment. We want to see every child in England given the opportunity to experience and learn about the natural environment. We want to help people take more responsibility for their environment, putting local communities in control and making it easier for people to take positive action.

The key reforms for reconnecting people and nature are:

- **improving public health locally**, by making high-quality green space available to everyone (paragraphs 4.5–4.13);
- **action to get more children learning outdoors**, removing barriers and increasing schools' abilities to teach outdoors (paragraphs 4.14–4.20);
- **new Green Areas Designation**, empowering communities to protect local environments that are important to them (paragraphs 4.23); and
- **help for everyone to 'do the right thing'**, at home, when shopping or as volunteers (paragraphs 4.37–4.51).

> "No one will protect what they do not first care about.[58]
>
> **Sir David Attenborough, 2010**

4.1 Our natural environment gives us a sense of place, pride and identity. Nature inspires and moves us. Connecting with nature helps children learn, and improves people's health and wellbeing. We know instinctively that we have much to gain by connecting with nature, but evidence points to an increasing disconnection. Our society is bearing the costs. Less outdoor activity and reduced contact with nature have negative consequences for public health and society. Some people have fewer opportunities than others to access a good-quality environment for their personal benefit. More people must have the opportunity for a lifelong connection with nature.

4.2 Nature benefits humans. This is also true in reverse. While the natural environment can do much to benefit our health and education and make our daily lives happier and richer, we also have an opportunity to protect and improve it. And we have a responsibility to do so if we want to continue to enjoy it. The Big Society has a very important role to play in protecting and improving our natural environment. We need to unleash the potential of citizens, neighbourhoods, communities and civil society.

4.3 Voluntary outdoor action to improve wildlife areas or clean up our beaches is important stewardship. But people can also connect through the choices they make in their everyday lives. Everyone has an important contribution to make – as shoppers, householders and gardeners, and as part of neighbourhoods and communities.

4.4 In our public consultation for this White Paper, people emphasised that they want to connect with nature: to enjoy it and protect it. They also highlighted the barriers, such as the demands on their time, a lack of information about local opportunities, and a need for expert advice for some types of local action. The Government wants to remove the barriers – to make it easier for people to do the right thing and put communities in control. Effective local connections benefit people and nature alike.

A nation for nature

- There are more than 9 million members of the main nature conservation charities (e.g. the RSPB, The Wildlife Trusts) and collectively they have more than 700,000 active volunteers.
- Some 54% of the adult population visit the natural environment every week.
- The BBC Breathing Places campaign gathered data which showed that 28 million people are interested in nature.
- In a Defra survey in 2009, 85% of respondents agreed that 'I do worry about the loss of species of animals and plants in the world'.
- More than 15,000 individuals, businesses and organisations took the time to respond to our call for ideas and helped to shape the development of this White Paper.

Connecting through nature's health service

4.5 Nature is good for human health. There is a wealth of evidence on the positive effect that spending time in the natural environment has on the health and emotional wellbeing of children.[59] The quality of the local natural environment is one of the factors that shapes our health over a lifetime. A good-quality environment is associated with a decrease in problems such as high blood pressure and high cholesterol. It is also linked with better mental health, reduced stress and more physical activity. If every household in England were provided with good access to quality green space, an estimated £2.1 billion in healthcare costs could be saved[60]. On the other hand, a poor local natural environment can damage people's health and contribute to health inequalities. For example, the social costs of the impacts of air pollution are estimated at £16 billion per year in the UK[61].

4.6 We want everyone to be able to make the most of 'nature's health service'. Our White Paper, *Healthy Lives, Healthy People: Our strategy for public health in England*,[62] recognises that the quality of the environment, including the availability of green space and the influence of poor air quality and noise, affects people's health and wellbeing. It details plans for a shift of power to local communities, including new duties and powers for local authorities to improve the health of local people. From April 2013, Directors of Public Health will be employed within upper tier and unitary local authorities. They will be ideally placed to influence local services, for example joining up activity on rights of way, countryside access and green space management to improve public health by connecting people with nature.

4.7 In chapter 2 we set out our commitment to foster Local Nature Partnerships. Reflecting the fact that the natural environment is a significant determinant of health, they have the potential to make a valuable contribution to the role of the new local Health and Wellbeing Boards in assessing local health needs. **Local Nature Partnerships and the Health and Wellbeing Boards should therefore actively seek to engage each other in their work**. **Forthcoming guidance will make clear that the wider determinants of health, including the natural environment, will be a crucial consideration in developing joint strategic needs assessments and joint health and wellbeing strategies.** Local Nature Partnerships will have a very important contribution to make in developing these documents. Although Local Nature Partnerships will not automatically be members of the Health and Wellbeing Boards, the two partnerships could have reciprocal representation, with this being determined locally.

4.8 So that local health professionals and others have the information they need, **we have committed Public Health England to provide clear, practical evidence about how to improve health by tackling its key determinants, including access to a good natural environment**. The National Institute for Health and Clinical Excellence (NICE) already produces some very helpful guidance documents for public health commissioners, for example regarding the environment and physical activity. **Public Health England and NICE will form a strong relationship in the future to enhance and promote use of these resources by Directors of Public Health within local authorities.**

4.9 In July we will launch a new Change4Life summer campaign through newspapers, the supermarkets and schools and on TV. This will inspire children and their families to get more active and eat more healthily over the summer holidays. Outdoor activities will be a big part of this, with ideas and tips for games in the park and healthy picnic options.

4.10 The Government recently consulted on a Public Health Outcomes Framework. This will encourage local authorities and communities to improve health and reduce inequalities, while leaving them free to decide how best to do this. The consultation document proposed an indicator on access to and use of green space, in addition to other indicators relating to noise pollution, air pollution and sustainable development plans. This recognised the health benefits of spending time in the natural environment, and tackling other environmental impacts on health and wellbeing. The Government will publish the final Framework later this year.

4.11 Poor air quality has negative impacts for both human health and the natural environment. Air quality meets the required standard in most places but still presents a challenge in large urban areas, including London. The effects from particulate pollution alone are estimated to contribute to the equivalent of 29,000 deaths per year[63]. We have committed £5 million of additional funding to the Mayor of London for local transport measures in 2011. In common

Case Study **Healthy living, making the most of public spaces: Rocky Park Urban Growers**

Tower Hamlets Homes (THH) manages 22,000 homes in East London. Most of these are flats without a private garden and access to green space is limited. In response, THH is making better use of open space through resident-led community food growing projects, allotments and urban orchards.

One award-winning project in Bethnal Green – run by a group of residents called The Rocky Park Urban Growers – involves over 150 residents in growing food and has transformed a former crime hotspot into a community hub. Residents have created raised beds and a herb garden used by a local special needs school.

The project also aims to improve biodiversity and add ecological value to public spaces. Rocky Park has already created a more constructive relationship between THH and local residents. Residents have a more active role in grounds maintenance and are reclaiming local disused spaces. Fast food is a problem in Tower Hamlets, but growers involved in Rocky Park are learning to live healthier and more active lifestyles. Food growing has also proved to be

© Tower Hamlets Homes

a common interest across diverse groups, increasing social cohesion, overcoming language barriers and reducing isolation.

According to Margaret Cox, the Chair of the Tenants & Residents Association: ***"People have pulled together by the mere fact that they are growing in the same space… Lots of young mums would take their children to school, come back and stay at home; now they come to the gardens and enjoy each other's company but more importantly have a greater understanding of each other and their different cultures."***

with many countries in Europe, we continue to face serious challenges in identifying transport measures to help us meet health limits for emissions of nitrogen dioxide. **In June 2011 we will consult on plans for meeting limits on nitrogen dioxide in the shortest time possible.**

4.12 We will continue to work at international, national, regional and local levels to pursue all practical and cost-effective options to reduce air pollution and improve air quality. **We will investigate a national framework for Low Emission Zones, to assess their potential to improve air quality in our urban centres.**

4.13 Later this year, we will consult on measures to reduce reporting burdens for local authorities and improve how air quality is controlled and monitored through Local Air Quality Management duties. This includes working with local authorities to share tools and best practice more effectively.

Connecting through education – in and about the natural environment

4.14 As well as having important health benefits, access to the natural environment can also improve children's learning. We want to see every child in England given the chance to experience and learn about the natural environment. The Government's White Paper, *The Importance of Teaching*,[64] will free teachers from unnecessary statutory duties creating more opportunities for different routes to learning, including learning outside the classroom. **Schools should be able to teach outdoors when they wish to do so. We will work with the Health and Safety Executive to remove unnecessary rules and other barriers to learning in the natural environment.**

4.15 We have created a Pupil Premium, intended to raise the attainment of children from low-income families. **This could be used to give fairer**

access to nature for pupils from deprived backgrounds, for example funding school trips to experience the natural environment. It will be for schools to decide how best to use the Premium for the benefit of their pupils.

4.16 The Government's National Curriculum Review will examine how we can put a clearer focus on the essential knowledge all children should acquire at school, while leaving heads and teachers free to decide how to teach this most effectively. The study of science and geography ignites pupils' curiosity about the world around them. They discover how scientific ideas contribute to technological change and improve quality of life. They recognise how human activity and natural processes can lead to changes in the environment, and engage with scientific debates, addressing important issues such as climate change. Outdoor learning can support educational attainment across the curriculum.

4.17 We welcome the work already done by local schools and environmental organisations. In 2010, 1.2 million children participated in environmental education activities at outdoor learning sites managed by Natural England, the RSPB, The Wildlife Trusts, the National Trust and the Wildfowl & Wetlands Trust. We also support the many other activities run for schools, including the annual Big Schools' Birdwatch, in which around 100,000 children discover wildlife in their own school grounds.

4.18 Natural England's support for the Natural Connections initiative will match schools with a range of environmental charities that can provide sites to visit. The aim is to deliver a better co-ordinated local service to schools and teachers, to enable much greater numbers of schoolchildren to experience the benefits of learning in the natural environment. **Natural Connections will provide an online 'one-stop shop' and direct support and advice for teachers, children and parents interested in learning outdoors. Thousands of local volunteers will be recruited to help schools.**

4.19 Through our delivery partner Keep Britain Tidy, we also support Eco-Schools in England. More than 16,000 schools take part in drawing up action plans on themes such as biodiversity, healthy living and managing waste and litter. Eco-Schools have been at the forefront of the Government's programme to plant 1 million trees. We also endorse the new Sustainable Schools Alliance, led by the National Children's Bureau and Sustainability and Environmental Education, which was launched in March 2011. Its principal aim

Case Study **Outdoor learning: Angling Unlimited**

© Angling Unlimited

Get Hooked on Fishing Midlands is one of a number of programmes operating under the umbrella of Angling Unlimited. It engages young people, many of whom have conditions such as dyslexia and autism or who are at risk of getting into trouble with the law. It is supported by a number of organisations including Birmingham City Council, Cadbury and Bournville Village Trust.

Angling Unlimited helps well over 1,500 young people every year, as well as a large number of adults with a variety of disabilities. Out of the young people referred by social services or the police 98.5% did not reoffend, while teachers report that after participating in the scheme, children's concentration, attendance and behaviour have improved. Importantly, most of the young people who have taken part believe they have learnt about the environment and 79 per cent say it has improved their concentration.

Heather Foulkes believes her son Alec is one of the scheme's great success stories. She says: ***"Coming here has changed his life. Alec is severely dyslexic and he's had lots of problems. When he started angling his reading age was eight years and three months. But in one year it leapt to age 11. And in that year he had just devoured fishing magazines. It was absolutely amazing."***

Since graduating from Rodbaston College in 2009, Alec is now nearing his second year on a Fishery Management course at Sparsholt College, which is part of Portsmouth University.

is to encourage every school in the country to put sustainability at the heart of its thinking.

4.20 Food is one of the essentials of life. We want young people to understand where their food comes from. We will continue to help schools, particularly those from deprived areas, organise educational visits to farms. These visits can improve children's understanding of food production and the effect that land management has on landscapes and the wealth of wildlife to be found there. More than 1,000 farmers in England are funded through stewardship schemes to provide educational visits, and between them they host around 100,000 schoolchildren per year. Away from school, public events such as 'Open Farm Sunday' (which in 2010 attracted 184,000 visitors onto 420 farms) and initiatives such as 'Let Nature Feed Your Senses' (for people with poor access to the countryside, such as elderly people or children with physical or mental disabilities) provide an important opportunity for people to appreciate farming and the countryside. **The Government will continue to support Open Farm Sunday, and to fund educational visits by schoolchildren up to the age of 16 and provide farm visits for vulnerable groups of people.**

Connecting through better neighbourhood access to nature

4.21 The Government wants to improve access to nature in local neighbourhoods, giving more people the opportunity to gain more benefits from connecting with it. The Government will give communities a wider range of powers which can be used to protect and improve nature in their neighbourhoods through the Localism Bill.

© Leeds City Council

4.22 We have established a Community Organisers scheme to train 5,000 people. Organisers will work closely with communities to identify local leaders, projects and opportunities and empower the community to improve their area. They will also help communities take advantage of the initiatives set out in the Localism Bill. Building on these new powers, we will help communities improve the quality, quantity and value of their green spaces, whether for their beauty, history, recreational purpose, tranquillity or the richness of their wildlife.

Localism Bill measures

- The Community Right to Bid will give community organisations greater opportunity to identify important green spaces, parks, gardens, woodlands or wildlife reserves, and bid for them should they be offered for sale or lease.
- Local communities will have a right to challenge to run local authority services, including for example statutory allotment sites, which will help them to become involved in delivering services which focus on environmental priorities.
- Local residents will have the power to call for local referendums on any local issue, including local environmental issues.
- Local authorities will be given a general power of competence, which allows them to do anything that is not specifically prohibited by law, setting them free to innovate in response to local needs and environmental objectives.
- Communities will be given a new right to draw up neighbourhood plans, enabling people to come together through a local parish council or neighbourhood forum and say where they think new houses, businesses and other developments should be built. Using neighbourhood plans will help communities plan proactively for community green space and environmental improvements, as well as ensuring that development takes account of the needs of the local environment and the wishes of residents.

4.23 We will consult later this year on proposals for a new Green Areas Designation that will give local people an opportunity to protect green spaces that have significant importance to their local communities and aim to introduce the Designation by April 2012. We propose that green spaces should be identified in neighbourhood plans and local plans which complement and do not undermine investment

Case Study **Local ecological networks: Northamptonshire Pocket Parks**

Northamptonshire County Council's Pocket Parks scheme allows local communities to create and manage green spaces in their area and develop easy public access to the countryside.

Pocket Parks make a valuable contribution to the protection and conservation of Northamptonshire's landscape, heritage and wildlife. They also give local people the opportunity to enhance the place in which they live or work and can assist in the regeneration of communities. Over the last 28 years, the Council has helped create 80 Pocket Parks. They vary in size from 0.10 acres to 87 acres and are found in all kinds of locations from town centres to quiet villages.

Local people can approach the council Pocket Parks Officer with a proposal to create a new park in their area, which they will manage through a land tenure agreement. The Pocket Park Officer offers advice and support on everything from constitutions to habitat management. The scheme relies on the energy and enthusiasm of local volunteers, who are supported by the council.

Raunds Pocket Park in Northamptonshire was once a landfill site. Volunteers helped to develop a circular path suitable for wheelchair users and created a new pond. An old elm hedgerow, scrub and brambles are now carefully managed to protect wildlife. Julie Barke, the Raunds Pocket Park Co-ordinator, says: ***"Because we have been able to maintain good access to the site, it is increasingly used by local people. It is particularly nice to see young children spotting more and more plant and insect life in the Pocket Park."***

© Northamptonshire County Council

in homes, jobs and other essential services. Given the importance of green spaces to the health and happiness of local communities the Government considers the new designation should offer suitably strong protection to localised areas that are demonstrably special and will consult on that basis.

4.24 The Government has also announced plans to introduce a new Community Right to Reclaim Land. It will enable communities to check who owns what land and, with the Government's help, whether hundreds of public bodies are making best use of their land and property. Used on its own, or in conjunction with the Community Right to Bid, this will mean that where best use is not being made of land that is important locally, communities will have a much better chance of bringing under-used publicly owned land back into use. In such cases community groups will then be able to use this land, depending on its circumstances, for a variety of purposes, including redeveloping it for use as a community garden or park, or as space for food growing and other community activities.

4.25 The Green Flag Award® scheme is the national standard for public green space, used by local authorities and a growing number of communities to maintain and improve the quality of precious green spaces. In the past, the scheme predominantly covered parks and community gardens, but its range now extends to woodlands, nature reserves, allotments, cemeteries, open spaces around social housing and, for the first time this year, a shopping centre. There is scope to extend the application of the Green Flag Award® scheme further in future. **We will continue to support the Green Flag Award® scheme in promoting quality space management as an ambition for all green space managers and to create more opportunities for wildlife to flourish in our green spaces, contributing to local biodiversity and enriching the experience of people spending time there.**

4.26 While many people enjoy pleasant green spaces near where they live, this is not the case for everyone. People in deprived areas are nearly six times less likely than those in affluent ones to describe their area as 'green'. Those living in deprived areas, minority ethnic communities, elderly people and those with disabilities have less access to green spaces or tend to use them less. The benefits of spending time in the natural environment are not open to everyone, which can contribute to health and other inequalities.

Monitor of Engagement with the Natural Environment (MENE) 2010

The frequency of visits to the natural environment varied greatly: while half the adult population normally visited a green space at least once per week (54%), 10% had not done so in the previous 12 months and 8% had done so only once or twice.

Levels of participation were higher among people aged between 45 and 64, people in employment and people in the ABC1 socioeconomic groups. Levels were significantly lower among the oldest age groups (65 and over), within the black and minority ethnic (BME) population and members of the DE socioeconomic groups.

Just under half (48%) of visits were to the countryside, while 41% were to green spaces such as parks within town and city locations. Visits by residents in the most deprived neighbourhoods, those in the lowest socioeconomic groups and the BME population were more likely to be to urban destinations and to places closer to home.

4.27 The availability and quality of green space is therefore important. We will work with local authorities and civil society organisations to consider new approaches and vehicles for accessing, maintaining and managing green spaces.

4.28 We will support local areas to improve the provision and state of green infrastructure. We will work with local authorities and civil society organisations to demonstrate the social, economic and environmental benefits that green infrastructure can provide. **The Government will establish a Green Infrastructure Partnership to support the development of green infrastructure in England. This will consider how green infrastructure can be enhanced to strengthen ecological networks and improve communities' health, quality of life and resilience to climate change.**

4.29 Trees are an essential part of our urban landscape. We have launched 'The Big Tree Plant', a national partnership bringing together a wide range of community organisations. The Big Tree Plant will get more people involved in planting and caring for trees throughout England, to make neighbourhoods more attractive, healthy places to live. Some 80% of people in England live in urban areas and fewer than 10% have access to local woodland within 500 metres of their home. The campaign will run until the end of this Parliament in 2015 and aims to plant 1 million trees. By the end of the first planting season in April 2011, The Big Tree Plant projects had already planted more than 100,000 trees.

4.30 We are also taking action to improve other aspects of local environmental quality which can affect our connection with nature, ranging from litter to noise and light pollution. Getting involved in voluntary action on wider neighbourhood issues can often draw in people who might otherwise not be interested in environmental concerns. We will continue to work with businesses, local authorities and civil society groups to develop new approaches to tackle litter and change the way people behave. **We are working with Keep Britain Tidy, businesses, local authorities and community groups to develop a new initiative called 'Love Where You Live', which will be launched this summer.** By taking personal responsibility and through collaborative action real and lasting improvements to the cleanliness of our cities, towns and countryside can be made.

4.31 For many people, a sense of tranquillity contributes to their enjoyment of the natural environment. We are committed to delivering the Noise Policy Statement for England that promotes good health and quality of life. As part of this, **we will work with local authorities to establish mechanisms for formally identifying and protecting urban Quiet Areas, so that people living in cities can benefit from access to areas of relative quiet for relaxation and contemplation.**

4.32 Light pollution is a growing problem. Stargazing is a form of contact with the natural world which is becoming more difficult for people living in built-up areas. In addition, the Royal Commission on Environmental Pollution 2009 report *Artificial Light in the Environment*[65] concluded that there is evidence of potential ecological impacts from artificial light. **We will work with industry and other bodies to reduce the negative impacts of artificial light and protect existing dark areas.** For safety

reasons, some types of premises, including airports and bus stations, are exempt from creating a statutory nuisance from artificial light sources. **In 2011 we will consult relevant organisations on whether the exemptions from artificial light statutory nuisance continue to be appropriate and take action if necessary.**

Connecting by improving access to the countryside

4.33 Clear, well-maintained paths and bridleways are important to give people access to the natural environment and can be enjoyed by cyclists, walkers and horse riders. There is considerable scope to improve and extend this network, for example through Local Access Forums and Rights of Way Improvement Plans. We will make it easier for local communities and civil society groups to get involved in developing and maintaining networks of paths and accessible green space.

4.34 We will consult on simplifying and streamlining the processes for recording and making changes to public rights of way, based on proposals made by Natural England's working group on unrecorded rights of way. This will make it easier to claim public rights of way and to make changes to them in order to create a network that meets the needs of local people. As part of the Government's wider barrier-busting initiative, we will also work with stakeholders to tackle any barriers to local involvement caused by regulations or a lack of information.

4.35 People make more than 57 million visits to our National Parks each year and these special places, together with our collection of 34 Areas of Outstanding Natural Beauty and 224 National Nature Reserves, form a rich and diverse set of national treasures. We want to see a shift away from people using cars to get to these beauty spots, with more people choosing public transport, cycling or walking. Not only do these transport methods have a lower environmental impact, but there is evidence that cyclists and walkers spend more in the local economy than visitors by car, benefiting local communities.

4.36 New cycling and walking routes, such as the South Downs Way or Hadrian's Cycleway, can have a significant positive impact on the local economy. The £3.85 million Pedal Peak District scheme to link Bakewell to Buxton in the Peak District National Park is supported by a £2.25 million government grant and is being used as a pilot to better understand the benefits improved cycling and walking access can bring to the local economy. **The Government's £560 million Local Sustainable Transport Fund will help local transport authorities do more to encourage walking and cycling, improve public transport and make better connections between different forms of sustainable transport.**

Connecting by 'paying back' to nature in our most visited landscapes

4.37 Tourism is the fifth largest industry in the UK and supports 2.2 million jobs in England, contributing nearly £97 billion to the economy.[66] In 2009/10, 2.86 billion visits were made to the natural environment in England, with visitors spending just over £20 billion.[67] This money helps to support many coastal resorts and rural communities. Our new tourism policy[68] sets out the importance of tourism to the economy. But tourism can also place a strain on the natural environment and these pressures need to be recognised and managed. Tourism must develop in a way that is flexible and responsive to the environment, respecting the needs of the people who live and work locally. This approach is enshrined in the action plans that VisitEngland is developing to support its Strategic Framework for Tourism 2010–20.[69]

4.38 Tourists visit many places in England in a variety of natural settings, from the Yorkshire Dales to Dartmoor. Tourism businesses directly benefit from these natural assets and may be willing to pay to help protect them. In some areas, voluntary payback schemes have already been established in which visitors or local business benefiting from tourism 'pay back' to the area in the form of donations for work which enhances the local natural environment. For example, Nurture Lakeland raised around £1.7 million over ten years for conservation projects. Payback schemes have significant local potential and could be expanded across the country. **VisitEngland will act as a source of best practice, identifying and sharing advice with destination management organisations and other bodies in the tourism industry that want to develop payback schemes.**[70]

Connecting through voluntary action – good for us and good for nature

4.39 Volunteering is one of the most fulfilling ways to experience the natural world. It can also help people develop new skills, solve local problems and develop a sense of local ownership and responsibility. This country already has a strong culture of conservation volunteering, and volunteers play a vital role in helping to monitor and maintain our environment. A comparison between 47 countries found the US and the UK to have the highest percentage (8%) of people volunteering in the environment.[71] The UK Biodiversity Indicators in Your Pocket 2010 report[72] found that between 2000 and 2009 there was a 51% increase in the time spent volunteering at eight major UK conservation charities,[73] totalling around 1 million working days in 2009.

4.40 Many more people would like to get involved. Research shows that 26% of non-volunteers are willing to start giving time through volunteering[74]. We want to turn these high levels of interest into action, so that more people experience the benefits of spending time in the natural environment. The Government has recently published a White Paper on Giving. Many of its measures will encourage volunteers to get involved with the natural environment. But we cannot boost volunteering alone and should not compete with voluntary sector bodies that have the expertise, trust and local presence to manage it more effectively. Instead, we want to build capacity for environmental volunteering.

Case Study **Volunteer action for river quality**

© Colne Rivercare Group

RiverCare groups are made up of volunteers who want to improve environmental quality along their local river or waterside area. They clean-up litter, take surveys of local wildlife and carry out work to improve biodiversity. The scheme was created and is funded by Anglian Water, operated by Keep Britain Tidy and supported by the Environment Agency.

The groups rely on the commitment and passion of local people. They are self-sustaining, making links with local organisations such as Wildlife Trusts and councils to help them expand their activities. Volunteers receive training on running events and practical support on site, safety guidance, insurance cover and equipment.

There are nearly 50 registered RiverCare groups across the Anglian region, with more than 1,000 volunteers. In the last five years alone, volunteers have given 55,000 hours, collecting 32,000 bags of litter and 13,000 bulky items. They have made a significant contribution to the quality of the rivers and watercourses they work on. The groups report increased signs of otters, water voles and kingfishers.

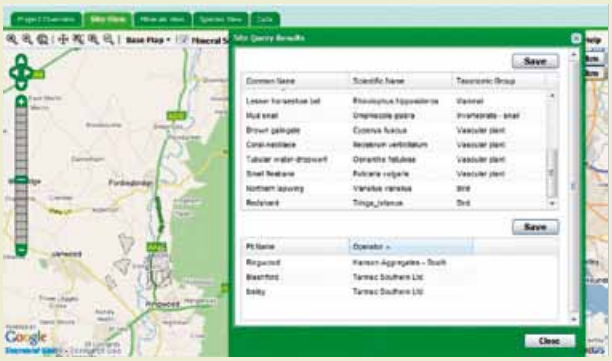
A member of Wensum RiverCare Group says: ***"The dyke was absolutely full of litter. Over 40 tyres, a fridge, a sofa and a mattress were pulled out during the first clean-up. We are increasingly collecting less litter during our litter picks because the appearance is better and people are less inclined to drop litter when the area is clean."***

© Colne Rivercare Group

Case Study **The Million Ponds Project Species Map**

The Million Ponds Project Species Map is an online tool which, at the click of a mouse, delivers a list of the rare plant and animal species in your neighbourhood. Anyone with an interest in wildlife can find out about the plants and animals in their area and help protect them by creating new ponds; helping maintain existing sites; and looking out for wildlife in their area.

The map is the first example of a new generation of web-based tools which use species distribution data to help people take practical action on the ground to conserve rare species. It was created by Pond Conservation with support from the Aggregates Levy Sustainability Fund and assistance from Nature After Minerals. Although it was originally intended as a tool for the minerals industry, it quickly became clear that it could have a much wider use. **http://www.pondconservation.org.uk/millionponds/bapspeciesmap**



Jeremy Biggs of Pond Conservation says: ***"Making new clean water ponds is one of best things you can do to protect freshwater wildlife – and with the information provided as part of the Million Ponds Project, its easy and simple for everyone to get involved, either at home or in the countryside."***

4.41 Volunteering opportunities can already be found through a number of websites such as **www.do-it.org.uk**, **www.volunteering.org.uk** and **http://vinspired.com**. In addition, the new National Citizen Service (NCS) includes a personal challenge element – typically a residential outdoor experience – which will give young people the chance to benefit and learn from the outdoor environment. Some 12 providers have been selected to deliver NCS pilots, and one of them – the Field Studies Council – will help young people to participate in environmentally focused community projects.

4.42 To boost volunteering further, we will launch a new phase of the Muck In4Life campaign. It will help improve the quality of life in towns, cities and the countryside. It will offer volunteering opportunities for all. We are committed to working with national and local partners to develop the new scheme. We will together explore ways in which it could engage people who are less likely to have the opportunity to enjoy the natural environment.

4.43 Monitoring the natural environment is a practical activity anyone can get involved with and is a great way of helping people interact with their natural environment. Individuals experience their local environment on a daily basis and are often best placed to notice changes and improvements in it. Much of this information is collected by dedicated volunteers and we recognise the importance of their contribution. We estimate that this voluntary work, if paid for, would cost over £50 million per year. For example, the power of public monitoring and observation has been demonstrated through the RSPB's 'Big Garden Birdwatch' in which 600,000 people took part in 2011, the UK Butterfly Monitoring Scheme with an estimated 2,000 volunteers collecting information on butterflies at 1,350 sites each year, and the British Trust for Ornithology's 40,000 active volunteers who are involved in monitoring birds and other wildlife.

4.44 We will continue to support biodiversity recording in the voluntary sector. Government's environmental bodies (the Joint Nature Conservation Committee, Natural England, the Environment Agency and the Forestry Commission) plan to invest almost £5 million over the next three years. In addition, **we will invest a further £1.2 million to support the development of the national biodiversity network and to create a new fund for biodiversity recording in the voluntary sector.** We will also support national and local organisations which co-ordinate and share the results of volunteer recording. We will help develop new approaches to collecting data, working with voluntary

What kinds of things can you do to have a more sustainable lifestyle?

Eco-improving your home (retrofitting), for example

- (A) Installing cavity wall insulation
- (B) Fitting double glazing
- (C) Fitting a water efficient shower head
- (D) Installing loft insulation
- (E) Installing renewable energy sources

Using energy and water wisely, for example

- (F) Switching to a green energy tariff
- (G) Line-drying laundry

Extending the life of things to minimise waste, for example

- (H) Giving clothes to charity shops
- (I) Making the most of kerbside and local recycling services

Cooking and managing a sustainable and healthy diet, for example

- (J) Choosing local produce and foods grown in season
- (K) Growing your own food

Choosing eco-products and services, for example

- (L) Borrowing and hiring or choosing second hand and recycled goods
- (M) Buying sustainably sourced fish e.g. certified by the Marine Stewardship Council

Travelling sustainably, for example

- (N) Cycling
- (O) Walking
- (P) Using public transport
- (Q) Car sharing
- (R) Eco-driving techniques

Setting up and using resources in your community, for example

- (S) Finding and using local shops
- (T) Working with the community to grow food

Using and future-proofing outdoor spaces, for example

- (U) Creating an environment for wildlife
- (V) Using a rainwater butt
- (W) Home composting garden waste and/or using peat-free compost.
- (X) Using your local green spaces

Be part of improving the environment, for example

- (Y) Volunteering for a local conservation project
- (Z) Taking part in the local planning process

Web-based tools available for use now

Natural England's website provides a wealth of information through its Nature on the Map application **www.natureonthemap.org.uk/**. Visitors can view maps of their local area and identify its natural resources, including nature reserves, country parks, habitats, and biodiversity.

The **Environment Agency**'s 'What's in your backyard?' online service **www.environment-agency.gov.uk/homeandleisure/37793.aspx** provides interactive maps of local areas, with information on air pollution, flooding, bathing water quality, pollution, river quality and landfill sites.

The **Forestry Commission** has recently launched 'ForestXplorer'. This mobile app enables people to use their iPhone, iPod or iPad to locate their nearest Forestry Commission woodland and quickly find out what they can do, see and discover. They can download handy trail maps, find out what events are on and even use the app to identify trees from their bark, seeds or leaves.

The Open University's iSpot tool **www.ispot.org.uk/** helps people identify wildlife and plant species. Members of the public can get involved by taking part in the national biodiversity survey and by joining the online nature community which helps identify species.

groups to improve the value of information gathered, and find new ways to manage and share data.

Connecting through better access to environmental information

4.45 To be able to connect with nature and take action to protect it, people need the right information at their fingertips. We will make it easier for people to make good environmental choices by providing clear information on Directgov's Environment and Greener Living webpages, with ideas on how to live more sustainably and links to further information.[75] **From summer 2011 Directgov will provide information on actions people can take to help the natural environment such as purchasing choices and making the most of green spaces.**

4.46 We will bring together web-based government information on the natural environment and make this available through a single 'My Environment' web portal, including facilities to search by post code for environmental features such as local nature reserves. This will allow people to see how the UK is responding to environmental challenges, find out about the environment in their local community, learn how they can play their part in creating a better environment and find out how they can benefit from connecting with nature. My Environment will also advise people on how to upload their own data to supplement that collected by government, meeting a request that came up frequently in responses to our consultation for this White Paper. We will make licensing for use of data as simple as possible, to promote greater transparency and sharing of data.

4.47 Information on its own is sometimes not enough to help people change their habits and take positive environmental action. A wider approach is needed to encourage and enable change. For example, later this year we will publish a Water White Paper, which will set out measures for water companies to help householders use water more efficiently. Households are responsible for using around half of the public water supply in England – an average of 370 litres per day per home or 146 litres per person in 2009/10. Using water more efficiently reduces demand and helps people and the natural environment.

4.48 Support for action is particularly effective if backed jointly by businesses, civil society organisations and public bodies. **To help these organisations, we will bring together key insights about sustainable behaviour and publish a revised Sustainable Lifestyles Framework, together with supporting practical tools, in summer 2011.** The framework will describe sustainable behaviour, identify best practice to influence it and consider why some people act on environmental issues and others do not.

4.49 Government, businesses and civil society organisations have been working together in the 'We Will if You Will'[76] initiative to encourage citizens to live more sustainably. The first campaign, called 'Eat Seasonably', encouraged the food sector and consumers to buy foods locally in season, and successfully influenced shopping habits. **We will work with retailers, civil society organisations and communities in a new phase of the initiative to: encourage the consumption of underutilised, sustainable fish species that would otherwise be discarded; incorporate**

biodiversity into retail spaces (such as green playgrounds); and make it easier for customers to choose eco-labelled and sustainably certified products.

4.50 Our updated *Green Claims Guidance*,[77] published in February 2011, sets out a practical step-by-step approach, with examples of good and poor practice, to help businesses make green claims which are clear, accurate and substantiated. **We are developing the UK's negotiating position on an EU eco-label for food. This will help us assess the possible impact of such a label on UK industry, and the potential for using eco-labels to achieve environmental benefits.**

4.51 The Government has initiated legislation to adopt a new 'Green Deal' that will make UK homes and businesses more energy efficient. The Green Deal will encourage private firms to help us conserve natural resources by ensuring that we reduce unnecessary waste of energy.

5 International and EU Leadership

Ambition

Our global ambitions are:

- internationally, to achieve environmentally and socially sustainable economic growth, together with food, water, climate and energy security; and
- to put the EU on a path towards environmentally sustainable, low-carbon and resource-efficient growth, which is resilient to climate change, provides jobs and supports the wellbeing of citizens.

The key reforms for International and EU Leadership are:

- **strong implementation of the Nagoya commitments on biodiversity**, pressing for effective implementation internationally (paragraphs 5.3–5.6);
- **a new intergovernmental platform for biodiversity and ecosystem services,** measuring progress towards meeting the new biodiversity targets (paragraphs 5.12);
- **helping developing countries to value their ecosystems**, improving the quality of the lives of the poorest on the planet (paragraphs 5.7–5.10);
- **reform the Common Agricultural and Common Fisheries Policies**, to achieve greater environmental benefits (paragraphs 5.20–5.22); and
- **support for the EU Roadmap for a Resource-Efficient Europe**, to secure supply chains for critical resources (paragraphs 5.24).

5.1 A global economy influences the global environment. Our lifestyles, consumer choices and policy decisions at home have impacts on the natural environment worldwide. The UK is the seventh largest economy in the world; we have responsibilities beyond our borders: our footprint matters. Conversely, changes to the environment internationally have a corresponding impact on nature in England. Our society is reliant on healthy ecosystems in other countries for regulating our climate, providing new medicines and providing the healthy soils and water supplies to grow our imports. We also want the global natural environment to generate cultural and aesthetic value. Our country cannot act on its own.

5.2 To influence international policies on the environment, we must first demonstrate a real commitment in England to protecting and improving our environment. The measures set out in chapters 2–4 of this White Paper show how we will do this. We will argue for a similar approach internationally, in the EU and across the UK, to protect and enhance the global natural assets on which the security and prosperity of all nations depend.

International leadership

5.3 The UK is a leader in developing and implementing international environmental policy, working for sustained growth of the green economy and demonstrating an appreciation of the global value of natural resources, especially for the world's poorest people. We are committed to achieving environmentally and socially sustainable economic growth, together with food, water, climate and energy security.

5.4 In 2010, the UK played an important role in the Conference of the Parties to the Convention on Biological Diversity, held in Nagoya, Japan. This historic conference agreed a new international deal to protect and enhance biodiversity and ecosystems. It emphasised the value of the natural environment to human welfare and livelihoods, and stressed the links between action on biodiversity, climate change and development (see the box below).

Key elements agreed at the Convention on Biological Diversity, Nagoya, Japan, 2010

More than 190 countries agreed an ambitious conservation plan to protect global biodiversity, and an international treaty to establish a fair and equitable system to enable nations to co-operate in accessing and sharing the benefits of genetic resources.

The new global vision is: **'By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people.'**

The parties also agreed a shorter-term ambition to **'Take effective and urgent action to halt the loss of biodiversity, [so] that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication'**. To achieve this, the parties agreed 20 targets to meet 5 strategic goals:

- address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society;
- reduce the direct pressures on biodiversity and promote sustainable use;
- improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity;
- enhance the benefits to all from biodiversity and ecosystem services; and
- enhance implementation through participatory planning, knowledge management and capacity building.

In addition, a resource package was also agreed to assist developing countries in fulfilling the objectives of the Strategic Plan and the Convention.

5.5 The UK will now be pressing for implementation of the Nagoya agreement at the international level, and through leading by example at home. The new Biodiversity Strategy for England (see chapter 2) is an important part of that commitment, along with completion of our network of Marine Protected Areas. We will be working with our EU colleagues and with our international partners to prepare for the next meeting of the Convention on Biological Diversity, to be held in India in October 2012. Among other things, we want it to take decisions on:

- indicators to track progress towards the targets agreed at Nagoya under the new Strategic Plan;
- new targets on various aspects of development aid, to deliver more resources for developing countries, in pursuit of the agreed biodiversity goals; and
- innovative finance mechanisms.

5.6 We will also be collaborating closely with our EU partners, so that the Nagoya Protocol on Access and Benefit-sharing is properly implemented and comes into force as soon as is practicable. This will help developing countries share in profits from the commercialisation of genetic resources (e.g. from drugs and cosmetics based on genetic resources), and will also provide access to those resources. This could be particularly beneficial to our pharmaceutical industry, by affording reliable access to genetic resources that could unlock solutions to health problems. It will alleviate poverty while encouraging and financing the protection of biodiversity and ecosystems.

5.7 Valuing and maintaining ecosystem services are central to the Government's approach to international development and poverty alleviation. In developing countries it is often the poorest who rely most on materials and services obtained directly from a healthy natural environment. The Government will step up its bilateral support for developing countries to value and enhance their own natural assets. The Department for International Development has established a new Climate and Environment Assessment, designed to integrate climate and environment issues fully into the business case for all development spending over £400. This is a marked difference from the old system where only those programmes over £1 million were subject to formal environmental screening.

5.8 We will also strengthen international efforts to value natural capital, including it in the agreed international standards for producing national accounts. We will contribute to the update of the UN's System of Integrated Environmental and Economic Accounting. **We are supporting the World Bank's Global Partnership for Wealth Accounting and the Valuation of Ecosystem**

Services (WAVES), which will enable between eight and ten developing countries to build the value of natural resources into their own national accounts.

5.9 We will also continue to use the Darwin Initiative to invest UK expertise and financial resources in improving the quality of the lives of the poorest on the planet, through funding projects on biodiversity and ecosystem services. In April 2011, we announced a further injection of at least £25 million of Darwin funding over the next four years to add to the £80 million already invested in similar projects in over 150 developing countries since its establishment in 1992, following the original Rio Summit. **The Government will fund a £210,000 project to undertake case studies to help apply the principles of the Economics of Ecosystems and Biodiversity (TEEB) study to the development of national strategic biodiversity plans, further enhancing our reputation as global leaders in the field of biodiversity.**

5.10 On climate change and biodiversity, the Government will take the lead in promoting safeguards for biodiversity in discussions on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD+). In the 2010 Spending Review, the UK Government announced that it would contribute £2.9 billion of international climate change finance from 2011 to 2015. The International Climate Fund (ICF) (see the box below) will provide a substantial amount towards forests. REDD+ will attract around $4.5 billion globally over the next two years for forest protection. Action to reduce emissions through tackling deforestation must also realise benefits for biodiversity.

5.11 We will also continue to give priority to the UK Overseas Territories (OTs) Biodiversity Strategy, through a co-ordinated approach across government that is led by the National Security Council. The Government will continue its engagement with the OTs in their efforts to conserve their biodiversity through programmes such as the Flagship Species Fund and one-off initiatives such as the £200,000 contribution towards a project to eradicate rodents on Henderson Island in the Pitcairn Group. Moreover, the Darwin Initiative is also making a significant difference to wildlife in our OTs. An additional £1.5 million has already been invested in Darwin projects in the three years from 2010, and this sum will increase further as a result of the new Darwin funding referred to above.

5.12 In 2010, the UN agreed the next steps to establish a new international body, the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). The UK strongly supported this ground-breaking initiative, and is committed to working with other governments and UN bodies to develop effective, efficient governance arrangements and a work programme. IPBES will

International Climate Fund

Some 98% of greenhouse gas emissions happen outside the UK. Tackling climate change and avoiding its dangerous consequences require global action. The world's poorest people will feel the biggest impacts of climate change. Preventing dangerous climate change is linked to our commitment to eradicate poverty. But there is also a national interest in tackling climate change: our economic development depends on the world's poorer countries developing sustainable, low-carbon paths. A low-carbon, climate-resilient global economy is key to economic wellbeing. The ICF demonstrates the UK's commitment to backing our calls for action on climate change with the necessary resources to support practical action. The ICF will:

- support adaptation to and mitigation of climate change in developing countries;
- tackle deforestation and realise biodiversity benefits;
- support bilateral programmes and multilateral funds; and
- contribute to our commitment to international negotiations for a long-term solution to climate change.

provide policy-relevant, authoritative assessments of the world's biodiversity and ecosystem services; this will enable the measurement of progress towards meeting the new biodiversity targets.

5.13 There is a gap in the international process to deal with the conservation of high seas biodiversity. We will work with our partners in the UK and around the world to establish a new global mechanism to regulate the conservation of marine biodiversity in the high seas. Such an agreement should set up a clear means of designating High Seas Marine Protected Areas, building on the work undertaken in Regional Seas Agreements.

5.14 Within Europe and globally, the UK is a significant trading nation in animals and plants and their derivatives. Working closely with EU colleagues, we will continue to play a leading role in taking forward the work of the Convention on International Trade in Endangered Species (CITES), so that trade does not threaten species' survival in the wild.

5.15 Recognising the environmental and economic damage that wildlife trafficking can cause domestically and internationally, and its links to other serious international crime, we will continue to play a leading role in tackling wildlife crime at home and on the international stage. We will work with CITES and related programmes, as well as with INTERPOL and EUROPOL and other national enforcement agencies, to share our expertise and strengthen international capability and resolve to combat the threat. We will ensure co-operation across government departments, within the proposed National Crime Agency structure and its Border Police Command, to share resources and expertise. **Following the announcement of our continued financial support for the National Wildlife Crime Unit, we will ensure that it plays an active role on the international stage as well as at home.**

5.16 We will also work through relevant agreements such as the Convention on Migratory Species, and in particular its regional agreements, to protect migratory species in the UK or its OTs and to share our experience with other countries. **Within the International Whaling Commission we will continue vigorously to support a moratorium on commercial whaling and promote the welfare and conservation of whales.**

5.17 We will be playing a key role in the UN Conference on Sustainable Development (Rio 2012), in June 2012, marking 20 years since the Earth Summit of 1992. We will be pursuing the twin aims of promoting the green economy in the context of sustainable development and poverty eradication, and strengthening the institutional framework for sustainable development. Rio 2012 is a global opportunity to achieve UK objectives for low-carbon, resource-efficient and climate-resilient growth, including sustainable management of natural resources and the promotion of environmentally sustainable agriculture. We will work with our EU and international partners, and in particular Brazil as hosts, so that Rio 2012 provides a coherent policy framework for the green economy. But to be truly successful, Rio 2012 will need to agree some clear, achievable measures to help the global economy make the transition towards greener growth and more sustainable development. It must build on the Organisation for Economic Co-operation and Development's Green Growth Initiative and the UN Environment Programme's Green Economy Strategy, which we are also supporting.

5.18 International environmental governance is cumbersome, with over 500 international treaties and other agreements related to the environment, and more than 50 UN bodies with the environment as part of their remit. Rio 2012 will consider options for strengthening sustainable-development governance and for improving coherence and co-operation. The UN Secretary-General's High Level Panel on Global Sustainability, which is looking at how best to join up the issues of poverty, energy, food security, water, climate change and environmental pressures, will report in time for Rio 2012.

Within the EU

5.19 The EU can play a positive role in developing environmental policies, agreeing standards and creating the world's largest green economy and

market for the trade in environmentally sustainable goods and services. The Government's aim is to provide environmental leadership in the EU to put it on a path towards environmentally sustainable, low-carbon, resource-efficient growth, resilient to climate change. Our priorities for influencing the EU include:

- achieving competitive agriculture, fisheries and food sectors which use and protect natural resources in a sustainable way and meet the needs of consumers;
- integrating the EU's objectives for environmental sustainability into all EU policies and spending;
- protecting, managing and using natural resources sustainably, so as to support economic growth; and
- implementing the stock of legislation properly across the EU, reviewing older directives and applying the principles of better regulation to new legislation.

5.20 In the next EU budgeting period (from 2014 to 2020), reform of of the Common Agricultural Policy (CAP) is central to achieving our ambitions for improving the environment at the same time as increasing agricultural competitiveness. England currently secures many environmental objectives through agri-environment schemes supported by Pillar 2 of the CAP (rural development). Successive reforms of the CAP have moved it towards greater market orientation and improved agricultural competitiveness, with an increasing focus on the achievement of public benefits in return for CAP expenditure. We want to see an acceleration of these trends, with the future CAP promoting a strong industry better placed to realise environmental public goods. Pillar 2 should receive a greater share of a smaller CAP budget. A reformed CAP should have an objectively allocated, more flexible, Pillar 2, with a stronger focus on results which recognises the significant role for the agricultural sector in delivering the sustainable and efficient use of natural resources, including a stronger focus on improved outcomes, climate change mitigation and biodiversity. We will also be seeking changes to the EU rules on rural development, to secure a range of objectives, including to make it easier for land managers to work together to achieve environmental goods.

5.21 Reform of the Common Fisheries Policy (CFP), due by 2013, is a crucial opportunity to address existing failings; radical decisions are needed. The Government is pressing for fundamental reform that simplifies and regionalises the CFP, building in the right

incentives for fishermen to operate sustainably and profitably. A reformed CFP must integrate fisheries management with other marine and conservation activities, and promote an ecosystems approach that takes climate change and other environmental challenges into account. CFP reform must deliver measures to meet legal obligations under EU and international commitments to protect the marine environment, such as progress toward Good Environmental Status under the Marine Strategy Framework Directive.

5.22 The Government is working towards eliminating the wasteful discarding of fish. We will work with the fishing industry to reduce discarding, including by continuing to test an alternative catch-quotas fisheries management system, which encourages fishermen to use their skills more selectively to maximise the value of their catch. We will also be looking at ways to encourage the consumption of underutilised, sustainable fish species that would otherwise be discarded. The market and consumers can play a major role here by increasing demand for them.

5.23 On the effective integration of the EU's environmental sustainability objectives into all EU policies and spending, we are pressing for a climate change audit of existing EU policies and spending plans, including those for the natural environment, energy, farming, water, infrastructure and external relations. This will reduce the risk that EU policies and spending inadvertently contribute to greenhouse gas emissions, and will improve adaptation to climate change.

5.24 On the use of natural resources to support growth, the UK wants a powerful EU2020 Strategy to achieve growth and jobs in an open global economy, raising prosperity and achieving low-carbon, resource-efficient growth, in particular through research and development, investment in innovation and the development of green technology. We will be contributing to the EU Sustainable Consumption and Production Action Plan, which should include speedy and ambitious implementation of regularly reviewed product standards under the Ecodesign and Energy Labelling Directives, and through effective EU-wide co-ordination of standards in green public procurement. We will continue to work with the European Commission on the forthcoming EU Roadmap for a Resource-Efficient Europe. This should be supported by improved evidence on the benefits of resource efficiency for businesses, and appropriate indicators to establish the availability of critical resources and the effectiveness of policies designed to reduce dependence on these materials.

5.25 We have been arguing for an ambitious new EU Biodiversity Strategy to put into effect what was agreed in Nagoya. We also want the EU to take effective, demand-side measures to address illegal logging in key forest countries by concluding Forest Law Enforcement, Governance and Trade Voluntary Partnership Agreements and through strong and effective EU legislation to limit the flow of illegal timber into EU markets.

5.26 We are pressing for development assistance which promotes low-carbon and resource efficiency to underpin environmentally sustainable growth, agriculture and food security; the mainstreaming of climate resilience and sustainable natural resource management into development policies and national poverty reduction strategies; and the use of natural resources to mitigate emissions and adapt to the effects of climate change.

5.27 On better regulation, the Government is looking for recognition that the blocks of EU environmental legislation are already substantially in place. Further environmental improvements are best achieved through proper implementation of existing legislation, better compliance and reviews of some older directives. We support the EU's initiative to review some of the older environmental directives as part of regulatory simplification. We are pressing for new or revised legislation to be evidence- and science-based; to be designed with regulatory and administrative burdens and compliance costs weighed against the benefits; and to provide flexibility.

6 Conclusion

6.1 We have set out a vision to 2060, and identified the first set of measures to move us in that direction. As we forge ahead, we must monitor progress and be honest and clear about successes and failures; we will need to learn from them and to spread that learning widely. Throughout, we have stressed that government alone cannot achieve the ambitions of this White Paper; everyone has a stake in realising the value of nature. We want economic actors, all sections of our society and individual citizens to opt for the natural choice. In this conclusion, we set out a plan for monitoring and reporting on the implementation of the White Paper.

Monitoring and reporting progress

6.2 Learning from the various landscape scale approaches to restore nature will be an important part of tracking progress. To foster this, **we will establish an Ecosystems Knowledge Network. Run by an independent organisation, this network will involve our environmental bodies and include local projects, drawing on practical experience to share learning and good practice**. It will facilitate a joined-up approach to ecosystem management, helping local communities to learn from each other.

6.3 Many organisations throughout this country already hold an immense wealth of information on the natural environment; this increases every year. Chapter 4 sets out action to support the contribution that individual volunteers and community organisations make to the monitoring of nature. The UK Environmental Observation Framework has already significantly improved the co-ordination of monitoring activities, so that data are made available in a coherent way. We will take forward environmental monitoring in partnership with these organisations, seeking their help and expertise. In addition, and **in line with the approach taken by the National Ecosystem Assessment (NEA), we will be joining up the Government's own environmental monitoring, to enhance our understanding of the state of ecosystem services.**

6.4 The Government will also reflect the true value of nature in monitoring wider economic and social trends, so we get a rounded picture of progress over time. The Office for National Statistics will produce better national measures to achieve this. Chapter 3 showed how our national economic measures will more fully reflect the value of natural capital and, by complementing the Gross Domestic Product, will signal the extent to which economic activity is benefiting from and supporting natural capital. In line with the measures in Chapter 4, **the new measures of national wellbeing which are in development will reflect our dependency on the natural environment for the quality of our lives**.

6.5 In addition, **we will develop a set of key indicators by spring 2012 to track progress on the ambitions of this White Paper**. Existing indicators will be reviewed and streamlined; crucial gaps will be identified to provide a comprehensive overview of progress. The review will suggest where indicators are needed; the data on which they should be based; how we can make best use of existing or new data collection processes; and whether the Government is best placed to manage their compilation. These indicators will embrace **a new, compact set of biodiversity indicators for the Biodiversity Strategy for England. We will consult on them and finalise them by spring 2012**. They will flow from the commitments we agreed at Nagoya and in the EU Biodiversity Strategy.

6.6 The NEA has produced a model for a more integrated approach to reporting about all aspects of the state of the natural environment. **By spring 2012, we will review how indicators and other environmental statistics are reported and the extent to which existing reporting meets the needs of government and other key audiences**. The review will explore how important indicators and statistics can be brought together to provide an accessible, independent and reliable statistical assessment of the natural environment. Reporting on indicators will also be used to strengthen the profile of the natural environment. In addition, the Government's environmental bodies will co-ordinate more closely when reporting on the state of the environment. As part of this approach, **the Government, through its environmental bodies, will periodically publish a single, concise and integrated report about the state of the environment on land**. This follows a similar arrangement whereby a single report is published about the state of our seas. This report will be supported as new data become available, by the production of web-based thematic reports, available through a single portal, about the state of different aspects of the environment in England. This will

complement the measures in chapter 4 to improve access to and interaction with environmental data.

6.7 Tracking business progress matters too. Chapter 3 set a challenge for businesses to improve their performance in managing natural capital, and outlined measures to help them do so. Environmental reporting by business provides a way for customers, shareholders, civil society, government and investors to see how businesses are rising to this challenge. The 'responsible investment' community is worth many billions of dollars. Many listed companies in the UK report on their environmental performance in their annual report. A number of organisations assess company environmental performance, such as Experts in Responsible Investment Solutions (EIRIS)[78] and FTSE4Good.[79] Analysis by the Environment Agency[80] found that only two-thirds of company reports in 2009/10 included quantified environmental information. The Environment Agency will continue to analyse company environmental reporting and to publish periodic assessments.

Annex 1: Commitments

Chapter 2: Protecting and Improving our Natural Environment

We want to improve the quality of our natural environment across England, moving to a net gain in the value of nature. We aim to arrest the decline in habitats and species and the degradation of landscapes. We will protect priority habitats and safeguard vulnerable non-renewable resources for future generations. We will support natural systems to function more effectively in town, in the country and at sea. We will achieve this through joined-up action at local and national level to create an ecological network which is resilient to changing pressures.

A vision for nature

1 Building on the National Ecosystem Assessment, the Government will support a further phase of ground-breaking research. It will investigate the mix of future actions most likely to secure the most benefits for nature and for people from our ecosystems. It will also develop practical tools to assist decision-makers in applying the lessons of the NEA. [15]

2 We will publish a new Biodiversity Strategy for England to follow this White Paper. It will respond to our international commitments and set a new strategic direction for biodiversity policy in England for the next decade. [15]

3 Our 2020 mission is to halt overall biodiversity loss, support healthy well-functioning ecosystems and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people. [17]

Local Nature Partnerships

4 We will encourage and support Local Nature Partnerships where local areas wish to establish them. These partnerships will work at a strategic scale to improve the range of benefits and services we get from a healthy natural environment. They will aim to improve the multiple benefits we receive from good management of the land. [19]

5 Partnerships which fulfil the broad vision set out in this White Paper will be recognised by Government and its environmental bodies. We will host an annual Ministerial event at which partnerships can come together to share best practice, discuss implementation issues and celebrate success. We will maintain a partnership database on the internet. [20]

6 The Government wants to provide support to both new and existing partnerships wishing to adopt an integrated, landscape scale approach. We will provide a one-off fund in 2011/12 worth £1 million, to develop Local Nature Partnerships. [20]

7 We will inaugurate a network of 50 Natural Value Ambassadors to engage key decision-makers and opinion formers using the latest evidence and materials available. [20]

Nature Improvement Areas

8 We will enable partnerships of local authorities, local communities and landowners, the private sector and conservation organisations to establish new Nature Improvement Areas (NIAs), based on a local assessment of opportunities for restoring and connecting nature on a significant scale. [21]

9 To provide inspiration and illustrate what works the Government will support the creation of Nature Improvement Areas. Natural England will set up a competition to identify 12 initial areas. We will provide £7.5 million over the current Spending Review period. [21]

10 Working within the framework of the National Policy Statements and the Government's planning reforms (see below), local authorities will be able to use local planning to support Nature Improvement Areas, including identifying them in their local plans where they choose, while not deterring sustainable development. [21]

11 We will capture the learning from Nature Improvement Areas, and review whether further action is needed in planning policy, regulation or capacity building, to support their development. [21]

12 The Government's environmental bodies are reforming the way they work together, to provide more coherent advice to local partners. This means sharing information to

help practitioners prioritise action based on environmental risks and opportunities. [23]

13 We will maximise the contribution which Environmental Stewardship and the Woodland Grant Scheme make towards our over arching objective to promote multiple benefits from ecological restoration at a landscape scale, including through Nature Improvement Areas.. [21]

Protecting natural value through the planning system

14 The Government will consult extensively on a draft of the National Planning Policy Framework later in the summer, and has already invited comments on its content and received responses from a wide range of environmental and other interested groups [22]

Offsetting the impacts of development on biodiversity

15 We will establish a new voluntary approach to biodiversity offsetting and will test this in a number of pilot areas. [22]

Planning for low-carbon infrastructure

16 The Government will work with others to establish a research programme to fill evidence gaps about impacts on the natural environment of the level of infrastructure needed to meet 2050 objectives, in particular with respect to the cumulative and indirect effects. [23]

Getting the best value from agricultural land

17 We will bring together government, industry and environmental partners to reconcile how we will achieve our goals of improving the environment and increasing food production. We will publish our conclusions within the next 12 months. [24]

18 We will use the review in 2012 of the Campaign for the Farmed Environment and the Greenhouse Gas Action Plan, as well as the evidence from elsewhere such as on pesticides or voluntary action under the Water Framework Directive, to assess more generally the effectiveness of this kind of voluntary industry-wide approach. [24]

19 We will work with our delivery partners and stakeholders to develop and pilot an approach to Environmental Stewardship that increases its focus on outcomes, including the possibility of allowing greater flexibility within agreements in how these outcomes are achieved. [25]

20 We will carry out a full review of how we use advice and incentives for farmers and land managers, to create a more integrated, streamlined and efficient approach that is clearer for farmers and land managers and yields better environmental results. [25]

Protecting and improving our woodland and forests

21 The Government welcomes the case the "Read Report" sets out and has asked the Independent Panel on Forestry to provide advice on an appropriate level of ambition for woodland creation and more active management, the mechanisms and market conditions needed and options for ensuring everyone has the opportunity to experience and enjoy our woodland resource. [25]

22 The Government is committed to providing appropriate protection to ancient woodlands and to more restoration of plantations on ancient woodland sites (in recognition of their particular value). We have asked the Independent Panel on Forestry for advice on the restoration of open habitats and plantations on ancient woodland sites. [28]

Diverse and living landscapes

23 We will work with local communities in a number of areas throughout England to support local engagement in landscape planning. [28]

24 We will work with civil society to update and improve the consistency of the national landscape character area profiles and integrate information on the ecosystem goods and services that they provide. Each profile will identify the environmental potential of landscape areas, to inform national policies such as agri-environment schemes and help local communities and planners to make informed decisions about land use. [28]

Safeguarding our soils

25 We will undertake a significant research programme over the next four years to explore: how soil degradation can affect the soil's ability to support vital ecosystem services such as flood mitigation, carbon storage and nutrient cycling;

and how to best manage our lowland peatlands in a way which supports efforts to tackle climate change. We will use the results of this research to set the direction of future action. [28]

26 We want to reduce peat use to zero by 2030, setting the following milestones:

- a progressive phase-out target of 2015 for Government and the public sector on direct procurement of peat in new contracts for plants;
- a voluntary phase-out target of 2020 for amateur-gardeners;
- a final voluntary phase-out target of 2030 for professional growers of fruit, vegetables and plants,
- we will establish a Task Force bringing together representatives from across the supply chain with a clear remit to advise on how best to overcome the barriers to reducing peat use, exploring all the available measures to achieve this goal,
- building on the advice of the Task Force, we will review progress towards these targets before the end of 2015 and consider the potential for alternative policy measures if necessary. [29]

Restoring nature in our rivers and water bodies

27 We will develop a strategy to identify and address the most significant diffuse sources of water pollution from non-agricultural sources. [29]

28 We are establishing ten catchment-level partnerships to develop and implement plans for creating and maintaining healthy water bodies. We will also support additional groups who wish to take a lead in trialling a catchment approach. [30]

29 The Environment Agency and Natural England will work together with farmers to increase the number and appropriate location of Entry Level options under the Environmental Stewardship scheme where there are diffuse pollution problems. [30]

30 We will reform the abstraction regime. The new regime will provide clearer signals to abstractors to make the necessary investments to meet water needs and protect ecosystem function. We will also take steps to tackle the legacy of unsustainable abstraction more efficiently. [30]

Restoring nature in our towns, cities and villages

31 We will provide funding to support the Big Wildlife Garden scheme. Backed by the Royal Horticultural Society and The Wildlife Trusts, the scheme will support a major national competition for Wildlife Garden of the Year, open to homes, schools and communities. It will also develop a definitive online guide for wildlife gardening, providing advice for gardeners of all levels and abilities. [32]

32 The Government will work with its transport agencies and key delivery partners to contribute to the creation of coherent and resilient ecological networks, supported, where appropriate, by organisation-specific Biodiversity Action Plans. We will host a forum with environmental stakeholders to inform future priorities for the enhancement of these green corridors. [32]

Managing our marine environment

33 The Government is committed to achieving good environmental status across England's marine area, working in partnership with those who use, enjoy and derive their income from the marine environment. [32]

34 The first two marine plans to be prepared will be in the East of England Inshore and Offshore marine plan areas and will be completed in 2013. We will have plans in place for the whole of the English marine area by 2022. [33]

Chapter 3: Growing a Green Economy

Our ambition is for a green and growing economy which not only uses natural capital in a responsible and fair way but contributes to improving it. It will properly value the stocks and flows of natural capital. Growth will be green because it is intrinsically linked to the health of the country's natural resources. The economy will capture the value of nature. It will encourage businesses to use natural capital sustainably, protecting and improving it through their day-to-day operations and the management of their supply chains.

Capturing the value of nature in our nation's account

35 We will put natural capital at the heart of Government accounting. We will work with the Office of National Statistics to fully include natural capital in the UK Environmental Accounts, with early changes by 2013. In 2012 we will publish a roadmap for further improvements up to 2020. [36]

36 The Government will establish an independent Natural Capital Committee reporting to the Economic Affairs Cabinet Committee which is chaired by the Chancellor of the Exchequer. The Committee will advise the Government on the state of English natural capital. [36]

37 To support the initial work of the Natural Capital Committee, the Government will take forward a scoping study in 2011 for a natural capital asset check. [36]

38 Later this year, the Government will publish a 'Roadmap to a Green Economy', to provide business with as much clarity as possible about the future direction of policy. [36]

Government and business working together in partnership

39 We have established a Green Economy Council with leading businesses, which will consider natural capital in its terms of reference. [37]

40 The Government will support a new international coalition of businesses and business organisations to follow up on the "TEEB for Business" report. The TEEB for Business coalition will catalyse and coordinate action by helping participating businesses from the UK and elsewhere, to understand and address their environmental impacts. [37]

41 We will work with business to consider how voluntary approaches could work on key products or natural assets, learning from existing voluntary deals on other environmental issues. [38]

42 We will work with local authority partnerships through the Total Environment initiative to identify and address barriers to using green infrastructure to promote sustainable growth, and share the lessons learned. [38]

Growing business opportunities that pay back to nature

43 We will publish an action plan in 2012 to expand schemes in which the provider of nature's services is paid by the beneficiaries, after undertaking a full assessment of the challenges and barriers. We will introduce a new research fund targeted at these schemes and will publish a best practice guide for designing them. We will also encourage pilots to develop across a broad spectrum of nature's services and beneficiaries. [29]

44 The Government will set up a business-led Ecosystem Markets Task Force to review the opportunities for UK business from expanding green goods, services, products, investment vehicles and markets which value and protect nature's services. It will report back to Government in 2012/13, through the Green Economy Council. [40]

45 Following the Task Force report we will explore how best to drive forward the potential and help remove barriers to their development. [40]

Helping business capture the value of nature through responsible supply chains

46 We will develop an agreed approach to water footprinting by December 2012, working through the Products Research Forum [42]

47 We will update the Business Link website to provide information on natural capital including guidance on tools and resources businesses can use to assess their dependencies on environmental assets and services and identify growth opportunities. [42]

48 The Government will publish new guidance for businesses by 2012 on how to measure and report their corporate environmental impacts. [42]

49 We will work with the EU Joint Research Council to develop evidence on the environmental impacts of products and their supply chains, and to consider future developments in minimum standards under the EU Ecodesign Directive. [43]

Government leading by example

50 As part of our approach to mainstream sustainable development the Government will fully consider the value of nature in all relevant Impact Assessments. [43]

51 Later in 2011, we will publish new supplementary guidance to HM Treasury's Green Book for use by all Government Departments on valuing the natural environment in appraisals. [43]

52 The Government will buy products that bring good value for money for the public purse, whilst being more sustainable and efficient. Government will engage with its suppliers to understand and reduce the impacts of its supply chain. We have therefore committed to embed the Government Buying Standards in departmental and centralised procurement contracts. [43]

53 Government Departments will be open about the steps they are taking to address biodiversity and the needs of the natural environment, including actions to promote, conserve and enhance biodiversity; and reduce the environmental impacts of food and catering services. [43]

Chapter 4 Reconnecting people and nature

Our ambition is to strengthen the connections between people and nature. We want to help more people enjoy the benefits of nature by giving them more freedom to connect with it. Everyone should have fair access to a good-quality natural environment. We want to see every child in England given the opportunity to experience and learn about the natural environment. We want to help people take more responsibility for the environment, putting people and local communities in control and making it easier for people to take positive action.

Connecting through nature's health service

54 Local Nature Partnerships and the Health and Wellbeing Boards should actively seek to engage each other in their work. Forthcoming guidance will make clear that the wider determinants of health, including the natural environment, will be a crucial consideration in developing joint strategic needs assessments and joint health and wellbeing strategies. [46]

55 To ensure local health professionals and others have the information they need, we have committed Public Health England to provide clear, practical evidence about how to improve health by tackling its key determinants including access to a good natural environment. [46]

56 Public Health England and NICE will form a strong relationship in the future to enhance and promote use of these resources by Directors of Public Health within local authorities. [46]

57 In July we will launch a new Change4Life summer campaign through newspapers, the supermarkets, schools and on TV. This will inspire children and their families to get more active and eat more healthily over the summer holidays. Outdoor activities will be a big part of this, with ideas and tips for games in the park and healthy picnic options. [46]

58 In June 2011 we will consult on plans for meeting limits on nitrogen dioxide in the shortest time possible. [47]

59 We will investigate a national framework for Low Emission Zones, to assess their potential to improve air quality in our urban centres. [47]

60 Later this year, we will consult on measures to reduce reporting burdens for local authorities and improve how air quality is controlled and monitored through Local Air Quality Management duties. [47]

Connecting through education – in and about the natural environment

61 Schools should be able to teach outdoors when they wish to do so. We will work with the Health and Safety Executive to remove unnecessary rules and other barriers to learning in the natural environment. [47]

62 We have created a Pupil Premium, intended to help raise the attainment of children from low-income families. This can give fairer access to nature for pupils from deprived backgrounds, for example, funding school trips to experience the natural environment. [47]

63 Natural Connections (supported by Natural England) will provide an online 'one stop shop' and direct support and advice for teachers, children and parents interested in learning outdoors. Thousands of local volunteers will be recruited to help schools. [48]

64 The Government will continue to support Open Farm Sunday and fund educational visits by schoolchildren up to the age of 16 and provide farm visits for vulnerable groups of people. [49]

Connecting through better neighbourhood access to nature

65 We will consult later this year on proposals for a new Green Areas Designation that will give local people an opportunity to protect green spaces that have significant importance to their local communities and aim to introduce the Designation by April 2012. [49]

66 We will continue to support the Green Flag Award scheme in promoting quality space management as an ambition for all green space managers and to create more opportunities for wildlife to flourish in our green spaces, contributing to local biodiversity and enriching the experience of people spending time there. [50]

67 The Government will establish a Green Infrastructure Partnership to support the development of green infrastructure in England. This will consider how green infrastructure can be enhanced to strengthen ecological networks and improve communities' health, quality of life and resilience to climate change. [51]

68 We are working with Keep Britain Tidy, businesses, local authorities and community groups to develop a new initiative called Love Where You Live which will be launched this summer. [51]

69 We will work with local authorities to establish mechanisms for formally identifying and protecting urban Quiet Areas, so that people living in cities can benefit from access to areas of relative quiet for relaxation and contemplation. [51]

70 We will work with industry and other bodies to reduce the negative impacts of artificial light and protect existing dark areas. [51]

71 In 2011 we will consult relevant organisations on whether the exemptions from artificial light statutory nuisance continue to be appropriate and then take action if necessary. [52]

Connecting by improving access to coast and countryside

72 We will consult on simplifying and streamlining the processes for recording and making changes to public rights of way, based on proposals made by Natural England's working group on unrecorded rights of way. [52]

73 The Government's £560 million Local Sustainable Transport Fund will help local transport authorities do more to encourage walking and cycling, improve public transport and make better connections between different forms of sustainable transport. [52]

Connecting by 'paying back' to nature in our most visited landscapes

74 Visit England will act as a source of best practice, identifying and sharing advice with Destination Management Organisations and others in the tourism industry who want to develop payback schemes. [52]

Connecting through voluntary action – good for us and good for nature

75 To boost volunteering further, we will launch a new phase of the Muck In4Life campaign. It will help improve the quality of life in towns, cities and the countryside. It will offer volunteering opportunities for all. We are committed to working with national and local partners to develop the new scheme. We will together explore ways it could engage people who are less likely to have the opportunity to enjoy the natural environment. [54]

76 We will invest a further £1.2 million to support the development of the national biodiversity network and to create a new fund for biodiversity recording in the voluntary sector. [54]

Connecting through better access to environmental information

77 From summer 2011 Directgov will provide information on actions people can take to help the natural environment such as purchasing choices and making the most of green spaces. [56]

78 We will bring together web-based Government information on the natural environment and make this available through a single 'My Environment' web portal, including facilities to search by post code for environmental features such as local nature reserves. [56]

79 We will bring together key insights about sustainable behaviour and publish a revised sustainable lifestyles framework, together with supporting practical tools, in summer 2011. [56]

80 We will work with retailers, civil society organisations and communities in a new phase of the initiative to encourage the consumption of underutilised, sustainable fish species that would otherwise be discarded; incorporate biodiversity into retail spaces (such as green playgrounds); and make it easier for customers to choose eco-labelled and sustainably certified products. [56]

81 We are developing the UK's negotiation position on an EU eco-label for food. This will help us assess the possible impact of such a label on UK industry, and the potential for using eco-labels to achieve environmental benefits. [57]

Chapter 5: International and EU Leadership

Our global ambitions are, internationally to achieve environmentally and socially sustainable economic growth, together with food, water, climate and energy security; and to put the European Union on a path towards environmentally sustainable, low-carbon and resource-efficient growth, which is resilient to climate change, provides jobs and supports the wellbeing of citizens.

International leadership

82 The UK will be pressing for implementation of the Nagoya agreement at the international level, and through leading by example at home. [60]

83 We are supporting the World Bank's Global Partnership on Wealth Accounting and the Valuation of Ecosystem Services (WAVES) which will enable eight to ten developing countries build the value of natural resources into their own national accounts. [60]

84 The Government will fund a £210,000 project to undertake case studies to help apply TEEB principles to the development of National Strategic Biodiversity Plans, further enhancing our reputation as global leaders in the field of biodiversity. [61]

85 Following the announcement of our continued financial support for the National Wildlife Crime Unit, we will ensure that it plays an active role on the international stage as well as at home. [62]

86 Within the International Whaling Commission we shall continue vigorously to support a moratorium on commercial whaling and promote the welfare and conservation of whales. [62]

Chapter 6: Conclusion, monitoring and reporting progress

87 We will establish an Ecosystems Knowledge Network. Run by an independent organisation, this network will involve our environmental bodies and include local projects, drawing on practical experience to share learning and good practice. [66]

88 In line with the approach taken by the National Ecosystem Assessment, we will be joining up the Government's environmental monitoring, to enhance our understanding of the state of ecosystem services. [66]

89 The new measures of national wellbeing which are in development will reflect our dependency on the natural environment for the quality of our lives. [66]

90 We will develop a set of key indicators by Spring 2012 to track progress on the ambitions of this White Paper. These will include a new, compact set of biodiversity indicators for the England Biodiversity Strategy. We will consult on them and finalise them by Spring 2012. [66]

91 By Spring 2012, we will review how indicators and other environmental statistics are reported and the extent to which existing reporting meets the needs of Government and other key audiences. [66]

92 The Government, through its environmental bodies, will periodically publish a single, concise and integrated report about the state of the environment on land. [66]

Endnotes

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ISBN 978-0-10-180822-4

9 780101 808224