UK 2012 Climate Change Risk Assessment

# Biodiversity and Ecosystem Services

## Sector Perspective

- Biodiversity is the variety of all living things. Its social and economic value is reflected in the concept of 'ecosystem services'. Provided by healthy ecosystems rich in biodiversity, these vital services include crop pollination, water purification, healthy soils and regulation of flooding. Whilst most biodiversity policy is co-ordinated by the individual countries of the UK, ecosystem services policy is at an early stage of development.

- The most important factors currently affecting biodiversity and ecosystem services are socio-economic and include human population size and distribution. Consumer values are also important, such as increasing trade in desirable exotic goods that harbour non-native species and may become pests. The biggest threats to date have been posed by habitat loss, fragmentation and degradation due to water and air pollution and land-use changes.

- Biodiversity and ecosystem services are sensitive to gradual changes in climate (e.g. increasing temperatures) and to more abrupt changes caused by extreme weather events (e.g. droughts, floods and storm surges).

- Climate change is already having a direct impact on biodiversity in the UK. This is evident in the shift in timing of seasonal events such as budburst, flowering, egg laying and arrival of migrant birds. However, climate change is generally acting as a further stress on ecosystems already under pressure.

- Biodiversity has many and close interdependencies with other sectors (e.g. agriculture, forestry, water, marine and fisheries). Actions in these sectors may intensify the threats from climate change, but also may offer opportunities to UK biodiversity and ecosystem services in the coming decades.

# Biodiversity and Ecosystem Services

**Climate change is projected to result in changes in temperature, rainfall patterns and sea levels, as detailed in the UK Climate Projections (UKCP09) analysis. Although a warming climate may result in opportunities for some species, climate change may lead to significant alteration to or loss of important species, habitats and ecosystem services in many parts of the UK.**

**The Climate Change Risk Assessment (CCRA) has completed an assessment of a range of impacts for which this sector may need to prepare. Some of the key points from this assessment are summarised here.**

*The results presented here do not take account of changes in society (e.g. population growth, economic growth and developments in new technologies); nor do they take account of responses to climate risks (e.g. future or planned Government policies or private adaptation investment plans).*

## Focus on… Soils

Maintenance of soil quality is a fundamental ecosystem service. Overall soil quality in the UK has been declining mainly as a result of land-use and land management changes. Further changes in the moisture and organic matter[1] contained within soils resulting from climate change may significantly affect the biological, physical and chemical processes underpinning soil quality. Drier summers leading to increased soil moisture deficits may result in increased release of greenhouse gases such as carbon dioxide and methane. Heavy rainfall, especially if following a dry period, may increase the chance of soil erosion. Peatland, beech woodland, blanket bog, some types of grassland, heathland, wetlands and coastal habitats are among the habitats that may be vulnerable to drying. This would have impacts on invertebrates such as worms and crane-fly larvae that are key species in ecosystem food webs and may lead to declining numbers of their predators (e.g. song thrushes and golden plover).

Confidence

M

Habitat vulnerability (example): over 50% of current peatland area may become vulnerable to change by the 2050s based on a reduction in available 'climate space' (the area where a species can potentially live because the climate is suitable).[2]

## Focus on… Pests, Diseases and Invasive Non-native Species

Although risks associated with pests, diseases and invasive non-native species are largely determined by socio-economic factors that encourage their introduction, climate change may aid their spread and persistence, causing damage to biodiversity, agriculture, forestry and aquaculture.[3]

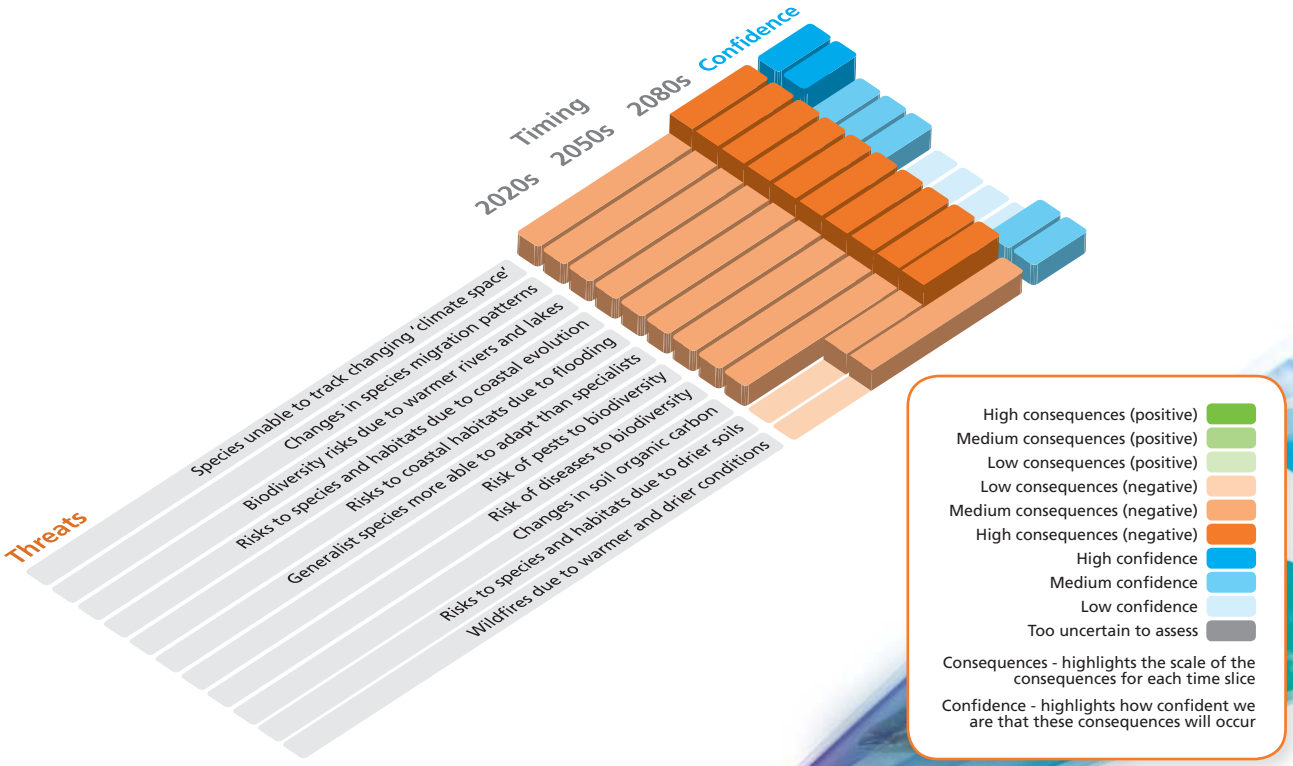
Invasive non-native species could find it even easier to out-perform native species and habitats as the climate changes. For example, the resilience of native species may be weakened by conditions such as drought, which invasive non-native species may be better adapted to survive and so may exploit the opportunity.

Milder winters may also increase the risk from pests and diseases and assist the spread of invasive non-native species. Wetter winters may increase problems from fungi and related organisms. Each pest, disease and invasive non-native species has its own characteristics, however, making generalisations about potential climate impacts very difficult.

## Focus on… Coastal Zones

Coastal ecosystems are very important for biodiversity because of the priority species they support (e.g. internationally important populations of overwintering birds and threatened species such as the bittern). Coastal zones also provide ecosystem services appreciated by humans, such as saltmarsh and sand dunes that have an important role in coastal defence. Although these ecosystems naturally change in response to long-term coastal evolution and changes caused by extreme weather events, in many places their ability to adapt to climate impacts is severely restricted by man-made structures such as fixed sea defences.

Rising sea levels and storm surges would increase the risk of flooding in low-lying areas, with both gains and losses of habitat, influencing the distribution of invertebrates and birds and rare habitats such as machair in Scotland. A large number of sites important to nature conservation occur within the coastal floodplain.[4] Overall, the south-west and the east of England may experience the greatest losses of coastal habitats.



Confidence

M Coastal floodplain habitat at risk of loss due to coastal flooding: of the 109,000 ha of habitat assessed, around 4% is currently at risk and this is projected to increase to around 5% by 2100.[5]

M Losses of specific coastal habitats due to coastal erosion (examples): up to 20% of saline lagoons in the east of England and up to 10% of reed beds in north-east England, under the most extreme projections.

## Focus on… Moving Species

'Climate space' is the area where a species can potentially live because the climate is suitable. If a species cannot move to adjust to changes in its climate space (often as a result of habitat loss, fragmentation and loss of landscape diversity) it becomes more vulnerable to local extinction. There is already evidence that the climate space of many UK species is changing, with some species' ranges shrinking and some expanding, while others have altered their habitat preferences at a local scale.

Climate change may also favour 'generalist' species (those able to thrive in a wide range of environmental conditions) and alter some migration patterns, either at departure or destination sites or on migration routes. For some species, this may provide new opportunities; for others, it may introduce new risks to their existence.

Confidence

H Species at risk of extinction due to loss of suitable climate space (examples): species of nature conservation importance including the woolly willow (a montane scrub species), the slender naiad (a freshwater plant) and the bittern (a wading bird) may lose between 90% and 100% of their climate space by the 2080s.[6]

H Changes in habitat preferences (example): studies of the silver spotted skipper butterfly suggest a shift towards cooler, taller grasslands.[7]

H Species likely to gain suitable climate space (examples): the wood white butterfly, the middle spotted woodpecker and the downy oak may enjoy an increase in climate space of over 50% by the 2080s,[8] increasing their European ranges further into the UK.

## Focus on… Water

The effect of pollution on water quality may be exacerbated by climate change due to lower flows in rivers and a resulting increase in concentration of pollutants. Temperature changes may affect nutrient cycling[9] and decrease oxygen supplies available for water habitats. During droughts, the risk of irreversible ecological change may increase.

Upland systems are particularly vulnerable to these type of issues. Changes to water levels, quality and temperature could have negative implications for fish stocks and freshwater species and the supply of clean water.

Confidence

M Reduction in average summer river flows by the 2050s (examples): between 7% and 54% in the driest part of England (the Anglian river basin region) and between 2% and 25% in Scotland's wetter river basins (in Shetland and the Orkneys).

## Focus on… Fire

Although the majority of wildfires are started by humans, either accidentally or deliberately, climate change may increase the likelihood of their occurrence. For ecosystems particularly sensitive to fire (e.g. woodland, semi-natural grassland, peatland and heathland), an increase in the number of large fires would lead to significant loss of biodiversity and of ecosystem services such as carbon storage.

Confidence

M Average annual change in risk of wildfires in National Parks: Dartmoor, the New Forest and the South Downs may experience up to a 50% increase in risk by the 2080s.[10]

[1] Decaying plant or animal material.
[2] Clark *et al.* (2010). *Clim. Res.* 45:131-150.
[3] The farming of aquatic organisms such as fish and shellfish.
[4] The coastal floodplain is measured as the 0.1% annual probability (or 1:1000 year event) of tidal and tidal/river floodplains, a standard measure used as the maximum floodplain extent.
[5] Eight habitat types were considered as part of Defra project CR0422.
[6] UK Climate Impacts Programme 2002 (UKCIP02) projections.
[7] Davies *et al.* (2006). *J. Ani. Ecol.* 75: 247-256.
[8] UKCIP02 projections.
[9] The movement of nutrients through ecosystems.
[10] Using the HadCM3 model only.

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## The Challenge of Adaptation

Climate change may result in gradual changes or an abrupt step change in biodiversity, with major implications for many ecosystem services that help to sustain human welfare. Moreover, the built-in ability of many ecosystems to adapt has already been reduced as a result of land-use changes and pollution, for example.

Awareness of climate change and its impacts, however, is typically very high in this sector. In addition, there is a clear understanding that the risks may be severe and escalating. Nevertheless, potential constraints exist on the sector's ability to adapt effectively to the challenge of climate change. For example:

- This is an exceptionally complex sector, characterised by the involvement of many different groups with widely differing agendas and by significant interaction with a range of other sectors whose focus may not be on biodiversity or ecosystem services.
- The current network of sites designated for biodiversity is often too small and too fragmented to allow natural adaptation of ecosystems to take place.

Development of a framework to integrate actions for the natural environment with other topics of importance to society is still at an early stage. In 2011, however, the National Ecosystem Assessment (see www.uknea.unep-wcmc.org) delivered the first comprehensive overview of UK ecosystem services, including their current status and trends, together with a future outlook.

Overall, there is a need to plan strategically and implement cross-sector actions that enhance ecological resilience and accommodate change, based on the best available knowledge (see www.defra.gov.uk/environment/biodiversity/documents/ebs-ccap.pdf).

In terms of addressing specific gaps in knowledge about climate change impacts and about adaptation to those impacts, the most important priorities include:

- Improving understanding of how actions in other sectors (including adaptation) may affect species, ecosystems and the services they deliver, and developing/implementing cross-sector activities that will enhance the outcomes and reduce conflicts for all sectors.
- More UK-level, standardised data collection and analysis on the rate and patterns of change, trends and thresholds/tipping-points associated with climate for species and ecosystems.
- Improving understanding of how climate impacts will affect ecosystems' in-built capacity to adapt to changes, how this may affect ecosystem services and when changes may become irreversible.

## Where to Get Further Information

For copies of the CCRA Biodiversity and Ecosystem Services Sector Report, the CCRA Evidence Report and Devolved Administration Reports, please visit www.defra.gov.uk/environment/climate/government/

## How the CCRA was conducted

The CCRA reviewed the evidence for more than 700 potential climate impacts on the UK economy, society and environment. Over 100 of these impacts across 11 sectors were taken forward for more detailed analysis, having been selected on the basis of likelihood, potential consequences and how urgently adaptation action may be needed to address them.

A plausible range of climate change scenarios was used in the analysis. Some aspects of socio-economic change (e.g. population growth) were also taken into consideration. Adaptation policies that are planned for the future were not considered, so that the underlying level of risk could first be compared across sectors.

The results presented here are based on the UKCP09 Medium emissions scenario for the 2020s (2010-2039) and the Low, Medium and High emissions scenarios for the 2050s (2040-2069) and the 2080s (2070-2099). A range of climate projections representing lower, central and upper estimates were considered within each emissions scenario. Where indicated, some analyses were based on the earlier UKCIP02 climate scenarios.

Risks are categorised as low, medium or high based on their economic, social and environmental consequences.

The CCRA findings are also categorised as having low, medium or high confidence. The level of confidence is the degree to which the findings are considered valid, based on the type, amount, quality and consistency of the evidence studied.

Further information on how the CCRA results should be interpreted is presented in the CCRA Evidence Report. www.defra.gov.uk/environment/climate/government/

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