

Climate Change and Biodiversity in North East England

Mike Harley (AEA), Keith Buchanan (KBA), Pam Berry (ECI)
and Nikki Hodgson (AEA)

Contents

Key messages at a glance	Page 4
Impacts on the region's species	Page 5
Implications for the region's habitats	Page 6
Implications for policy and practice	Page 11
Credits	Page 13

KEY MESSAGES AT A GLANCE

- *This study provides policy and decision-makers in North East England with an assessment of how biodiversity in the region might be impacted in the future by climate change. It also provides guidance on the sorts of policies and actions that could help species and habitats adapt.*
- *Climate change represents the most serious long term threat to the natural environment because of the damage it will cause to ecosystems, the biodiversity, landscape value and services to society which they support. By mid-century, one third of land-based species could be on the pathway to extinction because of climate change.*
- *A healthy, resilient natural environment, hallmarked by a rich diversity of habitat and species, is the bedrock of successful adaptation; and in protecting this we also safeguard ecosystem services vital to society and the economy.*
- *Adaptation supports and adds value to many mitigation measures e.g. reducing the erosion of upland peat to enhance its resilience also reduces its emissions of carbon to atmosphere, a key mitigation measure.*
- *Climate change will impact directly on the natural environment, as well as indirectly through society's responses to climate change. Action is needed to ensure that the resilience of the natural environment is increased and protected.*
- *At least one third of the UK Biodiversity Action Plan's priority habitats in the region contain vulnerable species. Those that may be most vulnerable include the iconic black grouse on the moorland fringes and puffins on the Farne Islands.*
- *These findings emphasise that species and their habitats are already being affected by climate change. A high proportion will be at greater risk in the future. Adaptation actions are needed now to help them adjust to the inevitable impacts. Urgency is due to the scale of action required and the timescale needed for newly created habitats to mature.*
- *There are a wide range of mechanisms within North East England that could contribute to adaptation for biodiversity. A ten-point plan is proposed. More land managed in wildlife-friendly ways will be necessary to maintain existing levels of biodiversity.*

IMPACTS ON THE REGION'S SPECIES

Climate change is already affecting biodiversity in North East England.

The distribution of birds and other wildlife is changing now in response to climate change – species' lifecycles and migration patterns are changing.

The northward movement of range margins of a number of species of butterfly and dragonfly have been observed in Britain. These studies are relevant to North East England as they highlight how species are responding to climate change by shifting their distributions.

Changing temperatures are affecting the availability of food for birds. Early appearance of some caterpillars means this vital food source may not be available when birds such as blue tits, great tits and robins seek food for their young.

The direct impacts of climate change on biodiversity include:

- Changes in phenology, which may lead to lack of synchrony between species
- Changes in species abundance and distribution
- Changes in community composition
- Changes in ecosystem processes
- Loss of space e.g. due to sea level rise

For example:

- Several new species of butterfly have arrived since 2000 including, white letter hairstreak, small skipper and brown argus.
- Frog spawning has become earlier and is attributed to rising temperatures.
- In the uplands, warmer weather in spring encourages golden plover to breed earlier – nine days earlier than 20 years ago. However, the craneflies needed to feed chicks are not hatching as quickly, so the balance between species is being upset.
- Redshanks, other wading birds, and mammals such as badger and hedgehogs are likely to face greater problems finding food as dry, hard soils in summer make it difficult for them to access worms.
- Kittiwake colonies are in decline throughout the east coast, apparently suffering from sand-eel shortage.
- The puffin is a key species in the North East England marine environment and has important links with tourism, particularly on the Farne Islands. The species is likely to be vulnerable to temperature rise, and the significant threats posed by warming seas changing the distribution and abundance of plankton and of sand eels on which it feeds.
- Black grouse is a special bird of North East England; virtually all of England's population of the species is found in this region. The species is characteristic of moorland fringes and was shown to be highly vulnerable to climate change. This could be exacerbated by storm events wetting chicks and increasing their mortality.
- Birds of prey, like the hen harrier and merlin, are not immune to the changing climate. Studies show that they may become a distant memory of North East England uplands by the turn of this century.
- Milder winters are allowing greater numbers of rabbits to breed at increasingly higher altitudes. Their grazing is exacerbating already serious climate change pressures on the unique arctic alpine flora for which Teesdale is famous, for example the spring gentian.

IMPLICATIONS FOR THE REGION'S HABITATS

At least one third of the 34 UK Biodiversity Action Plan priority habitats found in North East England contain vulnerable species. Information looking at the potential implications of climate change for the region's six most important habitats is presented here:

1. Blanket bog

North East England is of international importance for its blanket bog habitat. It has nearly 20 per cent of the entire English resource of this globally rare habitat.

There is increasing awareness of the wider importance and broader economic value of peat, both as a store of carbon and as a source of carbon dioxide when peat dries out and the carbon is lost.

The restoration of degraded blanket bogs to prevent further loss of peat and associated impacts on water quality, downstream flooding and deposits of peat sediment in water bodies is the focus of much current action. Maintaining blanket bogs so that they continue to sequester and store carbon, in the face of changing climate and land use, is a key challenge for the future.

Climate change will inevitably alter the hydrological conditions of bogs. Drier summers can cause peat break up and oxidisation, especially following the past pressures of drainage, burning and grazing. This can lead to a decrease in invertebrates, which are a vital food source for our important populations of wading birds and grouse. Craneflies, in particular, are very important for many of our northern and upland birds. The direct effect of warming on their populations is likely to result in significant changes in the distribution of a number of bird species; in particular the golden plover, a bird which could be lost to North East England uplands.

The predicted increased winter rainfall and storm events will likely lead to greater run off into surface streams, enhancing erosion risk and releasing carbon.

Familiar upland species such as curlew, dunlin, golden plover and red grouse could suffer under these changing conditions, as could plants like the internationally important yellow marsh saxifrage. Over 80 per cent of the UK's population of this plant find their home in the North Pennines.

2. The coast

The region's coast, a major tourism asset, is important for its wildlife. The Farne and Coquet Islands have huge colonies of spectacular seabirds and the largest grey seal colony in England. Over half of the entire world population of the pale-bellied brent goose is held at Lindisfarne.



Photo: Puffin

Much of the shoreline is nationally or internationally important for its flocks of wading birds, saltmarshes, sand dunes, sea grass beds and sea caves which are a haven both for their fascinating sea creatures and rock pool enthusiasts alike.

Sea level rise and coastal squeeze threatens the habitat for all these amazing animals. Familiar shoreline

species, such as redshank, plovers and dunlin, will all suffer and our rocky shores are likely to be gradually submerged and changed forever.

Rising sea temperatures are causing changes in the marine environment. Sand eels, a staple diet of many seabirds, are becoming increasingly difficult for the birds to find. Eventually the distribution of sand eels could be so distant from the seabirds' breeding colonies that they are effectively out of reach – this could spell disaster for our famous teeming tern colonies and the iconic puffin.

In addition, increasingly frequent and intense storm surges will severely impact on other coastal features such as the extensive and popular coastal dunes.

The North East England coastal dune systems are dynamic, mobile features that could be lost if sea defences or rising land prevent their movement.

3. Woodlands

North East England has a range of different types of woodlands, from characteristic oak woods in the upland gills to the immense Kielder Forest, which is one of the largest plantation forests in Europe and produces around five per cent of the UK's timber.

These woodlands support a mass of familiar wildlife, and are a treasured resource for the region providing peace, tranquillity and vital recreation and relaxation opportunities.

The region's conifers are particularly important for red squirrels, where Northumberland is the English stronghold.

Ancient woods, those continuously wooded since 1600, are home to more threatened species than any other habitat in the UK.

They are a rare habitat in the North East, a tiny 1.3% of the region's land cover, and almost half are less than 5ha and often surrounded by intensive land use.

Ancient woodland is characterised by species with poor powers of dispersal and, as it is so highly fragmented, the habitat and the species that it supports are vulnerable to climate change.

In addition to their wonderful wildlife, woodlands play a role in climate change mitigation by providing a carbon sink and store. They contribute to flood management through attenuating downstream peak water flows, protecting fish populations through shading and consequent water temperature reduction, and reducing soil erosion.

Across North East England, woodlands are likely to suffer a number of impacts as the climate changes.

Increase in winter rainfall may lead to increased water logging, which can affect the roots and stability of trees. Subsequent risks of increased tree fall and wind blow will be exacerbated by any increases in storm events.

Trees stressed by a changing climate are more susceptible to pests and diseases. The majority of insect pests that affect UK forestry are likely to benefit from climate change through increased activity and reduced winter mortality, although longer growing seasons and higher CO₂ levels may help mitigate this.

Wildfires are more likely in warmer drier summers putting woodlands, forests and their associated biodiversity at greater risk.

Familiar woodland biodiversity will also be at risk of change. Birds associated with the region's woodlands, such as pied flycatcher and nightjar, are vulnerable to future temperature rises. Many well-loved species, such as blue tits, may suffer from 'phenological' change.

When natural processes become out of step with each other – in the blue tits' case the timing of the hatching of their young will no longer coincide with the emergence of their caterpillar food source. Birds like song thrushes are vulnerable to any drying out of soils as it prevents them from finding their food.

Some species, however, may benefit from changing climate space, for example hornbeam (currently only native to SE England and East Anglia), field maple and wood anemone. Deer and red squirrel populations may also increase; but, in the latter case, the grey squirrel is at least as well adapted, so the pressure on red squirrels will continue.

4. Rivers/streams

North East England is characterised by its high-quality and varied rivers and streams. Supporting all forms of wildlife, from kingfishers to otters and from crayfish to salmon, the water bodies are a much-loved part of the environment, and are valued for both active and passive relaxation.

Freshwater fisheries contribute significant economic value to North East England; salmon alone is worth several million pounds per annum. The lower reaches of the Tees supports a nationally renowned coarse fishery.



Photo: Atlantic salmon (Kaleel Zibe) (Environment Agency)

Increasing temperatures and changing precipitation patterns are expected to have a number of impacts on the rivers and streams in North East England. Higher water temperatures, coupled with lower flow rates and decreasing oxygen levels in summer months, together with unprecedented flood events, are likely to be detrimental to freshwater pearl mussel, salmon, and trout. Some coarse fish species may benefit from these trends, but overall the diversity of the region's freshwater fisheries is threatened by climate change.

Lower summer flows and increased algal growth could prove detrimental to river jelly lichen (a nationally important BAP species) on the Coquet. The last remaining colony of water rock bristle in the UK is found in North East England and is likely to be impacted – possibly to the point of local extinction.

Storm events could cause severe erosion, and destruction of riverside and riverbed habitats. Changing sedimentation patterns can have significant detrimental impacts on riverbed wildlife, including fish eggs and spawn. Heavy localised rainfall can also lead to peaks of pollutants being pulsed through the river system.

North East England has nationally important populations of the native crayfish and these, as with much of our other native wildlife, is threatened by invading non-natives. Changing climate conditions may exacerbate this situation severely.

Vulnerability assessments for 20 species associated with rivers and streams showed a number of animals affected by increasing temperatures. The water vole, the familiar 'ratty' from Wind in the Willows, and reed bunting show particular vulnerability; both are expected to lose much of their range in North East England.

The region's rivers and streams, highly valued for their wildlife and fisheries, are particularly vulnerable to climate change. The River Basin Management process under the Water Framework Directive provides an excellent opportunity for regional partners to take joint action to safeguard rivers in North East England.

5. Upland hay meadows

Upland hay meadows are one of the rarest types of grassland in the UK. Recent estimates indicate that there are less than 1,100 hectares in the UK; 40 per cent are situated in North East England.

Upland hay meadows in England are now almost exclusively restricted to the higher valleys of the North Pennines and North Yorkshire. Teesdale and Weardale are widely acknowledged to possess some of the finest concentration of upland hay meadows found anywhere in the UK.



Photo: Meadow Pipet

Colourful orchids and spectacular black grouse are among the wonderful wildlife attracting visitors to walk in these areas and visit the region's uplands.

Many species typical of the upland hay meadows are at the southern limit of their distribution in England and are likely to retreat northwards as the climate warms. Wood cranesbill is a core component of these meadows; its future climate space is predicted to occur at higher altitudes in the future. It could be lost to the region.

Other classic hay meadow flowers such as globeflower, eyebright and lady's mantle are already showing signs of decline. Currently, this may be due to pressures other than those directly related to climate change (e.g. nitrogen deposition) but the increased impact from this extra factor will add to population fragmentation and overall vulnerability.

As the climate changes these hay meadows may also be invaded by more southerly species.

A very real threat is changing agricultural practices, driven by climatic and socio-economic factors, which could alter the way these areas are managed and threaten their special interest.

Changing precipitation patterns or extreme weather events, leading to seasonal flooding or drought, would add further stress.

A number of bird species were shown to be vulnerable to increasing temperatures. This includes black grouse, wheatear, grey partridge, and meadow pipit. Meadow pipit is already declining in numbers and is one of 10 European bird species whose ranges are likely to decrease most as a result of climate change.

6. Upland heath

North East England is famous for its uplands, its wonderful heather-covered hills, and the sights and sounds of its birdlife.

Nearly a fifth of all England's upland heath is found in the region, amounting to around 600 square kilometres. Much of this is of national and international importance for its classic upland biodiversity and holds the highest European conservation designations.

Birds like the curlew (the emblem of the Northumberland National Park), black grouse, the famous red grouse, and the wonderful but rare hen harrier are all specialities of this area.

Heathland already suffers various impacts; grazing pressure, drainage, afforestation and burning all contribute to its fragmentation, degradation and destruction. Increased stress through climate change is likely to add to these pressures.

Higher temperatures, changing precipitation patterns and wild fires associated with droughts and heat waves are a particular vulnerability.

Heathland habitat is principally maintained by only a few management regimes: sheep grazing, grouse moor management and conservation/recreation. Climate change will inevitably impact on all these regimes, but exactly how is difficult to predict. It certainly seems likely that the secondary effects of any agricultural changes or even woodland colonisation are likely to exceed any direct effects.



Photo: Red Grouse

Various heathland plant species are vulnerable to the predicted climate changes, as are classic upland bird species such as short-eared owl and black grouse.

Work by The Royal Society for the Protection of Birds (RSPB) and Durham University indicates that red grouse could certainly suffer in the future, with most of their current breeding areas in England predicted as no longer suitable.

This bird species is not only an emblem of the uplands but is also an important game bird in North East England. A decline in numbers could have economic implications for rural communities.

IMPLICATIONS FOR POLICY AND PRACTICE

It is impossible to predict with certainty what will happen to species in response to climate change. The ability of species to move through the North East England landscape is likely to be compromised by habitat fragmentation and other pressures (for example, pollution, habitat destruction, and so on). Without adaptation measures, these species will be more adversely affected than they would be with adaptations in place.

In addition to any direct effects, species will also be affected by indirect effects. That is those impacts likely to result from changes in socio-economic drivers, working practices, cultural values, policies and use of land and other resources in the face of climate change. This study was not able to look at this area in any detail but it is important to recognise that such indirect impacts could, due to their scope and speed, be at least as damaging as direct impacts.

There are a wide range of mechanisms within North East England that could contribute to adaptation for biodiversity. If these mechanisms are considered, alongside the landscape-scale initiatives planned or underway, there is already substantial geographical coverage of the region. Landscape-scale initiatives have considerable potential to contribute to biodiversity adaptation, and are already doing so. The Minerals Valley project is an example of good practice from which key lessons have been drawn. This potential could be more effectively exploited if there was effective coordination to embed complementary adaptation measures in each of the initiatives.

A critical point is that action for biodiversity has to be integrated across all sectors. Without this the indirect impacts, as referred to above, could be severe.

Ten point plan for biodiversity adaptation:

1. Implement the recommended adaptation actions, as set out under five key principles which are based upon the Defra's 'England Biodiversity Strategy Climate Change Adaptation Principles':

Take practical action now

- Conserve protected areas and all other high quality habitats
- Reduce sources of harm not linked to climate change
- Deliver current policy and legislation and seek improvements to increase flexibility

Maintain and increase ecological resilience

- Undertake habitat management to reduce the direct impact of climate change
- Conserve ecological variability of all habitats
- Increase populations of vulnerable species
- Restore ecosystem function by sympathetic management and by avoiding/reversing habitat fragmentation and aim to create substantial areas of new habitat
- Identify and maintain existing ecological networks
- Create buffer zones around all high quality habitats
- Utilise the region's landscape-scale initiatives as delivery mechanisms
- Control harmful invasive species where action can be sustained

Accommodate change

- Be prepared for 'new natives'
- Extend ecological networks
- Allow natural development of coasts and rivers
- Consider translocation where natural dispersal is unlikely

- Develop organisational capacity to cope with change and learn from experience and sharing information

Integrate action across partners and sectors

- Integrate adaptation and mitigation measures
- Integrate policy and practice across economic sectors
- Build and strengthen partnerships, involving the public and private sectors and engaging communities and stakeholders
- Raise awareness of the benefits that the natural environment provides to society

Develop knowledge and plan strategically

- Set a long-term vision, review goals and progress in the light of developing knowledge and evidence and re-assess objectives,
- Repeat regularly
- Establish long-term monitoring
- Identify indicators
- Assess effectiveness of adaptation actions.
- Undertake more comprehensive impact and vulnerability assessments carried out in this study as new evidence emerges
- Undertake scenario planning and implement no regrets actions
- Improve regional understanding of the role and benefits of biodiversity in ecosystem services
- Coordinate existing and potential delivery mechanisms and embed biodiversity adaptation within them
- Pilot new approaches to conservation management and monitor their success

Additionally, Facilitate knowledge transfer and action

- Increase understanding of the impacts of climate change on biodiversity
- Coordinate adaptation and mitigation measures within North East England and adjacent regions
- Strengthen the biodiversity elements in the regional adaptation study and in regional climate change action plan
- Avoid adaptation measures in one sector compromising adaptation in another sector
- Encourage Local Authorities to pursue National Indicator 188 in Local Area Agreements

2. This study provides signposts to guide the region in its approach to biodiversity and climate change adaptation. It sets out a suite of broad principles, which are not prioritised, as factors such as the potential impact of a sector, scale of activity and potential for synergies will all be relevant in implementation

3. Utilise the supportive statements within the region's principal policies (particularly the Regional Spatial Strategy, Regional Economic Strategy and Integrated Regional Framework) to underpin a programme of action to assist biodiversity in adapting to climate change. Iconic species, particularly those of economic significance, could help in communicating this need.

4. Encourage all regional policy documents to clearly recognise:

- The potential direct and indirect impacts of climate change on biodiversity
- The importance of biodiversity for its own sake, for economic reasons, and for the ecosystem services it provides
- The need to assist biodiversity in adapting to these potential impacts

- That more land needs to be managed in a wildlife-friendly manner in order to maintain even existing levels of biodiversity in a warming climate
- The need to make a commitment to such action

5. Develop the concept of 'ecosystem services' and the part biodiversity plays in their delivery in current policy documents.

6. Strengthen adaptation actions for the natural environment in the new Integrated Regional Strategy and ensure they cascade down through Local Development Frameworks.

7. Broaden the region's adaptation needs, as expressed in the North East England Climate Change Adaptation Study, to include biodiversity.

8. Extend the Climate Change Action Plan's adaptation actions for biodiversity.

9. Construct a region-wide adaptation plan for biodiversity, incorporating these actions, as an element of the Climate Change Action Plan. The North East Environment Forum has been identified as a potential lead to coordinating the delivery of these actions.

10. Review existing landscape-scale activities and initiatives and prioritise actions for vulnerable species and habitats, seeking to embed complementary adaptation actions within them and coordinate action across them, before deciding how to promote further landscape-scale programmes.



ClimateNE brings together a range of private, public and voluntary organisations committed to providing a focus on delivering a low carbon and climate resilient economy.

ClimateNE has developed a sound understanding of the scale of the challenge we face and has developed a robust evidence base that will enable both businesses and local government to provide confidence to define stretching targets and promote aspiration and achievement. This work includes the award-winning Climate Change Adaptation Study - looking at what the future climate is likely to be for the North East and how we will need to adapt; an analysis of Greenhouse Gas Emissions; and, crucially, the economic implications and opportunities for the region.



AEA is one of the UK's leading environmental consultancies with a strong track record in providing evidence-based support to public sector policy-makers in the UK and EU. Our Biodiversity Team comprises species, habitat and earth science specialists with wide ranging scientific, policy and field experience in the UK, Europe and the USA. One of our core strengths is our capability in climate impact assessments and the development of adaptation response strategies for biodiversity. We have in-house expertise in assessing the impacts of climate change on species, habitats and ecosystems. We also have an international reputation in the development of adaptation policy for conserving biodiversity in a changing climate and the geomantic tools and skills to underpin the delivery of on-the-ground adaptation measures.

Keith Buchanan is an AEA associate and environmental consultant with more than 25 years experience of working on biodiversity and landscape issues in the UK and internationally. Keith recently designed and led a major project in England to understand the impacts of climate change on wildlife, landscapes and people's enjoyment of those landscapes.



The Environmental Change Institute (ECI) is the University of Oxford's centre for the organisation and promotion of research and teaching on the environment. The Biodiversity Group is at the forefront of integrating and improving techniques for the projection of the impacts of environmental change on ecosystems and species. It undertakes research to advance understanding of ecosystem form and functioning at varying spatial and temporal scales and studies complex human-climate-ecosystem interactions by focusing upon modelling at regional to global scales. It also has a strong interest and expertise in mitigation of and adaptation to climate change.