

Scottish Natural Heritage

# Climate change and the natural heritage

## SNH's approach and action plan



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## Contact

John Baxter  
Policy and Advice Directorate  
Tel: 0131 316 2610  
E-mail: [john.baxter@snh.gov.uk](mailto:john.baxter@snh.gov.uk)

Bill Band  
Strategy and Communications Directorate  
Tel: 01738 458635  
E-mail: [bill.band@snh.gov.uk](mailto:bill.band@snh.gov.uk)

# Climate change and the natural heritage

## Ministerial Foreword

Climate change is one of the most serious threats which we in Scotland face. Rising temperatures, drier summers, wetter winters, sea-level rise, and an increased risk of flooding, will all affect our lives. There is a global need to take action to reduce the greenhouse gas emissions which are responsible, but changes in climate will not be completely eliminated by these actions. We need also to find ways of adapting to the effects of climate change.



The Scottish Government has faced up to these challenges, as we must if we are to create a more successful country. We have introduced world leading climate change legislation, requiring action to reduce greenhouse gas emissions by at least 80% by 2050, and through our Climate Change Delivery Plan, are focused on the transformational changes that will deliver this. We are developing a Climate Change Adaptation Framework that will help Scotland build its resilience to any potential negative consequences of climate change, while taking advantage of any opportunities that arise. In support of this, Scotland has access to the most comprehensive projections of climate change anywhere in the world.

In delivering on our aspirations we need urgent, coordinated action from all sectors, all across Scotland. Our climate change legislation puts in place the framework to support this. The public sector must show leadership, make clear its commitment to action, and work collaboratively to drive action both within the sector and in the communities it serves.

The natural heritage will be affected by climate change, but that heritage can help Scotland to play its part in global efforts to reduce emissions, and to adapt. We can manage woodlands and peatlands to store carbon for us, and we can harness the power of wind and waves to produce clean energy. Good management of the natural heritage can provide services that we rely upon, such as water supply, and reduce flood risk. By supporting Scotland-wide networks of healthy habitats, we can help wildlife disperse into new areas as the climate changes, and create better places for people to live.

The challenge of achieving this is considerable, and I commend SNH for setting out how it will work with others to ensure Scotland's nature prospers in a changing climate, bringing benefits for Scotland's environment, Scotland's economy, and Scotland's people.

A handwritten signature in black ink, appearing to read 'Stewart Stevenson'.

**Stewart Stevenson**

Minister for Transport, Infrastructure and Climate Change





# Climate change and the natural heritage

## SNH's approach



### Introduction

- 1 There is now a scientific consensus that the planet is warming and that the degree of recent changes can be explained only by the effect of human activities. The impact on Scotland's natural heritage is likely to be profound, causing very significant changes to our ecosystems and landscapes within a timescale measured in decades.
- 2 This statement sets out SNH's approach to climate change and SNH's role both in helping to mitigate its effects and in helping society and nature adapt to its consequences. Its publication follows the adoption, in April 2008, of 'Responding to climate change' as one of SNH's five corporate strategic priorities<sup>1</sup>. This statement is accompanied by SNH's first Climate Change Action Plan, setting out in more detail the actions which we intend to take over the next five years.
- 3 SNH views climate change as the most serious threat over coming decades to Scotland's natural heritage. In addition to its environmental consequences, climate change is likely to have major social and economic implications for people in Scotland and elsewhere. SNH aims to understand the effects of climate change on the natural heritage, and to help deliver the contribution that the natural heritage can make in limiting it and adapting to it.



## Implications of climate change for Scotland's natural heritage

- 4 Recent increases in the concentrations of greenhouse gases in the atmosphere result mainly from the burning of fossil fuels and the clearance of forests. The global climate is very sensitive to these increases as these gases, acting like glass in a greenhouse, trap heat within the earth's atmosphere.
- 5 Increasing amounts of greenhouse gases in the atmosphere lead to increasing global average air and surface sea temperatures, widespread melting of snow and ice, and rising sea levels. The oceans are becoming less alkaline as increasing levels of atmospheric carbon dioxide react with sea water. The climate is becoming more unpredictable with more frequent and more extreme weather events, such as heat waves, heavy rainfall, drought and high winds. Such extreme events are difficult to predict beyond a few days away, especially storms. The severity of these problems in particular places will depend on a variety of local factors.
- 6 Current indications (e.g. UK Climate Projections 2009) are that by the 2080s Scotland will be warmer, especially in summer. Snowless winters may become the norm in some parts; winters may become wetter and summers generally drier. Scotland's growing season may increase by 20–80 days. For biodiversity there are likely to be winners and losers. Warming has already caused earlier timing of spring events such as leaf unfolding, bird migration and egg laying. Where species adapt at different speeds this may impact on their populations. For example, caterpillars may emerge earlier than birds' eggs hatch, leading to a lack of food for some bird chicks. Shifts in ranges in plant and animal species have already been recorded, particularly northwards, and there may be new species moving to Scotland, such as the comma butterfly, which has already been observed. Movements may also occur up hillsides, and species already confined to high mountains in Scotland may be lost as conditions become unsuitable or other species replace them.
- 7 Effects on biodiversity are likely to be severe with species becoming extinct as a result of their being unable to adapt to a rapidly changing environment. These effects, when combined with associated disturbances such as flooding, landslips and pests, and human responses such as land-use change to grow bioenergy crops or new forests, will cause major changes to ecosystems and the relationships between species.
- 8 The most obvious changes in Scotland may be to coastal, marine and freshwater ecosystems. As sea levels rise, saltmarsh and machair habitats will be lost where man-made defences or natural topography prevent them moving inland. In the seas around Scotland there have already been shifts in ranges in algal, plankton and fish abundance. Rivers may become more affected by low flows in summer and by flash floods in winter washing out spawning beds for salmon. Wetlands may dry out in summer allowing woody species to colonise or causing peat to erode with consequences for carbon dioxide emissions. Less obvious but significant changes may occur in upland habitats as temperatures rise and snow cover declines. Changes in snow-bed vegetation have already been recorded.
- 9 There will always be a substantial amount of natural variability, giving rise to a wide range of weather events and weather patterns over months to years. Flexibility is likely to be key to making sure that infrastructure and land use, and associated social and economic interests, are resilient to future climate and weather conditions. The natural heritage has an important role to play by making sure that ecosystems retain sufficient integrity so that they continue to provide services, such as flood mitigation, productive land capacity and water supply that are of value to people.

## Scottish Natural Heritage's role

- 10 Climate change will affect almost every aspect of the natural heritage, and the natural heritage will help people adapt to its effects in a number of ways. As the Government organisation with responsibility for care for the natural heritage, SNH has a key role to play in guiding management of the natural heritage in a way which best responds to

climate change. We can do so by ensuring that our national approach and our local decision-making reflect the challenges of climate change in an appropriate way.

- 11 We strongly support the need for major global reductions in greenhouse gas emissions in order to avoid a dangerous level of climate change – taken as a 2°C warming over pre-industrial levels – beyond which there is potential for severe disruption of global ecosystems, food supply, social structures and the global economy. A wide range of measures is required, including energy efficiency, substituting renewable for fossil energy sources, a shift to more sustainable modes of transport, protecting the carbon stored in peatlands and other organic soils, and capturing carbon by growing new woodlands. Whilst Scotland overall is responsible for only 0.2% of global greenhouse gas emissions, SNH recognises the importance of Scotland, as a developed nation, showing leadership in emissions reduction.
- 12 There is a clear risk, as society responds to climate change, that either the urgency of taking action to reduce emissions, or short-term needs to protect infrastructure from flooding or landslip, will lead to action being taken which, in the longer term, is unsustainable, incurring environmental losses or diminishing the resilience of ecosystems. Our aim is to help guide a sustainable approach to responding to climate change, in which a strong, functioning natural environment plays an important role both in helping reduce emissions and in adapting to a changing climate.
- 13 SNH's roles include developing an understanding of the effects of climate change, supporting Government and society in the efforts made to limit these effects, and encouraging that the natural heritage be managed in a way which helps both people and nature to adapt. We aim to advise Government and other policy makers at both a national and local level on sustainable approaches to climate change, commission research, work with local initiatives to encourage and learn from action at a local level, and share and disseminate advice on good practice.
- 14 Our key contributions will be:
  - helping to understand and publicise the effects and consequences of climate change for the natural heritage;
  - advising on infrastructure and land management practices which help to mitigate climate change;
  - guiding adaptation so that nature can, as far as possible, adapt to a changing climate and so that people can make best use of natural processes in preparing for climate change; and
  - promoting action by organisations and individuals by setting an example in the management of SNH's own operations, and communicating our climate change messages clearly and effectively.
- 15 The following sections explain these contributions in more detail and outline our main goals.

### **Helping to understand and publicise the effects and consequences of climate change for the natural heritage**

- 16 There is considerable uncertainty over the likely effects of climate change on Scotland's natural heritage, and how these changes or trends can be influenced or managed. There is a need for better understanding of the changes likely in the range and distribution of species and habitats, and of the effect on ecosystems and landscapes as well as on people's dependence on these. Changes may also result from measures taken by others to mitigate or adapt to climate change. SNH aims to invest in research which will develop our understanding of these effects, and we will use that knowledge to inform the development of suitable adaptation strategies.
- 17 Understanding and knowledge needs to be shared widely among all those who are engaged in responding to climate change. We have a key role in disseminating information about how the natural heritage is changing and about ways of adapting to these changes.

## Advising on infrastructure and land management practices which help to mitigate climate change

- 18 There are new development and land use pressures associated with climate change mitigation – renewable energy development, sustainable transport projects, increased woodland cover, short-rotation forestry and coppice, and growing crops for transport biofuels. In advising on the environmental implications of such development, SNH must take into account the balance to be struck between the benefits of these developments in mitigating climate change and any direct adverse impacts such development may have on the natural heritage. At the same time it is important to protect and enhance our distinctive and diverse wildlife and landscapes, to safeguard that which is valued at national or international level, and to enable both people and nature to adapt to climate change. We aim for all of our policies to take account of this balance of interest.

### Renewable energy

- 19 SNH has a major interest and role in advising on energy developments, which represent a significant and increasing use of land and fresh water, and, in the future, of the sea. We provide advice to developers and to those authorities responsible for approving such development, with a view to enabling Scotland's rich renewable energy resource to be harnessed with least impact on the natural heritage. We have already published statements on *Energy and the Natural Heritage*, outlining how emissions of greenhouse gases associated with energy generation and use can best be reduced with least impact on the natural heritage; on *Renewable Energy*, expressing our strong support for the development of renewable energy subject to due care being taken to minimise adverse impacts on landscapes and wildlife; and on *Marine Renewable Energy and the Natural Heritage*, pointing to the scope for harnessing marine renewable resources while avoiding damage to the marine environment. We also have *Strategic Locational Guidance for Onshore Windfarms*, a statement on *Bioenergy and the Natural Heritage*, and (in preparation) a statement on *Transport and the Natural Heritage*.

### Carbon storage

- 20 Managing land to retain carbon in vegetation and soils is important, particularly here in Scotland where peatland and other carbon-rich soils represent a very significant carbon reservoir. The carbon stored in organic soils (notably peat) in Scotland is equivalent to over 180 years of greenhouse gas emissions from Scotland at current emission rates<sup>2</sup>. It is important that carbon-rich soils remain as long-term sinks rather than becoming sources of greenhouse gases, which occurs when they are drained or damaged. Where appropriate, management should seek not just to reduce carbon loss but to increase the amount of carbon stored in vegetation and soils. Plant photosynthesis recaptures carbon dioxide from the atmosphere, and if the plant material is long-lived or absorbed within the soil, the carbon is thereby 'sequestered'. Continued improvement in methodologies for calculating carbon loss, and greenhouse gas accounting, will increase the accuracy of net emissions estimates. Ways to reduce carbon loss, limit greenhouse gas emissions and increase carbon sequestration include:
- retaining bogs, wetlands and peatlands, avoiding new drainage, and raising the water level of peatlands that were previously drained;
  - minimising disturbance and cultivations on all soils, and concentrating necessary land-use change on mineral rather than highly organic soils;
  - retaining woodland cover, and encouraging woodland regeneration and new woodland on mineral soils;
  - practising continuous-cover forestry and retaining litter and deadwood; and
  - developing more efficient management of nutrients and chemical inputs to the soil to reduce emissions of greenhouse gases, including nitrogen oxides.

## Land management

- 21 Climate change is likely to lead to increased competition between the use of land for food production and energy crops, while meeting requirements to maintain biodiversity and opportunities for recreational access. Given the wide-ranging effects of climate change and its influence on so many aspects of land management, it will be desirable to seek an integrated approach, across all forms of land use and management, based on a consensus on what are appropriate changes. SNH expects to have a key role in contributing to such debates and in encouraging an approach that delivers benefits both for the natural heritage and for people.

## Transport and travel

- 22 SNH strongly supports the aim of reducing greenhouse gas emissions from transport, and the inclusion in Scotland's National Transport Strategy<sup>3</sup> of reducing emissions as one of three strategic outcomes sought. A range of approaches is required, including higher vehicle efficiency (through encouraging eco-driving, car sharing and car clubs), use of low-carbon vehicles powered by renewable energy sources, the use of more sustainable modes of transport, planning the growth of settlements around public transport networks and encouraging greater use of active travel – especially cycling and walking – for local journeys. As an organisation, we are driving down the emissions arising from our own business travel and will encourage good practice by our staff in travelling to work (see paragraph 40).
- 23 SNH will encourage all forms of active travel as a way for people to enjoy the outdoors, and at the same time improve health and reduce travel by road vehicles. A high-quality and safe natural environment can help to make such journeys more attractive. Good path networks in urban areas can enable people to walk or cycle to local services such as shops. Linking path networks to other transport routes, e.g. to rail stations and ferry terminals, enables users to access the countryside widely using public transport. SNH will also encourage provision of public transport services to popular countryside destinations where these enable people to have a lower carbon footprint than travelling by car. We will encourage the development of more sustainable tourism which is less reliant than hitherto on travel by private car, but in which opportunities for visitors to enjoy the natural heritage are not diminished.

## Guiding adaptation so that nature can as far as possible adapt to a changing climate and so that people can make best use of natural processes in preparing for climate change

- 24 SNH strongly supports action to help both society and nature adapt to the effects of climate change. Adaptation should be concerned with building the resilience of ecosystems, and restoring damaged ones, so that they can continue to support biodiversity as well as provide public benefits, e.g. by using the capacity of wetlands to help reduce the intensity of flooding downstream. Adaptation should be directed also at facilitating the ability of species to adapt or disperse as climatic conditions change.

## Resilient ecosystems

- 25 Climate change gives a new impetus to taking an ecosystem approach that considers the interdependence between species, habitats, and associated natural processes, and the benefits that people receive from these, such as water regulation, coastal protection, food production including fish and game, and the cultural, aesthetic, and economic benefits derived from people being able to enjoy wildlife and landscapes. Climate change is leading to change in the underlying processes and hence will affect such 'ecosystem services'.

- 26 We aim to maintain the resilience of ecosystems so that they continue to provide these services that support human life as well as biodiversity. Our response must be based on a better understanding of these natural processes and of the limits to their functioning, then using this expertise to guide land management. Reducing other pressures on ecosystems, e.g. from pollution or habitat fragmentation or attrition, will be important in building resilience to climate change, as will maintaining the extent and diversity of habitat types, landscape features, species, and genetic diversity. Maintaining ecosystem resilience has implications for all those connected with the management of the natural heritage.

### **Catchment and river flood management**

- 27 Restoring natural processes in freshwater systems – rivers, lochs and wetlands – will make them more robust in a changing climate. Flood management needs to be considered at the scale of the river catchment, and should take into account the effects of land use on run-off rates. Natural flood management techniques, such as the creation of wetlands or floodplains, should be deployed wherever possible to make full use of the ability of natural systems to reduce flood risk. Vegetation, soils and wetland habitats can play a major role in slowing run-off from catchments, and absorbing overspill within flood plains. Whilst these approaches are likely to cost much less and be more sustainable than building and maintaining engineered solutions such as barriers and walls, they may require significant changes in land use, transport infrastructure and business and housing developments. In practice, a mix of engineered and natural flood management approaches to adaptation is likely to be needed. The latter should be initiated as soon as possible since it can take time to build up their capacity to reduce flooding. Measures to improve flood management should be integrated with other adaptation action, such as enhancing riparian habitat to reduce the impact of increasing river water temperatures on salmon and trout in particular.

### **Coastal management**

- 28 Coastal management, in response to a rising sea level and increased storm surges, should take a similar approach to catchment management but at the level of the coastal cell – a stretch of coastline between major headlands within which coastal sedimentation and erosion processes are highly interdependent. Where there is an adequate sediment supply from adjacent sections of coastline, soft engineering techniques can be deployed by making use of coastal habitats, sand and gravel to absorb wave energy. This may involve removing existing coastal defences to allow the coast to realign inland, thus reducing pressure elsewhere. Managed coastal realignment can have benefits in replacing lost coastal habitat such as saltmarsh or mudflats, though the net effect will be to lose land area through coastal retreat. Decisions on where realignment is appropriate need to take account of the costs and benefits to a range of coastal land uses.

### **The urban environment**

- 29 In towns and cities, the natural environment can help develop resilience to the effects of climate change, e.g. using trees and shrubs around buildings and in public open space to reduce energy demands for cooling and insulating purposes, or using greenspace to manage floodwater within flood plains and stormwater through sustainable urban drainage schemes (SUDS). Managed with wildlife in mind, gardens and greenspace can contribute to ecological networks that can help biodiversity to adapt to climate change.
- 30 In urban settings a decreasing reliance on cars could result in more emphasis on the role of local greenspace for recreation, particularly in areas close to where people live and work, and of walking and cycling for access to local services and workplaces. Well-designed green networks can help to encourage and enhance the experience of such active travel.

## Management of nature conservation sites

- 31 The effects of climate change on nature will need careful consideration in biodiversity conservation policies – for species, sites and in the wider countryside. Protected sites will remain important for biodiversity conservation because they have characteristics, such as low nutrient levels, greater habitat diversity and natural processes, that will continue to favour high biodiversity. However, their current objective is to maintain the features for which the site was designated, and climate change may affect these species and habitats. Management needs to differentiate between changes that can be influenced through management, as presently occurs (e.g. such as allowing or preventing natural succession by altering grazing rates), and those that cannot be prevented (e.g. reduced snow lie) leading to certain plant species dying out, or migratory birds wintering further north in warmer winters<sup>4</sup>. As elsewhere, maintaining the underlying ecological processes and associated habitat structures, along with a level of habitat variability, is likely to be the best way of maintaining the resilience of protected sites and their associated biodiversity. Management of sites should also consider their role in flood management and carbon sequestration.
- 32 Management of individual sites should not be considered in isolation, but as part of a wider ecological network. For some species protected sites may be an important source for dispersal in response to climate change. They may also provide important habitats for species colonising from elsewhere. This role may be enhanced by improving the connectivity between sites. There may be scope to manage some sites to allow colonisation by species that are moving from areas where the climate has become unsuitable, where this is not detrimental to the sites' special features. Not all incoming species will be beneficial for biodiversity conservation – some of those most able to disperse are likely to be highly invasive (see paras 37 and 38).

## Species and habitat conservation priorities

- 33 With a changing climate, the 'climate space' for each species or habitat – the geographical and altitudinal zone to which it is well adapted – is likely to move, usually northwards or uphill, though the pattern may be more complex. Conservation targets for individual species and habitats that are considered priorities for action will need to take into consideration the implications of climate change and changes in climate space. As for site management, decisions need to be based on an understanding of whether any changes are due to climate change or other factors. Given that resources are limited, priorities should take into account the long-term implications of climate change for each species, and the loss of a species from a region, or even from Scotland, may need to be accepted. The general principles of maintaining ecosystem resilience – through maintaining extent and diversity of habitats, natural processes, landscape features and connectivity – will become all the more important. Again, the wider climate change role of habitats should also be considered, such as by peatlands in carbon sequestration or by wetlands and woodlands in water management.

## Ecological connectivity

- 34 With climate change, because of the need for species to be able to disperse into new areas, species are much more dependent on there being suitable habitats in the wider countryside rather than just on designated sites. Many habitats in lowland Scotland and also part of the uplands are already highly fragmented due to land-use change including agriculture, built development, transport infrastructure and afforestation. Further fragmentation needs to be avoided where possible, as species populations which have more habitat and are well connected are likely to be more resilient than if they are distributed across isolated fragments of habitat.
- 35 Connectivity may also help some species disperse as they find new climate space. The role of ecological networks and connectivity between habitats in aiding species dispersal and facilitating large-scale population shifts in response to climate change is

not yet clear. However, as an approach it makes good ecological sense. Hence a general principle underlying all forms of land management and land use planning should be to maintain and develop ecological connectivity. This principle should be embedded in agricultural and forestry practice, in the Scottish Rural Development Programme, and in management plans for National Parks and National Scenic Areas. Green networks in urban areas, such as the proposed Central Scotland Green Network, may have a strategic role in providing ecological connectivity through highly urbanised areas.

### Species translocations

- 36 Even with good networks of habitat, many species will not be able to disperse fast enough in response to climate change. For some species this may threaten their populations in Britain and elsewhere. It may be necessary to consider translocating such species to new sites, but this will be need to be based on thorough research. Translocations can be high risk and costly, because of difficulties in understanding precise habitat needs and associated uncertainties over survival rates, the possible need for off-site propagation or captive breeding, and the level of care needed to capture and release wild animals. They are therefore generally considered as a last resort. For a few species, the effects of climate change may simply result in no suitable climate space in the UK.

### Colonising species

- 37 A risk management approach is needed to identify potential threats to the natural heritage, and to agriculture and forestry, from invasive non-native species including pests and disease that are able to spread as a result of climate change. For those that pose the greatest threat, measures to prevent species arriving are best, followed by rapid eradication if this fails. These actions should be taken forward through the Invasive Non-native Species Strategy for Great Britain. Priorities for action should take account of both potential benefits and the costs of action, which can be significant, making eradication of some species impractical.
- 38 However, we should not necessarily take a blanket negative approach to 'non-native' species arriving in the UK. Species that currently occur in northern and western Europe may need to move into Britain if they are to maintain their populations as conditions in their current range become unsuitable. These are likely to be species with an ability to disperse over water, such as birds and insects, but other species may arrive with inadvertent assistance from people, e.g. plant seeds on vehicles. We may need to accept that Scotland's current plant and animal communities will change in ways that we are not used to and cannot anticipate.

### Promoting action by organisations and individuals by setting an example in the management of SNH's own operations, and communicating our climate change messages clearly and effectively

- 39 SNH is committed to setting an example in the management of our own operations to minimise greenhouse gas emissions, which we aim to reduce by 4% each year<sup>5</sup>. We work closely with Government and other public bodies to develop good practice and high standards in environmental management and carbon reduction which can be applied elsewhere within the public sector. We aim to ensure that we are seen as a public sector exemplar in the delivery of environmental policies, to complement the Scottish Government's Greener Scotland 'Leading by Example' Initiative, and to help meet its 'Greener' strategic objective *'to improve Scotland's natural and built environment and the sustainable use and enjoyment of it'*. Our new Inverness office, Great Glen House, has met the highest standards for energy efficiency, and we have installed, or are installing renewable energy generation at several offices. The majority of our visitor centres on National Nature Reserves are accredited to the Green Tourism Business Scheme, which requires close attention to reducing energy use in buildings.

- 40 Our Environmental Management Programme has already reduced emissions from travel through encouraging use of public transport, by investing in video-conferencing for meetings, and by reducing the carbon-intensity of our vehicle fleet for journeys that have to be made by car. We have staff travel plans for major offices, which we use to influence the provision of public transport and to encourage car sharing and cycling to work. We have also introduced a sustainable procurement policy, applying sustainability criteria to our procurement processes. The criteria relate to energy and resource use, waste minimisation, recycling and biodiversity impacts. We will continue to reduce our carbon emissions, with offices and units responsible for meeting agreed local targets, and will review and stretch our targets over time, working to support Scottish Government objectives, taking advice from the Carbon Trust and sharing good practice with other bodies in the public sector.
- 41 Having addressed reduction in our own emissions, our next priority is to encourage others to do so too, e.g. by attaching conditions to the grants we give to other organisations. We will review the emissions for which we are indirectly responsible through the advice we give, so as to ensure that our advice on better management of the natural heritage takes account of the need for carbon reductions. We will review our existing policies to ensure that they pay due regard to climate change objectives. We play a significant role in supporting environmental education and will use opportunities to raise a general awareness of climate change, its effects on the natural heritage, and what people can do to reduce it by their own actions.
- 42 We will review our operations in the light of the potential impacts of climate change, to ensure that our offices, properties, visitor facilities on nature reserves, and our ways of working are well prepared for the challenges which climate change may bring. Property developments will continue to take account of potential weather-related hazards and constraints relevant to location, including the potential over the medium to long term for the increased risk from flooding, coastal erosion, wind damage, rainfall patterns and volatile temperatures. Some current buildings may – over time – become less suitable for future weather patterns and sea-level rise and we will respond in good time, using information from property condition surveys. Maintenance of our current property portfolio and infrastructure operates on a shorter timeframe (around 3–5 years) and so will keep pace with local changes to weather patterns.

## Conclusion

- 43 These four roles and the objectives outlined above will guide SNH's work in responding to climate change over the coming years. In the next section the Climate Change Action Plan sets out in some detail the activities and actions which SNH intends to take over the next five years to progress these objectives.
- 44 Managing the uncertainties of climate change in decision making is likely to remain a major challenge for everyone in Scotland. There are substantial uncertainties about the timing, distribution, magnitude, and location of climate change impacts, and about how both human society and the natural world will respond to a changing climate. We do not have all of the answers. We will learn from others to improve the help, advice and guidance that we are able to offer. In developing our role and the objectives outlined above we intend to work with the Scottish Government, local government and the public sector, communities, the business community including developers, educational and research establishments and, most important, those who manage the land and sea.

## Notes

1 SNH Corporate Strategy 2008–2013

2 Scottish Government (2009) Climate Change Delivery Plan: Meeting Scotland's Statutory Climate Change Targets

[www.scotland.gov.uk/Publications/2009/06/18103720/0](http://www.scotland.gov.uk/Publications/2009/06/18103720/0)

3 Scottish Government (2006) National Transport Strategy

[www.scotland.gov.uk/Topics/Transport/NTS](http://www.scotland.gov.uk/Topics/Transport/NTS)

4 For a Scottish case study see UKCIP (2006) Incorporating Adaptive Measures to Climate Change on Sites Designated for Nature Conservation: A Guideline to Making Decisions

5 Our baseline year is 2007/2008 for which our emissions totalled 1739 tCO<sub>2</sub> (1203 tCO<sub>2</sub> from energy and 536 tCO<sub>2</sub> from transport). For details see SNH's Environmental Management Programme Annual Report 2007–2008

[www.snh.org.uk/pdfs/greening/B330139.pdf](http://www.snh.org.uk/pdfs/greening/B330139.pdf) (accessed 15 May 2009)

# Climate change and the natural heritage

## SNH's climate change action plan 2009–2014



### Introduction

- 1 Climate change is now widely recognised as the most significant issue facing the planet in the 21st century, with far-reaching implications not only for the human population but for all living things.
- 2 Changes are being observed at global, international, national and local scales. Average global temperatures are increasing, sea levels are rising, ocean acidification is occurring and the polar ice caps and glaciers are melting. At the same time, as a consequence, major global processes, such as the North Atlantic Conveyor, are showing signs of disruption and extremes of drought and flood are increasing.
- 3 In Scotland there is evidence of such changes with relative sea-level rise affecting large parts of the coast, maximum and minimum peak river flows increasing, average air and sea surface temperatures increasing, and species distributions changing.
- 4 Climate change is not a new phenomenon; there have been periods of extremes and high atmospheric carbon dioxide levels in distant past times. What is unusual now is the rate and scale of change, and the underlying cause of such changes, namely enhanced emissions of greenhouse gases associated with human activity.



- 5 Climate change will have profound effects on the basic elements of life for people – water, food production, health and trade and economics. *The Stern Report* (2006)<sup>(1)</sup> estimated that inaction on addressing the challenge could result in something between 5% and 20% loss in global GDP/year, compared with a cost of 1% GDP/year to reduce greenhouse gas emissions so as to avoid the worst impacts.
- 6 Climate change will have impacts on the environment at a range of scales from the individual to the habitat and the ecosystem. The shifting climate space for individual species has implications not only at that level but also between species where one is dependent on another, e.g. the time of flowering of a species may be advanced but the time of hatching of a dependent insect may not be changed. The changing climate space may also force species to move their distribution but other natural (or man-made) barriers may compromise their ability to do so, especially if the rate of change is fast. For most mobile species, such as birds and large mammals, such movement is not likely to be a significant problem across their range, although some local extinctions where climate space is lost are inevitable. For many invertebrates and plants, their rate of dispersal is so slow that they may not be able to keep up with the rate of change. In the marine environment there are similar natural barriers, such as fronts and headlands, preventing effective distribution.

The response to climate change can be with one of two ends in mind, namely Adaptation and Mitigation.

#### **Adaptation**

Adaptation is the adjustment of natural or human systems in response to actual or expected climate change which moderates harm or exploits beneficial opportunities (adapted from IPCC definition). Resilience of a social or ecological system enables it to absorb disturbances while retaining the same basic structure and ways of functioning and the capacity to adapt to change.

#### **Mitigation**

Mitigation measures seek to prevent climate change caused by human activity through reducing greenhouse gas emissions and enhancing greenhouse gas sinks. It can be achieved through energy efficiency measures, societal behavioural changes to reduce energy consumption, by using renewable energy rather than energy derived from fossil fuels, by technological advances in energy generation and protecting and enhancing natural carbon stores including peat and vegetation.

### **Framework of Government action**

- 7 The EU, UK and Scottish Governments are strongly committed to a low carbon economy. Through demonstrating strong leadership on climate change, the Scottish Government seeks to make its contribution to current UK and wider international climate change objectives to reduce emissions and to adapt to the unavoidable impacts, and to influence the international community to agree more ambitious future action.
- 8 At the UK level, the UK Climate Change Act<sup>(2)</sup> became law in November 2008 and, in Scotland, the Climate Change (Scotland) Bill ('Scottish climate change legislation'<sup>(3)</sup>)<sup>1</sup> was passed by the Scottish Parliament in June 2009. Both have committed the respective Governments to achieving ambitious targets to reduce greenhouse gas emissions by at least 80% by 2050. The Scottish climate change legislation has also set an interim reduction target of at least 42% by 2020, with a power to vary the interim target based on expert advice, and is supported by a Climate Change Delivery Plan, which sets out a vision of how these targets may be met<sup>2</sup>. Under the Scottish climate change legislation,

<sup>1</sup> The Scottish Bill will become an Act following Royal Assent in summer 2009.

<sup>2</sup> Electricity demand and supply, heat demand and supply, transport, rural land use and waste.

there is a duty on public bodies, including SNH, to help in delivering on these targets and to contribute to relevant programmes of adaptation to climate change.

- 9 Scotland's Climate Change Adaptation Framework<sup>3</sup> will set the strategic framework for action in Scotland to help cope with the inevitable consequences of past greenhouse gas emissions. Delivery of the Adaptation Framework will be facilitated by the Scottish Climate Change Impacts Partnership<sup>4</sup> (SCCIP). Scottish Ministers are also required, under the Scottish climate change legislation, to bring forward a land use strategy which contributes both to climate change mitigation and adaptation objectives.
- 10 Addressing the challenges and consequences of climate change cannot be taken in isolation, policies such as agriculture and fisheries management also have a major influence. Climate change not only puts more pressure on these resources but also potentially changes what land management options may be possible. The particular way to achieve the aims of Natura (an EU network of protected sites) and other nature conservation initiatives will be altered by climate change. For those species and habitats for which Scotland has special responsibility, whether efforts should be made to maintain their current distribution even in the face of climate change, or whether they should simply be assisted to adapt, is a question to be considered further.
- 11 In developing our understanding across the various natural heritage interests, we will make use of the UK Climate Projections 2009 (UKCP09)<sup>5</sup>, produced by the Met Office, and the UK Climate Change Impacts Partnership<sup>6</sup>, which are the most recent projections of the impact of climate change for the UK. Working from a basis of historical information on temperature, precipitation, storminess, sea surface temperatures and sea level, these projections make use of low-, medium- and high-emission scenarios to project the range of possible climate outcomes for temperature, precipitation, air pressure, cloud and humidity, and for the marine environment, sea-level rise, storm surge, sea surface and sub-surface temperature, salinity, currents and waves.

## SNH's Action Plan

- 12 'Responding to Climate Change' is a key priority of SNH's Corporate Strategy 2008–2013<sup>7</sup>. SNH has a key role in developing and implementing plans to aid adaptation to climate change, and a contributory role in the measures put in place in the mitigation of climate change through advising on the implications of whatever measures and new technologies are introduced, as well as through the actions of the organisation to reduce its carbon footprint. This 5-year Climate Change Action Plan sets out how we will help respond to these challenges for Scotland's natural heritage and our population by:
  - helping to understand and publicise the effects and consequences of climate change for the natural heritage;
  - advising on infrastructure and land management practices which help to mitigate climate change;
  - guiding adaptation so that nature can, as far as possible, adapt to a changing climate, and so that people can make best use of natural processes in preparing for climate change; and
  - promoting action by organisations and individuals by setting an example in the management of SNH's own operations and communicating our climate change message clearly and effectively.
- 13 The key to helping to understand, and thus address, some of what is going on is having targeted monitoring and research in place to help inform future decisions. Research is required to answer fundamental questions and inform future policy decisions. Long-term monitoring is required to measure the nature and rate of change of some of our most vulnerable habitats and species.

<sup>3</sup> Expected to be published towards the end of 2009.

- 14 The following sections of the Action Plan set out the activities that SNH will undertake in addressing the challenge of climate change. Many will be taken forward in partnership with other agencies and bodies. For convenience these activities are divided into a number of distinct, but interlinked, topics:
- A **Habitats and Species Management:** incorporating species and protected area management.
  - B **Freshwater Catchments, Coasts and Seas:** including fresh waters and wetlands, coasts and seas, and abating flood risks.
  - C **Enjoying the Outdoors:** incorporating recreation and tourism, towns and cities and landscape.
  - D **Land Use Planning:** including spatial planning and renewable energy.
  - E **Land Management:** advising on management of natural resources in agriculture, uplands, soils and woodlands.
  - F **Cross-Cutting Issues:** including trends and indicators, and developing supporting policies and institutional arrangements at national and local levels.
  - G **SNH Corporate Working:** covering SNH processes, policies and practice.
- 15 For each topic, after a general overview, the 'key issues' most relevant to our remit and priorities are identified. Where feasible, SNH will seek to collaborate with others to maximise efficiencies and beneficial outcomes and to resolve conflicts and minimise constraints.
- 16 The tables in each section set out our objectives, and the actions which SNH can expect to take during the period of this plan. These are set out in three columns— 'Understanding', 'Mitigation' and 'Adaptation' – which reflect the first three of the four key contributions outlined above. Our fourth contribution – SNH setting an example to others – will be delivered through actions contained in the 'Cross-cutting' and 'SNH Corporate working' sections.



## A Habitats and Species Management

### Species

- 17 Climate change is changing the abundance and distribution of many species in and around Scotland and is altering the synchrony of seasonal events. There will be 'winners' and 'losers' as some new species move in and others move out. Species with a predominantly southern distribution are most likely to benefit, such as the nuthatch (*Sitta europaea*), which is already spreading into southern Scotland. Species with a northern/mountain distribution are more likely to be adversely affected by climate change. This could be at a local, regional or national scale. For example, the alpine saxifrage (*Saxifraga nivalis*) is currently confined to locations above 837m in Scotland and appears extremely vulnerable to any future temperature rise.
- 18 Further habitat fragmentation as a result of climate change may lead to isolation of smaller populations of species. Such fragmentation needs to be avoided. Species populations with access to suitable inter-connected habitats are likely to be more resilient than those confined to isolated fragments of habitat.
- 19 Most species, however, will survive, although relative distributions, abundances and dominances may change. The changing climate already appears to be affecting the timing of natural seasonal events (phenology), such as spring flowering. This changing seasonality is a key issue that needs to be taken into account in future management decisions.
- 20 Those native species not able to adapt sufficiently quickly to climate change will experience increased stress, thus reducing their competitiveness and increasing their vulnerability to invasive non-native species. Of the 450 established non-native higher plant species in Britain, around 10–15% are already considered as invasive, and as a result of climate change this number could increase.

## Key issues for SNH

- 21 The main issues for native species include changing numbers and distribution, loss of synchrony between predators and prey, changes in habitat quality, quantity and availability, and the increased competition from invasive non-native species. Such issues will be addressed through appropriate management across the wider countryside and on protected areas. Work will be coordinated through a number of frameworks including the UK Biodiversity Action Plan<sup>[6]</sup>, Scottish Biodiversity Strategy<sup>[9]</sup> and Scotland's Species Action Framework<sup>[10]</sup>. The survival of species that are unable to disperse, but for which suitable habitat within Scotland still persists, may be assisted by translocations. Translocations, however, can be high risk and costly and are a last resort.
- 22 However, when seeking to increase resilience, it must be recognised that climate change is an additional stress on species and habitats, which may already be subject to a number of pressures, e.g. fisheries, agricultural intensification and diffuse pollution, etc. Future action will have to be prioritised based on a combination of affordability, feasibility and likelihood of long-term success.

## Protected Areas

- 23 SNH has responsibilities for a range of sites designated for their nature conservation interest, notably Sites of Special Scientific Interest (SSSIs), Natura sites (Special Areas of Conservation and Special Protection Areas) and National Nature Reserves (NNRs). SNH also has responsibilities for National Scenic Areas (NSAs) and advises Ministers on National and Regional Parks.
- 24 Collectively, SSSIs, NNRs and Natura 2000 sites cover more than 15% of Scotland and include a wide representation of Scotland's natural features. The majority are in private ownership and subject to a wide range of land uses. SNH encourages the conservation management of these sites through advice and the Scottish Rural Development Programme (SRDP) <sup>[11]</sup>. NNRs are used to showcase the best of Scotland's natural heritage. We encourage high standards on these reserves, and have direct responsibility for managing some NNRs. Selected NNRs also support the Environmental Change Network <sup>[12]</sup> (ECN).
- 25 SNH operates a programme of site condition monitoring (SCM), which, although not specifically designed to detect the effects of climate change, can provide a baseline to assist in picking up trends across Scotland.
- 26 Nineteen per cent of Scotland is covered by landscape designations: NSAs, National Parks and Regional Parks. These typically include extensive semi-natural areas, and provide scope for addressing the impacts of climate change on land managed for a range of different land management functions. Both National Park Plans have identified climate change as a key issue and the respective National Park Authorities will be key partners for SNH in developing practical planning and management responses to climate change. While less developed, the planning and management of NSAs also has potential to help address the impacts of climate change.
- 27 The developing SNH evidence base, includes both basic facts and figures and spatial, temporal and phenological trends analysis. Of the suite of 16 natural heritage indicators used by SNH <sup>[13]</sup>, the one specifically relating to climate change shows that seasonal events, in terrestrial, freshwater and marine environments, are occurring earlier.

## Key issues for SNH

- 28 Designated features on all protected areas may be affected by climate change. The notifiable features on SSSIs can be amended if the existing features are compromised as a result of climate change. SNH also advises the Scottish Government on the selection and designation of Natura sites. Where the qualifying features of such Natura sites are affected by climate change, new guidance for all EU Member States on how to respond to these changes will be required.

- 29 Furthermore, SNH and approved bodies<sup>1</sup> may manage NNRs to achieve various policy objectives, and these sites could be used to demonstrate adaptive management in response to climate change.
- 30 Protected areas will remain important for species and habitat conservation. They will provide source populations and colonising habitat for dispersing species. There will also be a role for protected landscapes in helping to address the impacts of climate change.
- 31 We anticipate that climate change will impact directly and indirectly on the special interests of protected areas. These impacts will add to the range of other pressures currently experienced by individual habitats and species. Given the relatively small size of most protected areas, and under a changing climate, we should consider their role as part of a much wider ecological network, encouraging in particular wetland management and carbon sequestration.

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<sup>1</sup> An approved body can be a non-governmental organisation or a public body owning and managing land as an NNR. For more detail please see SNH NNR Policy statement [www.snh.org.uk/pdfs/polstat/nnrpolcy.pdf](http://www.snh.org.uk/pdfs/polstat/nnrpolcy.pdf)

## Habitats and Species Management

	<b>Understanding</b>	<b>Mitigation</b>	<b>Adaptation</b>
	Helping to understand and publicise the effects and consequences of climate change for the natural heritage	Advising on infrastructure and land management practices which help to mitigate climate change	Guiding adaptation so that nature can, as far as possible, adapt to a changing climate and so that people can make best use of natural processes in preparing for climate change
<b>Species</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● greater understanding of those species most likely to be directly affected by climate change and its wider implications</li> </ul> <p><b>Actions</b></p> <p><b>Sp1:</b> Identify those species that are most sensitive and vulnerable to climate change, and prioritise options for future management.</p> <p><b>Sp2:</b> Develop and disseminate a joint Country Agencies and JNCC position on the independent establishment of species from continental Europe, filling niches vacated by movement of existing native species.</p>		<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● UKBAP species action plans are implemented to ensure objectives are met and that future climate change is taken into account</li> <li>● the movement of species through the Scottish landscape and fresh waters in response to climate change is supported by aiding habitat connectivity</li> <li>● prevention of invasions of non-native species and maintenance of healthy and robust ecosystems</li> </ul> <p><b>Actions</b></p> <p><b>Sp3:</b> Work with partners to deliver robust UKBAP species Action Plans.</p> <p><b>Sp4:</b> Work with partners to deliver an integrated ecosystem management approach.</p>
<b>Protected Areas</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● establish the role of protected areas, as part of a wider ecological network, in relation to climate change</li> <li>● SSSIs continue to represent the diversity and geographical range of the natural features of Scotland</li> </ul> <p><b>Actions</b></p> <p><b>PA1:</b> Determine the role of protected areas, as part of a wider ecological network and ecosystems approach, in relation to climate change.</p>		<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● maintain the integrity of the SSSI series</li> <li>● maintain a suite of NNRs to deliver primacy on nature, along with research, specialist management, health and well-being, interpretation and education, and understanding and enjoyment objectives, as appropriate to each site</li> <li>● protected areas are managed to take account of the climate change effects on those species present as notified features/qualifying interests of the sites</li> </ul> <p><b>Actions</b></p> <p><b>PA2:</b> Develop and disseminate guidance for adaptive management of protected sites, particularly those which will be affected by sea-level rise, flooding and erosion.</p>



## B Freshwater Catchments, Coasts and Seas

### Fresh water and wetlands

- 32 We expect that the impacts of climate change on the water cycle will be significant. Direct impacts upon Scottish rivers, burns and lochs will arise through changes in precipitation and temperature, and will compound the effects of existing pressures such as eutrophication and acidification. Increased flushing due to more frequent storm events may increase nutrient loss from the wetlands but also remove dissolved and particulate carbon. In addition, large amounts of water will bring in sediment and nutrients and disturb already settled sediment. Recorded trends include significant increases in river flows and temperature increases in particular parts of Scotland. For example, there has been a 40% increase in maximum winter flow in the River Teith<sup>[14]</sup> over the last 40 years with Loch Leven experiencing an increase of 1.5°C in mean spring temperature between 1970 and 2000<sup>[15]</sup>.
- 33 As part of the freshwater system, wetlands are a key habitat in mitigating climate change because of their large stores of carbon, and can significantly contribute to reducing both economic and human costs of flooding and eutrophication. Carefully managed wetlands can partially buffer climatic extremes whilst also enhancing the landscape. Wetlands provide many catchment benefits including flood storage, pollution removal, wildlife habitat, groundwater recharge, erosion control and maintenance of basal flows in watercourses that support Scotland's salmon fisheries.
- 34 In the future, increasing average temperatures and winter precipitation, along with the frequency of extreme events such as flood and drought, will lead to more pronounced seasonality in future flow patterns in rivers and growing seasons in lochs. Variable, wetter, warmer conditions will potentially encourage methane production from acidic wetlands, changing some wetlands from a sink to a carbon source. Predicted wetter conditions in the west may lead to an expansion of existing seasonal wetlands. Ecosystems, such as upland headwaters and rivers at the extremes of their range, are predicted to be particularly vulnerable and may require specific strategies to preserve their integrity.

- 35 Stable, warmer periods during the summer will lead to the drying of wetlands in some locations. This drying will result in carbon being returned to the atmosphere and may leach sulphur into run-off waters, leading to acidification. Some freshwater biodiversity is vulnerable to climate change as much of their conservation value lies in their isolation from other fresh waters (e.g. glacial relic fish populations). Non-mobile species are particularly vulnerable to change as they have little opportunity to adapt or move location. We can anticipate that increased temperatures will reduce the competitiveness of some native species, particularly cold-water adapted species such as Arctic charr, and favour non-native species.

### **Key issues for SNH**

- 36 By developing a coordinated approach with partners we can improve our understanding of how Scottish wetlands function as part of catchments. Wetlands play a key role in the wider dynamic catchment system, where habitat creation and loss is accommodated, and can provide robust ecosystem services, such as flood mitigation, in a changing climate. Peat contained in wetlands is a major carbon store, but current extractions release that carbon to the atmosphere. Management of wetlands to ensure they are in a resilient condition, and the ability to support existing species whilst accommodating those species displaced from southern habitats, is important.
- 37 Restoring natural processes in catchments is essential. There is, however, continued uncertainty about the rate and the scale of the effects of climate change, and the creation and loss of habitats is only possible in those dynamic systems able to adjust to changing regimes. In particular, the role of woodland in flood management needs to be recognised, along with catchment scale erosion and flood protection measures.
- 38 SNH will continue to work in partnership to take forward River Basin Management Planning across Scotland, and to assist in implementing the recently passed Flood Risk Management (Scotland) Act 2009<sup>[6]</sup>.

### **Coasts and Seas**

- 39 Climate change will lead to increased erosion and redistribution of coastal landforms and habitats, with consequent impacts on people and their property as well as habitats and other natural heritage interests. Recent scenarios indicate rates of relative sea-level rise will exceed those experienced during the last 7000 years in the coming decades<sup>[7]</sup>. These future scenarios are compounded by the fact that isostatic recovery (i.e. the rise of land masses that were depressed by the huge weight of ice sheets during the last glacial period) stopped keeping pace with global sea-level rise in the last century. Such a rate of change will have widespread and very significant effects on coastal processes, landforms, habitats and broader interests within the coastal zone. Rising relative sea level, falling sediment supply and fluctuating levels of storminess are particular issues for coasts, especially those which are low-lying.
- 40 The seas around Scotland are showing signs of the influence of increasing surface temperatures, with changes in the distribution of some common intertidal species and the establishment and spread of new invasive non-native species. Changes in the storminess and in particular frequency of the most severe storm events may result in further changes to the benthos. Increasing levels of atmospheric carbon dioxide lead directly to ocean acidification, which will also have major implications, especially for those organisms with calcareous skeletons (e.g. molluscs and phytoplankton).
- 41 The changing conditions will also affect the patterns of distribution of species and in some instances the timing of events. As a result, disruptions to ecological inter-linkages and inter-dependencies are already being seen, e.g. between seabird breeding success and changing proportions in sandeel and pipefish numbers.
- 42 Changes in hydrological patterns, including tidal currents and oceanic fronts, will affect the distribution of planktonic larval stages of many species. This will not only lead to

possible disruption of existing distribution patterns, but also potentially compromise their ability to relocate in the face of changing environmental conditions.

- 43 Changes in the distribution and abundance of various commercial fish species is also happening, with stocks of various whitefish moving north into cooler waters and more warm water species encroaching from the south. Such changes need to be viewed within the larger picture of other pressures on these stocks from fisheries and their future sustainable management.

### **Key issues for SNH**

- 44 Sediment coasts including sand dune, machair, saltmarsh and shingle already move around. The degree of mobility depends on local circumstances and this is likely to increase significantly in the future. Any adaptation activity will need to be carefully planned in order not to exacerbate a problem. It will be important to identify the most cost-effective measures, which will ideally work with, rather than against, natural processes.
- 45 The changes that will continue to occur in the sea will have direct effects on the community composition and consequently the features of interest of designated sites. We will need to ensure that all the implications of climate change are fully considered within the context of wider marine spatial planning. Issues such as renewable energy developments, new shipping routes and the introduction of new invasive non-native species will require further evaluation.

## Freshwater Catchments, Coasts and Seas

	Understanding	Mitigation	Adaptation
	Helping to understand and publicise the effects and consequences of climate change for the natural heritage	Advising on infrastructure and land management practices which help to mitigate climate change	Guiding adaptation so that nature can, as far as possible, adapt to a changing climate and so that people can make best use of natural processes in preparing for climate change
<b>Fresh Water</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● adaptive management strategies informed by sound knowledge of freshwater and wetland ecosystems and important species</li> </ul> <p><b>Actions</b></p> <p><b>Fw1:</b> Expand, renew and improve our present information base on freshwater and wetland habitats and species.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● wetlands are seen as a key component in sustainable management for climate change mitigation and habitat restoration</li> <li>● effective catchment management plans are developed to help mitigate flood risk and help achieve multiple benefits</li> <li>● maintain bogs in a healthy condition to ensure that they remain a carbon store and not a net producer of methane</li> </ul> <p><b>Actions</b></p> <p><b>Fw2:</b> Ensure that peat is not used for any operations undertaken by SNH, or on our behalf through our grants. Encourage other organisations and the public to phase out the use of peat products.</p> <p><b>Fw3:</b> Support the catchment management planning process.</p> <p><b>Fw4:</b> Provide support for bog habitat improvement through drain blockage schemes.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● improved resilience of river ecosystems, catchments and the lochs within those catchments</li> <li>● dynamic fully functioning wetlands that are accommodated within the landscape providing ecosystem services and economic benefits</li> <li>● threats to freshwater habitats are clearly identified and appropriate measures implemented to reduce or adapt to threats where possible</li> </ul> <p><b>Actions</b></p> <p><b>Fw5:</b> Support and utilise long-term datasets to inform adaptive management.</p>
<b>Coasts and Seas</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● those areas most vulnerable to rising sea level and/or storm waves are identified to improve understanding, advice and management options</li> <li>● policy makers and decision takers are well informed of the implications of climate change in the marine environment</li> </ul> <p><b>Actions</b></p> <p><b>CS1:</b> Coordinate Light Detection and Ranging (LiDAR) mapping campaign to assess and manage vulnerable coasts within SEARS<sup>1</sup> partnership.</p> <p><b>CS2:</b> Roll-out Shorelook Project, phase 2<sup>2</sup>.</p> <p><b>CS3:</b> Continue to contribute to the Marine Climate Change Impacts Partnership (MCCIP).</p>		<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● mechanisms are in place to allow for adaptive management decisions to be taken and to provide assistance to key species</li> </ul> <p><b>Actions</b></p> <p><b>CS4:</b> Contribute to informing the decision-making process for adaptive coastal management.</p>

<sup>1</sup> Scotland's Environmental and Rural Services, which includes Animal Health, Crofters Commission, Deer Commission for Scotland, Forestry Commission Scotland, National Park Authorities, Scottish Environment Protection Agency, Scottish Government Rural Payments and Inspections Directorate and Scottish Natural Heritage [www.sears.scotland.gov.uk](http://www.sears.scotland.gov.uk)

<sup>2</sup> The Shorelook Project aims to establish the pattern and rate of past coastal morphological and habitat change, assess the present situation and develop scenarios of future change for key sites on the coast where future management issues are likely to develop.



## C Enjoying the Outdoors

- 46 Climate change will have significant implications for people's interaction with the natural heritage. Key developments include the increasing rate and scale of landscape change; new patterns of recreation and tourism, both locally and nationally; new approaches to the design and planning of settlements, with an enhanced role for green infrastructure<sup>1</sup>; and continued efforts to develop new sources of renewable energy on land and sea.
- 47 Collectively, these developments have important implications for people's enjoyment and use of the natural heritage. If planned for and managed effectively, they also provide opportunities to increase people's contact with nature, to support better health and well-being and to contribute to the economy. SNH has an important role to play in increasing understanding and raising awareness of these changes and in developing new thinking, advice and best practice to make the most of these changes.
- 48 Landscapes are continually evolving, but the speed and significance of climate change and our response to it has the potential to accelerate change. Renewable energy generation and changes in forestry, land management and agricultural practices are likely to generate the most change, notably in the uplands. Changes to the design and planning of settlements, economic pressures on food supply and on land for development, shifts in grazing patterns and new crops such as biofuels may also alter the character of lowland landscapes. The use of new engineered solutions at the coast and in flood risk areas will present particular challenges as well as opportunities for our landscapes. Proactive land use management can help deal with these changes, and should play an important role in adaptation and mitigation policies.
- 49 A third of Scotland's £4.2 billion income from tourism is inspired by and focused on enjoying the outdoors, with our growing international reputation for wildlife watching, mountain biking, cycle touring and other activity-based holidays helping to support further growth in tourism. Continued growth in domestic tourism may produce climate change savings in terms of terms of reduced air travel, but further investment is required

<sup>1</sup> Green Infrastructure is the network of green (and blue) elements in and around urban areas. This includes public and private spaces such as parks, gardens, allotments, cemeteries, trees, green roofs and natural landscape features such as woodland, grassland, moors and wetlands. [www.sustainablecities.org.uk/green-infrastructure/](http://www.sustainablecities.org.uk/green-infrastructure/)

in provision and management of the outdoors and in sustainable tourism to realise this potential and to reduce any negative environmental impacts on the natural heritage.

- 50 We can anticipate changes to patterns of recreation resulting from climate change. For example, over the medium term, reduced snow-fall and snow-lie will reduce opportunities for winter sports, including skiing and snow mountaineering, while better spring and autumn conditions could extend our tourist season. Higher specifications in path and other infrastructure may be needed to cope with more visitors or extreme rain events, coastal and inland flooding, more frequent and extreme fluctuations in freeze/thaw, and less snow-fall. At the same time, longer growing seasons in the future could help in re-vegetating and reinstating ground damaged through recreational use.
- 51 In urban Scotland, predicted changes in weather patterns and sea level will have specific impacts. These impacts, and how we respond to them, could significantly change the planning and design of our towns and cities. Along with climate change adaptations, reducing the carbon footprint of towns and cities will influence both new and existing development. Our networks of open space, woodlands, wildlife habitat, parks and other natural areas can minimise direct climate change impacts. For example, tree planting can help to provide shade, so aiding urban thermal comfort, and ponds and wetlands can help to reduce flood risk as part of Sustainable Drainage Systems (SUDS). Better provision and planning of greenspace and greenspace networks can also provide opportunities for recreation, landscape enhancement and active travel close to home and support action on biodiversity.

### **Key issues for SNH**

- 52 Little has been done to assess the nature, scale or distribution of landscape change, or how people will respond to these changes. A major uncertainty is how social and economic responses to climate change might impact on the landscape and vice versa. With partners, SNH will seek opportunities for solutions which can deliver landscape, other natural heritage, social and economic advantages.
- 53 Increases in countryside recreation and sustainable tourism in Scotland have a significant role to play in reducing our carbon footprint, as well as contributing to other important social and economic objectives. Greater understanding is required about how best to maximise these opportunities and to manage the environmental impacts of these activities. Future provision and management will need to take account of the impacts of climate change on patterns of recreational use. Mitigation responses which reduce the reliance on cars will help to highlight walking and cycling for functional access and countryside recreation, particularly close to home. SNH can contribute by helping to influence good practice in countryside recreation and sustainable tourism, through supporting the provision, management and promotion of paths and places, and through best practice on our NNRs and other protected areas.
- 54 SNH will contribute to developing a greater understanding of the roles and benefits of green infrastructure through research and advocacy, by inputting to national planning policies and through supporting the establishment of green networks.
- 55 The Park Plans of both National Parks have identified climate change as a key issue and both the National Park Authorities will be key partners for SNH to work with in developing best practice in visitor and recreational management to address climate change.

## Enjoying the Outdoors

	Understanding	Mitigation	Adaptation
	Helping to understand and publicise the effects and consequences of climate change for the natural heritage	Advising on infrastructure and land management practices which help to mitigate climate change	Guiding adaptation so that nature can, as far as possible, adapt to a changing climate and so that people can make best use of natural processes in preparing for climate change
<b>Recreation and Tourism</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● increased understanding of environmental impacts of recreation and tourism in a changing climate</li> </ul> <p><b>Actions</b></p> <p><b>RT1:</b> Monitor and raise awareness and understanding of changes to patterns of recreational use and tourism resulting from climate change or policy responses to climate change.</p> <p><b>RT2:</b> Increase awareness and understanding of the potential role of outdoor recreation and sustainable tourism in contributing to climate change mitigation, alongside other social and economic objectives.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● support action to promote walking and cycling close to home</li> <li>● work with tourism partnerships to increase emphasis of sustainability issues across the industry</li> <li>● promote use of public transport for visitors to designated sites</li> <li>● all eligible visitor centres on NNRs to achieve accreditation of Green Tourism Business Scheme</li> </ul> <p><b>Actions</b></p> <p><b>RT3:</b> Promote sustainable travel for outdoor recreation, including travel to Long Distance Routes (LDRs) and NNRs.</p> <p><b>RT4:</b> Undertake research into environmental impacts of tourism, including climate change impacts.</p> <p><b>RT5:</b> Ensure that SNH funding for enjoying outdoors activity promotes reductions in emissions of greenhouse gases.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● provide policy and technical advice on the provision and management of paths and infrastructure in response to climate change or changing patterns of recreation resulting from climate change</li> </ul> <p><b>Actions</b></p> <p><b>RT6:</b> Ensure that SNH policy, research and practice on tourism and recreation adequately addresses the potential impacts of climate change.</p>
<b>Towns and Cities</b>		<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● planned, designed and managed new development which supports active travel and reduces Scotland's overall carbon footprint</li> </ul> <p><b>Actions</b></p> <p><b>TC1:</b> Develop and disseminate advice on the role of greenspace in towns and cities in reducing urban emissions, e.g. by creating shelter and accommodating active travel routes.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● an urban Scotland planned to enhance opportunities to enjoy the outdoors and support environmental services and enhanced ecological connectivity</li> <li>● initiatives are in place to ensure that greenspace contributes actively to the sustainable management of Scotland's towns and cities</li> </ul> <p><b>Actions</b></p> <p><b>TC2:</b> Develop and disseminate advice on the role of greenspace in towns and cities in enabling towns to adapt to climate change, e.g. by managing flood risks and maintaining ecological connectivity.</p>

Enjoying the Outdoors (continued)

	Understanding	Mitigation	Adaptation
Landscape	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● better understanding and communication of how landscapes may change as a result of adaptation and mitigation measures and, as far as possible, to unplanned social and economic responses</li> <li>● maintenance of a watching brief on climate change scenarios and the consequent direct and indirect impacts on Scotland's landscapes</li> </ul> <p><b>Actions</b></p> <p><b>L1:</b> Aid understanding and awareness of landscape impacts through modelling the significant changes.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● effective mitigation measures which set integrated objectives to establish resilient ecosystems for people and wildlife</li> </ul> <p><b>Actions</b></p> <p><b>L2:</b> Undertake good practice case studies to explore mitigation measures at the landscape scale.</p> <p><b>L3:</b> Provide a climate change mitigation perspective into nationally and locally important landscape strategies.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● effective adaptation measures which set integrated objectives to establish resilient ecosystems for people and wildlife</li> </ul> <p><b>Actions</b></p> <p><b>L4:</b> Undertake good practice case studies to explore adaptation measures at the landscape scale.</p> <p><b>L5:</b> Provide a climate change adaptation perspective into nationally and locally important landscape strategies.</p>



## D Land Use Planning

- 56 Land use planning in Scotland provides the spatial expression of economic, social and environmental policy. While dependent on the detailed policies in other sectors, new planning policies and approaches should be developed to maximise the contribution of land use planning to tackling climate change as set out in the Scottish Government's Climate Change Delivery Plan. Through planning policy and Strategic Environmental Assessment (SEA) at the national and local level, SNH can contribute to ongoing 'climate-proofing' of future plans and strategies and to guiding new development.
- 57 Land use planning is undergoing modernisation, e.g. the 2006 Planning Act<sup>[18]</sup> includes a duty on planning authorities to further sustainable development. The National Planning Framework, (NPF<sup>[19]</sup>), provides a spatial strategy and action plan for delivering sustainable economic growth and policies for transport, energy, housing and industry, water and drainage and natural heritage. Any significant effect of a Plan, Programme or Strategy on climatic factors must be assessed as part of the SEA process<sup>[20]</sup>.
- 58 In Scotland there is a very high potential for both electricity generation and the production of heat from renewables, largely due to high average wind speeds and high rainfall combined with suitable topography for hydro generation. Both hydro and windfarm developments tend to be in more remote, upland areas where sensitive habitats and species are more common and where landscape and visual impacts can be considerable, such that there is a need for careful assessment of natural heritage impacts and mitigation opportunities.
- 59 The Scottish climate change legislation requires Ministers to produce a land use strategy which will need to take account of the competing demands on land for energy, carbon sequestration and the essential services which the natural environment provides.

### Key issues for SNH

- 60 Capitalising upon Scotland's renewable energy resources poses a particular challenge for SNH in terms of potential impacts on the natural heritage. Wind, hydro and marine renewables in particular can have significant adverse impacts on species, habitats, landscapes, recreation and other natural heritage interests.
- 61 Future change can, in part, be guided by the town and country planning system and SEA. In guiding built development, these mechanisms provide the spatial expression of social, economic and environmental policies. Policies and priorities delivered through the

National Planning Framework, Scottish Planning Policy and the system of development plans will need to take into account actions required to manage climate change responses.

- 62 As part of wider change to address the design and planning of urban areas and settlements, greater understanding of the roles and benefits of green infrastructure in adapting to climate change needs to be developed. Aspirations and standards for the provision and management of green infrastructure also need to be raised. SNH can contribute to this work through research and advocacy, inputting to national planning policies and through supporting the establishment of green networks.

## Land Use Planning

	Understanding	Mitigation	Adaptation
	Helping to understand and publicise the effects and consequences of climate change for the natural heritage	Advising on infrastructure and land management practices which help to mitigate climate change	Guiding adaptation so that nature can, as far as possible, adapt to a changing climate and so that people can make best use of natural processes in preparing for climate change
<b>Renewables</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● more coordinated advice amongst SEARS partners' Renewable Energy proposals; for a range of Renewable Energy installation types</li> </ul> <p><b>Actions</b></p> <p><b>R1:</b> Liaise with SEARS<sup>1</sup> partners to develop guidance on renewable energy installations and the natural environment, including cumulative effects and potential benefits.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● high-quality and impartial advice is delivered on renewable energy planning applications</li> <li>● targeted guidance is delivered to developers and planning authorities on assessing the potential impacts of renewable energy proposals</li> <li>● maintenance of a national overview of the effects of renewable energy developments on the natural heritage</li> <li>● maintenance of dialogue with the renewable energy industry, Scottish Government and wider stakeholders, ensuring that natural heritage interests are safeguarded</li> </ul> <p><b>Actions</b></p> <p><b>R2:</b> Influence the development of bioenergy policy, to encourage use of biomass that represents the most efficient use of land for reducing emissions of greenhouse gases while safeguarding the natural heritage.</p> <p><b>R3:</b> Provide advice on new proposed marine renewables developments.</p> <p><b>R4:</b> Respond to consultations on renewable energy proposals.</p> <p><b>R5:</b> Maintain an overview of the impacts of energy development on the natural heritage and publish guidance as appropriate.</p> <p><b>R6:</b> Deliver a programme of 'Sharing Good Practice' events on renewables with partners.</p>	

<sup>1</sup> Scotland's Environmental and Rural Services, which includes Animal Health, Crofters Commission, Deer Commission for Scotland, Forestry Commission Scotland, National Park Authorities, Scottish Environment Protection Agency, Scottish Government Rural Payments and Inspections Directorate and Scottish Natural Heritage [www.sears.scotland.gov.uk](http://www.sears.scotland.gov.uk)

## Land Use Planning (continued)

	Understanding	Mitigation	Adaptation
<b>Spatial Planning</b>		<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● Scottish planning policy operates effectively at a range of scales (from NPF2 to local development planning)</li> <li>● significant natural heritage–climate change–mitigation issues are covered by SNH planning consultation responses</li> <li>● the Strategic Environmental Assessment process fully addresses climate factors at each stage</li> </ul> <p><b>Actions</b></p> <p><b>SP1:</b> Work with the Scottish Environment Protection Agency (SEPA) and Historic Scotland to ensure consistent provision of advice on SEA in relation to climate change.</p> <p><b>SP2:</b> Provide advice on the impacts of major development proposals, taking into account the opportunities for climate change mitigation.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● Scottish planning policy operates effectively at a range of scales (from NPF2 to local development planning)</li> <li>● significant natural heritage–climate change adaptation issues are covered by SNH planning consultation responses</li> <li>● the Strategic Environmental Assessment process fully addresses climate factors at each stage</li> </ul> <p><b>Actions</b></p> <p><b>SP3:</b> Provide advice on the impacts of major development proposals, taking into account the impacts of climate change.</p> <p><b>SP4:</b> Provide advice on planning policy, development planning and land management in relation to climate change, landscape and the natural heritage and ecosystem services.</p>



## E Land Management

- 63 It is anticipated that climate change in Scotland will have direct impacts at many levels across the range of different types, uses and management of land throughout the country.
- 64 Climate change directly influences the natural processes of soil formation and erosion, but it is also likely to influence farm production systems and natural ecosystem functions, thereby affecting soil properties, quality and productivity. Soils contain substantial reserves of carbon, particularly the peat soils of the cooler and wetter parts of the country. Land use and soil management contribute to substantial greenhouse gas emissions from the agricultural and forestry sectors, including carbon dioxide, methane and nitrous oxide.
- 65 Under a changing climate, soils currently classed as not versatile may become more amenable to agriculture, potentially changing the pattern of agricultural production in Scotland. The risk of increased carbon dioxide emissions increases with conversion of organic soils to cropland, as much of the stored organic matter decomposes.
- 66 Over most of Scotland longer growing seasons are being recorded due to warmer and wetter conditions. Improved cereal and grass growth are likely to lead to new farming enterprises becoming viable, while some existing enterprises may decline, either in direct response to the changing climate or to make way for new ones. We expect that the wider effects of climate change will include increased demand for food and non-food crops, including bioenergy crops, resulting in increased pressure on land.
- 67 In a warmer, wetter climate, diseases such as potato blight will be more difficult to control, with the possibility of non-native pests and plant and animal diseases becoming more established. Recent work<sup>[21]</sup>, however, indicates that our major tree species will still be broadly suited to Scotland. Significant uncertainties and risks lie within this assessment, e.g. rainfall changes may alter local site suitability for certain tree species.
- 68 Milder winters are likely to lead to higher deer numbers, adding to the issues of managing deer populations and their various woodland and moorland habitats. The Scottish Government has a target to expand woodland cover from 17% to 25%<sup>[22]</sup>, by the middle of the century, one of the objectives of which is to mitigate climate change. The Scottish Government's Climate Change Delivery Plan proposes that the planting

rate should increase from 4000ha/year to 15000ha/year by 2015. New funding may become available through carbon management schemes. The availability of suitable sites and competitive pressures from farming and energy developments may limit such planting, however, or bring it into conflict with natural heritage interests and associated services. There may be opportunities to strengthen Scotland's relatively small native woodland resource, which is in poor condition with an ageing population structure, and which is experiencing fragmentation and loss.

- 69 The uplands account for around 60% of Scotland's land area, and support a wide range of habitats. These in turn support great species diversity, some at the limits of their range. Uncertainties make it difficult to assess the potential impacts of climate change on the uplands' communities, but robust monitoring can provide us with the evidence to assess potential change.
- 70 Perhaps most obvious will be displacement of habitats upslope, with tree lines rising, more vigorous species encroaching into montane and alpine communities and reduced snow-lie threatening specialist niches. We may observe a loss of synchrony between abundant food sources, e.g. plants and insects, and those breeding animals dependent on them.
- 71 On top of these direct effects are indirect ones. Drier summers may increase the frequency and severity of wildfires, leading to soil and habitat loss and damage. Increased winter wetness, and particularly storm events, may also lead to greater erosion, including more frequent peat slides. As the guardian of some of the largest peat reserves in Europe, we need to improve our understanding of peatlands to allow us to take appropriate action.
- 72 The Scottish Government Scottish Soil Framework<sup>[23]</sup> promotes the sustainable management and protection of soils and the soil carbon resource in balance with the economic, social and environmental needs of Scotland; recognising that the most significant pressures on our soils in Scotland are climate change and loss of soil organic carbon. Sustainable use of soil is central to achieving many of the SNH strategic objectives, along with Government targets for reductions in greenhouse gas emissions by 2050.
- 73 Ecosystem responses to climate change and sea-level rise are conditioned by geomorphological processes<sup>1</sup>. How the land forming processes of the coasts, tidal areas, rivers and hill slopes respond to weather events and long-term climate changes will depend on the sensitivity of that particular dynamic environment, and what has happened there previously. Geodiversity<sup>2</sup> and biodiversity are closely linked, demanding integrated risk assessment and sustainable management of change, e.g. through managed realignment of the coast and 'natural' forms of flood management for flood-prone catchments. Such adaptation requires us to work with natural processes at a hill slope, catchment or coastal zone scale.
- 74 In developing adaptive management, it is important to better understand how landform systems and habitats will respond to the speed and scale of projected changes. For example, in the next two decades sea level rise is estimated to exceed rates seen over the last 10,000 years.

### **Key issues for SNH**

- 75 Changes in agriculture, such as conversion to short-rotation coppice, or woodland expansion on marginal agricultural land, could radically change the appearance of large areas. Pressure on land could lead to the renewed loss of lowland wildlife that depends on field margins, fallow and set-aside, and the food webs these habitats support. Further declines in cattle production in marginal and hill areas would result in changes to biodiversity and to these traditional landscapes.
- 76 However, a focus on reducing emissions of greenhouse gases from land use could potentially benefit the natural heritage, by adopting measures such as better targeting of fertilisers, reduced tillage, and retaining or enhancing wetlands and woodlands.

<sup>1</sup> Geomorphological processes are those which presently, as well as in the past, shape or have shaped the earth's land surface.

<sup>2</sup> Geodiversity is the variety of rocks, minerals, fossils, landforms, sediments and soils, together with the natural processes which form and alter them.

Efforts to increase woodland cover as climate change mitigation, should also be designed to achieve simultaneously other public benefits such as biodiversity and landscape enhancement, with appropriate siting and species use.

- 77 In adapting to climate change, the generally poor condition of our existing native woodlands, and their fragmented distribution and small area are key issues. This poor condition significantly increases the risk of biodiversity loss through local extinction, as individual woodlands are less resilient to external pressures.
- 78 Raising awareness of the value of Scotland's soils is important, especially of organic-rich soil, by providing good evidence and integrating soil management into existing policy, guidance and best practice advice. It is important to protect and enhance soils for their biodiversity value and as a carbon sink. Assessing the impacts of adaptation and mitigation measures on soil productivity and land versatility remains significant.
- 79 Managing ecosystem adaptations to climate change requires a better understanding of the links between geodiversity and biodiversity. In particular, improving knowledge of geomorphological and soil systems, including their sensitivities and likely responses to climate change, is important. Raising awareness that the landscape is dynamic, and of the need to accept and work with change, remains a key task for the future. Scenario modelling of likely geomorphological responses/projected trends for coasts and river catchments will help assessment of ecosystem vulnerability and inform adaptive management as processes adjust to climate change and sea-level rise.

## Land Management

	Understanding	Mitigation	Adaptation
	Helping to understand and publicise the effects and consequences of climate change for the natural heritage	Advising on infrastructure and land management practices which help to mitigate climate change	Guiding adaptation so that nature can, as far as possible, adapt to a changing climate and so that people can make best use of natural processes in preparing for climate change
<b>Agriculture</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● raised awareness of the impacts of pests and diseases on the natural heritage in a changing climate</li> <li>● raised awareness of the likely changes in agricultural patterns as a result of climate change</li> </ul> <p><b>Actions</b></p> <p><b>Ag1:</b> Assist in developing greater understanding and promoting awareness of the impacts of agricultural patterns and livestock diseases on the natural heritage, and the implications for biodiversity landscape, recreation and access.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● effective measures for farmers to mitigate climate change, particularly reduced nitrous oxide emissions, and soil managed to maintain a reserve of carbon</li> <li>● grazing management which protects peatland soils from oxidation and erosion</li> <li>● increased planting of native trees in the farmed landscape</li> </ul> <p><b>Actions</b></p> <p><b>Ag2:</b> Promote and adopt the use of low carbon emission options for the management of land.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● agri-environmental measures which contribute to a connected network of wildlife habitats in farmed landscapes</li> <li>● precautions developed against the spread of livestock diseases</li> <li>● sustainable crop protection practices are in place, making farming systems more resilient without increasing pressure on the environment</li> </ul> <p><b>Actions</b></p> <p><b>Ag3:</b> Continue to input to adaptation measures for sustainable land management.</p> <p><b>Ag4:</b> Promote the role of agri-environment schemes which increase the resilience of wider countryside populations.</p>

## Land Management (continued)


	Understanding	Mitigation	Adaptation
Woodlands	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● better understanding of how native woodland is affected by climate change, and how our woodlands and wider landscapes can be adapted to deal with the impacts of a changing climate</li> </ul> <p><b>Actions</b></p> <p><b>W1:</b> Publish and disseminate the results of the “Long March”, to inform future advice on ecological networks.</p> <p><b>W2:</b> Publish further guidance on establishing habitat networks, including web-base decision support tool.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● the expansion of new native woodland to deliver multiple benefits</li> </ul> <p><b>Actions</b></p> <p><b>W3:</b> Advise on forestry policy and practice to support native woodlands, e.g. Scottish Forestry Strategy and SRDP measures.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● native woodlands are in favourable condition with improved resilience to potential climate change impacts</li> <li>● reduced woodland fragmentation as a result of new woodland planting and other land use change (with limited impact on other habitats)</li> <li>● robust landscape ecology measures, e.g. patch size, fragmentation/connectivity, which act as both generic indicators and as components of the ‘favourable condition’ concept in native woods</li> <li>● the expansion of new native woodland</li> <li>● effective landscape or catchment-scale land use planning used as appropriate</li> </ul> <p><b>Actions</b></p> <p><b>W4:</b> Reduce herbivore impact on wider countryside woodland condition and area, especially on sites identified through the Native Woodland Survey of Scotland.</p> <p><b>W5:</b> Support initiatives to tackle removal of non-native species.</p>
Uplands	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● a greater understanding of current monitoring needs for upland species and habitats in the face of climate change</li> </ul> <p><b>Actions</b></p> <p><b>Up1:</b> Review monitoring in the uplands to prioritise future monitoring programmes.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● improved mechanisms which determine and ensure upland land management capable of delivering multiple benefits</li> <li>● criteria for prioritising blanket bog restoration projects</li> <li>● improved understanding of the carbon storage capacity of different vegetation communities and potential carbon losses and gains associated with community change</li> </ul> <p><b>Actions</b></p> <p><b>Up2:</b> Prioritise areas for management which promote biodiversity and net carbon gain.</p> <p><b>Up3:</b> In collaboration with partners (e.g. FCS and NE) establish the net carbon stores associated with upland and woodland vegetation communities.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● improved mechanisms which determine and ensure upland land management is capable of delivering multiple benefits</li> <li>● appropriate management for natural heritage benefits in the uplands, including measures to increase resilience to climate change impacts</li> </ul> <p><b>Actions</b></p> <p><b>Up4:</b> Develop and disseminate guidance on grazing and burning management.</p>

## Land Management (continued)

	Understanding	Mitigation	Adaptation
<b>Soils</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● raised awareness of the implications and impacts of climate change on organic soils</li> </ul> <p><b>Actions</b></p> <p><b>S1:</b> Publish and disseminate the results of research under the theme of 'Peat erosion and the management of peatland habitats'.</p> <p><b>S2:</b> Review greenhouse gas fluxes from degraded, intact and restored peatlands.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● soil carbon resources (in peat and other organic soils) are protected against accelerated carbon loss and maintain carbon levels through appropriate land use and management</li> <li>● soil is seen as a key component in sustainable management for adaptation/mitigation and restoration of sites and habitats</li> <li>● the Scottish Soil Framework and Soil Framework Directive implemented to raise awareness of value of Scotland's soil and to encourage integration of soil protection into relevant policy areas</li> </ul> <p><b>Actions</b></p> <p><b>S3:</b> Produce guidance and advice for sustainable use of soils for the protection of habitats, species and landscape; linking with the Scottish Soil Framework, SRDP measures and UK-led research.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● a better assessment of the degree and distribution of risk and sensitivity to change on the relationship between soil and habitats</li> </ul> <p><b>Actions</b></p> <p><b>S4:</b> Promote understanding of the relationship between soil and habitat sensitivity by supporting and participating in UK-led projects.</p>

## Land Management (continued)

	Understanding	Mitigation	Adaptation
<b>Geodiversity</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● raised awareness and understanding of the important role of geodiversity in developing adaptation management to address climate change impacts on the natural heritage</li> <li>● raised awareness of the likely responses of dynamic geomorphological and soil systems to climate change</li> <li>● raised awareness that the landscape is dynamic, can be hazardous, and that it is sometimes more appropriate for us to adapt, rather than seek to control natural processes</li> </ul> <p><b>Actions</b></p> <p><b>G1:</b> Promote the links between geodiversity and biodiversity in applied adaptive management.</p> <p><b>G2:</b> Develop the UK Geodiversity Action Plan, taking climate change issues into account.</p> <p><b>G3:</b> Promote awareness of the need to adapt our behaviour to cope with dynamic natural systems in a changing climate.</p> <p><b>G4:</b> Promote understanding of the relationship between geodiversity and habitat sensitivity by supporting and participating in UK-led projects.</p>		<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● all relevant adaptation management practices and policies take account of geodiversity processes</li> </ul> <p><b>Actions</b></p> <p><b>G5:</b> Develop and communicate scenarios of how active geological processes will respond to projected changes in climate.</p> <p><b>G6:</b> Develop adaptive management strategies taking account of dynamic and static geodiversity sites.</p>



**Marine climate change impacts**  
Exploring ecosystem linkages

Understanding the links between climate change impacts on the oceans is a critical priority for our future wellbeing. By taking a new 'bigger picture' approach, we can start to show how the interconnected nature of the marine ecosystem magnifies the many discrete impacts of climate change, documented in the MCCIP Annual Report Cards.

To support this new approach, we asked five groups of leading scientific experts on issues such as ocean acidification, Arctic sea-ice loss, seabirds and food webs, non-native species, and coastal economies to give us their views.

**CO<sub>2</sub> and ocean acidification**  
In the last 200 years, ocean acidity has increased by 30% and at a rate much faster than anytime in the last 50 million years. This has serious implications for marine ecosystems and climate regulation.


**Arctic sea ice**  
In the last decade there has been a 30% decrease in summer sea ice extent and a 15% reduction in winter sea ice, leading to changes in habitats and ecosystems.

**A view from above**  
Climate change has already caused changes in plankton, fish distribution and species composition in the seas around the UK. Declines in some seabird populations such as black-legged kittiwakes, terns and skuas may continue as a result.

**Non-native species**  
Most introductions of non-native species have arrived via human intervention, intentional or otherwise. The likelihood that they will establish and flourish in the UK marine environment could be greater due to climate change.

**Coastal economies and people**  
Many of our coastal communities will face both challenges (e.g. increased flood and erosion risks, declining traditional fisheries) and opportunities (e.g. new tourism patterns, new fisheries) through climate change.

[www.mccip.org.uk/eit](http://www.mccip.org.uk/eit)



**Action on Climate Change**

The Scottish Environment Protection Agency (SEPA), Scottish Natural Heritage (SNH), Forestry Commission Scotland and Historic Scotland are all government funded organisations with responsibilities for different aspects of Scotland's environment and heritage. We have come together to make a joint statement on climate change.

## F Cross-Cutting Issues

- 80 Climate change requires a response at all levels – international, national and local – and for action by individual sectors to be integrated, coordinated and supported by common principles and priorities. SNH will use its expertise and experience on the natural heritage to support the development of policy and guidance relating to climate change, and to secure agreement on shared principles and priority actions.

### Key issues for SNH

- 81 Working with other public bodies, e.g. SEARS partners and Historic Scotland, to define roles and responsibilities, SNH will ensure that our work complements, rather than overlaps with, that of others. SNH will make sure that work on communications and information supports, or where appropriate is integrated with, wider efforts.
- 82 SNH will make use of wider information, including the new UK Climate Projections 2009<sup>[24]</sup>, to test approaches under different climate futures and enable better decisions based on probabilities and risks.
- 83 The Scottish climate change legislation places a duty on public bodies, including SNH, to contribute to both emission reduction targets and adaptation to climate change. Local authorities in Scotland have signed up to a Climate Change Declaration<sup>[25]</sup> with commitments relating to adaptation, mitigation and communication. The delivery of outcomes identified through Single Outcome Agreements with Community Planning Partnerships provides a means of coordinating action amongst relevant partners at a local level. In some parts of Scotland, e.g. the Highlands and North-east Scotland, specific climate change partnerships have been set up to identify priorities.
- 84 Key climate change messages are being delivered with support from public communications campaigns in Scotland, coordinated through the Scottish Government. SNH will identify those aspects of climate change which, as a public body with responsibility for advice on the natural heritage, it should contribute to this wider network of communications.
- 85 As a corporate priority, SNH is developing an evidence base, as an inventory including basic facts and figures and trends analysis, including spatial, temporal and trends in the timing of natural events. Abundant environmental data exist but natural heritage trends showing responses to climate are thus far inconclusive. It is important to

undertake a coordinated review of all evidence in Scotland. By working with the Joint Nature Conservation Committee, SNH will investigate species and habitat distributions. Developing monitoring in a more coordinated way with others, including the SEARS family and, in particular, working with Forestry Commission Scotland (FCS) on habitat networks and Scottish Environment Protection Agency (SEPA) on the ecological status of water bodies, should prove cost-effective in the future.

## Cross-Cutting Issues

	Understanding	Mitigation	Adaptation
	Helping to understand and publicise the effects and consequences of climate change for the natural heritage	Advising on infrastructure and land management practices which help to mitigate climate change	Guiding adaptation so that nature can, as far as possible, adapt to a changing climate and so that people can make best use of natural processes in preparing for climate change
<b>Cross-Cutting Issues</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● key messages on climate change are communicated effectively within and outwith SNH</li> <li>● climate change legislation, policies, strategies and plans at all levels are well integrated and based on principles and actions that support the natural heritage, its enjoyment and sustainable use.</li> <li>● raised awareness of the implications of the impacts of climate change on the wider natural heritage</li> </ul> <p><b>Actions</b></p> <p><b>CCI1:</b> Provide advice and input related to the natural heritage to climate change legislation, policies, strategies and plans including at local, regional, Scottish, UK and EU levels where appropriate.</p> <p><b>CCI2:</b> Develop and implement an SNH Climate Change Communications Plan, along with partners.</p> <p><b>CCI3:</b> Assist in developing greater understanding and promoting awareness of the impacts of climate change on the natural heritage, e.g. under the wider SNH environmental education programme.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● informed policy and advice on mitigation through reporting on natural heritage trends</li> </ul> <p><b>Actions</b></p> <p><b>CCI4:</b> Identify and document natural heritage trends related to adaptation and mitigation of climate change.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● informed policy and advice on adaptation through reporting on natural heritage trends</li> </ul> <p><b>Actions</b></p> <p><b>CCI5:</b> Participate in climate change-related partnerships to share information and good practice, including UKIACCF<sup>1</sup>, SCCIP<sup>2</sup>, SENCE<sup>3</sup>, and local partnerships.</p>

1 UK Climate Change Interagency Climate Change Forum.

2 Scottish Climate Change Impacts Partnership.

3 The SENCE group comprises SNH, SEPA, HIE, Scottish Enterprise and the Sustainable Development Commission.



## G SNH Corporate Working

- 86 SNH will ensure that its internal processes, policies and practices model the efforts we are encouraging others to make. The SNH Environmental Management Programme<sup>[26]</sup> sets out the direction and key targets in terms of our own climate change impacts. We will work with other public bodies and government to drive up the standards and consistency of environmental/sustainability/climate change programmes throughout the public sector. These standards, policy and behaviour changes are delivered by different parts of SNH – managers in charge of staff and offices, NNR Programme Board, Business Support Services, HR, Finance and the Senior Management Group; as well as all employees having responsibilities to model good practice.
- 87 The impacts on climate change from the activities of public bodies have become increasingly important in recent years, with all public bodies now encouraged to develop and achieve carbon-reduction targets in their own operations. In SNH terms, this will include the carbon impact of grants, land management agreements, partnerships and agreements and professional advice to others as well as the impact of our own corporate operations.
- 88 The Scottish Government identifies a leading role for the public sector in the Climate Change Delivery Plan. In managing our own operations, SNH can support this through demanding reduction targets for carbon and other greenhouse gas emissions, sharing best practice and visible reporting on performance. The Scottish climate change legislation energy performance certificates, BREEAM<sup>1</sup> and other building standards all demand a process of continued improvement.

### Key issues for SNH

- 89 The biggest issues for SNH are continuing to reduce the organisation's emissions of greenhouse gases (which primarily arise from office energy use and from staff travel) and replacing fossil fuel use. SNH is delivering these actions through local management and via measures to change behaviours, such as promoting the use of video-conferencing for meetings; changes to SNH policies and procedures, e.g. our sustainable staff travel and procurement policies; along with additional specific measures at every SNH location.

<sup>1</sup> BREEAM (BRE Environmental Assessment Method) is the leading and most widely used environmental assessment method for buildings. [www.breeam.org/page.jsp?id=66](http://www.breeam.org/page.jsp?id=66)

We are among the first organisations to take up the new Carbon Management-lite approach from the Carbon Trust.

- 90 Our corporate office and other new offices (such as at Golspie) are designed to have very low carbon dioxide emissions and energy use. Our target to reduce carbon dioxide emissions year-on-year by 4% – starting from a 2007–08 baseline, which itself represents a reduction of 9% over the preceding four years, is one of the ways in which we can contribute to the greenhouse gas emissions reduction targets in the Scottish climate change legislation.
- 91 We will consider also the impacts of climate change, such as more frequent extreme weather events on our operations, and on our properties, visitor facilities on NNRs, and staff travel patterns, with a view to preparing for change.

### SNH Corporate Working

	Understanding	Mitigation	Adaptation
	Helping to understand and publicise the effects and consequences of climate change for the natural heritage	Advising on infrastructure and land management practices which help to mitigate climate change	Guiding adaptation so that nature can, as far as possible, adapt to a changing climate and so that people can make best use of natural processes in preparing for climate change
<b>SNH Corporate Working</b>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● raised awareness and understanding of the impacts of climate change on SNH business operations, properties and NNRs</li> </ul> <p><b>Actions</b></p> <p><b>CW1:</b> Review impacts of recent extreme weather events on SNH business operations, properties and NNRs, over the past five years, and use findings to adapt SNH activity as appropriate.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● reduced energy use in SNH and the installation of renewable energy technologies where appropriate</li> <li>● reduced fossil fuel use and reduced SNH energy emissions</li> <li>● reduction in others' greenhouse gas emissions, with our persuasion and support</li> </ul> <p><b>Actions</b></p> <p><b>CW2:</b> Reduce SNH's emissions through behaviour and policy changes, to meet specific annual targets.</p> <p><b>CW3:</b> Reduce carbon emissions from SNH work travel.</p> <p><b>CW4:</b> Install Renewable Energy systems at selected SNH properties.</p> <p><b>CW5:</b> All new buildings commissioned/occupied by SNH to have low greenhouse gas intensity.</p> <p><b>CW6:</b> Ensure that SNH funding includes greenhouse gas reduction criteria.</p>	<p><b>Objectives</b></p> <ul style="list-style-type: none"> <li>● SNH's operations prepared for the effects of climate change</li> </ul> <p><b>Actions</b></p> <p><b>CW7:</b> Incorporate adaptation actions to SNH business operations, properties and the NNR management planning process; and, as appropriate, providing demonstrations of these actions.</p>

## Notes

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### SNH commitment to customers

- We will ask customers for their views
- We will put things right if they go wrong
- We will give high standards of customer care
- We will publish our customer care performance

### [www.snh.org.uk](http://www.snh.org.uk)

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All of nature for all of Scotland