

Context

Scotland has a population of around 5.2 million and a total land area of about 78,800 km², which from a geographical perspective can be subdivided into four main regions: the Highlands & Islands, the Grampians, the Central Lowlands and the Southern Uplands. Scotland has a wide range of climatic, physical, economic and other features that distinguish it from the rest of the UK. These include:

- Relatively low temperatures and relatively high levels of rainfall.
- Around 800 islands, about 100 of which are inhabited.
- An abrupt and exposed northern coastline with deep nearshore areas.
- A large mountainous region covering the north west of the country, with a highly indented coastline with exposed islands, high sea cliffs and rocky skerries.

Due to this distinctiveness, a number of threats and opportunities arising from climate change may impact Scotland differently from England, Wales or Northern Ireland. Moreover, Scotland already experiences wide geographic variations in its climate and the scale of future climate impacts may also differ between Scottish regions.

Overall, as detailed in the UK Climate Projections published in 2009 (UKCP09), Scotland is projected to experience increasing average temperatures throughout the year, an increase in average rainfall in winter, a decrease in average rainfall in summer and rising sea levels. The Climate Change Risk Assessment (CCRA) has considered the main opportunities and threats that may result.

Key Findings

- Drier summers may reduce water availability, affecting both the natural environment and public water supplies.
- Changes in soil conditions and other aspects of the natural environment may affect biodiversity and the ability of many native Scottish species to thrive.
- Changes in climate may result in loss of species and changes in migration patterns.
- Changes in coastal evolution caused by more frequent extreme weather and by rising sea levels may impact coastal communities and habitats across Scotland.
- Changes to water temperature and quality in the seas around Scotland could have a negative impact on the quality of shellfish and lead to shifts in the location of fish stocks.
- Warmer conditions may lead to an increase in forest productivity and in yields of key agricultural crops, although there is a potential for increased threats due to new or more widespread pests and diseases.
- Increased coastal and inland flooding may affect people, property, infrastructure, natural habitats and a range of animal and plant species.
- Increased temperatures are projected to lead to a substantial reduction in the number of deaths and hospital admissions in the colder months and an increase in the warmer months.
- Extreme weather events are projected to increase, which may lead to an increase in insurance losses and disruption to information and communications technology (ICT) and transport networks.



Scotland

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

Focus on... the Natural Environment

Climate change may have profound impacts on Scotland's unique and spectacular natural environment. Some habitats and species that are predominant or extremely common in Scotland are projected to come under threat, with both biodiversity and landscapes changing significantly as a result.

Warmer, drier summers may lead to reductions in river flows and soil moisture. In mountainous areas, the drying out of peat-rich bogs could cause a loss of biodiversity as well as cutting the amount of carbon these priority habitats can store. Across Scotland, the risk of wildfire may increase significantly, with serious implications for habitats and wildlife.

Some native plant and animal species (e.g. the scotch argus butterfly) may find it hard to track changes in their 'climate space' (areas where the climate is potentially suited to them), although others (e.g. the nuthatch) may gain additional climate space. A warmer climate may also become more favourable for certain pests and diseases, with invasive non-native species becoming more prevalent in Scottish waters. Changes in the timing of budburst and other natural events could cause a decline in some species and affect food webs, while changes in migration patterns may also have a detrimental effect on some species.

Rising sea levels and coastal erosion may alter designated habitats in coastal areas (especially in Eastern Scotland). Erosion is projected to be a particular problem for Scotland's inner and developed firths, which are composed of soft coastlines. In the seas around Scotland, meanwhile, ocean acidification is already occurring. In future, this process may damage marine ecosystems and the quality of goods (e.g. shellfish) that they supply.

Confidence



Increase in risk of wildfire: between 30% and 40% by the 2080s (baseline: the 1980s).

Focus on... Agriculture & Forestry

Warmer temperatures and a longer growing season resulting from climate change are projected to lead to a substantial rise in yields of key crops. In particular, wheat and grass yields may see a major increase and forest productivity may benefit significantly. The positive effects may be most pronounced in Central, Eastern and Southern Scotland.

Drier summers could lead to increased drought, however. The risk may be most

severe in Eastern Scotland, where timber yields (especially of Sitka spruce) could be affected. Wildfires may also pose a growing threat to forestry, potentially reducing timber production.

Flooding and coastal erosion are projected to increasingly threaten agricultural land. The risk of pests and diseases damaging crops, livestock, trees, woodlands and forests may also increase. Rising temperatures could create optimum conditions for diseases to become established and to spread, especially by the end of the century. The threat posed to Scottish forestry by red band needle blight is already significant and may become particularly serious.

Confidence



Increase in area of agricultural land at risk of flooding: up to 100% by the 2050s and 170% by the 2080s (baseline: 1961-1990).



Increase in annual grass yields: up to 50% by the 2050s (assuming other factors affecting growth are not limiting).

Focus on... Business

Climate change is projected to present a range of threats and opportunities to Scotland's marine fishing industry. In particular, warming seas and reductions in water quality may lead to a shift in the location of commercial fish stocks and adversely affect shellfish quality. However, the potential opening of new sea routes in summer as a result of increased melting of Arctic sea ice may provide a major boost for Scottish ports, particularly in the most northerly parts of Scotland.

The tourist industry may also benefit from a changing climate. Coastal resorts could see visitor numbers increase due to a longer tourist season, although sea level rise and increased flooding and erosion may lead to some loss of beach area, other natural assets and tourist attractions. This includes around 10,000 ancient and historical sites which are at risk due to coastal erosion. Rising winter temperatures, on the other hand, could lead to a decline in the skiing industry.

Increases in all forms of flooding could pose a major risk to Scottish businesses. As well as direct damage to premises, significant disruption may affect operations and supply chains. The insurance and mortgage sector could be exposed to an increase in flood-related losses, while failure of the financial sector to take adequate account of climate change in general could affect its financial performance and therefore have damaging consequences for Scottish business as a whole.

Confidence



Increase in number of non-residential properties with a significant likelihood of flooding:¹ at least 40% by the 2050s and at least 60% by the 2080s (current number of non-residential properties with a significant likelihood of flooding approximately 5000).

¹ Significant likelihood of flooding is defined here as an annual probability of any form of flooding of 1 in 75 or greater.



Focus on... Buildings & Infrastructure

More frequent extreme weather events could disrupt transport and other key infrastructure across Scotland, while increases in coastal and inland flooding and changes in coastal evolution could adversely affect infrastructure and buildings in affected areas.

Transport disruption caused, for instance, by flooding and landslides could result in disproportionate damage to homes and businesses in isolated communities. However, milder winters may reduce disruption due to snow and ice, even though 'cold snaps' will still occur as a result of the weather's natural variability. Reduced heating demand in winter is projected to cut buildings' energy use, although energy demand for cooling in summer may rise.

A potential reduction in water availability in summer could affect domestic users, industry and business.

Confidence

M Increase in number of residential properties with a significant likelihood of flooding: at least 40% by the 2050s and at least 60% by the 2080s (current number of properties with a significant likelihood of flooding: between around 45,000 and 50,000).

M Increase in roads and railway lines with a significant likelihood of flooding: between at least 10% and 20% by the 2050s.

Increased coastal and inland flooding may lead to a small rise in the number of flood-related deaths and injuries. In addition, however, there could be a significant increase in mental health problems among some flood victims, with cases of anxiety, depression and similar conditions showing a marked rise.

Although warmer winters may deliver some valuable health benefits, higher winter temperatures and higher winter rainfall could also potentially have negative effects. For example, an increase in the growth of algae and fungi in buildings may exacerbate asthma and other respiratory diseases.

Confidence

M Reduction in cold-related deaths per year (based on current population figures): between 200 and 1570 by the 2050s, rising to between 330 and 2330 by the 2080s (context: in 2009, the total number of deaths in Scotland from all causes was 52,500).

M Increase in heat-related deaths per year (based on current population figures): between 25 and 285 by the 2050s, rising to between 50 and 660 by the 2080s.

A selection of opportunities and threats for Scotland

The diagram below outlines a selection of potential opportunities and threats for Scotland that could arise as a result of climate change, as identified by the CCRA and based on projections for the Medium emissions scenario (central estimate). The full list of opportunities and threats assessed for Scotland are given in the full CCRA Report on Scotland.

Focus on... Health & Wellbeing

In Scotland, the number of deaths and hospital admissions attributable to cold is projected to decline significantly as winters become milder, in parallel with a possible reduction in fuel poverty. However, heat-related deaths and hospital admissions caused by hotter summers are projected to increase.



The Challenge of Adaptation

Climate change will potentially present Scotland with a wide range of opportunities and threats. Because many of the threats are very closely interlinked, an integrated approach will be needed to build resilience.

Based on the CCRA's findings, the following three issues require early adaptation action:

- Reductions in river flows and therefore water availability in summer.
- Increases in flooding both on the coast and inland.
- Increasing risk to Scottish forestry from red band needle blight.

In terms of setting an overall framework for adapting to climate change, the Climate Change (Scotland) Act 2009 not only set ambitious targets for Scotland's transition to a low-carbon country but also established a legislative framework for the promotion of adaptation through:

- A Scottish Adaptation Programme responding to the risks identified for Scotland in the CCRA.
- An Annual Report on progress towards implementing the Programme.
- Duties for public bodies, requiring them to help deliver the Programme.
- A Land Use Strategy setting out objectives, proposals and policies on sustainable land use.

As a forerunner to the first Scottish Adaptation Programme, a Climate Change Adaptation Framework was published in 2009 aiming to improve understanding

about the consequences of a changing climate and to equip stakeholders with the skills and tools needed to adapt. This Framework has also established 12 key sectors where adaptation action will be focused. Action Plans for these were published in March 2011.

However, the CCRA has identified a number of gaps in the evidence and understanding needed to inform adaptation actions in Scotland. These include:

- The scale and extent of future flooding due to climate change (an assessment of present and future flood risk in Scotland is currently under way).
- Future changes in 'range shifts' (changes in the geographic area where a species can survive), requiring a better understanding of species distributions and interactions, habitat shifts and landscape structure.
- The likely impact of climate change on food demand in Scotland and the implications for agricultural intensification and for biodiversity.
- The consequences of climate change for important financial institutions in Scotland, in terms of their financial performance.
- The precise relationship between temperatures and death rates in Scotland.

Where to Get Further Information

For a copy of the full CCRA Report on Scotland, the CCRA Evidence Report or the CCRA Sector Reports, please visit www.defra.gov.uk/environment/climate/government/

For details of adaptation planning work now being undertaken in Scotland, please visit www.scotland.gov.uk/climatechange

How the CCRA was conducted

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

A list of the most important impacts for Scotland was subsequently developed through a process of consultation with stakeholders. This took into account the impacts considered to be the most important for the UK as a whole, together with particular features and issues relevant to Scotland.

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

The results presented here are based on the UKCP09 Medium emissions scenario for the 2020s (2010-2039) and the Low, Medium and High emissions scenarios for the 2050s (2040-2069) and the 2080s (2070-2099). In all cases, a range of probabilities from 10% to 90% was considered, to provide an indication of the uncertainty associated with these projections.

The CCRA categorised risks as low, medium or high based on their economic, social and environmental consequences. Findings are also categorised as having low, medium or high confidence, to illustrate the strength of evidence and consensus related to the direction and magnitude of different risks and opportunities.

Further information on how to interpret the CCRA results is presented in the full CCRA Report on Scotland available at www.defra.gov.uk/environment/climate/government/

