Indicators and trends

Monitoring climate change adaptation

climate change
Scotland's centre of expertise connecting climate change research and policy

Will species be able to track suitable space in a changing climate?	Version
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Some plants, animals and insects will be unable to thrive in their current locations as the climate changes. This can be directly due to the changing climatic conditions or because the changing climate is enabling other species to move into the location and compete for resources. In order to survive, some threatened species may be able to move to a new location where the climate is suitable. It is important to note that many species, including most of our waders and seabirds, are site faithful and will not move. They will simply not survive at their current locations when faced with competition from other species or declining availability of food or other resources.

For species that can and do move, this might mean moving northwards, up mountainsides to a higher elevation, or from south-facing to north-facing slopes. Climate change has already led to species movements, for example changing migration patterns of waterbirds. Species have been wintering at higher latitudes than previously (*Abundance of wintering waterbirds*).

Movements to new areas in response to a changing climate can depend on suitable habitat being available within those areas. Some species may be able to move or disperse to other areas of suitable habitat relatively easily, for example some butterfly species have been shifting their range northwards. Other species need to use 'corridors' or 'stepping stones' in order to move between fragmented areas of suitable habitat. Currently, fragmented habitats and lack of connecting features limit the ability of some species to track suitable climate space. Species that can only survive in a very narrow range of environmental conditions (including habitat 'specialist' species such as lichens of ancient woodlands *Proportion of ancient woodlands with declining overall suitability for lichen epiphytes*), those at the southern limit of their range in Scotland, and montane species are particularly likely to lose climate space; as the climate changes their habitat will shift northwards and/or to higher altitudes and become increasingly restricted (*Abundance and frequency of specialist and generalist species: snow-bed species*; *Abundance and frequency of specialist and generalist species: butterflies*)

Adaptation options What can be done, what are the policy levers?

The ability of some species to track changing climate space can be improved by provision of larger, better connected areas of suitable semi-natural habitat. This requires effective policy design and implementation across a number of sectors related to land use. Policy areas directly concerned are biodiversity and conservation, agriculture and forestry. Relevant guidance is contained within the UK Biodiversity Action Plan, and relevant policies include the Scottish Biodiversity Strategy and Scottish Forestry Strategy. Seabird populations can be affected through fisheries policy. For example, the EU Common Fisheries Policy, specifically regulations on discards, has impacted seabird populations. In the past, some scavenging species, such as Northern fulmar and gannet, benefitted from discards from fishing vessels; this may have led to populations increasing beyond a level that can be sustained by natural food sources. With a reduction in discards, scavengers such as great skua have

had to find other sources of food, including greater predation of other seabirds. Agri-environment and land use planning policy are also important, along with funding mechanisms such as those contained within the Scottish Rural Development Programme (SRDP). However, experience has shown that it can be difficult to make such mechanisms work effectively for targeted action. One success story is the role of SRDP funding in helping improve habitat for the marsh fritillary butterfly on farmland in Argyll, while contributing to the economic viability of farming in a marginal area. The EU Water Framework Directive is a driver for improving water quality, important for reducing agricultural run-off that adversely affects pond condition (*Extent and condition of natural landscape connections: hedgerows and ponds*). Landscape Scale Conservation schemes (*Area of land under landscape scale conservation*) have the potential to help create larger, better-connected areas of semi-natural habitat and there is evidence of their success in achieving species conservation objectives. This approach is a good fit with ecosystem services-driven policy and complements agri-environment and river basin management schemes. For some species, more targeted solutions will be required, such as the designation of new protected sites to facilitate shifts to more suitable habitats in a changing climate. While a great deal can be done to improve the availability of habitat to enable species to track changing climate space, in some cases the future climate in Scotland is unlikely to be suitable for some species; for example projections show that by the end of the century Scotland's climate will no longer be suitable for some species of seabird. However, other species may benefit from these changes, as evidenced by the northward spread of the little egret.

What do the indicators tell us?

The suite of indicators on tracking changing climate space cover:

The RISK of species being unable to track climate space and move to new areas of habitat:

- *Extent and condition of natural landscape connections: hedgerows and ponds* monitors the extent and condition of landscape features (hedgerows and ponds) that provide 'corridors' or 'stepping stones' between areas of habitat, (particularly in agricultural areas) enabling monitoring of whether we are successfully increasing the connectivity of areas of habitat. Range shifts in species due to climate change have been observed. Adequate habitat connectivity is vital in facilitating movement to allow species to track changing climate space, especially in the highly fragmented areas of semi-natural habitats that are common in Scottish landscapes. Therefore it is important to monitor connectivity to see whether the ability of species to move to new areas in response to changing climate space in future is being maintained and enhanced. The extent of hedgerows and ponds has been influenced in the past by agri-environmental policy and associated incentives; this indicator can help monitor the efficacy of such policy. The indicator demonstrates that in recent years the extent and condition of hedgerows has declined, while ponds have increased in number.

- *Proportion of ancient woodlands with declining overall suitability for lichen epiphytes* uses bioclimatic modelling to assess the future suitability of habitat for lichen epiphytes which are habitat specialists, existing only in Scotland's fragmented but undisturbed ancient woodland. This restricted distribution makes them excellent indicators for investigating the impact of climate change on species that are unable to easily track changing climatic space. The model indicates a regional difference, with a higher risk of declining climate suitability for lichens of ancient woodlands in

eastern Scotland (continental climate) than in the west (temperate rainforest).

Monitor and measure the IMPACT of climate change on selected indicator species:

- *Abundance and productivity of breeding seabirds*; *Abundance of wintering water birds*.

Seabirds are a good indicator of the health of marine environments. Food availability and climate change are considered to be the primary drivers of abundance and productivity of seabird populations in Scotland.

- Evidence shows that climate change is affecting migration patterns of birds, and the food chains they rely on. Many of our wintering water birds breed in the Arctic and are affected by changes in the quality of habitat there. It is expected that wintering water birds will continue to be affected by environmental change, with new species overwintering in Scotland and existing species shifting locations, both within Scotland and across Europe. This has consequences for the network of designated protected sites, with a need to ensure that sufficient refugia or designated sites are provided in new locations as required. Among overwintering waterbirds, trends in abundance are currently divergent for different species groups. Waders, as a group, have shown sustained declines since 2006. Ducks have remained stable and geese have shown large increases.

- *Abundance and frequency of specialist and generalist species: snow-bed species*; *Abundance and frequency of specialist and generalist species: butterflies*. It is expected that 'generalist' species that have the ability to thrive across different habitat types and environmental conditions will be better able to cope with a changing climate than 'specialist' niche species that are adapted to specific conditions. These indicators track specialist snow-bed bryophytes, and generalist compared to specialist butterfly species, respectively. In the case of snow-bed bryophytes, consistent trends at a national level have not been identified but a regionally differentiated pattern has emerged, with snow-bed bryophytes declining in the west but increasing in the east (Cairngorms), suggesting that structural change is occurring in snow-bed vegetation. For butterflies, generalist species have increased in abundance (1979-2013) while specialist species as a group have remained relatively stable. Climate change has enabled some generalist species to increase their range, while northerly distributed specialist species are expected to be negatively impacted; one such species, the large heath, has declined significantly in numbers in Scotland.

Monitor what ACTION is being taken to adapt – to better manage the risks and increase resilience to the impacts identified above:

- *Area of land under landscape scale conservation*. Landscape scale conservation (LSC) is increasingly recognised as an important tool in managing land to conserve and enhance biodiversity and ecosystem services. LSC can enable the creation of larger and linked areas of semi-natural habitat that can help species track changing climate space. This is recognised in policy, including the Scottish Biodiversity Strategy and Scottish Forestry Strategy. This indicator provides an initial estimate of the scale of such areas. It can help provide an understanding of how effectively large areas of habitat are being conserved and restored. Larger, well- connected areas of habitat are more resilient to climate change and other stressors, and enable species to track changing climate space more easily. An increase in the area under LSC will indicate effective implementation across a number of policy areas, including agriculture and biodiversity (LSC can contribute to the Aichi

Targets and Habitats Directive that are included in the Scottish Biodiversity Strategy). This is therefore a good indicator of the efficacy of these policies. There is currently a lack of information about the precise area under landscape scale conservation, in part due to the lack of a common definition of LSC to identify and measure projects consistently. A Landscape Scale Conservation Working Group has been formed to improve collaboration and share good practice; this group is part of the governance structure of the Scottish Biodiversity Strategy.

Indicators not yet developed:

Connectivity of key natural/semi-natural habitats

Connectivity of designated sites

Distribution of climate sensitive species

Amount of native woodland creation in existing native woodland habitat networks per year

Other relevant indicators

The *Tracking suitable space in a changing climate* narrative is closely linked to the *Resilience of the natural environment (terrestrial)*; and *Marine and coastal change* narratives, the former of which includes indicators that monitor the extent and condition of key habitats along with the action indicator *Natural Capital Asset Index*.

Agricultural policy and practice is an important driver of land use. In Scotland, climate change is expected to present an opportunity to increase agricultural productivity, while globally there will be increasing demand for food and climate driven concerns over food security. Together, these drivers are expected to lead to agricultural intensification. To realise this opportunity while retaining the areas of habitat and connecting corridors needed to enable species to track changing climate space, careful management is required. This is monitored in indicators such *as Proportion of farmland under High Nature Value farming systems* and *Sustainable intensification index*.