British Ecological Society-Scottish Policy Group – Parliamentary Briefing

Stage 1 debate: Climate Change (Emissions Reduction Targets) (Scotland) Bill

The Scottish Policy Group (SPG) is a group of British Ecological Society (BES) members promoting the use of ecological knowledge in Scotland. We act as a focal point to provide robust ecological evidence to the Scottish Government, Scottish Parliament and wider society.

Our approach to informing the Stage 1 debate is to provide context in terms of the likely impacts of climate change on Scotland's natural environment. This shows why urgency is required to reduce greenhouse gas emissions and why adaptation is as important as mitigation to protect Scotland's biodiversity, ecosystems and habitats.

Key messages:

- **Scotland's internationally important** ecosystems and communities are determined by, and dependent upon, its distinct oceanic climate
- **Many species are shifting their distribution poleward,** and the types of species found in different habitats are shifting in response to climate change [1]
- **Habitats on the edge of their climatic range** such as the west coast of Scotland's internationally important temperate rainforests that provide habitat for > 500 species of mosses, ferns, lichens and liverwort[2], and upland species specialists such as bryophytes and plants adapted to cool, wet conditions are particularly vulnerable to climatic changes as they have '*nowhere else to go'*
- **Mitigation is absolutely needed** as there is no other option than reducing emissions to avoid a massive loss of local biodiversity
- **Conservation efforts need a greater focus on adaptation** measures and monitoring as this will help address changes happening now and future uncertainty.

Examples of impacts and uncertainties - habitats and ecosystems

Scotland's Temperate rainforests - The future of Scotland's globally rare and internationally important temperate rainforests – such as the Atlantic oak woods found on Scotland's west coast - is highly uncertain. Temperate rainforest have high conservation value hosting > 500 species of mosses, ferns, lichens and liverworts such as spotty featherwort, Wilson's filmy fern, toothed pouncewort and hazel gloves – some such species are found nowhere else in the world[3]. The predicted future climate for this ecosystem is unlike any other currently found in Europe[4] and based on current examples it is not possible to predict future plant and animal communities. Further, diseases such as Ash dieback can cause a decline in habitat quality that exacerbates the impacts of climate change, and rapidly increase rates of species decline and extinction[5]. Improving the extent of habitat through strategic restoration within ecological networks and land management to improve habitat quality, such as controlling invasive non-native species, may enhance the resilience of assemblages of species to climate change - especially for ecosystems such as Scotland's rainforest that have 'nowhere else to go' because they are at the edge of their range.

Marine ecosystems - The UK's marine and coastal ecosystems are being affected by rising sea levels, increased temperatures, oxygen loss and rising acidity, other climate driven changes to salinity, wind, waves and currents as well as pressures from overfishing[6,7,8,9]. Warming seas are causing a continuing shift northward in habitat suitability and prey availability for many species; Leach's storm petrel, great skua and Arctic skua could become extremely rare or even extinct in the UK [10]. Changes in sea temperature are strongly linked to decreased breeding success of fulmars, Atlantic puffins, common, Arctic and little terns, and black-legged kittiwakes[11,12] – all of which breed along Scotland's coast.

Mackerel, Scotland's most important fishery, whose distribution has been limited in the past by sea temperature is now spreading into Icelandic and Faroese waters with consequences for fisheries quotas and governance[13]. Cold-water fish species are moving further northwards at estimated rates three times faster than terrestrial species and deeper - c 3.6 m per decade - which may make commercial exploitation more difficult[14]. Fish species are also expected to shrink in size[15], as their metabolism accelerates with increasing temperature they need more oxygen to sustain body functions, which is limited by the surface area of gills.

Dealing with uncertainty - the value of long-term data sets

Investment in long-term ecological monitoring (for example the UK Countryside Survey) is needed so that climate change progression can be assessed against baseline measurements and action can be targeted where it is most needed[16]. For example, long-term surveys of Scotland's vegetation conducted by the James Hutton Institute showed that climate change was a key factor of vegetation change in moorland and alpine plant communities over the last c 40 years.

- ***Case study: Moorlands –*** Scotland's internationally important dwarf shrub moorland, with its iconic 'purple summer bloom' has reduced in biodiversity value over the last forty years[17]. Specialist species associated with higher altitudes such as dwarf willow, bearberry, and alpine lichens have become rarer and common species have become more common. Climate change, along with nitrogen pollution and grazing, are the most important factors leading to changes.
- ***Case study: Alpine vegetation*** - Scotland's unique arctic-alpine vegetation includes rare vascular plants such as the alpine sow-thistle and alpine milk-vetch, while the bryophyte and lichen communities are recognised as internationally important in their own right and as habitat for important breeding bird assemblages[18] such as snow bunting, purple sandpiper, and dotterel. Reduced diversity within and between different alpine communities is linked to climate change, nitrogen pollution, and grazing.

Bird populations and distributions

Climate change is affecting a range of bird species found in Scotland. Projected future impacts are likely to produce both winners and losers, with upland species such as golden plover and red grouse, breeding seabirds such as puffins, skuas, black-legged kittiwake and many species of conservation concern such as dotterel and curlew most vulnerable to future decline; the risk of which will increase with the projected magnitude of climate change[19,20,21].

- ***Case study: golden plover*** One of the ways climate change affects birds is through impacts on key food species. For example, hot, dry summer weather reduces the abundance of craneflies, a keystone organism of peatland systems. This limits the breeding success of golden plovers and other upland birds that feed on craneflies the following spring, threatening their populations. Management to restore peatlands by blocking drainage ditches and raising water levels, to prevent them drying out, is a priority for climate change adaptation and can contribute to making these systems resilient to 2°C warming[22,23,24] and will also contribute to golden plover breeding success.
- ***Case study: Red grouse*** Red grouse is a heavily managed wild bird species important to Scotland's rural economy. It is vulnerable to the effects of climate change through direct impacts on breeding success, impacts on cranefly prey, as well as the condition of heather (which depends on climate) and disease. For instance, the incidence of strongylosis, being greater in warm, wet springs, as well as the prevalence of ticks, which can cause louping ill virus[25].

Spread of pests and diseases

Climate change will affect the presence or absence of viruses that may have economic impacts as well as affecting biodiversity.

- ***Case study: Spread of the Xiphinema diverscaudatum virus -*** Some virus-carrying nematodes that presently have a restricted distribution could spread further north. *Xiphinema diverscaudatum*, a vector of Strawberry Latent Ringspot Virus (SLRV), is distributed up to the Tay estuary. This means in the north of Scotland, strawberries are currently not at risk from this virus. However, a 1° C rise in temperature would permit the virus to extend into north-east Scotland[26].

For more details see the BES Scottish Policy Group's full response to the ECCLR's call for evidence on the Climate Change (Emissions Reduction Targets) (Scotland) Bill.

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[1] Devictor et al (2012) Differences in the climate debts of birds and butterflies at a continental scale. Nature Climate Change [2] 121-124
[2] https://scotland.forestry.gov.uk/managing/work-on-scotlands-national-forest-estate/conservation/habitats/woodland/atlantic-woodland
[3] https://scotland.forestry.gov.uk/managing/work-on-scotlands-national-forest-estate/conservation/habitats/woodland/atlantic-woodland
[4] Christopher J. Ellis & Sally Eaton (2016) Future Non-Analogue Climates for Scotland's Temperate Rainforest. Scottish Geographical Journal. [132: 3-4] 257-268
[5] Christopher J Ellis (2018) A mechanistic model of climate change risk: Growth rates and microhabitat specificity for conservation priority woodland epiphytes. Perspectives in Plant Ecology, Evolution and Systematics
[32] 38-48
[6] Turley et al (2009) CO2 and ocean acidification in Marine Climate Change Ecosystem Linkages Report Card 2009. (Eds. Baxter J.M., Buckley P.J. and Frost M.T.), Online science reviews 25pp.
[7] Hughes et al (2017) Temperature. MCCIP Science Review 2017
[8] Pinnegar et al (2017) Fisheries. MCCIP Science Review 2017, doi:10.14465/2017.arc10.007-fis.
[9] Scheffer et al (2005) Cascading effects of overfishing marine ecosystems Trends in Ecology and Evolution [20] 11 579-581
[10] *Ibid*
[11] Daunt et al (2017) Seabirds, MCCIP Science Review 2017, 42-46
[12] Burthe et al (2014) Assessing the vulnerability of the marine bird community in the western North Sea to climate change and other anthropogenic impacts. Marine Ecology Progress Series 507, 277–295.
[13] Pinnegar et al (2017) Fisheries. MCCIP Science Review 2017
[14] Pinnegar et al (2017) Fisheries. MCCIP Science Review 2017
[15] *Ibid*
[16] Lisa Norton (2018) Tracking ecology is not old-fashioned. Nature [506] Correspondence pp 309
[17] Britton et al (2017) Climate, pollution and grazing drive long-term change in moorland habitats. Applied Vegetation Science [20] 194-203
[18] Britton et al (2009) Biodiversity gains and losses: Evidence for homogenisation of Scottish alpine vegetation. Biological Conservation [142] 1728-1739
[19] Pearce-Higgins et al (2017) A national-scale assessment of climate change impacts on species: Assessing the balance of risks and opportunities for multiple taxa. Biological Conservation [213] 124–134
[20] Massimino et al (2017) Projected reductions in climatic suitability for vulnerable British birds. Climatic Change [145] 117.
[21] Johnston et al. (2013) Observed and predicted effects of climate change on species abundance in protected areas. Nature Climate Change [3] 1055–1061
[22] Pearce-Higgins et al (2010) Impacts of climate on prey abundance account for fluctuations in a population of a northern wader at the southern edge of its range. Global Change Biology [16] 12-23.
[23] Carroll et al (2011) Maintaining northern peatland ecosystems in a changing climate: effects of soil moisture, drainage and drain blocking on craneflies. Global Change Biology [17] 2991–3001.
[24] Pearce-Higgins (2011) Modelling conservation management options for a southern range-margin population of Golden Plover Pluvialis apricaria vulnerable to climate change. Ibis [153] 345-356
[25] Pearce-Higgins, J.W. (2017) Birds and climate change British Birds [10] 388–404
[26] R. Neilson and B. Boag (1996) The predicted impact of possible climatic change on virus-vector nematodes in Great Britain. European Journal of Plant Pathology [102] 193-199