Local Nature Recovery Toolkit Appendix III: Further Information on Climate Change

Introduction

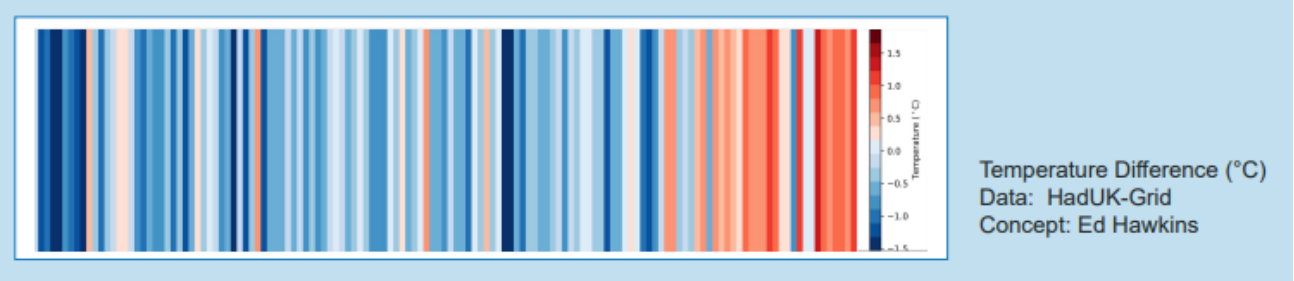
Climate change is one of the greatest drivers of change of terrestrial, freshwater, and marine habitats in the UK over the last 50 years.[1]

Since pre-industrial times global average temperatures have risen by about 1C and the knock-on effect of global change on the UK are captured in the Met Office's annual State of the UK Climate report for 2022.[2]

- UK climate continues to change, but temperature extremes are rising faster than averages;
- Climate change made a record-breaking warm year more likely;
- Rainfall was 6% lower than average, but there were slight increases in heavy rainfall;
- Sea-levels have risen by 18.5cm since 1900s, but rate is increasing with 60% in past 30 years;
- An extended spring and autumn season increased 'leaf-on' season by 7-16 days; and
- Without rapid, global efforts to reduce emissions, UK changes will continue to increase.

The local climate stripe below shows us how annual temperatures have increased over nearly 150 years, with many of the hottest years occurring in the last few decades. Each stripe shows whether a specific year was hotter (red) or colder (blue) than an average year over the period 1981-2000.

Figure 1: Local climate stripe (1884 to 2020) (Credit: Met Office)



Our warming climate and resulting changes to the climate system are already having dramatic impacts on nature. Compromised ecological needs, impacts on geographical range, disruption to food webs and life cycles, and erosion of habitat health will increasingly cause population decline in species and threaten their survival.[3] Climate change also interacts with other drivers of ecological change such as intensive agriculture or urbanisation, placing additional stresses on the natural environment.

Climate projections

Currently the world is on track for a temperature rise of nearly 3C by the end of the century based on existing national policy commitments to cut greenhouse gas emissions. Deep cuts of 28-42% will be needed over the next six years to achieve goals set through the Paris Agreement putting us on a pathway to either 2C or 1.5C of global warming. (Emissions Gap Report 2023 | UNEP - UN

[1] State of Nature 2023 - report on the UK's current biodiversity
[2] State of the UK Climate - Met Office
[3] Adaptation and the nature emergency - Climate Change Committee (theccc.org.uk))

Environment Programme). The IPCC's watershed special report in 2018 presented the stark reality of the differences between a 1.5C and 2C world, where half a degree significantly worsens risks for human and natural systems. Summary for Policymakers — Global Warming of 1.5 ºC (ipcc.ch)

The national climate projections for the UK (UKCP18) provide the most recent scientific evidence on how climate change could affect the country for a range of climate futures, with headline findings in the table below (ukcp18_headline_findings_v4_aug22.pdf (metoffice.gov.uk).

Table 2: UKCP18 headline findings

Warming trend	All areas of the UK will be warmer by the end of the 21st century.
Seasonal change	Increased chance of warmer, wetter winters & hotter, drier summers.
Extreme weather	Increased frequency and intensity of extreme weather events.
High temperatures	Hot summers becoming more common, with increased hot summer days and more frequent hot spells.
Rainfall changes	Although overall trend for drier summers, also future increases in the intensity of heavy summer rainfall events. Changing seasonality of heavy rainfall, more intense hourly rainfall extremes, and increased winter rainfall.
Coastal inundation	Increases to extreme coastal water levels, largely driven by sea level rise. Additional changes to storm surges cannot be ruled out.
Soil moisture	Decreased soil moisture during summers, consistent with lower rainfall.
Snow decline	Almost 100% decrease in lying snow by the end of 21st century.

The regional headlines for the area covered by the toolkit are shown in the table below. This regional data is presented for two different climate scenarios. The numbers in each column represent two 'emissions scenario' or possible climate futures, showing how temperatures, rainfall and sea level could change due to the influence of climate change (compared to figures for 1981-2000).

The first number reflects a climate where international efforts to cut greenhouse gas emissions keep global warming to about 2C by the end of the century ('medium emissions scenario'). The second number represents a 'high emissions scenario' where greenhouse gases continue to grow, resulting in about 4C of change by 2100. For example, winters in the 2050s (2040-2059) could be up to 2.9C warmer and 27% wetter, with summers up to 4.5C warmer and 42% drier. These figures are for average conditions, so they don't represent extreme events nor natural variability where any given year can deviate from the longer-term average. The appendix provides further technical information on these figures.

	2030s	2050s	2080s	
Summer Average Air Temperature (°C)	+1.0 to +2.2	+1.7 to +3.9	+3.1 to +7.6	↑
Summer Maximum Air Temperature (°C)	+1.1 to +2.6	+2.0 to +4.5	+3.5 to +8.9	↑
Winter Average Air Temperature (°C)	+0.7 to +1.6	+1.1 to +2.6	+1.7 to +4.6	↑
Winter Minimum Air Temperature (°C)	+0.7 to +1.7	+1.2 to +2.9	+1.8 to +5.1	↑
Annual Average Air Temperature (°C)	+0.8 to +1.6	+1.3 to +2.7	+2.2 to +5.1	↑
Summer Precipitation Rate (%)	-7 to -29	-12 to -42	-23 to -62	↓
Winter Precipitation Rate (%)	+6 to +19	+9 to +27	+16 to +51	↑
Sea Level Change (m)	+0.14 to +0.19	+0.24 to +0.36	+0.42 to +0.72	↑

Table 3: Regional climate projections for the area covered by the toolkit (Credit: Met Office)

There is a significant challenge in both the monitoring and understanding the impact of climate change on our natural world, and stress testing nature recovery proposals across the range of possible climate futures. How well nature adapts to climate change impacts is dependent on multiple, inter-connected factors. We need to grow our monitoring systems and evidence base to understand better both the state of our environment today, and the co-benefits of interventions.

The profile of hazards which the UK faces is also changing not only in the frequency, severity, and duration of more familiar extreme weather events such as flooding but the growing threat of wildfire and uncertainties in the spread of pests, diseases, and invasive non-nature species.

Climate change risks

The UK Climate Change Risk Assessment (UKCCRA3) identified threats to terrestrial and freshwater habits and species from multiple hazards as one the eight priority risks facing the country. Three other priority risk areas concern soil health, natural carbon stores & sequestration, and crops, livestock, and commercial trees. This means that half of the country's priority risks are linked in some way to the wellbeing of our natural environment. The table below identifies the 14 risks which are especially relevant to this Local Nature Recovery Strategy (excluding marine risks N14, 15, 16 and carbon storage & sequestration N5). (Independent-Assessment-of-UK-Climate-Risk-Advice-to-Govt-for-CCRA3-CCC.pdf (theccc.org.uk)

Table 1: UK Climate Change Risk Assessment – Natural environment risks

Terrestrial biodiversity	N1. Risks to terrestrial species and habitats from changing conditions & extreme events, including temperature change, water scarcity, wildfire, flooding, wind, and altered hydrology N2. Risks to terrestrial species and habitats from pests, pathogens, and invasive species N3. Opportunities from new species colonisations in terrestrial habitats N4. Risk to soils from changing climatic conditions, including seasonal aridity and wetness N18. Risks and opportunities from climate change to landscape character

Freshwater habitats	N11. Risks to freshwater species and habitats from changing climatic conditions and extreme events, including higher water temperatures, flooding, water scarcity and phenological shifts N12. Risks to freshwater species and habitats from pests, pathogens, and invasive species N13. Opportunities to freshwater species and habitats from new species colonisations
Marine & coastal environment	N17. Risks and opportunities to coastal species and habitats due to coastal flooding, erosion, and climate factors
Agriculture & forestry	N6. Risks to and opportunities for agricultural and forestry productivity from extreme events and changing climatic conditions (including temperature change, water scarcity, wildfire, flooding, coastal erosion, wind, and saline intrusion) N7. Risks to agriculture from pests, pathogens, and invasive species N8. Risks to forestry from pests, pathogens, and invasive species. N9. Opportunities for agricultural and forestry productivity from new/alternative species becoming suitable. N10. Risks to aquifers and agricultural land from sea level rise, saltwater intrusion

The risk assessment also highlights how climate change could affect ecosystems through the exceedance of thresholds and the triggering of tipping points, changing them in a way which modifies their functions and services. The impacts will inevitably be more pronounced with 4C of global warming, compared to 2C, and these risk thresholds could actually be closer to today's climate taking into account the cumulative impact of multiple environmental stressors. (UKCCRA Technical Report Chapter 3: Natural Environment & Assets).

The impact of sustained severe weather conditions, consecutive extreme events and/or record breaking seasons poses significant risks for our natural environment. A distinct type of event called Low Likelihood High Impact (LLHI) events are named in the UKCCRA3 to highlight the severe threat posed by 'infrequent high magnitude events' which occur for more extreme climate change projections, including:

- Severe & sustained drought over large proportion of the UK.
- Combined negative effects of abnormal/exceptional seasonal variations.
- Sustained storm conditions throughout a season or longer period (coastal habitats).

Droughts escalate and grow in severity starting off life as a meteorological drought due to low rainfall. As low rainfall persists, the drought progresses from agricultural (soil moisture), through hydrological (river flows & groundwater) through to socio-economic (water supply restrictions).

Species that are adapted to a particular climate may also find their geographical range changes along with the climate, with a northwards shift to be expected in general. For example, the figure below shows that much of the south and east of the UK would become unsuitable for bluebells with a 2C rise in temperature.

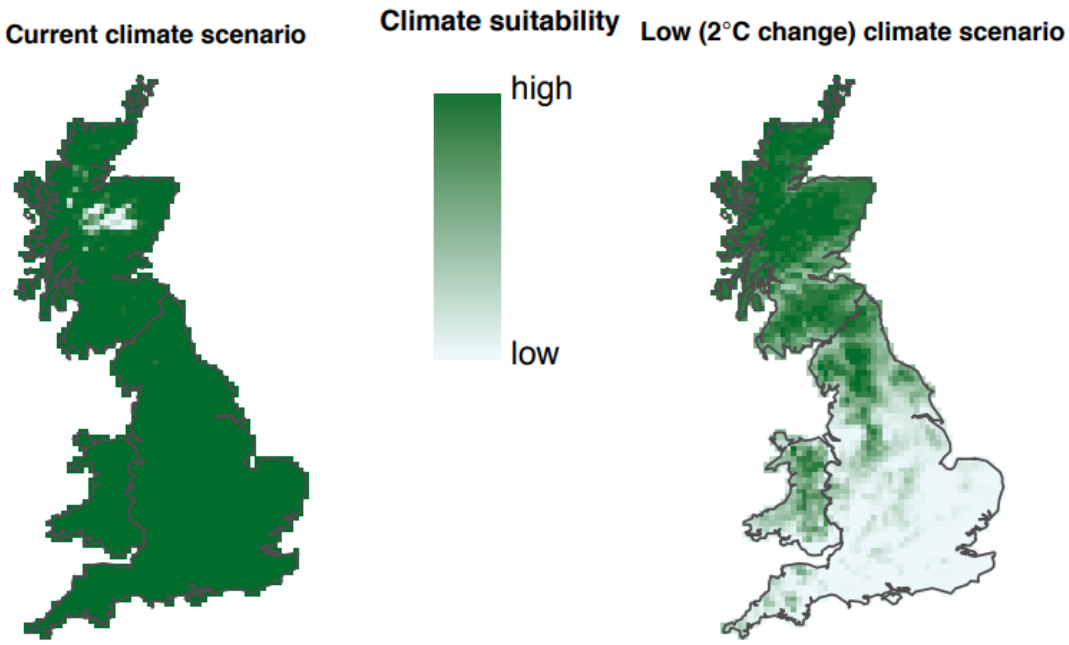


Figure 1 - projected change in potential bluebell distribution with 2C temperature rise (Credit: Natural England Climate Change Adaptation Manual - Evidence to support nature conservation in a changing climate - NE546 (naturalengland.org.uk))

Adaptation

The UKCCRA3 identifies the following key ecosystem service relationships, illustrating the clear cross-cutting benefits of using nature to mitigate climate risk while also delivering wider environment benefits:

- Soil integrity including slope stability
- Water purification & regulation
- Fluvial/pluvial flood hazard alleviation
- Coastal flood & erosion hazard alleviation
- Food & fibre (outputs from agricultural & forestry systems)
- Carbon storage
- Green & blue infrastructure
- Cultural interactions
- Natural control of pests, pathogens & non-native invasive species

The natural environment acts as critical infrastructure, where continued delivery of ecosystem services for human populations is dependent upon its own intrinsic resilience.

There are, therefore, two key ways that action for nature recovery needs to account for climate change impacts (CCC report):

1. Nature-Based Solutions to support climate and nature goals: using ecosystem and habitat restoration to mitigate climate impacts such as drought, flooding and extreme heat through the natural processes and ecosystem services which nature provides.
2. Support nature to adapt to climate change: reducing the impact of climate change on biodiversity and increasing resilience through building a resilient network, accounting for range-shifts and controlling the spread of pests, diseases, and invasive non-native species.

Restoring functioning, natural ecosystems, such as re-naturalised rivers and extensive grazing systems, will help mitigate climate impacts and improve nature's resilience to climate change (see *Error! Reference source not found.*). Continued delivery of ecosystem services is also dependent upon the natural environment being in a healthy state.

Specific measures may be needed to ensure ecosystems are resilient in the face of climate change, particularly for vulnerable habitats such as rivers, saltmarsh and standing water.

The most important response to climate change for mobile species, such as birds and mammals, is to ensure an ecologically connected landscape, so that they are able to move to new climate spaces as needed. However, for less mobile species, particularly plants, specific measures may be needed to increase the chances of survival for those that are rare, vulnerable and/or iconic, such as the bluebell.

Nature-based interventions that could help society adapt to climate change include:

1. Restoring coastal ecosystems & native vegetation in river catchments to improve biodiversity and moderate peak flows:
    a) Creation of mudflats and saltmarsh – areas potentially suitable for managed realignment & controlled inundation behind existing defences.
    b) Woodland creation – floodplain woodland (slow flood flow), riparian woodland (flood buffer, shade, and slow flood flow) and cross-slope woodland (reduce run-off higher slopes).
    c) Natural flood management - catchment-level and localised interventions - adapting farming practices, vegetation cover, small-scale water storage, renaturalisation of streams and ditches, and other natural processes which slow water flow.
2. Adapting land use and management practices on agricultural land and in agroforestry to build soil health sustainably with associated benefits for drought and flood risk, recharging of aquifers, slope stability and water quality.
3. Preventative measures to reduce wildfire risk through land use and management practices.
4. Bringing nature into cities & urban greening to reduce the 'urban heat island' effect, localised exposure to high temperatures, and mitigation of flood risk, with benefits for local populations:
    a) Large-scale urban greening (with blue infrastructure where possible) at street-level and integrated into buildings (walls & roofs) in public and private realm to provide urban cooling.
    b) Improving comfort of urban environment through urban greening and networks of shaded, cooling corridors, including tree planting (especially in deprived areas with existing under provision and lack of access to green space).
    c) Sustainable drainage systems (SuDS) within highways, urban spaces & developments to manage peak flows, and creation of parklets to temporarily store peak flows.

d) Renaturalisation of urban rivers and daylighting of artificial channels which reduce local flood risk.

Measures that could **help nature adapt to climate change** include:

1. **Creating a nature recovery network which restores & connects habitats, enabling species to move through landscapes and underpinning ecosystem health**, increasing nature's capacity to adapt to the changing climate, including the use of wildlife crossings to overcome key barriers and major severance zones.
2. **Preventative measures to mitigate the spread of pests, diseases, and non-native invasive species** which may thrive more with climate change.
3. **Building the resilience of urban wildlife and habitats to climate impacts**:
    a) Mosaic of habitats to reduce stresses to extreme weather and seasonal fluctuations, creation of nesting, roosting and refuge habitats (and artificial sites), provision of urban food sources, use of animal crossings, and reducing conflicts between urban infrastructure and wildlife such as flood asset design e.g., culverts and highways drainage e.g., gullies.
4. **Adoption of management practices that reduce the impact of extreme weather and chronic stresses caused by climate change** e.g., veteran tree management which reduces threat of strong winds and gales.