The upcoming Scottish Climate Bill is an opportunity to set strong targets and binding policy frameworks in legislation.

Scottish Environment LINK members are asking for:

A net-zero greenhouse gas emissions target for 2050. For Scotland to retain its reputation as a world leader in tackling climate change, it needs to be ambitious and bold. In order to align with the 1.5 °C ambition, an 89 - 97% reduction in GHG on 1990 is needed for 2050[2]. Under principles of climate justice, developed nations need to take a more ambitious decarbonisation path than developing nations, and Scotland needs to adopt a target that sends a strong message to other developed nations. Early action is also vital if we are to avoid the most dangerous impacts of climate change, and an **interim 2030 target of 77%** reduction on 1990 levels should be adopted.

A strengthened Land Use Strategy. The production of a Land Use Strategy was a requirement of the 2009 Climate Change Act but, although it contains policies to maximise ecosystem services from land use, including climate mitigation and adaptation, and to promote carbon-efficient agriculture, implementation has been weak. We would like requirements to: develop action plans, including milestones and outcomes; report annually on the outcomes; and establish Regional Land Use Frameworks covering all of Scotland.

A step change in effort to reduce agricultural emissions. Accounting for nearly a quarter of Scottish greenhouse gas emissions and with little progress in recent years, LINK members (supported by a range of other organisations and individuals[3]) are calling for measures to act on agricultural emissions, such as better soil management, a nitrogen budget and agro-forestry.

Implementation of a **National Ecological Network.** Restoration and enhancement of habitats would protect and increase carbon sequestration and storage as well as help our wildlife adapt to climate change[4]. To introduce such a network is a commitment in *Scotland's Biodiversity – a Route Map to 2020*, but there has been a lack of progress.

For Scottish Environment LINK's full response to the Climate change Bill consultation: scotlink.org/public-documents/link-response-to-the-scottish-governments-climate-change-bill-consultation-paper/

[2] theccc.org.uk/wp-content/uploads/2017/03/Advice-to-Scottish-Government-on-Scottish-Climate-Change-Bill-Committee-on-Climate-Change-March-2017.pdf

[3] Open letter to Cabinet Secretaries on carbon-neutral farming: scotlink.org/public-documents/open-letter-to-cabinet-secretaries-on-carbon-neutral-farming

[4] Scottish Environment LINK's Roadmap for adopting a National Ecological Network: scotlink.org/wp/files/SEL_A-Roadmap-for-Adopting-a-National-Ecological-Network-in-Scotland.pdf

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Scottish Environment LINK

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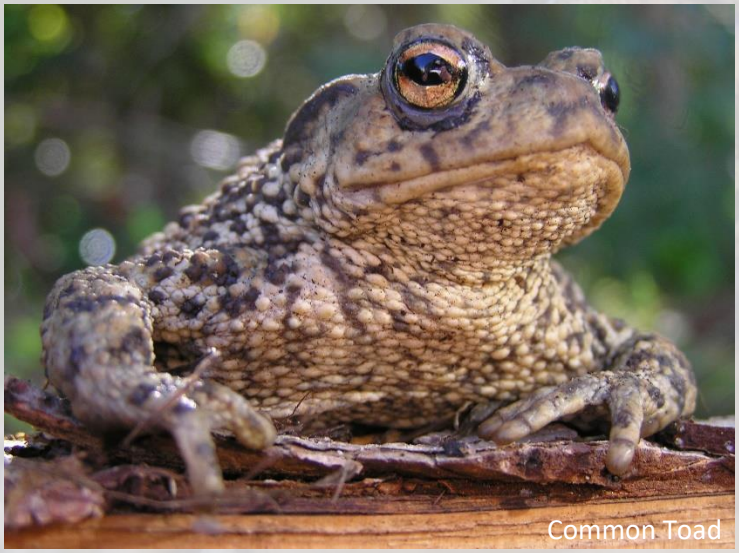
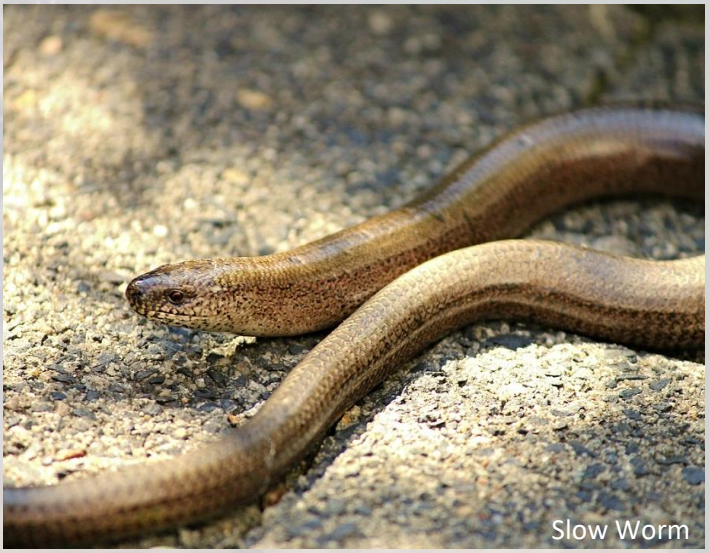
Climate Change: Amphibians and Reptiles


Common Toad


Slow Worm

There is strong evidence that climate change is affecting UK biodiversity and impacts are expected to rise as the magnitude of climate change increases[1].

Although further research is needed to better predict how our changing climate will affect amphibians, current understanding suggests a range of impacts.

In response to warmer temperatures, the breeding date for **common frogs, common toads** and **newts** has become earlier with increased risks of late frosts impacting on reproductive success.

Climate change is thought to be one of the causes of the drastic decline in the **common toad**. Research has shown that milder winters are detrimental for hibernating toads resulting in decreased body condition, body size and subsequent reproductive success. This change in weather has also lead to decreased body condition and over-winter survival for the **great crested newt**.

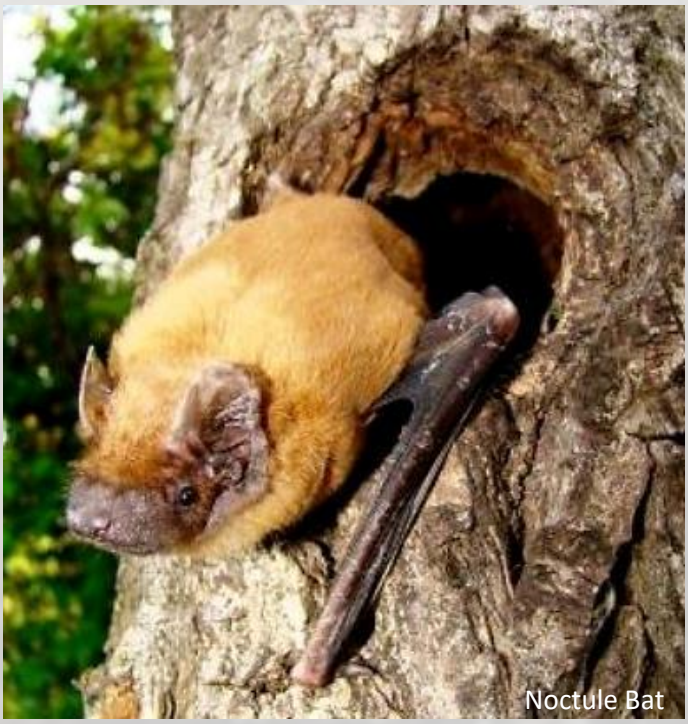
Species such as **smooth newt** and **common lizard** are likely to spread northwards and expand their range in Scotland. It is therefore important that there is suitable habitat in Scotland both for existing populations and for new populations to disperse into.

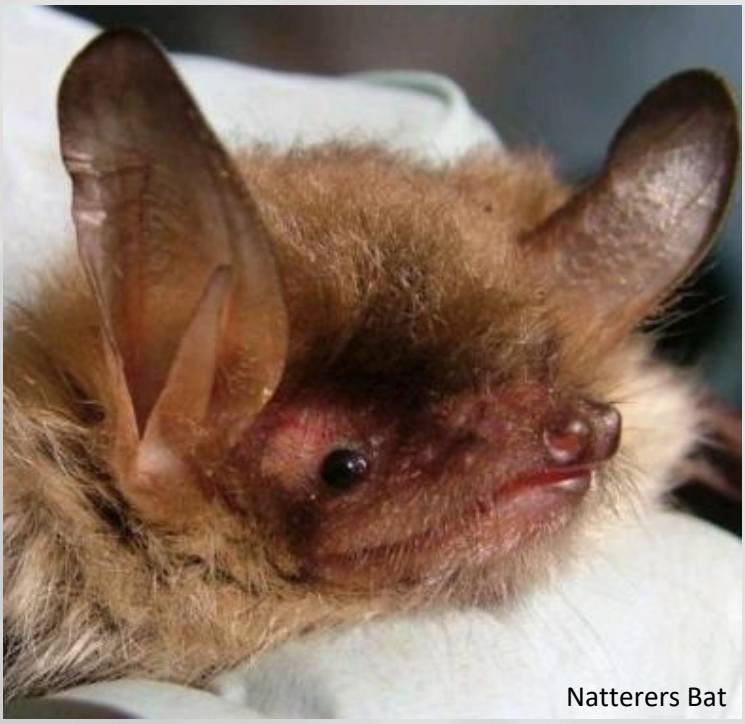
Climate change is one of the factors thought to be behind the decline in **slow worms**, exacerbating threats from habitat loss resulting from human development.

Scottish Environment LINK

[1] A recent IPES report predicts that by 2050, Climate Change could replace land-conversion as the main driver of species extinction.

Climate Change: Bats


Noctule Bat


Natterers Bat

There is strong evidence that climate change is affecting UK biodiversity and impacts are expected to rise as the magnitude of climate change increases[1].

Although further research is needed to better predict how our changing climate will affect bats and different bat species, current understanding suggests a range of impacts.

Climate change may affect bat populations through changes in their yearly hibernation cycle, breeding success and food availability. Bats are reducing their period of hibernation and this is thought to be linked to warmer winters meaning that an animal's metabolic rates cannot remain suppressed effectively. This can reduce body condition, breeding success and survival rates.

Direct links have been found between summer rainfall and survival of bat species, with drier springs and summers having a negative effect on insect prey abundance.

Scottish Environment LINK

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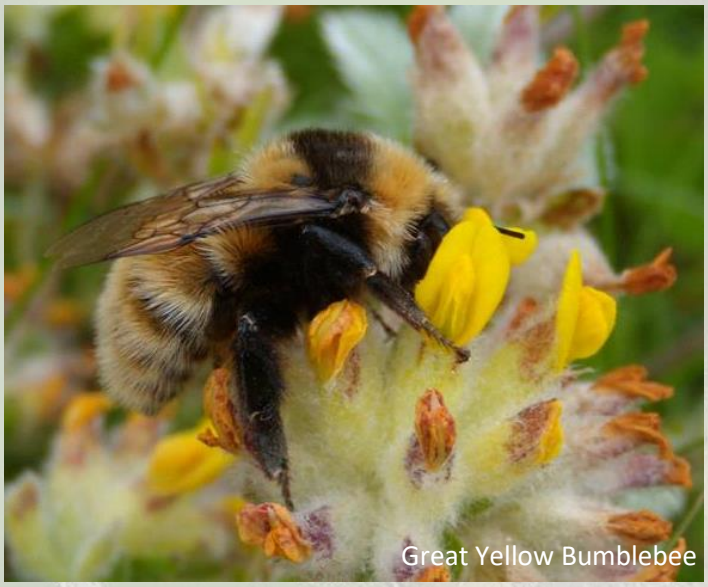
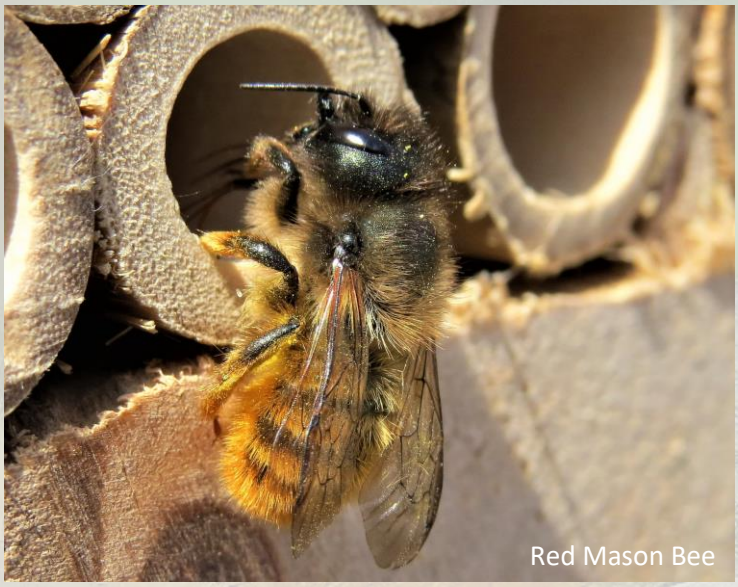
Climate Change: Bees


Great Yellow Bumblebee


Red Mason Bee

There is strong evidence that climate change is affecting UK biodiversity and impacts are expected to rise as the magnitude of climate change increases[1].

As our climate warms, climatically suitable habitats for bees are shifting northwards. Research shows that bumblebees can only disperse a few kilometres each year, and are finding it difficult to move to colonise new areas as climate change affects their habitats.

Although further research is needed to better predict how our changing climate will affect bees, current understanding suggests a range of impacts.

Upland habitats are particularly threatened by climate change, impacting on the **bilberry bumblebee.** The bilberry bumblebee thrives in upland areas and is dependent on species-diverse moorlands, in particular where there is bilberry and heather. It is therefore very vulnerable to climate warming and loss of suitable habitat.

Scotland's rarest bumblebee, the **great yellow bumblebee**, is especially vulnerable to climate change impacts. As a specialist species, it requires extensive, flower-rich grasslands to survive, and flowers that continue to bloom late into September to complete its lifecycle. It is able to disperse greater distances than other bumblebees, but it is now only found at the far north and western edges of the UK and continues to dwindle.

Scottish Environment LINK

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Climate Change: Butterflies and Moths


Common Blue

There is strong evidence that climate change is affecting UK biodiversity and impacts are expected to rise as the magnitude of climate change increases[1]. Most butterflies and moths have specific microhabitat and thermal requirements, making them very sensitive to the effects of climate change. Although a warming climate should see many butterflies and moths moving north, some are negatively affected by the other factors that come with climate change, such as increasing summer storms or milder winters. What's more, species with limited powers of dispersal cannot move northwards across landscapes where the 'stepping stones' of good breeding sites are too far apart. Moreover, recent research has shown that butterflies and moths are only likely to expand their distributions if they have stable (or increasing) population trends, and many species further south are declining due to habitat loss and other factors.

'Northern' species will suffer from the warming that climate change will bring. The summers may prove too hot for some, while others will die off in milder winters through disease. Several of our threatened species depend on damp habitats where the effects of drying out are likely to become obvious.

The **chequered skipper** is now only found within a 50km radius of Fort William, having gone extinct further south in the 1970s. It breeds on purple moor-grass, but only in mild, damp conditions. In Scotland the **forester** moth is only found in the south west where its caterpillars feed on common sorrel, a species of damp meadows. The **large heath** is a peatland specialist. It still seems to be widespread on the upland blanket bogs of the north and west, but has declined in the rest of the country where it is only found on isolated lowland peat bogs. Drying lowland peat bogs is the main cause of its demise.

Other declining species occur in dry habitats. Reduced summer rainfall can cause wilting and even death of caterpillar foodplants.

The **small blue** is now very rare in Scotland. Although it occurs on dunes, coastal cliffs and 'brownfield' sites, the flowering of its food plant, kidney vetch is very sensitive to drought. The female Blue only lays her eggs on the flower heads, where the caterpillars feed on the developing seeds. The **slender scotch burnet** is incredibly rare, and is confined to a few steep slopes on the south-facing coasts of Mull and Ulva. For such rare species, significant changes in the climate could easily spell extinction. The **common blue** and **small copper** are widespread species that occur primarily on dry grasslands around the coasts and in urban areas on 'brownfield' sites. They are however declining, and it is not uncommon to see their foodplants, bird's-foot trefoil and sheep's sorrel respectively, shrivelling during hot, dry summers. The **grayling** has virtually disappeared from most of the country, but is still widespread around the coast. Its caterpillars feed on fine-leaved grasses in very dry surroundings. The caterpillar needs bare ground upon which to sunbathe, but the milder winters seem to be encouraging more grass growth in these places, making the habitats unsuitable.

In common with the species above, **northern brown argus** lives on dry grasslands, where its caterpillars feed only on common rock-rose. Being a 'northern' species it will presumably find a warmer climate less suitable, but strangely this species faces another threat, from a distant cousin! The **brown argus** is a 'southern' butterfly, common and increasing fast in England. It is also moving north, and eventually will meet the northern brown argus. The result is speculative but it probably won't end well for the latter.

Scottish Environment LINK

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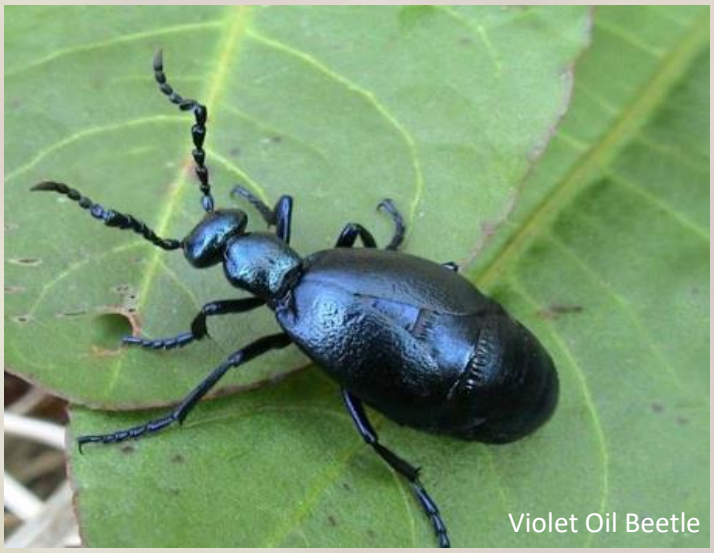
Climate Change: Invertebrates

There is strong evidence that climate change is affecting UK biodiversity and impacts are expected to rise as the magnitude of climate change increases[1].


Violet Oil Beetle

Although further research is needed to better predict how our changing climate will affect invertebrates, current understanding suggests a range of impacts.

Only found in remnants of raised bogs in Central Scotland, the **bog sun-jumper spider** has a very limited habitat, and drier summers will make this habitat less suitable.

Being critically endangered, the **freshwater pearl mussel** is very vulnerable to any climate change impacts that might affect their river habitats**.** Increasing water temperatures will likely limit the distribution of Salmon which form an integral part of the freshwater pearl mussel life cycle. Also living in rivers and streams, the nymphs of the **northern February red stonefly** require clean, cold, fresh flowing water. Rising water temperatures due to climate change is likely to limit the rivers where this species can live.

The **northern damselfly** lives in small pools and ponds. Restricted to a few sites in Scotland, it is threatened by loss of habitat due to climate change, and competition from warmth-loving species such as the **azure damselfly** moving northwards. The **pond mud snail** lives in soft, nutrient poor marshes, ditches and temporary pools. It is vulnerable to climate change related impacts on its habitat, such as longer periods where there is no water present in their ponds.

The **narrow headed ant** is unable to cross unsuitable habitat to colonise new areas and would have difficulties in dispersing. In order to disperse, the ant would need more functionally connected woodland.

Scottish Environment LINK

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Climate Change: Mammals


Badger


Hedgehog

There is strong evidence that climate change is affecting UK biodiversity and impacts are expected to rise as the magnitude of climate change increases[1]. Many species are occurring further north and there are also examples of shifts to higher altitudes. Changes in distributions have differed between species, probably reflecting the intrinsic characteristics of species and the effects of habitat fragmentation in slowing dispersal processes.

For many mammals the impacts of climate change are unclear and further research is needed to understand how they might be affected. However, current understanding suggests a range of impacts.

Periods of drought can reduce the survival of worm-specialist foragers such as **badgers** and **hedghogs**. Climate change may also affect the length and quality of hedgehogs' hibernation which can reduce body condition, breeding success and survival rates.

Water voles are fast declining. They live along rivers, streams and ditches, around pools and lakes and in marshes, reed beds and areas of wet moorland. Their main threat is predation by the Mink, but this is exacerbated by loss of habitat, in part due to climate change.

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Climate Change: Native Trees

There is strong evidence that climate change is affecting UK biodiversity and impacts are expected to rise as the magnitude of climate change increases[1].


Scots Pine

Many species are occurring further north and there are also examples of shifts to higher altitudes. Changes in distributions have differed between species, probably reflecting the intrinsic characteristics of species and the effects of habitat fragmentation in slowing dispersal processes. For our native trees, it is important to halt fragmentation and develop habitat networks.

Although further research is needed to better predict how our changing climate will affect many tree species, current understanding suggests a range of impacts.

Alder is most prevalent on wet ground next to rivers or lochs and is an important part of Riparian Woodland. Climate change impacts on wetlands are a potential threat to Alder.

Montane and coastal habitats are also key habitats likely to be affected by climate change. This will have an impact on **juniper.**

The very restricted geographic range of the **Arran whitebeam** and lack of dispersal opportunities, makes it vulnerable to the effects of a changing climate.

Aspen is one of the rarest of Scotland's native trees and its scarcity reduces its resilience to climate change impacts. **Wych elm** is also rare with some small populations remaining untouched by Dutch Elm disease in the north and west of Scotland. However, the threat of climate change means that the future of these Wych Elm populations is far from secure.

Rowan is found in upland woods as well as at lower altitudes. Lower altitude areas may become unsuitable for Rowan due to climate change.

Old woodlands dominated by **Scots pine** provide habitats for some of Scotland's rarest species, such as the Pine hoverfly and Scottish wildcat. However, many important areas for this iconic conifer may become less suitable as a result of climate change, which is likely to favour the growth of its competitors.

Yew is our longest lived tree species, with some Scottish individuals estimated to be thousands of years old. Predicted climate change impacts including increased heat waves and extreme temperatures are stressors for ancient trees, potentially resulting in increased mortality.

Scottish Environment LINK

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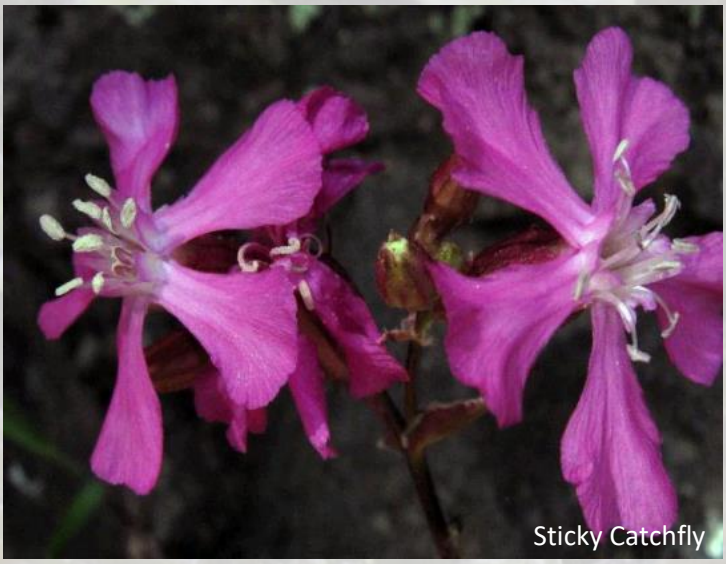
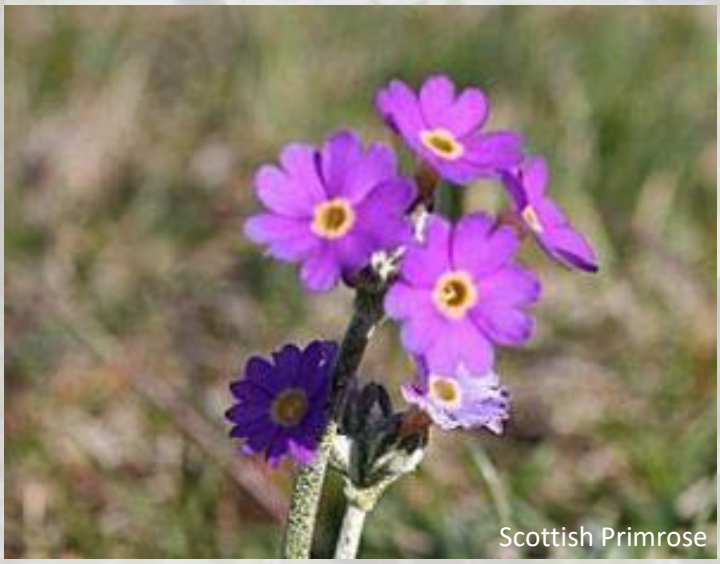
Climate Change: Plants


Sticky Catchfly


Scottish Primrose

There is strong evidence that climate change is affecting UK biodiversity and impacts are expected to rise as the magnitude of climate change increases[1].

In response to warmer temperatures, many species are occurring further north and there are also examples of shifts to higher altitudes. Changes in distributions have differed between species, probably reflecting the intrinsic characteristics of species.

Although further research is needed to better predict how our changing climate will affect different plant species, current understanding suggests a range of impacts.

The impact of increases in temperature on their upland habitats threaten **bearberry** and **mountain everlasting.** Also growing in the uplands, in high, bare mountain habitats, depending on cold winters and late snow-lie, **mountain sibbaldia**, is threatened by increase in temperature and less snow.

Rusty bog-moss is found throughout Scotland on both lowland raised bogs and blanket bogs, especially in the north and west. It is an important peat forming species, locking carbon into the peatland. Climate-related drying bogs is a potential risk to the moss, particularly in the lowlands.

Sticky catchfly is found on cliff ledges. It is very rare and vulnerable to droughts, making it susceptible to impacts of climate change.

Wilson's filmy fern and **tree lungwort** are found in the Celtic Rainforest; the oceanic woodlands on the west coast. Both depend on a certain range of temperature and humidity and are vulnerable to extreme weather events from climate change.

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Climate Change: Terrestrial and Wetland Birds


Golden Plover


Golden Eagle

There is strong evidence that climate change is affecting UK biodiversity and impacts are expected to rise as the magnitude of climate change increases[1].

Wild birds across Scotland are changing in abundance and distribution in a way consistent with a changing climate. Changes in distributions differ between species, reflecting intrinsic characteristics and the effects of habitat changes in dispersal processes.

Migratory birds are arriving earlier. **Swallows**, for example, are arriving 15 days earlier, and breeding 11 days earlier, than they did in the 1960s.

Climate change will increase the pressure on species already in decline. A number of our declining rare Scottish breeding birds, including **dotterel**, **whimbrel**, **common scoter** and **Slavonian grebe**, are predicted to be at a higher risk of national extinction. Ground nesting species like **black grouse** are known to be sensitive to changes in rainfall at critical parts of the breeding cycle.

Where research has investigated climate impacts on species in detail, complex patterns emerge. For example, climate change appears to be a significant threat to the **golden plover,** not only through direct impacts on key habitats, but also causing a mismatch in the annual timing of breeding and of the annual emergence of their chicks' critical invertebrate prey, craneflies.

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