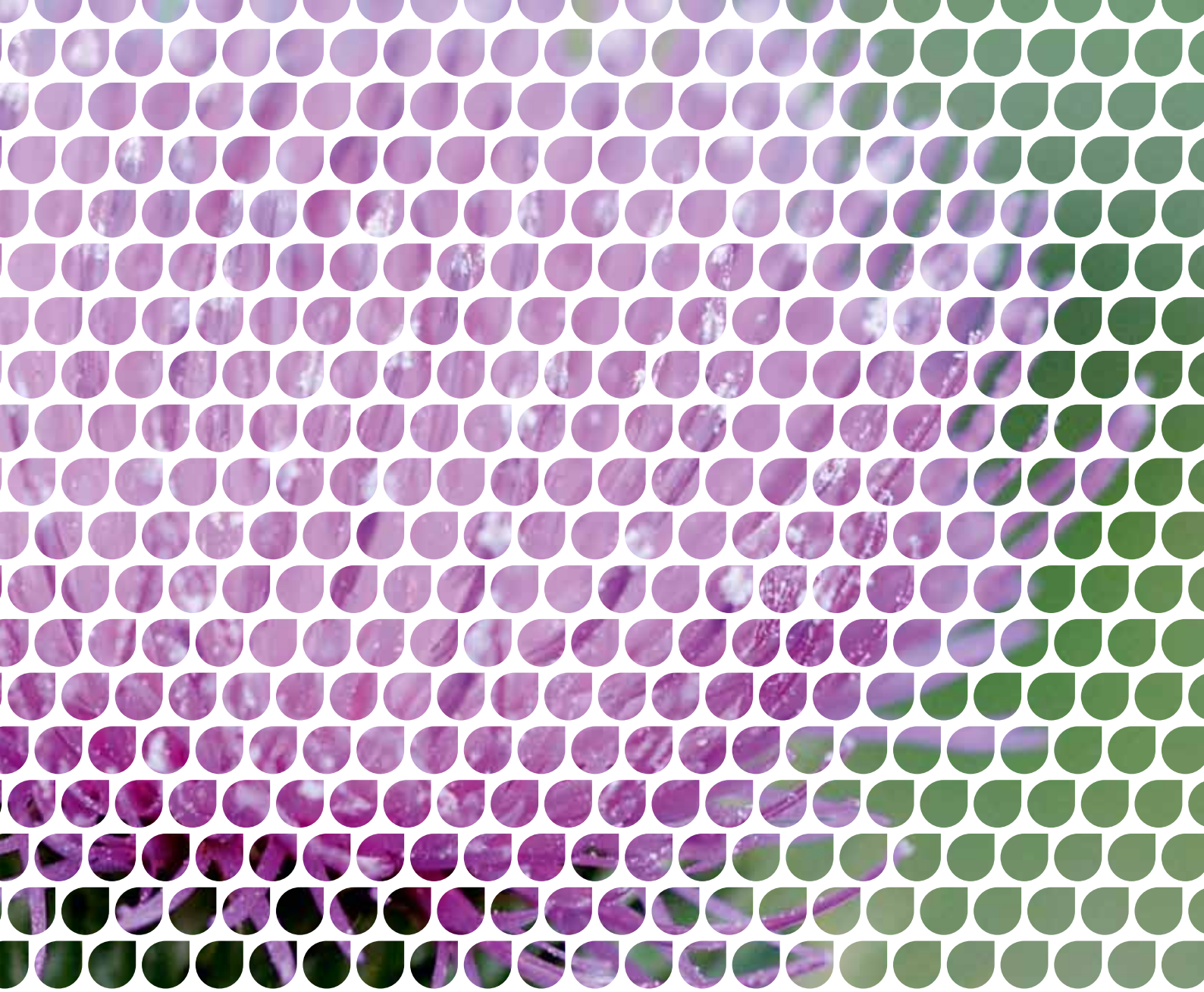

Scotland

state of nature

The natural environment is vitally important to Scottish cultural identity and to its economy – one fifth of all industries in Scotland rely significantly on the environment[1]. Nevertheless, Scotland's landscape has changed markedly over time. It is one of the most heavily deforested countries in Europe and attempts to reverse this in the 20th century, mainly with commercial non-native conifer plantations, caused further environmental degradation, in particular the loss and fragmentation of blanket bog and other valuable open habitats.

Sporting estates cover large areas of the Scottish Highlands and here much of the land is managed for deer and red grouse production. In these areas, deer grazing and management practices, such as the burning of heather, have had a marked effect on local wildlife.

Scotland's wildlife ranges from vast flocks of coastal wading birds, many of which breed in the crofted farmlands, to unique montane lichen communities and burnet moths. Some of the UK's most iconic species live here, including magnificent golden eagles and gnarled ancient Scots pines. Over 90% of the UK's standing water is found in Scotland's lochs and its rivers are of global importance for freshwater pearl mussels and Atlantic salmon.

One of Scotland's most important contributions to global biodiversity, however, is its mosses and liverworts, which make up one of the richest bryophyte floras in Europe[2], and include almost 60% of all known European species.


Pine marten

Peter Cairns

- ***Some of Scotland's most threatened mammals, such as the red squirrel[3], remain at suppressed levels and may still be declining. Others, such as the mountain hare, have started to decline more recently[4], although the pine marten has begun to recover[5].***
- ***Out of the 20 butterfly species assessed in Scotland, populations of 70% have either increased slightly or decreased slightly. Only the grayling has declined strongly. A quarter of butterfly species and many moths are spreading north, and several have colonised Scotland in recent decades, including the comma and holly blue[1].***
- ***Of the 115 widespread bird species assessed in Scotland, a similar number have increased and decreased. However, marine species are of particular concern: five out of twelve seabird species are declining strongly.***
- ***Flowering plants show similar patterns of change in Scotland compared to the UK overall: 54% of species are declining and 28% declining strongly.***

Measuring the state of nature in Scotland

The main *State of Nature* report gives an overview of how wildlife is doing across the UK. Here we concentrate on Scotland. Due to a lack of suitable data, we were only able to present quantitative trends for about 5% of the UK's species, and when we look at a smaller scale, the problem becomes even greater. As a result, although we report the best available data here for Scotland, the picture is far from complete – we simply do not have sufficient knowledge to make a robust quantitative assessment of the state of nature in Scotland. Even population trends for charismatic animals such as wildcats and red squirrels remain unquantified.

In many cases we suspect that trends at the UK level may hold true in Scotland, but this is not always the case. Caution should be used in drawing wider conclusions about the state of Scottish nature from the evidence we present here. As elsewhere in the UK, one of our strongest messages is that we need to know more about how nature is faring in Scotland.

Given these constraints, rather than attempt a lengthy overview of Scottish nature, we will briefly highlight the importance of four of Scotland's most special habitats, as well as a few measures of change in Scotland's wildlife.

Gannets

Some of the UK's most iconic species live in Scotland, including golden eagles and wildcats.

The Scottish Government publishes official biodiversity indicators, which are used, together with others, to describe the state of the environment in Scotland. A summary of these is given in the table[10]: an upwards arrow (▲) indicates an increase in abundance or diversity, a downwards arrow (▼) indicates the opposite, and an equal sign (◀▶) indicates little change.

Scottish biodiversity indicators

Indicator	Long-term trend
Wintering water birds	▼
Breeding seabirds	▼
Terrestrial breeding birds	▲
Butterflies	◀▶
Flowering plant diversity	▼
Freshwater invertebrate diversity	▲
Moths	◀▶

Several of the large datasets used in the main *State of Nature* report also provide country-specific assessments. Scotland-specific population trends, covering a period of up to 50 years, were available for flowering plants[6], some birds[4,7,8] and butterflies[9] and were used to derive the headlines (left). The same rules were used to allocate species into the four trend categories as in the main *State of Nature* report. These rules, as well as details of the datasets and analysis methods used, are given in the methods section of the main report.

Woodland

Caledonian pine forest

Scotland was once a heavily forested country, but by the 1700s, human actions and historic changes to the climate had reduced woodland to just 4% of the land area[1]. Nowadays, native woodland cover remains severely depleted, but more than a tenth of Scotland is covered in non-native plantation forest[11]. The natural value of these non-native plantations is much lower than that of native forests, and the fragmentation of native woodland is detrimental to many relatively sedentary woodland species.

Despite their diminished area, native woodlands are home to many of Scotland's threatened species and therefore are hugely important. Many of these species rely on the traditional woodland management practices people have used for centuries to harvest timber, produce charcoal or graze livestock.

Several special and wildlife-rich forms of native woodland are found in Scotland, including Caledonian pine forest and Western Atlantic oak and hazel woods. Although still small and fragmented, after four millennia of decline, Caledonian pine forests have begun to gradually increase in area[12]. The remaining forest is now largely protected and work is underway to improve conditions. For example, at Abernethy and Corrimony nearly 14 sq km has been restored or re-planted and deer have been managed to allow natural regeneration. Nevertheless, it will be decades before these new areas of woodland match the natural value of the remaining fragments, which are home to pine hoverflies, capercaillie and twinflowers.

The Atlantic oak and hazel woods of western Britain form a very distinctive habitat – temperate lowland rainforest, which is found in just a few places worldwide. These damp habitats are exceptionally rich in fungi, lichens and mosses. The diversity of these is staggering: more than 200 species of moss and liverwort have been found in a single ravine in Argyll[13].

Twinflower

New species are still being described in these habitats, and it was only recently that the global importance of our Atlantic hazel woods was recognised. Sensitive management, in particular getting the grazing level right and controlling invasive species, is key.

Case study

Rhododendron invasion

The invasion of rhododendron is a major issue in Scotland's woodlands. By shading out understorey plants and mosses, it has damaged the flora of over half the important Western Atlantic oakwood sites. It also carries a fungus-like disease which threatens commercial forestry and some native plants.

Rhododendron

More than 200 species of moss and liverwort have been found in a single ravine in Argyll.

Peatland and upland

Scotland holds the largest continuous area of blanket bog in the world, in the Flow Country of Caithness and Sutherland, and 5% of the global total[14]. Although peatlands cover a similar area to forest in the UK, they lock away 20 times more carbon. As well as providing this important ecosystem service, peatlands are vital for the unique community of species adapted to live there. These damp, colourful wetlands support an array of mosses and rare bog plants, and some of the highest density populations of wading birds, such as greenshanks, in Europe[14].

A tenth of Scotland's blanket bog is now covered by non-native plantation forest, which dries the land, halts peat development and fundamentally changes the habitat and wildlife that lives there. Peatland wader populations have declined because of afforestation[15] and recent research suggests that the number of birds such as dunlins and golden plovers are reduced on unplanted blanket bog habitats near to conifer plantations[16].

We know that it is possible to restore peatlands: for instance, some felled areas in the Flow Country showed an increase in moss cover from 15 to 25% in just six years, a clear sign of bog recovery[17].

Scotland holds 90% of the UK's montane habitat[11]. This habitat supports more threatened lichen species than any other habitat in the UK. Iconic wildlife such as the ptarmigan, dotterel and wildcat can all be found here and new species are still being discovered.

Atmospheric pollution and overgrazing continue to threaten montane habitat, and although difficult to predict, due to the complex interaction between temperature, rainfall, wind and grazing, it is likely that this habitat will be strongly influenced by climate change.

The woolly fringe moss *Racomitrium lanuginosum* is a key species in montane habitats, and often found with important alpine plants, such as crowberry. The high altitude heaths it forms are foraging areas for dotterels, which even use the moss to line their nests. However, *Racomitrium* heath is vulnerable to nitrogen pollution and overgrazing, which together allow grasses and sedges to become dominant[18].

Montane areas also support unique snowbed communities; rare lichens, liverworts and mosses that survive in and around areas of permanent snow cover in shaded mountain gullies[1].

Case study

Wildcats

Chris O'Reilly

Wildcat

Wildcats epitomise the remote, open landscapes of the Scottish uplands. However, in mainland Europe they are lowland woodland animals[19], and experts think that they have been driven to use Scotland's remote uplands by historic persecution. Recent research indicates that wildcats are effectively extinct east of the Great Glen[20]. However, assessments of population size or trajectory remain as elusive as the animals themselves. Estimates put the total population at fewer than 100 individuals, regarding others as hybrids between wildcats and feral domestic cats. Hybridisation is now regarded as the greatest threat to wildcats, but persecution may also still be a significant problem.

Eleanor Bentall

Forsinard Flows

Case study

Great yellow bumblebee


Mike Edwards

Great yellow bumblebee

This distinctive yellow bumblebee used to be found across the UK, but its range has declined drastically in the past 100 years[23] and now it is only found in the very north and west of Scotland. The loss of the UK's flower-rich habitats, as a result of changes to farming practices, is thought to be responsible.

Although not a machair specialist, the great yellow bumblebee is now strongly associated with machair habitats and areas where traditional crofting practices persist. There have been no specific agri-environment schemes to help conserve this bumblebee, but the species is likely to have benefited from options designed for corncrakes, such as the management of early and late cover along field margins and corners[24].

Agricultural intensification and the abandonment of crofts continues to pose a threat to island populations, and more work is needed to re-connect the remaining mainland populations in Caithness and Sutherland.

Farmland

As in the rest of the UK, much of the land in Scotland is used for farming, and it too has changed to a similar extent, as a result of the drive for more efficient food production. There are many areas in Scotland, however, where food production is marginal. Some of these areas, in particular those characterised by mixed farming of cattle and cereals, are hugely important for wildlife and are widely recognised as High Nature Value farming systems of international significance[21]. A key example is the calcareous dune pasture on the west coast of Scotland, most notably on the Western Isles, known as machair.

Machair is managed using traditional farming methods, with seasonal cattle-grazing and areas devoted to low-input cropping of local cereal varieties and potatoes. It is famous for summer carpets of wildflowers – a typical patch can have 45 plant species per square metre[22] – and is full of animal life. Bees, butterflies and birds abound, including a bird community with over 15,000 breeding pairs of six wader species at some of the highest recorded breeding densities[1].

Machair and other coastal grasslands are important for threatened bee species such as the great yellow bumblebee and threatened birds like the corncrake and corn bunting,


Mark Gurney (RSPB)

Irish lady's-tresses orchid

and provide the only British home for the Irish lady's-tresses orchid. These species are under threat from changing agricultural practices, the loss of floral diversity and habitat fragmentation.

Given the marginal returns on High Nature Value farming systems, farmers are under pressure either to change and intensify production methods, or abandon the land altogether in some places – scenarios that do not bode well for Scottish farmland nature.

Under current European arrangements, farmers can receive payments that may indirectly support High Nature Value farming systems, but this may not always be the case in future.


Niall Benvie

Machair in bloom

Marine


Chris Gomersall

Bottlenose dolphins

Scotland's marine environment is hugely important, both for its natural wealth and for the cultural and economic benefits it brings. Scottish waters hold internationally important populations of dolphins and whales, as well as 90% of the UK's grey seals and a staggering five million seabirds.

Some communities rely on fishing as a major source of jobs. However, fish catches have declined since 2000[25], in line with diminishing fish stocks. In particular, sharks, skates and rays are severely depleted all around the Scottish coast due to overfishing[25].

Evidence is mounting that climate change is having wide-ranging and dramatic impacts on marine ecosystems. Small changes to sea temperatures appear to be affecting entire food webs and may be responsible for the recent declines of Scottish seabirds.

In the North East Atlantic area, rising sea-surface temperatures have led to disruption of the synchrony between peak populations of phytoplankton and their predators, zooplankton. Evidence suggests that this has led to a major decline in copepod biomass since the 1960s. Copepods are in turn food for larval sandeels, so fewer copepods means fewer sandeels and less food for seabirds such as kittiwakes[26].

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Sue Kennedy