

ECOSYSTEMS AND BIODIVERSITY

Past drivers

- The key pressures on ecosystems and biodiversity in Scotland are:
 - pollution;
 - land use intensification and modification;
 - spread of invasive species and wildlife disease;
 - lack of recognition of the value of nature;
 - disconnection with nature;
 - climate change; and
 - marine exploitation.
- Agriculture, forestry and fisheries have had a major influence on Scotland's land and marine ecosystems.
- Legislation and River Basin Management Plans have supported improvements in water quality.

Where are we now?

- The condition of Scotland's ecosystems is varied. Water ecosystems are in a good or moderate state. Land components tend to be in poorer condition, with concern around uplands and farmland biodiversity. Soil condition is good overall but the ability of soil to perform critical functions under changing climate is at risk, especially in agricultural systems.
- From 1994 to 2016, 49% of Scottish species have decreased and 28% have increased in abundance. 11% of species in Scotland have been classified as threatened with extinction from Great Britain.
- Following a period of historic decline, the overall abundance of terrestrial birds has started to increase. The terrestrial breeding birds index increased by 19% between 1994 and 2017, however there are variations among species and some continue to decline.
- In 2019, 78.9% of natural features on protected nature sites were in favourable condition, maintaining a similar level to 2010.
- After decades of decline, land-based 'natural capital stocks' have improved over the past 18 years and, although below historic levels, are at their highest since 2000.

Where do we want to be?

- Protect and restore biodiversity on land and in our seas, and support healthier ecosystems.¹

Current initiatives

- Agri-environment: Strong scientific underpinning of measures but scope to increase efficacy through finer-scale targeting and improved support for habitat connectivity.
- CAP Greening: All Ecological Focus Area (EFA) measures have potential to result in positive outcomes, particularly if maintained in same location over time. However, EFA measures deliver less benefit than through more specific and targeted measures.
- Central Scotland Green Network: No evaluation on the impact on biodiversity and habitats.
- Protected Nature Sites: General agreement they have played an important role in nature conservation.
- Forest Grant Scheme: Strong scientific underpinning.
- Peatland Action Fund: A major on-going programme of peatland restoration with initial evaluations showing positive biodiversity benefits.
- River Basin Management Plans: Recognised by the EC as leading the way in our approach.

Future drivers

- Effects of climate change and how we adapt.
- Future global food consumption and food security.
- New agriculture and environment support measures post-Brexit.
- Land-use planning as a vehicle for driving change.

Key evidence gaps

- The appropriate balance between supporting designated sites and the wider environment in order to achieve biodiversity goals.
- Impacts of declining abundance of certain species (e.g. insects) and loss of habitat connectivity on biodiversity.
- The effectiveness of agri-environment measures, due to weak baseline data and the more recent impact of spatial targeting (impacts not yet assessed).
- How climate change will impact nature and the role of nature-based solutions in mitigating and adapting to climate change.
- The key priority sites for conservation and ecosystem health enhancement.

A Introduction

1. The resilience of ecosystems is their capacity to resist or recover from a range of environmental pressures, such as changes in land use and land management practices, direct and indirect effects of climate change and increasing economic and demographic demands on natural capital. The 2019 IPBES Reportⁱ highlighted that, at a global level, these pressures are contributing to the degradation of ecosystems, leading to loss of resilience. The impacts on ecosystem structure and function include loss of biodiversity, increases in invasive non-native species, soil health degradation and damage from pollution. The nature of many ecosystem responses to pressure may be complex, as in the case of tipping points where pressure on an ecosystem may lead to gradual change up to a threshold, beyond which there is a sudden, perhaps irreversible, change.
2. Whilst the components of ecosystems (biodiversity and abiotic/geodiversity elements) are important in their own right, all the food we eat and the resources we use ultimately come from nature and so overall ecosystem health is relevant to all of us. Due to the difference in how species and natural processes operate, some indicators, such as condition of freshwater, change relatively quickly. Whereas others are much slower to change, such as soil carbon.
3. Measuring the change in ecosystems is difficult, and while the overall picture of a particular indicator at the Scotland level may be positive, this does not necessarily mean that there are not specific areas which require attention. Scotland has published a set of ecosystem health indicators which begin to provide a comprehensive assessment.ⁱⁱ While this knowledge account focuses on the terrestrial environment, there are clear linkages with the health of our marine environment.
4. There have been major habitat shifts in Scotland following the industrial revolution and the intensification of farming, forestry and fisheries since the 1950s with the loss of historic native woodland, 'biomass' of wildlife, and national extinctions. Historic and ongoing land management practices across large areas of the Scottish Highlands, including soil management, grazing, burning, drainage and predator control, have had an impact on wildlife. Most of Scotland's ecosystems are highly modified and have suffered significant losses in the range and abundance of species and habitats as human activities have intensified. These ecosystems are severely degraded compared to natural, undamaged habitats.ⁱⁱⁱ
5. There are now projects aimed at the restoration of ecologically important species and habitats across Scotland such as beaver, wildcat, otter, red squirrel, and white-tailed eagle, along with native woodlands. Projects are also focused on soil health including soil carbon sequestration, reduction of GHG emissions, flood control, and reduction of land degradation.
6. Research suggests that a holistic ecosystem approach which looks at the health of the ecosystem in general, rather than just a few specific features or species, is more effective for the management of a changing environment.

B Recent trends

7. Overall, the state of Scotland's ecosystems is varied. The water environment is in a good or moderate state and has been either stable or improving in recent years. However, land components tend to be in poorer condition with some in decline and particular concern around farmland biodiversity and uplands.

8. When in a healthy condition, Scottish ecosystems can provide services such as water, food, fuel and energy, storm protection, carbon storage, minerals, and flood control. After decades of decline until the 1990s, our land-based 'natural capital stocks' have improved over the past 18 years. Although still significantly below historic levels, they are now at their highest level since 2000.^{iv} Freshwater habitats continue to improve although lochs have struggled to recover from the legacy of pollutants locked into catchment or sediments. Heathland and peatland habitats have made a substantial recovery from historic lows in 2012. For agriculture, there has been a historical downward trend driven by habitat loss. Overall, there is no significant change in carbon storage in arable or grassland soils since 1978 but there is evidence that older grasslands store more carbon.
 9. There has been woodland expansion in Scotland in recent years and woodland birds have shown marked improvements. However, designated woodland features in 'favourable' condition continue to decline. Woodland management needs to consider ecosystem services such as water and soil protection, as well as economic and carbon needs. Native woodland creation can provide more benefits for ecosystems and wildlife than commercial conifer plantations. Woodland expansion therefore needs to be balanced and achieved with the 'right tree in the right place'.^v
 10. Around 23% of our land and 18% of our seas are covered by Protected Nature sites. In May 2019, 78.9% of natural features on protected sites were assessed as being in favourable condition, an increase of 8.3 percentage points since 2005, though down from its high of 80.4% in 2016.^{vi}
 11. The index of abundance of terrestrial breeding birds, a proxy for biodiversity, has risen steadily since 1994 and in 2017 it was 19% above this baseline. However, the index peaked in 2008 and has fluctuated since.^{vii} While long-term monitoring data is lacking, it is generally acknowledged that this follows a period of historic decline. Some bird species continue to decline.
 12. The 2019 State of Nature report, which looked at a wider range of species (175 moth, 143 bird, 25 butterfly and 9 mammal species), found that from 1994 to 2016, 49% of Scottish species have decreased and 28% have increased in abundance. The occupancy indicator for 2,970 terrestrial and freshwater species showed a decline in average distribution of 14% between 1970 and 2015.^{viii} 11% of species in Scotland have been classified as threatened with extinction from Great Britain.
 13. Scotland's seas support a diverse array of habitats and species and contain nationally and internationally important populations such as the northern feather star, the burrowing sea anemone, the northern sea fan and cold water corals. There is evidence that fishing activities have impacted certain habitats, for example shallow and shelf subtidal sediments (including burrowed mud habitats). Aquaculture has also been linked by the Scottish Environment Protection Agency to localised adverse impacts on marine biodiversity, for example through the use of chemicals to control sea-lice.^{ix}
 14. Sharks, skates and rays face further declines and are severely depleted all around the coast; these declines are largely the consequence of historic overfishing. Populations of some seabirds, harbour seals and some fish species have declined due to climate change, human activities and competition from other species. These declines may be associated with broader changes in the food web, for example, the decline in availability of sandeels has had a major influence on recent changes in seabird numbers.^x
- C Past drivers of change**
15. Changes in biodiversity are often associated with land management and atmospheric pollution, although the effects of climate change are also becoming evident (e.g. shifts in butterfly populations^{xi} and some arctic-alpine species). 'Scotland's Biodiversity – A Route Map to 2020'^{xii} identifies seven key pressures on biodiversity in Scotland: pollution; land use intensification and modification; spread of invasive species and wildlife disease; lack of recognition of the value of nature; disconnection with nature; climate change; and marine exploitation.

16. Land degradation and declines in soil health, notably erosion and compaction^{xiii} are compounded by climate change.
 17. The role of agriculture and forestry in shaping landscapes and terrestrial ecosystems is important as they affect a large proportion of Scotland's land area (c.70% and c.18% respectively^{xiv}). In particular, agriculture has had a major influence on Scotland's ecosystems over the past 70 years which, in part, has been influenced by changes in global food consumption, the post-World War II drive for increased food production, and innovations in farm technology.
 18. Red deer densities in Scotland have increased by 60% since 1961, with evidence that grazing by deer and other herbivores is a major cause of unfavourable condition of natural features in protected areas.^{xv}
 19. Pollinators, which are a vital part of our biodiversity and wider environment, have declined in their abundance and distribution.^{xvi} However, butterfly populations, both specialist and generalist species, have remained stable since the indicator baseline year of 1979. Small skipper, Essex skipper, ringlet, orange-tip and red admiral all appear to be benefitting from climate change.^{xvii}
 20. Changes in species in Scotland are often associated with invasive non-native species and land use patterns. The abundance of birds may be affected by many factors such as the weather, changes to habitats and changes in the abundance of food sources. Raptor persecution is the most high profile type of wildlife crime in Scotland and it can have serious impacts on the populations of some bird of prey species at local, regional or national level.
 21. The latest assessment of the condition of Scotland's protected sites identified negative pressures on natural features on protected sites from invasive species, over-grazing, water management and recreation/disturbance.^{xviii}
 22. Diffuse pollution from agriculture is recognised as a key pressure on water quality, with 252 rivers and lochs in Scotland affected by diffuse pollution pressures. Wetlands on lower ground, although small, are important biodiversity components of the farmed landscape and are at risk from diffuse pollution. However, levels of the principal air pollutants have all declined in Scotland since 1990, and all but ammonia are at levels below 40% of their 1990 values.^{xix}
 23. For forestry, the UK Government's tax support for forest planting (in place until 1989) provided incentives which encouraged planting on land that was marginal for forestry, resulting in environmental damage and conflict.
 24. There are two significant large-scale pressures on the Scottish marine area which impact on the seabed and species: human activity contributing to climate change and fishing. In addition aquaculture can have localised impacts. The size of fish stocks are affected by several factors, including commercial fishing and other factors such as climate change and success of recruitment (the number of young fish entering the adult population each year).
- D Future drivers**
25. At a global level, the 2019 IPBES report^{xx} reinforces the importance of soil to support a healthy environment and as a driver of natural biologically mediated cycles. Soil is important for controlling air and water quality and regulating the carbon cycle.
 26. The IPBES Global Assessment (2019) confirmed the five direct drivers of biodiversity loss as: changes in land use (including, over and under-grazing, excessive compaction and increasing erosion risk from farm/forestry interventions); built infrastructure; over-exploitation (hunting, fishing, shooting etc); climate change; and invasive species (both native and non-native) and novel pests and diseases. In addition to being a driver in its own right, climate change intensifies all of the other drivers.

27. In terms of climate change, a key future driver will be how we both mitigate climate change, including the use of natural carbon storage solutions, and adapt to a changing climate and associated impacts on ecosystems and wildlife.
28. Public attitudes and behaviours are also a major driver and the IPBES Global Assessment (2019) highlights that contact with nature and valuing nature are key underlying causes of the direct drivers of biodiversity loss. Land-use planning will continue to be a vehicle for driving change as it results in the infrastructure that, together with social and individual factors, determine behaviours.

E Current initiatives

29. Agri-environment Climate Scheme: As part of the EU Common Agricultural Policy (CAP) Pillar 2, this scheme promotes land management practices which protect and enhance Scotland's natural heritage, improve water quality, manage flood risk and mitigate and adapt to climate change. Overall, there is strong scientific underpinning of the agri-environment options but scope to increase efficacy of options through better targeting and habitat connectivity. However, weak baseline data makes it difficult to assess the overall impact of the scheme.
30. CAP Greening: This is a mandatory component of the EU CAP Pillar 1 Direct Payments Scheme which supports agricultural practices which are beneficial for the climate and the environment. A review found that all Ecological Focus Area (EFA) measures within Greening have the potential to result in positive outcomes, particularly if maintained in the same location over time. However, EFA measures deliver less benefit than through more specific and targeted measures.^{xxi} Evaluations by the EC^{xxii} and the European Court of Auditors^{xxiii} concluded that the scheme has only had a limited and variable impact on farm management practices and unlikely to significantly enhance the CAP's environmental and climate performance.
31. River Basin Management Plans: The Water Framework Directive (2000) requires Member States to establish a framework for the management of our water resources through the introduction of River Basin Management Plans, a cyclical, detailed planning mechanism for setting environmental objectives for each water body within a river basin district. Scotland's approach to tackling controlled activities and diffuse pollution has been recognised by the European Commission as leading the way in Europe.
32. Central Scotland Green Network (CSGN): This is one of Europe's biggest greenspace projects, covering over 19 local authority areas and 3.5 million people. It supports the restoration of ecosystems through upland and lowland habitat management and woodland creation and management. An evaluation indicated a minimum return on investment of £2.14 for every pound spent on the CSGN. However it did not examine the impact on biodiversity and habitats.^{xxiv}
33. Protected Areas for Nature: There are 1,866 protected areas in Scotland, covering around 23% of our land and 18% of our seas. There is agreement that they have played an important role in nature conservation, but are not in themselves a sufficient response to the widening and increasing pressures on the natural environment. They have also tended to focus more on rarity and maintaining the status quo than responding to a changing environment and the dynamic character of natural systems,^{xxv} although studies elsewhere have shown that protected areas offer opportunities for 'non-target wildlife species' and form important hubs in the wider countryside.
34. Forest Grant Scheme: This supports the creation of new woodlands, contributing towards the Scottish Government's target of 10,000 hectares of new woodlands per year and the sustainable management of existing woodlands. There is a strong scientific underpinning of the forestry options.

35. Peatland Action Fund: Aims to restore Scottish peatlands whilst also supporting demonstration sites and events to raise standards and encourage innovation for effective peatland restoration. Initial evaluations show positive biodiversity benefits.
36. Natural Capital Accounting: Natural capital approaches are increasingly utilised to assess business decisions in a more holistic way. Natural capital accounts allow organisations to gauge wider economic impacts of their land or natural capital assets. The Natural Capital Protocol utilises Natural Capital Accounting to highlight risks, opportunities, impacts and dependencies on natural capital. Ultimately the natural capital accounting approach should allow natural capital managers to make more informed decisions and provide more benefits from their operations.

Endnotes

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- xxi CAP Greening Review, Scottish Government, <http://www.gov.scot/Topics/farmingrural/Agriculture/CAP/CAP2015/Greening/CAP-Greening-Review>
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