

Transport Scotland Biodiversity Strategy Annex 1: Factors Contributing to the Decline in Biodiversity

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Factors Contributing to the Decline in Biodiversity

Decline in Global Biodiversity

A growing body of scientific evidence shows that human activity has had a pervasive impact on all aspects of life on Earth, including biodiversity. [Humanity accounts for about 0.01% of all life yet is estimated to have caused the loss of 83% of all wild mammals and half of all plants on the planet. Species extinction driven by human activity is occurring at a high rate](#), leading many scientists to label our era as the sixth “mass extinction”. In 2024, the [World Wildlife Fund](#) reported that over the past 50 years the average size of wildlife populations has declined by 73% globally and by 35% across Europe.

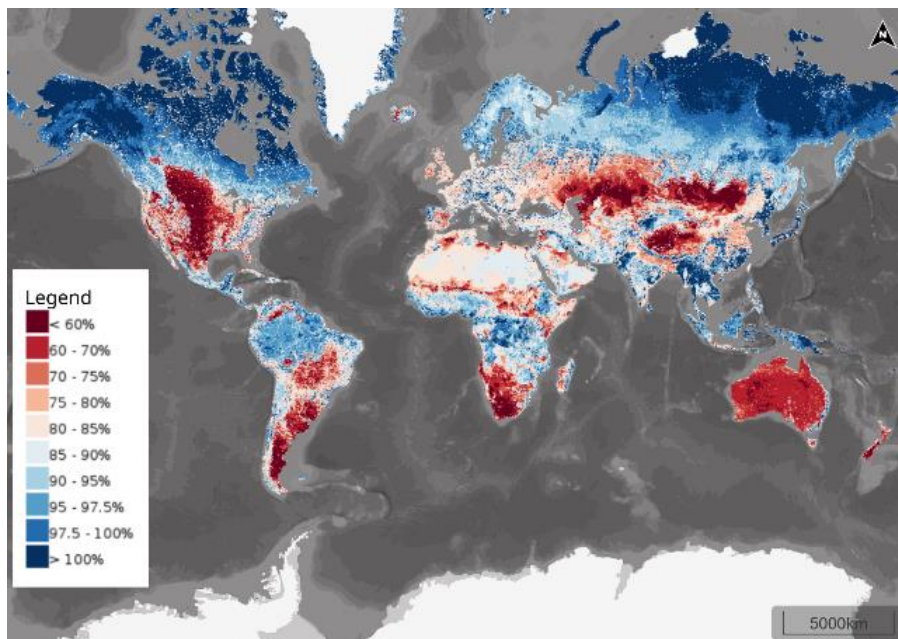


Figure 1. Biodiversity Intactness Index map showing the modelled average abundance of originally-present species, relative to their abundance in an intact ecosystem (i.e. 100%). [CC BY 4.0](#)

The Scottish Biodiversity Strategy cites the five direct drivers of global biodiversity loss as identified by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) 2019 [Global Assessment Report on Biodiversity and Ecosystem Services](#). These are:

- changing use of land and sea resources, especially for agriculture, forestry, fish farming, and coastal infrastructure;
- direct exploitation of organisms via harvesting, logging, hunting, and fishing;
- climate change;
- pollution; and
- invasive non-native species (INNS) and growing prevalence of pathogens.

These are discussed in greater detail in the following section.

Biodiversity Loss in Scotland

Understanding the current state of biodiversity and the extent and rate of its decline in Scotland is the starting point for developing a strategy aimed at halting and reversing losses. [Indicators of the abundance of marine seabird populations and selected terrestrial species in Scotland show significant declines](#). Research published in the [State of Nature Scotland 2023 report](#) highlights that:

- since systematic monitoring of 407 species began in 1994 the abundance of those species has reduced on average by 15% and in the last decade alone 43% have declined;
- since 1970 the distribution of half of flowering plants has decreased;
- one in nine Scottish species are threatened with extinction including mountain bumble bees, red squirrels, Scottish wildcats, capercaillies, swifts, puffins, curlews, kestrels, tree sparrows, brown hares, hedgehogs and wild pansies to name just some terrestrial species; and
- Scotland's seabirds have declined by half between 1986 and 2019.

As of 2021, [Scotland ranked 28th from the bottom among 240 countries](#) when measured using the Biodiversity Intactness Index which indicates the proportion of nature that remains intact following human activities on land.

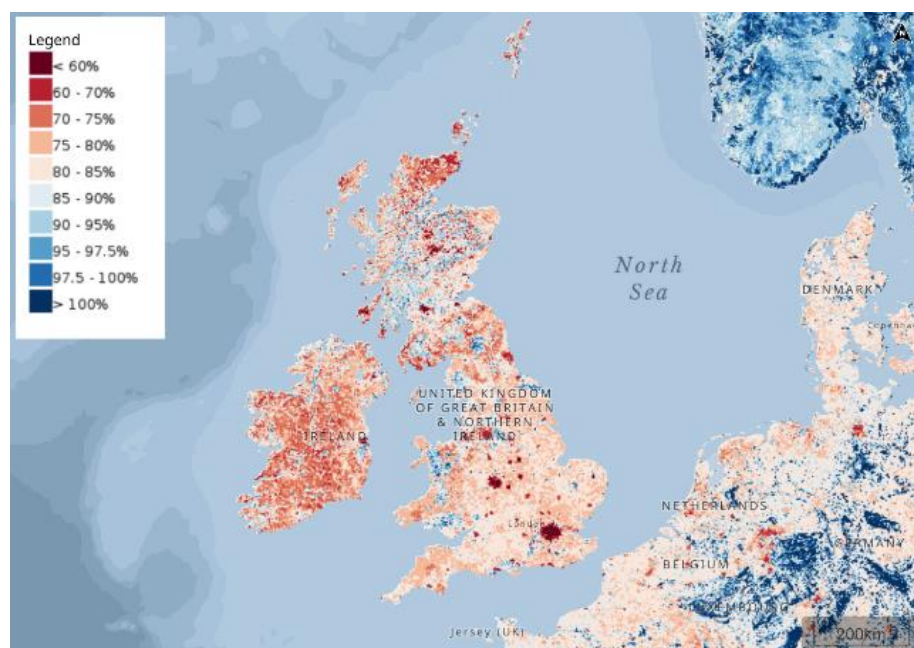


Figure 2. Biodiversity Intactness Index map close-up. [CC BY 4.0](#)

Beyond the five direct drivers of global biodiversity loss mentioned above, Scotland's environment is influenced by indirect factors like consumption habits, demographics and urban growth, economics and technology as well as political, institutional and governance factors. They include the societal values, attitudes and behaviours that contribute to substantially exceeding our share of planetary resources.

A range of Scottish policies are being designed to address these indirect drivers, such as the forthcoming [Environment Strategy](#) and [Land Use Strategy](#). However, achieving meaningful change demands bold, urgent action and effective on-the-ground delivery.

While many of these fall outside the scope of this sectoral biodiversity strategy, Transport Scotland is committed to taking responsibility for raising awareness and influencing attitudes in areas within the scope of the strategy.

Land Use Change and Habitat Fragmentation

The way in which people use the land and sea is considered the biggest [driver of biodiversity loss in Scotland](#). Land use changes can involve fragmenting habitats into smaller isolated patches, creating barriers to natural movements of wildlife and groundwater. This leaves species reliant on these habitats under intensified survival pressures restricting their ability to move, feed or mate. For example, areas of woodland may be divided by road construction or felled entirely for urban or agricultural expansion. The resultant smaller, isolated habitats lose resilience and become prone to long-term decline as they cease to be ecologically functional units. NatureScot research clearly highlights the [poor connectivity of a number of key habitat types across Scotland](#).

Additionally, land use change impacts our soil health. Natural soils, as opposed to anthrosols (soils that have been heavily modified through human interventions) are a vital reservoir for biodiversity, supporting a vast array of plants, animals and microorganisms. Historically on transport projects they have often been mishandled, at best treated merely as a substrate for planting, or at worst as an inconvenient surplus material to be buried or exported off site. Urgent measures are now needed to halt their degradation and ensure their protection and conservation. Soil in construction sites can be lost through excavation and erosion, be polluted, compacted, or sealed with impermeable materials – all leading to reduced soil function. This in turn can alter flood patterns, further threatening biodiversity. The transport sector plays a significant role in this kind of biodiversity loss by fragmenting or destroying habitats, restricting wildlife movement, and impacting the management and viability of natural soils. In addition, traffic noise may have a greater fragmentation impact for some ecological features than the land-take itself.

Climate Change and Extreme Weather

Climate change is the biggest threat to Scotland's natural environment. Changing rainfall patterns, water scarcity, flooding, ocean warming and acidification, extreme heat and wildfire are all impacting the rate and extent of terrestrial, freshwater and marine species losses across Scotland. Some species are being driven to extinction while others are shifting habitats in response to changing temperatures, weather patterns, and rising sea levels, disrupting their natural movement, behaviour and distribution. Beyond being a direct driver of biodiversity loss, climate change is amplifying the threat of other drivers, for example accelerating the transmission of pests and diseases and the spread of invasive non-native species, further destabilising ecosystems.

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Scotland's [uplands, peatlands, and oak woodlands](#) are among the terrestrial ecosystems most at risk to the impacts of climate change, while [coastal habitats](#) such as machair and saltmarsh face threats from rising sea-levels, air and water temperatures. Additionally, climate change is affecting soil health, ecosystem resilience, tree growth and species distribution, making adaptation efforts increasingly critical.

The Government's nature-based Scottish National Adaptation Plan [\[3\]](#) (SNAP3) sets out an ambitious high-level transport objective and includes a series of actions for building resilience across the Transport System. This plan highlights the critical need for a strategy to realise cross-cutting benefits from biodiversity to increase the resilience of the Trunk Road Network against the impacts of climate change. In 2024, the Scottish Government proposed making climate resilience a national outcome in Scotland's [National Performance Framework](#).

Thoughtful design and infrastructure management of the transport estate will play an important part in promoting climate change resilience and adaptation. In 2023, Transport Scotland published the [Approach to Climate Change Adaptation and Resilience](#) (ACCAR). This strategic framework set an ambitious vision for a well-adapted transport system safe for all users, reliable for everyday journeys and resilient to weather-related disruption. Under Sub-Outcome AR1.13, the plan highlights the importance of integrating biodiversity in the landscape design and management as part of trunk road adaptations. This approach will ensure that infrastructure development supports ecological sustainability while enhancing resilience to climate change. The recently published [Trunk Road Adaptation Plan](#) (TRAP) is an action-oriented 5-year framework for adapting the Trunk Road Network to the key climate risks. The promotion of Nature-based Solutions – incorporating blue-green infrastructure for natural flood, landslide, wind, and heat management to improve the climate resilience of the network and adjacent areas – is one of the actions contained within it.

Invasive Non-native Species

Recognised as a major driver of biodiversity loss, invasive non-native animal and plant species (INNS) are continuing to establish in Scotland at unprecedented rates causing damage to natural ecosystems. It is estimated that the [annual cost of invasive non-native species to the Scottish economy](#) may be as much £500 million. In many cases, INNS spread quickly and outcompete native flora and fauna disrupting ecosystem function and introducing novel pathogens and diseases. They have been identified as the biggest pressure on protected nature sites in Scotland. The [invasive non-native plants](#) that cause the most damage in Scotland on land include *rhododendron* (*Rhododendron ponticum*), Japanese knotweed (*Reynoutria japonica*), giant hogweed (*Heracleum mantegazzianum*), Himalayan balsam

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(*Impatiens glandulifera*) and American skunk-cabbage (*Lysichiton americanus*). The invasive animal species threatening Scottish woodland ecosystems in particular are [grey squirrel](#) (*Sciurus carolinensis*), [American mink](#) (*Neovison vison*) and [Sika deer](#) (*Cervus nippon*). There are also numerous freshwater and marine INNS present in Scotland including [New Zealand pigmyweed](#) (*Crassula helmsii*), [curly waterweed](#) (*Lagarosiphon major*), [water fern](#) (*Azolla filiculoides*), [North American signal crayfish](#) (*Pacifastacus leniusculus*) and [carpet sea squirt](#) (*Didemnum vexillum*). The Scottish Government has set up a [Non-Native Species Action Group](#), to ensure effective policy co-ordination and practical implementation in Scotland.

The EU Regulation 1143/2014 on the prevention and management of the introduction and spread of invasive alien species was amended through the [Invasive Non-native Species \(EU Exit\) \(Scotland\) \(Amendment etc.\) Regulations 2020](#). The latter adopts the EU list of invasive species of Union concern as the Scottish [list of species of special concern](#). Transport networks are a significant factor in the spread of the plant INNS in particular. Underlying mechanisms of dispersion include the disturbance of road or railway verges, the air currents associated with vehicle movement that aid seed dispersal and seed transfer via moving vehicles.

Some plant species are categorised as injurious weeds by the [Weeds Act 1959](#), such as common ragwort (*Jacobaea vulgaris*) or are considered invasive/successful colonisers such as rosebay willowherb (*Chamaenerion angustifolium*). There may be a direction to manage these species for the benefit of some stakeholders, however, they are native so not considered a threat to natural ecosystems and should not be the focus of a biodiversity strategy. Sycamore (*Acer pseudoplatanus*) is a [non-native species viewed by some as an aggressive coloniser and a threat to native flora, and by others as contributing to high levels of biodiversity](#). The tree is widely naturalised and planted across Britain and is generally not subject to control except where it has been identified as a detriment to native woodlands.

Pests and Diseases

Pests and diseases are having a detrimental effect on Scottish biodiversity and on woodlands in particular. The [common tree pests present in Scotland](#) now include Great spruce bark beetle and Large pine weevil, with the latter capable of causing extensive damage to young trees. In addition, the warming climate will increase the opportunities for non-native pests to become established in new areas, which local flora and fauna as well as land managers may be ill equipped to deal with. Ash dieback is a highly destructive disease caused by the fungus *Hymenoscyphus fraxineus*. It is present throughout Scotland causing significant damage to Scotland's ash population, with implications for woodland biodiversity and ecology. Other pathogens affecting Scottish woodlands include conifer root and butt rot, *Dothistroma* needle blight, *Phytophthora austrocedri* juniper disease, Dutch elm

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disease and *Ramorum* disease which affects mainly European larch. There are also numerous known future threats to Scottish woodlands, such as [Asian longhorn beetle](#), [bronze birch borer](#), [oak processionary moth](#), honey fungus, nematodes and viruses. The transport sector can contribute to these problems by spreading pests and diseases through the build-up of soil and organic material on vehicles and machinery.

Pollution

Transport in general and roads and road traffic in particular are a major source of [air pollution](#) and particulate matter that adversely affects habitats and species of Scotland. Heavy metals such as lead, zinc, cadmium, copper, nickel, manganese and chromium contaminate soils, water and vegetation, affect pollinators and are toxic to plants at high levels. High nitrogen levels are damaging to sensitive soils, plants and habitats across Scotland. Accumulated pollutants wash off the road and into the soil. Soil pollution reduces soil biodiversity and delays the recovery of soil communities. This in turn may alter the ability of the system to retain and sequester carbon and nutrients leading to loss into the freshwater environment and reduction of air quality. Transport is also linked to ground-level ozone, which harms pollinators and limits plant growth. In addition, road surface runoff carrying a combination of pollutants and de-icing salt can contaminate the nearby soil and freshwater habitats affecting their salinity. High salinity is toxic to many species and alters the diversity and distribution of aquatic species.

Noise pollution is an increasing cause of biodiversity loss affecting animal behaviour. It disrupts animal communication, foraging and migration patterns, hinders mating and predator avoidance and causes stress and increased mortality. Noise and vibration often occur together for example during piling work. Underwater noise and vibration are detected by fish as pressure waves and particle motion. This can result in the avoidance of areas by fish, injury or even death. Light pollution can also cause disturbance of nocturnal species such as bats.

Traffic-Wildlife Collisions

The accidental traffic-wildlife collisions which occur along transport routes are another factor directly contributing to the biodiversity decline in Scotland. A variety of [animals are killed on Scotland's roads](#) and railways including deer, foxes, badgers, otters, barn owls, red squirrels and hedgehogs. [Road collisions](#) are also one of the main threats to [Scotland's most threatened mammal](#), the Scottish wildcat. There is also [evidence](#) that traffic collisions involving the nation's most recently designated European Protected Species, the Eurasian beaver, are increasing as populations expand in number and distribution.

[Deer Vehicle Collisions](#) (DVCs) are the most frequent cause of wildlife mortality on the transport networks, with around reported 1,850 cases per year on Scottish roads since 2016. As there is no legal obligation to report DVCs unless human injury occurs, some estimate that the actual number could be as high as [12,000 per year](#). This is both an animal welfare and a public safety issue. However, due to a lack of natural predators in Scotland, deer numbers do need to be controlled. The recently proposed Natural Environment (Scotland) Bill aims to improve [deer management](#). Information on vehicle collisions with deer and other wildlife is collated by the OCs and has been used to inform mitigation recommendations. Infrastructure measures such as fencing, deer leaps, as well as operational and procedural measures utilising innovative technologies (e.g. [automated deer deterrent system](#) utilising AI detection) are also used on the railway network to reduce the risk of wildlife colliding with trains.

Marine wildlife, such as whales, seals and basking sharks, is also occasionally seriously [injured or killed in collision with vessels](#) ([ship strikes](#)). There is no readily available data on the mortality of birds resulting from collision with aircraft, however, due to the considerable danger posed by birds to aircraft and the people they carry, [efforts are made to prevent bird strikes](#) by discouraging them from areas around airfields and avoiding flight through areas where they are likely to be in higher concentrations.



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