STATE OF NATURE

2023 | state of nature PARTNERSHIP

Chris O'Reilly (rspb-images.com)

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SUMMARY

The UK, like most other countries worldwide, has experienced a significant loss of biodiversity. The trends in nature presented here cover, at most, 50 years, but these follow on from major changes to the UK's nature over previous centuries. As a result, the UK is now one of the most nature-depleted countries on Earth.

The main causes of these declines are clear, as are many ways in which we can reduce impacts and help struggling species. The evidence from the last 50 years shows that on land and in freshwater, significant and ongoing changes in the way we manage our land for agriculture, and the effects of climate change, are having the biggest impacts on our wildlife. At sea, and around our coasts, the main pressures on nature are unsustainable fishing, climate change and marine development.

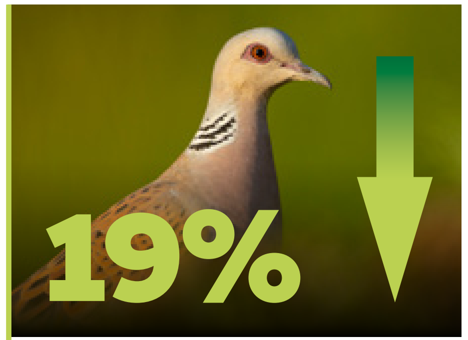
More broadly there has been growing recognition of the value of nature, including its role in tackling climate change, and the need for its conservation among the public and policymakers alike.

With each report our monitoring of change improves and we have never had a better understanding of the state of nature. Yet, despite progress in ecosystem restoration, conserving species, and moving towards nature-friendly land and sea use, the UK's nature and wider environment continues, overall, to decline and degrade. The UK has set ambitious targets to address nature loss through the Global Biodiversity Framework, and although our knowledge of how to do this is excellent, the size of the response and investment remains far from what is needed given the scale and pace of the crisis.

We have never had a better understanding of the State of Nature and what is needed to fix it.

#STATEOFNATURE

Terrestrial and freshwater



The abundance of 753 terrestrial and freshwater species has on average fallen by 19% across the UK since 1970.

Within this average figure, 290 species have declined in abundance (38%) and 205 species have increased (27%).

The UK distributions of 4,979 invertebrate species have on average decreased by 13% since 1970.

Stronger declines were seen in some insect groups which provide key ecosystem functions such as pollination (average 18% decrease in species' distributions) and pest control (34% decrease). By contrast, insect groups providing freshwater nutrient cycling initially declined before recovering to above the 1970 value (average 64% increase in species' distributions).

Since 1970, the distributions of 54% of flowering plant species and 59% of bryophytes (mosses and liverworts) have decreased across Great Britain.

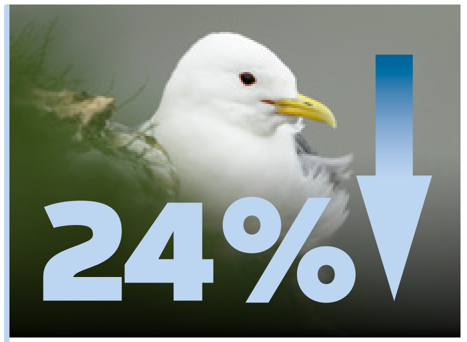
By comparison, only 15% and 26% of flowering plants and bryophytes, respectively, have increased. In Northern Ireland, since 1970, 42% of flowering plant species and 62% of bryophytes have decreased in distribution, compared to 43% and 34%, respectively, that have increased.

Turtle dove, Ben Andrew (rspb-images.com); Forester moth, Mike Read (rspb-images.com); Heath Spotted-Orchid, Andy Hay (rspb-images.com); Ladybird Spider, Ian Hughes (rspb-images.com); Kittiwake, Ben Andrew (rspb-images.com); Grey Seal, Ben Hall (rspb-images.com); Atlantic Yellow Nosed Albatross, Steffen Oppel (rspb-images.com)

10,008 species were assessed using Red List criteria.

2% (151 species) are extinct in Great Britain and a further 16% (almost 1,500 species) are now threatened with extinction here. In Northern Ireland, 281 (12%) of 2,508 species assessed are threatened with extinction from the island of Ireland.

Marine



The abundance of 13 species of seabird has fallen by an average of 24% since 1986.

The situation is worse in Scotland, where the abundance of 11 seabird species has fallen by an average of 49% since 1986. These results pre-date the potentially major impact of the ongoing outbreak of Highly Pathogenic Avian Influenza.

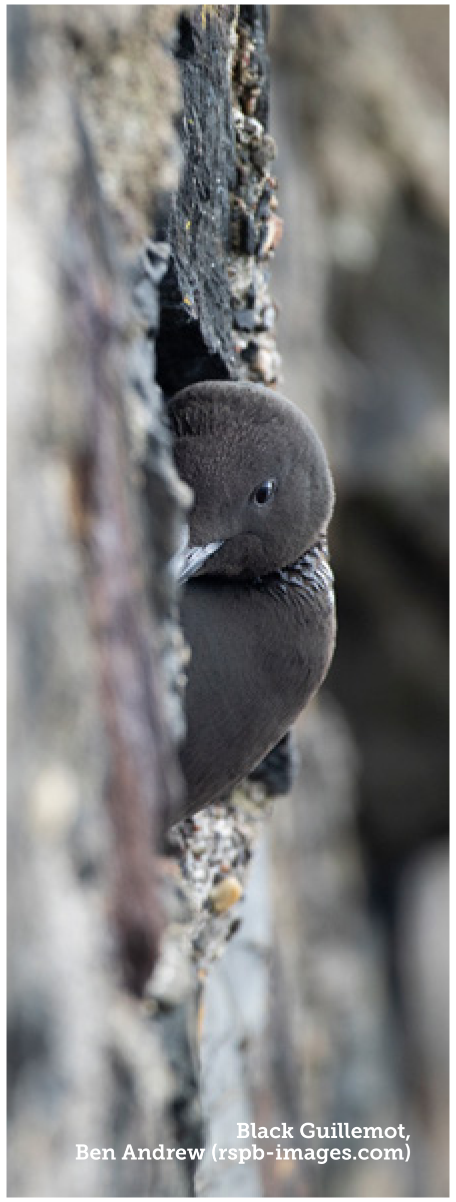
Varied picture for other marine life.

We know less about changes in species' abundance and distribution in UK seas. Well-monitored species of demersal fish (those living on or near the seafloor, 105 species) showed an average increase in abundance during the 1990s and early 2000s but have since declined. Whales and dolphins (three species) have shown little change in average abundance since the early 1990s. Grey Seal abundance has increased as they recover from historical hunting pressure. Harbour Seals are in decline in parts of north-east Scotland and south-east England, but are stable or increasing in other regions.

UKOT and CDs

UK Overseas Territories and Crown Dependencies.

94% of the species unique to the UK and its territories are found on the Overseas Territories. Across the Overseas Territories and Crown Dependencies, 11% of 6,557 species assessed are threatened with global extinction.



Black Guillemot, Ben Andrew (rspb-images.com)

What do our headlines mean?

This report focuses on three measures of biodiversity change: abundance (the number of individuals), distribution (the proportion of sites occupied) and extinction risk. These measures have been assessed for hundreds and in some cases thousands of species native to the UK, as the available data allow.

Our results show:

- The number of species that have increased or decreased in abundance or distribution over time
- The average change in abundance or distribution across species over time
- The proportion of species at risk of being lost from the country.

Here we present UK findings in most cases. Where UK information is not available, we present results for Great Britain and Northern Ireland separately.

RESPONDING TO THE CRISIS

The UK and many of the UK Overseas Territories and Crown Dependencies are party to a new set of international biodiversity targets under the Convention on Biological Diversity (CBD): the Global Biodiversity Framework. To support the delivery of these, each UK country has committed to developing and implementing national biodiversity strategies. In many cases, countries have developed (or are committed to developing) legally binding targets to restore nature. In this report, we have grouped the CBD targets into the five broad areas discussed below.

IMPROVING SPECIES STATUS:

There is good evidence that conservation can be effective for individual species when it can be applied to a large proportion of the population, and targeted conservation action has set some species on the path to recovery. Halting and reversing biodiversity decline is vital, but it is only the first step towards a healthy environment with resilient species populations, thriving habitats and functioning ecosystems.

"targeted conservation action has set some species on the path to recovery"

INCREASING NATURE-FRIENDLY FARMING, FORESTRY AND FISHERIES:

In the UK a fifth of farmland is in agri-environment schemes, but only a part of this could be considered as nature-friendly farming. 44% of woodland is certified as sustainably managed and half of marine fish stocks are sustainably harvested. All three measures have improved over the past 20 years, but there is a long way to go. Sustainable management is a positive step but does not necessarily mean the same as well-managed for nature. At a local level, many species benefit from nature-friendly farming, but the impact of different schemes on species populations has been variable. The best available information suggests that nature-friendly farming needs to be implemented at a much wider scale to halt and reverse the decline in farmland nature. The increased proportion of sustainably harvested fish stocks appears to be having a positive impact, with the proportion of large fish in landings, an indication of population health, increasing since 2002.

"nature-friendly farming needs to be implemented at a much wider scale to halt and reverse the decline in farmland nature"

EXPANDING AND MANAGING PROTECTED AREAS:

11% of UK land is in protected areas (areas subject to a legal nature conservation designation). However, within this only 44% of the measured attributes of terrestrial and freshwater Areas or Sites of Special Scientific Interest are in favourable condition. In protected areas on land, there is some evidence that target species or species of conservation concern have more positive trends than outside them. Although 38% of UK waters are designated as protected areas, we lack a comprehensive condition assessment and management is not yet fully implemented at most sites. Work is ongoing to designate marine protected areas and implement fisheries management within them. This will contribute towards the 2030 target of 30% of land and sea under effectively managed protected areas or other areas well-managed for nature.

"Only 11% of UK land is in protected areas, and not all of these are well-managed for nature"

INCREASING ECOSYSTEM RESTORATION:

Restoration is taking place across a wide range of ecosystems, from peatlands to urban forests to seagrass beds, with more than 5,000 hectares (ha) of degraded peatland being restored each year. Despite this, only 14% of priority habitats, 7% of woodland and 25% of peatlands are assessed to be in good condition. Large areas of the UK seafloor do not meet Good Environmental Status because of habitat disturbance from fishing. Restoration and creation of carbon-rich habitats have clear co-benefits for climate change mitigation and adaptation, as well as biodiversity, but realising these will require a step-change in the rate and scale of restoration.

"Only 25% of peatlands are in good condition"

CO-ORDINATING OUR RESPONSE:

Action to restore nature is best co-ordinated with action to mitigate and adapt to the impacts of climate change because land-use scenarios suggest that wildlife is likely to benefit from maximising nature-based solutions (for example, native woodland creation and peatland restoration) in order to achieve net-zero in the land sector. However, this will need to be achieved whilst meeting people's needs for food, energy and access to nature. Access to nature supports human health and well-being but there is inequality, with people in poorer socio-economic settings having less access to wildlife-rich natural spaces.

"Access to nature supports human health and well-being"

The power of volunteers

It is through the collective efforts of thousands of skilled people, most of whom are volunteers, that we can report on the state of nature. Without their enthusiasm and commitment, we could not understand the pressures on nature, or whether our efforts to address these pressures through conservation action have been effective.


Green-veined white Butterfly, Paul Turner (rspb-images.com)

THE CASE FOR NATURE

Nature needs space to live and flourish, but around the globe we humans have decreased and diminished those spaces. This is especially the case in the UK. There are substantial negative consequences of living in a nature-depleted country. These include impacts on human health, and direct costs associated with adaptation to lost and damaged ecosystem services. For example, pollinating insects are worth millions of pounds to UK agriculture, and their population declines threaten food production[1]. Recent years have seen severe flooding in the UK arising from development in areas prone to flooding and climate change. There are enormous costs both of allowing continued degradation and repairing damage[2], so it is far more cost-effective to avoid causing damage in the first place. Where it has already occurred, restoring nature can cost less in the long-term than bearing the costs of continued degradation[3].

The UK's peatlands are a prime example. They are an enormous carbon store, but three-quarters are damaged or degraded, releasing the equivalent of 5% of UK greenhouse emissions each year[4]. Restoring peatlands and other systems to protect their existing carbon stores will improve our resilience to current climate change, can help mitigate future change and will boost nature.

Protecting and restoring healthy, functioning natural systems is essential, not only for nature's sake, but for people as well[3]. The good news is that there are decades of successful conservation practice to draw upon, and for many habitats and species there is detailed evidence of what actions work[72]. Research suggests that urgent action can reverse some of the biodiversity loss and damage of recent decades[5].

If we are to halt and reverse biodiversity decline we need not only to increase our efforts towards conservation and restoration, but also to tackle the drivers of biodiversity loss[6], especially in relation to our food system[5]. That means making our food production more sustainable and nature-friendly and adjusting our consumption to reduce demand for products that drive loss of nature.

All of society needs to be involved in efforts to halt biodiversity loss. Encouragingly, as the recently launched People's Plan for Nature shows[7], many people in the UK are deeply committed to protecting and restoring nature.

> ***"Pollinating insects are worth millions of pounds to UK agriculture"***

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KEY FINDINGS

Atlantic Puffin, Drew Buckley (rspb-images.com)

We present an objective assessment of the state of nature in the UK. The metrics show how species status has changed over time and the variation in trends among species. We focus on measuring change over two periods: the medium term, up to 50 years; and short-term trends, the last 10 years. The changes in the past 50 years follow extensive preceding changes to our land and seascapes (see Historical Change). The metrics we present are not directly comparable to previous *State of Nature* reports, as we report across a wider range of species and some methods have been updated.

In the UK we have a wealth of data on which to assess the state of nature. This primarily comes from volunteer-based species monitoring and recording schemes. Our species' status metrics use two data types: **Abundance data** from structured monitoring schemes in the UK, including those that monitor birds, mammals, butterflies, moths and marine fish. Our abundance metrics report the average change in abundance across species. **Distribution data** from biological recording datasets can now be used to generate trends for thousands of species across a wide variety of taxonomic groups (including vascular plants, lichens, bryophytes and a number of invertebrate groups). These trends measure the change in the proportion of occupied sites, so our metrics report the average change in distribution for these species. Unless otherwise stated, figures were produced for this report.

For many species, distribution is the most appropriate way to measure status: for instance, it would be impractical to count the number of individual moss plants but looking at changes in where they can be found tells us a lot about both the mosses themselves and the pressures on their habitats. Change in distribution does not tell us whether a species' range is shifting. For example a species may be found in a similar proportion of sites but those sites are found farther north in the country than previously. Our metrics focus on species native to the UK as well as those introduced at least 500 years ago.

Many of the same monitoring and recording datasets used in this report also underpin official UK and UK country biodiversity indicators, which are published annually for groups including birds, butterflies and mammals, as well as other measures of biodiversity status. We feature some of these indicators in *State of Nature 2023*.

Change in abundance and change in distribution are different measures of the state of nature. Changes in these two measures are often related, although changes in abundance are likely to be detected sooner and be of greater magnitude than changes in distribution. Additionally, in some cases, abundance and distribution trends move in opposite directions.

The term 'wildlife' is used throughout this report to include all living organisms in their many forms, from mammals to lichens, plants to birds, fungi to invertebrates. For a fuller description of the methods used please see the Methods section.

Terrestrial and freshwater species

Change in species' abundance

Trends in species abundance largely derive from key volunteer-based monitoring schemes such as the Breeding Bird Survey, UK Butterfly Monitoring Scheme, Wetland Bird Survey, National Bat Monitoring Programme, Rothamsted Insect Survey and bespoke species surveys.

The UK abundance indicator for 753 terrestrial and freshwater species shows a decline in average abundance of 19% (Figure 1, Uncertainty Interval (UI): -30% to -9%) between 1970 and 2021. Over the short-term period (2010 to 2020), the decline was 3% (UI: -8% to +2%). We have no evidence that the rate of change in the last decade of the indicator is atypical of the changes seen in previous decades.

Within multispecies indicators like these, there is substantial variation among individual species trends.

To examine this, we have allocated species into abundance trend categories based on the magnitude of population change. Rates of change equivalent to at least a doubling or halving of the population size over 25 years were considered 'Strong' increases or decreases. Rates of change equivalent to at least an increase of a third or a decrease of a quarter over 25 years were considered 'Moderate' changes.

- Over the long term, 290 species (38%) had strong or moderate decreases and 205 (27%) had strong or moderate increases; 261 (35%) showed little change (Figure 1).
- Over the short term, 282 species (38%) had strong or moderate decreases while 273 species (37%) had strong or moderate increases.

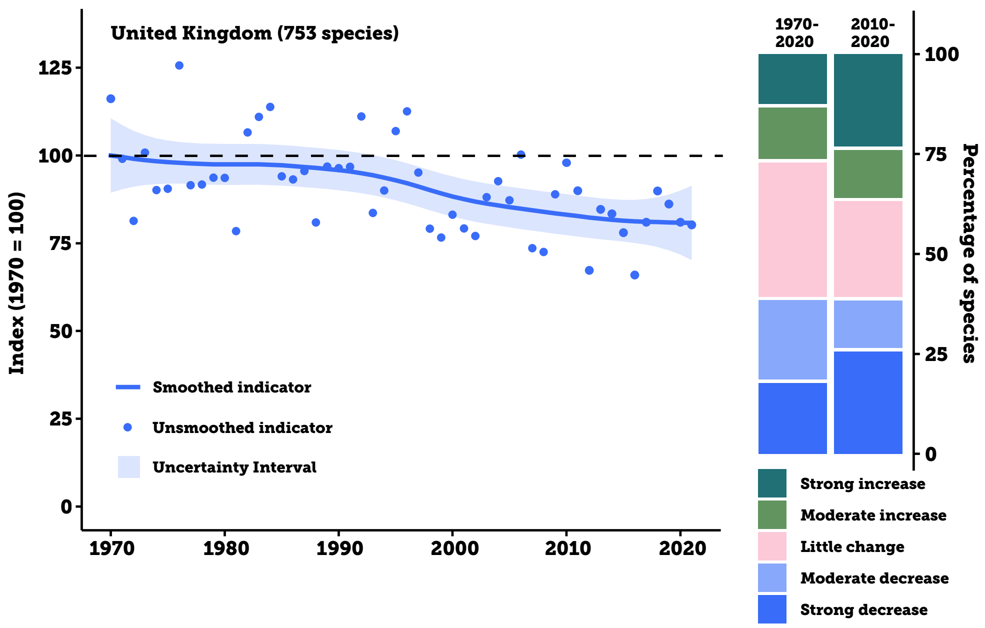


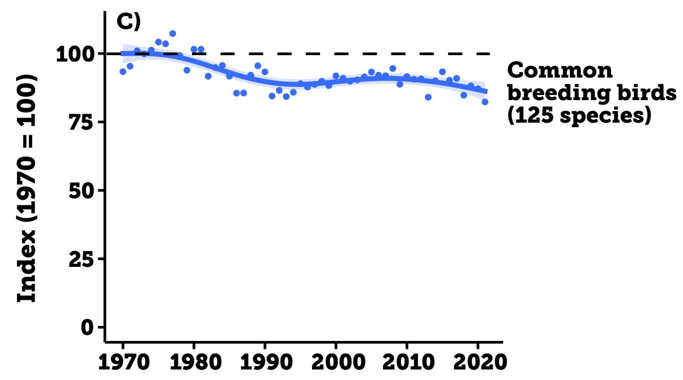
Figure 1: Change in average species' abundance across terrestrial and freshwater species (mammals, butterflies, moths, landbirds and wetland birds). The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in abundance (1970- 2020: 753 species, 2010-2020: 743 species).

See page 184 to find out how to interpret this report

Change in species' abundance by group

Composite multispecies indicators can hide other important underlying trends. Here we present trends in some major species groups, which all contribute to the headline abundance indicator.

- The long-term decrease in average abundance of moths (-31%; UI: -44% to -18%) has not slowed; short-term declines are 7% (UI: -13% to -2%) (Figure 2A).
- The specialist butterflies[8] indicator ended 18% below its starting value (Figure 2B, -18%; UI: -39% to +4%), with the majority of this change in the 1970s. Generalist butterflies have greater inter-annual variation but overall have remained stable (Figure 2B, 10%; UI: -14% to +33%).
- The abundance indicator for common breeding birds declined by 14% (Figure 2C, UI: -17% to -10%). The UK Wild Bird Indicator shows that within this group, farmland birds have suffered particularly strong declines of on average 58%[9].
- Rare or colonising bird species (those with fewer than 1000 pairs) showed on average a strong increase in abundance over the long term to 2020 (Figure 2D, 145%; UI: 127% to 164%). This increase was driven by the rapid recovery of some species from very low numbers and the arrival of colonising species. Note that species in the rare and colonising group make up just 0.01% of the total number of individual birds in the UK[10].



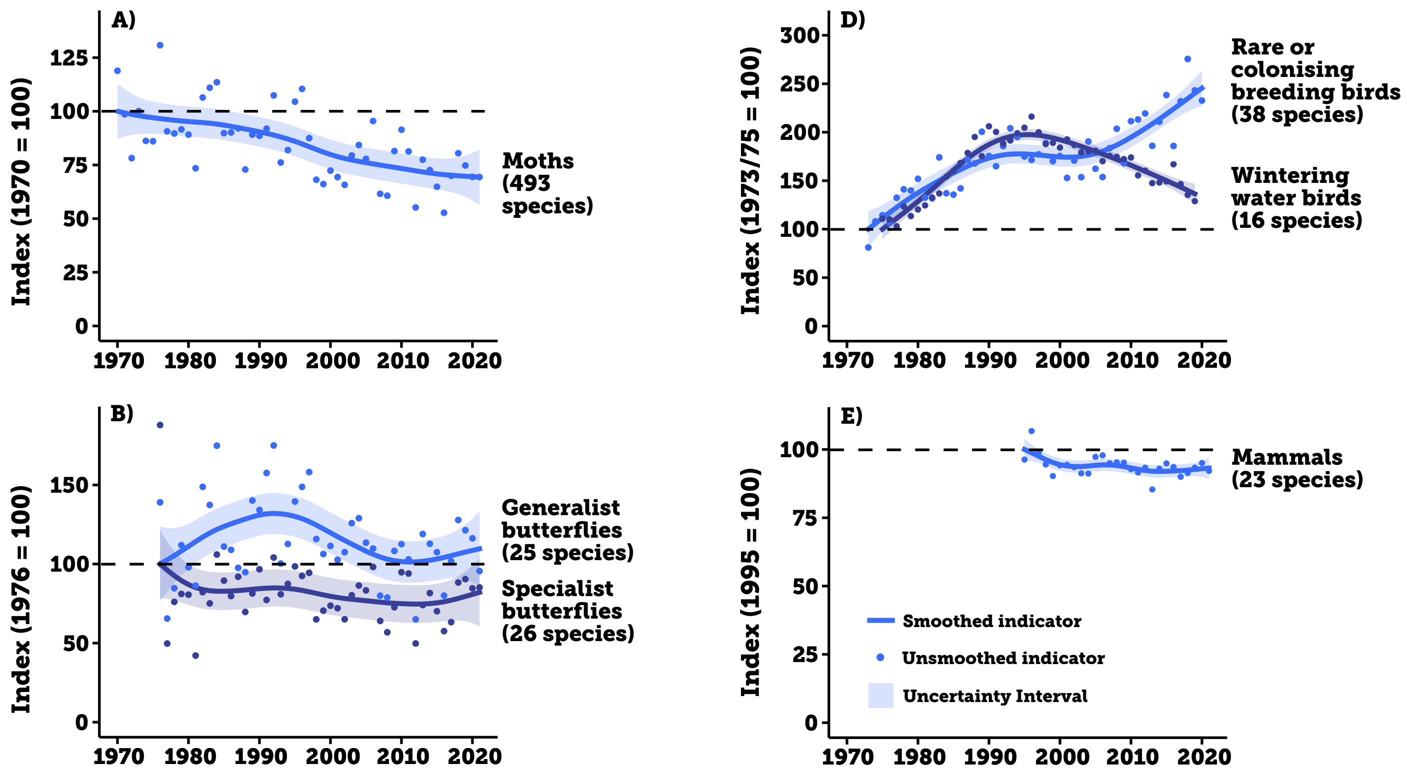


Figure 2: Change in average species' abundance across terrestrial and freshwater species in the UK by rarity, level of specialism or taxonomic group.

- Wintering waterbirds showed on average an increase of 36% (Figure 2D, UI: 26% to 47%) between 1975 and 2019. The indicator rose rapidly in the 20th century but has since steadily declined. Some species have shifted their wintering ranges in response to climate change, resulting in a smaller proportion of each population wintering in the UK, while others are declining due to poisoning from lead ammunition[11].
- Mammals show a small long-term decline in average abundance, of 7% between 1995 and 2021 (Figure 2E, UI: -11% to -3%). Within this average change some species like Water Vole and Hazel Dormouse have declined dramatically, whereas several bat species are recovering from severe historical declines.

Status of UK priority species

One measure of the success of conservation action is whether populations of priority species have stabilised or recovered. Each UK country has a list of species that have been prioritised for reasons such as rapid population decline. Taking these lists together there are 2,890 species from all major taxonomic groups that are a conservation priority for one or more of the UK countries.

The UK Priority Species Indicator[12] (Figure 3), part of the official UK Biodiversity Indicators, shows the average change in species' abundance for 228 priority species between 1970 and 2021. These species are a sample of the 2,890 species in the combined priority species list for the UK, for which robust abundance trends are available, and include birds (103), butterflies (24), mammals (13) and moths (88). Seabirds are the only marine species included in this indicator. By 2021, the index had declined to 37% of its base-line value in 1970. Over this long-term period, 19% of species showed a strong or weak increase and 58% showed a strong or weak decline. In the short-term, between 2016 and 2021, the indicator did not change.

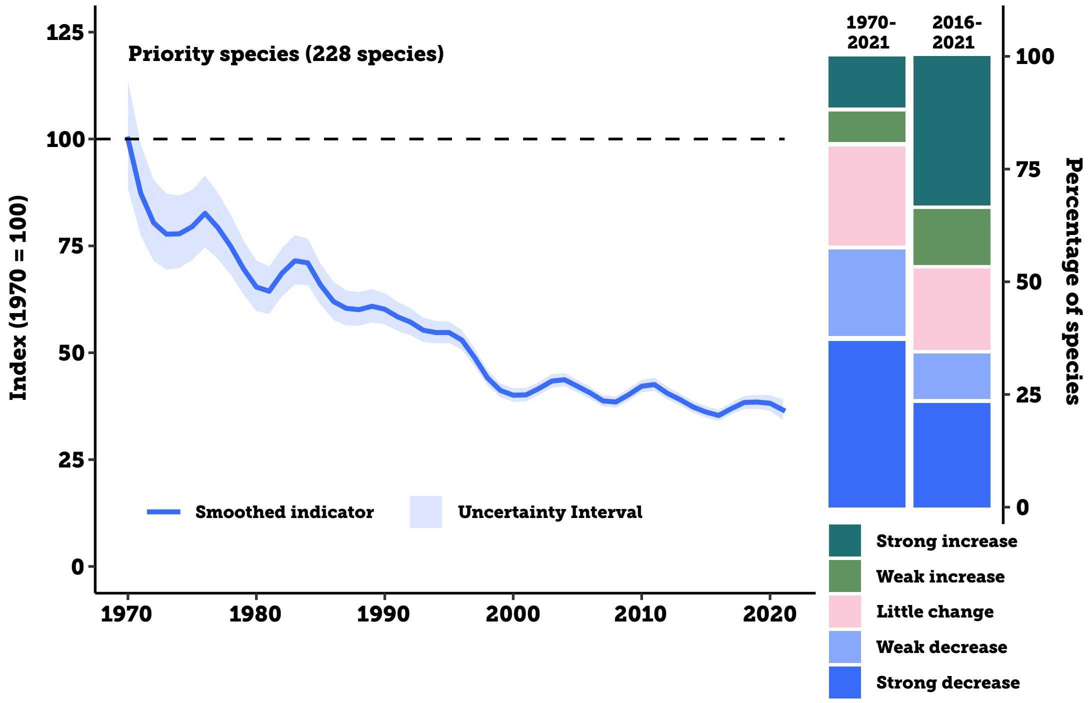


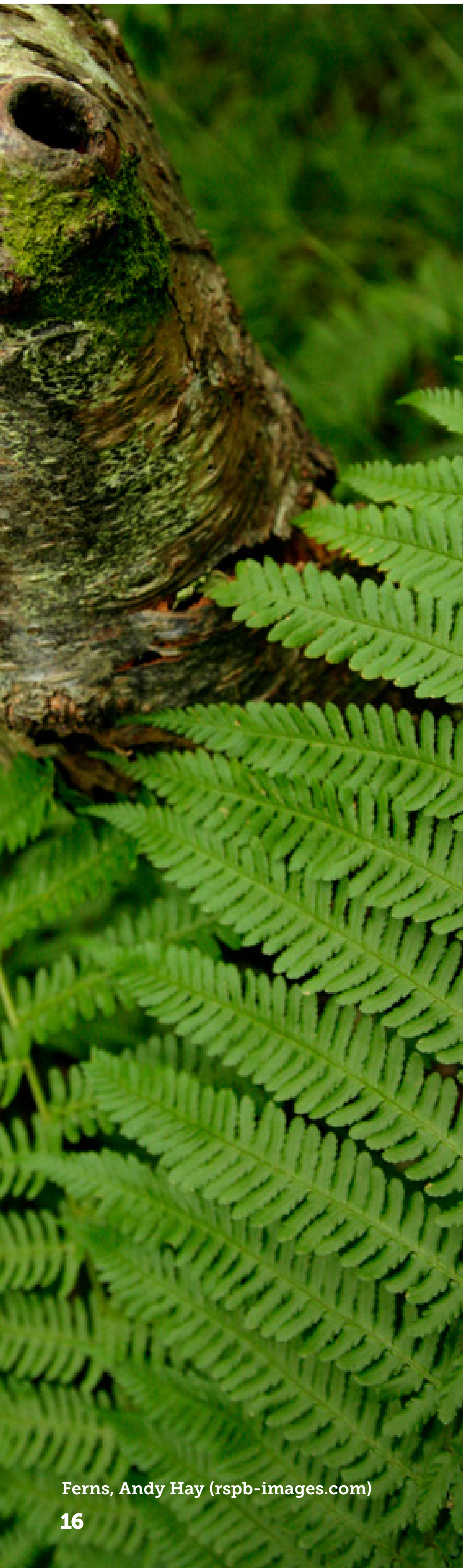
Figure 3: UK Biodiversity Indicator C4a. Change in the abundance of priority species in the UK, 1970 to 2021[12].
Source: jncc.gov.uk/ukbi-C4a. The line graph shows trends in the index of relative abundance for 228 priority species. The blue line with shading shows the smoothed trend with its 95% credible interval. The bar chart shows the percentage of species within the indicator that have increased, decreased (weakly or strongly) or shown little change in abundance (1970 – 2021: 228 species, 2016 – 2021: 215 species).

Change in species' distribution

Distribution change in plants and lichens

- On average, vascular plant species' distributions have decreased by 16% (Figure 4A, UI: -18% to -14%) between 1970 and 2019. Within this average, 54% of vascular plant species decreased in distribution, 15% increased and 31% showed little change. Species adapted to low nutrient conditions and wild plants of arable land have shown strong declines (see Historical Change section).
- On average, bryophyte species' distributions have decreased by 19% (Figure 4B, UI: -22% to -16%) between 1970 and 2019. Within this average, 59% of bryophytes decreased in distribution, 26% increased and 15% showed little change. Some bryophytes have benefited from reduced sulphur dioxide air pollution, but this has not been sufficient to stabilise species' distributions on average[34].
- Lichens initially declined slightly in distribution but on average have increased this century, with the indicator being 15% (Figure 4C, UI: 2% to 27%) higher in 2021 compared to 1980. Within this average, 43% of lichens decreased in distribution, 48% increased and 9% showed little change. In many parts of the UK, lichens were very badly impacted by historic industrial pollution[13]. Reductions in sulphur dioxide pollution are allowing some species to begin to recover. However, ongoing high levels of nitrogenous air pollution mean that recovery is skewed towards pollution-tolerant species.

Tree lungwort and green satin lichen, Andy Robinson (rspb-images.com)



Ferns, Andy Hay (rspb-images.com)

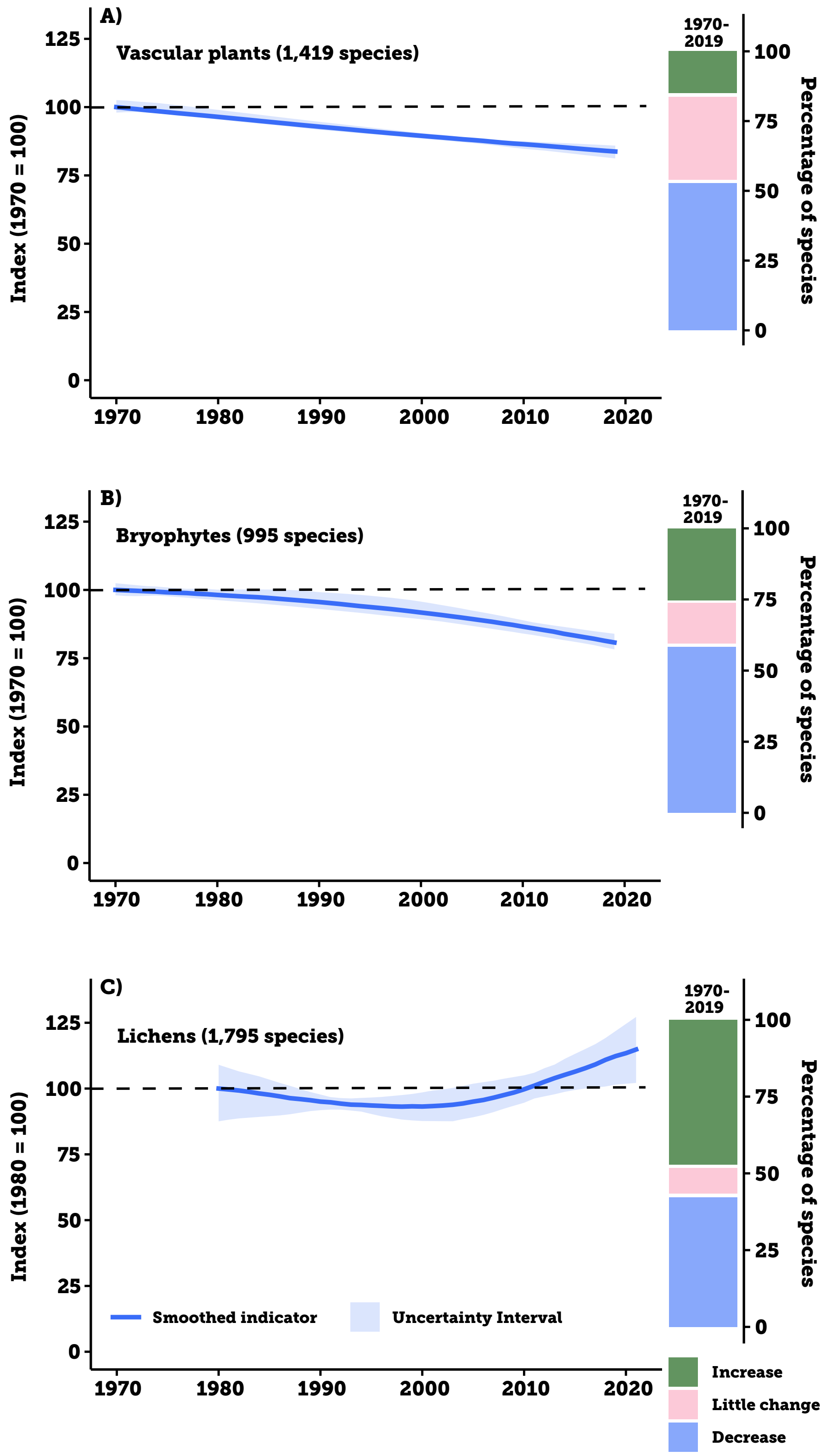


Figure 4: Change in average species' distribution of A) vascular plants, B) bryophytes and C) lichens in Great Britain. The bar charts show the percentage of species within each indicator that have increased, decreased or shown little change in distribution. The vascular plant data and analysis are taken from the Plant Atlas 2020[53].

Distribution change in some animal groups

Across 4,979 invertebrate species, there was an average decrease in species' distributions of 13% between 1970 and 2020 (Figure 5A, UI: -17% to -10%). This average change hides substantial variation among individual species: 33% of invertebrate species showed strong or moderate decreases and 25% showed strong or moderate increases; 42% showed little change.

To help understand these patterns, insect species groups were categorised by the ecological functions they provide[14]. Some groups provide more than one function and so are included in more than one indicator.

- Pollinating insects (bees, hoverflies and moths), which play a critical role in food production, show an average decrease in distribution of 18% (Figure 5B, UI: -21% to -14%) since 1970.
- Predators of crop pests (ants, carabid, rove and ladybird beetles, hoverflies, dragonflies and wasps) showed an average decrease in distribution of 34% (UI: -39% to -29%).
- The average distribution of species providing freshwater nutrient cycling (mayflies, caddisflies, dragonflies and stoneflies) saw an initial decline followed by a strong recovery ending 64% (UI: 42% to 87%) higher in 2021 compared to 1970. This pattern may in part be related to changes in river water quality[15], but although many measures of water pollution have improved over the past few decades, significant water pollution issues remain, in particular in catchments linked to intensive agriculture[349].

Between 1970 and 2016 the distribution of small mammals (mice, voles and shrews) decreased on average by -29% (Figure 5C, UI: -49% to -3%) and those of mid-sized mammals (eg mustelids and hares) showed a similar but not significant change of -15% (UI: -30% to +2%)[16].

Caddisfly, RSPB (rspb-images.com)

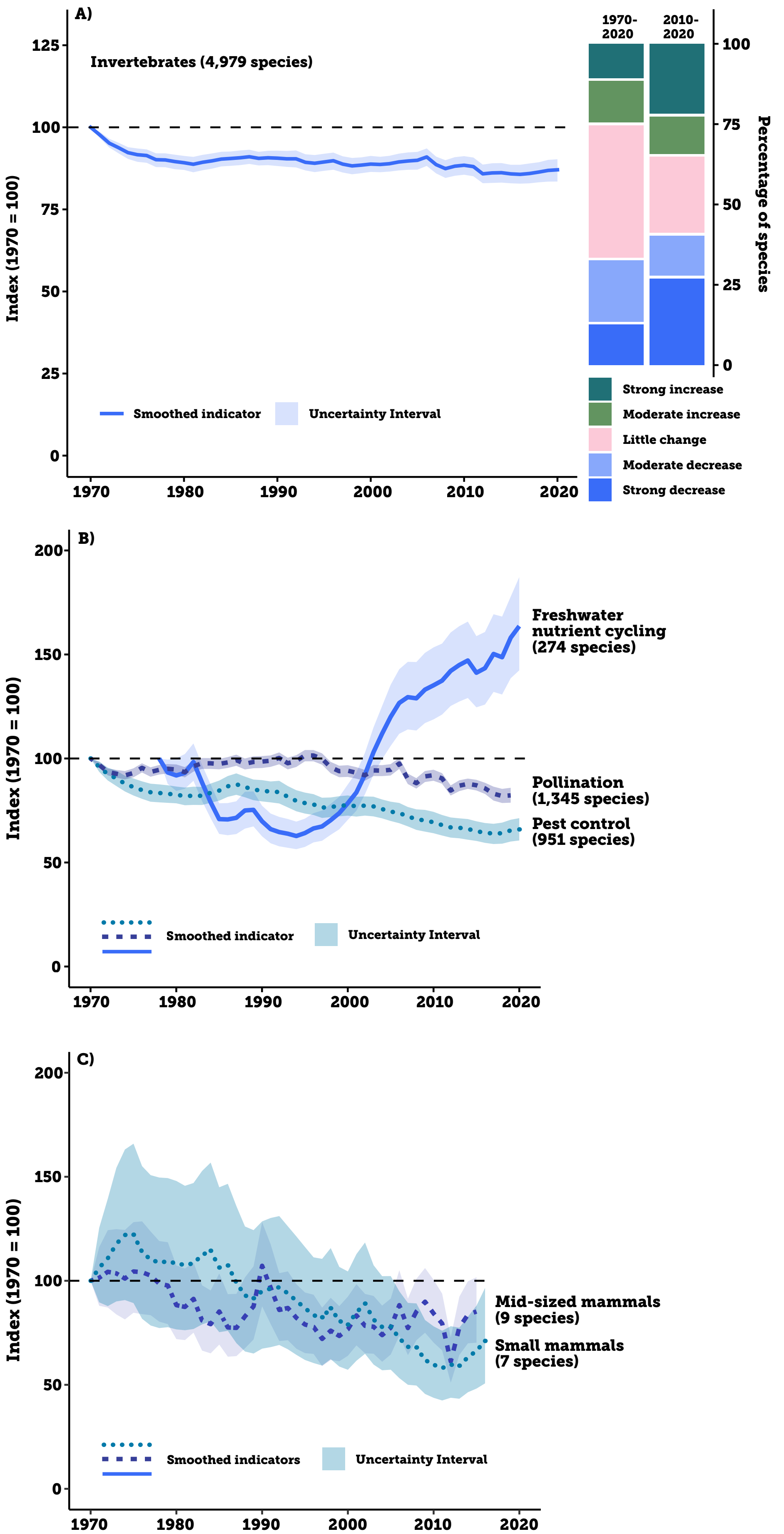


Figure 5: Change in average species' distribution for A) terrestrial and freshwater invertebrates in the UK. The bar charts show the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in distribution; B) Insect species grouped by ecological function (pollination, pest control and freshwater nutrient cycling); C) mammals.

Extinction risk

Here we show species organised by International Union for the Conservation of Nature (IUCN) Red List category of extinction risk at a national scale. At the time of writing, no assessments for marine species had been published other than for seabirds, although one is underway for marine mammals. Species assessed as Critically Endangered, Endangered or Vulnerable are classified as threatened by IUCN and therefore deemed at risk of extinction in Great Britain.

Since the 2019 *State of Nature* report, the number of taxa assessed using the IUCN Regional Red List process[334] in Great Britain has increased from 8,431 to 10,008. At present we cannot assess whether extinction risk is changing over time because the vast majority of our species have only a single Red List assessment.

Of the extant taxa for which sufficient data are available, 1,497 (16.1%) are classified as threatened and therefore at risk of extinction from Great Britain (Figure 6). In addition, 146 species are known and 52 considered likely to have become extinct from Great Britain since 1500, and a further five are only found in captivity. Summarising these results by the main higher taxonomic groups, 674 plants (21.5%), 202 fungi and lichens (11.4%), 145 vertebrates (39.2%) and 476 invertebrates (11.9%) are classified as being at risk of extinction from Great Britain (Figure 6).

A separate summary of Irish Red List assessments (for the whole island of Ireland) found that 12% of assessed species that were found in Northern Ireland were at risk of extinction, including 144 (9.8%) plants, 11 (20.4%) vertebrates and 126 (13.9%) invertebrates (see NI key metrics).

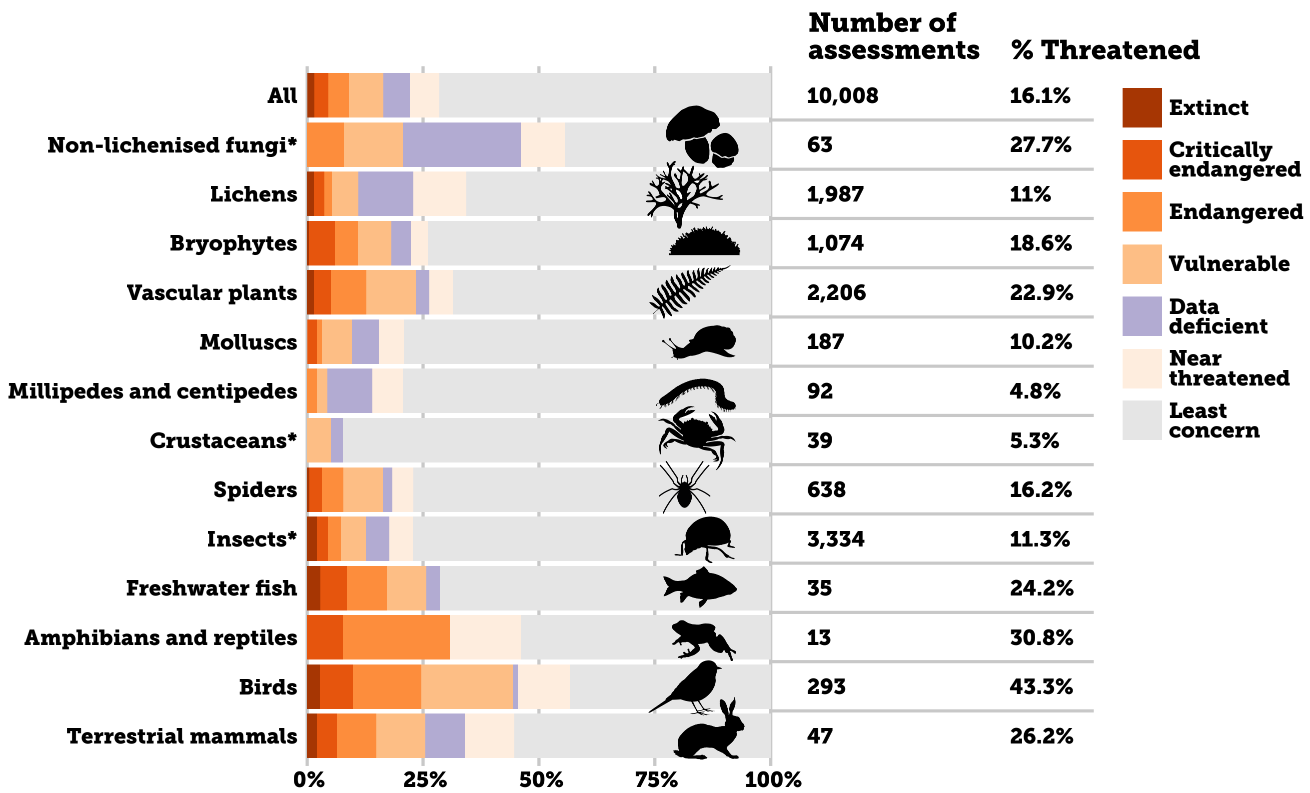


Figure 6: Summary of Red List assessment for Great Britain, showing the proportion of assessed taxa in each Red List category. *Note that only 17% of insect species have been assessed, 10% of crustaceans and less than 1% of fungi.

Marine

In 2010, the UK Marine Strategy Regulations were established to mandate measures that achieve or sustain Good Environmental Status (GES) in the marine environment via the development of a comprehensive UK Marine Strategy. This provides a framework for assessing, monitoring and implementing measures to achieve the UK's vision of 'clean, healthy, safe, productive and biologically diverse' ocean and seas.

The last assessment of GES in 2018[106] revealed a mixed picture in the environmental status of marine mammal, bird and fish populations, and in food webs[17]. GES was not achieved for seabirds, demersal fish communities and offshore seabed habitats. While achievement was uncertain for marine mammals, pelagic habitats and intertidal habitats. An updated GES assessment is due in 2024.

Given that GES has not yet been achieved, existing conservation measures have clearly had limited success. Further efforts will be required to ensure that the marine environment is in good condition, in line with the UK's aspirations and commitments.

Processing Hake at sea, RSPB (rspb-images.com)

Marine fish

The abundance of marine fish and the composition of wider food webs have been influenced by commercial fishing and climate change in addition to natural environmental changes, water quality changes, infrastructure and other human activities (eg, dredging, marine noise). Since 1993, warming sea temperatures have enabled a large proportion of smaller-bodied pelagic fish species (eg, Sardine and Sprat) to increase in abundance[18]. Fishing pressure led to declines in a number of larger-bodied species, such as North Sea Cod[19].

The abundance indicators (Figure 7) use data from a range of trawl surveys for around 100 demersal fish species that live on or near the seafloor (eg, Cod, Haddock, Saithe). The abundance of demersal fish species in both the Celtic Seas and Greater North Sea increased on average in the early years of the 21st century but by 2021 had declined back towards levels found in the early 1990s (Figure 7; Celtic Seas: 14%, UI: 6% to 22%; Greater North Sea: -8%, -14% to -1%). Little is known about the majority of non-commercial fish populations in UK waters, and trends in commercial stocks should be considered against a backdrop of overfishing dating back to at least the 1880s[21].

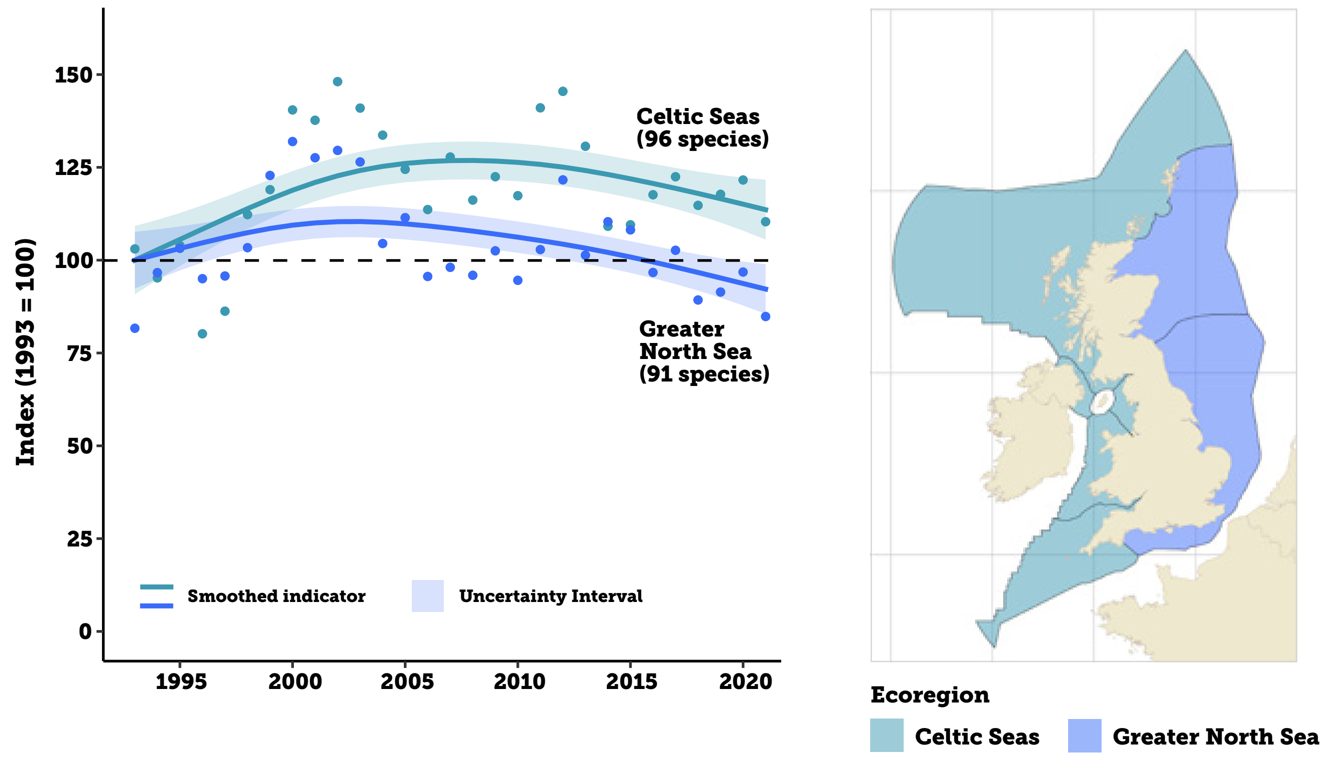


Figure 7: Change in average species' abundance for demersal and bathypelagic fish species in the UK Exclusive Economic Zone (EEZ) areas of the Oslo Paris convention (OSPAR): Celtic Seas and Greater North Sea.

Breeding seabirds

The last published seabird census covered 1998-2002 and reported over eight million seabirds breeding in Great Britain and Ireland annually[22]. The latest seabird census was completed at the end of the 2022 breeding season. The results of this full survey of nearly 12,000 known breeding colonies will be published later in 2023.

The UK breeding seabird indicator, based on annual monitoring at a subset of sites for 13 species between 1986 and 2019, shows an average decline in abundance of 24% (Figure 8[23]). In the short term the indicator has shown little change between 2013 and 2019. Between 1986 and 2018, two species have declined strongly (Arctic Skua and Kittiwake) while a further five species have shown a weak decline. The focus is on updating the seabird indicator given growing pressures on our seabirds, especially from the latest outbreak of Highly Pathogenic Avian Influenza (HPAI). Further monitoring of the effects of HPAI will be essential to understand the effects on UK seabirds and other wildlife.

Marine mammals

Since 1994, the Small Cetaceans in European Atlantic Waters and the North Sea Survey (SCANS) has estimated cetacean abundance[24]. Data from the fourth survey in 2022 are not yet available; however, the 2016 survey collected data for nine of the 28 cetacean species which regularly occur in UK waters. Sufficient data for three of these species (Harbour Porpoise, White-beaked Dolphin and Minke Whale) are available to calculate abundance trends in the Greater North Sea. Populations appeared stable between the mid-1990s and 2016, but due to the few time points available for comparison, declines in Harbour Porpoise and White-beaked Dolphin could not be ruled out.

Regular seal surveys are possible when they haul out onto land to moult or pup (Harbour Seal) or breed (Grey Seal) and regular monitoring has been carried out for both species around UK coasts since at least the 1990s and 1980s respectively. Between 2016 and 2019 UK Grey Seal pup production increased by approximately 1.5% per year; however, these changes were not

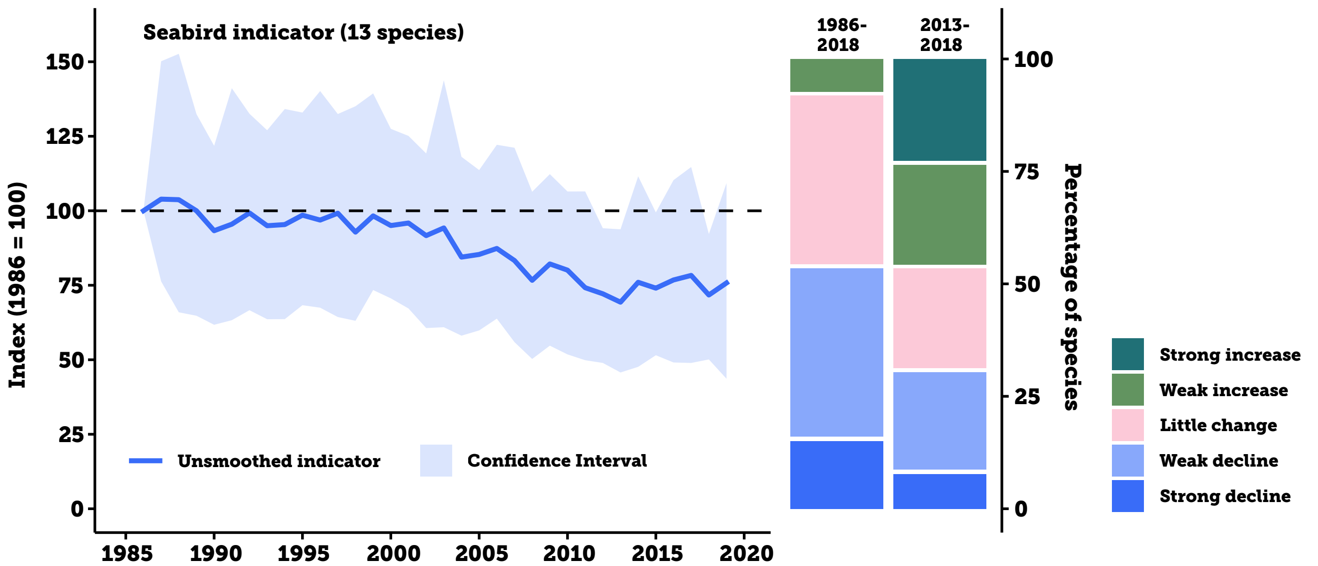


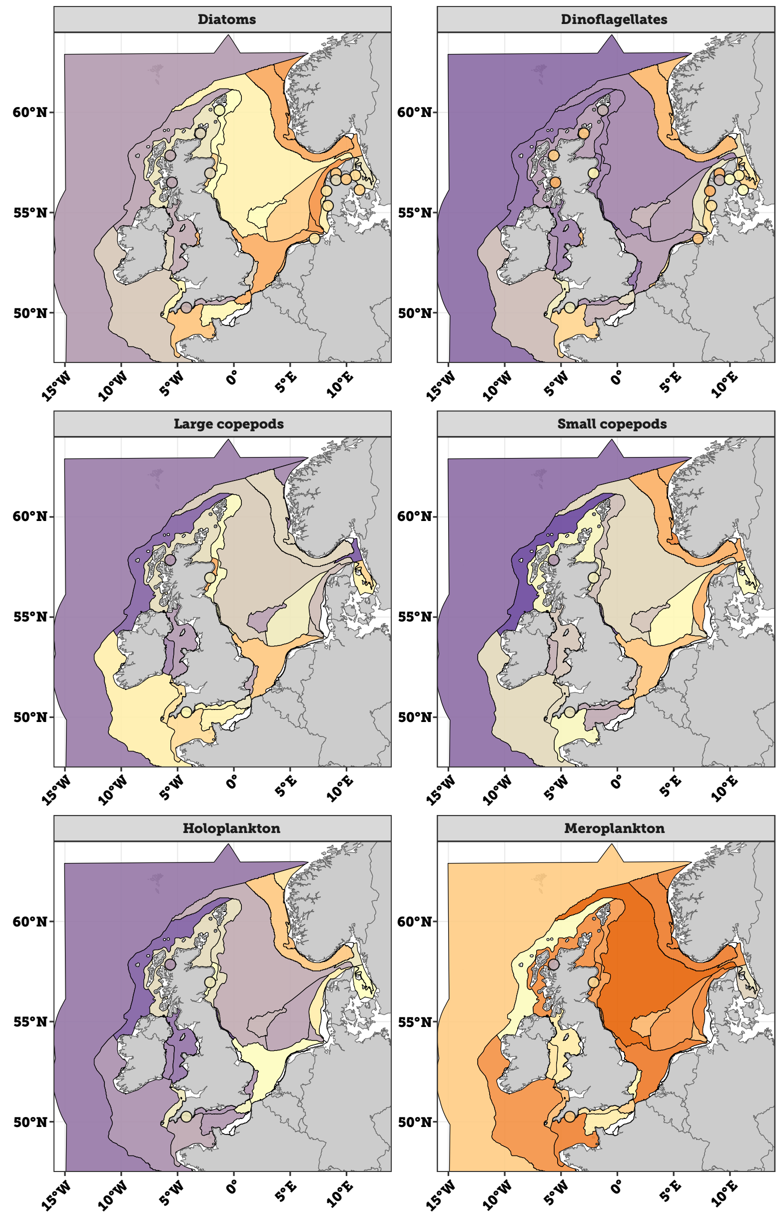
Figure 8: UK Biodiversity Indicator: C5 Seabirds, showing the average change in abundance of 13 species of seabirds[23]. Source: jncc.gov.uk/ukbi-C5. The blue line with shading shows the indicator and associated 95% Confidence Interval. The bar chart shows the percentage of species within the indicator that have increased, decreased (weakly or strongly) or shown little change in abundance.

experienced uniformly around Britain[27]. There have been notable declines in parts of Scotland. Harbour Seals are counted annually at colonies in England and east Scotland and every five years in colonies of north and west Scotland. It is estimated that the UK population has increased since the late 2000s, and is now close to levels seen prior to a population crash in 2002 caused by the phocine distemper virus. There are some concerns about local population declines however, with the 2019 count in the Southeast England area showing a 25% population decline compared to the mean of the previous five years. In addition to this, populations along the east and north coasts of Scotland and the Northern Isles are ~40% below the pre-2002 levels.

Plankton – the base of the food web

The marine food web is founded on tiny phytoplankton and zooplankton. Plankton communities respond quickly to environmental changes, making them valuable indicators of ecosystem condition, although it can often be difficult to identify specific underlying causes of observed changes.

An indicator of phytoplankton biomass generated using satellite remote sensing data (Figure 9) shows increases in some areas over the past 60 years[25,26]. Changes in diatoms and dinoflagellates, two groups of phytoplankton underpinning marine food webs, are associated with shifts in trophic pathways and carbon cycling. Small copepods, a type of zooplankton that are important prey for larval fish, have shown long-term abundance increases in some coastal areas but decreases offshore. The abundance of planktonic larvae (ie meroplankton), including sea urchins and crustaceans, has increased in most areas and is associated with rising sea temperatures.



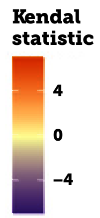


Figure 9. The change in plankton lifeform abundance of 6 functional groups between 1960 - 2019. Sea areas are coloured according to the results of the Kendall trend test which indicates how consistent the increase or decrease in abundance has been. Fixed point stations are represented by filled circles.

Scallop, Graham Eaton (rspb-images.com)

Marine benthos – life on the seafloor

Life on the seafloor around the UK is highly diverse, with more than 10,000 species. It is very challenging to obtain data and information about these organisms due to where they live. However, for the first time in the *State of Nature* report, trends in distribution between 2005 and 2021 have been modelled for 438 taxa using citizen science records from the Seasearch programme[28] (Figure 10). This is a first estimate of how coastal benthic organisms are faring, and the opportunistic nature of citizen science means the aggregated trend is likely to be biased towards better recorded groups, such as sea snails and red algae, with records from only more accessible locations. Despite the overall increasing trend, some taxonomic groups showed reducing occurrence. For example the distributions of starfish and related species decreased on average.

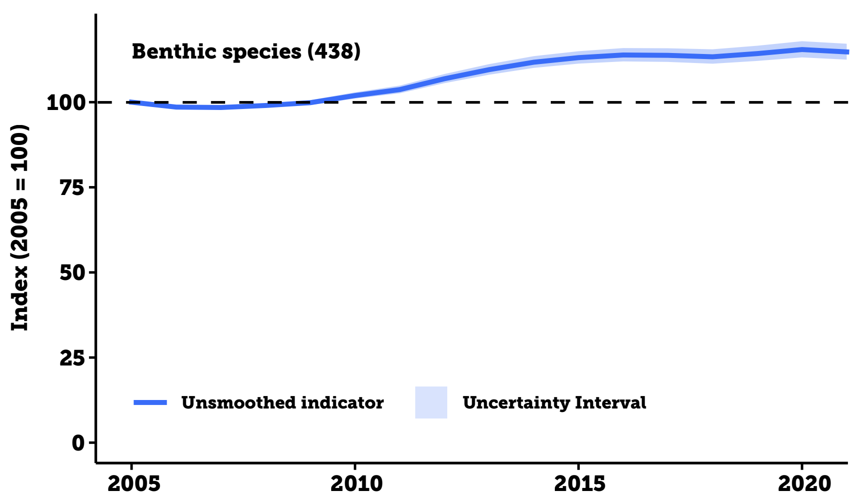


Figure 10: Change in average species' distribution of benthic species from 2005 to 2021 combined from models of 438 taxa across 20 different taxonomic groups. All records were collected by the Seasearch programme.

Northern Starfish, Graham Eaton (rspb-images.com)

Pressures and responses

The *State of Nature report 2019* reviewed the major pressures on the UK's nature over the past 50 years. Here we have summarised these pressures and looked at recent trends to see whether their impacts are likely to have been continuing over the last decade (Figure 11). We focus on the direct drivers of biodiversity change, rather than the underpinning societal values and behaviours, including production and the consumption patterns that may drive them.

Figure 11: Summary of the key drivers of change in nature in terrestrial and freshwater, and marine biomes over the last 50 years. Summary of terrestrial and freshwater drivers of change based on expert elucidation, taken from Burns et al 2016[29]. Changes reflect the relative impact of each driver in explaining population change in a sample of 400 species from a wide range of taxonomic groups. Summary of marine pressures is taken from the UK National Ecosystem Assessment[30].

Other pressures and responses

Pollution

Most air pollutants have declined substantially since 1970, but ammonia declined more slowly and has increased again in the last few years[31,32]. Despite these declines, 73% of the area of sensitive habitats in England is still exposed to damaging levels of acidification, and nitrogenous air pollution levels were exceeded in 97% of the area of sensitive habitats[33] in England. Some species of lichens and moss have responded positively to reduced air pollution[34], but many continue to decline in distribution, as do vascular plants adapted to habitats low in nutrients[35].

Freshwater insect species have, on average, shown a strong recovery in distribution since 1990 following earlier declines (see Key findings). This is likely in part to be due to improvements river water quality from the 1990s onwards[15,36]. The proportion of lakes, rivers and estuaries in the UK in good or high ecological status has remained static at 36% in the last decade[37] and there are indications that the recovery of freshwater invertebrates has slowed[36].

51% of beached Fulmars in the North Sea have more than 0.1g of plastics in their stomachs. This reflects the abundance of floating litter and provides an indication of harm[38].

Invasive non-native species

The number of invasive species has increased in freshwater, terrestrial and marine biomes in the last decade in line with ongoing trends since 1970[39].

Through the Biosecurity for LIFE project, 95% of the UK's internationally important seabird islands now have biosecurity measures in place. Non-native American Mink predate many species, including endangered Water Voles. There is a successful control programme that now covers a large part of Scotland, and a similar initiative has also begun in East Anglia.

Habitat management

The UK has a rich diversity of habitats and ecosystems. The condition of these and the way they are managed is also an important driver of our changing nature. See Ecosystem and habitat Restoration and Nature-friendly farming, and sustainable fisheries and forestry.

Key long-term drivers of change in nature			Recent changes in key drivers of change		
Biome	**Key drivers of change (IPBES driver if different)**	**Long-term impact**	**Changes in the last decade**	**Implications for nature**	**Report chapter**
Terrestrial and freshwater	Intensive agricultural management (changing use of land and sea)	Policy driven increases in agricultural productivity have met increased food demand, but many management practices have had major negative impacts on nature.	Total farming productivity continues to increase[40]. Volume of fertiliser used continues to decline from a peak in the 1980s[40]. The percentage of farmland in agri-environment schemes has increased[41].	Good evidence that well-designed agri-environment schemes can benefit nature, but that current scales of roll out are inadequate for recovery[44].	Nature-friendly farming, and sustainable fisheries and forestry (page 50)
Terrestrial and freshwater	Climate change	Climate change has caused major changes to nature on land and at sea, including range shifts, population changes and disruption to food webs. Climate change also interacts with and exacerbates the impacts of other drivers.	Temperatures on land are 0.5°C warmer than 1981–2010 and 1.1°C warmer than 1961–90. Summers are 15% wetter than 1981–2010 and 17% wetter than 1961–90[42].	Climate change is accelerating and the negative impacts on nature are likely to increase. While warmth-adapted species are likely to continue to expand their UK distributions, montane species on the edge of their ranges in the UK will be squeezed out. Nesting birds will become increasingly mismatched with peaks in invertebrate food sources essential for their chicks. On land, well-designed nature-based climate mitigation measures are likely to have positive impacts for nature[45].	Ecosystem and habitat restoration (Page 72), and Nature, climate and people (Page 82)
Marine	Climate change		Sea temperatures are 0.1°C warmer than 1991–2020 and 0.7°C warmer than 1961–90. Mean sea level is 16.5 cm higher than in 1900 and is rising increasing quickly[42].	At sea, future warming is likely to continue to shift primary and secondary plankton production northwards. This may negatively affect ocean carbon storage in the coming decades[46] as well as having a knock-on impact on the marine food web.	
Marine	Overexploitation (direct exploitation of organisms)	Past overfishing caused declines in commercial fish species and damage to benthic habitats.	51% of marine fish stocks are now harvested at or below maximum sustainable yield, or within an acceptable mortality range, up from 23% 2009–2019[43].	The proportion of large fish per catch in the North Sea increased from a low of 4% in 2002 to 12% in 2012 but has more recently declined to 6%[47].	Nature-friendly farming, and sustainable fisheries and forestry (page 50)

Emerging pressures

Transitioning to renewable energy

- All UK countries have committed to reach 'net-zero' by 2045 (Scotland) or 2050 (England, Wales, and Northern Ireland)[48].
- To meet these critical climate mitigation targets large-scale installation of renewable energy is needed[48] which comes with its own trade-offs as well as some potential co-benefits for nature[261].
- The UK Government and devolved administrations have committed to effective spatial planning and prioritisation, which will be essential if we are to achieve these goals while also helping nature to recover.
- See Nature, climate and people for more details.

Wildlife disease

Several plant and animal diseases threaten our wildlife, including the ongoing impacts of Ash dieback, phocine distemper in seals and trichomoniasis infections in finches.

Highly Pathogenic Avian Influenza

The ongoing outbreak of Highly Pathogenic Avian Influenza (HPAI) is the most serious the UK has ever recorded. A particularly virulent form has been affecting bird populations in the UK since 2021. Over the winter of 2021/22, avian flu primarily affected overwintering geese, as well as swans and ducks, some birds of prey and domestic poultry. The impact on the population of Barnacle Geese that come from Svalbard to winter on the Solway in Scotland was devastating, with around a third of the population dying. The breeding season of 2022 saw a much wider number of bird species affected, especially seabirds, and also a number of individuals of various mammal species believed to have eaten infected birds. In total over 70 bird and mammal species have been affected[49]. Eighteen of the 25 UK breeding seabird species tested positive for HPAI in 2022 and across RSPB reserves at least 15,000 birds were recorded dead[50] The full impact on seabird populations from the 2022 breeding season is the subject of ongoing monitoring and research. Impacts on seabirds are likely to be particularly severe, as they would normally have high adult survival rates and are slow to reproduce. For Great Skua and Gannet, two of the species where observed mortality was greatest, the UK hosts 60% and 56% of the global populations respectively. Initial estimates suggest a decline in occupied Great Skua territories of more than a half in Foula, Shetland, which is the largest colony of this species in the world[51]. The ongoing impact of avian flu is difficult to predict, but this unexpected additional pressure on our wildlife emphasises the need for resilient ecosystems and abundant species populations.

Funding for conservation

In recent years, public sector funding for biodiversity conservation has declined, both in absolute terms and as a percentage of Gross Domestic Product[52]. This amounts to a real-term decrease of 24% over the last five years. Governmental expenditure on international biodiversity conservation, including in the UK's Overseas Territories, has increased steadily since 2000/01, although in absolute terms this is typically around 4% of the annual amount spent in the UK. Non-Governmental Organisation (NGO) expenditure on biodiversity has increased by 16% in real terms since 2010/11, although this decreased by 3% in real terms over the five years to 2021.While public support for nature conservation is strong (see for example, People's Plan for Nature), the Covid-19 pandemic led to a reduction in the amount of financial support received by environmental NGOs.

Northern Gannet, Ashley Cooper (rspb-images.com)

HISTORICAL CHANGE

Great Skua, Andy Hay (rspb-images.com)

The *State of Nature* reports focus on recent changes in biodiversity. But we have been shaping our landscapes and wildlife for millennia. The UK's biodiversity has been depleted by centuries of habitat loss, development and persecution before the 1970 baseline. Historical declines can mask the scale of the deterioration. Each new generation views the world they grew up in as the reference, rather than recognising that biodiversity is already depleted.

It is challenging to measure this depletion precisely. Instead, we present three case studies to illustrate longer-term change: change in vascular plant communities, the biodiversity intactness index, and the impact of marine fisheries.

Terrestrial and freshwater – plant species change

The third vascular plant atlas for the UK and Ireland was published in 2023[53]. This huge undertaking collected more than 30 million records from nearly 8,500 volunteer surveyors who undertook botanical surveys in nearly all of the 3,983 10 x 10 km squares in the British Isles. Comparing the current distributions of species to records dating back to the 1930s, the authors were able to estimate changes in distribution across 1,419 native and long-established non-native plant species in Great Britain. On average, species declined in distribution by 23% UI -21% to -24%). More than half of these species declined (54%), whilst only 15% increased.

Plants adapted to low fertility conditions (Figure 12) and low competition, and plants associated with cultivated land, have shown the greatest declines since the 1950s. This is primarily due to changes in agricultural practices (see Pressures and responses section), including the conversion of semi-natural grasslands to arable, changes to grassland management (such as reseeding, fertilisation and more intensive grazing) and the drainage of wetland habitats. These species may also have been negatively impacted by air pollution. Plants of upland habitats have in general experienced less severe changes in distribution than in the lowlands, although importantly many heathland and bog specialists have declined due to burning, drainage, increased grazing pressure and increased plantation forestry.

The impact of climate change can also be seen in these long time-series. Some southern species have expanded their ranges northwards, whereas some northern species at the southern limits of their global ranges in Britain have retreated due to reduced snow cover and increased competition with more warmth-adapted species.

> ***"Vascular plant distributions have declined on average by 23% since the 1930s"***

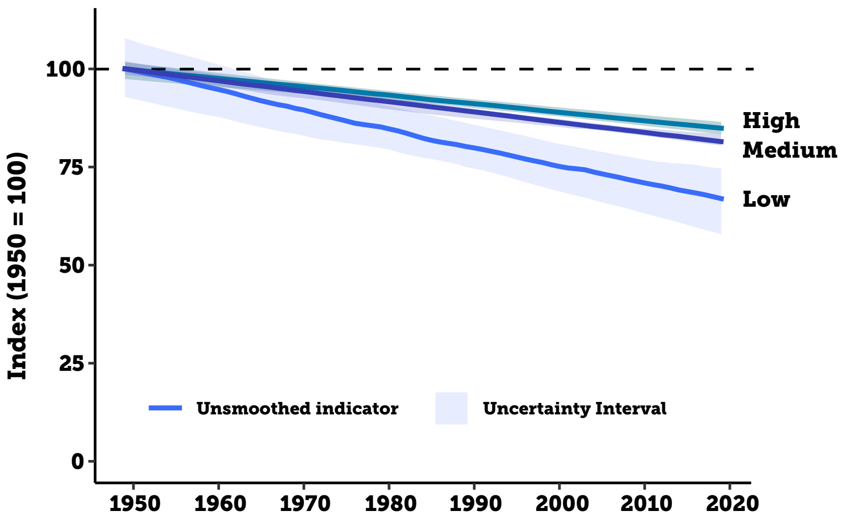


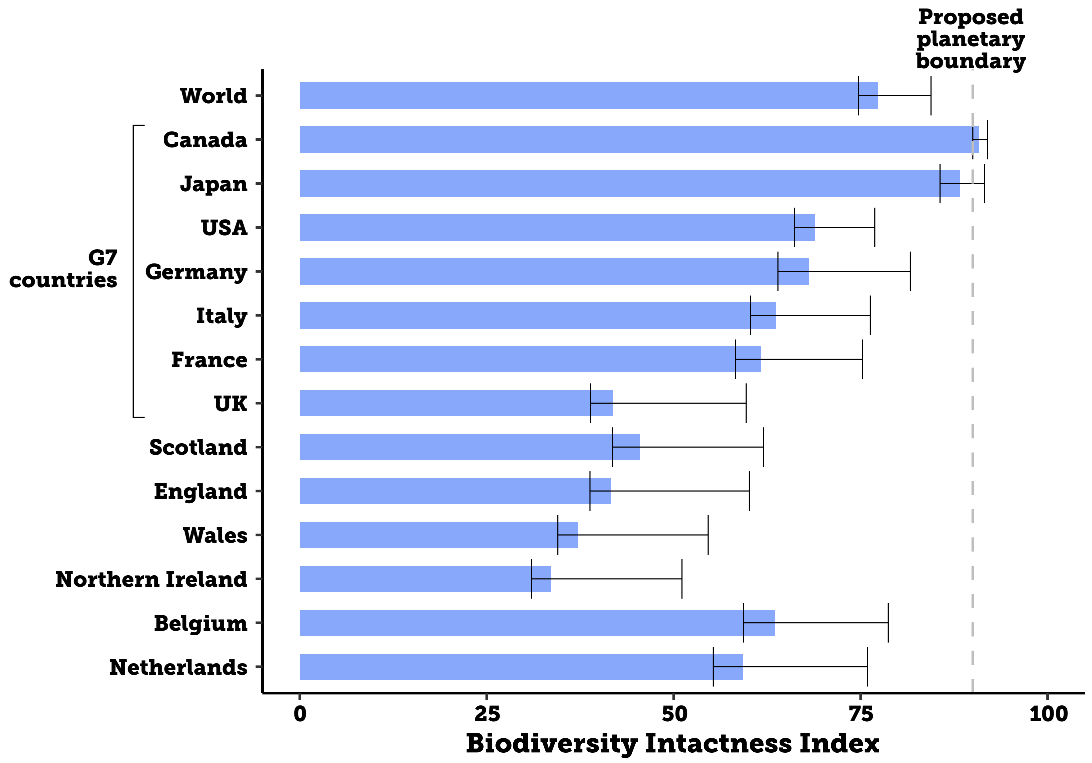
Figure 12: Change in average species' distribution for vascular plants in Great Britain split by Ellenberg Fertility score, a measure of the soil fertility to which each species is best adapted.

Biodiversity Intactness

Taking an even longer-term approach, the Biodiversity Intactness Index (BII) attempts to estimate the proportion of species still present in an area and their abundance, despite human impacts. This involves comparing species richness and abundance across different levels of land-use intensity, with the least modified or utilised examples of a habitat acting as a proxy for the species assemblage in the absence of human pressure. Data are collated from ecological studies across the globe and the relationships between land cover, land-use intensity, and species richness and abundance are modelled. These models give an estimate of species diversity and abundance at near-undisturbed sites compared to similar areas with high human activity. Currently around 58,000 species are represented in the BII dataset, covering a wide range of taxonomic groups.

The most recent estimate of the global BII is 77% (Figure 13[54]). This is substantially lower than the 90% level suggested as necessary to keep within planetary boundaries needed to maintain healthy functioning ecosystems[55]. The BII varies globally and as anticipated is lower in post-industrial countries. Amongst the G7 countries, only Canada has a BII above the suggested planetary boundary threshold. The UK has a BII of 42%, which is the lowest amongst the G7 countries by a substantial margin; the four UK countries all have similarly low estimates. The UK index is also lower than other small, post-industrial, densely populated countries in western Europe, like the Netherlands and Belgium (Figure 13).

Figure 13: Estimates of the Biodiversity Intactness Index for 2010 for the world, the biggest global economies, the G7 countries, and select other small, densely populated post-industrial countries in north-west Europe for a more direct comparison to the UK[104,404]. The error bars around each estimate were generated by refitting the models leaving out each major biome in turn.



Marine – fish landings and systems change

Elsewhere in this report we highlight the increasing proportion of large fish in a catch and of fish stocks exploited within sustainable limits. (See Nature-friendly farming, and sustainable fisheries and forestry). These are positive steps. However, it is important to set these in the context of the scale of change that has occurred in marine systems around the UK in the past 100 years and more. There remain few, if any, areas in UK seas untouched by commercial fisheries that could be used as reference sites.

In a 90-year study in the English Channel, a measure of the average trophic level of the fish and invertebrate species caught declined over time, with large, high trophic level fish species like Cod being replaced by smaller, lower trophic level fish and invertebrates like Scallops[56]. This phenomenon has been termed 'fishing down the food web'[57].

Alongside this reduction in the abundance of commercially caught species there have been significant changes to the structure and functioning of ecosystems. These have been direct, from the removal of what are often top predator species, and indirect, from habitat damage caused by fishing gear, primarily bottom-trawls[58].

Fishing down the food web has also been observed in the Firth of Clyde, where the only commercially viable fishery now is for *Nephrops*, a small but economically important crustacean, whereas the area was once important for Herring and whitefish fisheries. The impact of bottom-trawl fisheries on the abundance of target and other demersal species and on the seabed was observed in the Clyde as early as the 1880s, leading to a ban of bottom-trawls in the Firth and across the whole of Scotland within three nautical miles of shore in 1889[59,60]. The three nautical mile closure was repealed in 1984. Although there is no direct evidence linking the two events, demersal fisheries collapsed shortly afterwards, and it seems likely that protection from bottom-trawling in the Clyde helped to sustain landings of demersal fish in nearby waters until the 1980s[59].

A similar situation has occurred on the east coast of Scotland in the Firth of Forth. Here rich mollusc beds were the target of commercial fisheries in the 19th century, in particular oysters. Now, low-diversity soft-sediment communities dominate the seabed in the Firth. These communities are less productive and diverse, with reduced mollusc biomass and species richness, likely due to the damaging effects of earlier bottom-trawling and dredging[61].

The Restoration Forth project is starting to address these declines. This project aims to release 30,000 oysters and restore four ha of seagrass by the end of 2024. This is a small step towards restoring a healthy resilient environment in the Firth. However, if successful, this project could act as a case study to illustrate the potential benefits of ecosystem restoration.

Trawler fishing for Sandeels with Gannets & Kittiwakes, Chris Gomersall (rspb-images.com)

CONSERVATION RESPONSE

Pasqueflower, Ben Andrew (rspb-images.com)

GLOBAL NATURE RECOVERY TARGETS

In December 2022 the Convention on Biological Diversity (CBD) COP15 summit agreed the Kunming-Montreal Global Biodiversity Framework[62] (known as the Global Biodiversity Framework). It confirmed a global mission to halt and reverse the loss of nature by 2030 and achieve recovery by 2050, so that nature will thrive, 'sustaining a healthy planet and delivering benefits essential for all people'. This is in line with the Nature Positive goal demanded by organisations worldwide in the years leading up to COP15[63].

The new Global Biodiversity Framework includes four outcome-oriented goals to achieve by 2050, covering:

(Goal A) Recovery of ecosystems, species and genetic diversity;

(Goal B) Sustainable use and human benefits;

(Goal C) Equitable sharing of benefits; and

(Goal D) Implementation (Figure 14).

These are underpinned by 23 action targets to be achieved by 2030, falling under three headings:

1) **Reducing threats to biodiversity**

2) **Meeting people's needs through sustainable use and benefit sharing**

3) **Tools and solutions for implementation and mainstreaming**

In the following chapters we discuss conservation action in the UK countries, framed around one or a set of these targets in each case, but touching on many of them. We summarise what action is being taken, what we understand about the impact of these conservation actions on nature and people and, where possible, the future outlook.

> ***"In December 2022, the CBD COP15 summit confirmed a global mission to halt and reverse the loss of nature by 2030, and achieve recovery by 2050"***

Global Goals for 2050

Goal A:	Goal B:	Goal C:	Goal D:
Outcomes for ecosystems, species and genetic diversity	Sustainable use and nature's contributions to people	Equitable sharing of benefits from genetic resources	Means of implementation, including finance

2030 Mission

To take urgent action to halt and reverse biodiversity loss to put nature on a path to recovery for the benefit of people and planet

Global Targets for 2030

Reducing threats to biodiversity

Target 1: Spatial planning

Target 2: Ecosystem restoration

Target 3: Protected areas

Target 4: Recovery of ecosystems, species and genetic diversity

Target 5: Overexploitation

Target 6: Invasive non-native species

Target 7: Pollution

Target 8: Climate change

Meeting people's needs

Target 9: Sustainable use of wild species

Target 10: Sustainable production

Target 11: Nature's contribution to people

Target 12: Urban environment

Target 13: Access and benefit sharing

Tools and solutions

Target 14: Mainstreaming

Target 15: Business action

Target 16: Sustainable consumption

Target 17: Biosafety

Target 18: Subsidy reform

Target 19: Financial resource mobilisation

Target 20: Capacity building

Target 21: Knowledge and data sharing

Target 22: Indigenous peoples and local communities

Target 23: Gender

Report chapters	Core targets
Improved species status	Goal A, T4
Nature-friendly farming and sustainable forestry and fisheries	T10
Protected areas	T3
Ecosystem restoration	T2
Nature, climate and people	T1, T8, T12

Figure 14: Summary of the goals and targets agreed within the Kunming-Montreal Global Biodiversity Framework and how these targets are discussed within this report.

There is a consensus that it is vital for the new global targets to be more effective than their predecessors in driving action to stop and reverse biodiversity loss. Earlier CBD targets have been criticised for being imprecise, hard to measure progress towards and having insufficiently strong implementation mechanisms[64]. The new framework is underpinned by commitments to mobilise resources for implementation, and to follow a cycle of planning, monitoring, reporting and review. To avoid repeating past failures[65], countries agreed to these implementation steps to drive the delivery of the global framework at the domestic level.

The Global Biodiversity Framework targets have been recognised by governments in the UK. The Welsh[66] and Scottish Governments[67] have promised to bring forward legislation to introduce binding nature recovery targets, and the UK Government has recently done so for England through the Environment Act 2021[68]. Northern Ireland is currently drafting a new biodiversity strategy. Statutory targets have been shown to increase accountability, drive action and embed cross-sector responses in areas of environmental policy such as climate change mitigation, waste and air quality[69]. The response for nature needs to be given the same priority.

Bittern, Andy Hay (rspb-images.com)

Improved species status

Goal A of the Global Biodiversity Framework commits parties to: halt human-induced extinctions of threatened species; achieve a ten-fold reduction in risk and rate of extinction; and maintain genetic diversity and increase the abundance of native wild species to healthy and resilient levels by 2050[62].

Preventing extinctions, and reversing declines in species' abundances and distributions requires targeted actions for specific species and broad measures to improve environmental quality and tackle drivers of nature loss[70]. This will in turn require actions from genes to ecosystems and from local to global scales. A suite of complementary actions is available, including creating protected areas, changing habitat management, restoring lost or degraded habitat, improving connectivity among populations, eradicating invasive species, carrying out conservation translocations, protecting species and introducing supportive legislative policies.

In the UK, many previously common and widespread species are continuing to decline. However, there are many success stories of species benefiting from conservation. These include the reintroduction of the Large Blue butterfly; bats benefiting from protection at their roost and hibernation sites, and the over 200 Bitterns now booming in revitalised reedbeds. Understanding the impact of conservation on the populations of widespread UK species remains challenging. This is because conservation action is often monitored at a site or project level. It is also a challenge to understand the scale at which different interventions would need to be applied to meet and exceed these targets. If we are to improve the effectiveness of conservation, it should be based on evidence. Progress can be accelerated by sharing successes and failures[71].

It is important to remember that halting declines and reducing extinction risk are not the end goal of conservation. They are a critical step towards species recovery, or attaining the 'healthy and resilient levels' stated in the Global Biodiversity Framework.

Headlines

There is good evidence that conservation is effective for individual species when it can be applied to a high proportion of the population, and targeted conservation action has set some species on the path to recovery.

Despite many examples of conservation impact on individual species, the collective impact of conservation actions across taxa in the UK is not as well studied. This makes it harder to draw conclusions at a larger scale.

Halting and reversing biodiversity decline is vital, but it is only the first step towards a healthy environment with resilient species populations, thriving habitats and functioning ecosystems.

Wood White, David J Slater (rspb-images.com); Bittern, Ben Andrew (rspb-images.com); Brown long-eared bat, Daniel Hargreaves Bat Conservation Trust

RSPB Radipole Nature Reserve, Mike Read (rspb-images.com)

Action – how is species conservation conducted in the UK?

In recent decades, many effective conservation tools have been developed[72]. Figure 15 presents examples of species that have been subject to interventions. These include: targeted actions, such as habitat restoration or management; wider landscape interventions, like agri-environment schemes; or legislative change, providing an enabling policy framework. The species reflect a variety of biomes, taxonomies and life histories, with conservation actions implemented at a range of spatial scales by landowners, charities, government and the public. These examples focus on a single conservation action, but in most cases more than one type of action will be needed to fully restore species populations. Equally, actions designed to favour one target species often have beneficial impacts on others[73].

Species and Great Britain Red List status	UK Population change	Population size/Range	Conservation actions	Conservation actions and impact
Red Squirrel – Endangered  Red Squirrel, Ben Andrew (rspb-images.com)	**37%** ↓ contraction in range between 1993 and 2016[74]	Widespread	Invasive species control	Conservation action for Red Squirrels takes place throughout the UK. For example, Saving Scotland's Red Squirrels (SSRS) works with volunteers and landowners to protect Red Squirrel populations from the non-native, invasive Grey Squirrel, through targeted control in priority areas. Grey Squirrels outcompete Reds for resources and are a host for squirrelpox virus. This is asymptomatic in Greys, but deadly to Reds. When Grey Squirrels move into a Red Squirrel territory, they usually replace the native Red population within 15 years[75]. Without the work of SSRS, it is likely the Red Squirrel's range in Scotland would have contracted considerably in line with national trends. Instead, red populations have remained largely stable, and even increased in localised areas[76].
Twaite Shad – Vulnerable  Twaite Shad, Jack Perks (rspb-images.com)	**29%** ↓ decline in abundance 2008–2020[77]	Rare	Fish ladders	*Unlocking the Severn*, the largest project of its kind in Europe, is reconnecting Twaite Shad to over 150 miles of spawning habitat by creating four fish passes around otherwise impassable weirs. Tracked Shad were seen spawning upstream of the third pass in the year after construction, as were Sea Lamprey, another threatened species. There have also been wider benefits for other fish within the Severn, with 25 different fish species recorded swimming through the fish pass at Diglis.
Crawfish – Not assessed  Crawfish, Kate Lock	**576%** ↑ increase in distribution in England 2004–2020[78]	Rare	Protected areas	Crawfish (or spiny lobster) was fished close to extinction in the 1970s and 1980s and is rated red on the Cornwall Wildlife Trust Good Seafood Guide. Populations have increased in south-west England since 2014. However, landings per unit effort (LPUE) declined by 50% between 2016 and 2018, raising concerns about over-exploitation. The species is a designated feature of six Marine Conservation Zones, but receives no active management other than general restrictions that apply everywhere (ie, minimal landing sizes and prohibition of landing females with eggs). There are numerous opportunities to support this species recovery by working with fishers to avoid unsustainable levels of fishing. Recording has been largely limited to within Marine Protected Areas, so it is not yet possible to assess the role of protected areas in recovery or maintenance of populations.

Figure 15: Species examples showing the range of conservation interventions for a range of taxa. See page 19 for more detail on IUCN Red List categories.

Species and Great Britain Red List status	Population change	Population size/Range	Conservation actions	Conservation actions and impact
Skylark – Least concern  Skylark, Ben Andrew (rspb-images.com)	Abundance declined by **56%** ↓ 1970 – 2018[79] 10-year trend of 8% decline	Widespread	Agri-Environment Scheme	Skylark populations have declined in line with intensification in farm management[81,82] but show more positive trends where higher-level agri-environmental options are adopted in England, especially in pastoral systems[83]. Take up of these schemes is currently not widespread enough to support species' recovery in England.
Duke of Burgundy – Vulnerable  Duke of Burgundy, David Kjaer (rspb-images.com)	Abundance declined by **35%** ↓ 1979 – 2021[84] 10-year trend little change	Scarce	Habitat management	Duke of Burgundy has recently been down-listed from Endangered to Vulnerable in Great Britain[85] and conservation at many sites is likely to have played an important role in this status improvement. For example, habitat management in the North York Moors helped stabilise populations by providing open grassland to support the larval foodplants Primrose and Cowslip, and the scrubby grassland patches utilised by the species[86].
Wood Bristle Moss – Least concern  Bristle Moss, Claire Halpin British Bryological Society	Range increased by **1699** hectads (10x10 km) (1995 – 2013)	Scarce	Legislation to reduce air pollution	Many bryophytes and lichens are negatively impacted by air pollution. The European Union (EU) National Emissions Ceiling Directive (Directive 2001/81/EC) compelled nations to work to reduce levels of various pollutants, including sulphur dioxide. The resulting declines in SO_2 have coincided with population recoveries in a range of epiphytic bryophyte species, including the Wood Bristle Moss[87]. Note that ammonia pollution is increasing and continues to have negative impacts on many epiphytic lichens.
Large Marsh Grasshopper – Near threatened  Large Marsh Grasshopper, Jeroen Stel (rspb-images.com)	**8%** ↓ decline in range 1985 – 2010[88]	Rare	Translocation, reinforcement	The range of the Large Marsh Grasshopper declined rapidly in recent decades to just two populations in southern England. To help the species re-establish, a small number of adults from the remaining populations were collected in 2018. Some were released in a wetland site in Norfolk, others were reared in captivity with the help of volunteer 'Citizen keepers'. The young were subsequently released. Excitingly, in 2020, individuals born in the wild in Norfolk were confirmed breeding. This is the first sign that translocation may play a valuable role in this species recovery.

Impact – species and habitats

An accurate assessment of conservation effectiveness relies on high-quality biodiversity data. Progress towards the Global Biodiversity Framework target of a ten-fold reduction in extinction risk will be measured using the global Red List Index[89]. This is based on using repeated global Red List assessments to assess changes in species status. In this report, we summarise IUCN Red Lists for nearly 10,000 species, giving us an unprecedented insight into the threat of extinction for species in Great Britain.

However, we have less information about how extinction risk has changed over time. Only two groups, butterflies and bryophytes, have been assessed more than once using the latest IUCN criteria[90]. Of the 62 species assessed in both the 2010 and 2021 butterfly Red Lists, 16 changed status: 11 species moved to more threatened categories and five became less threatened. At least three of the latter, Duke of Burgundy (Figure 2), High Brown Fritillary and Pearl-bordered Fritillary, have been subject to direct conservation action that is likely to have contributed to their improved status[85]. There are plans to repeat many of the Red Lists for Great Britain each decade to track changes in extinction risk over time[91].

Status improvements in Red List assessments indicate, but do not directly estimate conservation impact, and are not apparent until formal re-assessment.

Another approach is Green Status assessment[92,93], a complement to the IUCN Red List[94]. The Green Status considers whether species are present, whether populations are viable, and whether they are performing their ecological functions, across their entire historical range. These factors are combined into a percentage score which reflects how close a species is to its fully recovered state. The assessment also estimates the impact of conservation to date, the anticipated impact of conservation in the future, and the long-term recovery potential. For example, Eurasian Otter is assessed globally as Near Threatened (Red Status[95]) and Largely Depleted (Green Status[96]), with a recovery score of 40%. Conservation has likely benefited the species, and if continued would increase the Green Status score to 54% in 10 years. Work remains to downscale this global methodology for use at a national scale.

While we have a wealth of information about the effectiveness of individual conservation actions (eg, ConservationEvidence.com), these are usually for a small number of species within a defined area (see examples in Figure 2). Recent research has demonstrated that conservation action results in improved population trends for individual target vertebrate species[97]. However, less is known about how conservation action affects non-target taxa, and there are few large-scale experimental studies[98,99]. This has led to repeated calls for a better understanding of the impact of conservation[100,101]. Elsewhere in this report, we highlight recent research assessing the impact of conservation interventions at a national or regional scale, for example protected areas[102,103] or Agri-Environment Schemes[83].

> **"Of the 62 species assessed in the 2010 and 2021 butterfly Red Lists, 11 species became more threatened and five became less threatened"**

Lymington yacht marina, Mike Read (rspb-images.com)

Impact – people and planet – multi-taxa species recovery projects

Ecosystem restoration and landscape-scale conservation have a central role in tackling the nature and climate emergency. Multi-species conservation projects that embody this concept include Back from the Brink and the Solent Seascape Project in England, Species on the Edge in Scotland, Natur am byth! Saving Wales' threatened species in Wales and Co-operation Across Borders for Biodiversity which spans sites in Northern Ireland, Scotland and the Republic of Ireland.

These partnerships operate at multiple sites and tackle an array of conservation challenges including habitat loss, invasive species impacts and disturbance, which benefits threatened target species across multiple taxa. Moreover, they engage local communities, connecting people with nature. Back from the Brink involved 59,000 people, including over 10,000 who learnt new skills and nearly 4,000 who volunteered their time. Similarly, the Zoological Society of London has been working alongside local residents to restore nearly 40 km of waterways in the River Thames catchment since 2000. This has generated multiple benefits for nature, but also resulted in better water quality, reduced threat from flooding, and has supported the wellbeing of people involved in the project and the wider community. This project has been expanded at other sites throughout England and recently in Scotland as well.

Future – what is the aim of conservation?

Halting and reversing biodiversity decline is vital, but it is only the first step towards a healthy environment with resilient species populations, thriving habitats and functioning ecosystems.

Although broad descriptions of what recovery might look like have been proposed[104,105], it has proven challenging to use these ideas to guide conservation in practice. Several complementary concepts of recovery are used in the UK, including Favourable Conservation Status (FCS) in terrestrial systems and Good Environmental Status (GES) (Figure 16) in marine systems. Good Ecological Status (GES) is also used for freshwater habitats.

FCS sets out what 'good' looks like for individual habitats and species, based on definitions of favourable natural range, area, population, and habitat structure and function. For most species, even those which are defined as Threatened on Regional Red Lists, baseline data are not available for most of these parameters. Filling these data gaps, and implementing effective ongoing monitoring, is a priority if there are to be meaningful attempts to assess improvements in conservation status over time. The concept is rooted in the international Bonn Convention, to which the UK is signatory. By defining a species recovered state, FCS can provide an end point for Species Recovery Curves, a concept describing a species progress from depleted populations to full recovery, via improved ecological understanding and management intervention. Natural England has been developing and publishing definitions of FCS for a selection of species and habitats in England following a methodology which seeks to combine the best available evidence and specialist expertise (Figure 16). The RSPB has also been developing methodologies for the definition of FCS for UK breeding bird populations, and is collaborating with Natural England and Durham University to develop these methods further. The ambitions within the Natural England definitions form the basis of bespoke FCS strategies that can guide strategic nature recovery actions and, through the new Environment Act powers, development of Local Nature Recovery Strategies.

In marine systems, GES goes beyond individual species and habitats to define when waters are healthy, biologically diverse, clean and productive. In marine systems, GES seeks to balance sustainable human use with preventing deterioration, and securing environmental protection and ecosystem restoration. GES can only be achieved through holistic ecosystem management, so the UK works closely with our European neighbours through the OSPAR (Oslo Paris Convention) process to develop indicators and targets. The UK Marine Strategy[106] provides a framework for achieving GES in our seas through 11 'descriptors' of the marine environment: biodiversity, non-indigenous species, commercial fish, food webs, eutrophication, sea-floor integrity, hydrographical conditions, contaminants in the environment, contaminants in seafood, marine litter, and underwater noise. A broad suite of indicators linked to these descriptors is monitored to evaluate progress towards GES environmental targets. Indicators range from plankton community change to beach litter, to Kittiwake breeding success (Figure 16).

For rivers, lakes, estuaries and coastal waters, Good Status (within the Water Framework Directive, comprising Good Ecological and Good Chemical Status) takes a similar approach, considering a wide range of parameters that must all be brought to at least 'Good' for the waterbody to be considered to be in good overall health, and capable of delivering benefits for nature and for society. All these processes are dependent upon robust monitoring data and analysis to assess progress.

> ***"Halting and reversing biodiversity loss is vital. But it is only the first step towards a healthy environment with resilient species, thriving habitats and functioning ecosystems"***

Figure 16: Examples of ways to define nature recovery.

	Hazel Dormouse	Sensitive fish species
Method	Favourable Conservation Status (FCS)	Good Environmental Status (GES)
Scale	England	Greater North Sea/Celtic Seas
Targets	Return range and population size to historic estimates of presence in 49 counties (1885) and 2.7 million individuals (1993) and be assessed as Least Concern of extinction from Great Britain.	All sensitive fish species, those thought most likely to be impacted by fishing, should be increasing.

Hazel Dormouse, Ernie Janes (rspb-images.com) ; Sea lamprey, Jack Perks (rspb-images.com)

Nature-friendly farming and sustainable fisheries and forestry

Target 10 of the Global Biodiversity Framework is particularly relevant here and seeks to ensure that areas under agriculture, aquaculture, fisheries and forestry are managed sustainably, including a substantial increase in biodiversity friendly practices that will support long-term resilience and productivity of the systems as well as help to conserve and restore biodiversity.

This chapter outlines how the current and future state of nature depends on the degree to which the fisheries, farming and forestry sectors pursue nature-friendly or sustainable approaches.

Troup Head RSPB reserve, Andy Hay (rspb-images.com)

To meet Target 10 of the Global Biodiversity Framework, approaches to fishing, farming and forestry that support ecosystem function and that are both sustainable and nature-friendly should be prioritised. Fishing, farming, and forestry are important industries in the UK, providing food, fibre and livelihoods. The geographic extent of these industries means that careful planning and sustainable management is essential to help halt biodiversity loss, and to mitigate and adapt to the effects of climate change.

Marine fishing has long been a part of the UK's culture. However, overfishing and unsustainable fishing methods that result in bycatch and that damage benthic (seafloor) habitats have been major drivers of marine biodiversity loss[107,108], and there have long been concerns about the sustainability of fish stocks[107,109].

71% of the UK's land is managed by farmers and other land managers[110]. A combination of technological advancements, use of agro-chemicals and changing agricultural policy has reduced the capacity of farmed landscapes to support wildlife, resulting in widespread biodiversity loss[111].

Forestry is economically important, and woodland cover is gradually increasing in the UK from a baseline of heavy deforestation. Uniform planting of non-native tree species and lack of effective management in native woodlands have led to reductions in woodland wildlife and an increased risk to native tree species from new pests and pathogens[112,113].

Headlines

Half of marine fish stocks are sustainably harvested. Sustainable management is a positive step, but does not necessarily mean the same as well-managed for nature. In the UK a fifth of farmland is in agri-environment schemes, but only a part of which could be considered as nature-friendly farming. 44% of UK woodland is certified as sustainably managed. All three measures have improved markedly over the past 20 years.

The increased proportion of sustainably harvested marine fish stocks appears to be having a positive impact, with the proportion of large fish in landings increasing since 2002. Many terrestrial species have been shown to benefit from nature-friendly farming at a local level, but the impact of different schemes on species populations has been variable.

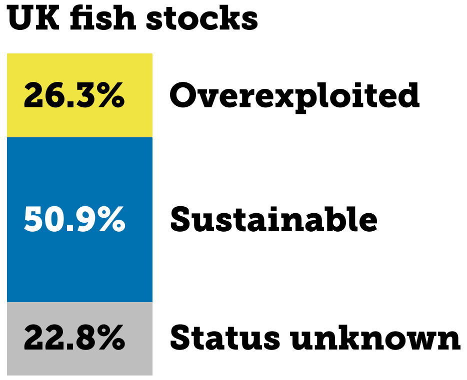
The UK Fisheries Act 2020 has come into law, which aims to use our marine resources sustainably and protect ecosystem services. The best available information suggests that nature-friendly farming needs to be implemented at a much wider scale to halt the decline in farmland nature.

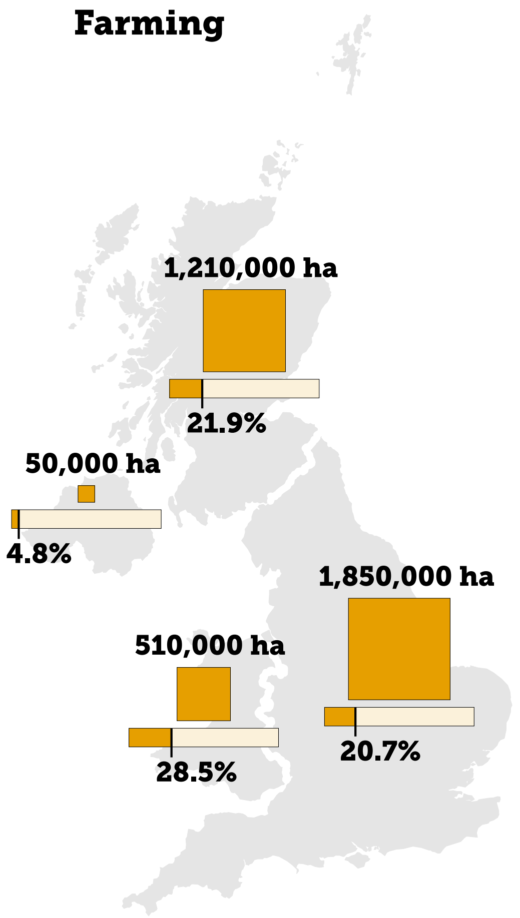
RSPB Hope Farm, Ben Andrew (rspb-images.com); Sea Bass, Graham Eaton (rspb-images.com); Common Roach, Jack Perks (rspb-images.com)

Wildflower margins, Ben Andrew (rspb-images.com)

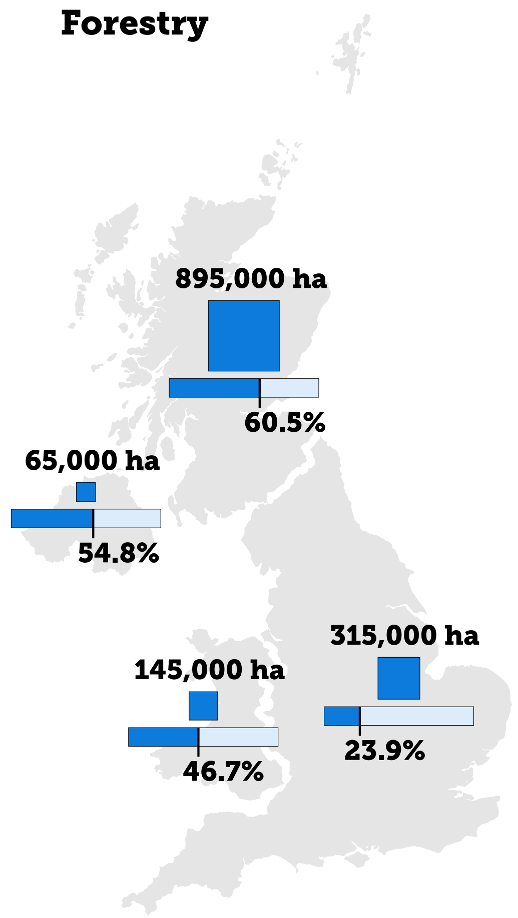
Action – extent and condition

Sustainable use of natural resources is now embedded in the UK's global and national policy commitments. Here we consider the current extent and condition of UK fishing, farming and forestry practices in light of these statutory targets and goals.





Area of each UK country in agri-environment schemes. Bars show this area as % of Utilised Agricultural Area.



Areas of certified woodland in each UK country. Bars show % of all woodland that is certified.

Figure 17: Extent of nature-friendly farming and sustainable fisheries and forestry in the UK[114]. Percentage of UK marine fish stocks (quota) harvested sustainably 2019 (source jncc.gov.uk/our-work/ukbi-b2-sustainable-fisheries). Area of each UK country in agri-environment schemes, (source: jncc.gov.uk/our-work/ukbi-b1a-agri-environment-schemes) and proportion of agricultural land covered by these schemes in each UK country 2020. Area of woodland and percentage of woodland area certified as sustainably managed by country in 2022 (UKWAS) (source: jncc.gov.uk/our-work/ukbi-b1b-sustainable-forestry).

Marine fisheries

UK fishing vessels land around 400,000 tonnes of fish each year in the UK and an additional 200-300,000 tonnes abroad. The majority of UK landings by weight are in Scotland (around 70%)[109]. The percentage of UK quota-fish stocks fished at or below their maximum sustainable yield (FMSY), and/or within acceptable mortality range levels, has improved from 9% in 1990 to 50.9% in 2019[114]. However, 26.3% of UK quota-fish were overfished in 2019 (Figure 17).

The latest data for the Sensitive Fish Indicator, which tracks changes in the population status (occurrence, abundance and condition) of fish and shellfish species at risk of depletion, do not meet the UK target of Good Environmental Status (GES) for the Greater North Sea. Over the last 50 years, 33% of the 48 species assessed show a significant decline in occurrence, and in the short term (last 10 years) 22% of the 51 species assessed show a significant decline. Conversely, 56% of the species assessed show a significant increase in occurrence over the long term and 57% a significant increase in the short term[116]. For the Celtic Seas the latest OSPAR assessment found that for the 26 sensitive fish species that could be assessed (out of 50 species in total), 12 met the long-term threshold of 'recovering' and a further seven showed no further decline[117].

Farmland

Farmland wildlife is declining due to a variety of factors including agricultural intensification since the 1950s and the use of pesticides[118]. Agriculture accounts for 11% of UK greenhouse gas emissions[119,120]. These pressures damage public health and are impacting wildlife. In the UK between 1970 and 2020, farmland birds have declined on average by 58%[114]. In response to these impacts on nature, the UK Government and devolved administrations have launched various initiatives over the years, generically known as Agri-Environment Schemes (AES), to promote more sustainable and nature-friendly farming. In 1992, there were 0.3 million ha of land in the UK in AES, and by 2020 this had risen to just over 3.6 million ha, accounting for 21% of farmland (Figure 17), although given the requirements of some targeted schemes, not all this area is considered to be under nature-friendly farming. Higher-level schemes include the Higher-level Environmental Farming Scheme (Northern Ireland), Agri-Environment Climate Scheme (Scotland), Glastir Advanced (Wales) and countryside stewardship or landscape recovery tiers of Environment Land Management schemes (England).

Each UK nation has its own agri-environment scheme framework. The most recent agri-environment scheme in Wales, Glastir, supported land management to reduce greenhouse gas emissions, reduce flooding and water pollution, halt biodiversity loss, manage historic landscapes and access, and manage and create woodland. Agreements targeting species recovery will be covered by the Sustainable Farming Scheme Optional and Collaborative Layers due to be launched between 2025 and 2029. In Northern Ireland, DAERA Environmental Farming Scheme has agreements which normally last five years. The voluntary scheme is made up of three levels, a Wider-Level Scheme aimed at the countryside outside environmentally designated areas; a Higher-Level Scheme primarily aimed at site-specific environmental improvements at important sites or for priority habitats and species; and a Group-Level Scheme with additional advice to support co-operative work by farmers in specific areas. In England, the Countryside Stewardship agri-environment scheme funds land management to increase biodiversity, improve habitat condition, expand woodland, improve air and water quality and support natural flood management; around 1.6 million ha of land are managed under this scheme[122]. Post-Brexit, new agri-environment schemes have been introduced in England, including Landscape Recovery which is designed to support large-scale projects for environmental and climate benefits. In Scotland, the Agri-Environment Climate Scheme (AECS) is designed to promote land management practices which protect and enhance the natural heritage, improve water quality, manage flood risk, and mitigate and adapt to climate change. It also helps to improve public access and preserve historic sites[123].

Forestry and woodland

In 2022, woodland cover in the UK was 13% (3.24 million ha), up from 12% in 1998. Woodland cover in England in 2022 was about 10% with an additional 4% covered by trees outside woodland. Trees outside woodland are an important feature, particularly for wildlife, as they offer additional foraging resources and facilitate movements across often intensively managed landscapes. At present, woodland cover in the UK is approximately half native tree species and half non-native, particularly in conifer plantations. Ancient woodland is estimated to cover around 2.5% of the UK's land area and we also have at least 123,000 ancient and veteran trees[112].

The UK Woodland Assurance Standard (UKWAS) sets common woodland management standards in the UK and is recognised by both the Forest Stewardship Council and the Programme for the Endorsement of Forest Certification (PEFC). In 2022, there were 1.4 million ha of certified woodland across the UK, representing 44% of the total woodland area, up from 36% in 2001 (Figure 17). The area of certified woodland has increased in Britain since 2004, but not in Northern Ireland[124].

However, despite increases in both woodland cover and UKWAS certification in the UK, woodland wildlife is decreasing[112]. This is largely due to woodland fragmentation, habitat degradation and the lack of woodland management such as coppicing. In 2020, Forest Research published the first systematic Woodland Ecological Condition (WEC) assessment, covering all British woodlands: native and non-native, semi-natural and plantation. Woodland stands were scored against a single benchmark with 15 woodland ecological condition indicators, including amount of deadwood, veteran trees, open space, diversity of tree species, ages and structure. Scores were combined to provide an overall assessment of favourable, intermediate or unfavourable. In Great Britain, 7% of native woodland stands are in favourable condition, 92% are in intermediate and 1% are in unfavourable condition[125].

Bluebell woodland, David Palmar (rspb-images.com)

Impact – species and habitats

Fisheries impacts

Heavy marine fishing pressure leads to a fall in the proportion of large fish. Reducing the pressure should reverse this trend after a multi-year delay[114]. The effect of overfishing can be seen in the large fish indicator (Figure 18)[114], where large fish in the North Sea survey made up only 6% of the catch weight in 2019. This is below the value of 15% recorded in 1983, but above the low of 2% in 2001. The indicator had been steadily increasing after 2001, suggesting fish populations were benefiting from more sustainable management, until a sharp decline occurred in the indicator between 2016 and 2019. In 2019, there was a substantial reduction in large Cod and Saithe and an increase in smaller Haddock, Whiting and Dab[114]. Some interannual fluctuations are expected due to environmental conditions and sampling effort, but if this downwards trend continues it would suggest that fish stocks remain overexploited (Figure 18).

Bycatch and entanglement

One of the ways fishing can reduce its impact is by addressing bycatch – where non-target species are accidentally caught in fishing gear. Bycatch in UK waters is responsible for the injury and death of between 2,200-9,100 Fulmars and 1,800-3,300 Guillemots[126] as well as thousands of marine mammals and elasmobranchs (sharks, skates and rays) each year[127]. Bycatch estimates for elasmobranchs are hard to quantify due to the diversity of species involved and because some are caught and retained as part of mixed fisheries. Current figures are likely to underestimate the true scale of the issue as data come from limited observations. Cetaceans and Basking Sharks are susceptible to entanglement in creel (pot) fishing gear, including at least six Humpback Whales and 30 Minke Whales each year[128].

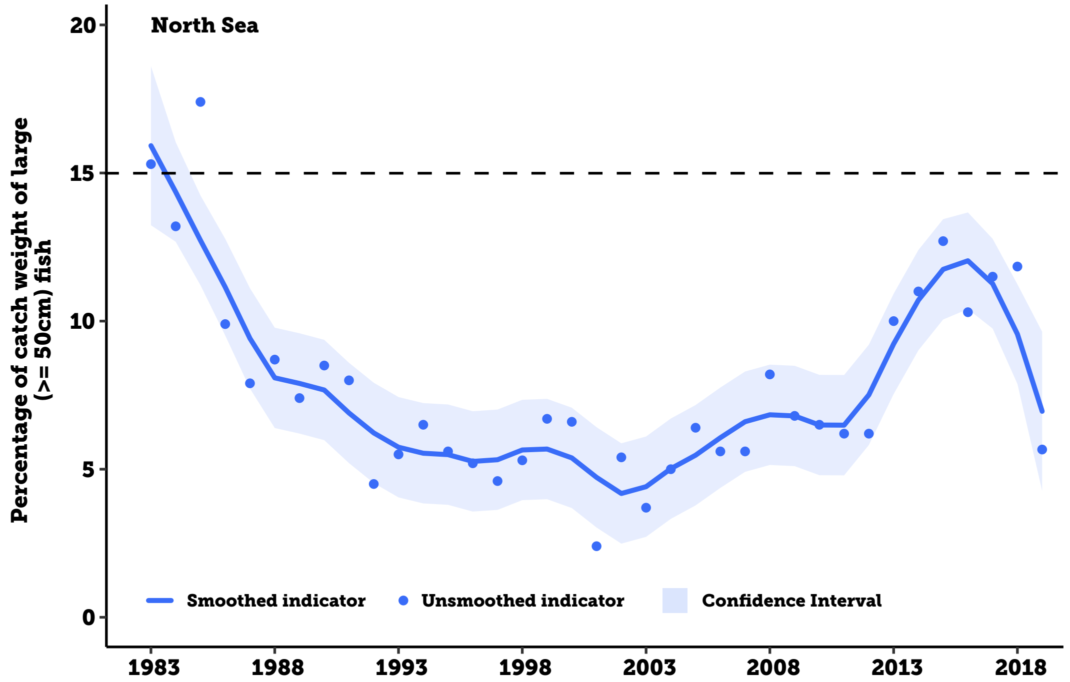


Figure 18: Percentage of large fish, by weight, in the North Sea. (Source: jncc.gov.uk/uk-bi-d1a[114].) The line graph shows the unsmoothed trend (points) and a LOESS smoothed trend (solid line) with the shaded area showing the 95% Confidence Interval around the smoothed trend. The dotted line shows the target proportion.

Many organisations are working with fishers, scientists and governments to address bycatch. This has involved working with fishers to understand seabirds' risk to longlines to design effective mitigation measures, and there is research in Cornwall trialling the effectiveness of 'looming eyes' buoys and predator-shaped kites to discourage seabirds from gillnets. In Scotland, there is currently a series of projects underway to prevent accidental bycatch in creels through the Scottish Entanglement Alliance – formed of scientists, fishers, NatureScot and NGOs.

> **"Many organisations are working with fishers, scientists and governments to address bycatch"**

Impact of sustainable agricultural management

Agricultural intensification is known to be the major driver of biodiversity decline on land in the UK[129]. Yet many UK farmers do take positive steps to conserve wildlife on their land. In particular, a number of agri-environment schemes (AES) encourage improved environmental stewardship in farming, with measures specifically designed to help stabilise and improve populations of farmland wildlife, including birds and invertebrates. These include the provision of over-wintered stubbles and planted wild bird cover crops to provide seed in the winter, uncropped margins or those sown with native plants on arable fields and sympathetic management of hedgerows[118].

Although AES are the primary policy mechanism for addressing farmland biodiversity declines in the UK, their effectiveness is mixed, both for biodiversity generally[130,131] and specific taxonomic groups[132-134]. However, there is strong evidence that well-targeted schemes, accompanied by appropriate advice, have increased the abundance of multispecies groups[135,136,138] and single species such as Corn Bunting[139,140], although this is sometimes over long time-scales[141]. Despite the importance of these schemes, policy-makers still lack empirical guidance on how much AES-type provision is needed to meet biodiversity targets, with notable recent exceptions[83].

A study in Northern Ireland compared conventional and AES management techniques on upland grassland. The AES management maintained more diverse swards with a higher coverage of native plant species, and was associated with greater species richness and abundance of terrestrial invertebrates compared to conventional management[138]. The Department of Agriculture, Environment and Rural Affairs (DAERA) is also monitoring the effectiveness of Environmental Farming Scheme options for birds across Northern Ireland. Previous studies have shown how targeted arable scheme options have increased the abundance of Yellowhammers, Tree Sparrows and House Sparrows[142].

Research in England contrasted farm systems in three lowland regions with higher-tier, lower-tier and no AES provision. In arable and pastoral regions, 57% and 59% of farmland bird species had more positive population growth under higher-tier AES than on no AES farmland, but there was little difference in the mixed farming region. The lower-tier AES farmland showed little difference in any of the regions. To increase regional farmland bird populations by 10% over 10 years, 47% and 26% of the farmed landscape would have to be devoted to higher-tier AES agreements in arable and pastoral landscapes respectively[83].

Scotland hosts the UK's main populations of Corncrake, and the species' continued survival is due to hard work by crofters, farmers, NGOs and government agencies. Targeted AES bolstered Corncrakes from fewer than 500 males in 1993 to 1,274 in 2014[143], although this number has since fallen. A recent study in northeast Scotland found positive associations between bird abundance and specific AES land management options that met species ecological requirements: in particular, water margins for Reed Buntings, and species-rich grasslands for Yellowhammers, while planting hedgerows improved plant diversity and pollinator abundance[144]. AES measures, such as the provision of cover crops, benefit seed-eating birds including Goldfinch, Linnet and Yellowhammer[145].

The Welsh AES Glastir, and its predecessor Tir Gofal, have had mixed outcomes for biodiversity[146-148]. Further data collection is essential to see if key biodiversity groups, including lowland and priority birds, begin to show positive responses. A new Sustainable Farming Scheme is being developed, due to be launched in 2025. Sufficient funding for data collection, analysis and scientific reporting on AES effectiveness remains essential to know if the right biodiversity outcomes are being delivered.

> **"Well-targeted schemes, accompanied by appropriate advice, have increased the abundance of multi-species groups"**

Corncrake, Graham Goodall (rspb-images.com)

Case study:

Natterjack Toad in range pond

Natterjack Toad recovery programme: monitoring to inform site management

The Natterjack Toad is rare in Britain, found in around 60 locations. The species has specialised habitat requirements and is associated with coastal sand dunes, saltmarsh and sandy heaths. The long-running Natterjack Toad breeding survey, coordinated by Amphibian and Reptile Conservation (ARC), aims to provide an annual estimate of their breeding population. Volunteers, including farmers and other land managers, visit waterbodies repeatedly through the breeding season, and record the occurrence and quantity of spawn, tadpoles and toadlets. Knowing which pools are used for breeding, and where populations are thriving or need help, allows ARC to provide tailored advice that land managers can use to improve the species' prospects. Actions include managing habitat in and around breeding ponds to increase breeding success, improving the availability and condition of breeding, foraging and hibernation habitats, and increasing connectivity among colonies. Farmers can use various options in AES to help them create and restore Natterjack Toad habitat.

Over the past two decades, Natterjack Toad populations have stabilised or expanded at some sites where conservation management has been well-resourced. At other sites, populations have declined, contracted in range, or become locally extinct over the same period.

Case study:

RSPB Hope Farm, Ben Andrew (rspb-images.com)

RSPB Hope Farm

The RSPB purchased Hope Farm in 1999 as a demonstration and research site, to examine the feasibility of running a successful lowland arable farming business whilst increasing wildlife value through agri-environment measures. More recently, the focus has broadened to include wider environmental impacts such as reduction of diffuse pollution and improving climate regulation services. From the outset, detailed monitoring of wild birds, mammals, insects and flora has been undertaken, alongside spatial records of crop yields, inputs and agronomy. This facilitates comparison of the relative benefits of different management techniques on food production, biodiversity, and climate change mitigation. Between 2000 and 2012, crop yields, relative abundance of 19 farmland bird species, and CO_2 and N_2O emissions related to crop production were recorded. By diversifying crop rotation and using 10% of formerly cropped land to support nature, food energy production dropped to 90.4% of previous levels, breeding bird populations increased by 177%, and GHG emissions were cut by 9.4%[153].

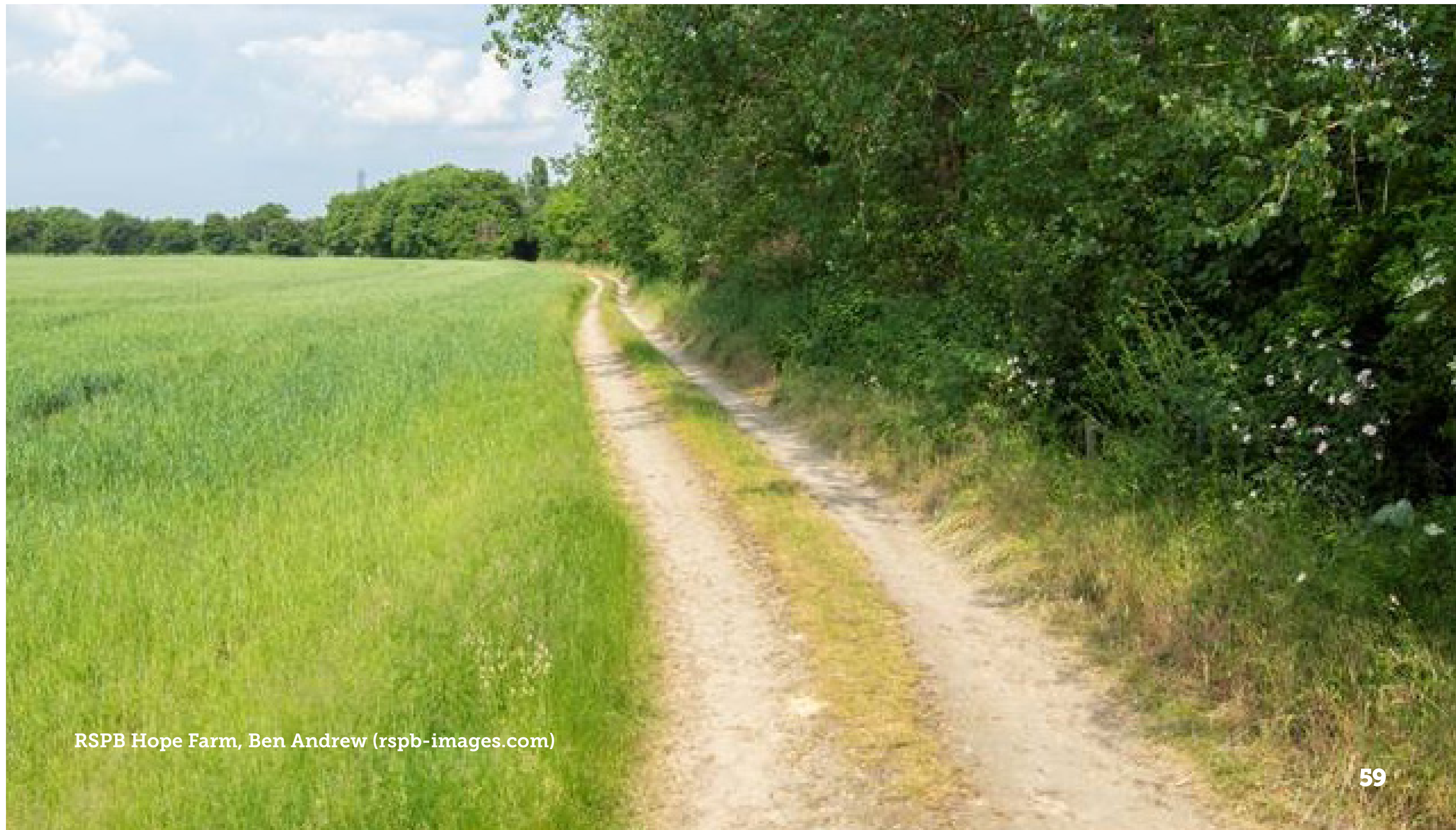
Impact of woodland management

While UK woodland cover has more than doubled in the last 100 years, much of this comprises non-native species established during large-scale afforestation in the middle of the 20th century. Plantations were frequently established on heath, moor and peatland habitats with strongly negative consequences for open habitat wildlife, soil carbon and water management. More recently, changes to forestry standards and practice have begun to reverse these impacts. For example, it is possible to adapt commercial forestry to support wildlife through practices such as continuous cover forestry. The Forest Stewardship Council Ecosystem Service Certification adds sustainability targets to certified woodland; wider adoption would improve forestry sustainability.

Changes in woodland structure following the loss of traditional management techniques have been identified as one of the drivers of population decline of specialist woodland birds[81]. Although new woodlands are being established around the UK, it may take centuries of development before they can support specialised species found in ancient sites. Actively managing existing woodlands to have varied age structure, or species-targeted woodland management through AES can help to increase bird diversity in the short term[151]. Currently, little is known about the impact of broader AES woodland management schemes, and work is underway to assess the impact of the Woodland Improvement (WD2) option under Countryside Stewardship schemes[152].

Impact – people and planet

The Nature Friendly Farming Network (NFFN) is a farmer-led independent organisation, established in November 2017, uniting more than 1,600 farmers across the UK who are committed to managing their land for wildlife and public good, at the same time as growing and providing safe, healthy and nutritious food. Ongoing work has had multiple benefits for species and farmers[118].



RSPB Hope Farm, Ben Andrew (rspb-images.com)

Future

Fisheries

The UK Government and devolved administrations now have full responsibility for managing fisheries in the UK's Exclusive Economic Zone (EEZ) up to 200 nautical miles from our coastline, subject to access arrangements made under the Trade and Co-operation Agreement. The UK Government leads on international fisheries quota negotiations from the overall Total Allowable Catch (TAC). Since the last *State of Nature* report, the UK Fisheries Act (2020) has come into law, and Scotland has a Future Fisheries Management Strategy to 2030. The UK Fisheries Act 2020 aspires to enhance the sustainability of marine resources and protect ecosystem services while continuing to focus on economic considerations. Of the eight fisheries objectives set out in the Act, five (sustainability, precautionary, ecosystem, bycatch, and climate change) aim to enable more environmentally-sensitive fishing practices. These objectives should support the health of the marine environment and ensure the long-term viability of the fishing industry.

A series of Fisheries Management Plans is also being developed, and discussions are underway that could reform how monitoring at sea is conducted. This could support the delivery of climate-smart fishing, through actions such as deployment of Remote Electronic Monitoring (REM) with cameras on vessels[154].

Steps are being taken to implement ecosystem-based fisheries management. These include commitments to alter management of industrial fisheries for Sandeels in the North Sea. Sandeels are a small shoaling fish, vital to the health of marine ecosystems – they have been described as the most important forage fish in the North Sea, as they are key to the diets of seabirds, marine mammals and larger fish. Climate change is the main pressure on Sandeels, but industrial-scale fishing exacerbates declines. All the UK administrations have recognised that urgent measures are needed to protect the species and the wider marine ecosystem. Defra consulted on a closure of the English waters of the North Sea while Scotland has announced plans to consult on a closure of Scottish waters to Sandeel fisheries. In addition, Sandeel fishing off the North East coast of the UK has been halted since 2000[155].

> ***"The UK Fisheries Act 2020 aspires to enhance the sustainability of marine resources and protect ecosystem services while continuing to focus on economic considerations"***

Farmland and woodland

There have been criticisms of AES implementation in the UK. These criticisms concern insufficient monitoring of AES efficacy, and that the expected benefits for nature have not been realised[156]. Research is needed to test and improve AES management prescriptions, and assess whether interventions benefit target taxa on land directly under AES management, or mobile taxa that move onto the land as resources improve. Recent work has been undertaken to design an effective survey methodology to begin to meet these research needs[156].

The Future Agricultural Policy proposals in Northern Ireland suggest that over time the majority of funding will move from direct payments into the delivery of other measures such as the new 'Farming with Nature' AES. However, there have been significant delays to this programme and its fate is uncertain. Meanwhile, farmland birds continue to decline across Northern Ireland, with 35% of species now on the Red List of highest conservation concern. It is essential that a new scheme is appropriately funded in order to maintain the good that has been achieved through nature-friendly farming practices for priority habitats and species, whilst also increasing nature restoration at a landscape scale and across the wider countryside.

Since 2018 in England, the Department for Food, Environment and Rural Affairs (Defra) has been designing new domestic agricultural policies. They have reimplemented Countryside Stewardship, and introduced two additional schemes, the Sustainable Farming Incentive and Landscape Recovery[157]. The Sustainable Farming Incentive will fund practices to improve farm-level sustainability such as integrated pest management, soil stewardship and critical farmland wildlife resources such as seed and flower-rich areas. Landscape Recovery will fund large-scale land use change projects including woodland planting, and restoration of peatland, species-rich grassland and rivers to support species and biodiversity, address climate change, improve water quality and public access. This scheme is only in the pilot phase. Defra funded 21 landscape recovery projects in 2022 and plans to fund an additional 25 projects in 2023. This funding covers the project development phase, with successful projects expected to use private finance to co-fund the delivery phase.

UK countries are also now working to put in place agriculture and environmental legislation post-Brexit. For example, the ambitious Environment Improvement Plan target in England requires that 65 to 80% of landowners and farmers adopt nature-friendly farming on at least 10-15% of their land by 2030[122]. Reaching this target may be enough to halt species' declines in lowland landscapes[83]. Greater levels of AES provision would be necessary for priority and specialist bird species, and a greater area would likely be required in upland farming systems. Estimates suggest that between 36-50% of woodland bird populations need to be under Woodland Improvement Grant management to affect population trends[151].

Targets set under the Environment Act 2021 require that nitrogen, phosphorus and sediment pollution from farming will each be reduced by 40% by 2038, yet it remains unclear how action will be locally targeted and encouraged, and whether the reductions will be sufficient to enable the recovery of freshwater wildlife. Ultimately, the future of many species associated with farmlands and woodlands depends on the widescale adoption of nature (and climate) positive practices by land managers in all parts of the UK and a shift to more nature positive systems of farming and woodland management overall.

Protected areas

Target 3 of the Global Biodiversity Framework is the '30 by 30' target, which commits to protecting 30% of land and sea, a target to which all four UK governments have committed. This need not be via legal designation, but priority should be given to designating areas of particular importance for biodiversity and ecosystem functions and services.

Protected areas are legally designated and delineated sites where natural features including species and habitats are safeguarded and managed for the benefit of wildlife and people. Protected areas are a key pillar of nature conservation and recovery, and considerable global momentum has formed around their designation. The protected area target of the 2020 Aichi Convention on Biodiversity agreement was one of the few to be met, with countries collectively designating 17% of land and 10% of sea globally.

Crucially, protected areas should also be effectively managed, integrated into wider landscapes, equitably governed, and provide local communities with equitable access to benefits; all these factors are key to ensuring effective protected areas. Protected areas in the UK cover a range of protection levels and spatial scales including: a core suite of statutory nature conservation sites, small local community nature reserves, wide expanses of ocean marine protected areas, and landscape scale designations for cultural as well as natural heritage.

In this chapter we focus on protected areas designated primarily for nature conservation. We illustrate their extent and condition and review their impact on species and the wider benefits to people. We then consider the mix of protected areas and other areas managed for nature that may contribute towards meeting our '30 by 30' target.

Sand dunes, Ernie Janes (rspb-images.com)

Headlines

11% of UK land and freshwater is in conservation-focused protected areas and within this only 44% of the measured attributes of Areas or Sites of Special Scientific Interest are in favourable condition. 38% of UK marine waters are designated as protected areas. We currently lack a comparable comprehensive condition assessment for all UK marine protected areas.

On land, species are on average more abundant and species richness greater in protected areas, with some evidence of more positive population trends for species of conservation concern. Protected areas support habitat retention and restoration, providing climate change mitigation via carbon sequestration and climate change adaptation via, for example, flood management.

Work is ongoing (at different stages in different parts of the UK) to implement fisheries management across MPAs and to designate new protected areas, including Highly Protected Marine Areas. The UK governments' drive to reach the '30 by 30' target will see new areas designated for nature and people. Critically, as well as providing more space for nature these will need to be less pressured and meet the other Lawton principles of sites that are bigger, better and more connected.

Otter, Jules Cox (rspb-images.com); RSPB Langford Lowfields Nature Reserve, Malcolm Hunt (rspb-images.com); Gannet, David Tipling (rspb-images.com)

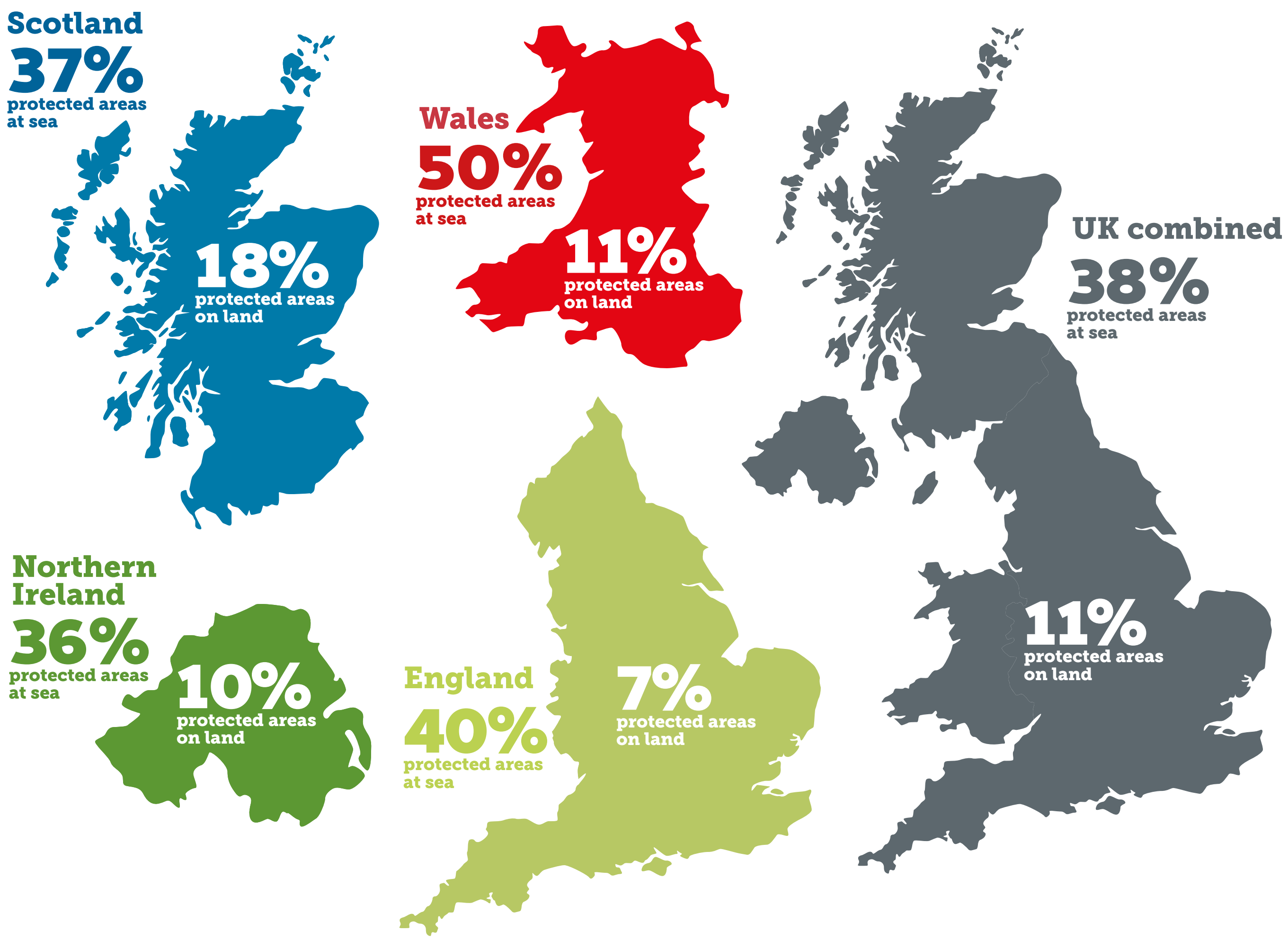
Action – extent and condition of protected areas

The UK has a variety of protected area designations. On land, the main site level designations for nature are Areas or Sites of Special Scientific Interest (A/SSSIs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Ramsar sites and National Nature Reserves (NNRs). Taken together, these sites cover 11% of UK land[158] (Figure 19A). In these sites the primary focus is on nature conservation, but other activities are permitted if they do not damage the natural features. National Parks and Areas of Outstanding Natural Beauty are landscapes designated for a range of purposes including conserving natural beauty, wildlife and cultural heritage; and providing opportunities for public enjoyment, understanding and recreation. Where there is conflict between purposes, conservation is supposed to take priority.

At sea, significant progress has been made in designating Marine Protected Areas (MPAs), including new Marine Conservation Zones and Nature Conservation MPAs, and the first Highly Protected Marine Areas (HPMAs) were identified in 2023. Together with marine-focused SPAs and SACs, designated sites now cover 38% of UK waters[158].

RSPB Mersehead Nature Reserve, Alan Coe (rspb-images.com)

A)



B)

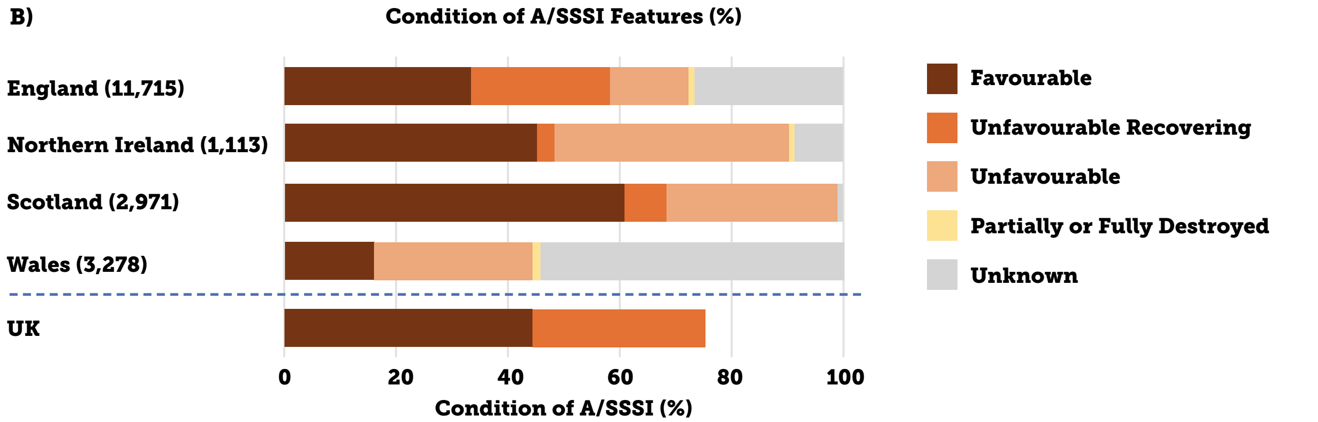


Figure 19: Protected areas in the UK. A) Extent of areas in the UK subject to a legal nature conservation designation on land and at sea, taken from UK Biodiversity Indicator C1, Tables C1i/C1ii[158]; includes A/SSSI, NNR, Ramsar, SAC, SPA, MCZ and ncMPAs. Source: jncc.gov.uk/our-work/ukbi-c1-protected-areas. B) For the UK, the percentage of area (England) or features (Scotland, Wales and NI) of biological A/SSSIs in Favourable or Unfavourable recovering condition in the UK taken from UK Biodiversity Indicator C1: Protected Areas. The country results are weighted by the area of the A/SSSI network present in that country before combining. For each UK country a summary of the condition of terrestrial and freshwater biological A/SSSI features in each country. The total number of features is given in brackets in each case. Summary information was downloaded (England, NI), or the condition dataset downloaded and summarised (Scotland, Wales) from country statutory agency websites[159-162]. Please note the baseline SSSI assessment for Wales does not include the category 'Unfavourable Recovering'.

Currently, less than half of the area or monitored features in UK A/SSSIs are in 'favourable' condition (Figure 19B). A further third are assessed as 'recovering', although some features may take many years to reach 'favourable' status. At a UK level, there has been a substantial increase in the proportion of A/SSSIs in 'unfavourable recovering' condition since 2005, but a small decline in the proportion in 'favourable' condition in the past few years[158]. In part, this is because many of the pressures impacting designated sites originate from the wider landscape and landowners or site managers cannot easily address them. For example, pollution from agriculture and sewage overflows results in poor water quality affecting designated freshwater habitats. Natural England reported in 2019 that 89.7% of SSSI river units were in unfavourable condition and NRW found in 2020 that 60% of SSSI freshwater biodiversity features were unfavourable. This highlights that, in addition to site-level actions such as habitat management, strong policies are needed to manage off-site impacts like pollution or invasive non-native species if the condition of designated sites is to be improved.

The condition of terrestrial A/SSSIs, SPAs and SACs is assessed using Common Standards Monitoring in most UK countries. Monitoring in Wales previously concentrated on SAC features, but a more comprehensive assessment of SAC, SPA and SSSI feature condition was recently published[160]. However, information for 51% of sites was insufficient to make an assessment.

Many sites elsewhere in the UK have not been assessed recently either; for example, 78% of English SSSIs have had no site visit between 2015 and 2021.

We do not currently have a comprehensive condition assessment for MPAs, partly as many were only recently designated. At the UK level in 2021, 11% of MPAs had full monitoring in place, and 75% had partial monitoring, which may focus on features at higher risk[164]. In Wales, marine site-level feature condition assessments in 2018 reported 46% of features were in favourable condition, 45% in unfavourable condition and 9% were unknown[163]. The logistical difficulties and expense of monitoring makes it challenging to assess the impact of management and determine whether sites are moving towards their objectives. Monitoring offshore (more than 12 nautical miles) MPAs is particularly resource intensive, making full regular condition assessments difficult to achieve.

Before 2022, few offshore MPAs had fisheries management in place to reduce disturbance to vulnerable habitats, with management focused on a small number of sites supporting the most vulnerable habitat features or in deep water areas.

Bottom-trawling using mobile gear can be particularly damaging to habitats such as bivalve reefs[165,166], in some cases altering the entire composition of ecosystems and the functions they provide. Between 2015 and 2019, bottom-trawling was still evident at 98% of offshore sites designated to protect the seabed[167].

Although over three-quarters of UK MPAs had management partially or fully documented in 2018, this had only been fully implemented in 10% of sites[164].

Impact – species and habitats

Here, we consider evidence from the UK and ask, do UK protected areas support more species, at greater abundances, than the wider land or seascape, and do they support species' recovery?

Do protected areas on land contain more species or greater abundances of species?

Across a suite of over 1,200 invertebrate species, (including ants, bees, hoverflies, ladybirds, spiders, and wasps), an average of 30 more species were found in 1 km squares with high levels of protection compared to unprotected areas[103]. Similarly, 48% of bird species had a greater likelihood of occurrence and higher abundance as the extent of protected areas in the surrounding area increased[168]. There is good evidence that these trends are stronger for rarer species and habitat specialists; for example, protected areas held almost double the number of rare invertebrate species compared to unprotected areas[103,168]. Each additional 20% coverage by protected areas in a landscape equates to 5% greater abundance of birds of higher conservation concern[102].

Although the patterns of higher species richness or abundance in protected areas may be explained by historically greater losses in unprotected areas, protected areas are generally sited in nature-rich areas[169,170]. English landscapes containing protected areas have a higher representation of priority species compared to unprotected landscapes[171]. Similarly, an NRW assessment found that in general species assessed as threatened on Great Britain's Red Lists were well represented in Welsh Protected Areas. For example, more than 80% of Red List bryophyte and lichen species had at least one population in a SSSI, and most have their entire Welsh population protected[172,173]. Welsh SSSIs support 234 threatened invertebrate species, which result in 545 single-species features, and 93 nationally important invertebrate assemblages. 53% of IUCN threatened species recorded from Wales are represented as SSSI features[174]. At the UK level, there is some evidence that globally threatened species are less well represented across protected areas, with only 31 of 187 globally threatened species listed as notification features for A/SSSIs. However,this may reflect the timing of the threat assessment relative to site notification, or simply lack of survey data for these species at the time of notification[175].

> ***"Between 2015 and 2019, bottom-trawling was still evident at 98% of offshore sites designated to protect the seabed[167]"***

Does protection lead to more positive population trends?

While there is compelling evidence that protected areas are richer in nature, evidence regarding species trends is more mixed. In some cases, protected areas do lead to positive population trends. For example, trends for bird species of conservation concern are more positive when there is a high coverage of protected areas in the surrounding area[102]. Similarly, sites designated for a target species group, for example SPAs for birds[168] or SPAs and Ramsar sites for wetland birds[176], have stronger positive associations with both current abundance and increasing trends in abundance.

> ***"Trends for bird species of conservation concern are more positive when there is a high coverage of protected areas in the surrounding area"***

While protected areas are associated with higher probabilities of occurrence for rarer, declining or habitat specialist birds, protection does not completely halt declines in abundance[168]. Recent trends in invertebrate species' distribution have contracted at a similar rate in both protected and unprotected areas, even across a subset of rarer species[103]. Likewise, for a range of plants and animals, trends in declining and priority species are on average similar in landscapes with and without protected areas[171]. The extent to which population declines reflect site-level issues, or drivers that lie beyond site boundaries (eg, climate change, diffuse pollution), is uncertain.

Impact of Marine Protected Areas

Compared with terrestrial protected areas, we do not currently have the same level of understanding of the impacts of UK MPAs on the occurrence and status of species and habitats. Monitoring and management of MPAs are currently seldom fully implemented[164], and enforcement is challenging. However, many MPAs are subject to the Habitats Regulations, and all activities that need a marine licence (which excludes fishing) must undergo a Habitat Regulations Assessment. Regulation of fishing activities that affect habitats and species, benefits the entire MPA, allowing both commercially exploited species and broader assemblages, particularly benthic communities, to recover. Lyme Bay, with its species-rich, disturbance-sensitive reef habitats[177], is one of the most thoroughly studied MPAs in the UK. Trawl fisheries have been excluded from the 200 km^2 site since 2008 and the area is managed in a collaboration between the local fishing industry and conservationists to provide benefits for both fishing and conservation. A decade after the trawling ban, benthic communities, fish and invertebrates have all benefited. The number of species and the diversity of ecological functions they represent increased markedly in the protected area but remained static in control sites[178]. While the diversity and abundance of commercially exploited fish species increased in all sites, it was to a greater extent within the MPA[179].

In 2022 bylaws were passed to regulate fisheries in four offshore MPAs in England[180]. The most extensive of these is Dogger Bank: covering 12,331 km^2, the largest continuous expanse of shallow sandbank in UK waters, home to amphipods, Hermit Crabs, Starfish and importantly Sandeels, a key food for many other fish, seabirds and cetaceans[181]. An average of 623 hours of trawl fishing effort per km^2 per year occurred in Dogger Bank between 2015 and 2019[167]. Now trawl fishing is prohibited across the entire site. In the six months following the bylaw introduction, only 13 hours of fishing were recorded[182]. A programme is underway to instigate fisheries management measures in all English MPAs by the end of 2024. In Scotland, 27 MPAs already have specific fisheries measures in place, and measures for a further 39 MPAs will be developed by 2024, in partnership with the fishing industry, other stakeholders, and other European countries.

New measures are also being developed to protect biodiverse habitats such as seagrass, maerl and flame shell beds at key coastal biodiversity locations.

> ***"A programme is underway to instigate fisheries management measures in all English MPAs by the end of 2024"***

Sea bed at Lyme Bay, Dr Emma Sheehan

Impact – people and planet

Carbon and protected areas

Healthy ecosystems generate many benefits for people: providing sources of food, income for local communities and opportunities for recreation. Critically, they also provide cost-effective climate change mitigation through carbon capture and storage, and help with adaptation to climate impacts such as reducing the impact of storms, flooding or coastal erosion.

Across nature-rich terrestrial habitats, 47% of carbon stocks are found within existing protected areas[183]. Restoring degraded sites in the network will protect carbon stocks and, in some cases, increase them via sequestration[184]. In marine environments, MPAs offer not only a route to restore habitats, species and functioning ecosystems, but can also contribute substantially to climate change mitigation if they protect and effectively manage 'blue carbon' stores[185,186]. Recent estimates suggest that around 200 megatonnes of carbon are stored in UK shelf sediments[187].

> ***"The English North Sea MPA network holds more carbon stocks and provides greater sequestration than non-designated areas"***

In the English North Sea the MPA network holds more carbon stocks and provides greater sequestration than non-designated areas; 46% of stored carbon and 43% of carbon sequestration occurs within MPAs, with 2.5% of the UK's total blue carbon found in Dogger Bank[188].

Future – how to reach our protected areas targets?

A key question is how to best expand the current protected area network and ensure that they and other nature-rich sites are managed effectively to meet the new global target of '30 by 30'.

The expanded network needs to include species and habitats of conservation concern that are not yet covered by protected areas. For example, UK MPAs do not include any SPAs for Balearic Shearwater, despite a quarter of the global population using British waters during migration and foraging. The species is globally Critically Endangered due to increasing pressures from bycatch in fishing gear, declines in fish prey and offshore energy developments[189,190].

Designations like Highly Protected Marine Areas (HPMAs) are designed to achieve full ecosystem recovery. The first three HPMAs in England were designated in July 2023, in total covering nearly 1,000 km². A consultation on HPMAs in Scotland took place in early 2023.

Protecting 30% of the UK's land and sea for nature by 2030 will require a mix of protected areas and Other Effective Area-based Conservation Measures (OECMs; Box 1); areas where management benefits biodiversity, even if conserving nature is not the primary objective. Flexibility in the network will be key, as climate change may reduce the suitability of existing protected areas, leading to decline or extirpation of target species.

There is strong evidence that terrestrial protected areas help colonising or range-shifting species, something that is becoming commonplace in a changing climate. There is a positive association between protected area extent and colonisation of new areas by birds, and protected areas are more likely to be colonised by locally-novel pollinator species compared to unprotected areas[103]. Hence protected areas will be vital for nature in the future, even if the species and habitats they support change over time. To support climate adaptation, new protected areas should include both current climate refugia and the likely future climatic niches for species and habitats. New sites should be well connected to the existing network.

> ***"The first three HPMAs in England were designated in July 2023, in total covering nearly 1,000 km²"***

Box 1

Other Effective Area-based Conservation Measures (OECMs) are defined by the IUCN as 'A geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the *in situ* conservation of biodiversity with associated ecosystem functions and services and, where applicable, cultural, spiritual, socio–economic, and other locally relevant values'[191]. Hence, they should achieve positive biodiversity outcomes, even though biodiversity conservation may not be their primary objective. Alongside protected areas, OECMs have a role to play in delivering the '30 by 30' target in the new CBD Global Biodiversity Framework.

OECMs have been applied in situations where biodiversity outcomes are already being delivered through inclusive approaches. They are yet to be used on land in the UK but may be relevant to long-term management and restoration efforts driven primarily by carbon or water objectives that can also measurably benefit biodiversity. Six potential OECMs have been suggested in UK waters, including the Irish Sea cod box[164]. As with protected areas, long-term protection, and effective management and monitoring will be crucial if UK OECMs are to count towards the '30 by 30' target.

Ecosystem and habitat restoration

Target 2 of the Global Biodiversity Framework commits to ensuring that 30% of degraded habitats are under effective restoration by 2030 and to restore, maintain and enhance nature's contribution to people, through ecosystem-based approaches and nature-based solutions (NbS) to climate change.

The global biodiversity crisis is driven by a range of anthropogenic pressures and the UK in particular has experienced significant habitat loss, change and degradation during the last century[192]. Against this context, recent decades have seen a growing appreciation of the wider value of habitat or ecosystem resilience, and the importance of ecosystem services[193]. Both global and national policy initiatives are encouraging restoration and protection of natural and semi-natural habitats[194-196].

Nature-based solutions involving ecosystem restoration can provide important co-benefits for nature and people, including flood alleviation, improved livelihoods and biodiversity conservation[184]. Restoration should therefore help ecosystems become more resilient and enhance biodiversity, which in turn should enable more effective species conservation.

Ecosystem restoration holds the potential to enhance biodiversity, ecological function, and ecosystem services. When the pressures on an ecosystem are reduced, restoration can occur naturally. It can also be managed and applied at scales from local (eg, 0.25 ha[197]) to landscape (eg, 250,000 ha[198]) and in environments as varied as urban[199], marine[201] or upland forest[202]. It can be challenging to decide on a specific goal or end-state for restoring an ecosystem; however, there is increasingly a move away from attempting to preserve ecosystems as static entities and a shift towards actions enabling better adaptation to changing climatic conditions and other external pressures.

This chapter illustrates the extent, condition and rate of restoration of ecosystems where possible and discusses the impact of restoration across a broad suite of ecosystems.

Headlines

Restoration is taking place across a wide range of ecosystems, with more than 5,000 ha of degraded peatland being restored each year. Despite this, only 14% of priority habitats assessed are in good condition and only 7% of native woodland and 25% of peatlands are in good ecological status. Good Environmental Status has not been achieved for seafloor habitats and is uncertain for intertidal and soft sediment marine habitats.

Ecosystem restoration projects are underway and can improve species' abundance and enhance biodiversity. Restoring natural ecosystems can improve human wellbeing and aid adaptation to the effects of climate change.

The rate of ecosystem restoration must increase to meet the agreed nature and climate targets, although the full benefits of some restoration projects may not be realised for decades or centuries. Restoration projects co-developed locally are likely to lead to better outcomes for both people and the environment.

Celtic rainforest woodland habitat, Ben Andrew (rspb-images.com);
RSPB Radipole Nature Reserve, Mike Read (rspb-images.com);
RSPB Geltsdale Nature Reserve, Luke Blazejewski (rspb-images.com)

Beavers, Beaver Trust (rspb-images.com)

Action – condition of ecosystems and extent of restoration

Here we present data on the extent and condition of a range of terrestrial and marine UK habitats. Reduction in anthropogenic pressures and restoration of these habitats would have significant potential benefits for nature and climate. 44% of UK woodland is under sustainable management certification[203], and 7% of British woodland was in good ecological condition at the last assessment undertaken between 2010 and 2015[125]. Less than half of UK saltmarsh[204] and a quarter of peatland are in good ecological condition[206]. At the current restoration rates, only a small additional extent of peatland and saltmarsh will be in good condition by 2050 (Figure 20). None of the marine regions assessed in 2018 met the Good Environmental Status (GES) target of less than 15% of the seafloor subject to high levels of fishing-related disturbance (Figure 21)[205]. GES was also uncertain for intertidal and soft sediment habitats during the last assessment in 2018[200].

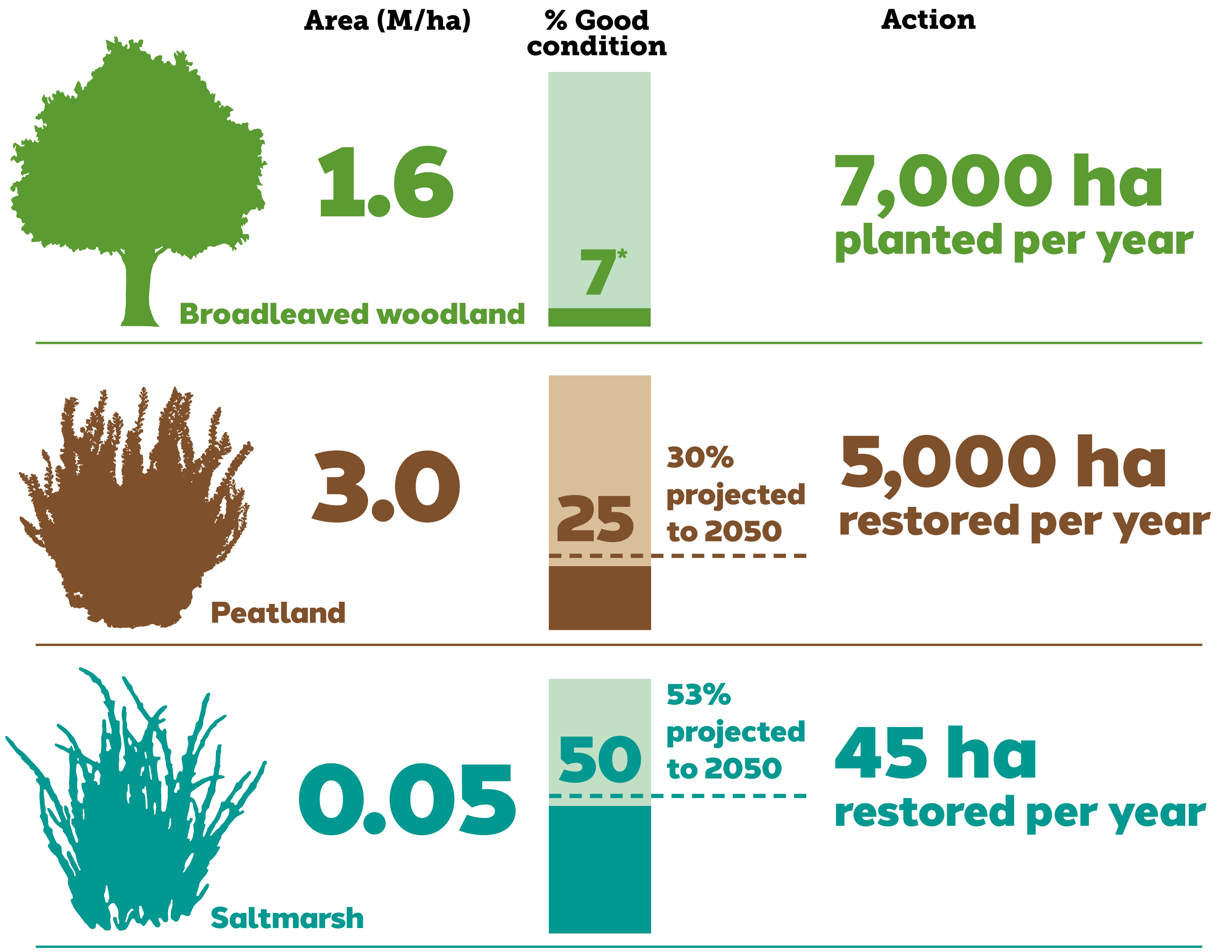
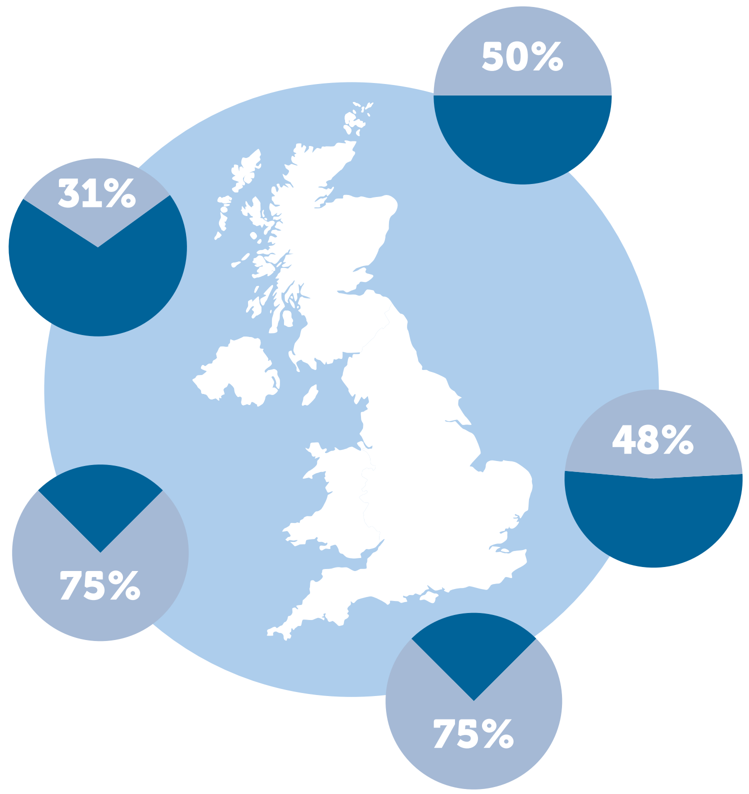


Figure 20. The extent, condition and rate of recovery or creation of select habitats on land. Woodland: extent and rate of planting[203], and condition[125]; Peatland extent, condition and rate of recovery[206,207]; Saltmarsh: extent and rate of recovery[208], and condition[204]. *Woodland condition figure covers all native woodland.

Progress against the UK target was assessed in sub-divisions of each UK Marine Strategy Framework Directive sub-region (the Celtic Seas and Greater North Sea); and in UK waters in adjacent OSPAR regions (see Figure 21)[205]. An updated OSPAR assessment will be published in 2023.

The Article 17 Habitats Directive report collated data on 77 UK habitats of European importance. These are habitats considered to be rare, endangered or vulnerable in Europe[204]. The majority of the UK's habitats of European importance are marine (51%) by area, which reflects the country's significant proportion of marine territory compared to land area. The remainder comprise wetlands (26%), heathlands (15%), woodlands (3%), grasslands (2%), with freshwaters, coastal areas and rock (1%). Of these, 77 assessed habitats, 62 are in unfavourable to bad condition, eight inadequate and only six in favourable condition. Here, unfavourable to bad condition refers to a habitat that has undergone major negative changes in structure or function and/or quality[209].



Assessment area		% area of cells predicted to be exposed to disturbance categories 5-9	Assessment against target (<15%)
UK Marine Strategy Framework Directive sub-region	sub-division		
Celtic Seas	Southern Celtic Seas	75	Not achieved
	Nothern Celtic Seas	31	Not achieved
Greater North Sea	Southern North Sea	48	Not achieved
	Northern North Sea	50	Not achieved
	English Channel	75	Not achieved

Figure 21: **Percentage of seafloor predicted to be subject to higher levels of disturbance (category 5-9) by fishing[205]**
Source: UK Marine Monitoring and Assessment Strategy 2018, adapted from OSPAR Intermediate Assessment 2017.

Impact – species and habitats

There are many ecosystem restoration initiatives in the UK including woodland, grassland, saltmarsh and marine habitats. In this section, we consider the impacts such restoration projects have on the species that live there.

Woodland

Woodland restoration can involve a range of measures including planting or fostering natural regeneration of native tree species, reducing excessive grazing and browsing pressure from livestock and deer, eradicating or controlling invasive non-native species such as *Rhododendron ponticum*, and thinning or coppicing to open the woodland canopy.

Examples of restoration projects include: the National Forest for Wales; the Heart of England Forest, which aims to create a continuous 12,000 ha woodland across Worcestershire and Warwickshire; the Celtic Rainforest along Britain's Atlantic coastline; the Woodland Trust seeking to treble the area of native woodland in favourable ecological condition by 2030[112]; and the Caledonian Forest Restoration Project, which aims to restore the ancient woodland of the Scottish Highlands. Woodland restoration has positive impacts on a variety of UK species. For example, diversifying woodland structure and age, increasing the proportion of native tree species, and increasing the area of canopy openings can benefit bird species such as the Willow Warbler, Marsh Tit and Redstart[151]. Coppicing in native woodlands and clear-felling small areas in commercial woodlands can increase butterfly diversity and abundance[210]. However, restoration schemes must balance the requirements of species aided by increased management with those that benefit from a minimum intervention approach. For example, woodland thinning promotes common and adaptable bat species, but rarer species need old-growth woodland features such as standing dead trees and cavities[211].

Grassland

In the UK, grassland restoration for conservation involves a range of techniques and management strategies to improve habitat quality including: sowing native grass and wildflower seeds, controlled grazing, invasive species control, and scrub clearance and tree removal. These techniques have positive impacts on a range of species, including birds, insects, and plants. For example, allowing natural regeneration of grasslands or sowing grass and wildflower seeds into arable fields in southern England improved moth abundance and species richness[212]. Similarly, restoring landfill sites to grasslands and then managing them by mowing or grazing benefits a variety of bird communities[213]. Lapwing, Redshank and Curlew populations all benefit from the restoration and management of lowland wet grassland by encouraging natural hydrological conditions and processes (sometimes supported by the use of dams and weirs), maintaining swards through seasonal grazing and mowing, and by mechanically removing shrubs and trees to remove perches for avian predators[214].

Intertidal and marine habitats

A recent report identified opportunities for the restoration of six marine and coastal habitats and species in Wales: intertidal mudflats, coastal saltmarshes, seagrass beds, Horse Mussel beds, Honeycomb Worm reefs, and Native Oyster habitats[215]. The report outlined various restoration management techniques, including transplanting and seeding of vegetation, removal of invasive species, and installation of artificial structures. This would have several positive impacts, including provision of supporting habitat for a variety of flora and fauna, increased fish populations, and improved water quality through the removal of pollutants and nutrients. Restoration is expected to promote natural hazard regulation and increased resilience, as intertidal and shallow subtidal habitats attenuate waves, reducing erosion at the coast and expenditure on coastal defence infrastructure[215].

Saltmarshes provide valuable habitat for a wide range of plant and animal species. Restoration techniques include managing grazing pressure, removing invasive species and managed realignment. Saltmarsh systems are particularly important for hosting nationally and internationally important bird species, providing resources and habitat needed for breeding, wintering and migratory staging, sometimes supporting huge populations of wintering wildfowl[208]. In the UK, saltmarshes also play an important nursery role for some species of fish, including several commercially important species[216]. In addition to these biodiversity benefits, restored saltmarshes provide important ecosystem services, including coastal protection and carbon sequestration.

Case study:


RSPB Wallasea Island Nature Reserve, David Wootton (rspb-images.com)

Wallasea Island

The Essex coast in south-east England has lost 91% of its intertidal salt marsh in the last 400 years due to land claims for agriculture, increasing coastal erosion and sea-level rise. Wallasea Island was enclosed in sea walls and used for grazing marsh until it was drained and converted to arable land in the 1930s. Between 2009 and 2016, the Environment Agency and the RSPB undertook a managed realignment on the site to restore intertidal habitat, creating more space for sea water in the estuary. More than 3 million tonnes of earth were brought by boat from the tunnels of a large rail infrastructure project in London to help create a 115 ha intertidal area of saltmarsh, islands and mudflats. The reserve covers more than 740 ha, two-thirds of which have now been transformed from arable farmland to saltmarsh, mudflats, lagoons and grazing marsh. Wallasea Island is now a wildlife-rich habitat and a popular site for people to visit, with 30,000 visitors in 2020[405].

Impact – people and planet

Urban ecosystem restoration

Biodiversity, tree cover, clean air and clean water are threatened in UK urban areas[217,218]. Connection and access to nature for urban citizens is unequal and diminishing. Evidence shows access to good quality greenspaces varies greatly depending on where we live, and that the most economically deprived areas often have less accessible public greenspace[219]. Ecosystem restoration in urban environments faces multiple challenges in terms of land use and urban planning, including knowledge gaps leading to obstacles in evidence-based implementation as well as regulatory and financial barriers that hinder buy-in[220,221].

> *"In 2022, 93% of participants surveyed who took part in activities in Tiny Forest said it made them feel refreshed and revived. 97% said they felt close to nature"*

Case study:


Black Mountain Primary Tiny Forest
© Earthwatch Europe

Earthwatch Europe, Tiny Forest

The Tiny Forest movement is a novel urban greenspace intervention, where a diverse mix of 600 native trees and shrubs are planted in a 200m² area, following the Miyawaki method developed in the 1970s in Japan.

Earthwatch Europe has planted a network of over 200 Tiny Forests across the UK since 2020 with partners, communities, businesses and schools. The aim is to ensure Tiny Forests are for everyone and seek, where possible, to plant Tiny Forests in areas of multiple deprivation (currently 50% of Tiny Forests in England are in the most deprived 30% of areas[222]. Tiny Forests provide access to nature and unique learning opportunities about ecosystem services and biodiversity provided by trees.

Communities are engaged in planting, looking after, and monitoring the forests for environmental and social benefits provided by trees. Nearly 3,500 citizen scientists took part in surveys in 2022 across 80 Tiny Forests[223] investigating carbon storage, flood management, thermal comfort and invertebrate biodiversity. A network of citizen science volunteers and university academics are increasing knowledge and understanding of tree planting methods in small, underused sites in urban areas most in need of improved greenspace for people and wildlife. 93% of participants surveyed who took part in activities in Tiny Forest in 2022 said it made them feel refreshed and revived, while 97% said they felt close to nature.

Ecosystem restoration as a nature-based solution to climate change

Ecosystem restoration on land and at sea can be an effective nature-based solution to climate change, offering a myriad of benefits to people and the planet. The Nature, Climate and People chapter of this report covers diverse nature-based solutions for a range of habitats, but here we highlight ecosystem restoration of peatlands as a key opportunity for nature-based solutions. UK peatlands include blanket bog, raised bog and fenland habitats, with blanket bog covering 12% of the UK's land area, representing 10-15% of the global extent of this habitat. This includes the Flow Country in North Scotland, the largest and most intact blanket bog in Europe. Peatlands are the largest terrestrial carbon store in the UK. While near-natural peatlands are a significant store, and ongoing sink, for carbon, degraded sites release carbon and thus contribute to climate warming. Three-quarters of UK peatlands are damaged or degraded by a range of pressures, including acidification from nitrogen deposition, overgrazing, burning, draining, and afforestation with commercial timber plantations. National funding from Scotland and Wales' National Peatland Action Programmes, and England's Nature for Climate fund is supporting peatland restoration at large scales, including by 'Moors for the Future' in the Peak District and 'Cooperation Across Borders for Biodiversity' in the Garron Plateau SAC in County Antrim.

> *"Initial results from blanket bog restoration suggest the water table is rising, and invertebrates and bird assemblages are gradually converging with those found in natural bog"*

Case study:


RSPB Forsinard Flows Nature Reserve, RSPB (rspb-images.com)

RSPB at Forsinard National Nature Reserve

Work in the Flow Country includes restoration projects by the RSPB at Forsinard NNR over the last 25 years, which included felling 2,593 ha of non-native forestry with the aim of restoring natural bog habitat[224]. Using large-scale trials, the RSPB has tested new felling and drain blocking techniques, trialling and implementing the best restoration practices. Initial results suggest the water table is rising, and invertebrate and bird assemblages are gradually converging with those found in natural bog. Near-natural and restored peatlands not only store carbon but also help maintain water quality and aid in flood management, by slowing runoff during storm events. Quantifying these benefits to people can be difficult, as valuations are influenced by many different factors such as habitat connectivity, and hydrological benefits are highly dependent on circumstances throughout the catchment. The Flow Country is currently under consideration for World Heritage status, which could bring significant social, cultural and economic benefits to the area.

Future – what is restoration aiming for?

Ecosystem restoration works for wildlife, people and as a tool for climate change mitigation. However, restoration can be a lengthy process with outcomes dependent on multiple factors. In some cases, projects may produce noticeable results within a few years, but in many cases, it may take decades or even centuries to secure all the benefits of restoration. The timescales involved in restoration efforts can make it challenging to monitor progress, and this has important implications for policy. Restoration projects need long-term planning and investment, as well as adaptive management strategies that allow flexibility in approach if progress stalls. There is still much to learn about the most effective approaches to restore functioning and resilient ecosystems, and there are many viewpoints on how best to achieve this, including the much-debated concept of rewilding. Some of these knowledge gaps can be addressed with large, long-term restoration projects such as in Cairngorms Connect in Scotland.

Critically, the current monitoring and reporting of habitat condition in the UK is insufficient to enable the UK government to ascertain whether it is on track to meet its statutory targets. Although information on habitat quality and restoration rates is incomplete, current rates of restoration are inadequate to restore 30% of degraded habitat by 2050. To meet the interim 2030 target of 30% of degraded habitat under effective restoration, it is essential to work more closely with local people who live or work near the habitats or landscapes under restoration. If a shared restoration plan is co-developed between local people and practitioners, it is likely to lead to better outcomes for both people and the environment[225].

Case study:


Red Squirrel, Ben Andrew (rspb-images.com)

Cairngorms Connect

Cairngorms Connect is the UK's largest habitat restoration project, covering 60,000 ha in the Cairngorms National Park. This is a long-term ecological restoration project with a 200-year timeframe, which aims to restore habitats such as native woodland, peatlands and rivers. Neighbouring landowners have united over a shared vision for landscape restoration, including collaborative deer control that enables native woodland to regenerate. As a result, there has been a marked expansion in the area of native woodland, including species palatable to deer such as Birch and Aspen. There are early signs that this is benefiting woodland-associated species, including birds such as Willow Warbler and moths such as Coxcomb Prominent and Lesser Swallow Prominent.

One of the key aspects of Cairngorms Connect is its focus on involving and collaborating with local people. Engaging with local communities is key to achieving conservation goals and ensuring local people benefit from the project. Cairngorms Connect works closely with local communities, including farmers and landowners, to develop conservation plans and initiatives that are compatible with their needs and interests. The project also provides opportunities for local people to participate in its conservation efforts through volunteering and citizen science programmes. These help to build a sense of ownership and pride in the local environment, while increasing public awareness of conservation issues.

The concept of rewilding

The idea of 'rewilding' has become increasingly prominent in UK conservation in recent decades. It can also be controversial, provoking a range of reactions, including among farming communities and other rural stakeholders[226]. While useful attempts have been made to provide a unifying definition of rewilding [eg,[227]], it remains a contested concept that is applied to a wide variety of different practices – not least in the media[228]. These range from large-scale habitat restoration and species reintroductions and other conservation translocations to the greening of urban spaces. This variety has led some to argue that the term 'rewilding' does not carry significant meaning, or that it is indistinguishable from other forms of ecological restoration[229]. Despite overlap, however, most definitions of rewilding are characterised by shared underlying principles. Carver et al.[227] define these as follows:

1. Rewilding utilises wildlife to restore trophic interactions.
2. Rewilding employs landscape-scale planning that considers core areas, connectivity, and co-existence.
3. Rewilding focuses on the recovery of ecological processes, interactions, and conditions based on reference ecosystems.
4. Rewilding recognises that ecosystems are dynamic and constantly changing.
5. Rewilding should anticipate the effects of climate change and where possible act as a tool to address impacts.
6. Rewilding requires local engagement and support.
7. Rewilding is informed by science, traditional ecological knowledge, and other local knowledge.
8. Rewilding is adaptive and dependent on monitoring and feedback.
9. Rewilding recognizes the intrinsic value of all species and ecosystems.
10. Rewilding requires a paradigm shift in the coexistence of humans and nature.

While these principles are not universally applied, they outline characteristics common to most conceptions of rewilding: an emphasis on dynamic processes rather than static assemblages of species; a focus on increased spatial scale to enable large-scale processes to take place; lower levels of ongoing human management of ecosystems; an increased tolerance of uncertainty, enabling and accepting unexpected outcomes; and an acceptance that people and communities should be at the centre of rewilding approaches.

Nature, climate and people

Our response to the biodiversity and climate crisis cannot be separated from the multitude of ways people use our land and sea. As a society we must integrate our responses to the full set of international and domestic nature targets, whilst addressing the impacts of climate change and reducing future emissions, and providing the food, fuel and health benefits we derive from nature.

These needs are acknowledged in the Global Biodiversity Framework, which includes targets to: i) ensure that all areas are under biodiversity-inclusive spatial planning (Target 1); ii), minimise the impact of climate change on biodiversity and increase its resilience, adaptation and mitigation including nature-based solutions (Target 8) and; iii) increase the quality of, and access to, green and blue spaces close to people (Target 12).

Simultaneous achievement of these multiple goals is not straightforward, requiring an evaluation of the benefits and costs associated with each action. Moreover, action we take domestically could lead to unintentional impacts on nature overseas. An example of this 'offshoring' would be importing food from highly biodiverse landscapes in other countries as a consequence of nature consevation measures implemented in the UK. Here we explore how these multiple goals interact with three examples: at sea, considering the role of marine spatial planning in balancing climate mitigation and nature restoration; in urban environments, looking at how the health and wellbeing benefits of natural spaces relate to biodiversity; and on land, examining the implications of land-based climate change mitigation and adaptation for climate, nature and food production.

Headlines

In addition to committing to the Global Biodiversity Framework, all UK governments have made legally binding targets to reach net-zero by 2045 or 2050, with associated ambitious targets for tree planting and renewable energy generation. Targets have also been set, in some places, to increase people's access to quality natural spaces.

Major increases in renewable energy capacity include a UK target for 50GW from offshore wind power by 2030. Robust spatial planning is critical to protect and restore nature at the same time. Nature is vital for human health and wellbeing but access is unequal and the attributes of natural spaces that provide these benefits are not fully understood.

Land-use scenarios suggest that wildlife is likely to benefit from maximising nature-based solutions to achieving net-zero in the land sector, but that there will be trade-offs with current food production priorities and other land-uses.

Dove Gardens community garden initiative, Rob Carmier (rspb-images.com); Windmill offshore of Blyth, Andy Hay (rspb-images.com); Tractor tour, Ben Andrew (rspb-images.com)

Offshore wind farm, Ben Andrew (rspb-images.com)

Action – extent of anticipated land and sea-use change

In addition to committing to the post-2020 Global Biodiversity Framework, all UK governments have made legally binding targets to reach net-zero by 2045 (Scotland) or 2050 (the rest of the UK)[230-232,409]. Meeting this goal requires mitigation to reduce further greenhouse gas emissions. However, responding to climate change also includes adaptation, which involves coping with, and preparing for, the impacts of current and future climate change. Both adaptation and mitigation will entail substantial land and sea-use change (Figure 22).

Adaptation efforts can include restoring natural processes, such as river basin management to reduce flooding and storm damage. For wildlife, adaptation involves providing a resilient network of natural habitats, with more, larger, and better-connected sites, to accommodate the inevitable range-shifts driven by climate change alongside preventing the spread of invasive non-native species.

Land-based mitigation efforts focus on restoring carbon-rich habitats, such as peatlands, and creating habitats, particularly woodland (Figure 22). The impacts of woodland creation for both climate and nature will also vary over decades and centuries as woodland matures, and depend on a range of factors, such as the tree species involved, the soil types, the level of ground disturbance, whether forest expansion is via planting or natural regeneration[233] and what habitats are being replaced to make space for trees[233-236].

Other mitigation efforts involve changes to electricity generation, and the UK is committed to a vast increase in renewable energy capacity (Figure 22). Through the British Energy Security Strategy[237], the UK Government announced an ambition for 50GW of energy from offshore wind by 2030, representing a near fivefold increase across the course of this decade. Further expansion is likely beyond 2030, with the Climate Change Committee recommending a further doubling of capacity by 2050[238].

RSPB Haweswater Nature Reserve, RSPB (rspb-images.com)

Tree planting targets (ha per year)

UK 30,000 increase tree cover from 13 to 17% by 2050*[239].

England 7,200 (to 2042**)[240]

Scotland 14,000[244]

Wales 5,000***[246]

Northern Ireland 900[247]

Offshore wind capacity target (GW)

UK Increase from 11 to 50 GW by 2030[237]

Scotland Increase from 2.2 to 11 GW[245], and Scottish Government currently consulting on further increases

Wales Generate electricity equal to 70% of consumption from renewable sources by 2030[406]

Northern Ireland Increase from 0 to 1 GW; 80% of consumption by 2030[248]

Access to nature

England Everyone should live within a 15-minute walk of green or blue space[241]

Scotland Increase the proportion of adults who live within a five minute walk of their local green or blue space[242]

Wales No one should live more than a six-minute walk (300m) from their nearest natural green space[243].

Northern Ireland Draft Biodiversity Strategy proposes that by 2050, 90% of households have publicly accessible quality natural space of more than 2 ha within 400 m of their home and at least one site of more than 20 ha within 2 km[410].

Figure 22: Targets for tree planting, offshore wind energy capacity and people's access to nature, for the UK and UK countries. Not all countries have a target in each area.
* The UK country commitments do not currently sum to the UK total. Figures cover all types of forest, including plantation forestry.
** Full target is 180,000 ha over 25 years.
*** Full target is 43,000 ha of new woodland by 2030, and 180,000 ha by 2050.
† The target relates to energy generation across all renewable sources, not only offshore wind.

These shifts in land and sea usage are in the context of a UK human population predicted to grow by four million by 2050[249], with an increased proportion of people living in towns and cities. Population changes necessitate substantial house building targets and targets for increased access to local natural spaces, making urban greening a priority. This is important for people, but also for nature, as well-designed natural spaces in towns and cities support animal dispersal across the landscape.

Impact – species and habitats

Offshore wind and marine spatial planning

The UK and devolved governments have set ambitious but necessary targets for renewable energy generation, with a very large proportion met by offshore wind (Figure 22). Meeting these targets is critical for nature and people, given the extensive and increasing ecosystem-level impacts of climate change, including in the marine realm[250]. However, poorly planned offshore wind projects can have wide-ranging impacts on the already degraded marine environment. The projected major increase in deployment will create additional pressures in these ecosystems.

The most studied potential impacts of offshore wind are on seabirds: from direct collision[251], displacement from foraging areas[252,253], or as a barrier to important flight paths, either during migration, or regularly when breeding adults are provisioning chicks at their nests[256]. Impacts on migrating bats is also a significant concern but far less information is available than for birds[257,258]. There is also clear evidence that noise, in particular from construction activity such as pile driving, has short-term, negative impacts on cetaceans[259] and fish[260]. There are also potential negative impacts from artificial light.

The potential impacts of offshore windfarms on benthic and fish communities are less clear[261]. Some fish, and other taxa that make use of magnetic or electrical environmental cues, have exhibited changes in their behaviour in relation to the electrical fields around subsea cabling[262] and as a result of operational noise[263]. Beyond the immediate disturbance to the seabed and potential associated carbon emissions during construction, introducing hard substrates like turbine foundations to soft sediment, habitats may alter species' communities by acting as artificial reefs. Over time, these reefs may support a diverse, but altered, benthic community[264,265]. This, coupled with prohibited or otherwise reduced fisheries effort, may result in increased local abundance of many fish species[266]. Increased fish densities within windfarms may attract seabirds, heightening collision risk[268]. Moreover, fisheries efforts may be displaced to areas outside the windfarm, so impacts on broader fish populations are unclear[267].

One area of active research is the implications of the broad physical changes the turbines have on water currents and wind conditions. Ocean stratification may be impacted and even break down in the presence of turbines traversing the water column. This can lead to increases in primary production and downstream impacts to the wider food chain[269].

Research on offshore windfarm impacts has focused on the fixed-base turbines used in most existing windfarms. Floating wind turbines, without a solid foundation on the seafloor, offer the opportunity to site windfarms in much deeper water and therefore in a larger proportion of our seas. With careful planning and impact assessment processes, this greater flexibility in installation locations could help to avoid the most sensitive areas. However, as floating wind turbines are a newer technology, the potential impacts are less well understood and the uncertainties greater.

The necessary development of offshore wind must consider the potential impacts when identifying sites and planning construction, especially given the global importance of UK waters for seabird populations[270]. Largely driven by anthropogenic pressures, such as climate change, fisheries and invasive non-native species, we have already seen an average decline of 24% in well-monitored seabird species in the UK (see Key findings), including a 49% decline in Scotland (see Scotland section). These declines were measured prior to the recent and ongoing outbreak of Highly Pathogenic Avian Influenza (see Pressures and responses section). Added to existing pressures, offshore wind installations must take particular account of the state of our seas and leave wildlife populations resilient to unanticipated future challenges.

A series of initiatives is being developed which could enable the offshore wind sector to become the catalyst for nature positive developments in the UK. Measures are being taken to address the impacts of offshore windfarms, alongside addressing the legacy of human activities at sea. The Offshore Wind Evidence and Change Programme (OWEC) aims to strategically address ecological evidence gaps for more sustainable development of offshore wind. This is funding projects such as tracking year-round seabird movements to build a more complete picture of how they use the seas, and the POSEIDON project, which is reviewing environmental risks across UK waters to better advise future planning frameworks. Defra is currently developing the Offshore Wind Environmental Improvement Package (OWEIP), which includes identifying mitigation standards to increase the use of mitigation to reduce offshore windfarm impacts[271].

Marine spatial planning

Robust marine spatial planning needs to be at the forefront of delivering nature conservation and the green industrial revolution. This supports the expansion of renewables such as offshore wind and tidal energy to meet our climate targets, encourages sustainable fisheries and fishing communities, whilst minimising the impacts on nature and taking advantage of potential co-benefits. Ensuring that offshore wind and other developments are targeted in the right areas is one of the ways that we can guarantee the essential energy transition best supports the entire marine environment to move towards Good Environmental Status. A prime example of this is the seabird sensitivity mapping tool developed for Scotland which incorporates seasonal variation in seabirds' distributions[272].

The development process now recognises that cumulative impacts of multiple offshore installations need to be considered in the planning process. However, there are many outstanding uncertainties requiring further research. In 2020, the government-led Scottish Sectoral Marine Plan for Offshore Wind was published[273]. This plan considers a wide range of potential social, economic and environmental impacts and describes a set of potential new areas for offshore wind development to reach the 2030 10 GW expansion target. There is now an ongoing sectoral plan for offshore wind in Scotland and the Marine Spatial Prioritisation Programme (MSPri) in England. Spatial planning tools are currently under consideration in Wales to support the Welsh National Marine Plan and in the Offshore Renewable Energy Action Plan for Northern Ireland[274].

Impact – people and planet; health and wellbeing benefits of natural spaces

Access to nature and green space has many benefits to mental and physical health[275-277] and can reduce socio-economic based inequalities in health measures[277]. The National Survey of Wales demonstrated a positive relationship between mental wellbeing and both frequency of visits to green and blue spaces, and the greenness of participants' home area[278]. In England, the People and Nature Survey found more than 90% of adults who had visited green and natural spaces in the past 14 days agreed that time spent outdoors is good for their physical and mental health[279].

However, access to nature is not equal across the UK, both in terms of physical distance to different types and qualities of green and blue spaces[280], but also in terms of barriers to use, whether these be safety concerns, cultural norms or accessibility[281]. One recent study found that the quality of urban freshwater habitats was better in more affluent areas[282]. Access to nature close to home is very important and 88% of households in Great Britain do have access to a garden[283]; however, this varies by socio-economic status and ethnicity. London has the lowest garden access (79%), and in that city 66% of land in the wealthiest areas is either private gardens or public outdoor space, compared to 45% in the poorest areas[284]. In addition to gardens, around 72% of people in Great Britain live within 15 minutes' walk of a public park[283]. In England, a new government indicator suggests that 62% of people live within a maximum of 1 km of green space[285].

Since 2002, the Woodland Trust has collated data on woodlands close to people's homes. The most recent assessment found that 67% of the population lives within 4 km of a 20 ha wood and a further 23% would do so as well, if additional woodlands were made open to the public. However, only 16% of the population has access to a smaller woodland (2 ha) within 500 m of their home[286]. This assessment looked only at the distance to nearby woodland as the crow flies. It did not account for whether the woods were linked to the nearby population by a path or road. A recent review published by Natural Resources Wales highlights the range of evidence from studies which demonstrate the positive associations between exposure and access to coastal and marine environments and benefits to physical and mental health[287].

Despite the health and wellbeing benefits of access to nature it is less clear what role biodiversity plays in nature-health relationships. In other words, do these health benefits increase in richer and more biodiverse natural spaces? A recent systematic review found that 14 of 24 studies observed some positive relationship between the richness or diversity of the natural environment and mental health or mental wellbeing[288]. For example, the restorative benefits of parks in Bradford was associated with their biodiversity[289], and higher bird abundance was associated with lower incidence of depression, anxiety and stress[290]. However, 17 studies also found non-significant relationships and two found negative relationships[288], suggesting the link is not yet fully understood. There is some suggestion that measures of the abundance of certain species groups, such as birds, may be more important than species richness[291]. A better understanding of these relationships would allow us to better assess the co-benefits and potential trade-offs of managing land for people and for nature, in both urban and rural settings.

> ***"Access to nature and greenspace has many benefits to mental and physical health.[275-277] It can reduce socio-economic based inequalities in health measures"***

Corwen community garden, Richard Bowler (rspb-images.com)

Future – integrating climate and nature responses on land

The UK's finite land area must provide food, energy, construction and other materials for people, as well as contributing to climate change adaptation and mitigation, and biodiversity conservation. Successfully balancing these multiple demands can be difficult. Nature-based solutions are a suite of methods that may help maximise the potential benefits of climate change mitigation and adaptation for both people and nature; critically they must provide measurable benefits for biodiversity[292]. Examples of key nature-based solutions in the UK include both preventing greenhouse gas emissions from peatland and increasing sequestration of atmospheric carbon dioxide by creating woodland and other natural and semi-natural habitats. Peatlands hold enormous amounts of carbon, which is kept safe when habitats are in good condition.

There are potentially substantial co-benefits of nature-based solutions[183], but poorly-designed projects can result in trade-offs between climate change mitigation and biodiversity conservation[293]. This is particularly the case with afforestation on organo-mineral soils (also termed 'shallow peat soils'), that may lead to negative outcomes for both net carbon sequestration[235] and nature. Recognition of this has led to new guidance being issued for England preventing woodland planting on peat deeper than 30 cms[294], given that even ambitious levels of nature-based solutions proposed by the Climate Change Committee would only sequester a few years' worth of current emissions by 2100.

The potential impact of nature-based solutions on the production of UK's food, goods and services should also be considered, whilst avoiding moving the impacts of production overseas. One way to begin to understand these synergies and trade-offs is by modelling alternative future scenarios. Given the complex mix of factors at play and the uncertainties of any model, they cannot tell us precisely what will happen in the future. However, the scenarios can help us understand the potential effects of different approaches to climate change mitigation and land management, and facilitate discussions around the major societal decisions in which governments and communities are engaged.

The RSPB Land Use Scenarios Project focused on understanding the implications of nature-based climate change mitigation (woodland creation, peatland restoration, low carbon farming practices and other climate mitigation measures) for climate, nature and food and timber production[295]. From the nine scenarios modelled to 2050, all but the baseline scenario saw big reductions in greenhouse gas emissions from agriculture, forestry and other land use, with the more ambitious application of nature-based solutions leading to larger emissions reductions (Figure 23). It was clear, however, that net zero is a challenging target.

On average, across models, birds were predicted to respond positively to climate mitigation scenarios, though farmland birds are expected to lose habitat. Furthermore, scenarios which reduce greenhouse gas emissions also tend to reduce food production. A combination of moderate levels of dietary change, food waste reduction and yield growth could offset this drop in food production[295], and more widespread application of effective agri-environment schemes could help offset the loss of habitat for farmland wildlife[83]. Researchers are currently making these scenarios more comprehensive. They are not only considering the spatial requirements of onshore renewables but also using "participatory methods" to model future scenarios at the landscape scale. Participatory methods involve actively involving and engaging various stakeholders, such as local communities, experts, and organisations, in the decision-making process. This approach allows for a collaborative and inclusive approach to compare and contrast results from both local (landscape scale) and national (top-down) perspectives.

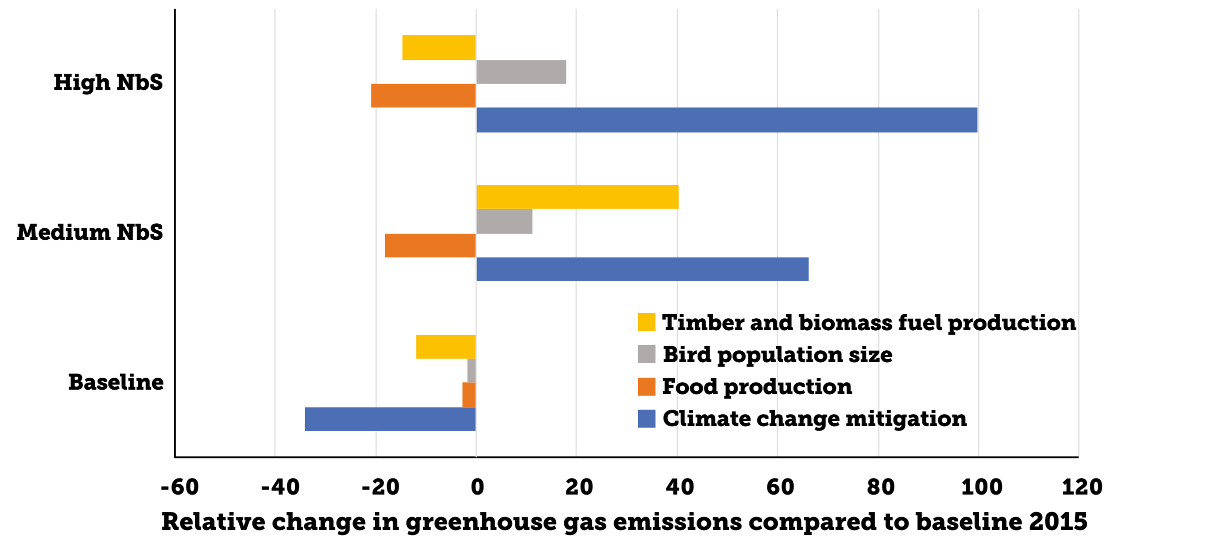


Figure 23: Subset of exploratory future climate mitigation scenarios[295] showing the projected impact on food production, timber and biofuel production, birds and climate (greenhouse gas emissions). Medium nature-based solutions are termed 'Balanced pathway' in the paper and are based on a scenario from the Committee on Climate Change[239]. High nature-based solutions are termed 'Nature-based Solutions' in the paper.

Farmland, Sam Turley (rspb-images.com)

CYMRU

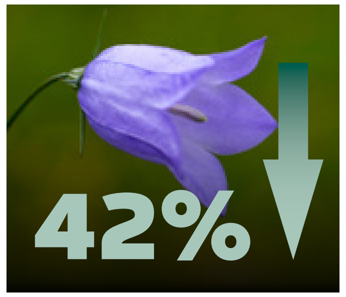
Gyda dros 2,000 km o arfordir, coedwig law dymherus gyda bryoffytau, cennau a ffyngau, a mynyddoedd rhostir Eryri (Eryri) a Bannau Brycheiniog, mae gan Gymru gynefinoedd pwysig gyda bywyd gwyllt unigryw[324]. Mae'r amgylchedd morol yn chwarae rhan hanfodol, gan gynnwys cytrefi adar môr o bwysigrwydd rhyngwladol oddi ar Sir Benfro a Phen Llŷn. Yn 2018, amcangyfrifwyd bod 31% o arwynebedd tir Cymru wedi'i orchuddio â chynefinoedd lled-naturiol[235]. Gydag 88%[326] o dir Cymru yn cael ei ddefnyddio ar gyfer amaethyddiaeth, mae natur yn agored i newid mewn arferion ffermio. Yn ogystal, mae gorchudd coetir yng Nghymru wedi cynyddu bedair gwaith ers 1918, yn bennaf oherwydd plannu conwydd anfrodorol[236].

RSPB Ramsey Island , Nathan Lowe (rspb-images.com)

Penawdau

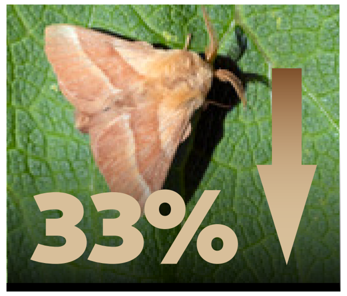
Gostyngiad o 20% ar gyfartaledd yn amlder rhywogaethau

Mae'r doreth o 380 o rywogaethau daearol a dŵr croyw ar gyfartaledd wedi gostwng 20% ledled Cymru ers 1994. O fewn y duedd gyffredinol hon, mae 140 o rywogaethau wedi prinhau (37%) a 107 o rywogaethau wedi cynyddu (28%). Rhywogaeth gwyfynod ar gyfartaledd a ddangosodd y dirywiad cryfaf; 43%.



Mae fflora Cymru yn newid yn fawr

Ers 1970, mae dosbarthiad 42% o rywogaethau planhigion blodeuol a 44% o fryoffytau (mwsoglau a llysiau'r afu) wedi gostwng ledled Cymru, o'i gymharu â 40% a 46% o rywogaethau planhigion blodeuol a bryoffytau yn y drefn honno sydd wedi cynyddu yn eu dosbarthiad. Mae planhigion blodeuol sy'n gysylltiedig â chynefinoedd ucheldirol wedi prinhau ar gyfartaledd, tra bod llawer o fryoffytau epiffytig yn gwella o effeithiau llygredd diwydiannol blaenorol.



Patrymau newidiol amrywiol yn y dosbarthiad rhywogaethau infertebratau

Dangosodd dosbarthiad Cymru o 3,036 o rywogaethau infertebratau dueddiadau cyferbyniol; gostyngodd dosbarthiad 993 o rywogaethau (33%) a chynyddodd dosbarthiad 953 o rywogaethau (31%).

Mae 18% o rywogaethau dan fygythiad

O'r 3,897 o rywogaethau sydd wedi'u hasesu gan ddefnyddio meini prawf y Rhestr Goch, mae 18% (663 o rywogaethau) dan fygythiad o ddiflannu o Gymru.

Cadarnle adar y môr

Ychydig iawn o newid a welwyd ar gyfartaledd ers 1986 yn y niferoedd o saith rhywogaeth o adar môr sy'n cael eu monitro'n rheolaidd, mewn cyferbyniad â'r gostyngiadau cyfartalog mewn rhai rhannau eraill o'r DU.
Fodd bynnag, mae'r canlyniadau hyn yn rhagddyddio'r achosion presennol o ffliw adar pathogenig iawn.

Am y tro cyntaf, rydym yn gallu cyflwyno dangosydd niferoedd rhywogaethau aml-ddosbarth ar gyfer Cymru, oherwydd bod mwy o ddata ar gael. Yn y dyfodol hoffem ddatblygu mesurau cyflenwol ychwanegol i gyflwyno asesiad mwy cyflawn o gyflwr natur.

CANFYDDIADAU ALLWEDDOL

Oherwydd bod data penodol i Gymru yn cael ei gwmpasu'n fwy tacsonomig nag mewn adroddiadau Sefyllfa Byd Natur blaenorol, roeddem yn gallu cynnwys dangosydd cyfun ar gyfer niferoedd ar gyfer 380 o rywogaethau daearol a dŵr croyw am y tro cyntaf. Mae'r dangosydd hwn yn cwmpasu'r cyfnod 1994 i 2021, sy'n llawer byrrach na'r cyfnod 50 mlynedd rydym yn adrodd arno ar gyfer y DU a Lloegr, a dylid dehongli'r canlyniadau a gyflwynir yma gyda hyn mewn golwg. Er enghraifft, efallai na fydd y dangosydd yn dal yr effaith o ganlyniad i ddwysáu rheolaeth amaethyddol yn ail hanner yr 20fed ganrif. Yn gyffredinol, gallwn adrodd ar gyfran lai o rywogaethau ar lefel Cymru nag y gallwn ar gyfer y DU. Er enghraifft, dim ond hanner y 220 o rywogaethau adar sy'n bresennol yng Nghymru y gallwn eu cynnwys yn y dangosydd helaethrwydd rhywogaethau (Ffigur 24), o'i gymharu â thri chwarter o rywogaethau adar y DU yn y dangosydd helaethrwydd rhywogaethau'r DU (Ffigur 1). Mae tueddiadau o ran niferoedd yn seiliedig ar newidiadau mewn nifer yr unigolion ar safle sy'n cael ei fonitro, mesur sy'n adlewyrchu maint poblogaeth rhywogaethau. Mae tueddiadau dosbarthu yn seiliedig ar newidiadau yn nifer y safleoedd lle mae rhywogaeth yn bresennol. Gallai rhywogaeth y mae ei chwmpas wedi newid ddal i fod â dangosydd dosbarthiad sefydlog os yw cyfanswm yr arwynebedd a feddiannir wedi aros yr un fath. I gael dehongliad llawnach o fetrigau newid rhywogaethau a gyflwynir yma gweler yr adran Pwysau. Mae'r newidiadau a ddisgrifir yma yn dilyn newidiadau helaeth i'n tirweddau a'n morweddau yn gynharach yn yr 20fed ganrif a chyn hynny (gweler yr adran Newid hanesyddol).


Ynys Feirig, David Wootton (rspb-images.com)

Lapwing, Andy Hay (rspb-images.com); Harebell, Michael Harvey (rspb-images.com); Lackey, David Kjaer (rspb-images.com); Large Heath Butterfly, John Ibboton; Fulmar, Richard Carlyon (rspb-images.com)

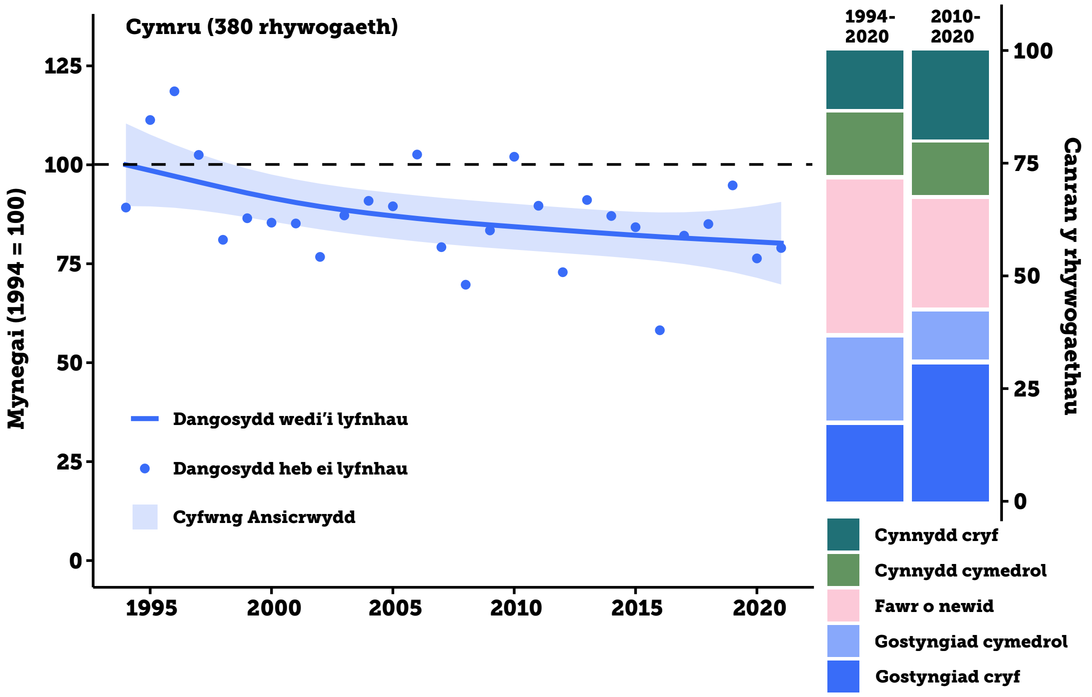
Daearol a dŵr croyw

Newid yn helaethrwydd rhywogaethau

Mae'r dangosydd yn dangos gostyngiad mewn amlder cyfartalog o 20% (Ffigur 24, Cyfwng Ansicrwydd (UI): -30% i -9%) rhwng 1994 a 2021. Dros y 10 mlynedd diwethaf (2010–2020), y gostyngiad oedd 4% (UI: -11% i +2%).

O fewn dangosyddion amlrywogaeth fel y rhain mae amrywiad sylweddol rhwng tueddiadau rhywogaethau unigol. I archwilio hyn, rydym wedi dyrannu rhywogaethau i gategorïau tueddiadau yn seiliedig ar faint y newid yn y boblogaeth, dros y cyfnodau hir a thymor byr.

- Ers 1994, dangosodd 140 o rywogaethau (37%) ddirywiad cryf neu gymedrol a dangosodd 107 o rywogaethau (28%) gynnydd cryf neu gymedrol; Ychydig o newid a welwyd mewn 133 o rywogaethau (35%).
- Yn y 10 mlynedd diwethaf (2010-2020), dangosodd 160 o rywogaethau (43%) ddirywiad cryf neu gymedrol a dangosodd 122 o rywogaethau (32%) gynnydd cryf neu gymedrol; ychydig o newid a welwyd mewn 94 rhywogaeth (25%).



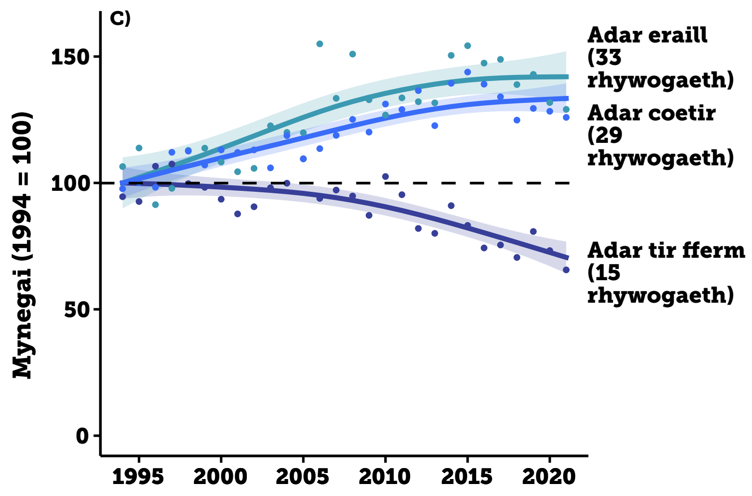
Ffigur 24: Newid yn amlder rhywogaethau cyfartalog ar draws rhywogaethau daearol a dŵr croyw yng Nghymru, yn seiliedig ar dueddiadau penodol Cymru o ran adar (108 o rywogaethau), gloÿnnod byw (33 rhywogaeth), mamaliaid (saith rhywogaeth) a gwyfynod (232 o rywogaethau). Mae'r siart bar yn dangos canran y rhywogaethau o fewn y dangosydd sydd wedi cynyddu, gostwng (yn gymedrol neu'n gryf) neu wedi dangos fawr ddim newid yn eu niferoedd (1994 – 2020: 380 o rywogaethau, 2010–2020: 376 o rywogaethau).

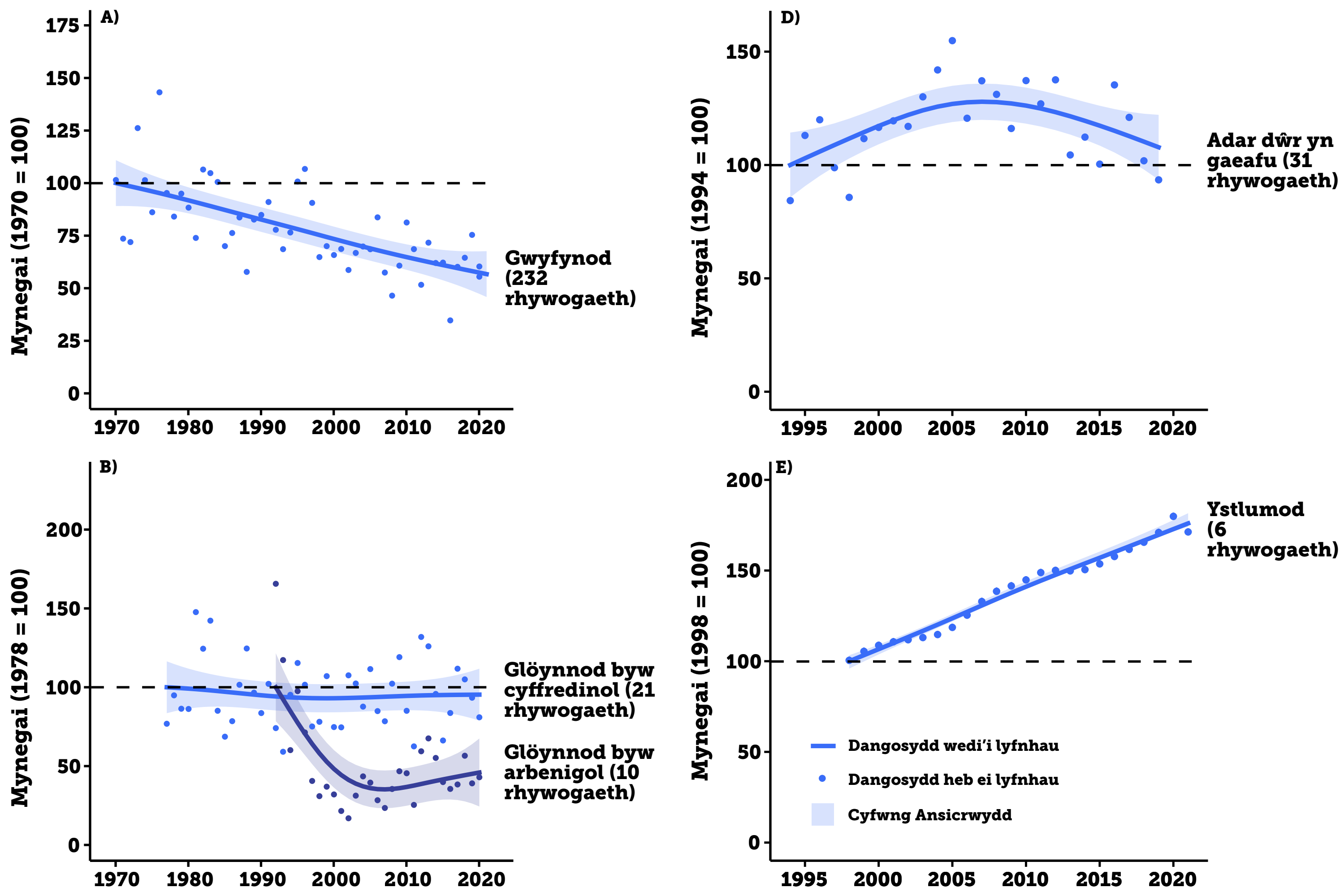
Gweler tudalen 184 i ddarganfod sut i ddehongli'r adroddiad hwn

Dangosyddion helaethrwydd rhywogaethau fesul grŵp

Mae natur gyfansawdd dangosyddion amlrywogaeth yn golygu y gallant guddio amrywiadau pwysig mewn tueddiadau rhwng rhywogaethau unigol, a grwpiau rhywogaethau. Yma, er mwyn helpu i ddeall newidiadau yn y prif ddangosyddion helaethrwydd yn well, rydym yn ei gyflwyno wedi'i ddadgyfuno i grwpiau rhywogaethau mawr.

- Mae'r dangosydd helaethrwydd ar gyfer 232 o rywogaethau gwyfynod mwyaf cyffredin Cymru yn dechrau yn 1970 ac ar y cyfan yn dangos gostyngiad mewn niferoedd cyfartalog o 43% (Ffigur 2A, UI: -54% i -32%). Dros y 10 mlynedd diwethaf, roedd y dangosydd 4% yn is yn 2020 o'i gymharu â 2010 (UI: -13% i +5%).





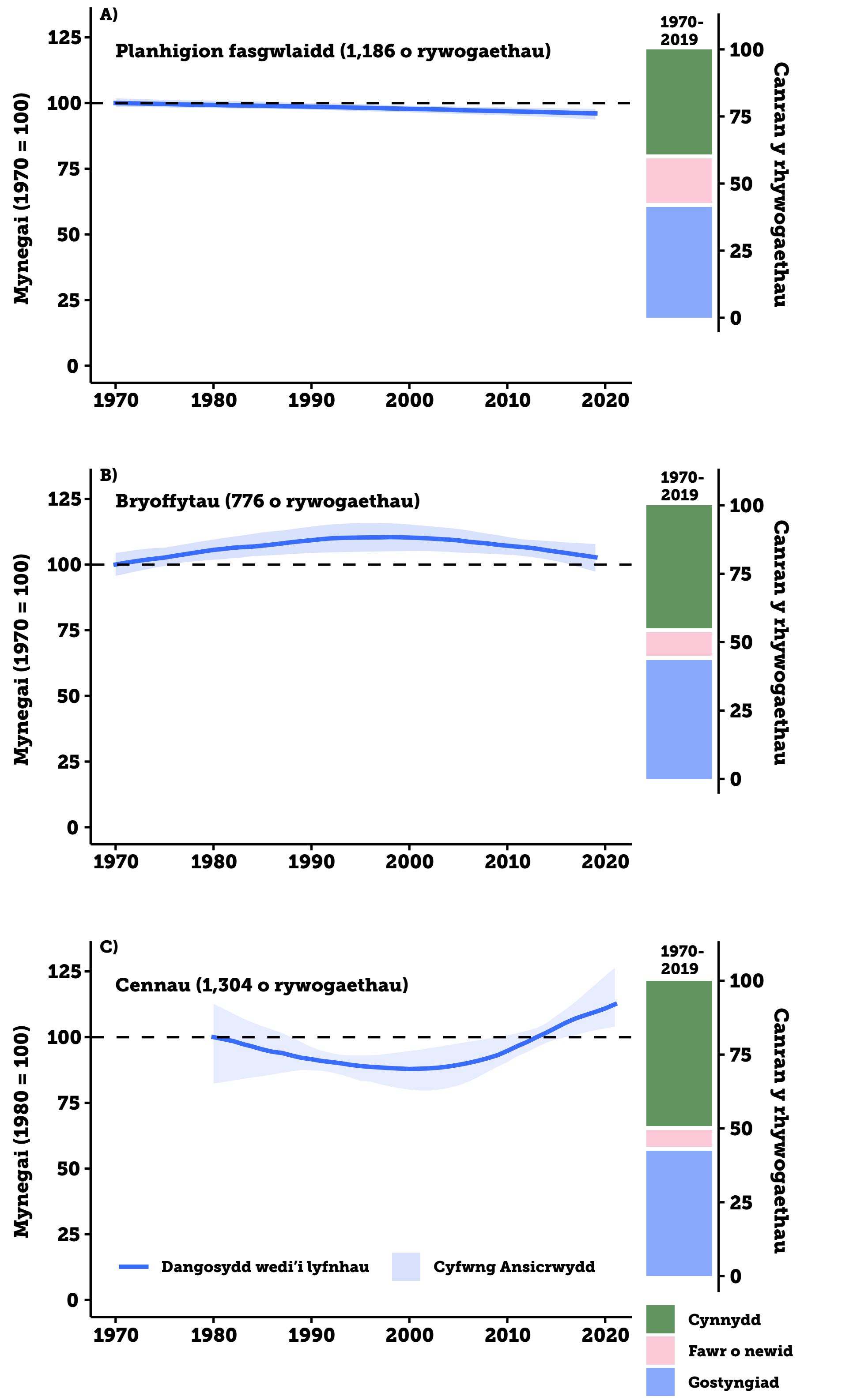
Ffigur 25: Newid yn amlder rhywogaethau cyfartalog ar gyfer rhywogaethau daearol a dŵr croyw yng Nghymru yn ôl dewis cynefin, lefel arbenigedd neu grŵp tacsonomig.

- Bu gostyngiad mewn glöynnod byw arbenigol o fwy na'u hanner ers 1993 (Ffigur 25B, -54%, UI: -76% i -32%). Mae glöynnod byw cyffredinol yn dangos mwy o amrywiad rhyngflynyddol ond yn gyffredinol maent wedi aros yn sefydlog (-5%, UI: -21% i 12%).
- Mae'r dangosydd helaethrwydd ar gyfer rhywogaethau adar tir fferm yn dangos gostyngiad mewn niferoedd cyfartalog o 29% ers 1994 (Ffigur 25C, UI: -36% i -23%). Mae hyn yn debyg i'r patrymau a ddangosir ym mhob un o wledydd eraill y DU ac eithrio'r Alban[327], er bod y dangosydd yn dechrau ar ôl y prif gyfnod o ddwysáu rheolaeth amaethyddol. Mae adar y coetir ac adar eraill wedi gweld cynnydd cyfartalog o 33% (UI: +27% i +39%) a 42% (+32% i +52%) yn y drefn honno. Fodd bynnag, mae'n bosibl y bydd cynnydd yn y boblogaeth yn gwyro tuag at rywogaethau adar coetir preswyl a chyffredinol, gyda phryderon cadwraeth parhaus ar gyfer arbenigwyr coetir fel y Gnocell Fraith Leiaf ac ymfudwyr traws-Sahara (ee Telor y Coed).
- Ar gyfartaledd, ychydig o newid y mae adar dŵr sy'n gaeafu yn ei ddangos rhwng 1994 a 2019 (Ffigur 25D, +8%; UI: -6% i 22%). Cododd y dangosydd yn gyflym yn negawd cyntaf yr 21ain ganrif ond mae wedi gostwng yn raddol ers hynny. Mae poblogaethau adar dŵr gaeafu wedi ymateb i hinsawdd sy'n newid, gyda phoblogaethau gaeafu yn symud yn gyntaf i ddwyrain y DU ac yna i gyfandir Ewrop wrth i dymheredd y gaeaf gynyddu, gan agor ardaloedd gaeafu a fu unwaith yn anghroesawgar, yn nes at eu mannau magu[326].
- Mae'r dangosydd niferoedd ar gyfer chwe rhywogaeth o ystlumod yn dechrau ym 1998 ac yn gyffredinol mae'n dangos cynnydd o 76% ar gyfartaledd (Ffigur 25E, UI: +72% i +80%), wedi'i ysgogi'n bennaf gan gynnydd mawr mewn dwy rywogaeth o ystlumod sy'n ymadfer ar ôl prinhad hanesyddol. Mae'r tueddiadau hyn yn debyg i'r rhai a geir ledled y DU ac maent yn debygol o fod yn gysylltiedig â newid deddfwriaethol sy'n rhoi mwy o amddiffyniad i fannau clwydo a gaeafgysgu[328].
- Mae data ar wahân yn dangos[329] bod helaethrwydd eog yr Iwerydd (*Salmo salar*) wedi gostwng yn sylweddol ledled Cymru yn y degawd diwethaf, ac yn 2021 aseswyd holl stociau afonydd fel 'mewn perygl' (91%) neu 'mewn perygl yn ôl pob tebyg' (9%).

Newid yn nosbarthiad rhywogaethau

Planhigion a chen

- Mae'r dangosydd dosbarthiad ar gyfer 1,186 rhywogaethau o blanhigion fasgwlaidd yn dangos gostyngiad o 4% (Ffigur 26A, Cyfwng Ansicrwydd (UI): -6% i -2%) rhwng 1970 a 2019. O fewn hyn roedd amrywiad sylweddol rhwng tueddiadau rhywogaethau unigol. Gostyngodd dosbarthiad 42% o rywogaethau, tra bod 40% o rywogaethau yn dangos cynnydd mewn dosbarthiad. Dim ond 18% o rywogaethau a ddangosodd ychydig o newid. Dirywiodd rhywogaethau cysylltiedig â chynefinoedd ucheldirol yn ogystal â glaswelltiroedd asidig a chalchaidd ar gyfartaledd, tra bod rhywogaethau sy'n gysylltiedig â choed llydanddail a choetiroedd conwydd wedi cynyddu[53].
- Mae'r dangosydd dosbarthiad ar gyfer 776 o rywogaethau bryoffyt (mwsoglau a llysiau'r afu), gyda data Cymreig penodol, yn dangos dim newid ar gyfartaledd (Ffigur 26B, +3%; UI:-3% i +8%). Roedd hyn yn cuddio'r ffaith bod dosbarthiad bron pob rhywogaeth wedi newid. Gostyngodd dosbarthiad 44% o rywogaethau, tra bod 46% o rywogaethau'n dangos cynnydd mewn dosbarthiad. Dim ond 10% o rywogaethau a ddangosodd ychydig o newid. Mae mwsoglau epiffytig (y rhai sy'n byw ar blanhigion eraill), wedi gweld codiadau cyfartalog arbennig o gryf yn gysylltiedig gyda gostyngiad mewn llygredd sylffwr deuocsid.
- Dangosodd y dangosydd dosbarthiad ar gyfer 1,304 o rywogaethau cen, gyda data penodol i Gymru, gynnydd cyfartalog o 13% rhwng 1980 a 2021 (Ffigur 26C, UI: 4% i 26%). Gostyngodd dosbarthiad 43% o rywogaethau, tra bod 50% o rywogaethau yn dangos cynnydd mewn dosbarthiad. Mewn sawl rhan o'r DU, effeithiwyd yn ddrwg iawn ar gennau gan lygredd diwydiannol hanesyddol[330]. Mae gostyngiadau mewn llygredd sylffwr deuocsid yn caniatáu rhai rhywogaethau i ddechrau gwella[354]. Fodd bynnag, mae lefelau llygredd aer nitrogenaidd uchel a pharhaus yn golygu y gall adferiad fod yn gogwyddo tuag at rywogaethau a all oddef hyn.



Ffigur 26: Newid yn nosbarthiad rhywogaethau cyfartalog ar gyfer A) planhigion fasgwlaidd, B) bryoffytau ac C) cennau yng Nghymru. Mae'r siart bar yn dangos y ganran o rywogaethau o fewn y dangosydd sydd wedi cynyddu, gostwng neu wedi dangos fawr ddim newid mewn dosbarthiad.

Infertebratau

Mae'r dangosydd dosbarthiad ar gyfer 3,036 o rywogaethau o infertebratau daearol a dŵr croyw, gyda data sy'n benodol i Gymru, yn dangos dim newid mewn dosbarthiad cyfartalog rhwng 1970 a 2020 (Ffigur 27A, -4%, Cyfwng Ansicrwydd (UI): -12% i +4%)

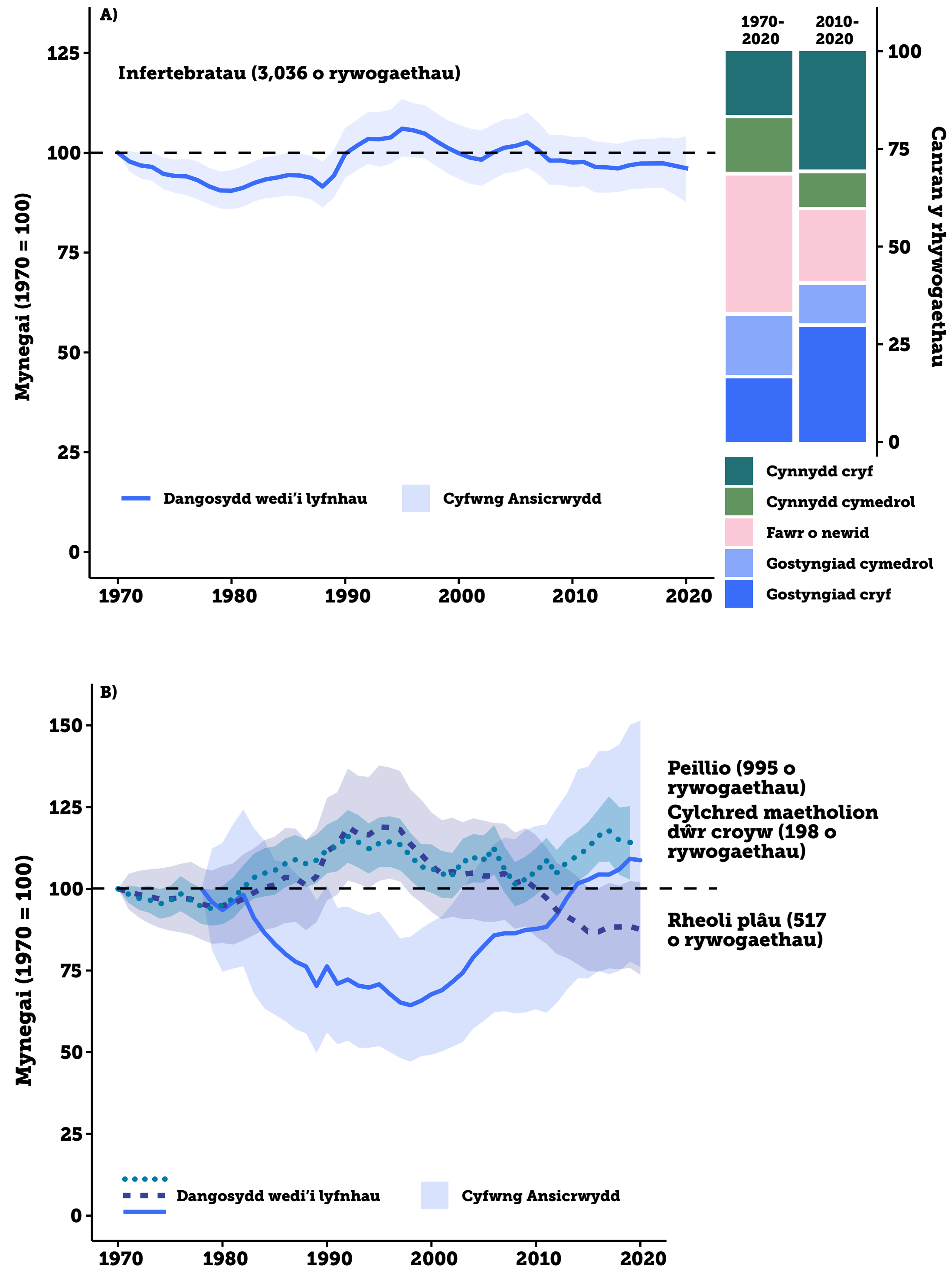
Er mwyn archwilio'r amrywiad mewn tueddiadau dosbarthiad rhywogaethau, dyrannwyd tueddiadau i gategorïau yn seiliedig ar faint y newid dosbarthiad.

- Ers 1970, dangosodd 33% o rywogaethau ostyngiadau cryf neu gymedrol a dangosodd 31% gynnydd cryf neu gymedrol; ni ddangosodd 36% fawr o newid.
- Ers 2010, dangosodd 41% o rywogaethau ostyngiadau cryf neu gymedrol a 40% gynnydd cryf neu gymedrol; ni ddangosodd 19% fawr o newid.

Er mwyn helpu i ddeall y patrymau newid dosbarthiad hyn yn gliriach, cafodd grwpiau rhywogaethau eu categoreiddio yn ôl y swyddogaethau ecolegol a ddarperir ganddynt[331]. Mae rhai grwpiau yn darparu mwy nag un swyddogaeth ac felly yn cael eu cynnwys mewn mwy nag un dangosydd.

- Mae pryfed peillio (gwenyn, pryfed hofran a gwyfynod), sy'n chwarae rhan hanfodol mewn cynhyrchu bwyd, yn dangos cynnydd cyfartalog o 14% mewn dosbarthiad (Ffigur 27B, UI: +3% i +25%) ers 1970. Nid yw'r cynnydd cyfartalog hwn yn nosbarthiadau pryfed peillio, gan gynnwys gwyfynod, yn negyddu'r gostyngiadau mewn niferoedd a ddangosir yn Ffigur 2. Ar gyfartaledd, mae cyfran y safleoedd y ceir rhywogaethau gwyfynod ynddynt yn cynyddu ond mae nifer yr unigolion ar gyfartaledd yn gostwng[332].
- Dangosodd grwpiau o bryfed (morgrug, carabid, chwilod crwydr a buchod coch cwta, pryfed hofran, gweision y neidr a gwenyn meirch) sy'n rhagflaenu rhywogaethau sy'n niweidio cnydau bwyd ostyngiad cyfartalog o -12% yn eu dosbarthiad (UI: -26% i +2%).
- Gwelodd dosbarthiad cyfartalog rhywogaethau sy'n cynnal cylchred maetholion dŵr croyw (clêr Mai, pryfed pric, gweision y neidr a phryfed y cerrig) ostyngiad cychwynnol ac yna arwyddion o adferiad a ddaeth i ben 9% yn uwch yn 2020 o'i gymharu â 1978, er gyda Chyfwng Ansicrwydd mawr (UI: -24% i +51%). Gall y patrwm hwn fod yn rhannol gysylltiedig â newidiadau yn ansawdd dŵr afonydd[333], ond er bod llawer o achosion o lygredd dŵr wedi gwella dros y degawdau diwethaf, mae problemau llygredd dŵr sylweddol yn parhau, yn enwedig mewn dalgylchoedd sy'n gysylltiedig ag amaethyddiaeth ddwys[349].


White-footed Hoverfly, Nick Upton (rspb-images.com)

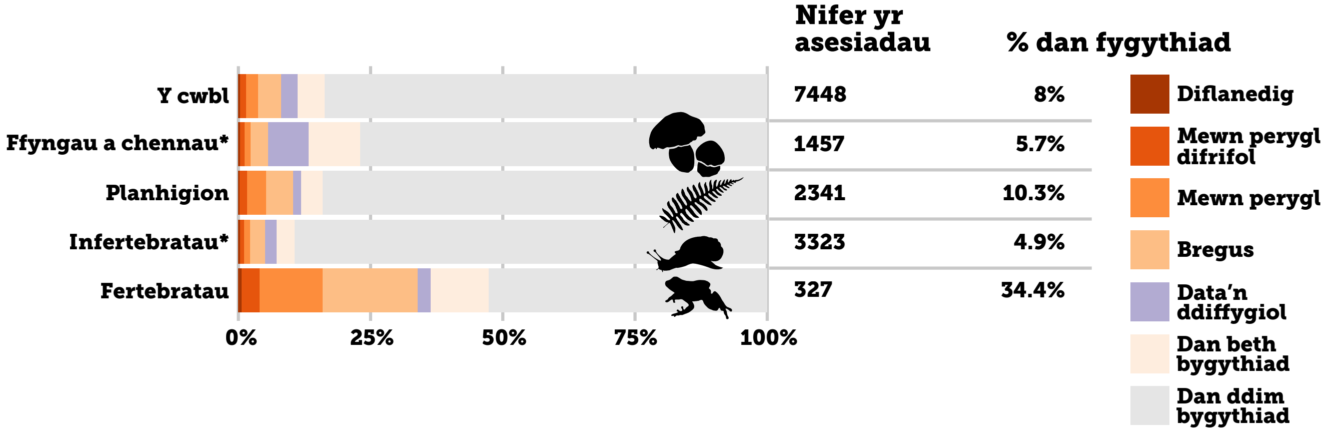


Ffigur 27: Newid yn nosbarthiad rhywogaethau cyfartalog ar gyfer A) Infertebratau daearol a dŵr croyw yng Nghymru. Mae'r siartiau bar yn dangos canran y rhywogaethau o fewn y dangosydd sydd wedi cynyddu, gostwng (yn gymedrol neu'n gryf) neu wedi dangos fawr ddim newid mewn dosbarthiad. B) Rhywogaethau pryfed wedi'u grwpio yn ôl swyddogaeth ecolegol (peillio, rheoli plâu a chylchrediad maetholion dŵr croyw).

Risg difodiant
Asesiadau Rhestr Goch Prydain Fawr

Yma rydym yn dadansoddi asesiadau Rhestr Goch Yr Undeb Rhyngwladol dros Gadwraeth Natur (IUCN) ar gyfer Prydain Fawr i ddangos cyfran y dosbarthiadau y gwyddys eu bod wedi digwydd yng Nghymru, sy'n gymwys ar gyfer pob un o'r categorïau bygythiad safonol. Mae dosbarthiadau yr aseswyd eu bod mewn Perygl Difrifol, Mewn Perygl neu Ddiamddiffyn yn cael eu dosbarthu'n ffurfiol fel rhai sydd dan fygythiad. Dim ond asesiadau a gymeradwywyd yn ffurfiol gan y corff cadwraeth natur statudol comisiynu sydd wedi'u cynnwys.

Ers adroddiad *Sefyllfa Byd Natur* 2019, mae'r nifer y dosbarthiadau a aseswyd yn ffurfiol gan ddefnyddio proses Rhestr Goch Ranbarthol yr IUCN[334], y gwyddys ei bod wedi digwydd yng Nghymru, wedi cynyddu o 6,500 o rywogaethau i 7,448. Ar hyn o bryd ni allwn asesu a yw'r risg difodiant yn newid dros amser oherwydd dim ond un asesiad Rhestr Goch sydd gan y mwyafrif helaeth o rywogaethau. O'r dosbarthiadau sy'n bodoli, y mae digon o ddata ar gael ar eu cyfer, mae 579 (8.0%) yn gymwys fel rhai dan fygythiad ac felly maent mewn perygl o ddiflannu o Brydain Fawr (ar y raddfa y gwneir asesiadau Rhestr Goch arni) (Ffigur 28). O'r gwahanol grwpiau tacsonomig, mae 236 (10.3%) o blanhigion, 76 (5.7%) o ffyngau a chennau, 109 (34.4%) o fertebratau a 158 (4.9%) o infertebratau yn gymwys fel rhai sydd dan fygythiad.



Ffigur 28: Crynodeb o Restrau Coch Cenedlaethol Prydain Fawr ar gyfer rhywogaethau sy'n bresennol yng Nghymru, gan ddangos cyfran y rhywogaethau a aseswyd ym mhob categori Rhestr Goch, yn ôl grŵp tacsonomig eang. *Ar lefel Prydain Fawr dim ond grwpiau dethol o infertebratau sydd wedi cael eu hasesu a llai nag 1% o rywogaethau ffyngau.

Toad, Richard Bowler (rspb-images.com)

Asesiadau Rhestr Goch yr IUCN sy'n benodol i Gymru

Er mwyn cynyddu cymaroldeb rhwng grwpiau a gwledydd tacsonomig, rydym yn cyflwyno asesiadau Rhestr Goch yr IUCN a gynhaliwyd ar lefel Prydain Fawr; fodd bynnag, mae nifer o grwpiau tacsonomig wedi'u hasesu ar gyfer risg difodiant ar raddfa Gymreig. Mae'r rhain yn dangos:

Grŵp (nifer o asesiadau)	Dan fygythiad yng Nghymru		Diflanedig yng Nghymru
	Canran	Rhif	Rhif
Cyfanswm	**18%**	**663**	**95**
Cennau (1,316)	**18%**	**208**	**22**
Rhydau (214)	**21%**	**40**	**7**
Bryoffytau (850)	**18%**	**146**	**26**
Planhigion fasgwlaidd (1,467)	**18%**	**256**	**38**
Mamaliaid (39)	**33%**	**11**	**2**
Ymlusgiaid ac amffibiaid (11)	**18%**	**2**	**0**

Adar o Bryder Cadwraethol Cymru

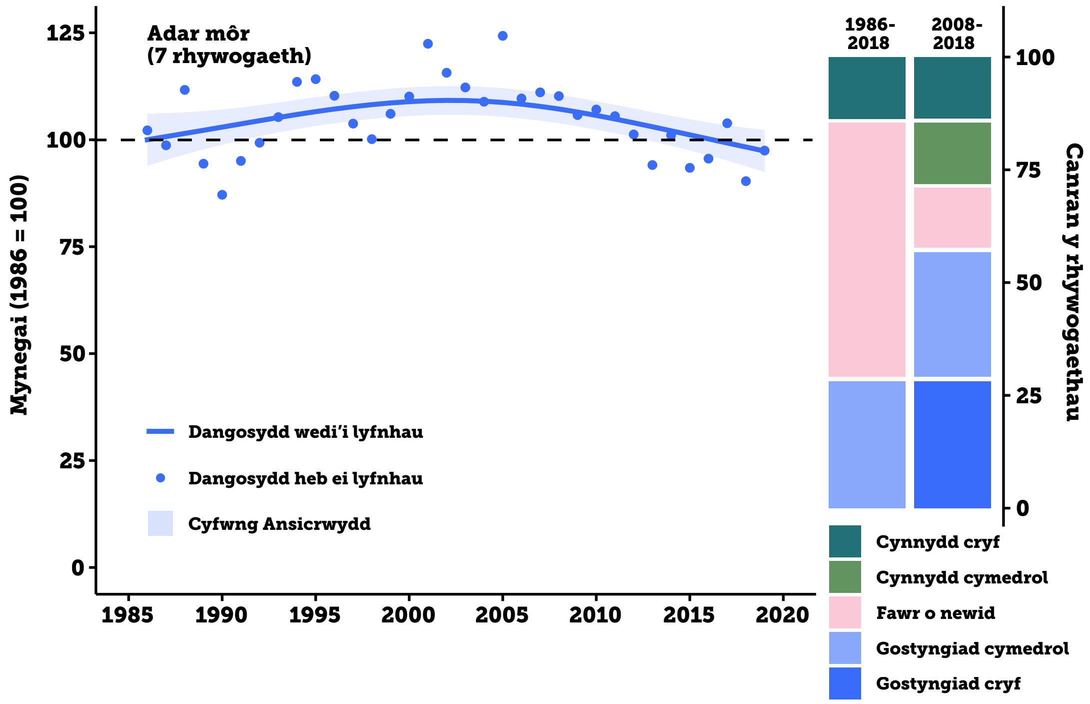
Er nad yw'n bosibl pennu eto sut mae risg difodiant yn newid dros amser ar gyfer y rhan fwyaf o'r tacsa, mae pedwar asesiad wedi'u gwneud o dueddiadau yn y niferoedd a'r dosbarthiad o adar yng Nghymru ers 2002, y mwyaf diweddar yn 2022[352]. Mae'r rhain yn defnyddio cyfres gyson o feini prawf i ddyrannu pob un rhywogaeth sy'n digwydd yn rheolaidd fel Coch, Ambr neu Wyrdd; y Prif feini prawf ar gyfer y Rhestr Goch yw gostyngiad o fwy na 50% dros 25 mlynedd, neu gyfnod hwy fel y mae'r data'n caniatáu. Roedd yr asesiad diweddaraf yn dangos o blith 220 o rywogaethau a aseswyd, fod 60 (27%) bellach ar y rhestr goch, o'i gymharu â 27 (12%) yn asesiad 2002. Er bod rhai newidiadau – ychwanegiadau i'r rhestr Ambr yn bennaf– yn deillio o ddata gwell, roedd llawer o ganlyniad i dueddiadau sy'n dirywio. Mae'r cwymp cyflym mewn niferoedd o ydfrain sy'n bridio a Phibyddion Du sy'n gaeafu yng Nghymru yn golygu eu bod wedi symud o Wyrdd i Goch ers 2016. Cyhoeddwyd Rhegen yr Yd a Bras yr Yd yn ddiflanedig fel adar magu yng Nghymru, sy'n golygu bod 11 rhywogaeth o adar wedi'u colli o Gymru ers 1800. Mae gwelliannau statws mewn 14 rhywogaeth, gan gynnwys Cambig, Barcud Coch a'r Fronfraith, wedi galluogi'r rhywogaethau hyn i symud o Ambr i Wyrdd.

Morol

Newid yn nifer y rhywogaethau

Adar môr

Mae'r dangosydd helaethrwydd ar gyfer saith rhywogaeth o adar môr yng Nghymru yn dechrau ym 1986 ac ar y cyfan nid yw'n dangos llawer o newid net mewn helaethrwydd cyfartalog hyd at 2019 (Ffigur 29, -3%; Cyfwng Ansicrwydd (UI): -8% i +2%). Darlun cymysg sydd i adar y môr yng Nghymru. Mae Gweilch y penwaig wedi cynyddu dros y cyfnod. Fodd bynnag, mae Gwylanod cefnddu lleiaf a gwylanod coesddu wedi dirywio. Mae poblogaethau yn agored i bwysau amrywiol, gan gynnwys newid yn yr hinsawdd, argaeledd ysglyfaeth/bwyd, colli cynefinoedd ac ysglyfaethu. Tra bod rhai poblogaethau wedi dangos cynnydd yn y blynyddoedd diwethaf, maent yn parhau i fod yn agored i newidiadau yn y dyfodol gan eu bod wedi'u crynhoi mewn nifer fach o gytrefi[335].

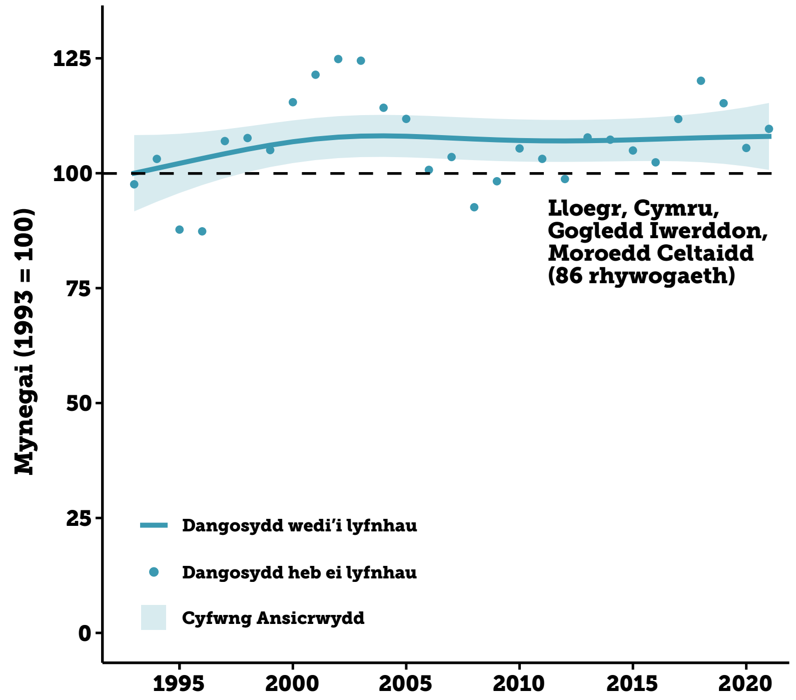


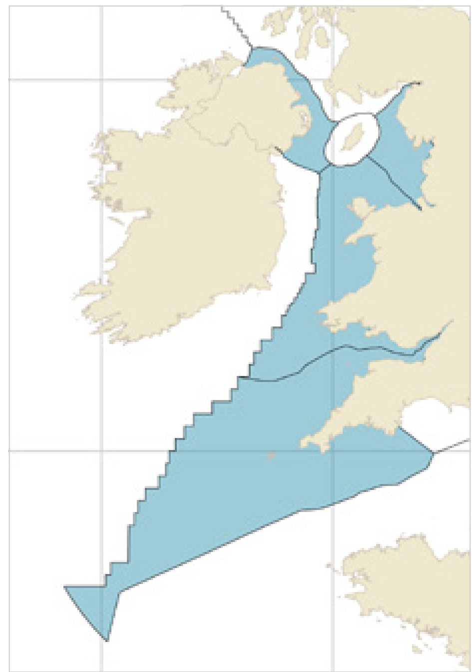
Ffigur 29: Newid yn niferoedd cyfartalog rhywogaethau ar draws saith rhywogaeth o adar môr gyda thueddiadau penodol i Gymru. Mae'r siart bar yn dangos canran y rhywogaethau o fewn y dangosydd sydd wedi cynyddu, lleihau neu wedi dangos fawr ddim newid mewn helaethrwydd.

Bottlenose Dolphin, Richard Carlyon (rspb-images.com)

Pysgod dyfnforol

Nid oedd digon o ddata yn nyfroedd glannau ac alltraeth Cymru i gynhyrchu dangosydd helaethrwydd cadarn ar gyfer pysgod dyfnforol, felly dyma ddangosydd sy'n defnyddio data o gydran Cymru, Iwerddon a'r Môr Celtaidd o Barth Economaidd Neilltuedig (EEZ) y DU. Rhwng 1993 a 2021 cynyddodd y dangosydd 8% (UI: 1% i 15%), gan awgrymu o bosibl adferiad rhai rhywogaethau o ddirywiad blaenorol. Dylid nodi bod llawer o stociau o rywogaethau pysgod a physgod cregyn sydd wedi'u targedu'n fasnachol yn cael eu hasesu a'u rheoli dros raddfeydd daearyddol mawr ac efallai nad y rhywogaethau a gynhwysir yn y dangosydd yw'r rhai sy'n cael eu pysgota'n nodweddiadol gan fflyd Cymru mewn niferoedd sylweddol.





Ffigur 30: Newid yn amlder rhywogaethau cyfartalog ar gyfer rhywogaethau pysgod dyfnforol yng Nghymru, Lloegr a Gogledd Iwerddon ac elfen Moroedd Celtaidd EEZ y DU o 1993 i 2021.

Mamaliaid morol

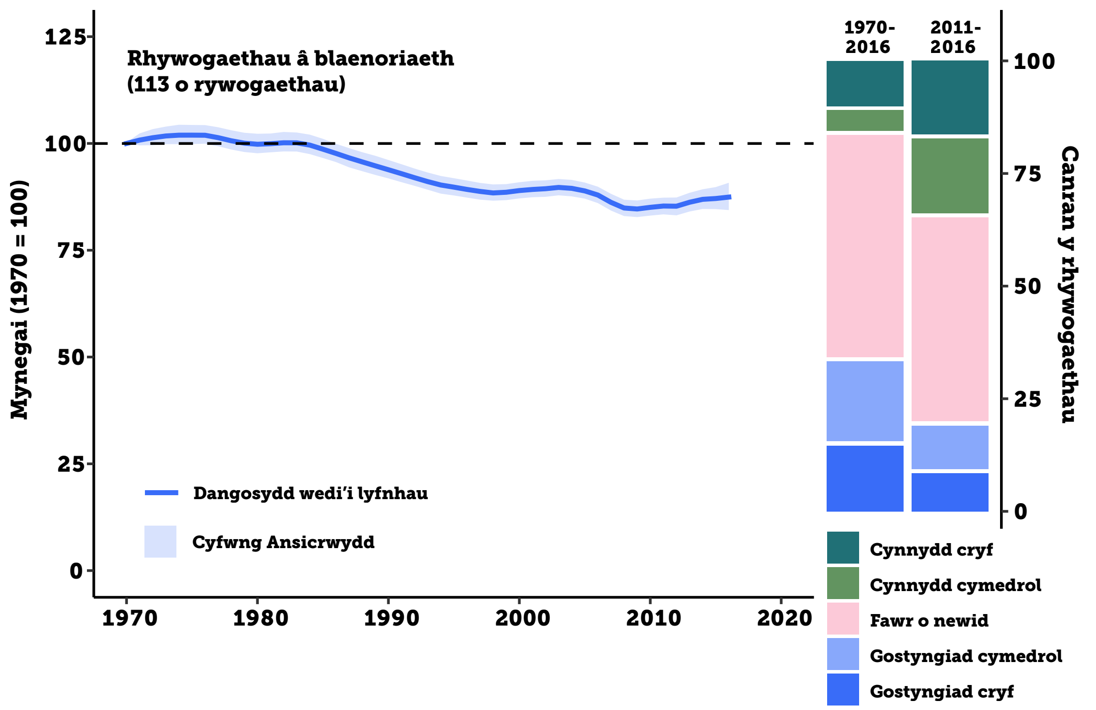
Mae poblogaeth y Morloi Llwyd yn nyfroedd Cymru wedi dangos tuedd ar i fyny mewn cynhyrchiant morloi bach dros y tymor hir, gyda chynnydd yn niferoedd y boblogaeth[335]. Yng Nghymru, ystyrir bod poblogaeth y Dolffin Trwyn Potel o amgylch Bae Ceredigion yn sefydlog dros y tymor hir ac mewn cyflwr ffafriol[254], ond credir bod helaethrwydd wedi gostwng o bosib dros y degawd diwethaf[336].

Dangosyddion bioamrywiaeth swyddogol Cymru

O dan Ddeddf Llesiant Cenedlaethau'r Dyfodol (Cymru) 2015, mae Llywodraeth Cymru yn cynhyrchu ystod o [ddangosyddion Llesiant Cenedlaethol](). Mae carreg filltir yn y Ddeddf 'i wrthdroi'r dirywiad mewn bioamrywiaeth gyda gwelliant yn statws rhywogaethau ac ecosystemau erbyn 2030 a'u hadferiad clir erbyn 2050'. Mae dangosyddion yn cael eu datblygu i adrodd ar hyn, gan gynnwys Dangosydd 44 – statws amrywiaeth fiolegol yng Nghymru (Ffigur 31). Mae hwn ar hyn o bryd yn cael ei ystyried yn ddangosydd 'arbrofol' sy'n ceisio mesur tueddiadau mewn dosbarthiad rhywogaeth blaenoriaethol Cymru (Adran 7). Fe'i defnyddir i fonitro cynnydd gyda'r garreg filltir. Nid yw'r dangosydd yn cynnwys unrhyw rywogaethau morol ar hyn o bryd ac mae hefyd yn hepgor grwpiau o rywogaethau a gwmpesir gan gynlluniau monitro strwythuredig (adar, mamaliaid, glöynnod byw a gwyfynod). Rhwng 1970 a 2016 bu gostyngiad o 13% yn y dangosydd. Mae cynlluniau i ddatblygu'r dangosydd hwn ymhellach ac ymchwilio i ddangosyddion helaethrwydd rhywogaethau cyflenwol.

Pwysau

Fel mewn mannau eraill yn y DU, mae byd natur yng Nghymru dan bwysau. Mae rheoli tir amaethyddol wedi'i nodi fel y ffactor mwyaf arwyddocaol sy'n gyrru newid poblogaeth rhywogaethau yn y DU[341]. Gyda 90%[339] o arwynebedd tir Cymru yn cael ei ddefnyddio ar gyfer amaethyddiaeth, mae dros 50% o orchudd tir Cymru yn laswelltir wedi'i wella a ddominyddir gan rygwellt[351]. Mae natur ar draws yr ucheldiroedd a'r iseldiroedd wedi bod, ac yn parhau i fod, yn agored i arferion ffermio megis rheoli glaswelltiroedd a rhostir yn fwy dwys, colli amrywiaeth cynefinoedd ar raddfa'r dirwedd, pori da byw dwys gyda mewnbwn uchel, ac effeithiau ar rywogaethau arbenigol fel y rhai sy'n gysylltiedig â dirywiad cynefinoedd amaethyddol megis tir âr dwysedd isel.



Ffigur 31: Y dangosydd arbrofol sy'n mesur tueddiadau yn nosbarthiad 113 o rywogaethau â blaenoriaeth yng Nghymru (ffigur wedi'i gymeryd o Smart et al. 2022[337]).

Mae'r Cynllun Ffermio Cynaliadwy newydd, sy'n yn cael ei ddatblygu ar hyn o bryd ac i fod i ddechrau yn 2025, yn anelu at fynd i'r afael â rhai o'r effeithiau arferion amaethyddol presennol. Mae sefydliadau cadwraeth natur yn galw am y cynllun i wneud y mwyaf o gyfleoedd i adfer natur yn ogystal â storio carbon a lleihau'r defnydd o blaladdwyr a maetholion sy'n llifo i afonydd.

Mae dosbarthiad planhigion fasgwlaidd wedi gostwng llai yng Nghymru o'i gymharu gyda rhannau eraill o Brydain Fawr ar gyfartaledd, ond o fewn hyn mae cryn dipyn o symud, gyda thros 40% o ddosbarthiad rhywogaethau yn cynyddu neu'n gostwng yn y drefn honno. Mae dosbarthiad planhigion sy'n gysylltiedig â chynefinoedd iseldir wedi aros yn gymharol sefydlog ers 1970, ac mae'r rhai sy'n gysylltiedig â choetiroedd conwydd wedi gweld cynnydd cyflym. Mae rhywogaethau planhigion fasgwlaidd sy'n gysylltiedig â chynefinoedd ucheldirol fel corsydd a rhostiroedd wedi prinhau'n gyson, er yn fwy graddol ar gyfartaledd nag yn Lloegr a'r Alban, a dangosodd rhywogaethau sy'n gysylltiedig â glaswelltir calchaidd ddirywiad serth, fel mewn mannau eraill ym Mhrydain. Mae dirywiad yr olaf yn adlewyrchu trosi glaswelltir parhaol i ddefnydd tir arall a chyflwr gwael y glaswelltir, er enghraifft oherwydd newidiadau mewn pwysau pori (tanbori a gorbori), rhywogaethau anfrodorol (Cotoneaster) a llygredd[53].

Gwelir patrwm tebyg o newid ar gyfer bryoffytau, a Chymru yw'r unig ran o Brydain Fawr lle mae rhywogaethau mwsogl a llysiau'r afu yn dangos cynnydd hirdymor mewn dosbarthiad cyfartalog. Fodd bynnag, mae'r cynnydd cyffredinol hwnnw'n cuddio rhai dirywiadau sylweddol mewn cynefinoedd bryoffytau arbenigol. Mae bryoffytau epiffytig, a'r rhai sy'n tyfu ar goncrit, tarmac a chynefinoedd artiffisial eraill, wedi cynyddu'n sylweddol iawn ledled Prydain[353] fel mae llygredd sylffwr deuocsid wedi dirywio, ac yn gyffredinol y tueddiad yng Nghymru oedd cynnydd rhwng 1970 a thua 2000. Ers 2000, mae dosbarthiad rhai rhywogaethau wedi parhau i gynyddu, ond mae dosbarthiadau ar gyfartaledd wedi gostwng oherwydd gostyngiadau ymhlith llawer o arbenigwyr gweundir, rhostir, trylifiadau a chreigiau ucheldirol. Efallai bod y newid cyffredinol o 1970 i 2020 ychydig ar i fyny, ond mae hynny'n cuddio dirywiad mewn llawer o rywogaethau[354,355]. Mae lefelau cyson uchel o amonia atmosfferig, yn bennaf o'r diwydiant amaethyddol, uwchlaw'r trothwy critigol ar gyfer bryoffytau a chennau ar draws 69% o Gymru[356]. Mae pwysau eraill sy'n effeithio ar ddŵr croyw a chynefinoedd daearol yng Nghymru yn cynnwys llygredd a rhywogaethau anfrodorol goresgynnol.

Ar raddfa DU canfuwyd bod newid hinsawdd yr ail ysgogydd pwysicaf o newid mewn rhywogaethau ac y mae'n debygol mai hwn hefyd yw yr achos yng Nghymru[341]. Mae helaethrwydd cannoedd o rywogaethau o wyfynod wedi gostwng yn sylweddol yng Nghymru yn yr 50 mlynedd diwethaf a newid hinsawdd wedi cael ei amlygu fel pwysau mawr ar boblogaethau gwyfynod[357]. Tra'i bod yn debygol bod effaith net newid hinsawdd ar wyfynod yng Nghymru yn negyddol, mae hefyd yn debygol o fod wedi cefnogi cynnydd mewn rhywogaethau eraill, yn ogystal ac effeithio ar ffenoleg rhywogaethau (yr amseriad o ddigwyddiadau tymhorol).

Mae'r newid yn yr hinsawdd hefyd yn cael ei amlygu fel pwysau allweddol ar fywyd morol yng Nghymru, ochr yn ochr â phroblemau ansawdd dŵr, gan gynnwys sbwriel yn y môr. Er eu bod yn hollbwysig i gynlluniau i liniaru'r newid yn yr hinsawdd, mae gan dargedau uchelgeisiol i gynyddu'r ynni adnewyddadwy sy'n cael ei gynhyrchu ar y môr[358] y potensial i gael effaith niweidiol ar fywyd morol os na chânt eu cynllunio, eu rheoli a'u monitro mewn modd sensitif.

WALES

CLICK HERE FOR THE WELSH LANGUAGE VERSION ▶

With over 2,000 km of coastline, temperate rainforest with bryophytes, lichens and fungi, and the moorland mountains of Eryri (Snowdonia) and Bannau Brycheiniog (Brecon Beacons), Wales boasts important habitats with some unique wildlife[324]. The marine environment plays a vital role, including internationally important seabird colonies off Pembrokeshire and the Llŷn Peninsula. In 2018, it was estimated that 31% of Wales' land area was covered in semi-natural habitats[325]. With 88%[326] of Welsh land used for agriculture, nature is vulnerable to change in farming practices. In addition, woodland cover in Wales has quadrupled since 1918, mostly due to planting non-native conifers[326].

RSPB Ramsey Island , Nathan Lowe (rspb-images.com)

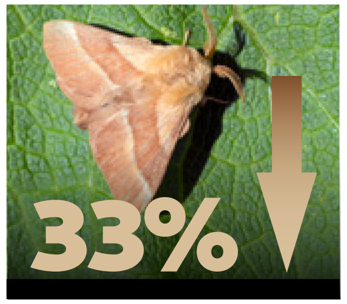
Headlines

Average 20% decline in species' abundance

The abundance of 380 terrestrial and freshwater species has on average fallen by 20% across Wales since 1994. Within this general trend, 140 species have declined in abundance (37%) and 107 species have increased (28%). Moth species on average showed the strongest decline: 43%.

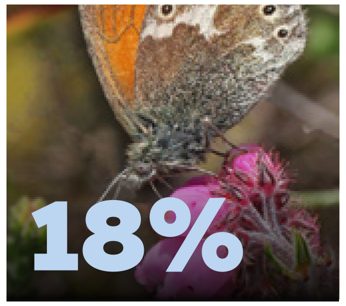
The flora of Wales is greatly changing

Since 1970, the distributions of 42% of flowering plant species and 44% of bryophytes (mosses and liverworts) have decreased across Wales, compared to 40% and 46% of flowering plant and bryophyte species respectively that have increased in distribution. Flowering plants associated with upland habitats have on average declined, whereas many epiphytic bryophytes are recovering from the effects of previous industrial pollution.



Variable patterns of change in the distributions of invertebrate species

The Wales distributions of 3,036 invertebrate species showed contrasting trends: the distributions of 993 species declined (33%) and the distributions of 953 species increased (31%).



18% of species are threatened

Of 3,897 species that have been assessed using Red List criteria, 18% (663 species) are threatened with extinction from Wales.

Seabird stronghold

The abundance of seven regularly monitored species of seabird has showed little change on average since 1986, in contrast to average declines in some other parts of the UK. However, these results pre-date the current outbreak of Highly Pathogenic Avian Influenza.

We are for the first time able to present a multi-taxa species' abundance indicator for Wales, due to increased data availability. In future we would like to develop additional complementary measures to present a more rounded assessment of the state of nature.

KEY FINDINGS

Owing to greater taxonomic coverage of Wales-specific data than in previous *State of Nature* reports, we were able to include a combined abundance indicator for 380 terrestrial and freshwater species for the first time. This indicator covers the period 1994 to 2021, which is much shorter than the 50-year period we report on for the UK and for England, and the results presented here should be interpreted with this in mind. For example, the indicator may not capture the impact resulting from the intensification of agricultural management in the second half of the 20th century. We can generally report on a smaller proportion of species at a Wales level than we can for the UK. For example, we can only include half of the 220 bird species present in Wales in the species' abundance indicator (Figure 24), compared to three-quarters of UK bird species in the UK species' abundance indicator (Figure 1). Abundance trends are based on changes in the number of individuals at a monitored site, a measure that reflects species population size. Distribution trends are based on changes in the number of sites where a species is present. A species whose range has changed could still have a stable distribution indicator if the total area occupied has stayed the same. For a fuller interpretation of the metrics of species' change presented here see the Pressures and responses section. The changes described here follow extensive changes to our land and seascapes earlier in the 20th century and before (see Historical change section).

Ynys Feirig, David Wootton (rspb-images.com)

Lapwing, Andy Hay (rspb-images.com); Harebell, Michael Harvey (rspb-images.com); Lackey, David Kjaer (rspb-images.com); Large Heath Butterfly, John Ibboton; Fulmar, Richard Carlyon (rspb-images.com)

Terrestrial and freshwater

Change in species' abundance

The indicator shows a decline in average abundance of 20% (Figure 24, Uncertainty Interval (UI): -30% to -9%) between 1994 and 2021. Over the last 10 years (2010–2020), the decline was 4% (UI: -11% to +2%).

Within multispecies' indicators like these there is substantial variation between individual species' trends. To examine this, we have allocated species into trend categories based on the magnitude of population change, over the long and the short-term periods.

- Since 1994, 140 species (37%) showed strong or moderate declines and 107 species (28%) showed strong or moderate increases; 133 species (35%) showed little change.
- In the last 10 years (2010–2020), 160 species (43%) showed strong or moderate declines and 122 species (32%) showed strong or moderate increases; 94 species (25%) showed little change.

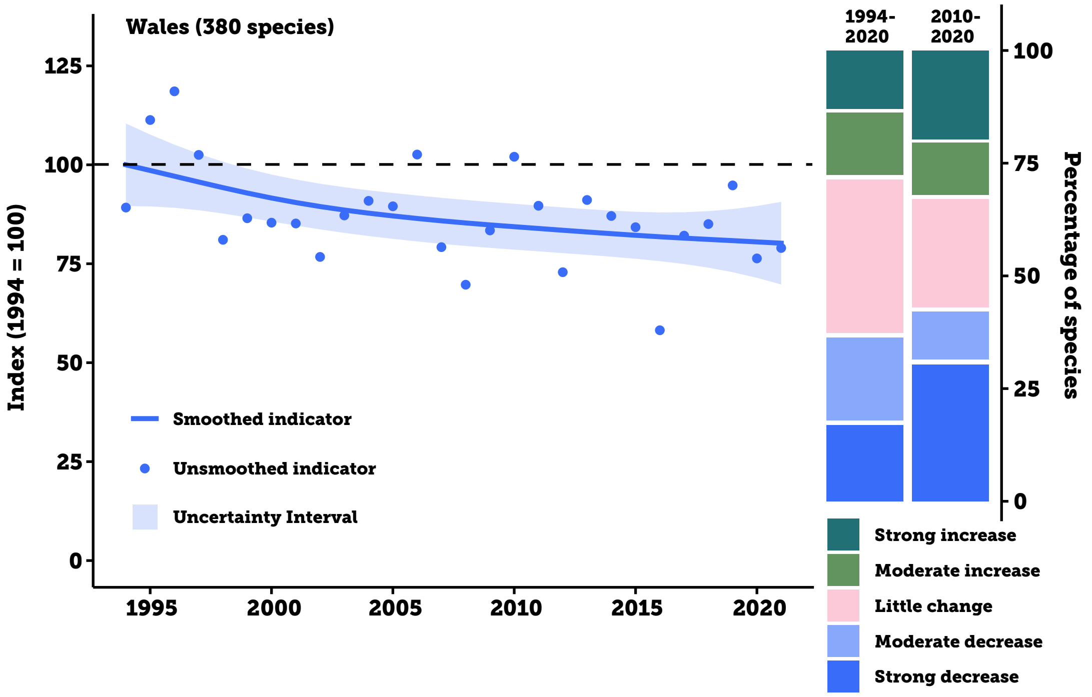


Figure 24: Change in average species' abundance across terrestrial and freshwater species in Wales, based on Wales-specific trends of birds (108 species), butterflies (33 species), mammals (seven species) and moths (232 species). The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in abundance (1994 – 2020: 380 species, 2010 – 2020: 376 species).

See page 184 to find out how to interpret this report

Species' abundance indicators by group

The composite nature of multispecies' indicators means they can hide important variations in trends among both individual species and species groups. Here, to help better understand changes in the headline abundance indicators, we present it disaggregated into major species' groups.

- The abundance indicator for 232 of Wales' commonest moth species starts in 1970 and overall shows a decline in average abundance of 43% (Figure 25A, UI: -54% to -32%). Over the last 10 years, the indicator was 4% lower in 2020 compared to 2010 (UI: -13% to +5%).

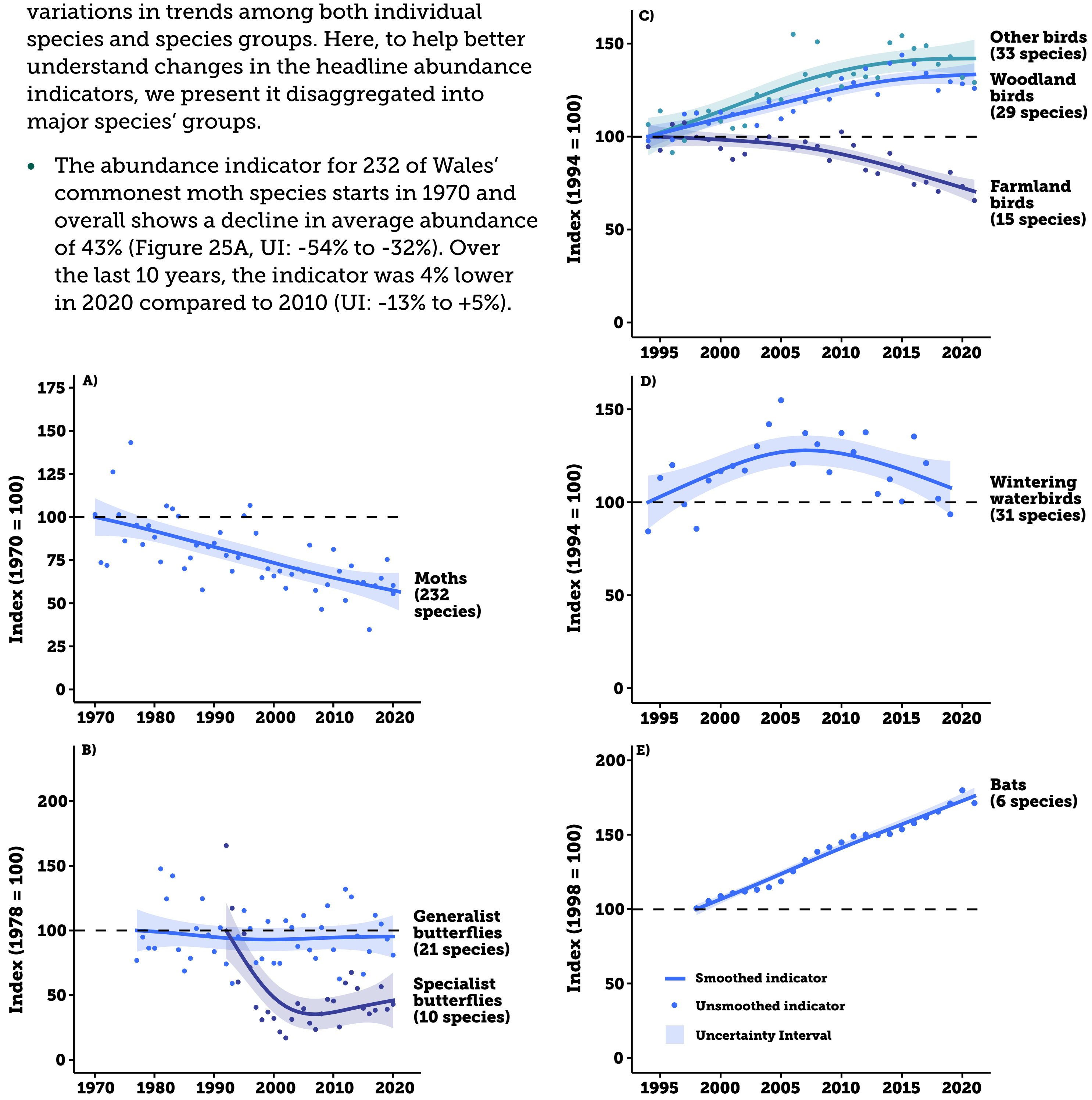


Figure 25: Change in average species' abundance for terrestrial and freshwater species in Wales by habitat preference, level of specialism or taxonomic group.

- Specialist butterflies declined by more than half since 1993 (Figure 25B, -54%, UI: -76% to -32%). Generalist butterflies show greater inter-annual variation but overall have remained stable (-5%, UI: -21% to 12%).
- The abundance indicator for farmland bird species shows a decline in average abundance of 29% since 1994 (Figure 25C, UI: -36% to -23%). This is similar to patterns shown in all other UK countries barring Scotland[327], despite the indicator starting after the main period of intensification of agricultural management. Woodland birds and other birds have seen an average increase in abundance of 33% (UI: +27% to +39%) and 42% (+32% to +52%) respectively. However, population increases may be skewed towards resident and generalist woodland bird species, with ongoing conservation concerns for woodland specialists such as Lesser Spotted Woodpecker and trans-Saharan migrants (eg Wood Warbler).
- Wintering waterbirds show on average little change between 1994 and 2019 (Figure 25D, +8%; UI: -6% to 22%). The indicator rose rapidly in the first decade of the 21st century but has since steadily declined. Wintering waterbird populations have responded to a changing climate, with wintering populations first shifting to the east of the UK and then to continental Europe as winter temperatures have increased, opening up once inhospitable wintering areas, closer to their breeding grounds[326].
- The abundance indicator for six bat species starts in 1998 and overall shows an increase in average abundance of 76% (Figure 25E, UI: +72% to +80%), primarily driven by large increases in two bat species that are recovering from historic declines. These trends are similar to those found across the UK and are likely linked to legislative change giving increased protection to roosts and hibernation sites[328].
- Separate data shows[329] that Atlantic Salmon abundance has declined markedly across Wales in the past decade, and in 2021 all river stocks were assessed as 'at risk' (91%) or 'probably at risk' (9%).

Change in species' distribution

Plants and lichens

- The distribution indicator for 1,186 vascular plant species shows a decline of 4% (Figure 26A, Uncertainty Interval (UI): -6% to -2%) between 1970 and 2019. Within this there was substantial variation between individual species' trends. The distribution of 42% of species decreased, whereas 40% of species showed an increase in distribution. Only 18% of species showed little change. Species associated with upland habitats as well as acid and calcareous grasslands declined on average, whereas species associated with broadleaved and coniferous woodland increased[53].
- The distribution indicator for 776 bryophyte species (mosses and liverworts), with Welsh-specific data, showed on average no change (Figure 26B, +3%; UI:-3% to +8%). This masked the fact that the distribution of nearly all species changed. The distribution of 44% of species decreased, whereas 46% of species showed an increase in distribution. Only 10% of species showed little change. Epiphytic mosses (those that live on other plants), have seen particularly strong average increases associated with declines in sulphur dioxide pollution.
- The distribution indicator for 1,304 lichen species, with Wales-specific data, showed an average increase of 13% between 1980 and 2021 (Figure 26C, UI: 4% to 26%). The distribution of 43% of species decreased, whereas 50% of species showed an increase in distribution. In many parts of the UK, lichens were very badly impacted by historic industrial pollution[330]. Reductions in sulphur dioxide pollution are allowing some species to begin to recover[354]. However, ongoing high levels of nitrogenous air pollution mean that recovery may be skewed towards species that can tolerate this.

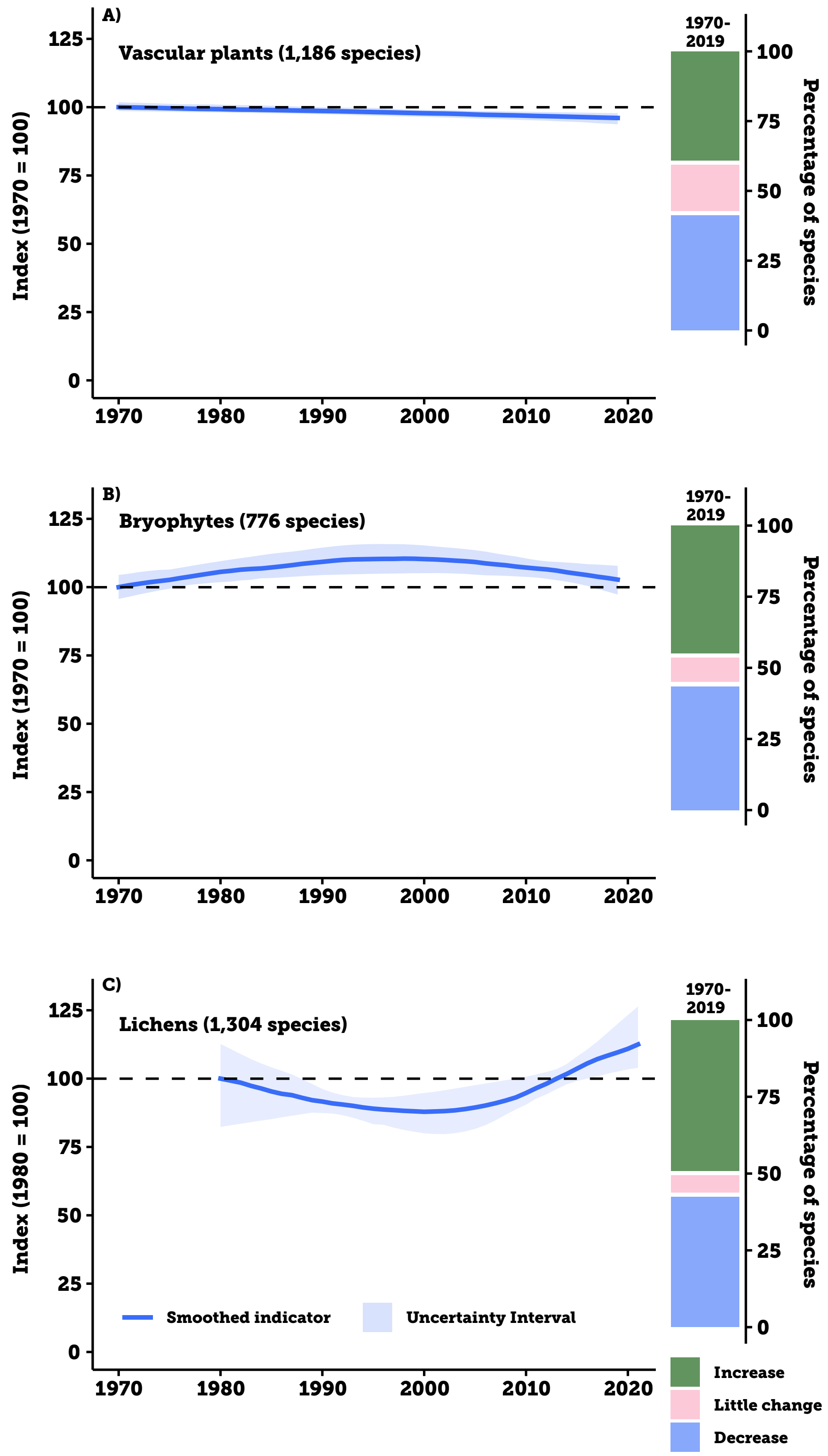


Figure 26: Change in average species' distribution for A) vascular plants, B) bryophytes and C) lichens in Wales. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in distribution.

Sticta Limbata, P Philpot / Plantlife

Invertebrates

The distribution indicator for 3,036 terrestrial and freshwater invertebrate species, with Wales-specific data, shows no change in average distribution between 1970 and 2020 (Figure 27A; -4%, Uncertainty Interval (UI): -12% to +4%).

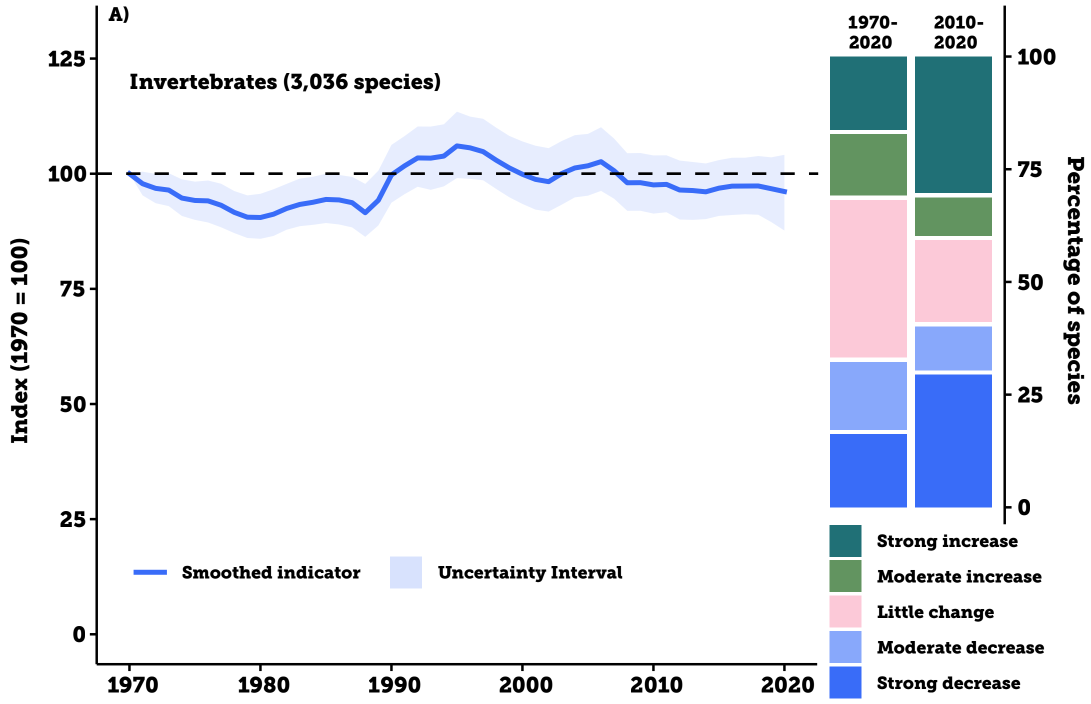
To examine the variation in species' distribution trends, we allocated trends into categories based on the magnitude of distribution change.

- Since 1970, 33% of species showed strong or moderate decreases and 31% showed strong or moderate increases; 36% showed little change.
- Since 2010, 41% of species showed strong or moderate decreases and 40% showed strong or moderate increases; 19% showed little change.

To help understand these patterns of distribution change more clearly, species groups were categorised by the ecological functions they provide[331]. Some groups provide more than one function and so are included in more than one indicator.

- Pollinating insects (bees, hoverflies and moths), which play a critical role in food production, show an average increase of 14% in distribution (Figure 27B, UI: +3% to +25%) since 1970. This average increase in the distributions of pollinating insects, including moths, does not negate the declines in abundance shown in Figure 25. On average, the proportion of sites moth species are found at is increasing but the number of individuals is on average declining[332].
- Insect groups (ants, carabid, rove and ladybird beetles, hoverflies, dragonflies and wasps) that predate species which damage food crops showed an average decline of 12% in distribution (UI: -26% to +2%).
- The average distribution of species supporting freshwater nutrient cycling (mayflies, caddisflies, dragonflies and stoneflies) saw an initial decline followed by signs of a recovery ending 9% higher in 2020 compared to 1978, although with large Uncertainty Intervals (UI: -24% to +51%). This pattern may in part be related to changes in river water quality[333], but although many measures of water pollution have improved over the past few decades, significant water pollution issues remain, in particular in catchments linked to intensive agriculture[349].

White-footed Hoverfly, Nick Upton (rspb-images.com)



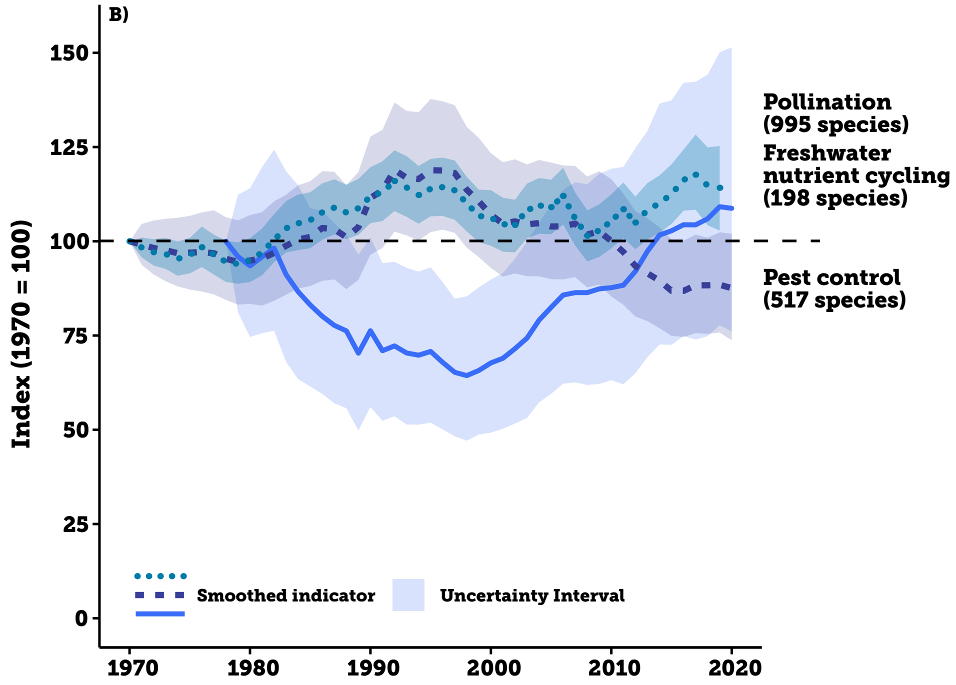


Figure 27: Change in average species' distribution for A) Terrestrial and freshwater invertebrates in Wales. The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in distribution. B) Insect species grouped by ecological function (pollination, pest control and freshwater nutrient cycling.

Extinction risk
Great Britain Red List assessments

Here we break down the IUCN Red List assessments for Great Britain to show the proportion of taxa that are known to have occurred in Wales which qualify for each of the standard threat categories. Taxa assessed as Critically Endangered, Endangered or Vulnerable are formally classified as threatened. Only assessments formally approved by the commissioning statutory nature conservation body have been included.

Since the 2019 *State of Nature* report, the number of taxa formally assessed using the IUCN Regional Red List process[334], and known to have occurred in Wales, has increased from 6,500 species to 7,448. At present we cannot assess whether extinction risk is changing over time because the vast majority of species have only a single Red List assessment. Of the extant taxa, for which sufficient data are available, 579 (8.0%) qualify as being threatened and are therefore at risk of extinction from Great Britain (the scale at which Red List assessments are made) (Figure 28). Of the different taxonomic groups, 236 (10.3%) plants, 76 (5.7%) fungi and lichens, 109 (34.4%) vertebrates and 158 (4.9%) invertebrates qualify as threatened.

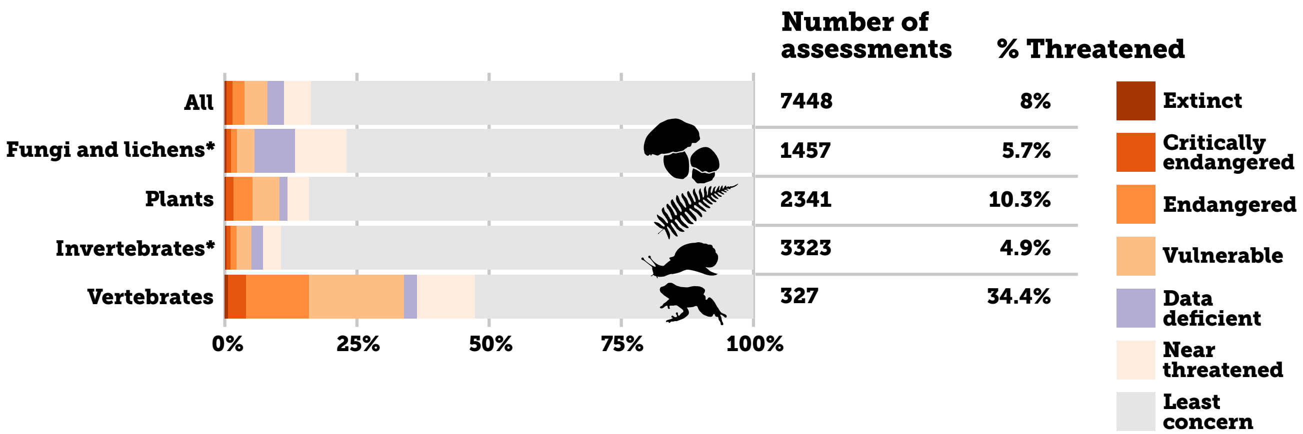


Figure 28: Summary of Great Britain National Red Lists for species' present in Wales, showing the proportion of assessed species in each Red List category, by broad taxonomic group. *At a Great Britain level only selected invertebrate groups have been assessed and less than 1% of fungi species.

Toad, Richard Bowler (rspb-images.com)

Wales-specific IUCN Red List assessments

In order to maximise comparability between taxonomic groups and countries, we present IUCN Red List assessments undertaken at a Great Britain level; however, several taxonomic groups have been assessed for extinction risk at a Welsh scale. These show the following findings:

Group (number of assessments)	Threatened in Wales		Extinct in Wales
	Percentage	Number	Number
Total	18%	663	95
Lichens (1,316)	18%	208	22
Rusts (214)	21%	40	7
Bryophytes (850)	18%	146	26
Vascular plants (1,467)	18%	256	38
Mammals (39)	33%	11	2
Reptiles and amphibians (11)	18%	2	0

Birds of Conservation Concern Wales

Although it is not yet possible to determine how extinction risk is changing over time for most taxa, four assessments have been made of trends in the abundance and distribution of birds in Wales since 2002, the most recent in 2022[352]. These use a consistent suite of criteria to allocate each regularly occurring species as Red, Amber or Green to denote levels of conservation concern; the principal criteria for Red-listing are a decline of more than 50% over 25 years, or a longer period as the data allow. The latest assessment showed that of 220 species assessed, 60 (27%) are now Red-listed, compared to 27 (12%) in the 2002 assessment. Although some changes – mainly additions to the Amber list – resulted from improved data, much was the result of declining trends. The rapid fall in numbers of breeding Rook and of wintering Purple Sandpiper in Wales means that they have moved from Green to Red since 2016. Corncrake and Corn Bunting were declared extinct as breeding birds in Wales, meaning that since 1800 11 species of bird have been lost from Wales. Status improvements in 14 species, including Avocet, Red Kite and Song Thrush, enabled these species to move from Amber to Green.

Marine

Change in species' abundance

Seabirds

The abundance indicator for seven seabird species in Wales starts in 1986 and overall shows little net change in average abundance to 2019 (Figure 29, -3%; Uncertainty Interval (UI): -8% to + 2%). There is a mixed picture for seabirds in Wales. Razorbill has increased over the period. However, Lesser Black-backed Gull and Kittiwake have declined. Populations are susceptible to various pressures, including climate change, prey/food availability, habitat loss and predation. Whilst some populations have shown increases in recent years, they remain susceptible to future changes as they are concentrated in a small number of colonies[335].

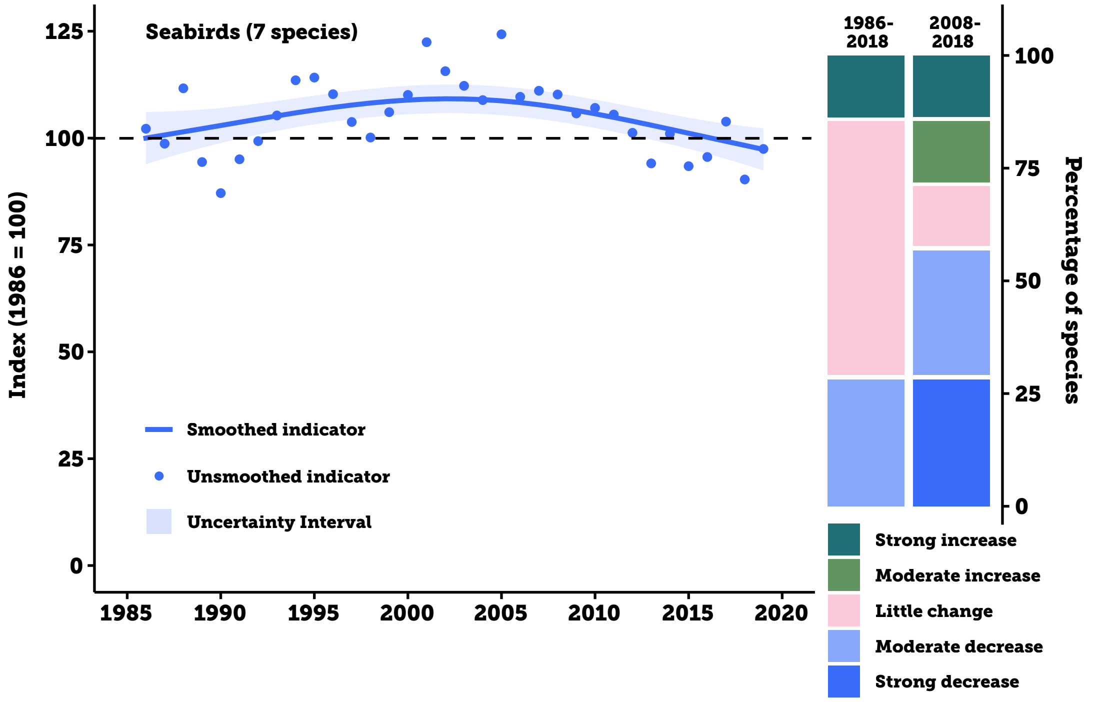
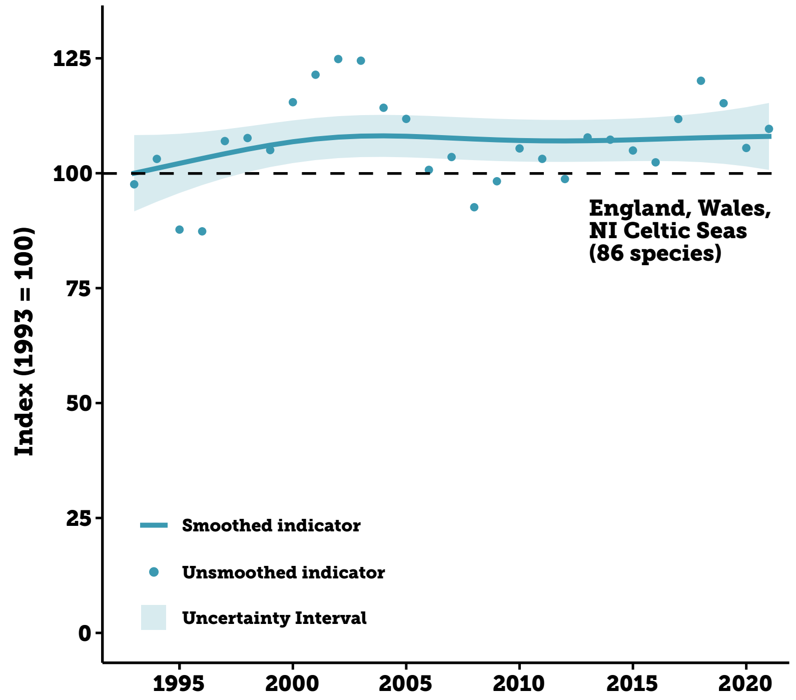


Figure 29: Change in average species' abundance across seven seabird species with Wales-specific trends. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in abundance.

Bottlenose Dolphin, Richard Carlyon (rspb-images.com)

Demersal fish

There was insufficient data within Welsh inshore and offshore waters to produce a robust abundance indicator for demersal fish, so here we present an indicator using data from the Wales, Ireland and Celtic Seas component of the UK EEZ. Between 1993 and 2021 the indicator increased by 8% (Figure 30, UI: 1% to 15%), potentially indicating the recovery of some species from previous declines. It should be noted that many stocks of commercially targeted fish and shellfish species are assessed and managed over large geographic scales and that the species included in the indicator may not be those typically landed by the Welsh fleet in significant numbers.



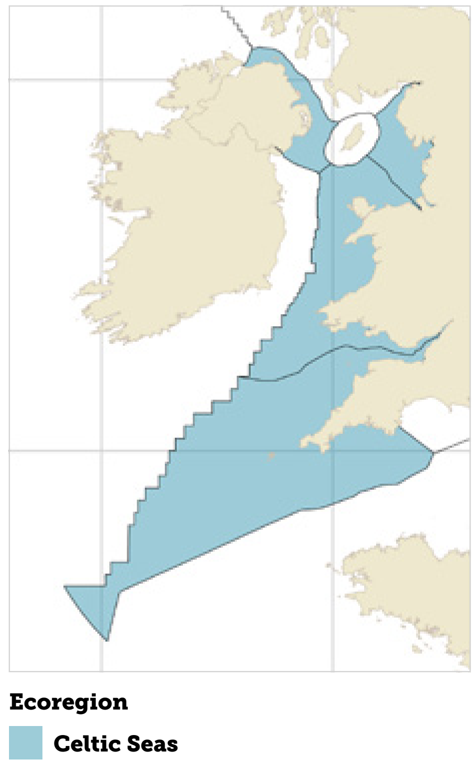


Figure 30: Change in average species' abundance for demersal and bathypelagic fish species in the Wales, England and Northern Ireland and Celtic Seas component of the UK Exclusive Economic Zone (EEZ) from 1993 to 2021.

Marine mammals

The Grey Seal population in Welsh waters has shown an upward trend in pup production over the long term, with an increase in population abundance[335]. In Wales, the coastal Bottlenose Dolphin population centred around Cardigan Bay is considered to be stable over the long term and in favourable condition[254], although abundance is thought to have possibly declined in the last decade[336].

Wales official biodiversity indicators

Under the Wellbeing of Future Generations (Wales) Act 2015, the Welsh Government produces a range of National Wellbeing indicators. There is a milestone within the Act 'to reverse the decline in biodiversity with an improvement in the status of species and ecosystems by 2030 and their clear recovery by 2050'. Indicators are being developed to report on this, including Indicator 44 – status of biological diversity in Wales (Figure 31). This is currently considered an 'experimental' indicator that aims to measure trends in distribution of Welsh priority (Section 7) species. It will be used to monitor progress with the milestone. The indicator does not currently contain any marine species and also omits species groups covered by structured monitoring schemes (birds, mammals, butterflies and moths). Between 1970 and 2016 the indicator declined by 13%. There are plans to further develop this indicator and to investigate complementary species' abundance indicators.

Pressures

As elsewhere in the UK, nature in Wales is under pressure. Management of agricultural land has been identified as the most significant factor driving species population change in the UK[341]. With 90%[339] of Welsh land area utilised for agriculture, over 50% of Wales landcover is improved grasland dominated by rye grass[351]. Nature across the uplands and lowlands has been, and remains, vulnerable to farming practices such as more intensive grassland and moorland management, loss of landscape-scale habitat diversity, high input and intensive livestock grazing, and impacts on specialist species such as those associated with declining agricultural habitats such as low-intensity arable land.

The new Sustainable Farming Scheme, which is currently under development and due to begin in 2025, aims to address some of the impacts of current agricultural practices. Nature conservation organisations are calling for the scheme to maximise opportunities to restore nature as well as to store carbon and to reduce the use of pesticides and nutrient run-off into rivers.

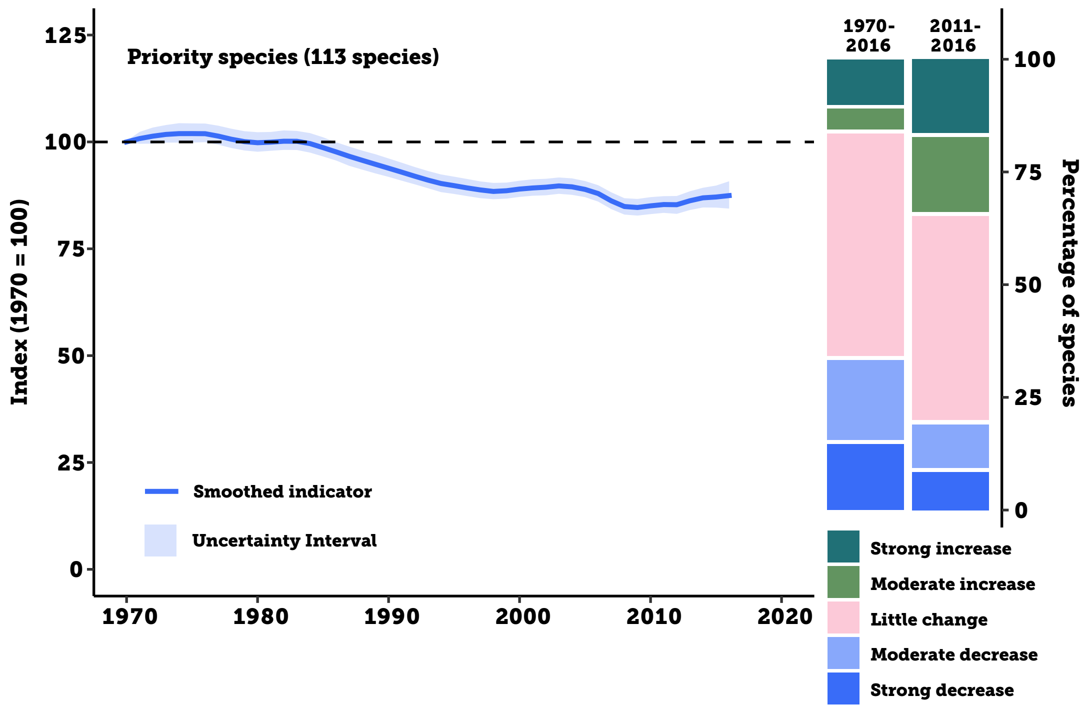


Figure 31: The experimental indicator measuring trends in distribution of 113 Welsh priority species (figure taken from Smart et al. 2022[337]).

The distributions of vascular plants have on average declined less in Wales compared to other parts of Great Britain, but within this there is considerable flux, with over 40% of species' distributions increasing or decreasing respectively. The distributions of plants associated with lowland habitats have remained relatively stable since 1970, and those associated with coniferous woodlands have seen rapid increases. Vascular plant species associated with upland habitats like bogs and heathlands have shown consistent declines, albeit shallower on average than in England and Scotland, and species associated with calcareous grassland showed steep declines, as elsewhere in Britain. The latter's decline reflects both conversion of permanent grassland to other land uses and grassland's poor condition, for example due to changes in grazing pressure (both under and overgrazing), non-native species (Cotoneaster) and pollution[53].

A similar pattern of change is seen for bryophytes, Wales being the only part of Great Britain where moss and liverwort species show a long-term increase in average distribution. However, that overall increase masks some substantial declines in habitat specialist bryophytes. Epiphytic bryophytes, and those which grow on concrete, tarmac and other artificial habitats, have increased very substantially across Britain[353] as sulphur dioxide pollution declined, and the overall trend in Wales was an increase between 1970 and around 2000. Since 2000, some species' distributions have continued to increase, but distributions have on average declined because of reductions amongst many specialists of moorland, heathland, flush and upland rock. The overall change from 1970 to 2020 might be slightly upwards, but that masks declines in many species[354,355]. Persistently high levels of atmospheric ammonia, primarily from the agricultural industry, are above the critical threshold for bryophytes and lichens across 69% of Wales[356]. Other pressures affecting freshwater and terrestrial habitats in Wales include pollution and invasive non-native species.

At a UK scale climate change was found to be the second most important driver of species change and it is likely that this is also the case in Wales[341]. The abundance of hundreds of moth species has declined substantially in Wales in the last 50 years and climate change has been highlighted as a major pressure on moth populations[357]. Whilst it is likely that the net impact of climate change on moths in Wales is negative, it is also likely to have supported increases in other species, as well as impacting species' phenology (the timing of seasonal events).

Climate change is also highlighted as a key pressure for marine life in Wales, alongside water quality issues including marine litter. Although critical to plans to mitigate climate change, ambitious targets to upscale renewable energy generation at sea[358] also have the potential to negatively impact marine life, if not planned, managed and monitored sensitively.

SCOTLAND

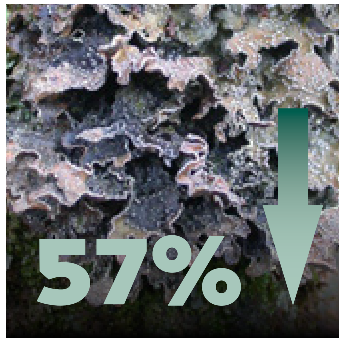
From the montane habitats of the highest peaks, areas of blanket bog and upland heath to the Caledonian pine forests, lochs, coasts and seas, Scotland supports a broad array of wildlife. This includes species found nowhere else in the UK such as One-flowered Wintergreen, Crested Tit and Capercaillie. The deep seas around Scotland host the UK's only underwater mountains, seamounts. Scotland is also of international importance for its breeding seabirds and marine mammals[324]. With approximately 80%[359] of land used for agriculture, changes in farming policies continue to impact Scotland's biodiversity. However, threats are wide-ranging, including climate change, non-native forestry, habitat fragmentation, pollution and introduced species.

Pinewood Wester Ross, Phil Formby / WTML

Headlines

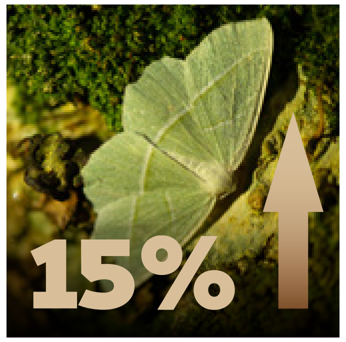
Average 15% decline in species' abundance

For 407 terrestrial and freshwater species, abundance across Scotland has fallen by 15%, on average, since 1994.



Strong decreases in plant and lichen distributions

Since 1970, the distributions of 47% of flowering plants, 62% of bryophytes (mosses and liverworts) and 57% of lichens have decreased, compared to 27, 25 and 34% of flowering plants, bryophytes and lichens respectively, that have increased in distribution.



Average 15% increase in the distributions of invertebrate species

Distributions of 2,149 invertebrates increased by 15% on average since 1970. This was driven by climate change and large average increases in the distributions of aquatic insect species that support freshwater nutrient cycling.

11% of species are threatened

Of 7,508 species in Scotland that have been assessed using IUCN Red List criteria, 11% have been classified as threatened with extinction from Great Britain.

49% decline in average abundance of Scottish seabirds

The abundance of 11 seabird species in Scotland has fallen by 49% on average since 1986. These results pre-date the current outbreak of Highly Pathogenic Avian Influenza.

Grayling, Paul Sawyer (rspb-images.com); Norwegian specklebelly, Andy Acton; Emerald Moth, Phil Formby / WTML; Capercaillie, Ben Andrew (rspb-images.com); Fulmar, Richard Carlyon (rspb-images.com);

KEY FINDINGS

Abundance trends are based on changes in the number of individuals at a monitored site, a measure that reflects species population size. Distribution trends are based on changes in the number of sites where a species is present. A species whose range has changed could still have a stable distribution indicator if the total area occupied has stayed the same.

The species abundance indicator for Scotland covers the period 1994 to 2021. Ecologically, this is a very short timeframe and the findings need to be considered in the context of previous historical losses highlighted in this report. For example, the indicator does not capture the impact resulting from historic woodland losses, forestry expansion or the intensification of agricultural management following the second world war. We can generally report on a smaller proportion of species at a Scotland level than we can for the whole UK, because there are fewer people recording, often covering larger and more remote areas. For a fuller interpretation of the metrics of species change presented here see the Pressures section. The changes described here follow extensive changes to our land and seascapes earlier in the 20th century and before (see Historical change section).

Large Emerald Moth, Helen Rowe

Terrestrial and freshwater

Change in species' abundance

The abundance indicator for 407 terrestrial and freshwater species, for which Scotland-specific trends are available, shows a decline in average abundance of 15% between 1994 and 2021 (Figure 32, Uncertainty Interval (UI): -26% to -5%). Over the last 10 years (2010–2020) the decline was 9% (UI: -15% to -2%).

Within multispecies indicators like these there is substantial variation between individual species trends. To examine this, we have allocated species into trend categories based on the magnitude of population change, over the long and the short-term periods (Figure 32).

- Since 1994, 126 species (31%) showed strong or moderate declines and 153 species (38%) showed strong or moderate increases; 128 species (31%) showed little change.
- Over the last 10 years (2010-2020), 172 species (43%) showed strong or moderate declines and 144 species (36%) showed strong or moderate increases; 82 species (21%) showed little change.

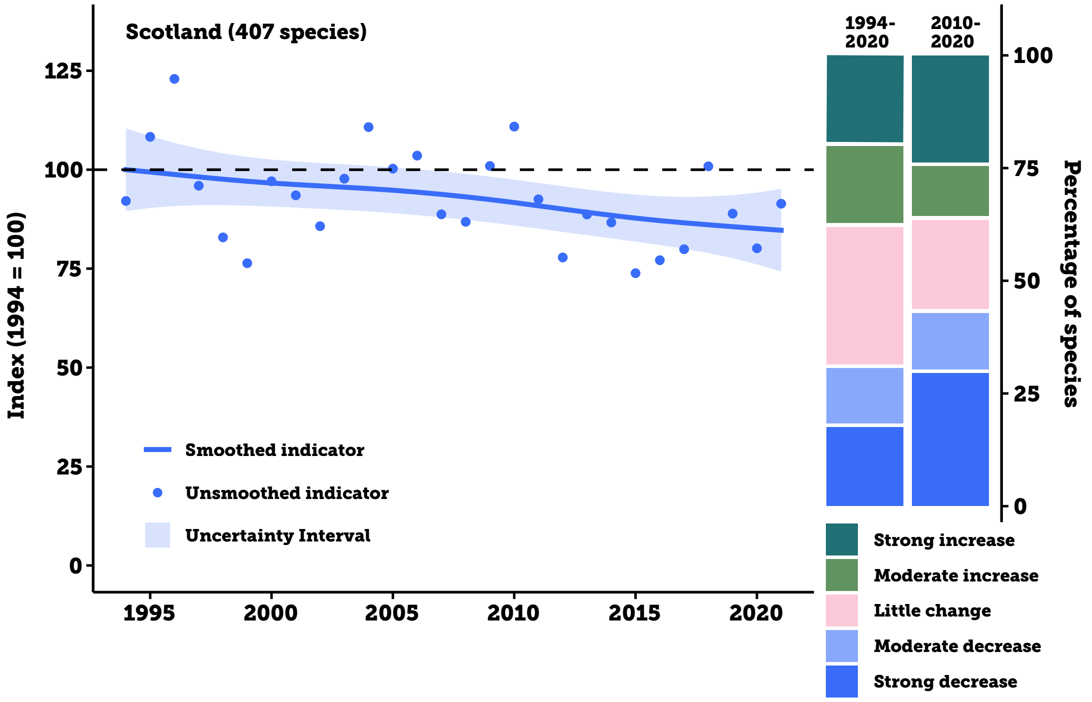


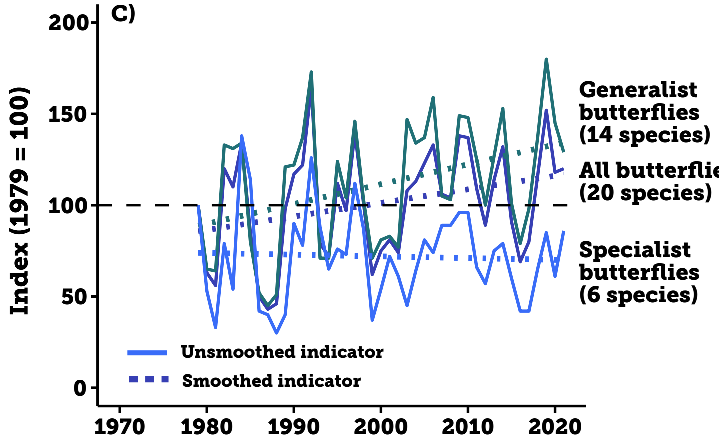
Figure 32: Change in average species' abundance across terrestrial and freshwater species in Scotland, based on Scotland-specific trends of birds (130 species), butterflies (26 species), mammals (9 species) and moths (242 species). The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in abundance (1994–2020: 407 species, 2010–2020: 398 species).

See page 184 to find out how to interpret this report

Species' abundance indicators by group

The composite nature of multispecies indicators means they can hide important variations in trends among both individual species and species groups. Here, to help better understand changes in the headline abundance indicators, we present it disaggregated into major species groups. This allows the use of longer or shorter time series where available.

- The abundance indicator for 242 moth species starts in 1970 and overall shows a decline of 18% (Figure 33A, UI: -29% to -6%). Over the past 10 years, the indicator was -17% lower in 2020 compared to 2010 (UI: -25% to -9%).



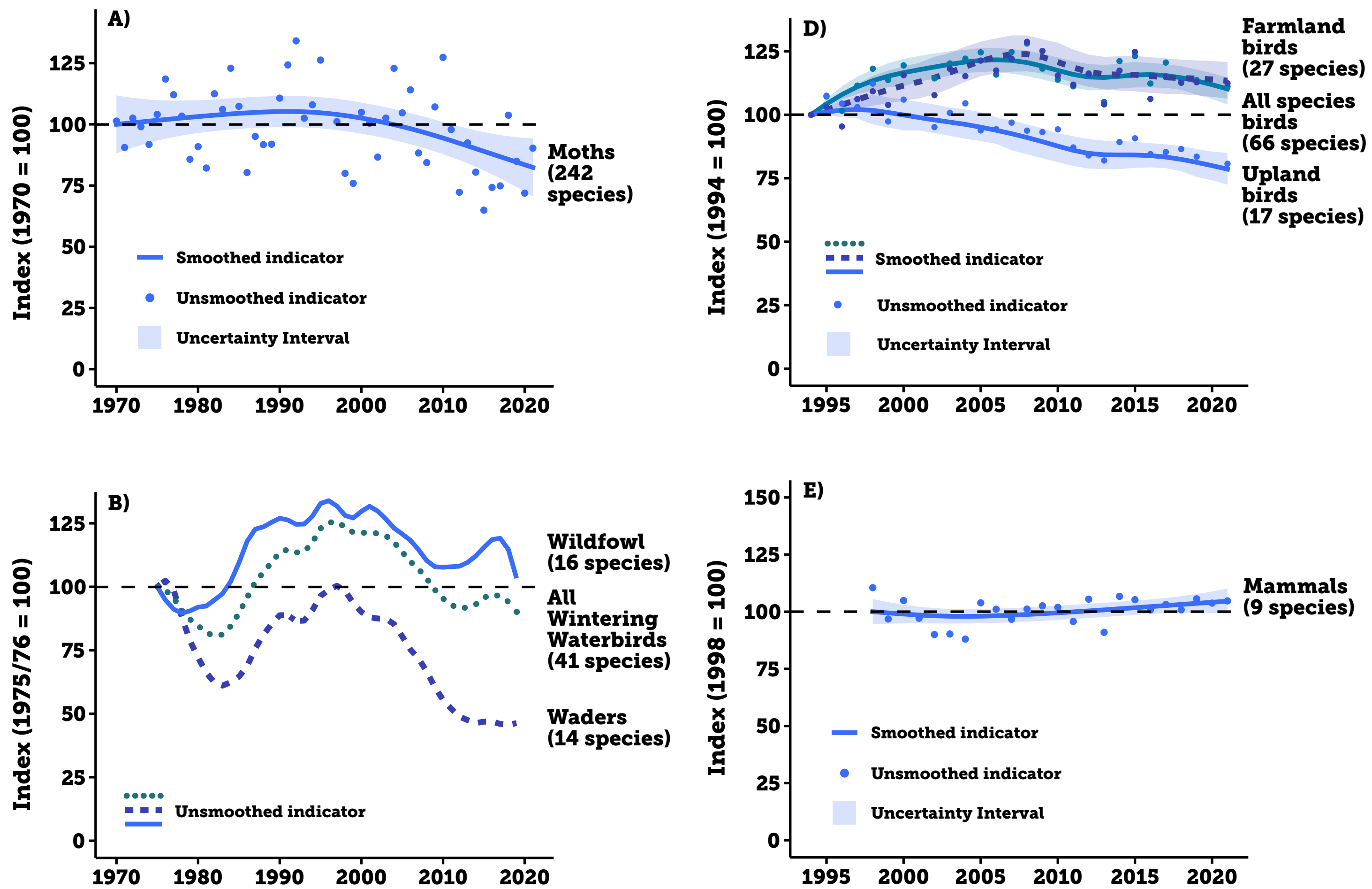


Figure 33: Change in average species' abundance for terrestrial and freshwater species in Scotland by habitat preference, level of specialism or taxonomic group. A) Moths, B) NatureScot Scottish Wintering Waterbird Indicator, C) NatureScot Terrestrial Insect Abundance - Butterfly Indicator, D) NatureScot Scottish Terrestrial Breeding Bird Indicator and E) Mammals. Source for NatureScot's Indicators: nature.scot.

- Scotland hosts internationally important numbers of wintering waterbirds. Many of Scotland's estuaries are crucial for wintering and migrating waders and waterfowl. Between 1975 and 2019 overall waterbird numbers (41 species/populations) have on average decreased by 10% (Figure 33B[363]). Within this, wader species (14 species) have fared particularly poorly, having declined to 55% lower than in 1975/76. The quality of migratory stopover sites for waders, and timing mismatches in breeding season food availability in Arctic breeding grounds, may be negatively impacting these species[363].
- Since the start of the time series in 1979 to the most recent assessment in 2021 the all-species and generalist butterfly species groups increased by 43% and 46% respectively (Figure 33C), likely influenced by a warming climate, allowing species traditionally restricted to more southerly parts of the UK to become more abundant in Scotland[360]. The specialist species group shows a stable trend. Of the 20 species included in the all-butterfly species index, nine have increased significantly, two have decreased.
- Since the start of the time series in 1994 to the most recent estimate in 2021 the all-species combined bird indicator increased by 10%[361] (Figure 33D, UI:5% to 15%). The farmland bird indicator increased by 13% (UI: 6% to 21%), in contrast to patterns of change shown in farmland birds in other UK countries[327]. It should be noted that both indicators are now declining and the farmland indicator started after the main period of intensification of agricultural management, so that earlier losses are not reflected. Within farmland, abundance trends are in general more positive in pastoral areas compared to arable ones. The upland bird index decreased by 21% (UI: -28% to -15%) over the same time period. Long-term changes in upland bird populations may have been influenced by climate change, plantation forest expansion and changes in site management[362].
- The abundance indicator for nine mammal species starts in 1998 and shows no change in average abundance (Figure 33E, 5%, UI: -1% to +10%). Within this average, there is a good deal of variation in species levels changes. The indicator covers five bat species, three of which have increased following historic declines, two increasing deer species, and the declining Rabbit and Brown Hare.

Change in species' distribution

Plants and lichens

- The distribution indicator for 1,223 vascular plant species shows a decline of 14% (Figure 34A, UI: -16% to -13%) between 1970 and 2019. Within this average, the distributions of 47% of species decreased, 27% of species increased and 26% showed little change. Species associated with arable farmland and semi-natural grassland showed particular declines[365].
- The distribution indicator for 879 bryophyte species showed an average decline of 32% (Figure 34B, UI: -38% to -27%) since 1970. The distributions of 62% of decreased, 25% increased and 13% showed little change. Warmer drier summers as a result of climate change are likely to be having a negative impact on some bryophyte species[367].
- The distribution indicator for 1,577 lichen species showed an average decline of 36% (Figure 34C, UI: -38 to -33%) between 1980 and 2021. The distributions of 57% of species decreased, 34% increased and 9% of species showed little change. Scotland is the only UK country where lichen distributions are declining on average. Historical declines in lichens associated with heavy industry were less severe across much of Scotland[330], which may explain why they tend to show less of a positive response to reduced sulphur dioxide pollution. In Scotland, the loss of lichens may reflect the decline of nitrogen sensitive species as the cumulative effects of nitrogenous air pollution have grown, plus the ongoing effects of habitat loss[368]. However, a regional decline in identification capacity may also be part of this overall pattern.

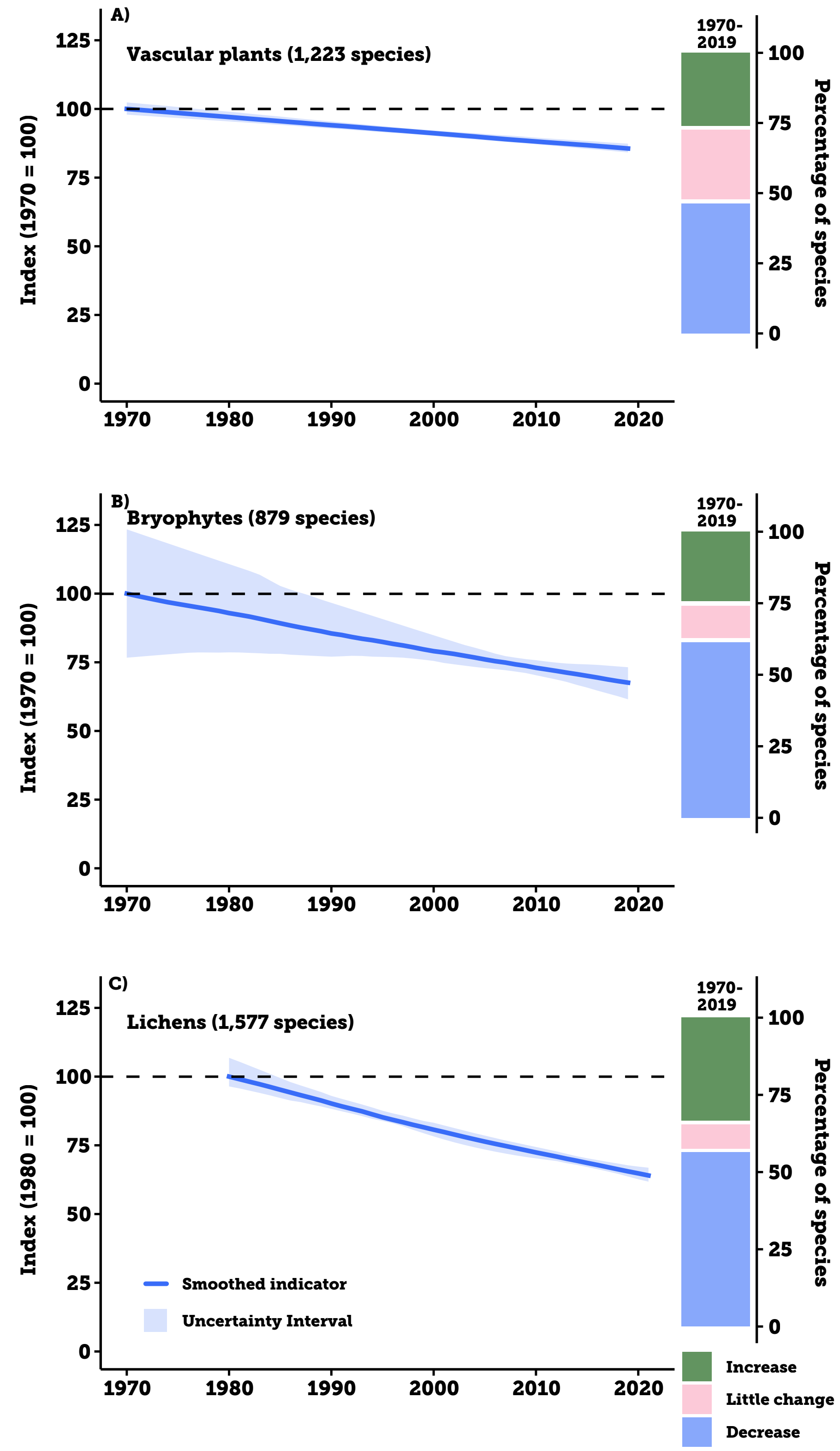


Figure 34: Change in average species' distribution for A) vascular plants, B) bryophytes and C) lichens in Scotland. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in distribution.

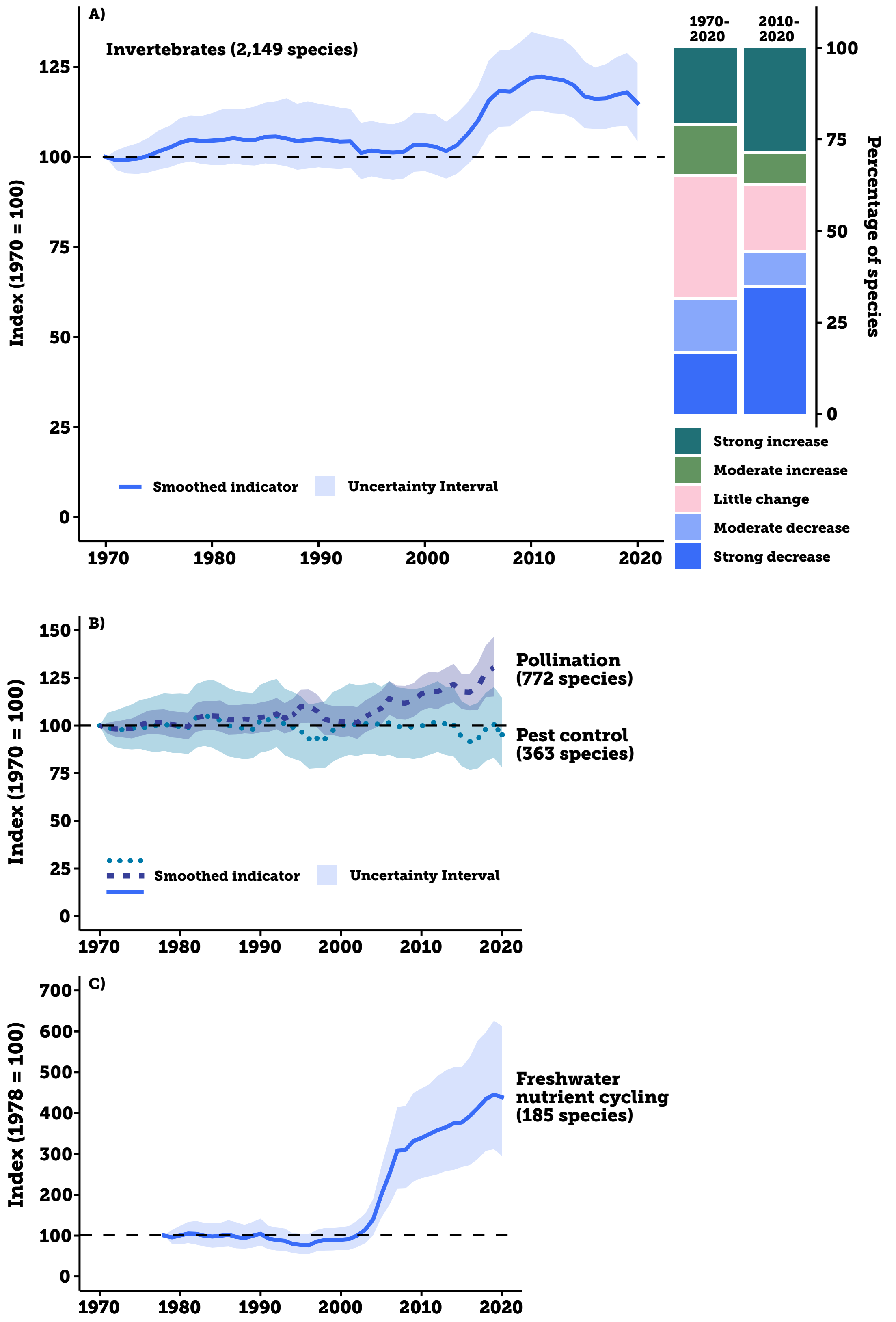


Figure 35: Change in average species' distribution for A) Terrestrial and freshwater invertebrates in Scotland. The bar charts shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in distribution. Insect species grouped by ecological function, B) pollination, pest control and C) freshwater nutrient cycling.

Invertebrates

The distribution indicator for 2,149 terrestrial and freshwater invertebrate species, with Scotland-specific data, increased between 1970 and 2020 by an average of 15% (Figure 35A, UI: +4% to +26%). Within this average, similar proportions of species showed strong or moderate decreases (32%), strong or moderate increases (35%) or little change (33%).

To help understand these patterns more clearly, species groups were categorised by the ecological functions they provide (Figure 35B[331]). Some groups provide more than one function and so are included in more than one indicator.

- Pollinating insects (bees, hoverflies and moths), which play a critical role in food production, show an average increase of 30% (Figure 35B, UI: 15% to 47%) since 1970. This contrasts with pollinator declines in other UK countries and across much of Europe. Climate change might be a factor in this increase, but the trend merits further study.
- Insect groups (ants, carabid, rove and ladybird beetles, hoverflies, dragonflies and wasps) that predate species which damage food crops (act as pest control) showed on average little change (-5%; UI: -22% to +15%).
- The average distribution of species providing freshwater nutrient cycling (mayflies, caddisflies, dragonflies and stoneflies) shows a very rapid increase in the 2000s, ending 339% (Figure 35C, UI: 195% to 514%) higher in 2020 compared to 1978. This pattern may in part be related to changes in river water quality[333] around the turn of the 21st century following implementation of the Water Framework Directive. However (unlike other UK countries), the initial decline in distributions prior to the 1980s is not captured here, as we can only report subsequent changes. This very rapid increase in freshwater insects explains much of the increase in the 'all invertebrates' indicator (Figure 35A). It does not however reflect any more recent changes in freshwater species since 2020.

Black Darter Dragonfly, Mark Hamblin / scotlandbigpicture.com

Extinction risk

Here we break down the IUCN Red List assessments for Great Britain to show the proportion of taxa that are known to have occurred in Scotland, that qualify for each of the standard threat categories. Taxa assessed as Critically Endangered, Endangered or Vulnerable are formally classified as threatened. Only assessments formally approved by the commissioning statutory nature conservation body have been included.

Since the 2019 *State of Nature* report, the number of taxa formally assessed using the IUCN Regional Red List process[334], and known to have occurred in Scotland, has increased from 6,413 species to 7,508. At present we cannot assess whether extinction risk is changing over time because the vast majority of species have only a single Red List assessment. Of the extant taxa, for which sufficient data are available, 764 (10.7%) qualify as being threatened and are therefore at risk of extinction from Great Britain (the scale at which Red List assessments are made) (Figure 36). Of the different taxonomic groups, 347 (14.6%) plants, 140 (8.6%) fungi and lichens, 119 (36.5%) vertebrates and 158 (5.6%) invertebrates qualify as threatened.

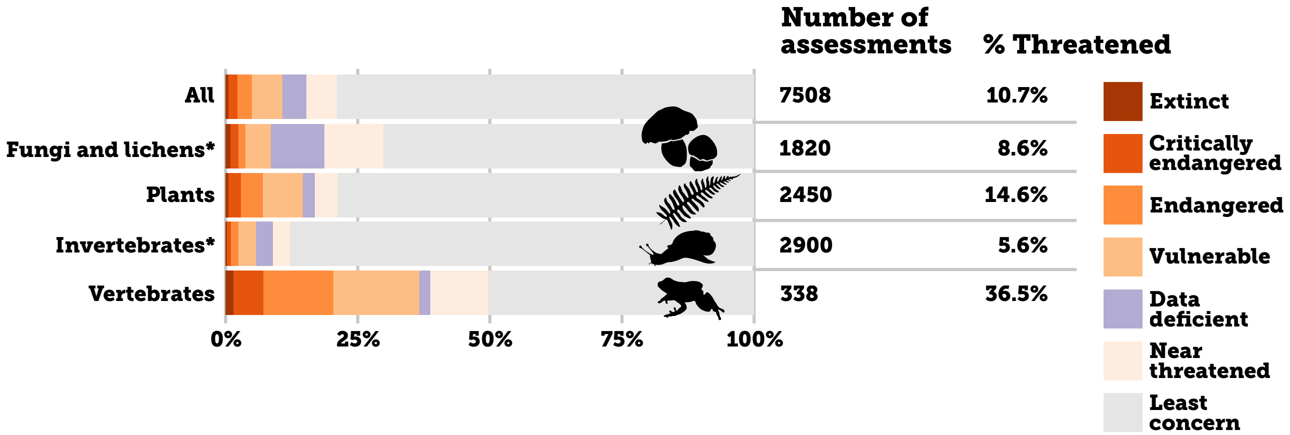


Figure 36: Summary of Great Britain National Red Lists for species present in Scotland, showing the proportion of assessed species in each Red List category, by broad taxonomic group. *At a Great Britain level only selected invertebrate groups have been assessed and less than 1% of fungi species.

Marine

Change in species' abundance

Seabirds

Scotland's breeding seabirds are of international importance. Between 1986 and 2019, the abundance indicator for 11 breeding seabird species shows an average decline of 49% (Figure 37[369]). Of particular concern are precipitous declines in Arctic Skua and Kittiwake, influenced by climate change and changes in fish populations in part associated with fishing pressure. These declines pre-date the as yet unknown but significant likely negative impact of ongoing outbreaks of Highly Pathogenic Avian Influenza.

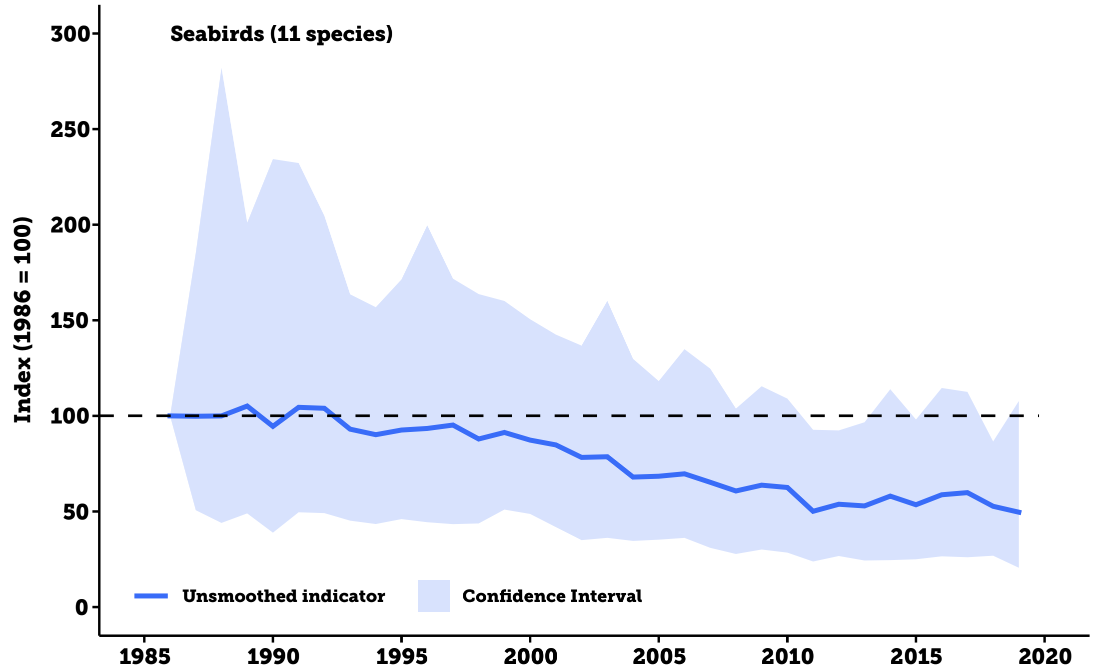


Figure 37: Scottish Biodiversity Indicator – The Numbers and Breeding Success of Seabirds[369]. Change in average species' abundance across 11 seabirds with Scottish-specific trends. Source: nature.scot

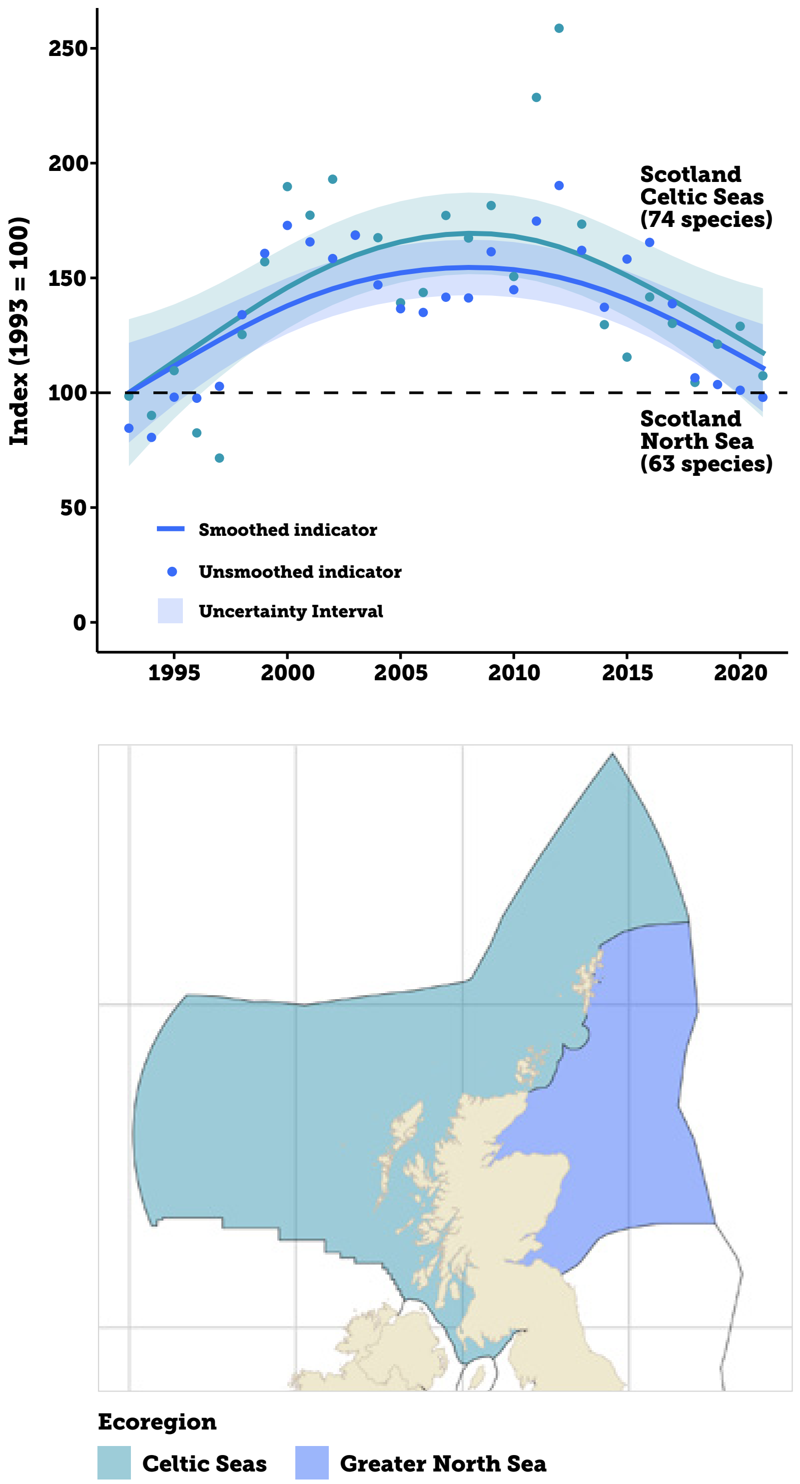


Figure 38: Change in average species' abundance for demersal and bathypelagic fish species (fish that live at or close to the seabed) in the Scottish Celtic Seas and the Scottish Greater North Sea from 1993 to 2021.

Demersal fish

Average abundance of demersal fish species in both the Celtic Seas and Greater North Sea increased in the early years of the 21st century but has since declined towards pre-2000 levels (Figure 38, Celtic Seas: +17%, UI: -11% to +46%; Greater North Sea: +11%, UI: -8% to +30%). The proportion of stocks of fish and shellfish harvested sustainably (below the maximum sustainable yield) has more than doubled since 1991, with the latest estimate being 69% in 2019[370]. However, some fish stocks such as Cod remain in a poor state while others like Sandeels are still harvested in large tonnages despite being important prey for seabirds, marine mammals and other fish species[338]. The increase in stocks sustainably harvested may account for some of the increase in the demersal fish indicator during the first half of the time series. Some areas of the North Sea have been closed to Sandeel fisheries since 2000 and there are signs that this has benefited both the fish and their seabird predators[155]. It is less clear what is driving the more recent declines. Work is ongoing to improve understanding of climate change-driven impacts on plankton communities at the base of the marine food web and implications for wider ecosystem functioning, including the productivity of fisheries[340].

Pressures

On land, pressures come from many sources, including climate change, agriculture, upland management, land-use change, habitat fragmentation, changes in grazing levels (particularly overgrazing by deer), pollution and invasive non-native species.

Climate change places additional stresses on Scotland's wildlife, sometimes exacerbating the impacts from other pressures, for example habitat fragmentation[342] or invasive non-native species. Many species previously only present in the south of the UK are now present in Scotland and increasing in abundance. This is a pattern shown particularly clearly with butterflies, with generalist butterfly species increasing on average and several species thought to be positively impacted by climate change[360]. Conversely, species already at the southern limit of their range in Scotland and that directly or indirectly depend on cooler climates for survival, eg, Mountain Ringlet, Cross-Whorl Snail and Dotterel, are potentially vulnerable to ongoing climate change, as are montane plants and bryophytes[343]. Three Arctic-Alpine specialist vascular plants have suffered severe declines of over 50% of their population size since the mid-1990s[344]. Scotland hosts internationally important populations of bryophytes (mosses, liverworts and hornworts). These species are well adapted to our moist climate. However, warmer summers and more frequent droughts are affecting the assemblage of species, with a decline in species that are intolerant of hotter or drier summers[367]. Droughts are becoming more frequent and more intense, and modelling suggests that this pattern will continue, with intensifying impacts on habitats and species[345].

Pollution

The Scottish distributions of more than half of lichen species have declined since 1980. Statistical analysis of data from long-term grassland sites in Scotland demonstrates that while there is some recovery from high levels of sulphur deposition in the 1970s there is no comparable recovery from the impacts of nitrogen pollution[346]. Anthropogenic nitrogen deposition is implicated in the decline in condition and extent of some key habitats in upland areas of Scotland[347]. Montane specialist bird species such as Dotterel are dependent on this habitat, and loss of Racomitrium heath is implicated in the decline of this species.

Significant efforts to restore Scotland's rivers did not occur until 1965. Reductions in heavy industry, the enforcement of new international and national legislation and heightened environmental awareness all

Grangemouth oil refinery, David Palmar (rspb-images.com) contributed to improvements in river quality. The proportion of river length classed as polluted declined from 7% in 1998 to 3% in 2018[348]. This change coincided with rapid increases in the distributions of many freshwater insects and may have played a part in these species' recoveries. Although many measures of water pollution have improved over the past few decades across Scotland and the UK more broadly, significant issues remain, in particular in catchments linked to intensive agriculture[349].

Agriculture

Scotland supports three-quarters of the vascular plant species found in Great Britain, and the distributions of 47% of these have declined since 1970. Species associated with arable farming have shown particular declines associated with changes in agricultural management, for example the increased use of herbicides and artificial fertilisers, and also the abandonment of small-scale cropping around crofts in northern and western areas. Species associated with acid and calcareous grassland also showed substantial declines likely linked to conversion of these habitats to farmland and associated increased use of chemical fertilisers, re-seeding and a change from hay to silage production[365].

Sea use and climate change

Scotland's seas are also subject to a range of pressures. Progress has been made on improving water quality, contaminants and eutrophication in coastal waters, and some fish stocks are showing signs of recovery. Other pressures, such as those associated with climate change, ocean acidification, marine plastics, unsustainable fisheries, offshore renewables and other developments, still exist and there is evidence of change in pelagic habitats and plankton communities.

Non-native species and disease

The ongoing outbreak of Highly Pathogenic Avian Influenza (HPAI) in wild birds is the most serious ever recorded. The impact in the winter of 2021/2022 on the population of Barnacle Geese that come from Svalbard to winter on the Solway in Scotland was devastating, with around a third of the population dying. Eighteen of the 25 UK breeding seabird species tested positive for HPAI in 2022 and across RSPB reserves at least 15,000 birds were recorded dead. Seabirds are particularly vulnerable, as they normally have high adult survival rates and are slow to reproduce and will be slow to recover. For Great Skua and Gannets, two of the species where observed mortality was greatest, Scotland hosted, before HPAI impacts began, 60% and 46% of the global populations respectively. Initial estimates suggest a decline in occupied Great Skua territories of well over a half in Foula, Shetland, which is the largest colony of this species in the world[371] and seabird population monitoring work in 2023 will produce estimates of the impacts of HPAI on the numbers of those seabird species most badly affected in 2021/22. Raptors have experienced marked declines in breeding success linked to HPAI, particularly Golden and White-tailed Eagles[350]. The ongoing impact of HPAI is difficult to predict, but this novel additional pressure on our wildlife emphasises the need for resilient ecosystems and species populations.

Invasive non-native species (INNS) continue to spread and increase in terrestrial, freshwater and marine environments across Scotland[39]. INNS present on islands that are important for breeding seabirds constitute a major threat to globally significant populations. Invasive species continue to impact habitats and native species across Scotland, and several projects are underway to combat the threat. However overall the problem is intensifying, and the threat is likely to increase with climate change.

RSPB Inversnaid, Loch Lomond, Andy Robinson

NORTHERN IRELAND

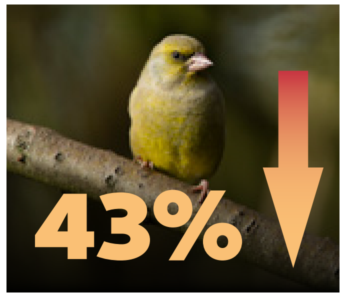
The wet and mild climate of the island of Ireland and a complex geology have led to a unique composition of habitats. The landscape is dominated by enclosed farmland, interspersed by blanket bog, water bodies, lakes and fens. Northern Ireland supports species and subspecies found nowhere else in the UK, including the Irish Hare, Irish Damselfly and Irish Whitebeam[324].

With over 650 km of coastline and over 6,800 km^2 of sea area, the marine environment is significant. It supports internationally important wintering waterbirds, as well as breeding seabird colonies[324] and marine mammals.

Approximately 76% of land is used for agriculture[372], which means changes in farming policies have a major impact on biodiversity.

Belfast Lough, Simon Watterson (rspb-images.com)

Headlines

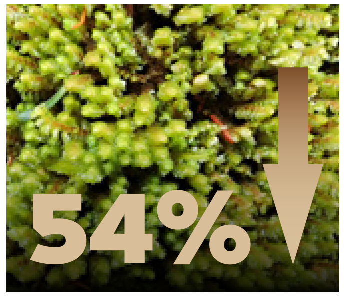


Rapidly declining farmland birds

The abundance of 17 farmland bird species has on average fallen by 43% across Northern Ireland since 1996. Across all 64 breeding birds assessed, species' abundance had declined on average by 10%.

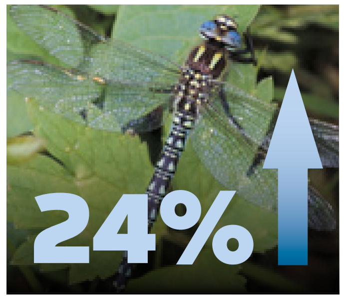
Average 30% decline in wintering waterbirds abundance

The indicator of average species' abundance in Northern Ireland of 36 wintering waterbird species has fallen by 30% since 1988.



Average 54% decline in bryophyte species' distributions

Since 1970, the distributions of 576 species of bryophytes (mosses and liverworts) have declined on average by 54% and the distributions of 891 species of flowering plants by 14%.



Average 24% increase in the distributions of invertebrate species

Seventy per cent of species in this assessment were moths. The distributions of 552 invertebrate species in Northern Ireland showed contrasting recent trends, the distributions of 162 species (29%) declined and the distributions of 223 species (40%) increased.

12% of species are threatened

Of 2,508 species in Northern Ireland that have been assessed using IUCN Regional Red List criteria, 12% have been classified as threatened with extinction from Ireland as a whole.

Northern Ireland has less biodiversity data than the other UK countries and we cannot yet produce a multitaxa species abundance indicator for Northern Ireland as we do elsewhere. There are some important groups, such as lichens, where there are currently insufficient data available to produce an indicator for Northern Ireland. For the groups we can report on, the time period covered is often shorter and the proportion of species included per group is lower.

KEY FINDINGS

Owing to low sampling intensity, partly as a result of its smaller geographical size, a single combined abundance indicator was not created for Northern Ireland; however, smoothed abundance indicators were calculated for six separate species groups (Figure 39). These were created using Northern Ireland-specific data for all species, except for bats where trends for all Ireland were used. As less data are available, the bird indicators for Northern Ireland include 37 species well monitored by the breeding bird survey and an additional 19 species less well covered but whose trends are considered robust because their habitat is represented and abundance does not fluctuate greatly between years. Abundance trends are based on changes in the number of individuals at a monitored site, a measure that reflects species population size. Distribution trends are based on changes in the number of sites where a species is present. A species whose range has changed could still have a stable distribution indicator if the total area occupied has stayed the same. For a fuller interpretation of the metrics of species change presented here see the Pressures section.

The changes described here follow extensive changes to our land and seascapes earlier in the 20th century and before (see Historical change section). The indicators go back to 1988 at the earliest and some only cover the 21st century. This is much shorter than the 50-year period we report on for the UK and for England and the results presented here should be interpreted with this in mind. For example, the indicators do not capture the impact resulting from the intensification of agricultural management in the second half of the 20th century.

Carlingford Lough Islands, Andy Hay (rspb-images.com)

Greenfinch, Ben Andrew (rspb-images.com); Lapwing, Ben Andrew (rspb-images.com); Western Earwort, Gordon Rothero; Shrill Carder Bee, Nick Upton (rspb-images.com); Hairy Dragonfly, Chris Gomersall (rspb-images.com)

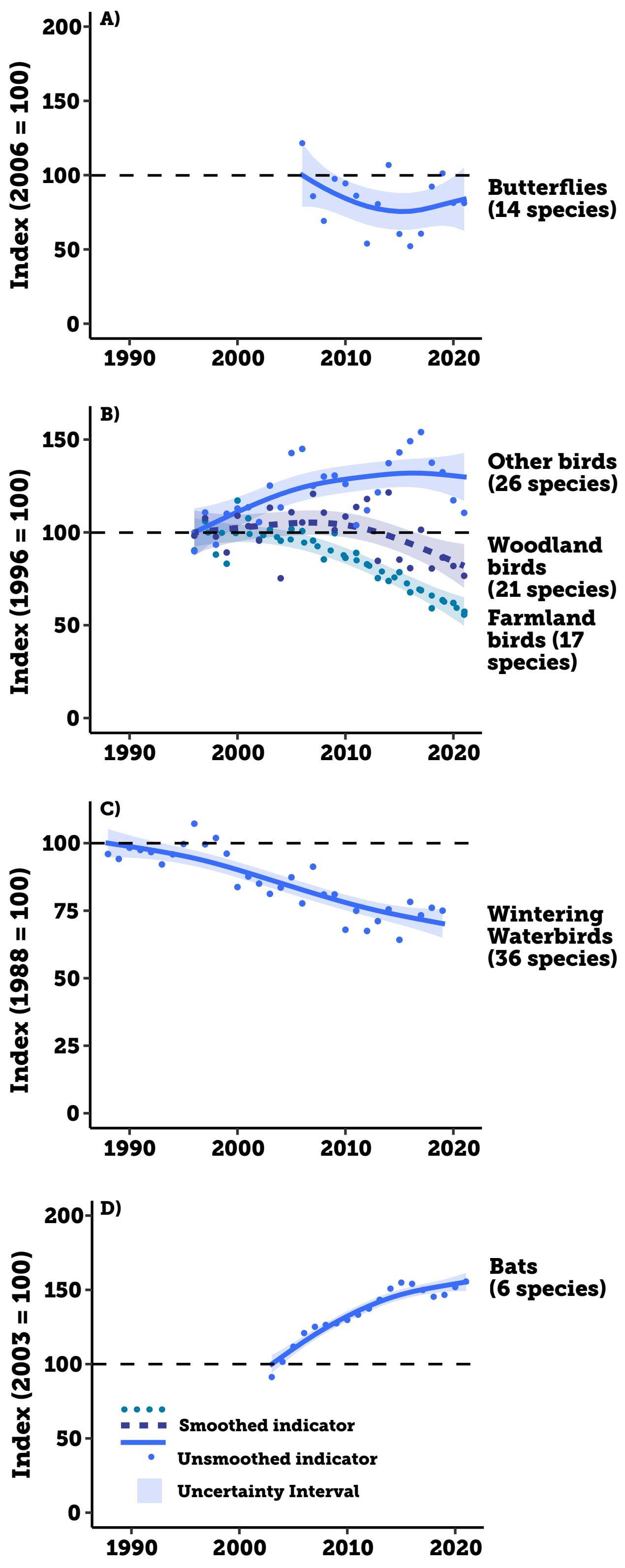


Figure 39: Change in average species' abundance for terrestrial and freshwater species in Northern Ireland by habitat preference and taxonomic group.

Terrestrial and freshwater

Change in species' abundance by group

- The abundance indicator for 14 butterfly species starts in 2006 with a decline that levelled off about 10 years ago. Overall change in average abundance to 2021 is -16% (Figure 39A, Uncertainty Interval (UI): -37% to +5%). Only about half of the resident and regularly breeding butterfly species in Northern Ireland had sufficient data to calculate long-term trends and some species of conservation concern cannot yet be included, such as Small Blue and Dingy Skipper[375].
- The abundance indicator for farmland bird species shows a decrease in abundance on average of 43% between 1996 and 2021 (Figure 39B, UI: -50% to -35%), similar to other UK countries[327], despite the indicator starting after the main period of intensification of agricultural management. Woodland birds have also declined on average, in particular in the last 10 years (-18%; UI: -30% to -6%). Other breeding birds, which includes many wetland species, have on average increased in abundance by 30% (UI: +17% to +43%). Across all 64 breeding bird species there was a 10% decline (UI: -18% to -3%; combined trend line not shown on figure). A breeding bird indicator is published by NIEA[373]. Our analysis includes an additional eight rarer bird species but shows similar patterns of change.
- The abundance indicator for 36 wintering waterbirds species starts in 1988 and overall shows a decline in average abundance of 30% by 2019 (Figure 39C, UI: -35% to -25%). Diving duck species wintering at Lough Neagh have experienced large declines this century. Climate change may mean a lower proportion of the populations are wintering in Northern Ireland, but the declines also coincide with a dramatic decrease in the macroinvertebrate community in Lough Neagh[374].
- The abundance indicator for six bat species starts in 2003 and overall shows an increase in average abundance of 55% (Figure 39D, UI: +49% to +61%). Over the last 10 years, the indicator was 14% higher in 2020 compared to 2010. Two new bat trends were included in the report this time, Nathusius' Pipistrelle and a combined assessment for Myotis species. Due to low survey coverage, there is greater uncertainty associated with this data and conclusions should be interpreted very cautiously. Nathusius' Pipistrelle show a strongly increasing trend, whereas Myotis species show a strong decline[407].

Change in species' distribution

Plants

The distribution indicator for 891 vascular plant species showed an average decline of 14% (Figure 40A, UI: -18% to -10%) between 1970 and 2019. Within this average, 42% of species decreased in distribution, compared to 43% of species, which showed an increase.

Distributions of 576 bryophyte species in Northern Ireland have on average declined by more than a half since 1970 (Figure 40B, 54%; UI: -68% to -37%). Within this average, 62% of species declined in distribution, compared to 34% of species which showed an increase; remarkably few species showed little change in distribution.

One key pressure on plants in Northern Ireland is continued high levels of nitrogenous air pollution. Out of the UK countries, Northern Ireland has the greatest percentage of nitrogen-sensitive habitats exceeding critical ammonia levels for both lower and higher plants, and ammonia levels continue to rise[356].

We were unable to produce a lichen indicator for Northern Ireland for this report, but these important datasets do exist and we would hope to make use of them in future.

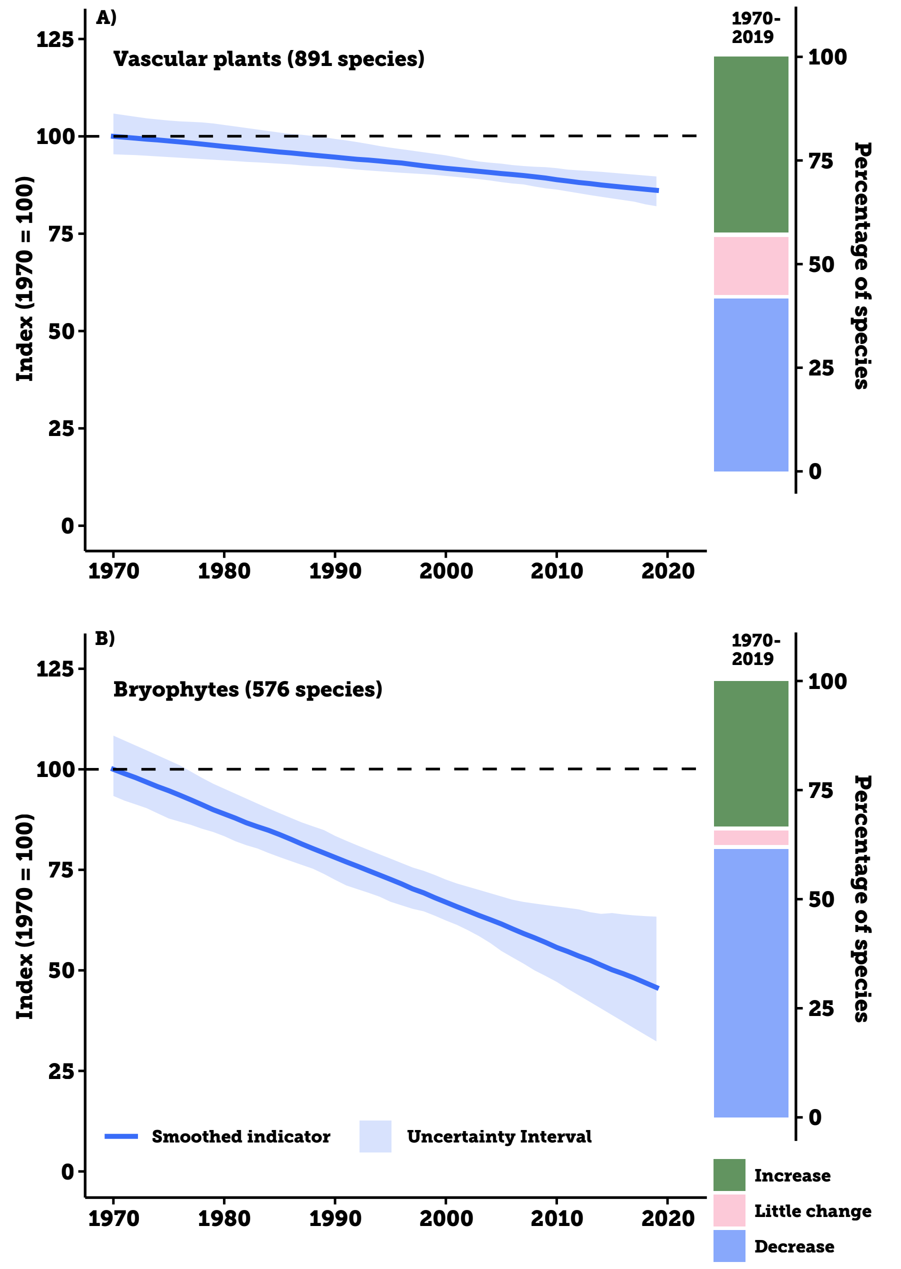
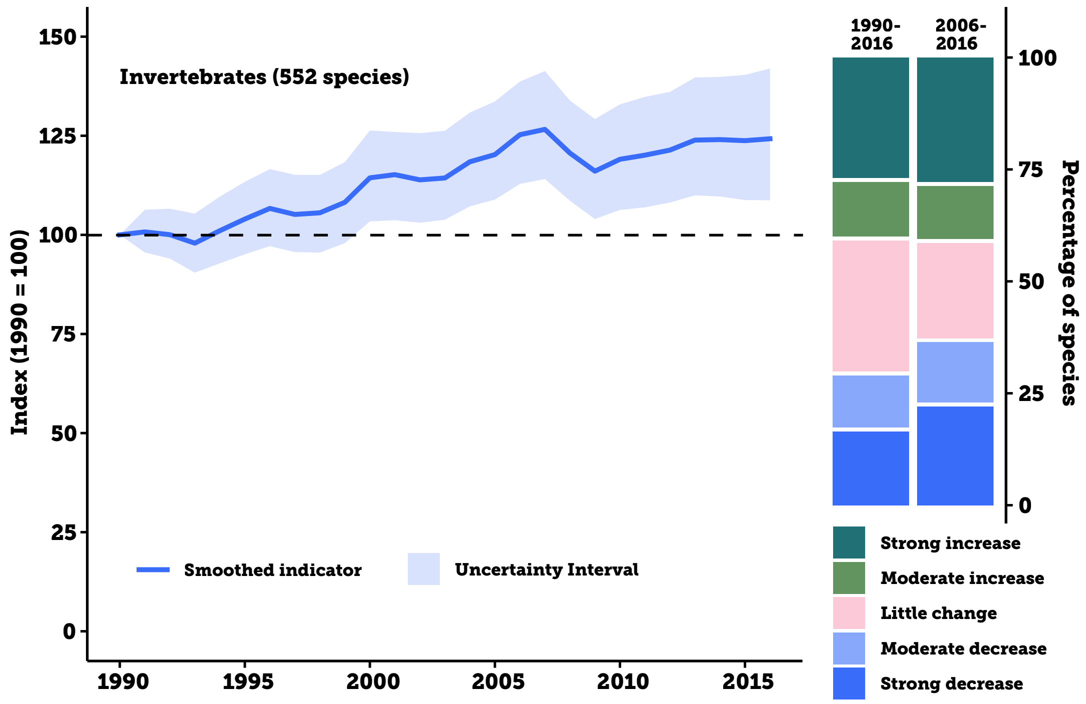


Figure 40: Change in average species' distribution for A) vascular plants and B) bryophyte species in Northern Ireland. The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in distribution.

Invertebrates

The distribution indicator for 556 terrestrial and freshwater invertebrate species, with Northern Irish data, shows an increase in species' distributions on average between 1990 and 2016 (Figure 41, 24%, UI: 9% to 42%). It should be noted that this indicator covers a much shorter period than similar indicators of invertebrate distribution for the UK and other UK countries; it also ends earlier. This increase in average distribution is contrary to reported decreases in invertebrate abundance in recent years[376]. Nearly 70% of the species included in the indicator are moths. The latest *State of Moths* report's[376] distribution indicator does not cover Northern Ireland, but it does show an average increase in species' distributions across Great Britain and the Isle of Man, and mentions some cool-adapted species advancing their northward range boundary in relation to climate change, which is likely to be a contributing factor for the increases presented here. Within the average indicator shown in Figure 41, since 1990, 29% of species showed strong or moderate decreases and 40% showed strong or moderate increases; 30% showed little change. In the last 10 years (2006-2016), 37% of species showed strong or moderate decreases and 41% showed strong or moderate increases; 22% showed little change.

Figure 41: **Change in average species' distribution** for terrestrial and freshwater invertebrate species in Northern Ireland. The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in distribution.



See page 184 to find out how to interpret this report

Extinction risk

As no IUCN Red List assessments have been conducted at a Northern Ireland scale, here we summarise the Red List assessments for the island of Ireland, but we include only species known to have occurred in Northern Ireland. Taxa assessed as Critically Endangered, Endangered or Vulnerable are formally classified as threatened. This approach represents our best estimate of Extinction Risk in Northern Ireland; however, it is imperfect, as the population status of species may differ in Northern Ireland compared to the island as a whole.

Since the 2019 *State of Nature* report, the number of taxa formally assessed using the IUCN Regional Red List process[334], and known to have occurred in Northern Ireland, has increased from 2,450 species to 2,508. We cannot, at present, assess whether extinction risk is changing over time because the vast majority of species have only a single Red List assessment.

Of the extant taxa, for which sufficient data are available, 281 (11.5%) qualify as being threatened and are therefore at risk of extinction from the island of Ireland (the scale at which Red List assessments are made) (Figure 4). Of the different taxonomic groups, 144 (9.8%) plants, 11 (20.4%) vertebrates and 126 (13.9%) invertebrates were assessed as threatened.

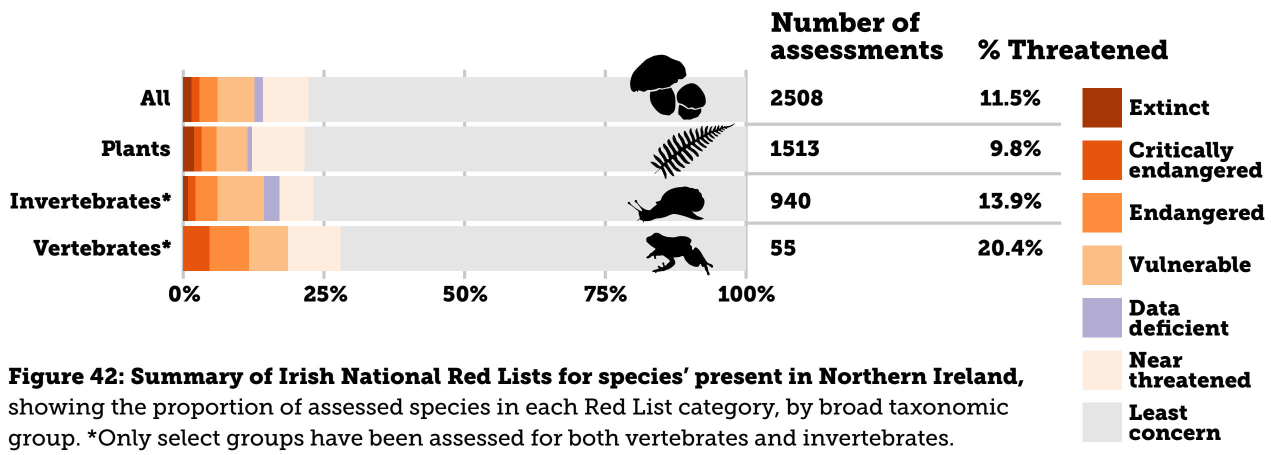


Figure 42: Summary of Irish National Red Lists for species' present in Northern Ireland, showing the proportion of assessed species in each Red List category, by broad taxonomic group. *Only select groups have been assessed for both vertebrates and invertebrates.

Birds of conservation concern in Northern Ireland

Bird populations across the island of Ireland have not yet been assessed using the IUCN Regional Red List process; however, the fourth status review, Birds of Conservation Concern in Ireland 4, was published in 2021[377]. Like the UK Birds of Conservation Concern, this distinct and separate process assesses species against set criteria and allocates them to one of three lists – Red, Amber and Green – to denote levels of conservation concern (with Red being the highest concern level). Over the last two decades, these reviews have documented the declining status of Ireland's bird populations. Since 1999[378], the number of species on the Red List has tripled from 18 to 54 species; representing 25.6% of the regularly occurring birds (Figure 43). These are species that are either classed as threatened with global extinction or have undergone severe declines in population/range across the island of Ireland. Within this assessment process, an additional seven species were classed as 'former breeders'.

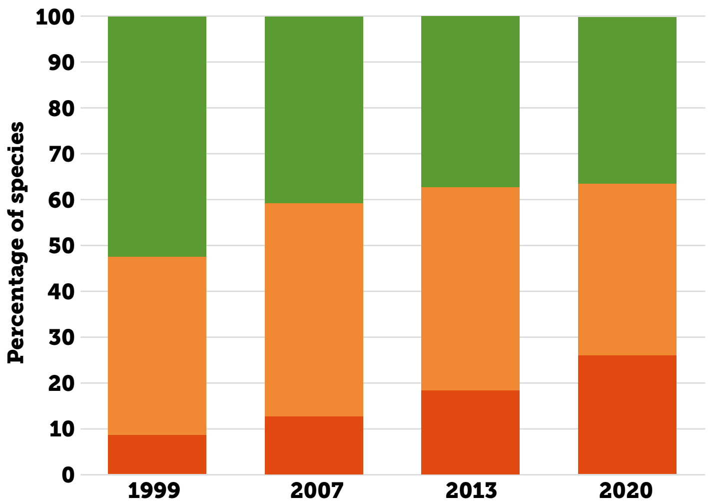


Figure 43: Summary of status for 196 species assessed in each of the four Birds of Conservation Concern Ireland assessments which were carried out in 1999, 2007, 2013 and 2020[377].

Reeds at sunset, Andy Hay (rspb-images.com)

Marine

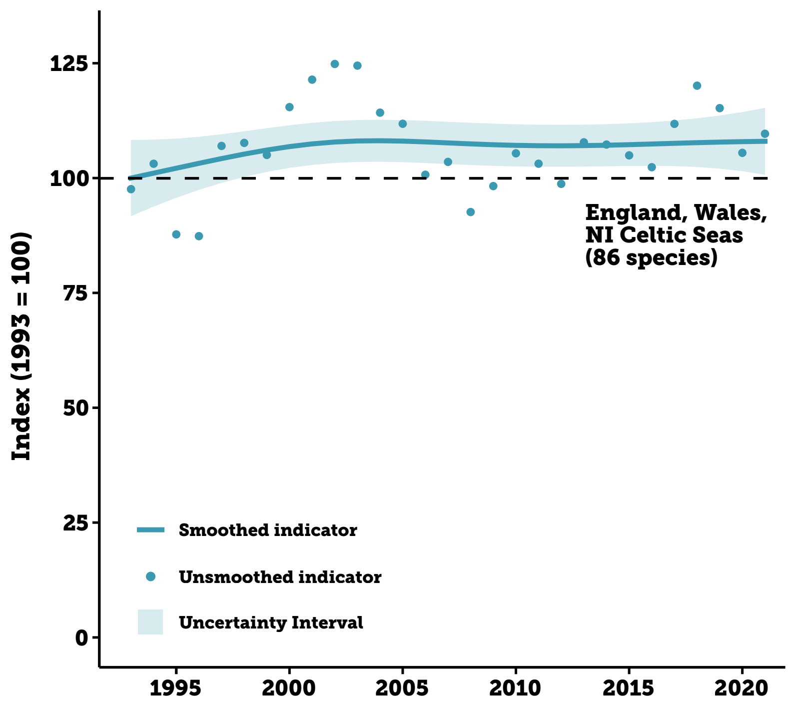
Change in species' abundance

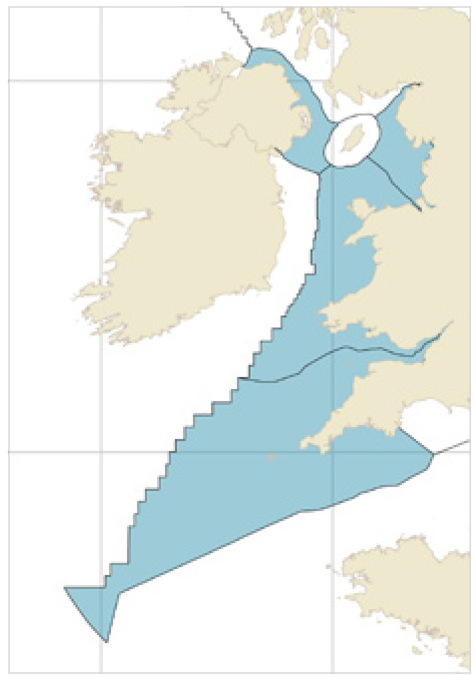
Seabirds

We have insufficient data on seabird populations in Northern Ireland to present a seabird indicator, with only two species comprehensively monitored by the Seabird Monitoring Programme. Twenty two of the 24 seabird species that are included in BoCCI4[377] breed in Northern Ireland and 21 of these are Red or Amber Listed.

Demersal fish

There was insufficient data within the Northern Ireland Marine Area to produce a robust abundance indicator for demersal fish, so here we present an indicator using data from the waters of Northern Ireland, Wales and the Celtic Seas component of England. Between 1993 and 2021 the indicator increased by 8% (Figure 44, UI: 1% to 15%), potentially indicating the recovery of some species from previous declines. It should be noted that many stocks of commercially targeted fish and shellfish species are assessed and managed over large geographic scales and that the species included in the indicator may not be those typically landed by the Northern Ireland fleet in significant numbers.





Ecoregion
Celtic Seas

Figure 44: Change in average species' abundance for demersal and bathypelagic fish species in the Wales, England and Northern Ireland and Celtic Seas component of the UK EEZ from 1993 to 2021.

Pressures

Northern Ireland has a great depth of quality natural habitats, both on land and at sea. Although human intervention has greatly reduced their overall coverage, there are still pockets of high-quality habitat and there is significant potential for restoration of habitats and for species recovery.

There are a range of pressures on the natural environment of Northern Ireland. On land, a constant pressure across the whole of the UK is that from baseline loss of habitat from conversion of land that was natural or semi-natural – to development, urbanisation or intensive management. With increased urbanisation and tourism comes increased human disturbance and the likelihood of introductions of invasive non-native species and new pathogens. The terrestrial landscape is dominated by farmland (76% coverage[379]), which has become more homogeneous with a move away from mixed farming towards improved grassland; arable farmland now makes up only 3% of the land area. Of the 60% of agricultural land that is now grass, 70% is now classified as improved[380]. Total income from farming in the livestock sector has increased by as much as 20% in Northern Ireland since 2019 with the numbers of livestock units also having increased[379]. In itself this is not proof of any further recent intensification, only an indication that the pressures on natural and semi-natural habitats that come from livestock in Northern Ireland are unlikely to have reduced. When compared across the UK, Northern Ireland has similar livestock levels per farm, but farms in Northern Ireland are, on average, half the size of those across the UK, therefore stocking densities are likely to be generally higher. Pig and laying hen numbers in Northern Ireland have increased in recent years, and numbers are three and six times more per farm respectively than the UK average[379].

Greenhouse gas emissions in Northern Ireland have continued to decline from a base measurement year (1990) and most recent reductions since 2019 came from transport and residential use, rather than from the largest contributor (27%) agriculture, which is the only sector from which there has been an increase in emissions since 1990[379]. Northern Ireland produces 12% of the UK's ammonia emissions, mostly from agriculture, while only representing 6% of the land area. Persistently high and increasing levels of nitrogenous air pollution are a major pressure on plants and lichens in Northern Ireland, with ammonia levels above the critical ecological threshold for bryophytes and lichens across the entire country and above the critical threshold for vascular plants across over a third of the land area[356], the latter encompassing around a quarter of protected areas.

The high levels of ammonia emissions in Northern Ireland present a particular threat to the region's remaining fragments of ancient woodland habitat. Many woodland fungi have been shown to be sensitive to nitrogen deposition, and there is particular concern about impacts on ectomycorrhizal species (associated with tree roots), and the subsequent impacts on tree health and associated invertebrate species. The loss of these woodland fungi also results in soil carbon release to the atmosphere, with climate change implications. There are increasing areas of woodland being planted in Northern Ireland in recent years, with grant support to encourage afforestation and sustainable management of privately owned woodland provided by the rural development programme[379]. It is likely that encouragement of planted woodland will continue as one mitigation for greenhouse gas emissions and it is hoped that planting will occur in areas where there will be few, if any, negative impacts on priority species and habitats. Coniferous plantations, their increased planting as well as the self-seeding spread of non-native conifers, are a pressure on those species that prefer more open landscape, for example breeding wading birds. Northern Ireland's native woodland resource is under pressure from invasive non-native pest species and an increased risk of diseases such as Ash die-back.

Ten per cent of the UK's peatland resource can be found in Northern Ireland. Only 15% of peatland assessed is in good condition, and a new peatland strategy[381] will look to quantify the natural capital value of this resource, alongside, hopefully, the intrinsic species and habitat benefits of significant restoration. An additional pressure in our upland heaths comes from uncontrolled burning of habitats and wildfires, which are likely to become more common. Similarly, research on the impact of high ammonia levels on Northern Ireland's peatlands suggests this could threaten restoration efforts[382].

Currently no river or freshwater lake in Northern Ireland has 'good' overall ecological and chemical status[383]. Recent changes to the assessment method introduced the measurement of presence of ubiquitous, Persistent, Bio accumulative, Toxic (uPBT) substances, which were detected in all sites. Before this, around a third of rivers were assessed as having high or good ecological status in 2021[379].

The complex coastline of Northern Ireland and varied seabeds of the Irish Sea and Malin Sea hosts a huge variety of cliffs, inlets, sea-loughs, islands, marine and coastal habitats.

Current advances in engineering mean that almost all of the seabed around Northern Ireland is likely to be within reach of offshore wind. Advances in windfarm technology are outstripping our knowledge of where important marine habitats, such as seabird feeding areas, are located. The marine realm also faces ongoing pressures from unsustainable fisheries.

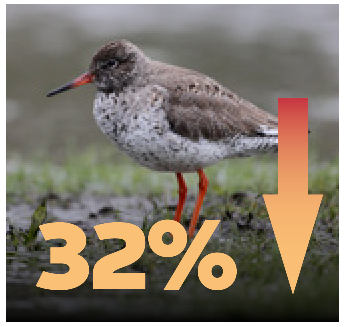
The situation for seabirds in Northern Ireland is mixed. On Rathlin Island, a biosecurity programme (LIFE Raft, 2021-2026) aims to eradicate non-native rats and ferrets in order to protect priority breeding seabirds and other biodiversity. This is hoped to provide a massive boost, particularly for the burrow-nesting seabirds on the island. Through the summer of 2022, Highly Pathogenic Avian Influenza (HPAI) infected seabird colonies and other species in Northern Ireland. HPAI seemed to arrive slightly later into Northern Ireland seabird colonies such as those on Rathlin Island[384] and more healthy chicks may have survived to fledge than in some Scottish colonies. A programme is underway to assess the impact of the 2022 outbreak on breeding seabird colonies, including those in Northern Ireland. There is a lack of data relating marine predators to their important feeding areas around the Northern Ireland coast. Similarly, monitoring of inshore fisheries and the growing aquaculture industry would aid understanding of any additional pressures these pose to the natural environment.

ENGLAND

With over 4,400 km of coastline, England supports internationally important coastal and marine ecosystems, with large numbers of wintering waterbirds on its extensive estuaries and saltmarshes, while the sea cliffs and offshore islands contain notable breeding seabird colonies[324]. Intensive management of agricultural land since World War II, has led to significant loss and fragmentation of semi-natural habitats. Despite this, it still contains a range of internationally important habitats, such as the blanket bogs, ancient woodlands, chalk rivers, calcareous grasslands and lowland heathlands. England supports at least 40 endemic species, such as the Lundy Cabbage and Lundy Cabbage Flea Beetle[324].

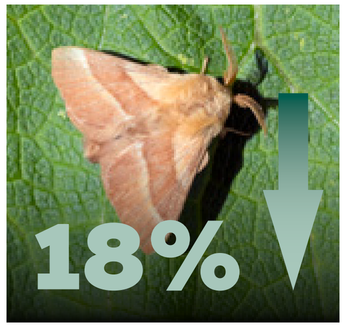
Adur Estuary RSPB reserve, Andy Hay (rspb-images.com)

Headlines



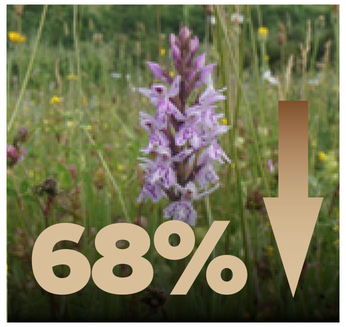
Average 32% decline in species' abundance

The abundance of 682 terrestrial and freshwater species has on average fallen by 32% across England since 1970. Within this general trend, 316 species have declined in abundance (46%) and 161 species have increased (24%).



Average 18% decrease in the distributions of invertebrate species

The English distributions of 4,815 invertebrate species on average decreased by 18% since 1970. Stronger declines were seen in some insect groups which provide key ecosystem functions such as pollination (average 22% decrease species' distributions) and pest control (40% decrease). Whereas insect groups providing freshwater nutrient cycling initially declined before recovering to above the 1970 value (average 50% increase).



Decreases in the distributions of over half of plant species

Since 1970, the distributions of 64% of flowering plant species and 68% of bryophytes (mosses and liverworts) have decreased across England, compared to increases of 18% and 22% of flowering plant and bryophyte species' respectively. In contrast, many lichen species have shown a strong recovery since 1980, with 63% of species' distributions increasing, compared to 31% declining.

13% of species are threatened

Of 8,840 species in England that have been assessed using IUCN Regional Red List criteria, 13% have been classified as threatened with extinction from Great Britain.

Variable change in seabirds

The abundance of 11 regularly monitored species of seabird showed little change on average since 1986, with strong increases in Gannet numbers, but declines in several surface feeding species such as Kittiwake. Importantly, these results pre-date the main impact of the current outbreak of Highly Pathogenic Avian Influenza.

Redshank, Andy Hay (rspb-images.com); Lackey, David Kjaer (rspb-images.com); Common-spotted orchid, Patrick Cashman (rspb-images.com); Turtle Dove, Ben Andrew (rspb-images.com); Gannet, Katie Nethercoat (rspb-images.com)

KEY FINDINGS

Abundance trends are based on changes in the number of individuals at a monitored site, a measure that reflects species population size. Distribution trends are based on changes in the number of sites where a species is present. A species whose range has changed could still have a stable distribution indicator if the total area occupied has stayed the same. For a fuller interpretation of the metrics of species' change presented here see the Pressures section. The changes described here follow extensive changes to our land and seascapes earlier in the 20th century and before (see Historical change section).

Terrestrial and freshwater

Change in species' abundance

The abundance indicator for 682 terrestrial and freshwater species, for which England-specific data are available, shows a decline in average abundance of 32% (Figure 45, Uncertainty Interval (UI): -42% to -21%) between 1970 and 2021. Over the last 10 years the decline was 7% (UI: -12% to -2%).

Within multispecies indicators like these there is substantial variation between individual species' trends. To examine this, we have allocated species into trend categories based on the magnitude of population change, over the long and the short-term periods.

- Since 1970, 316 species (46%) showed strong or moderate declines and 161 species (24%) showed strong or moderate increases; 205 species (30%) showed little change.
- In the last 10 years (2010–2020), 280 species (41%) showed strong or moderate declines and 246 (36%) showed strong or moderate increases; 151 species (22%) showed little change.

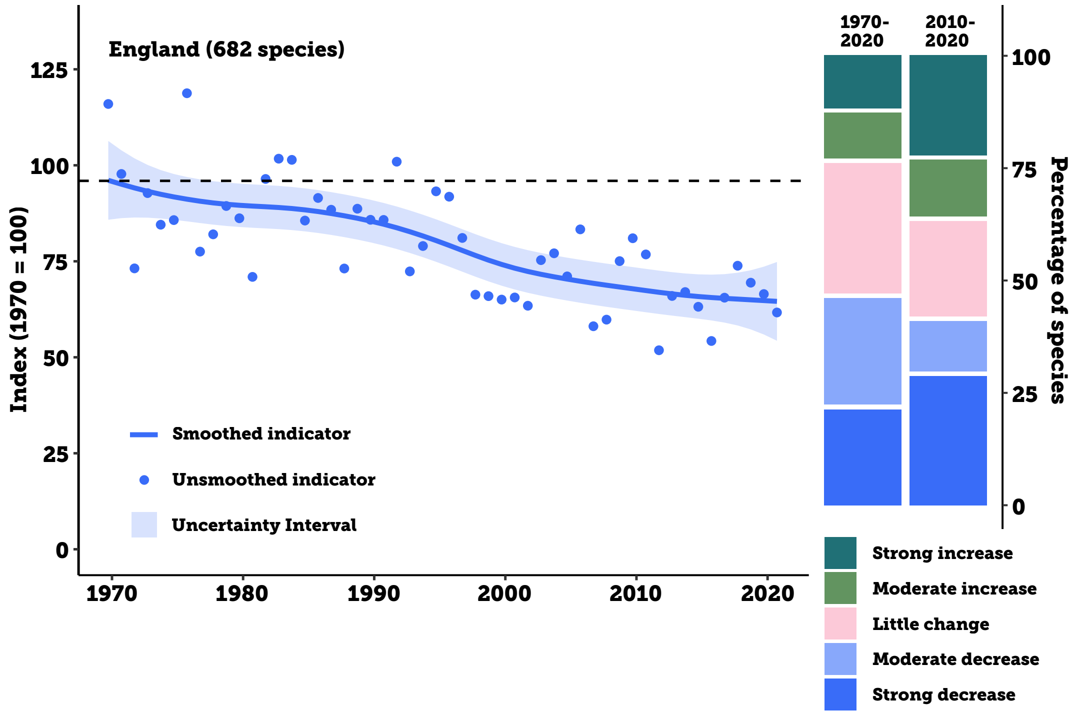


Figure 45: Change in average species' abundance for terrestrial and freshwater species in England, based on England-specific trends of birds (159 species), butterflies (55 species), mammals (15 species) and moths (453 species). The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in abundance (1970–2020: 682 species, 2010–2020: 677 species).

Species' abundance indicators by group

The composite nature of multispecies indicators means they can hide important variations in trends among both individual species and species groups. Here, to help better understand changes in the headline abundance indicators, we present it disaggregated into major species groups.

- The abundance indicator for 453 moth species starts in 1970 and overall shows a decline in average abundance of 44% (Figure 46A, UI: -56% to -32%).
- Specialist butterflies have declined by 25% (Figure 46B, UI: -45% to -4%) in the long term, but the majority of this decline was in the 1970s. Generalist butterflies have greater inter-annual variation but overall have remained stable (-4%, UI: -24% to +15%).

Map-winged Swift Moth, Robert Conn (rspb-images.com)

- The abundance indicator for common breeding birds declined by 16% (Figure 46C, UI: -20% to -13%). The England Wild Bird Indicator shows that within this group farmland birds have suffered particularly strong declines of on average 59%[385].
- Rare and colonising bird species (those with less than 1,000 pairs) showed on average a strong increase in abundance between 1973 and 2019 (Figure 46D, 255%; UI: 222% to 289%). This increase was driven by the rapid recovery of some species from very low numbers and the arrival of colonising species. At a UK level, species in the rare and colonising group make up just 0.01% of the total number of individual birds in the UK[386].
- Wintering waterbirds show on average an increase of 67% (Figure 46D, UI: 51% to 83%) between 1975 and 2019. The indicator rose rapidly in the 20th century but has since steadily declined. Some of the changes may be explained by species' wintering ranges shifting in response to climate change, resulting in changes in the proportion of each population that winters in the UK.
- The abundance indicator for 15 mammal species starts in 1998 and overall shows no change in average abundance (Figure 46E, 4%; UI: 0% to +9%). Within this average, some species have declined strongly, such as Hazel Dormice, whereas some bat species are slowly recovering from previous declines at the national scale. Compared with other taxa the trend data is relatively short and so will not capture long-term trends.

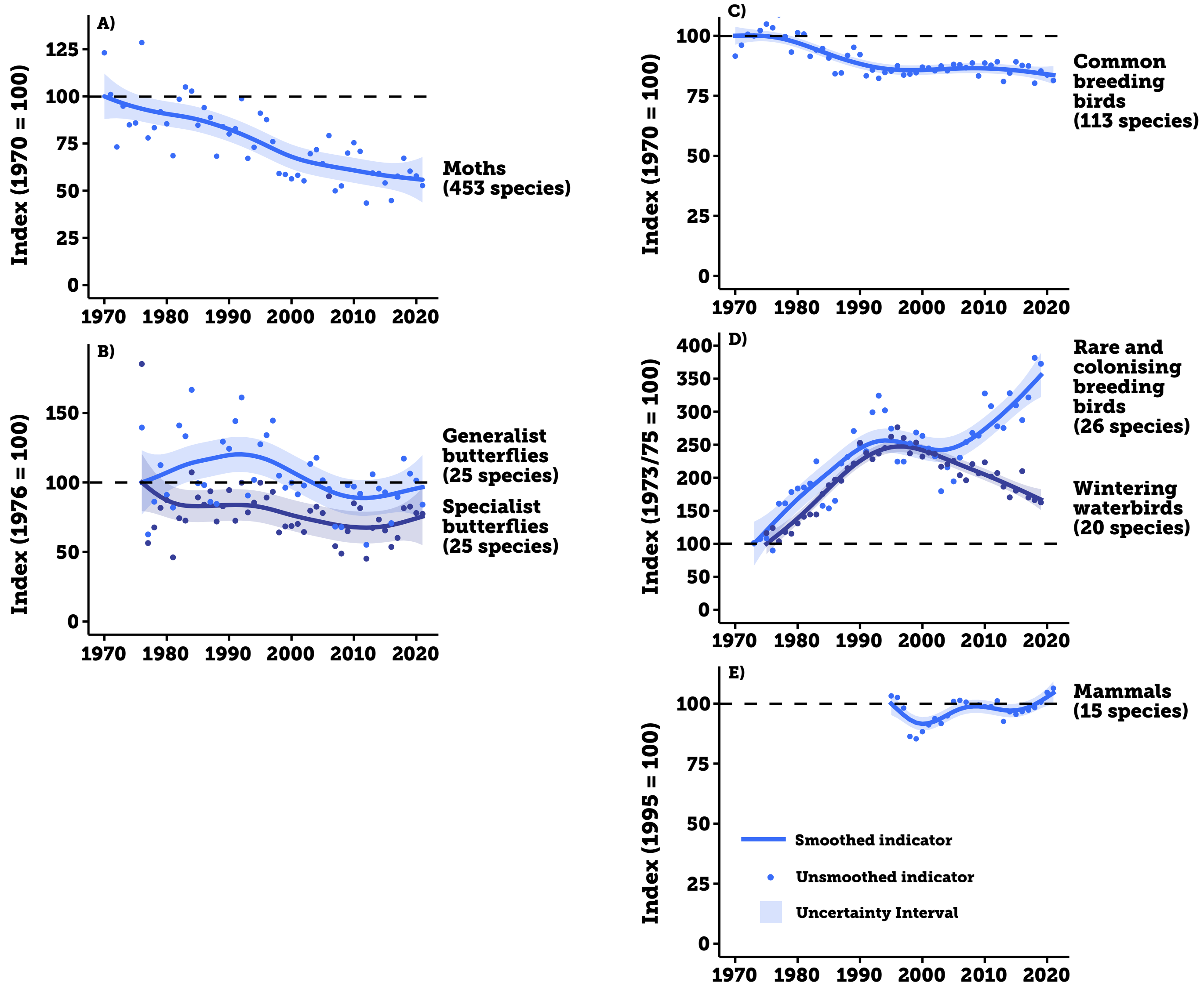


Figure 46: Change in average species' abundance for terrestrial and freshwater species in England by rarity, level of specialism or taxonomic group.

Change in priority species

One measure of the success of conservation action is whether populations of priority species have stabilised or recovered. The England Priority Species Indicator[387], (Figure 47) shows changes in the relative abundance of priority species in England for which data are available. Priority species are defined as those appearing on the priority species' list for England (Natural Environmental and Rural Communities Act 2006 - Section 41). In England there are 943 species and subspecies on the priority species' list. The priority species were highlighted as being of conservation concern for a variety of reasons, including rapid decline in some of their populations.

Like the species' abundance indicator described above (Figures 45, 46) the England Priority species Indicator includes Birds (44), Butterflies (21), Mammals (6) and Moths (78). Seabirds are the only marine species included in this indicator and there is insufficient data to include most invertebrates and any plants or fungi. By 2018, the indicator had declined by 82% (UI: -83% to -81%) of its baseline value in 1970 (Figure 47). Within this change 7% of species increased in abundance and 83% showed a strong or weak decline. This decline continued in the final five years of the indicator.

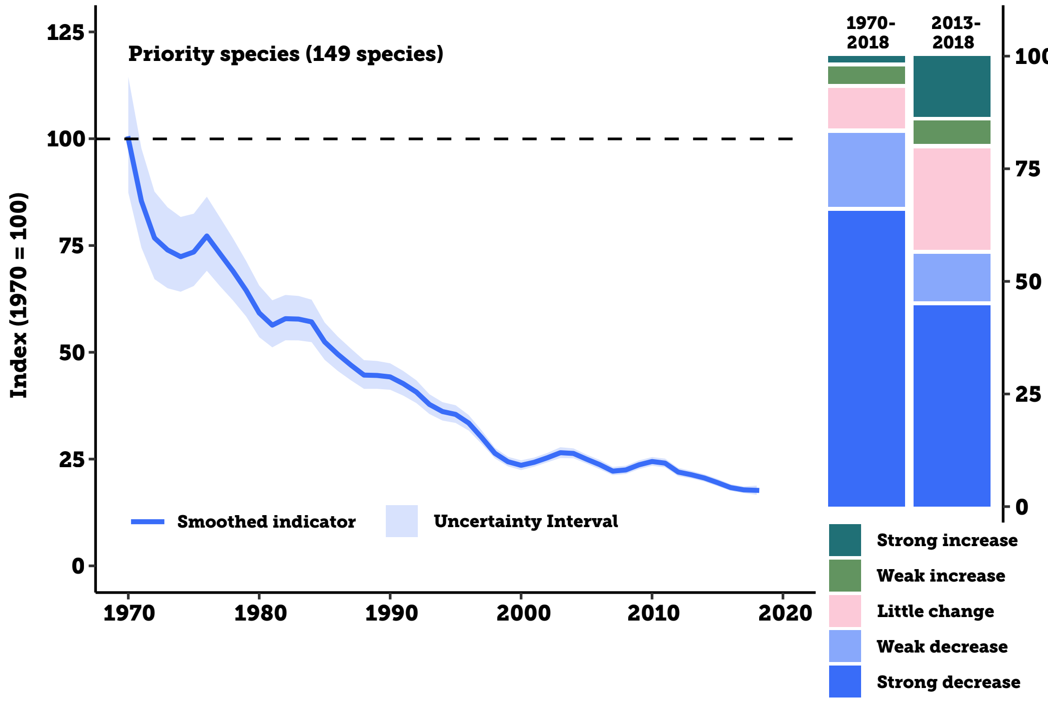


Figure 47: England biodiversity indicators: 4A. Status of priority species: relative abundance[387]. Change in average species' abundance of priority species in England, 1970 to 2018. The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in abundance. Source: gov.uk/government/statistics/england-biodiversity-indicators

Change in species' distribution

Plants and lichens

The distribution indicator for 1,348 vascular plant species shows a decline of 19% (Figure 48A, UI: -23% to -16%) between 1970 and 2019. Within this change, the distributions of three times as many species decreased (64%) compared to those that increased (18%). The distributions of 18% of species showed little change. Species adapted to low nutrient conditions and species of arable land have shown strong declines[365].

On average, bryophyte species' distributions have decreased by 35% (Figure 48B, UI: -37% to -33%). Within this average, 68% of bryophyte species decreased in distribution, compared to 22% of species whose distribution increased and 10% that showed little change. Some bryophytes have benefited from reduced sulphur dioxide air pollution, but this has not been sufficient to stabilise species' distributions[354].

The distribution indicator for 1,437 lichen species, with England-specific data, showed a strong increase in average distribution of 80% between 1980 and 2021 (Figure 48C, UI: 60% to 102%). Within this average, 31% of species decreased, 6% showed little change and 63% increased in distribution. In many parts of the UK, lichens were very badly impacted by historic industrial pollution, England being the worst affected[330]. Reductions in sulphur dioxide pollution are allowing some species to recover. However, ongoing high levels of nitrogenous air pollution mean that recovery is skewed towards species that can tolerate this.

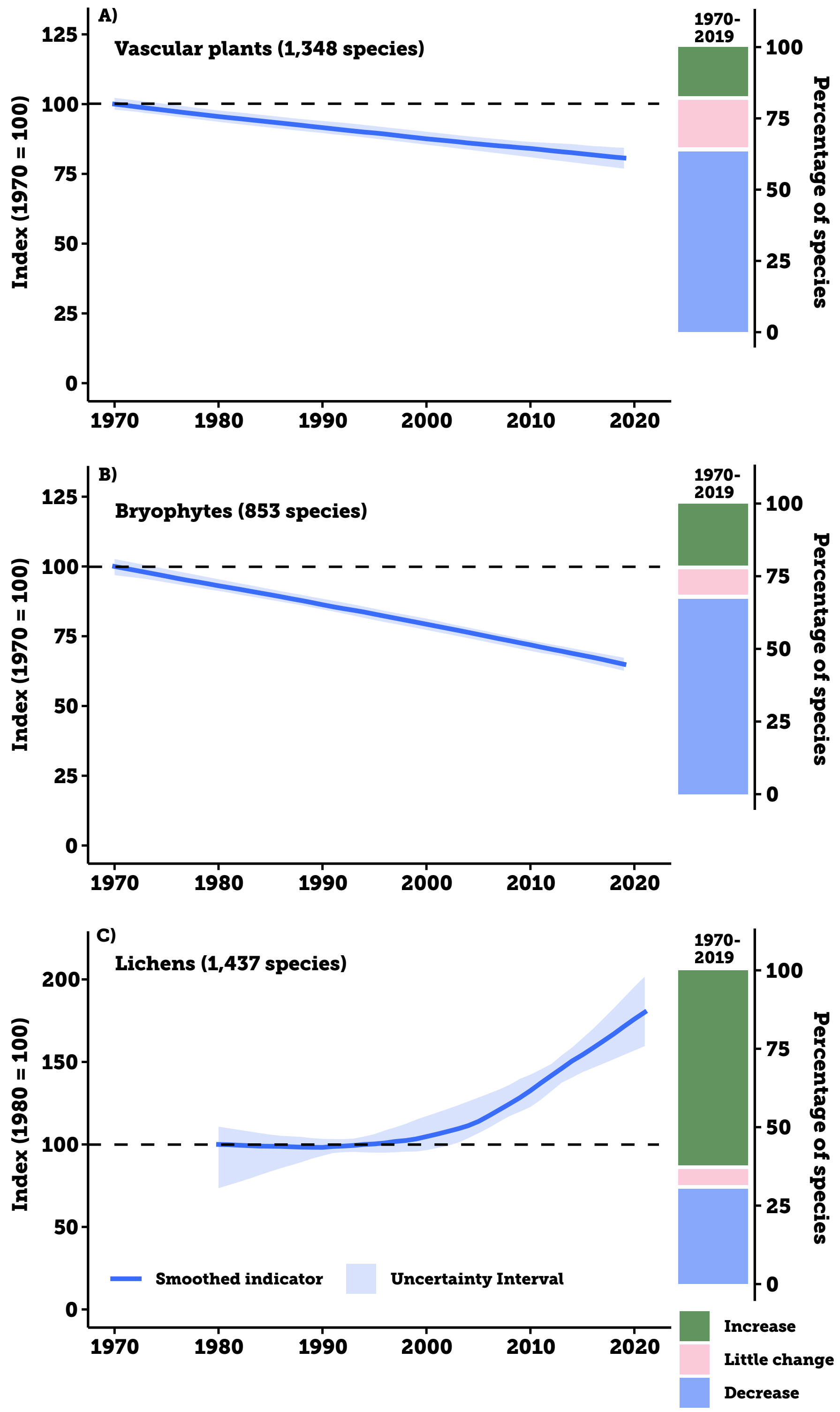
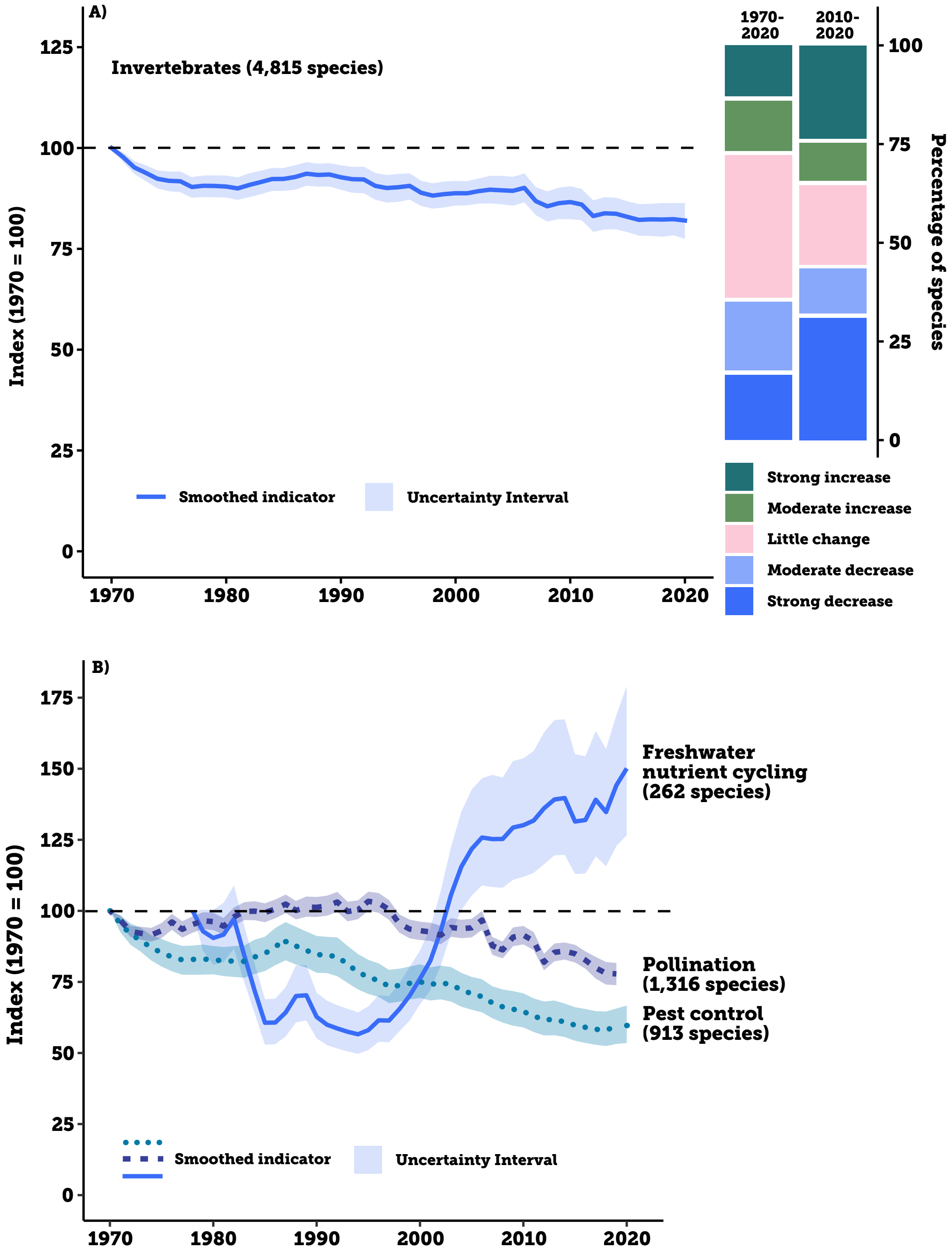


Figure 48: Change in average species' distribution for A) vascular plants, B) bryophytes and C) lichens in England. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in distribution.

Figure 49: Change in average species' distribution for A) terrestrial and freshwater invertebrates in England. B) Insect species grouped by ecological function (pollination, pest control and freshwater nutrient cycling). The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in distribution.



Invertebrates

The distribution indicator for 4,815 terrestrial and freshwater invertebrate species, for which England-specific trends are available, shows a decrease in average distribution of 18% between 1970 and 2020 (Figure 49A, UI: -23% to -14%). Within this change, since 1970, 36% of species showed strong or moderate decreases and 27% showed strong or moderate increases; 37% showed little change.

In the last 10 years (2010–2020), 44% of species showed strong or moderate decreases and 35% showed strong or moderate increases; 21% showed little change.

To help understand these patterns more clearly, species groups were categorised by the ecological functions they provide (Figure 49B[331]). Some groups provide more than one function and so are included in more than one indicator.

- Pollinating insects (bees, hoverflies and moths), which play a critical role in food production, show an average decrease in distribution of 22% (UI: -26% to -18%) since 1970.
- Insect groups (ants, carabid, rove and ladybird beetles, hoverflies, dragonflies and wasps) that predate species which damage food crops showed a precipitous average decline in distribution of 40% (UI: -46% to -33%) since 1970.
- The average distribution of species providing freshwater nutrient cycling (mayflies, caddisflies, dragonflies and stoneflies) saw an initial decline followed by a strong recovery ending 50% (UI: +27% to +79%) higher in 2020 compared to 1978. This pattern may in part be related to changes in river water quality[333] but although many measures of water pollution have improved over the past few decades, significant water pollution issues remain, in particular in catchments linked to intensive agriculture[349]. The UK version of the indicator starts in 1970 and also shows declines during the 1970s, so the initial declines observed here do not include changes prior to the late 1970s.

Median Wasp, Grahame Madge (rspb-images.com)

Extinction risk

Here we break down the IUCN Red List assessments for Great Britain to show, for those taxa known to occur (or have previously occurred) in England, the proportion that qualify for each of the standard threat categories, by broad taxonomic group. Taxa assessed as Critically Endangered, Endangered or Vulnerable are formally classified as threatened. Only assessments formally approved by the commissioning statutory nature conservation body have been included.

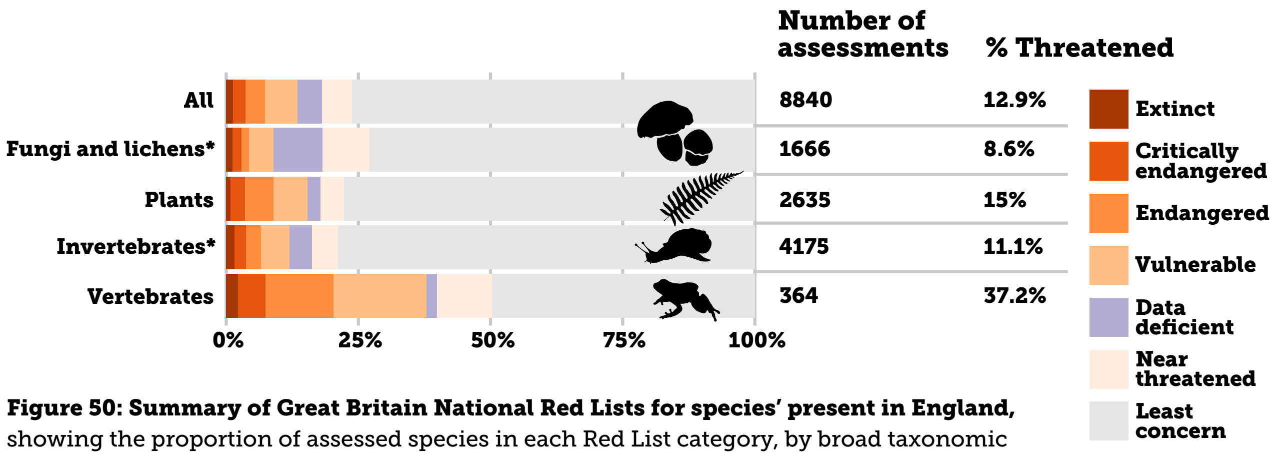


Figure 50: Summary of Great Britain National Red Lists for species' present in England, showing the proportion of assessed species in each Red List category, by broad taxonomic group. *At a Great Britain level only selected invertebrate groups have been assessed and less than 1% of fungi species.

Since the 2019 *State of Nature* report, the number of taxa formally assessed using the IUCN Regional Red List process[334], and known to have occurred in England, has increased from 7,615 to 8,840. Of the extant taxa, for which sufficient data are available, 1,076 (12.9%) qualify as being threatened and are therefore at risk of extinction from Great Britain (the scale at which Red List assessments are made) (Figure 50). Of the different taxonomic groups, 383 (15.0%) plants, 128 (8.6%) fungi and lichens, 130 (37.2%) vertebrates and 435 (11.1%) invertebrates qualify as threatened. We cannot, at present, assess whether extinction risk is changing over time because the vast majority of species have only a single Red List assessment. Natural England plans to repeat Red List assessments on a decadal basis and use them to produce a Red List Indicator to assess how extinction risk is changing over time[388]. This will be used to measure progress against the Environment Act 2021 target (relating to England only) to *"reduce the risk of species' extinction by 2042, when compared to the risk of species' extinction in 2022"*[389].

Marine

Change in species' abundance

Seabirds

The abundance indicator for 11 seabird species in England[385] starts in 1986 and overall shows no change in average abundance of 11%; (Figure 51, UI: -7% to +44%). Gannet abundance has increased rapidly, which has had a marked positive effect on the indicator. The five species that forage on the surface of the sea, for example Kittiwake, declined on average by 22%, in contrast to the four species that forage by diving, which increased on average by 168%. These changes were measured prior to the recent and ongoing outbreak of highly pathogenic avian influenza (see Pressures section).

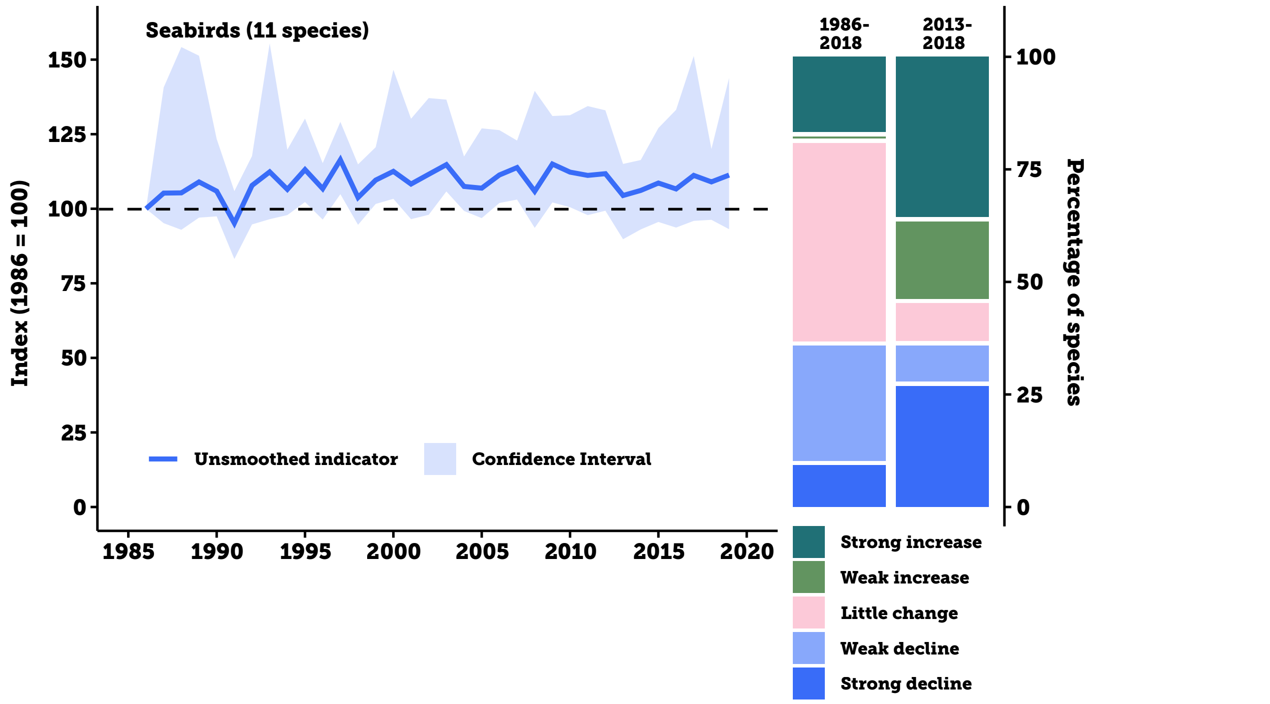


Figure 51: England biodiversity indicator 8: Seabirds. Change in average species' abundance[385] of breeding seabirds in England 1986 to 2019. The blue line with shading shows the indicator and associated Uncertainty Interval, the points show the underlying unsmoothed indicator. The bar chart shows the percentage of species within the indicator that have increased, decreased (weakly or strongly) or shown little change in abundance. Source gov.uk/government/statistics/england-biodiversity-indicators.

Demersal fish

The abundance indicator for the English North Sea declined by 23% since 1993 (Figure 52, UI:-32% to -15%). There was insufficient data within the English Celtic Seas to produce a robust abundance indicator for demersal fish, so here we present an indicator using data from the Wales, England and Northern Ireland Celtic Seas component of the UK Exclusive Economic Zone (EEZ). Between 1993 and 2022 the indicator increased by 8% (UI: 1% to 15%), potentially indicating the recovery of some species from previous declines.

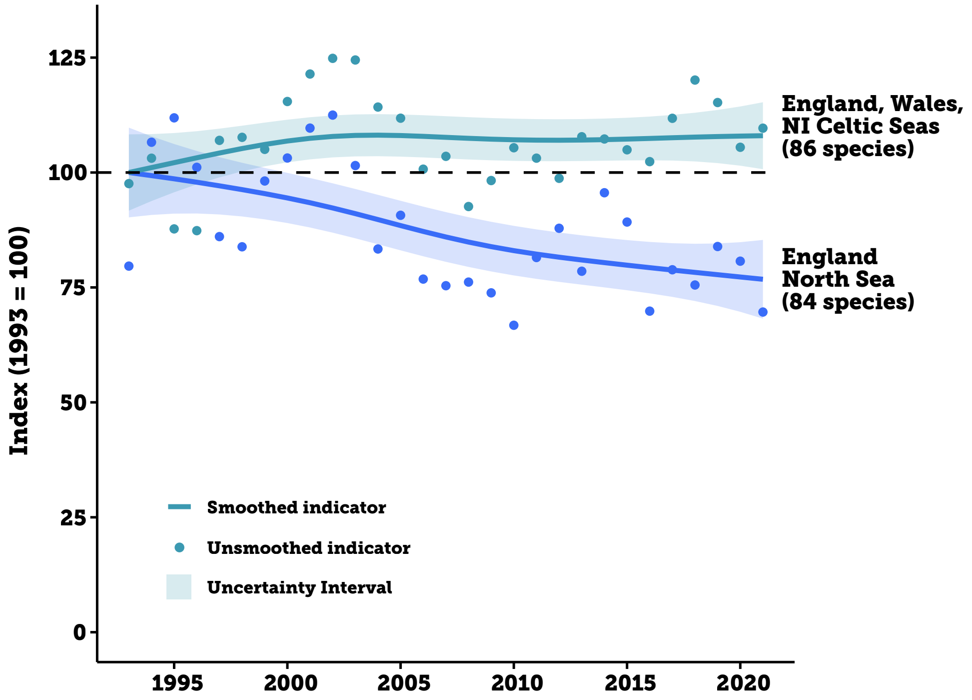
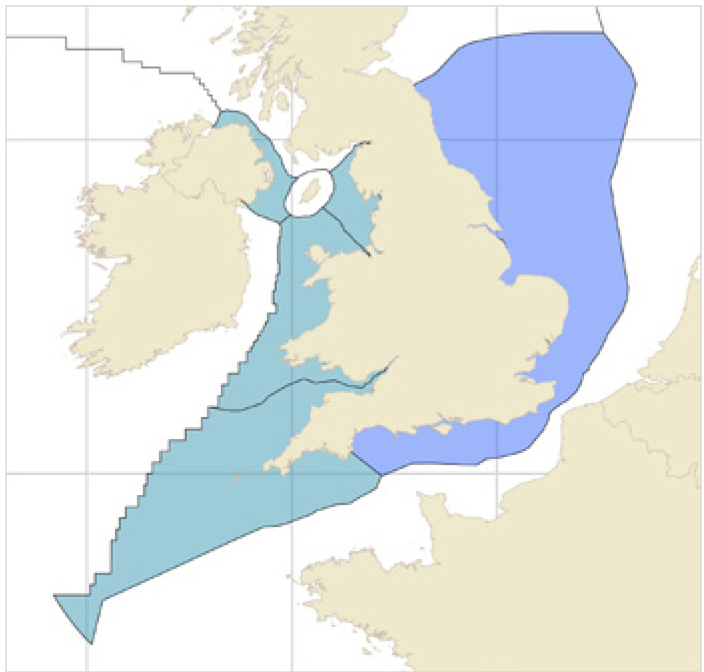


Figure 52: Change in average species' abundance for demersal and bathypelagic fish species in the English, Welsh and Northern Irish Celtic Seas and the English Greater North Sea from 1993 to 2021.



Pressures

Nature continues to be under pressure in England. Although it is difficult to compare the multitaxa species abundance indicators for each country, due to the different time periods they cover, the average decline in species' abundance of 32% in England (Figure 45), is considerably greater than for the UK (19%).

Many of the pressures and recent changes in them described for the UK remain pertinent for England (see Pressures and responses section). Intensive management of agricultural land, largely driven by policies and incentives since World War II, has been identified as the most significant factor driving species' population change in the UK[341]. As agricultural land constitutes 69% of England's area[390], these changes have had a major detrimental impact on its biodiversity. By 2021, the England farmland bird index had fallen 59% below its 1970 level[385] and our distribution indicators for species' providing pollination services and pest control services both saw substantial declines (Figure 49). Vascular plants associated with arable land and those adapted to areas of low soil fertility, such as semi-natural grasslands, have shown the greatest declines since the 1950s, largely due to changes to agricultural practices[365]. Farming also plays a role in 40% of England's waters failing to achieve good status under the Water Framework Directive[366]. Steps are being taken towards more sustainable and nature-friendly farming. The extent of farmland under agri-environment schemes has rapidly increased in recent years[391], but measures of farmland biodiversity have not yet stabilised or begun to recover.

Persistently high levels of ammonia air pollution remain a major pressure for bryophytes and lichens in England, with ammonia levels above the critical threshold for bryophytes and lichens across 94% of England[356]. Only in Northern Ireland is this issue worse, with 100% of land affected. Declines in sulphur dioxide pollution have allowed some bryophytes, including many epiphytes, to recover and has also likely played a role in the average increase in distribution seen in the lichen distribution indicator (Figure 48).

At a UK scale, climate change was found to be the second most important driver of species change and it is likely that this is also the case in England[341]. The abundance of hundreds of moth species has declined substantially in England in the last 50 years and climate change has been highlighted as a major pressure on moth populations[357]. Whilst it is likely that the net impact of climate change on moth abundance in England is negative, it is also likely to have supported increases in other species, as well as impacting species' phenology (the timing of seasonal events).

Climate change and overexploitation have been highlighted as the key long-term pressures on marine life in the UK[324] and these likely remain true at an England level. Added to these are the more recent potential pressures from marine renewable energy development. Although critical to plans to mitigate climate change, ambitious targets to upscale renewable energy generation at sea[392] also have the potential to negatively impact marine life, if not planned, managed and monitored sensitively. Steps are being taken to do this with the Marine Spatial Prioritisation Programme.

UK OVERSEAS TERRITORIES AND CROWN DEPENDENCIES

The United Kingdom has significant obligations beyond its shores, with the three Crown Dependencies (CDs) and 14 Overseas Territories (OTs). The OTs are diverse, ranging from sub-Antarctic islands to tropical Caribbean and Pacific islands, hosting a wide array of ecosystems vital for global biodiversity. They are home to around 1,500 endemic species, far more than the UK itself. The CDs also support unique wildlife, especially in the Channel Islands, with higher diversity in reptiles and amphibians due to their southerly location. Being mostly islands, the marine environment plays a crucial role, with the OTs having vast territorial seas. While the CDs and OTs are semi-autonomous, several have committed to the international Convention on Biological Diversity[395].

Comfortless cove, Vivienne Booth (rspb-images.com)

Headlines

11% of species are threatened with global extinction

Of the 6,557 OT and CD species that have been assessed for the global IUCN Red List, 11% are classed as threatened and therefore at risk of global extinction.

Most threatened groups

50% of sharks and rays, 33% of reptiles and amphibians and 25% of reef-forming corals found across the OTs and CDs are classified as threatened and therefore at risk of global extinction.

26% of land and 75% of seas have been designated as protected areas

This varies widely by territory, with less than 1% of the marine biome protected in Caribbean OTs, but 84% in the South Atlantic OTs.

Breeding success for the MacGillivray's Prion

Breeding success of MacGillivray's Prion was 12 times higher immediately following the mouse eradication attempt on Gough Island that failed, showing the potential benefit of successful island restoration.

Spiky Yellow Woodlouse, Ed Thorpe (rspb-images.com); Great White Shark, Jules Cox (rspb-images.com);
Northern Rockhopper Penguin, Steffen Oppel (rspb-images.com); MacGilvray's prion, Jamie Cleeland (rspb-images.com)

KEY FINDINGS

The OTs support several global biodiversity hotspots, such as the unique invertebrate and plant communities of the St Helena cloud forest, the endemic and highly threatened reptiles found on the Turks and Caicos and the Cayman Islands, as well as globally important seabird colonies, including a quarter of the world's breeding penguins and largest albatross colony. To date, 32,216 native species have been recorded across the OTs, however, the true figure is likely to exceed 100,000 species[396].

Extinction risk

Here we focus on the global status of species found across the OTs and CDs and show the proportion that currently qualify for each of the IUCN Red List threat categories (Figure 53). More assessments are needed to better understand the true status of wildlife.

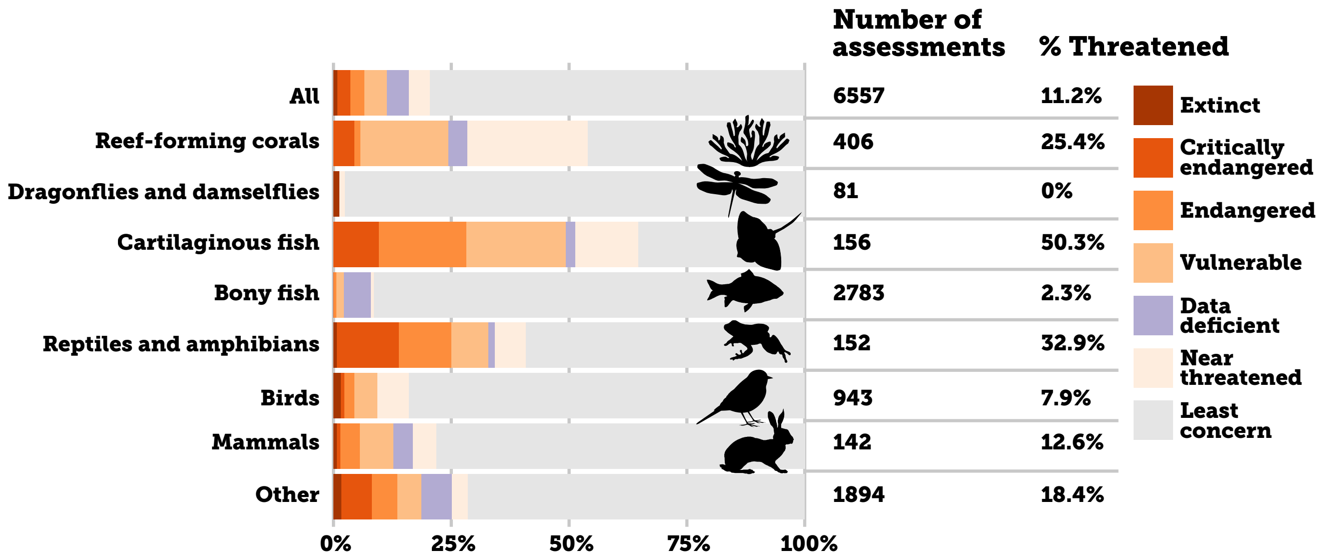


Figure 53: Summary of the Global IUCN Red List assessments for species present in one or more OTs or CDs. Only groups that are well represented (>80% of the group have been assessed at a global scale, with >50 species found on the OTs/CDs) are included.

The IUCN's Red List of threatened species represents the world's most comprehensive information source on the global conservation status of species, with more than 150,000 assessed to date[397]. Since the last *State of Nature* report in 2019, the number of species' found across the OTs and CDs which have been formally assessed at a global scale by the IUCN Red List has increased from 5,898 to 6,557; however, this still represents a small proportion of the total number present. Forty-six species formerly found on one or more OT or CD have now been classed as globally Extinct. Most of the extinctions are historic (since 1500 AD) but losses have continued. Three species were formally assessed as globally Extinct in the 20th century, and four have already been added so far this century, the most recent in 2021. A further four species are classified as Extinct in the Wild, 19 species as Critically Endangered (possibly Extinct), and one Critically Endangered (possibly Extinct in The Wild)[397].

Of the extant species, for which sufficient data are available, 697 (11.2%) are classified as threatened (Critically Endangered, Endangered or Vulnerable), and therefore at risk of global extinction. Of the different taxonomic groups, 50.3% of cartilaginous fish – sharks, rays and skates – 32.9% of reptiles and amphibians, 25.4% of reef-forming corals, 12.6% of mammals, 7.9% of birds, 2.3% of bony fish and no dragonflies and damselflies are assessed as being threatened with global extinction[397].

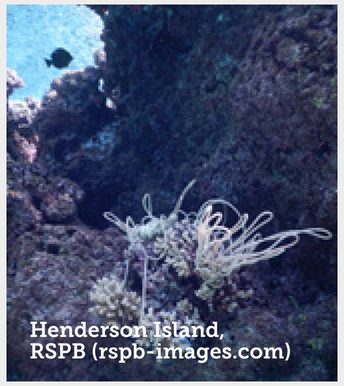
Multitaxa assessments of change in extinction risk over time can be measured through Red List Indexes[398]. Although this is not currently available for all OT and CD species, JNCC has published an interim indicator (K3: Status of endemic and globally threatened species in the UK Overseas Territories[399]), which sets a baseline from which to measure changes in the status of key endemic and globally threatened species found in the OTs. Of the 653 endemic taxa included in the indicator, 45.5% are currently listed as threatened on the IUCN Red List.

Recent changes in the status of some of the most threatened wildlife

The number of species declared extinct from across the OTs and CDs has increased by one to 46 since the 2019 *State of Nature* report. This has been accompanied by an increase in the number of species' assessed as Critically Endangered (139 to 167). Although some of this increase will be due to new species being assessed, many have seen a decline in status.

The bad news

The global status of 16 species of reef-forming corals *Anthozoa* and *Hydrozoa sp.*, found across the Caribbean OTs has been uplisted to Critically Endangered since 2019. This group is under considerable pressure globally and is predicted to decline rapidly due to an increase in severe bleaching conditions caused by climate change and other threats[397].

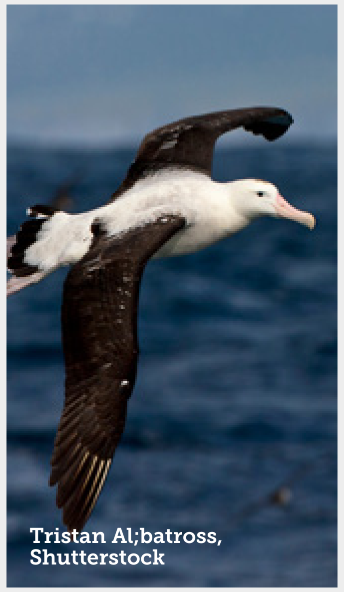


Henderson Island, RSPB (rspb-images.com)

The global status of eight species of shark or rays *Chondrichthyes sp.* found in water around the OTs has been uplisted to Critically Endangered since 2019, including the Great Hammerhead and Oceanic Whitetip Sharks. This group is threatened globally by overfishing, primarily relating to trade in meat, fins, and other products[397,400].

Oceanic Whitetip Shark, Shutterstock

The 2019 *State of Nature* report highlighted two Critically Endangered birds that breed in the OTs – the Gough Bunting and Tristan Albatross. Both remain Critically Endangered, and unfortunately these have been joined by another two species – the Wilkins's Finch and MacGillivray's Prion. Found in the Tristan da Cunha group of islands, both are threatened by invasive non-native insects and mice, as well as habitat loss. The global population of Wilkins's Finch is now thought to be fewer than 50 individuals[397].



Tristan Al;batross, Shutterstock

Some good news

As a result of conservation action, the global population of the endemic Turks and Caicos Rock Iguana appears to have stabilised over the last decade. In consequence, the global status of the species has been downlisted from Critically Endangered to Endangered[397].

Atlantic Bluefin Tuna occurs around several of the OTs and CDs. The species was downlisted from globally Endangered to Least Concern in 2021, as the Eastern Atlantic stock, comprising around 80% of the global population, was believed to be increasing; however, the Western Atlantic stock remains threatened due to historic overfishing[397].

Forest Thrush has been downlisted from Vulnerable to Near Threatened in part due to increases on Montserrat, where the population is recovering from rapid declines caused by the volcanic eruptions in 1995-1997[397].

Turks and Caicos Rock Iguana, Ed Marshall (rspb-images.com); Atlantic Bluefin Tuna, Shutterstock; Montserrat Forest Thrush, Ajhermae White

Biological monitoring

There are numerous examples of long-term biological studies across the OTs and CDs; however, there is currently insufficient information available to create multispecies indicators, as shown for the UK and some of its component countries, but the situation is improving. The Isle of Man is also publishing a *State of Nature* report in 2023 and in 2021, Manx BirdLife published the first assessment of the conservation status of wild birds in the Isle of Man[401]. Of 166 regularly occurring species in the territory, 48 (29%) were Red-listed and 68 (41%) Amber-listed.

Standardised approaches to record collection and keeping ensures biological records are high quality and comparable within and among the OTs and CDs. These include websites and apps that allow citizen scientists to upload biological records, such as St Helena's iRecord. In the Channel Islands, a new initiative is being developed to align and bring together data from the various biological recording centres using the Indicia toolkit, known as CiRecord.

Pitcairn Island, RSPB (rspb-images.com)

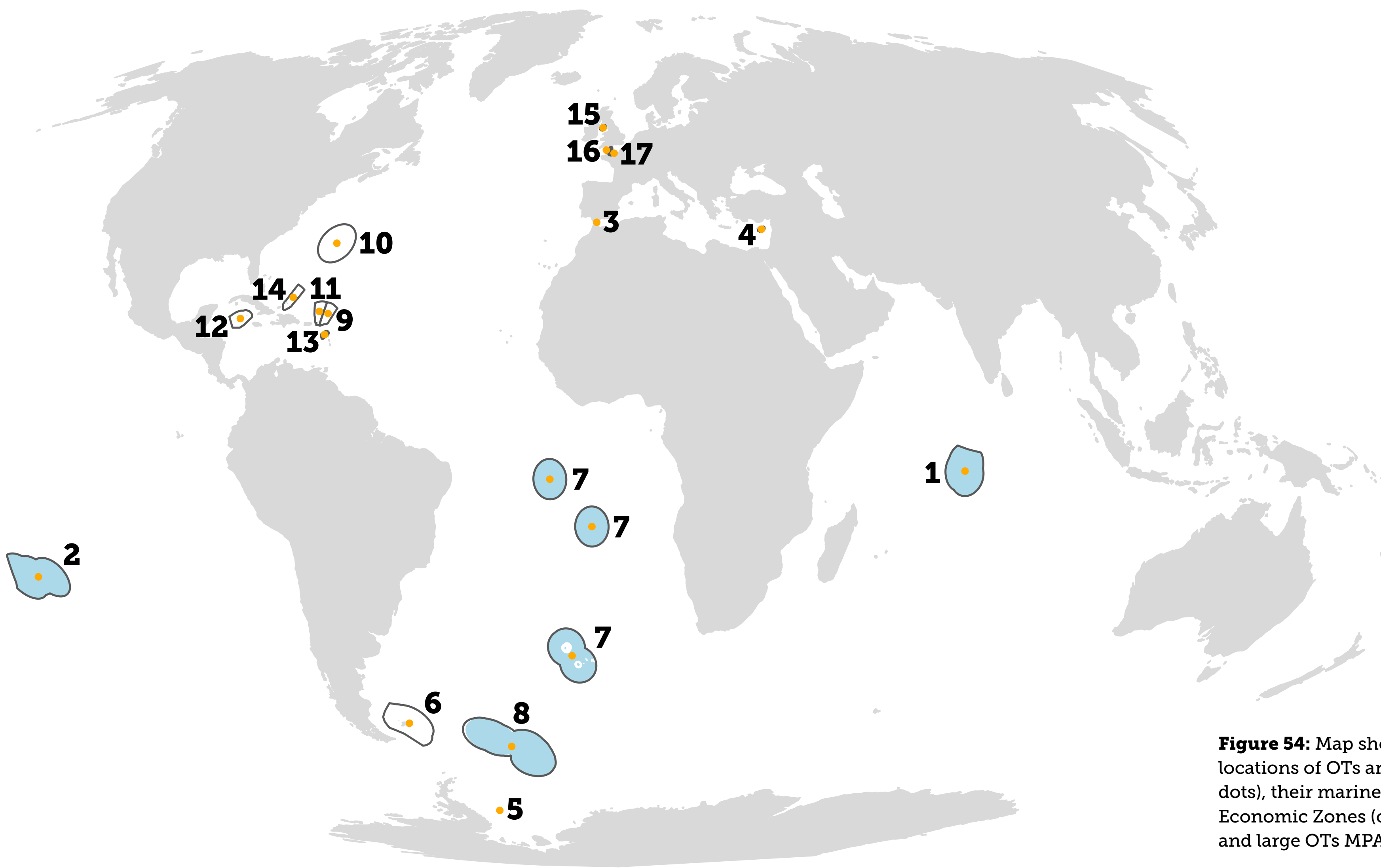


Figure 54: Map showing the locations of OTs and CDs (orange dots), their marine Exclusive Economic Zones (outlined in black) and large OTs MPAs (blue fill).

Extent of terrestrial and marine protected areas

Levels of terrestrial site protection are highly varied across the UK Overseas Territories (Figure 54, Table 1) for a myriad of biological, historical, political, cultural and legal reasons. The uninhabited territories of South Georgia and the South Sandwich Islands has now protected 100% of its terrestrial environment, while the densely inhabited territory of Gibraltar has protected 30% of its landmass. Other inhabited Territories, most frequently those with very high levels of private land ownership, have safeguarded less than 5% of their landmass in protected areas. Once designated, there is a need to ensure effective management of protected areas. Significant management projects of recent years include the attempt to remove invasive house mice threatening Gough Island World Heritage Site (Tristan da Cunha), and a project to restore the cloud forest of the Peaks National Park (St Helena) for both biodiversity and water security.

The levels of marine protection have meanwhile changed dramatically over the past decade. All bar two Territories now have at least one Marine Protected Area (MPA) in place, and several host MPAs amongst the largest in the world. The UK Government's Blue Belt programme provides support for the monitoring, surveillance and management of MPAs in the nine participating Territories, utilising the latest technologies and satellite surveillance to ensure these vast marine areas are protected against illegal fishing. The most recent large-scale MPA in the Territories was designated by the community of Tristan da Cunha in 2021, covering 90% of their marine zone and it is now the largest no-take reserve in the Atlantic. Work is now underway to support the Tristanian community in their management and understanding of their biologically rich waters: atlanticguardians.org

	OT/CD	Terrestrial and freshwater		Marine	
		Area of PAs (km²)	% coverage	Area of PAs (km²)	% coverage
1	British Indian Ocean Territory	62	60.6	1,479,757	100.0
2	Pitcairn Islands				
3	Gibraltar	100	38.1	110	22.7
4	Sovereign Base Areas of Akrotiri and Dhekelia				
5	British Antarctic Territory*				
6	Falkland Islands	4,294	26.5	2,827,829	84.4
7	St Helena, Ascension and Tristan da Cunha				
8	South Georgia and the South Sandwich Islands				
9	Anguilla	173	15.0	898	0.1
10	Bermuda				
11	British Virgin Islands				
12	Cayman Islands				
13	Montserrat				
14	Turks and Caicos Islands				
	All UKOTs	**4,628**	**26.1**	**4,308,594**	**75.0**
15	Isle of Man		12.3		5.5
16	Bailiwick of Guernsey		4.0		0.4
17	Bailiwick of Jersey		17.8		6.3

*No data currently available.

Table 1: The proportion of terrestrial and freshwater biomes and marine biomes designated as protected areas across the OTs and CDs. Data for the OTs are taken from the interim Defra K4 indicator: Extent and condition of terrestrial and marine protected areas in the UK Overseas Territories[394]. Figures for the CDs were extracted from protectedplanet.net/en

Case study:

Protected Areas

Alderney's Ramsar Site is designated for its priority marine habitats and important seabird colonies. Long-term monitoring has provided high-quality data for species and habitats within the site. This has led to the creation of zoned areas to help with the protection of breeding Puffin and Ringed Plover and knowledge of the distribution of culturally important species like Green Ormer (a sea snail), all three of which are on the edge of their respective ranges. Alderney's Ramsar site is the only internationally recognised marine designation within the Bailiwick, meaning these sites hold particular importance within the region and especially Alderney.

Ecosystem and habitat restoration

The OTs and CDs hold a wide array of internationally important and unique ecosystems and habitats. Owing to a variety of pressures, ranging from over-exploitation to invasive species to climate change, many of these have become degraded, but projects both past and present are helping to turn the tide.

Restoring St Helena's cloud forest

The St Helena Cloud Forest Project is a highly collaborative multi-year project working to protect the island's vitally important cloud forest within the 'Peaks National Park'. This globally significant area holds approximately 250 unique species, over one-sixth of the endemic species of the UK and its territories, including the island's iconic Spiky Yellow Woodlouse. It also plays a vital role in capturing water from the clouds that cloak the steep slopes of the forest. The Peaks National Park provides most of the island's fresh water supply, with an amazing 60% estimated to come from mist capture alone rather than direct rainfall. Before human habitation this important habitat covered an estimated 600 ha, today just 16 ha of fragmented cloud forest remain.

To restore the forest, the project is clearing areas of invasive species and growing native plants that can be used to create new areas of cloud forest. In 2022, the St Helena Government produced more than 42,000 plants, well over a target of 27,500, and planted more than 18,000 plants from 17 different species into wild restoration sites and living gene banks. The project is developing existing propagation facilities through the establishment of a world class micro-propagation facility. This will enable the scaling up of production of hard-to-grow species like endemic ferns to add to this success.

Building on previous habitat creation, the new corridors between existing patches of cloud forest are already seeing wildlife benefits – in 2022, the Spiky Yellow Woodlouse was observed using habitat corridors that were created just four years previously.

To improve water security, and help the island adapt to climate change, the project is improving the understanding of the water cycle on St Helena and monitoring climate and water levels, to target further cloud forest restoration to areas of high potential mist capture. It is also supporting sustainable development of St Helena by creating opportunities through ecotourism, education, sustainable land use and conservation training.

Impact of introduced non-native species

Impacts from invasive non-native species (INNS) is one of the primary threats to global biodiversity, particularly on islands, and this has led to many global extinctions over recent centuries. Non-native mammals, plants and insects pose a major threat to the unique biodiversity found across the OTs and CDs, and a variety of approaches are being used to address these impacts, including their removal as well as strengthening biosecurity measures to protect against further incursions.

The Gough Island restoration programme

Gough Island is a remote, uninhabited island in the Tristan da Cunha archipelago, and part of a UNESCO World Heritage Sites due to its outstanding natural beauty and vast numbers of breeding seabirds, some of which are threatened with global extinction and found nowhere else in the world. Naturally free of land predators, House Mice were accidentally introduced to the island during the 19th century, causing extensive damage to the environment, including the loss of well over two million seabird eggs and chicks each year[402].

In 2021, a large partnership of organisations and institutions, led by the RSPB and Tristan da Cunha, embarked on an ambitious expedition to eradicate the mice from the island to give the seabirds a chance to recover and thrive once again. Despite an immense effort, the operation was not successful and three months after the operational team had left the island, a mouse was discovered. Since then, numbers of mice have begun to increase.

Although the Restoration Programme did not succeed, it has given seabirds a much needed, although temporary, safe ground to breed. Monitoring surveys of key species carried out in the following breeding season provided some amazing results with no evidence of predation by mice. This has resulted in a dramatic increase in the breeding success for many of the seabirds (Figure 55); for example, for the first time this century more than 1,000 Critically Endangered Tristan Albatross chicks fledged, while the breeding success of MacGillivray's Prion, another Critically Endangered seabird, increased from an average of 6% before the mouse eradication attempt to a phenomenal 82% immediately afterwards. The instant positive effects of the absence of mouse predation demonstrate the value of returning to Gough to eradicate the mouse population.

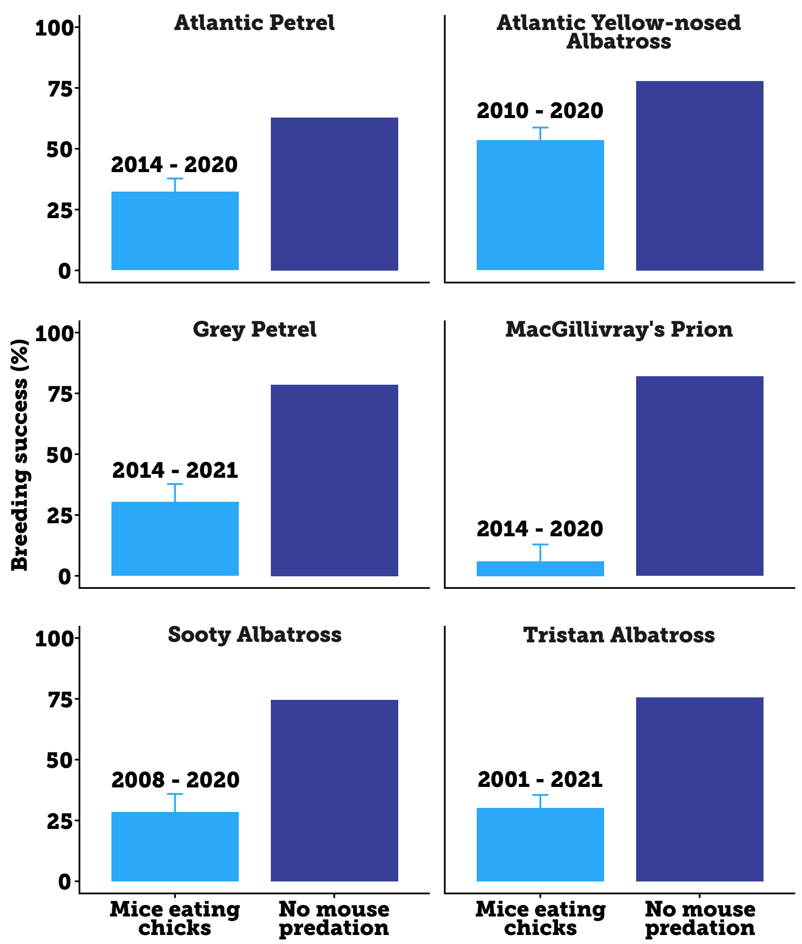


Figure 55: Breeding success of six seabird species on Gough Island whose chicks are predated by mice. The light-blue bars show the average breeding success in the years prior to the mouse eradication attempt, and the dark blue bar shows breeding success in the year immediately following.

Impact of INNS removal on Dog Island

Dog Island, a 207-hectare uninhabited island off Anguilla, is an internationally important wildlife site, supporting four endemic reptiles, over 100,000 pairs of nesting seabirds and endangered sea turtle populations. A restoration project launched in 2011 to increase 'local capacity to control alien invasive mammals' and 'monitor changes in wildlife populations', has successfully eradicated non-native Black Rats from the island and reduced the feral goat population. This has resulted in notable recovery in its native fauna, with increases in some reptile populations, eg the Anguilla Bank Ground Lizards, and land bird populations as well as plant biomass[403].

INNS control on the Channel Islands

The Channel Islands contain four distinct jurisdictions across two Bailiwicks; Jersey, Guernsey, Alderney and Sark, and is also home to other small islands and islets. Whilst each island has a unique assemblage of flora and fauna, some of which are endemic, they all share similar ecosystem types; high energy marine environments with large tidal ranges, cliffs, sand dunes, and wooded valleys with wet meadows.

The Channel Islands, like all small islands, are particularly vulnerable to the threats posed by invasive non-native species (INNS). The impacts of INNS are evident in all jurisdictions as native species and habitats are being lost or degraded due to the establishment of invasives such as Sour Fig and Red Ripple Bryozoan.

In recognition of the significant environmental, financial and social impacts caused by INNS, the Governments have prioritised their prevention and control. This is being achieved through collaboration between each island, whereby government officials, NGOs and volunteers are sharing information, expertise, and workloads which cover multiple jurisdictions. The Government of Jersey is currently undertaking a risk assessment of established INNS across all the islands. This streamlines resources and enables smaller islands, without dedicated INNS teams, to benefit from these workstreams.

Torteval coast, Guernsey, Rosemary Despres (rspb-images.com)

Hedgehog, Paul Sawer (rspb-images.com)

State of Biodiversity Data

The indicators presented in the document reflect the data used to construct them. An important property of indicators is that they should be representative of the UK geography, environments and taxa in the UK. This improves the chances that the indicators truly reflect the state of nature. It is also important that the data are accurate in terms of counts of individuals, taxonomic identity and location. This chapter assesses the representativeness and accuracy of the data used in this report.

Taxonomic bias in terrestrial and freshwater species' status metrics

The taxonomic groups included in the UK species' abundance indicator are limited to those with long-term monitoring data (Figure 56) and account for around 2% of all UK species. These typically come from monitoring schemes with formal sampling designs and standardised field and analytical methods. While relying solely on this indicator to explain changes in biodiversity in the UK, may lead to an incomplete and potentially biased understanding of overall change over time, it provides the only comprehensive estimate of species' abundance change in the UK using robust data. Important groups such as plants, fungi, and all other invertebrates are not considered in the abundance indicator, although these groups are included in the distribution indicators, which cover approximately 21% of UK species.

National Red List assessments evaluate the conservation status of species within a particular country or region. These assessments consider a range of factors, such as population size, distribution and changes in both, as well as threats, to assign a category of risk ranging from Least Concern to Critically Endangered. The Great Britain Red Lists summarised in this report include assessments for all species of some groups, like vertebrates or vascular plants, but only a relatively small proportion of insects (17%), crustaceans (10%) and fungi (0.004%). Assessments are based on available data and, for harder to identify and less visible groups, data are generally scarcer and fewer experts are available to conduct the reviews.

Another important note is that at present there are no published Great Britain Red List assessments for marine species (except seabirds), although assessments for marine mammals are underway. Data availability and quality for different taxonomic groups can also influence the proportion of species assessed as threatened. Taxonomic groups which have better quality data, such as birds, can be assessed against more Red List criteria than those with poorer quality data. This is one reason why data-rich groups tend to have higher proportions of species assessed as threatened.

Figure 56: Percentage of UK species from each taxonomic group used in the metrics of species' status for terrestrial and freshwater species. *Estimated number of native UK species, see stateofnature.org.uk for sources used. Vascular plants includes native species and ancient introductions (archaeophytes).

Percentage of species included

Taxonomic Group (terrestrial and freshwater species)	Abundance indicator	Distribution indicators	Red List summary	No. of UK species*
Birds	77	0	100	244
Mammals	49	0	100	47
Amphibians and reptiles	0	0	100	13
Insects	3	25	17	23,947
Millipedes, centipedes and allies	0	23	65	142
Spiders	0	83	100	728
Crustaceans	0	0	10	400
Molluscs	0	70	78	239
Bryophytes	0	100	100	1,098
Vascular plants	0	100	100	2,206
Lichens	0	100	100	1,987
Non-lichenised fungi	0	0	0.004	15,195

Biases in the data used to construct the invertebrate distribution indicator

The data used to construct the terrestrial distribution indicators were subject to formal 'risk of bias' assessments[408]. Most records were collected in the English and Welsh lowlands. Even in these regions, few locations were sampled consistently over time. This could reflect the distribution of recorders or of the species themselves. Figure 57 demonstrates this for a subset of the data, from the Soldierflies and Allies recording scheme, which is a fairly typical scheme in terms of data coverage (although there is much variation). In terms of taxonomic bias, it is rare for an individual Soldierfly species to have been recorded in every year. While the models used to produce species' time-series from these data attempt to statistically correct for the lack of data for some species in some years, they are unlikely to have eliminated the issue.

Biases in the data used to construct the marine benthos indicator

The marine benthos indicator in this report includes 438 species from across 20 different taxa and shows an overall increase in species' distribution in the UK's seas. However, dataset coverage is biased. These opportunistic surveys are predominantly restricted to shallow coastal reef habitats and concentrate on epifaunal taxa. Notably, surveys generally avoid areas suitable for towed fishing gear that contacts the seabed. As with the other indicators there is also geographic variation, for example, the Squat Lobster is declining across much of its range in England, Scotland and Wales but is increasing in Northern Ireland. The all-species' indicator should therefore be considered with caution.

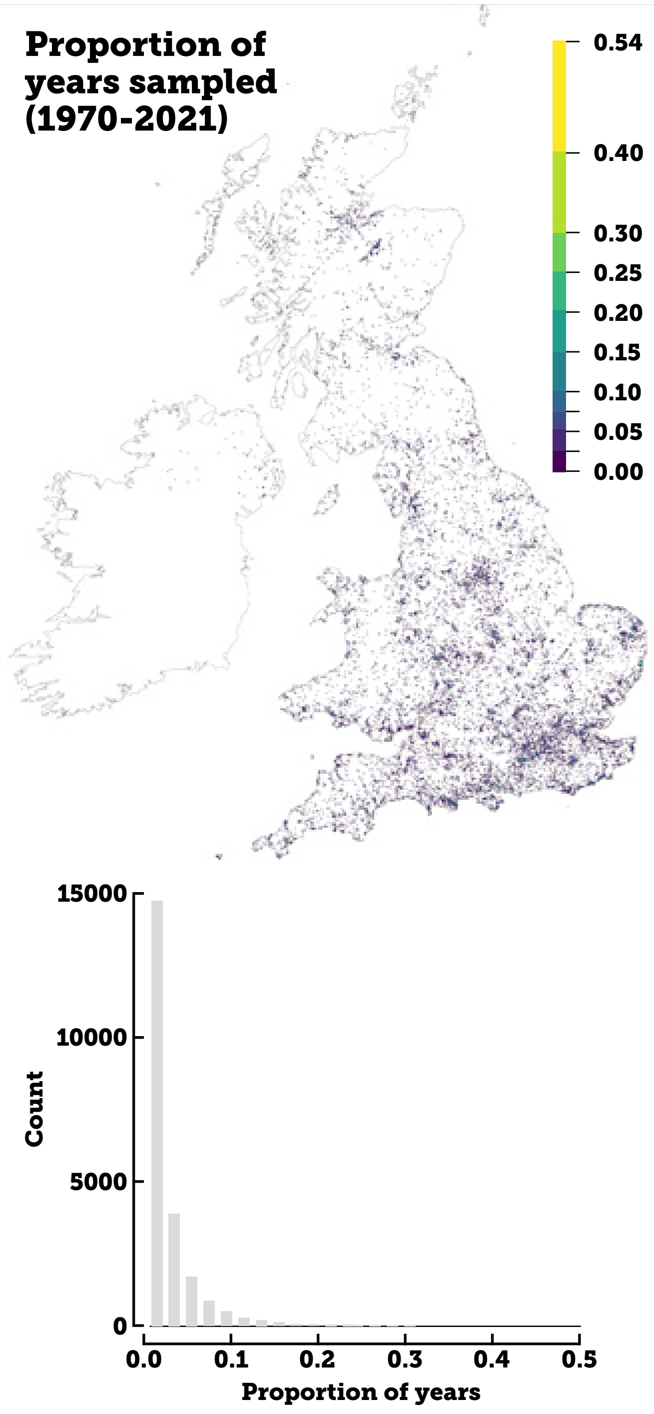


Figure 57: The proportion of years (1970 - 2021) in which records were submitted to the Soldierflies and Allies recording scheme for each 1 km grid square in the UK (a subset of the data used for the invertebrate distribution indicator). A) Depicted as a map, B) Depicted as a histogram.

Summary

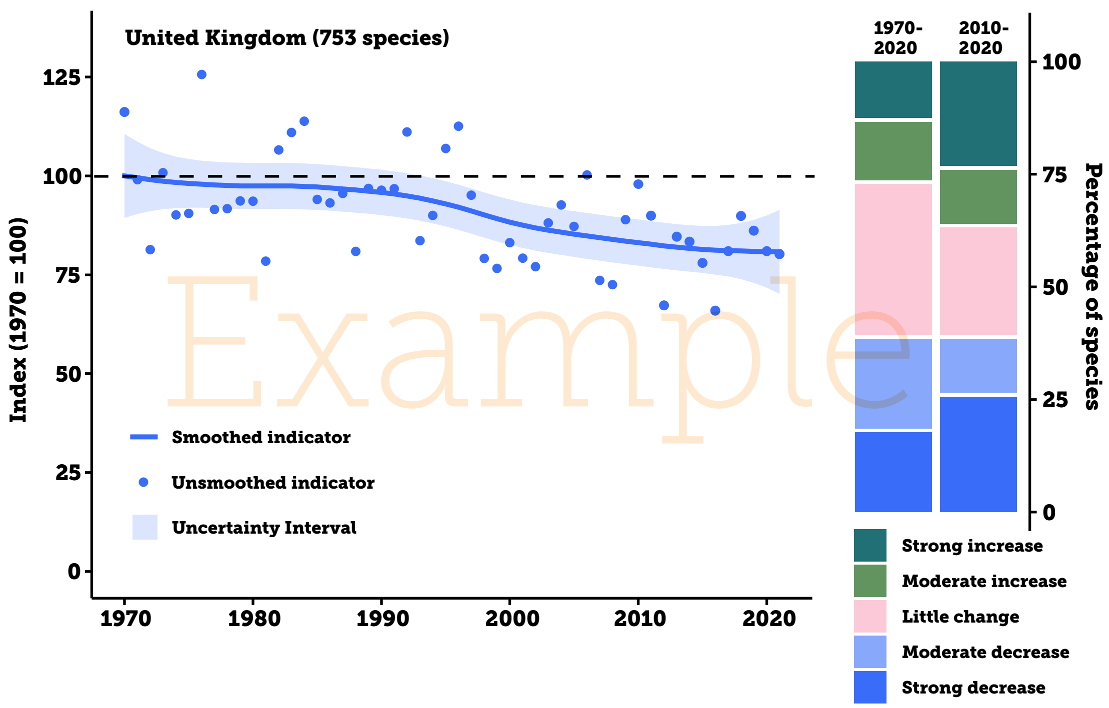
This report contains information on many species in the UK, but it is important to keep in mind that the data presented are not necessarily representative of all UK species. The datasets were chosen based on the availability of good quality data, but we cannot easily draw conclusions about species that were not assessed. Moreover, the data were collected using different methods, at diverse scales, in various locations and analysed using different statistical techniques. Additionally, some monitoring schemes may not have sufficient sampling density to detect changes in localised or rare species. As a result, the trends reported may be biased towards more common widespread species and taxonomic groups with greater data coverage.

Arguably the full value of volunteers' contributions to the state of nature is not yet fulfilled due to issues associated with the UK's complex data management structures. It is estimated that only 50% of existing biodiversity data is accessible to those who wish to use it. Resolving these issues would greatly increase the availability of evidence to inform, plan and measure nature's recovery.

The need for biodiversity indicators underpinned by robust and reliable species' data is becoming ever more critical considering the global, international, UK-wide and national commitments to end the biodiversity crisis. The data used in this report are the best available for the UK, which has many long-term recording and monitoring schemes, encompassing both the scientific community and the collective efforts of thousands of dedicated volunteers. We believe the data, with careful analysis and interpretation, provide a solid basis for making long-term generalisations on the state of nature in the UK. Without this knowledge we would be unable to understand the pressures we place on species or the impact of conservation action seeking to ameliorate these pressures.

How to interpret this report

We have included this section to help you understand the different measures presented in the *State of Nature 2023* report and how they should be interpreted. For full details of the methods and how these measures were calculated, as well as caveats around interpretation, please refer to pages 188 to 194.



Which data have we used?

- We present trends in abundance (for 753 species) and distribution (for around 9000 species) for terrestrial and freshwater species' across the UK, and trends in abundance for over 100 marine species (demersal fish, marine mammals and seabirds) and distribution for 437 species (benthic invertebrates, fish and algae).
- Abundance trends are based on changes in the number of individuals at a monitored site, a measure that reflects a species' population size. Distribution trends are based on changes in the number of sites where a species is present. Distribution trends may be calculated at different spatial scales, here we use 1 km^2 for terrestrial and freshwater invertebrates and 10 km^2 for plants and lichens.
- These records came from a wide range of sources, including national monitoring schemes and biological records.
- Abundance trends are for native species only. Distribution trends for invertebrates and marine benthic organisms are primarily for native species but may include a small number of non-native species. Due to the small number of these species, their impact on the average trend lines is likely to be minimal[296]. Distribution trends for vascular plants include species' introduced to the UK more than 500 years ago.
- We present assessments of national Red List status for 10,008 native species.
- Details of our data sources and the species they cover are at stateofnature.org.uk

How are distribution and abundance metrics related?

The status of species as measured by abundance is considered a key metric for conservation – providing information as to how species are faring and assessing the effectiveness of conservation measures or the impact of particular pressures. However, such data are taxonomically limited, and in contrast the volume of opportunistic species' records[297] extends the taxonomic, spatial and temporal coverage of species datasets and analyses. Recent statistical developments have enabled greater use of these datasets for the estimation of species' distribution trends[298-300]. Distribution and abundance trends are often related, and there is evidence that they tend to operate in the same direction[301,302]. However, the relationship between the two measures of change can be complex. In particular, there is evidence that the magnitude of change in distribution trends is smaller than changes in abundance. This is because many species can show substantial variation in abundance without disappearing from sites or occupying new ones. Additionally, for some species or species' groups abundance and distribution trends move in opposite directions, but this is less common[303,304].

What are the graphs telling me?

The measures we present, at a UK and individual country level, show the following:

- Change over time – Species indicator – The average change in the status of species, based on abundance or distribution data.
- Categories of change – The percentage of species in each trend category eg strong increase or little change.
- Extinction risk – An assessment of Red List status for each species occurring in that country.

Please note that our measures are not directly comparable with those presented in the previous *State of Nature* reports because the current report is based on an increased number of species, updated methods and, in some cases, different data sources.

Change over time – Species indicator

These graphs show indicators based on the abundance data and distribution data separately. Species indicator graphs show the average change in the status of species based on either abundance or distribution data. The shaded areas show a measure of uncertainty around the indicator. This is measured in several different ways, which are described in the Methods section.

Results reported for each figure include total percentage change in the indicator over the long term and the short term.

Categories of change

Each species was placed into one of three or five trend categories based on annual percentage changes. Results reported for each figure include the percentage of species that showed strong or moderate changes, and those showing little change, in each time period.

Thresholds for assigning species' trends to the categories are given on page 192. A small number of species did not have a short-term assessment, as data were unavailable for recent years.

Extinction risk

We summarised the Great Britain Red Lists to present the proportion of species in each threat category overall, and by different taxonomic groups. In each country we interpret existing Great Britain Red Lists, based on those species known to have occurred in a particular country, with the exception of Northern Ireland, where we used all-Ireland Red List assessments. For the Overseas Territories and Crown Dependencies we summarised available global IUCN Red List assessments.

Results reported for each figure include: the overall percentage of species assessed that are regarded as threatened with extinction from Great Britain, Ireland or globally. This is the percentage of extant species, for which sufficient data are available, classified as Critically Endangered, Endangered or Vulnerable in the latest IUCN Red List assessments.

Official statistics

Where appropriate, trend figures from the official UK or UK country biodiversity indicators[305] are presented. In these cases the source url is given in the figure caption.

What time period does this report cover?

In general we show abundance trends in species from 1970 to 2021 and distribution trends from 1970 to 2020. We refer to this as our long-term period. Our short-term period covers the final 10 years of an indicator, often 2010 to 2020. Data availability means that some abundance and distribution indicators start after 1970. For instance, distribution trends for benthic marine species run from 2005 to 2021.

Green satin lichen, Jill Donnachie / WTML

Methods

The methods on this page describe the process used to collate measures of species status and how these were combined into our headline metrics:

1. A multispecies indicator, which charts average species change over time.
2. A categorical change metric, which describes the proportions of species in three or five change categories based on the direction and magnitude of average annual change over the period of the indicator and the final 10 years.
3. A Red List metric, which presents the proportion of species at risk of extinction.

The methods are based on those used in previous *State of Nature* reports and published in Burns et al. (2018)[306].

Data collection

We collated as many datasets as possible describing population change of native UK species in order to populate the population change metrics (see Figure 56 State of Biodiversity Data section and stateofnature.org.uk). Most of these datasets contained species time series derived from statistical models, rather than raw counts or observations. Population change was described either by changes in the relative abundance of species (changes in the number of individuals) or the relative distribution of species (changes in the number of sites where a species is found). The long-term period tended to be 1970–2021 for abundance time series and 1970–2020 for distribution time series, due to a time lag in the collation and reporting of biological data. The short-term period was the final 10 years of the indicator, often 2010–2020. Data were derived from a wide range of sources; details of the datasets behind our analyses, and the species they cover, are given in the additional online material. The species' abundance time series included in our assessment met the following criteria:

- Two or more comparable estimates of a species' abundance were made between 1960 and the present, with a broad geographic coverage across the species' UK range.
- Results, or at least the methodology for data collection and/or analysis, had been published.
- Start and end estimates for each species were at least 10 years apart.

If more than one dataset was available for a species', precedence was given to the most robust dataset, based on the survey method subject to the fewest known biases, and maximising the sample size and time period covered. If two or more datasets were of similar quality and duration, then an average was calculated and used.

The distribution time series were based on the opportunistic recording data collected by National Recording Schemes; a full list is available in the acknowledgements. These schemes collect data on a vast array of taxonomic groups, from slime moulds to spiders. However, it can be difficult to use datasets of opportunistic records to assess changes over time, as recording effort varies across the UK and over time.

The majority of the species' distribution time series included in our assessment were updated versions of those presented in Outhwaite et al. (2019)[307], who used hierarchical occupancy modelling in a Bayesian framework to help control for imperfect detection[299,300]. Distribution was modelled at a 1 km^2 scale, and we retained species' time series with a minimum of 10 years of reliable estimates, with no more than a 10-year gap in records[296,308]. Species were included in the modelling if they met criteria indicating the available data would produce a distribution trend with acceptable precision[309]. Rarely recorded species (< 1 record in every 100 visits) were excluded if there were on average fewer than 3.1 records across the 10% of the best recorded years. More frequently recorded species were excluded if there were fewer than 6.7 records across the 10% of the best recorded years[309]. Exclusion criteria are based on classification trees, selected to balance the rates at which species are excluded when not meeting precision thresholds and included when meeting the precision thresholds. For the country-level trends we use an additional threshold of 10 records within the country in order to avoid including vagrants.

For bryophytes and lichens, occurrence data were summarised to 10 km^2/time -period combinations and modelled using an alternative approach[313]. This approach was also taken for vascular plants, using an analysis originally published in the Plant Atlas 2020[310]. In addition to datasets of species' population change, we collated national IUCN Red List assessments.

Processing species' data

Within the collated dataset of abundance time series, a small number of time series had missing values, zero values or an end date prior to 2021 and required minor processing following the methods used for previous reports[306]. Data for any years prior to 1970 were removed.

European Beaver, Philip Price / scotlandbigpicture.com

Moth data

Moth abundance data from the Rothamsted Insect Survey light trap network were analysed using the generalised abundance index methodology proposed by Dennis et al. (2016)[311] to produce UK and UK country species' abundance trends. Four hundred and ninety-three species produced reliable UK trends based on expert assessment of the underlying data and the analysis results updated following Harrower et al (2019)[312].

Plant and lichen data

For vascular plants, the Botanical Society of Britain and Ireland is the main source of high-quality distribution data, with data holdings stretching back to the 19th century and beyond. For bryophytes and lichens the equivalent datasets are maintained by the British Bryological Society and the British Lichen Society respectively. For each dataset the total period covered was divided into broad time segments and those considered to be largely unbiased with respect to species' relative frequencies were retained for analysis. We then applied the "Frescalo" algorithm[313] to these data to adjust for variable recording effort within and across time periods. Outputs from this process provided estimates (means and standard deviations) of a species' frequency in its overall area of occupancy within each time period. One hundred generalised additive models (GAMs) per species were then fitted to 100 random draws from species' frequency estimate distributions specified by the per-time period Frescalo means and standard deviations. One hundred multispecies indicators were then constructed by averaging across each set of random draws across species; the median and the 90% Uncertainty Intervals of the distribution of the multispecies' indicator is presented. This process enabled us to create smoothed time trends whilst propagating all model-based uncertainty[310]. Finally, the estimated frequency in 1970 was taken as our baseline year, with subsequent values normalised to this point.

Demersal fish data

Marine fish time series were based on ICES "bottom-trawl" data from DATRAS. We generated trends for three regions, using surveys in the entire UK Exclusive Economic Zone (EEZ; ie, 200 nautical miles radius, totalling > 773,000 km^2 but excluding the Isle of Man), and separately for the areas of the North Sea and Celtic Seas within the UK EEZ[314,315]. We created the population change metrics thus:

- Limited the species' pool to demersal and bentho-pelagic species using data from FishBase.org. These are species that the surveys are designed to capture. Other species are caught inconsistently, and hence the data are unsuitable for generating population trends.
- Qualitatively assessed temporal bias in spatial coverage of the surveys using the R package occAssess[316]. We removed data prior to 1993 as earlier survey coverage was very patchy. Despite uneven effort, we retained surveys from all four quarters of each year.
- Summarised the average annual abundance for each species, using the total number of individuals per species caught in each year in each survey region (ie, UK EEZ, or North Sea or Celtic Seas within the UK EEZ). Species were only included if there were at least nine years of data between 1993 and 2022. Species with gaps in annual abundance estimates had values interpolated using a GLM. Where data ended before 2021 the final value was held constant. Finally, we calculated the geometric mean abundance for all species in each year in each survey area. Uncertainty estimates were generated using bootstrapping.

Benthic species' data

Records for benthic species were obtained from the Seasearch dataset, a partnership of organisations led by the Marine Conservation Society that collects data on seabed species and habitats. The Seasearch programme is for volunteer scuba divers and snorkellers who record benthic marine species and habitats around the British Isles and adjacent seas. Now consisting of more than 830,000 spatial records for benthic species, it is an extensive, long-term time-series. Although records for some areas extend back to the late 1970s, it was not until the mid 2000s that all areas were fully active in the programme, hence for consistency among countries, the trends presented run from 2005 to 2021. However, dataset coverage is biased as surveys are predominantly restricted to shallow coastal reef habitats and concentrate on epifaunal taxa. In particular, surveys generally avoid areas suitable for towed fishing gear that contacts the seabed.

Population change was described by changes in the distribution of species (changes in the number of sites where a species is found). Although semi-quantitative measures of abundance are collected by Seasearch, they are not yet analysed in a way that can provide trends in abundance. In contrast with the terrestrial and freshwater records, which are collected and analysed by taxonomic group, Seasearchers record any and all species that they are able to recognise during a visit, irrespective of taxonomy. Distribution models are run using the entire Seasearch dataset. Distribution trends were developed using a hierarchical occupancy modelling in a Bayesian framework[78,299,300] very similar to that mentioned previously. Distribution was modelled at a 1 km^2 scale, and species were retained when there were at least 100 records, with no more than a five-year gap in records[78,296,308].

Producing our measures of species' population change

Species' indicators

To create the species' abundance indicators, all individual species' time series were converted to species' indices by expressing each annual estimate as a percentage of the first year of the time series and the index was calculated as the geometric mean of the species' indices[317]. Species' indices starting after 1970 entered the index at the geometric mean value for that year. Uncertainty Intervals (UI) for each indicator were created using bootstrapping across species'[318]; in each iteration (N=10,000) a random sample of species was selected with replacement and the index was recalculated. We generated smoothed species' indicators and associated UI using a thin-plate spline model[319]. We focus on the total change in the smoothed species' indicator in the results and also present the unsmoothed indicator[308]. Change in the final 10 years of the species' abundance indicators was taken as the geometric mean of the species level change across the decade. Species level change calculations are defined in the 'Categorical change' section on page 192. Uncertainty Intervals were generated using bootstrapping.

To estimate the multispecies' distribution indicator with uncertainty, the posterior distribution of the annual distribution estimates for each species was utilised. For 999 iterations, the geometric mean distribution estimate (on the unbounded log-odds scale) each year across all species was estimated. These estimates were converted back to the odds scale, then scaled so the mean estimate in the first year (1970) was set to 100, and summarised each year using the mean and Uncertainty Intervals.

If the Uncertainty Interval around the indicator estimate in the final year did not contain the starting value of 100, the change across the period of the indicator was considered significant.

Testing for change over the period of the indicator

For each multitaxa species' abundance indicator we assessed whether there was evidence that the rate of change in the final decade was atypical of the rate of change in previous decades, using a linear model of the form: Indicator ~ year* Period, where "Period" was a categorical variable specifying the five decadal time periods between 1970-2021.

Categorical change

For each species we calculated the total change, then the average annual change over the entire period of the index and the final 10 years – although in many cases the start and/or end years for the individual species' data did not exactly match the years for the overall indicator. Total change was the penultimate year of a smoothed index for a species' expressed as a proportion of the first year[306]. Each measure of total change was then converted to an annual average rate of change, which was used to categorise species' change. We placed each species into one of five trend categories, defined as follows:

- Strong increase: Annual change greater than or equal to +2.81%, the rate of change that would lead to population size or distribution doubling or more over 25 years.
- Moderate increase: Annual change between +1.16% and +2.81%.
- Little change: Annual change between -1.14% and +1.16%.
- Moderate decrease: Annual change between -2.73% and -1.14%.
- Strong decrease: Annual change less than or equal to -2.73%, the rate of change that would lead to a population halving or more over 25 years.


Barnluasgan celtic rainforest event, Bill Baillie

This categorisation was based on the magnitude of change, not the statistical significance of that change. Statistical significance is determined by interannual trend variance, which is influenced by sample size, and by the actual interannual variation in population change, which is determined by species' life history. This means that statistical power varies between species and between taxonomic groups. Thus, our values are the best available estimates for each species, but we must acknowledge that many species' trend estimates are highly uncertain.

For species' groups modelled using Frescalo, the classification of species' trends into three categories followed the approach of Pescott et al.[320], using the mean trend of an ensemble of 100 bootstrapped linear trends fitted to random draws from species' per-time period Frescalo mean frequency estimates and their uncertainties (standard deviations). The resulting trends were classified using the scheme of Stroh et al. (2023)[310].

IUCN Red List assessments

At a global level, the IUCN coordinates the process of assessing which species are threatened with extinction, and has developed Red List assessment criteria[90] to make the process as transparent and consistent as possible.

These criteria are based on a variety of parameters, including the rate of change in species' abundance or distribution, total population size, number of populations and an assessment of threats. The IUCN's Red List of Threatened Species represents the world's most comprehensive information source on the global conservation status of species.

Data downloaded from ucnredlist.org (27/01/2023) were used to calculate the number of species assessed under the various threat categories for each OT and CD. These were based on "Land Region" queries for all OTs and CDs, with the exception of the Bailiwick of Jersey and Guernsey exclusive economic zones, Isle of Man territorial waters, Cyprus Sovereign Base Areas and the British Antarctic Territory, which used spatial queries[321].

How threatened a species is may vary across its range, and often regional or national Red Lists are produced, documenting which species are threatened at different spatial scales[322]. We have brought together all the national Red Lists for Great Britain that have been produced using the latest guidelines from the IUCN[90,322]. For more details of the Red Lists used, please see stateofnature.org.uk

We summarised the global and regional Red Lists to present the percentage of species in each category and the percentage considered threatened across all species, and at different taxonomic levels. We followed recognised guidelines[323] and used the best estimate (the mid-point) when calculating the percentage of extant species, for which sufficient data are available, classified as Threatened (CR + EN + VU)/(Number assessed – EX – DD).

Country-level reporting

We do not have the same volume of information on species' trends within the UK's constituent countries as we do for the UK as a whole. We have attempted to repeat analyses, as presented for the UK, in the sections for England, Northern Ireland, Scotland and Wales, but in some cases, this was not possible.

We have produced abundance population change metrics (species' indicators and categorical change metrics) across all species for Scotland, England and Wales, but only at a taxonomic group level for Northern Ireland. Distribution change metrics were produced using the same methodology as the UK-level indicator for all four countries, although we were not able to produce a lichen indicator for Northern Ireland.

Equally, even when metrics have been produced, it should be noted that the population change and distributional change metrics for the constituent countries were based on fewer species and suffered from greater bias towards well-recorded taxa.

For national Red Lists, we used lists of species present in England, Scotland and Wales to interpret the existing Great Britain Red Lists in a national context – this means that the status of a species outside a nation may influence the Red List results presented for that nation. In the case of Northern Ireland, we have used all-Ireland Red List assessments for species occurring in Northern Ireland, as this allowed the consideration of a broader taxonomic scope than data from Northern Ireland alone.

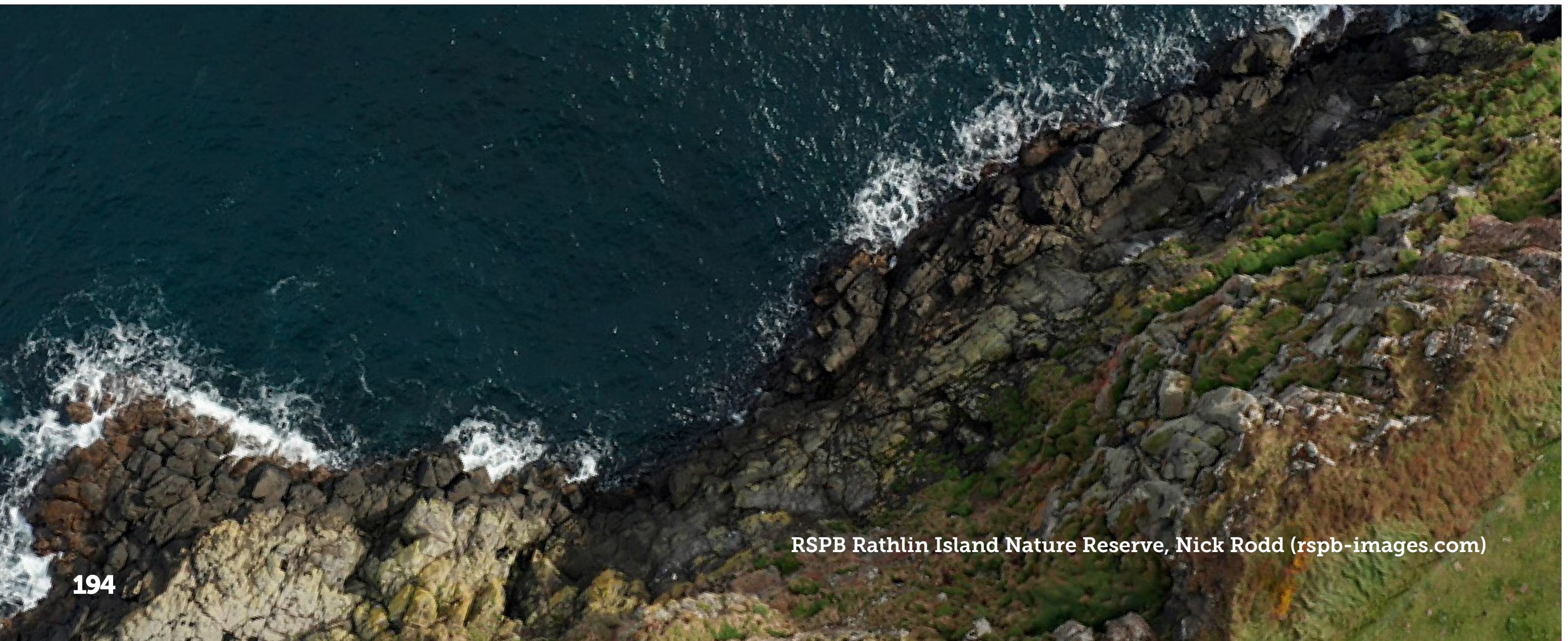
Caveats

The datasets presented in this report are a summary of the information available. However, although they cover many species, the datasets have not been selected to reflect a representative sample of UK species, either within or between taxonomic groups or habitats. This means that we should be cautious about extrapolating findings beyond the species assessed (see State of Biodiversity data section).

We have put together datasets collected using different methods, measured at a variety of spatial scales and analysed using different statistical techniques. How a species has been monitored – the method, effort and extent of surveying – can influence whether the results were suitable for our analyses, and indeed the species' trend itself.

Although some rare species are targeted by specific schemes, many of the monitoring schemes that produce the datasets included in this report have a wide range geographically but may not have sufficient sampling density locally to pick up changes in localised or particularly rare species. As a result, trends for relatively few of these species are reported. Our population change metrics may therefore be biased towards the more common, widespread and generalist species, as well as being biased towards certain taxonomic groups. The datasets also differ in spatial coverage.

Although official guidelines are used to produce national Red Lists, there is room for variation in interpretation of these guidelines and so there are small differences in the way different authors have compiled the national Red Lists summarised here. This is particularly true in defining which species are not threatened (of Least Concern).



RSPB Rathlin Island Nature Reserve, Nick Rodd (rspb-images.com)

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Collecting biodiversity data

Structured monitoring schemes

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Recording societies

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A Rocha UK – Caring for God's Earth
Action for Conservation
Alderney Wildlife Trust
amphibian and reptile conservation
ALERC – Association of Local Environmental Records Centres

Bat Conservation Ireland
Bat Conservation Trust – www.bats.org.uk
Botanical Society of Britain & Ireland
British Arachnological Society
British Bryological Society – 100 Years 1923–2023
British Dragonfly Society – 40 Years 1983-2023

British Lichen Society
BTO – Birds Science People
buglife
Bumblebee Conservation Trust
Butterfly Conservation – Saving butterflies, moths and our environment
CEDaR – Centre for Environmental Data and Recording

UK Centre for Ecology & Hydrology
BRC – Biological Records Centre
CIEEM
Chester Zoo
earthwatch Europe
Freshwater Habitats Trust

Friends of the Earth
iSpot – ispotnature.org
The James Hutton Institute
Government of Jersey
John Muir Trust – For wild land & wild places
JNCC – Joint Nature Conservation Committee

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Marine life
NBN Trust – Making data work for nature
NFBR
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NatureScot – NàdarAlba – Scotland's Nature Agency – Buidheann Nàdair na h-Alba
NIEA – Northern Ireland Environment Agency – www.daera-ni.gov.uk
Northern Ireland Marine Task Force
ORCA – Looking out for Whales and Dolphins

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RSPB
RZSS – The Wildlife Conservation Charity

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Scottish Wildlife Trust
Shark Trust
States of Guernsey
Ulster Wildlife
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VWT – Vincent Wildlife Trust
WDC – Whale and Dolphin Conservation
WWT
The Wildlife Trusts
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WWF
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