STATE OF NATURE

WALES

2023

state of nature PARTNERSHIP

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

Curlew, Drew Buckley (rspb-images.com)

Contents

SUMMARY

Wales, along with the other countries of the UK and like most other regions 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 Wales' nature over previous centuries. As a result, Wales is now one of the most nature-depleted countries on Earth.

The main causes of these declines are clear, as are some of the 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 pollution, climate change, over exploitation (historic fisheries), invasive species and marine development.

In recent years there has been growing recognition of the value of nature, including its role in tackling climate change and its benefits to people's health and wellbeing. The need to protect and restore nature is recognised by the public and policy makers alike.

It is clear that despite some progress to restore ecosystems, save species and move towards nature-friendly land and sea use, Wales' biodiversity and wider environment continues to decline and degrade. With each subsequent *State of Nature* report our monitoring and measuring of these losses improves and refines. Wales has committed to ambitious targets to address nature loss through the new Global Biodiversity Framework. A response commensurate with the scale of the crisis will require collaboration between public, private and voluntary sectors.

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

#STATEOFNATURE

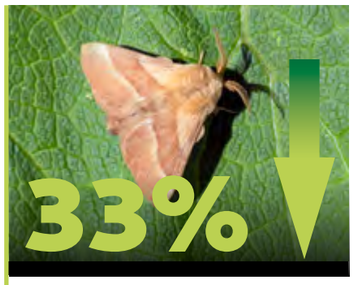
Headlines

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.

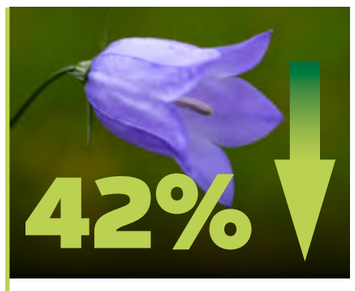
Average 20% decline in species' abundance

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%. Separate data shows that Atlantic Salmon *(Salmo salar)* 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%).



Variable patterns of change in the distributions of invertebrate species

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



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.

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, there is variation within this average trend, and these figures pre-date the current outbreak of Highly Pathogenic Avian Influenza.

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

What do our headlines mean?

The 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 Wales, as 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 over time
- The proportion of species at risk of being lost from the country.

For the first time we are able to present a multi-taxa species abundance indicator for Wales, due to increased data availability. In future we hope to develop this indicator further by incorporating additional datasets.

Changes in species' abundance and changes in species' distribution are often related but can in some cases move in opposite directions. Changes in abundance are likely to be detected sooner and be of greater magnitude than changes in distribution and as such species' abundance is a key way to measure our progress towards nature recovery. Species extinction risk is another key measure for nature conservation – if the numbers of species at risk of extinction reduces, this indicates that nature conservation efforts are having some success.

The indicators presented in this report show average trends, and they are important for helping us understand the overall picture. However, they hide a lot of detail and variation, and in some cases include only a small proportion of the species found in Wales. It is necessary to look more closely at individual species and groups of species connected with different habitat types in order to see a fuller picture and understand how we should respond.

House Sparrow, Ben Andrew (rspb-images.com)

Responding to the crisis

Wales is party to a new set of international biodiversity targets under the Convention on Biological Diversity. To support the delivery of these, the Welsh Government has committed to setting legally binding nature recovery targets that will be aligned with a refreshed national biodiversity strategy for Wales before the next Senedd elections in 2026. Under newly passed agricultural legislation for Wales, the Welsh Government is developing a Sustainable Farming Scheme. Nature restoration will need to be a core objective of the Scheme to enable this key driver of biodiversity loss to become a major contributor to nature's recovery alongside other essential nature improvement mechanisms being developed. In this report, we have grouped these targets into five broad areas.

IMPROVED SPECIES STATUS
We share some examples of conservation projects that have benefited vulnerable species. 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.

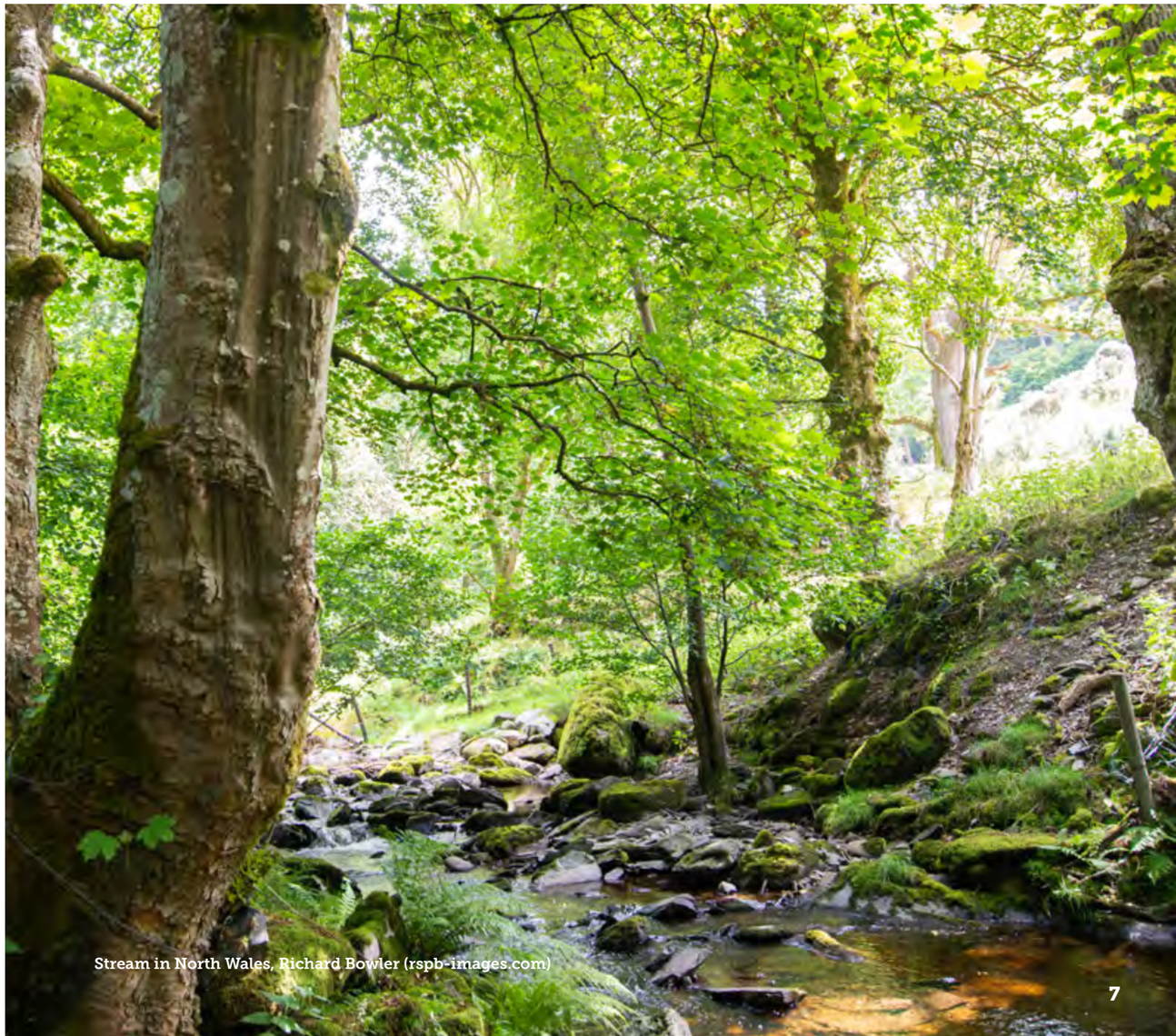
NATURE-FRIENDLY FARMING AND SUSTAINABLE FORESTRY AND FISHERIES
With 90% of Wales' land being farmland, we discuss the critical role of the developing Sustainable Farming Scheme in supporting nature's recovery. Around 47% of woodland in Wales is certified to the UK Forestry Standard, but the need for forestry to become more nature-friendly has been recognised.

PROTECTED AREAS
11 % of Wales' land is protected, but only a third of features (35%) where an assessment was possible were classed as being in favourable condition. 50% of our marine area is included in marine protected areas, but again fewer than half of the features are in favourable condition. We present data that indicate the importance of SSSIs for vulnerable species, and reflect on the importance, for nature recovery, of site protection and management hand-in-hand with wider landscape measures. To deliver on the target to protect and effectively manage 30% of land and sea by 2030, our protected areas need to be better, bigger and more connected.

ECOSYSTEM RESTORATION
We present data on the scale of the challenge to restore Wales' degraded ecosystems, and some forthcoming and ongoing restoration initiatives.

NATURE, CLIMATE AND PEOPLE
We consider the challenges of tackling climate change and biodiversity loss in synergy, while meeting people's needs for food, materials and access to nature. A Nature Service for Wales has been identified by a broad coalition of over 100 organisations as an opportunity to develop skills, provide jobs and restore nature.

The power of volunteers
It is through the collective efforts of thousands of people, most of whom are volunteers, that we can report on the state of nature. Without their efforts, we could not understand the pressures on nature, nor whether efforts to address these pressures through conservation action have been effective. In Wales the volume of biodiversity data submitted via citizen science is lower than in more populated areas of the UK, due to a correspondingly smaller pool of volunteers. However, our capabilities to analyse this data, and use more of the records supplied at different levels – including to Local Environmental Records Centres - are improving.



Stream in North Wales, Richard Bowler (rspb-images.com)

INTRODUCTION

From over 2000 km of coastline – long beaches, sheltered estuaries and bays, wild rocky coasts and islands – through the temperate Celtic rainforest with its rich communities of bryophytes, lichens and fungi, to vast areas of moorland, bogs and mountains, Wales is home to some unique wildlife.

Puffin, Sam Turley (rspb-images.com)

Some Welsh species, like the Rigid Apple Moss, Scarce Yellow Sally Stonefly, Snowdon Leaf Beetle and Snowdon Lily, are found nowhere else in the UK[1]. Wales' rich marine biodiversity includes internationally important seabird colonies off Pembrokeshire, Anglesey and the Llŷn Peninsula, as well as a semi-resident population of Bottlenose Dolphins in Cardigan Bay, which are only present due to the diversity of habitats and species that are found beneath the waves.

Nature needs space to live and flourish, but around the globe humans have decreased and diminished those spaces. The Biodiversity Intactness Index is a measure of how altered and depleted species' abundance and composition are, and for Wales the value is 37%. Although this is similar to other parts of the UK, it ranks amongst the lowest globally[2].

This affects us too. Nature plays a critical role in all aspects of our lives, and there is substantial evidence for the negative consequences of living in a nature-depleted country. These include indirect costs such as impacts on human health and wellbeing, and direct costs associated with adaptation to lost and degraded ecosystem services.

It is far more cost-effective to avoid such damage in the first place or, where damage has already occurred, to restore nature rather than bear the costs of continued degradation[3]. Wales' peatlands are a prime example of this. They are an enormous carbon store, but 90% are damaged or degraded[4]. Across the UK degraded peatlands release the equivalent of 5% of UK greenhouse emissions each year[5]. Restoring peatlands via initiatives such as the Wales National Peatland Action Programme has potential to boost biodiversity, mitigate climate change by sequestering carbon and support adaptation to the effects of climate change – for example, healthy peatlands hold water, slowing its flow across landscapes and so reducing flooding.

Protecting and restoring healthy, functioning natural systems is essential, not only for nature's sake, but for humans 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 which actions work. However, the science shows that nature conservation action alone is not enough to halt and reverse the loss of nature. If we are to 'bend the curve' of biodiversity loss we need not only to increase our efforts towards conservation and restoration, but also to tackle the drivers of loss, especially in relation to our food system[6]. This means making food production more sustainable and nature-friendly, and adjusting our consumption to reduce demand for products that drive the loss of nature. These changes have society-wide implications and so all of society needs to be involved in efforts to halt biodiversity loss[7]. There is a strong public appetite for nature protection and restoration in Wales and the UK at large as evidenced by the recently launched Natur a Ni people's assembly recommendations, consultation from the Natur am Byth species recovery partnership and the UK People's Plan for Nature[8,9].

In June 2021 the Senedd declared a nature emergency and the Welsh Government committed to establishing legally binding nature recovery targets.

KEY FINDINGS

Terrestrial and freshwater

Change in species' abundance

The indicator shows a decline in average abundance of 20% (Figure 1, 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.

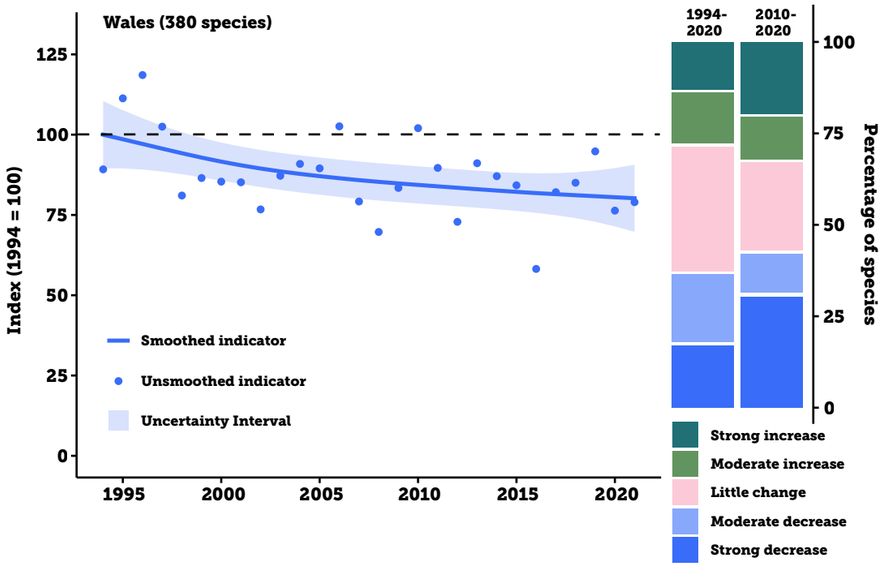


Figure 1: Change in average species' abundance across terrestrial and freshwater species in Wales, based on Wales-specific trends of birds (108 species), butterflies (33 species), mammals (seven species) and moths (232 species). The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in abundance (1994–2020: 380 species, 2010–2020: 376 species).

See page 40 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 2A, UI: -54% to -32%). Over the last 10 years, the indicator was 4% lower in 2020 compared to 2010 (UI: -13% to +5%).

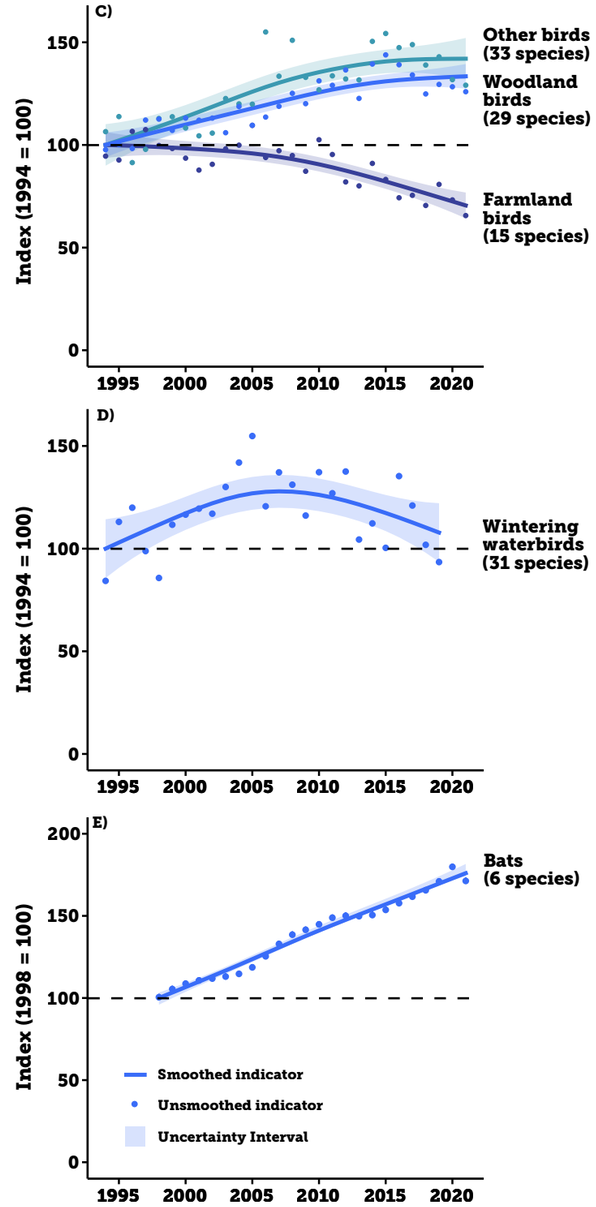


Figure 2: Change in average species' abundance for terrestrial and freshwater species in Wales by habitat preference, level of specialism or taxonomic group.

- Specialist butterflies declined by more than half since 1993 (Figure 2B, -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 2C, UI: -36% to -23%). This is similar to patterns shown in all other UK countries barring Scotland[84], 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 2D, +7%; 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[103].
- The abundance indicator for six bat species starts in 1998 and overall shows an increase in average abundance of 76% (Figure 2E, 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[85].
- Separate data shows[104] that Atlantic Salmon abundance has declined markedly 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 3A, 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[86].
- The distribution indicator for 776 bryophyte species (mosses and liverworts), with Welsh-specific data, showed on average no change (Figure 3B, +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 3C, 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[87]. Reductions in sulphur dioxide pollution are allowing some species to begin to recover[100]. However, ongoing high levels of nitrogenous air pollution mean that recovery may be skewed towards species that can tolerate this.

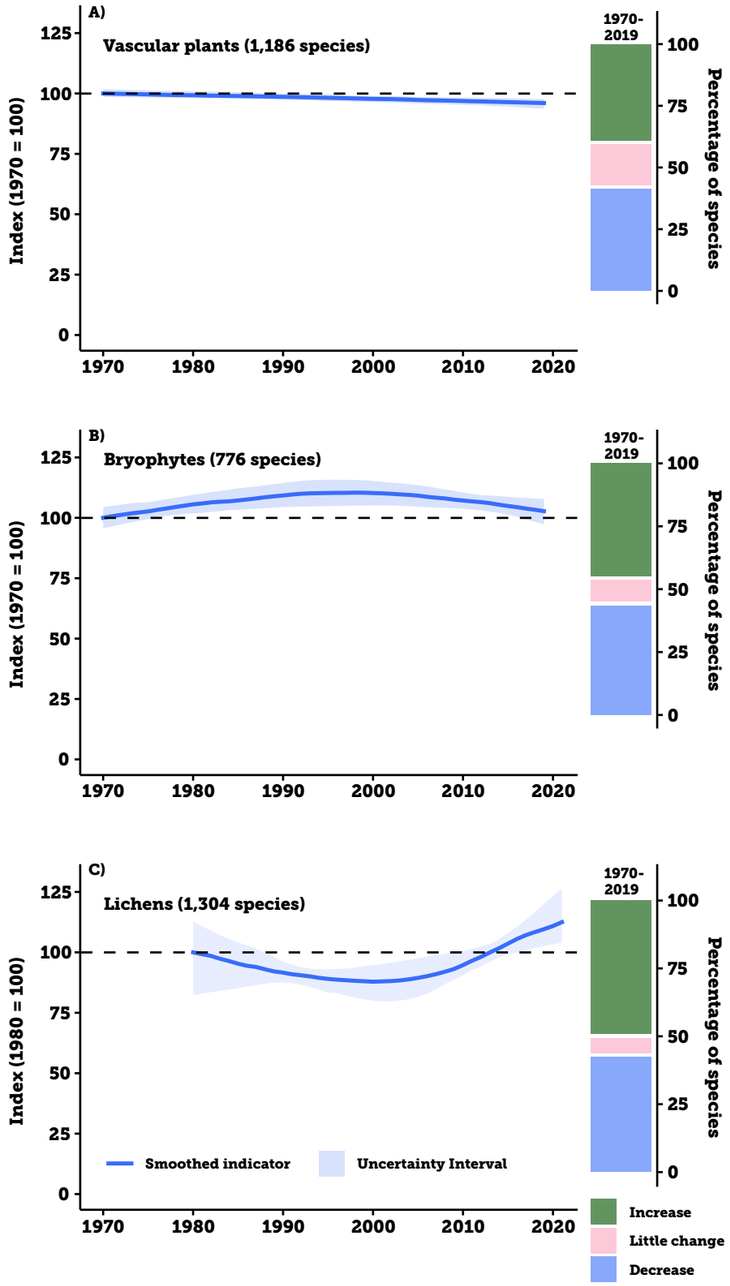


Figure 3: Change in average species' distribution for A) vascular plants, B) bryophytes and C) lichens in Wales. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in distribution.

Sticta Limbata, P Philpot / Plantlife

Invertebrates

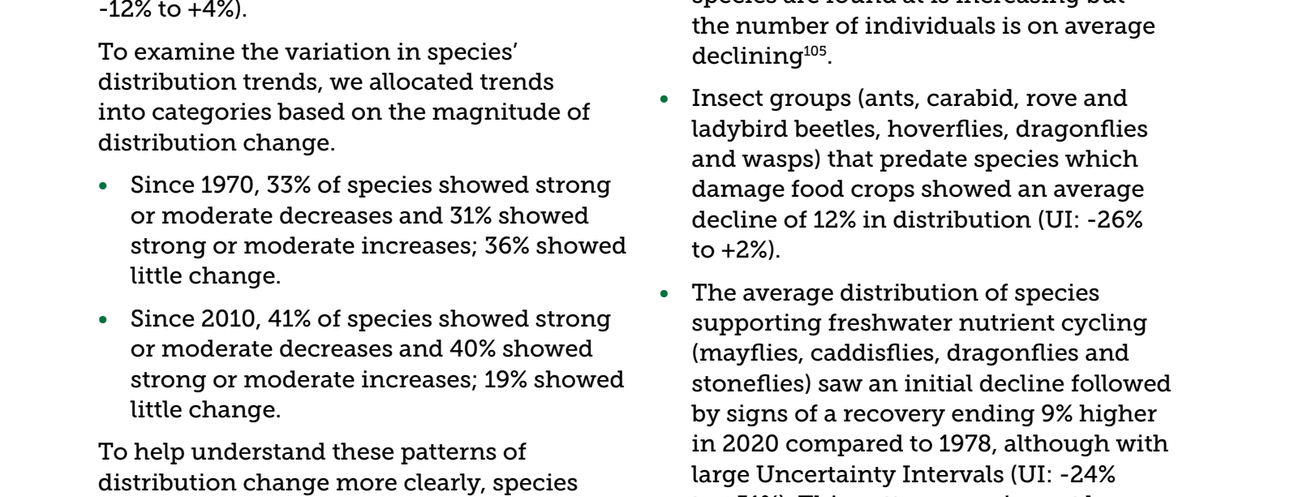
The distribution indicator for 3,036 terrestrial and freshwater invertebrate species, with Wales-specific data, shows no change in average distribution between 1970 and 2020 (Figure 4A; -4%, Uncertainty Interval (UI): -12% to +4%).

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

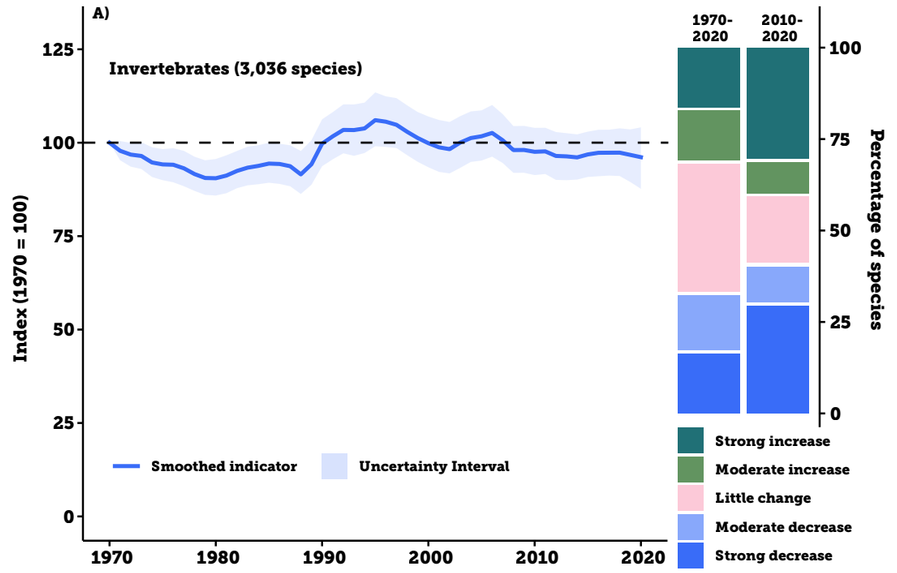
- Since 1970, 33% of species showed strong or moderate decreases and 31% showed strong or moderate increases; 36% showed little change.
- Since 2010, 41% of species showed strong or moderate decreases and 40% showed strong or moderate increases; 19% showed little change.

To help understand these patterns of distribution change more clearly, species groups were categorised by the ecological functions they provide[88]. 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 4B, 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 2. On average, the proportion of sites moth species are found at is increasing but the number of individuals is on average declining[105].
- 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[89], 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[106].



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



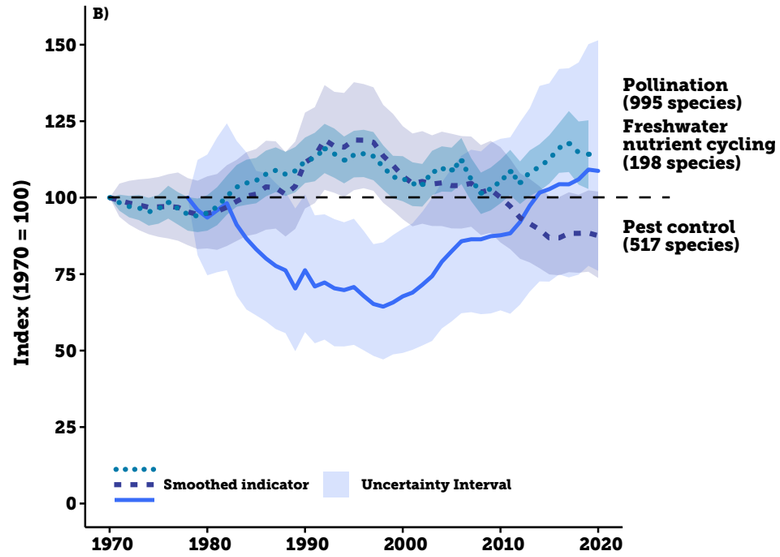


Figure 4: Change in average species' distribution for A) Terrestrial and freshwater invertebrates in Wales. The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in distribution. B) Insect species grouped by ecological 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[90], 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 5)). 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.

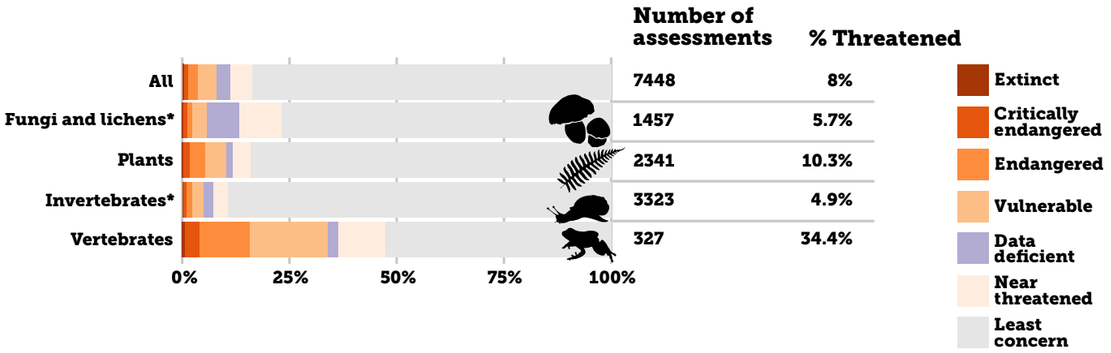


Figure 5: Summary of Great Britain National Red Lists for species present in Wales, showing the proportion of assessed species in each Red List category, by broad taxonomic group. *At a Great Britain level only selected invertebrate groups have been assessed and less than 1% of fungi species.

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 or whole Ireland 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 Number
	Percentage	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[10]. 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 6, -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[91].

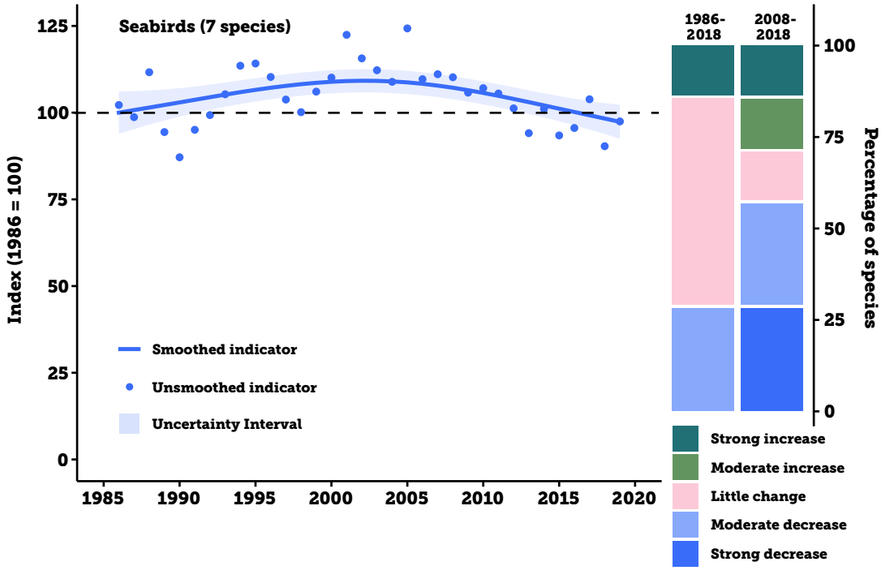


Figure 6: Change in average species' abundance across seven seabird species with Wales-specific trends. The bar chart shows the percentage of species within the indicator that have increased, decreased or shown little change in abundance.

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 7, 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.

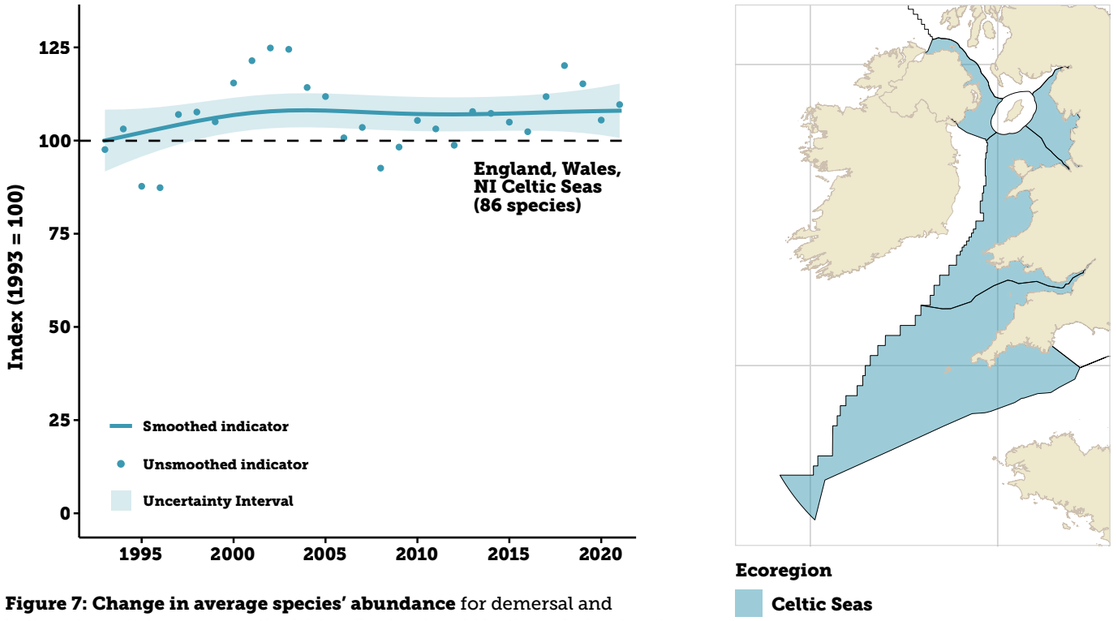


Figure 7: Change in average species' abundance for demersal and bathypelagic fish species in the Wales, England and Northern Ireland and Celtic Seas component of the UK Exclusive Economic Zone (EEZ) from 1993 to 2021.

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[91]. In Wales, the coastal Bottlenose Dolphin population centred around Cardigan Bay is considered to be stable over the long term and in favourable condition[107], although abundance is thought to have possibly declined in the last decade[92].

Wales official biodiversity indicators

Under the Well-being 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 8). 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[97]. With 90%[95] of Welsh land area utilised for agriculture, over 50% of Wales landcover is improved grassland dominated by rye grass[98]. 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.

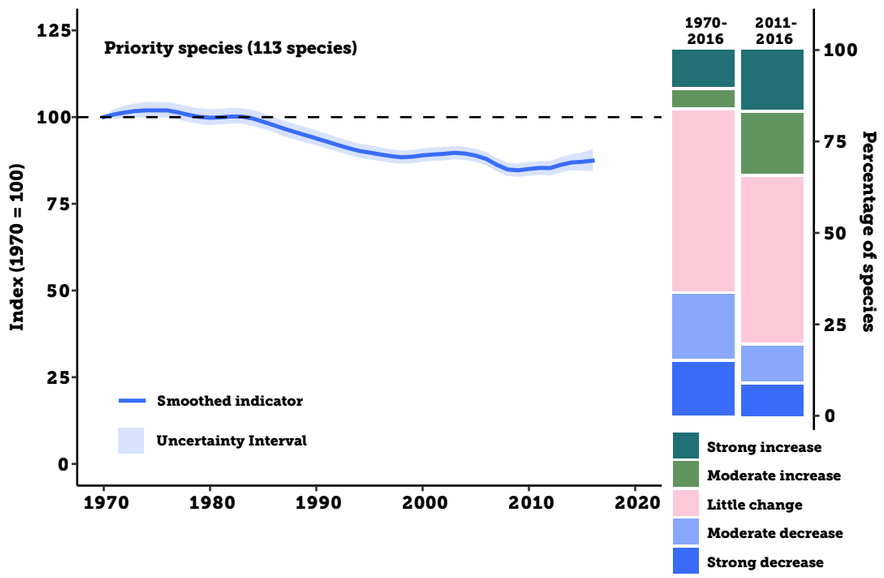


Figure 8: The experimental indicator measuring trends in distribution of 113 Welsh priority species (figure taken from Smart et al. 2022[93]).

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[86].

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[99] 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[100,108]. Persistently high levels of atmospheric ammonia, primarily from the agricultural industry, are above the critical threshold for bryophytes and lichens across 69% of Wales[102]. 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[97]. 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[101]. 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[109] also have the potential to negatively impact marine life, if not planned, managed and monitored sensitively.

CONSERVATION RESPONSE

Global nature recovery targets

In December 2022, the Convention on Biological Diversity (CBD) COP15 summit agreed the Kunming-Montreal Global Biodiversity Framework[11] (hereafter referred to as the Global Biodiversity Framework). It confirmed a global mission to halt and reverse the loss of nature by 2030, and achieve recovery, so that, by 2050, 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 around the world in the years leading up to COP15[14].

The new Global Biodiversity Framework includes four outcome-oriented goals to achieve by 2050, which are underpinned by 23 targets to achieve by 2030, falling under three headings, as shown in Figure 9.

There is a clear consensus that the new global targets must 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[15]. 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[17], countries agreed to these implementation steps to drive the delivery of the global framework at the domestic level.

The Welsh Government has committed to the Global Biodiversity Framework and will set statutory nature recovery targets to support this. The nature recovery response needs to be given equal priority across all sectors, as well as within other areas of environmental policy such as climate change mitigation, planning, waste and air quality. Establishing statutory targets will help increase accountability, drive action and embed appropriate cross-sector responses. A Biodiversity Deep Dive, led by the Welsh Government, has developed a set of collective actions to be taken forward in Wales to support nature's recovery. The target to protect 30% of land and sea by 2030 (the '30 by 30' target) is a strategic focus to see where and how action could be accelerated[18].

In the following chapters we discuss the challenges of restoring biodiversity in Wales, 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 actions on nature and people and, where possible, the future outlook.

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	T4
Nature-friendly farming and sustainable forestry and fisheries	T10
Protected areas	T3
Ecosystem restoration	T2
Nature, climate and people	T1, T8, T12

Figure 9: Summary of the goals and targets agreed within the Kunming-Montreal Global Biodiversity Framework and how these targets are discussed within this report.

Shrill Carder Bee, Nick Upton (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, maintain genetic diversity and increase the abundance of native wild species to healthy and resilient levels by 2050[11]. While many previously common and widespread species continue to decline in Wales, there are some success stories of species benefiting from conservation action. It is important to remember that restoring lost species, halting declines, and reducing extinction risk should not be viewed as the end goal of conservation but a critical step towards biodiversity recovery to the 'healthy and resilient levels' stated in the Global Biodiversity Framework. In order to meet targets for nature's recovery in Wales it will be essential that 'healthy and resilient levels' are clearly defined and that the actions needed to achieve agreed targets for effective species recovery are fully implemented and monitored.

Action – how is species conservation being conducted in Wales?

Figure 10 presents examples of species conservation projects from a range of biomes, taxonomies and life histories, with conservation actions implemented at a range of spatial scales by landowners, NGOs, government agencies and the public, the latter often contributing as project volunteers. These examples focus on a few key conservation actions. In most cases many actions are needed to fully restore species' populations. Equally, actions designed to favour one target species often have beneficial impacts on others[12], as well as improving habitat condition and boosting ecosystem services. Many actions need to be maintained in the long term and this can be particularly challenging, but threatened species responses are a powerful indicator of success for habitat-focused nature recovery actions.

Natur am Byth

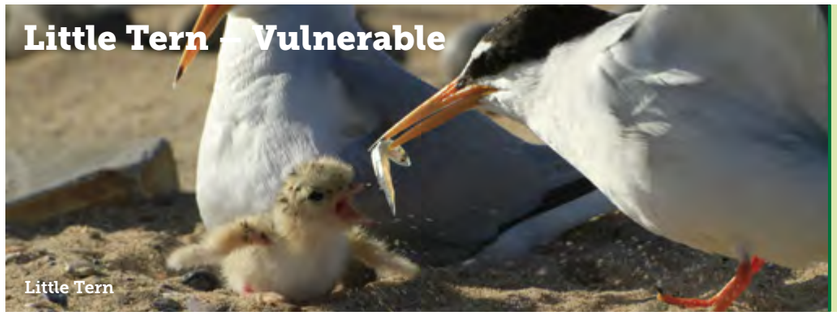
Natur am Byth is Wales' flagship species recovery programme uniting nine environmental NGOs with Natural Resources Wales (NRW) in the largest multi-project partnership of its kind in Wales, running from 2023 to 2027[19]. Using species recovery assessments, public consultation and ecological surveys, 67 vulnerable and threatened species were identified as targets for action.

The component projects are spread across a wide geographic area incorporating a diverse range of communities, habitats and landscapes. These vary from the coastal dunes and cliff systems of Pembrokeshire; urban edges of Swansea, Cardiff and Newport; the mountain peaks of Eryri; grassland, fens and lowland heaths of Pen Llŷn and Ynys Môn; to the wooded and rocky outcrops of the border country. Critical to the project is the inclusion of the most biodiverse marine areas in Wales, off the coasts of Pembrokeshire, Pen Llŷn and Ynys Môn.

Five of the projects are multi-taxa with actions that will benefit a range of species based upon a shared challenge or opportunity. The other six projects are focused on securing the survival of a single vulnerable species, eg the Shrill Carder Bee, for which the Gwent Levels in South Wales are one of a very few remaining strongholds, and the Scarce Yellow Sally Stonefly that occurs in only one location in the UK, on the River Dee near Wrexham.

Our most endangered species have the potential to inspire the public and the Natur am Byth partners are using arts-based engagement, training and digital methods to work with local communities in supporting action for nature and wellbeing.

Figure 10: Species examples showing the range of conservation interventions for a range of taxa.

Species and Great Britain Red List status	Conservation actions	Conservation actions and impact
 Eel grass Bed, Shutterstock	**Seed planting**	Seagrass beds comprised of Eel Grass support much biodiversity, provide fish nursery areas and store significant 'blue carbon' in sediments. Beds suffered massive range decline in the early 20th century due to disease and limited natural seed dispersal which has prevented recovery. One of several seagrass restoration projects in Wales, the Seagrass Ocean Rescue project is planting 10 ha of seagrass across North Wales[20]. Early in 2023, 200,000 seagrass seeds were planted on Pen Llŷn, 50,000 of these sub-tidally. Further planting effort will take place at this and other sites as the project progresses.
 Little Tern	**Manage disturbance and risk of predation**	Little Terns migrate from West Africa to Gronant, Denbighshire, to nest each year. From 1989 to 2019, Gronant was the site of their only major colony in Wales and it is of international significance, now accounting for over 10% of the UK breeding population. Denbighshire County Council has wardened the site for the last 19 years, with volunteers putting in over 600 hours of time in 2022. Wardens use a combination of public engagement, especially with dog walkers, and predator deterrent using electric fencing. The colony was a record size in 2022, with 211 pairs. Importantly, the population growth at Gronant is likely driven by high levels of breeding success rather than by recruitment of adults fledged from other UK colonies.
 Cors Fochno, ©NRW	**Peatland restoration**	The Endangered Large Heath Butterfly has suffered significant declines in England and Wales. In the most recent butterfly Red List, its status deteriorated from 'Vulnerable' to 'Endangered' due to a 57% decrease in distribution between 2010-2019[21]. Large Heath is associated with upland and lowland bog where larvae feed on Hare's-tail Cottongrass. In Wales, nationally important populations occur on six sites. On one of these, Cors Fochno, the population has been monitored annually from 1986 to 2022. Recent analyses have highlighted that the population has remained stable and is considered to be in a favourable condition[22]. Numbers are highest where active bog is in good condition and it is likely that the population at this site has benefited from positive peatland restoration.
 Red Squirrel, Ben Andrew (rspb-images.com)	**Invasive species control**	Conservation action for Red Squirrels is taking place in several locations across their fragmented Welsh distribution. This has found particular success on Anglesey, where the Red Squirrels Trust Wales has successfully eradicated Grey Squirrels. Grey Squirrel management is also now taking place on the adjacent mainland and Red Squirrels are expanding their range there as well. The population in Gwynedd has suffered several squirrel pox outbreaks in recent years, although the population has persisted. Work is underway by the Mid Wales Red Squirrel Partnership to enable the expansion of the vulnerable Red Squirrel population in Mid Wales. Already monitoring is showing that Red Squirrels are appearing in areas where they were thought to have died out.

Nature-friendly farming, and sustainable forestry and fisheries

The new Global Biodiversity Framework includes Target 10 to: "*Ensure that areas under agriculture, aquaculture, fisheries and forestry are managed sustainably, in particular through the sustainable use of biodiversity, including through a substantial increase of the application of biodiversity-friendly practices, such as sustainable intensification, agroecological and other innovative approaches contributing to the resilience and long-term efficiency and productivity of these production systems and to food security, conserving and restoring biodiversity and maintaining nature's contributions to people, including ecosystem functions and services.*" This section outlines the dependency of the current and future state of nature on the degree to which the farming, forestry and fisheries sectors pursue more nature-friendly or sustainable approaches.

Farming

Agriculture currently accounts for 90% of the land area in Wales, primarily for livestock production[23]. A combination of changing agricultural policy, technological advancements and use of agro-chemicals and biocides has reduced the capacity of farmed landscapes to support wildlife, resulting in widespread biodiversity loss[25].

Agri-environment schemes (AES) have been the primary policy mechanism for addressing farmland biodiversity declines in Wales and across the UK. Schemes have generally had both 'broad and shallow' elements and higher-level or more targeted elements designed to support particular habitats or species. In 2020, 30% of the area of agricultural holdings in Wales was subject to higher-level or targeted agreements under Glastir, which has been Wales' AES since 2012[24].

The Glastir Monitoring and Evaluation Programme (GMEP) uses models to explore the potential impacts of Glastir. Initial results suggest habitat condition for species studied is likely to be encouraged by the Glastir actions explored. However, it may be 10 years or more before soil and canopy height conditions are suitable for species associated with final target habitats for Glastir interventions[32]. Further field data collection will be essential to see if key biodiversity groups show positive responses, but the modelling emphasises the need for consistency and patience in maintaining interventions if the benefits are to be realised. GMEP relies on existing structured monitoring schemes such as the Breeding Bird Survey; however, these overlook species that have declined sharply and are now rare, such as Lapwing. To assess the impact of Glastir and future farm payments targeted at supporting such species, bespoke monitoring will be needed.

Studies have found that Glastir and its predecessor scheme, Tir Gofal, have had mixed outcomes for biodiversity[26-28]. While evidence of the success of AES is mixed[26-30], this is set in the wider context of ongoing declines in species associated with farmland. This indicates that wider provision of nature-friendly measures is needed to reverse these declines.

The UK's departure from the EU has meant reform in Wales' agricultural policy, leading to the passing of the Agriculture (Wales) Bill by the Senedd in July 2023. This established 'Sustainable Land Management' as the basis for future farm payments in Wales, with four objectives (to be co-delivered): tackling climate change; maintaining and enhancing the resilience of ecosystems; sustainable food production; and conserving and enhancing Welsh culture and enabling engagement with it. The Welsh Government has made it clear that it considers restoring biodiversity and ecosystems to be a key part of sustainable land management[33].

From 2025, all farm payments will be via the new Sustainable Farming Scheme (SFS). The scheme will include requirements for all farms, such as managing at least 10% of each farm as habitat, through to options for farmers to work collaboratively for species recovery at landscape scale. However, the latter elements are unlikely to come into effect until close to the end of the decade, limiting their opportunity to contribute to 2030 biodiversity targets. Continued funding of data collection, analysis and scientific reporting on the effectiveness of options under the SFS remains essential to assess whether biodiversity outcomes are being delivered and farmers are being enabled to make a major contribution to nature recovery.

Forestry

Woodland cover is gradually increasing in the UK, although from a baseline of heavy deforestation. Much of the new woodland comprises uniform planting of non-native tree species for harvest. Along with a lack of effective management in native

Landscape, Drew Buckley (rspb-images.com)

woodlands, this is leading to a reduction in woodland wildlife and an increased risk to native tree species from new pests and pathogens[34,35]. These issues mean there is a growing imperative for careful planning and sustainable management of forestry and tree planting in order to halt and reverse biodiversity loss, and to mitigate and adapt to the effects of climate change.

The UK Woodland Assurance Scheme (UKWAS) sets common woodland standards in the UK (the UK Forestry Standard/ UKFS) and is recognised by both the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC). Whilst parts of UKFS-compliant forests will be managed for objectives other than nature, UKFS requires any semi-natural habitat present to be maintained or enhanced.

The estimated area of woodland in Wales that is certified through the UKWAS is 145,000 ha[36] (47% of the total). This includes the entirety of the Welsh Government Woodland Estate and, as of 2022, 20% of privately owned woodland (up from 14% in 2001). In addition, managed woodland in receipt of grant payments or felling licence should be managed in accordance with the UKFS. Improvements in woodland management in the private sector have been heavily dependent on grant aid. This additional element appears to have decreased in recent years, due to the cessation of the Welsh Government's Glastir Woodland Management Scheme. A new scheme – the Woodland Investment Grant – was launched by the Welsh Government in 2022, for woodland creation and expansion in accordance with the UKFS, as part of the National Forest policy.

The recommendations of the Welsh Government's Biodiversity Deep Dive included a commitment for the Welsh Government and Natural Resources Wales to lead by example through demonstration, changing practices that are detrimental to nature, and by exploring further opportunities to ensure that delivering for nature is one of the priority objectives for the Welsh Government Woodland Estate.

Marine fisheries

Marine fishing has long been a part of the culture of Wales, as in other parts of the UK. Overfishing and fishing methods that damage benthic habitats have been major drivers of marine biodiversity loss across the UK[37,38] and there have long been concerns about the sustainability of fish stocks[37,39]. Many commercially targeted fish and shellfish species are assessed at scales much larger than Welsh waters, and there is insufficient data available even for important Welsh fisheries species – eg Whelk, Scallop, Lobster – to assess sustainability.

More broadly, the sustainable management of natural resources is not limited to considering individual stocks but must also consider the resilience of ecosystems. As well as supporting fisheries, fish stocks play a vital role in the wider marine food web. Recent studies have improved our knowledge of the spawning and nursery grounds of forage fish species, those preyed upon by other animals[40], and identified the pressures these species face in Welsh waters[41]. Species such as Herring and Sandeels are considered most sensitive to human activities and development due to their dependence on specific seabed substrates during at least part of their life, including spawning.

Protected areas

Protected areas are a key pillar of nature conservation and recovery, and considerable global momentum has formed around their designation. The Global Biodiversity Framework includes a target to conserve and effectively manage 30% of land and inland water, and marine and coastal areas, through ecologically representative, well-connected and equitably governed systems of protected areas and other area-based conservation measures. The Framework states that priority should be given to designating areas of particular importance for biodiversity and ecosystem functions and services.

Action – extent and condition

Wales has a variety of protected area designations. On land, the main site level designations for nature are Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Ramsar sites and National Nature Reserves (NNRs); taken together these sites cover 11% of Wales' land area (including freshwater and coastal areas to high water mark). This is the same as the UK average and compares with England 7%, Scotland 18% and Northern Ireland 10%[42]. The primary legal purpose of these designations is nature conservation and most are privately owned. Their success depends on appropriate management which can be secured through a range of mechanisms such as management agreements or agri-environment schemes.

Designated landscapes – National Parks and Areas of Outstanding Natural Beauty, have a range of purposes, including but not limited to the conservation of natural heritage. They typically include a mix of land uses and are not considered in their entirety as protected areas in the context of the 30% target.

The Natural Resources Wales 2020 Baseline Evaluation of protected sites assessed the condition of the freshwater and terrestrial features of Wales' SSSIs[43]. The results show that evidence was insufficient to determine the condition of over half of the features on these sites. Of those that were assessed, 35% of biodiversity features were in favourable condition and 63% in unfavourable condition. These findings provide an important baseline to inform the future approach to management and monitoring across the wider suite of protected sites (SSSIs, SACs and SPAs).

In the marine environment, 69% of Welsh inshore waters (out to 12 nautical miles) and 50% of all Welsh waters (out to the median line) are designated as Marine Protected Areas (MPAs)[44]. Other UK nations have between 36% and 38% of their marine waters designated as MPAs. In Wales, indicative marine site-level feature condition assessments in 2018 reported 46% of features were in favourable condition, 45% in unfavourable condition and 9% were unknown[45].

RSPB South Stack Nature Reserve, Ben Hall (rspb-images.com)

Impact

SSSIs are crucial for the conservation of some of Wales' most threatened species, with many found only on designated sites. For example, 85% of bryophyte species and 83% of lichen species on the Great Britain Red List that occur in Wales are present on at least one SSSI[46,47]; (Figure 11), with the majority of the populations of most Critically Endangered (CR) and Endangered (EN) bryophytes and lichens entirely protected within SSSIs. The entire Welsh population of the CR lichen *Cladonia peziziformis* lies within three coastal heathland SSSIs, whilst most of the Welsh population of the CR liverwort Black Crystalwort is within Stanner Rocks SSSI. Likewise, all 18 Welsh stonewort species occur in protected sites (Figure 11).

For invertebrates, of those with published status reviews, 51% of Threatened species are qualifying features of SSSIs, and a further 18% whilst not qualifying are also found on SSSIs (Figure 11). Welsh SSSIs host 227 invertebrate species and 17 invertebrate assemblages of national importance equating to 621 features across 203 SSSIs. Key species include the Scarce Yellow Sally, Glutinous Snail and High Brown Fritillary. Over 100 threatened and scarce invertebrate species are restricted to a single locality. A small number of species are found at multiple Welsh sites but not found elsewhere in the UK. These include the Large Mason Bee at Porth Ceiriad and Porth Neigwl and the Money Spider *Porrhomma rosenhaueri* from Lesser Garth Cave and Nant Glais.

While these examples highlight the important role SSSIs play in ensuring that threatened species are not lost, we must also consider whether protected areas support population recovery. There are currently no specific national schemes designed to evaluate overall species' abundance or biodiversity in protected areas, in comparison to areas outside them, and there is a general data shortfall for priority species[48]. However, studies have found that in some cases protected areas are associated with more positive species' 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[49]. Similarly, sites designated for a target species group, for example SPAs for birds[50] or SPAs and Ramsar sites for wetland birds[51], have stronger associations with trends in abundance. However, recent trends in invertebrate species' distribution have on average declined both in protected and unprotected areas at a similar rate, even across a subset of rarer species[52]. 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[53]. The extent to which population declines reflect site-level issues, including effectiveness of management, governance and enforcement, or drivers that lie beyond site boundaries (eg, climate change, diffuse pollution) is uncertain.

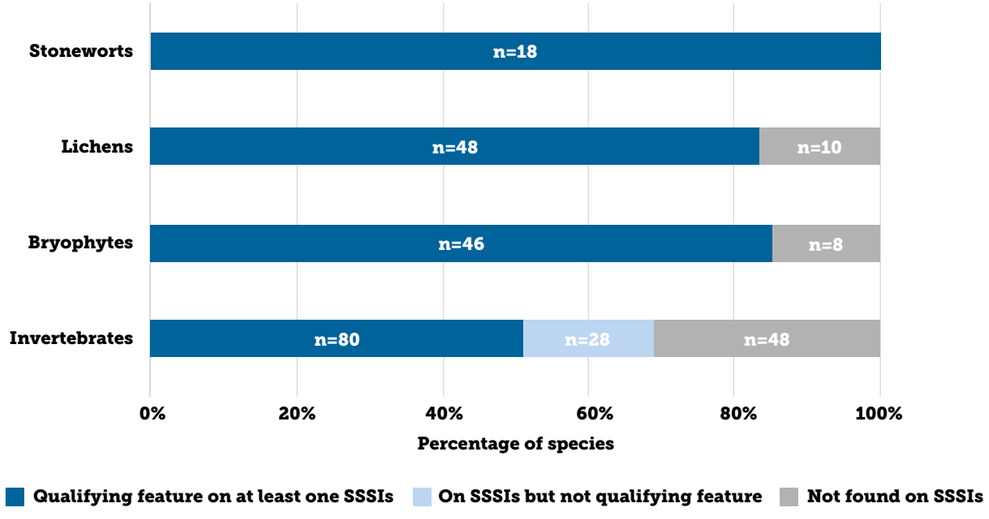


Figure 11: Representation of Great Britain Red Listed stoneworts, lichens, bryophytes and invertebrate species (Threatened: Vulnerable, Endangered or Critically Endangered) on SSSIs in Wales[46,47].

Protected areas are also important for safeguarding priority habitats, but in some cases only a small proportion of the total extent falls within a SSSI. For example, semi-natural grasslands are particularly vulnerable to loss of extent, from pressures such as agricultural intensification, or decline in condition due to issues such as undermanagement. There are just over 460 SSSIs in Wales with qualifying grassland features, but most grassland habitat in Wales currently receives no statutory protection: only 9% of grassland 'priority habitat' (habitat listed under Section 7 of the Environment (Wales) Act 2016) is found on SSSIs.

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 flooding or coastal erosion. The importance of deep peat for biodiversity in Wales is reflected in the 169 SSSIs notified for one or more peatland biological interest features, with 44,045 ha of peat (54% of the Welsh resource) represented on 250 SSSIs in total[54]. Restoring degraded sites in the network will reduce emissions by protecting carbon stocks found in peatlands and, in some cases, increase them via sequestration[55].

Similarly, in marine environments, MPAs can protect and effectively manage 'blue carbon' stores. The total contribution of Welsh marine SAC features to carbon storage was estimated to be approximately 11 Mt of carbon in the top 10 cm of sediment. This accounts for almost 10% of the total carbon storage across all habitats in the Welsh National Marine Plan area. The rate of sequestration was approximately 12,300 t of carbon per year across the SAC network, which accounts for 47% of the total carbon sequestered within Welsh habitats[56]. Features which covered large spatial extents, such as estuaries and large shallow inlets and bays, contributed the most towards carbon storage and sequestration across the network; however, designated saltmarsh features contributed the most towards blue carbon per unit area[57].

Future

Well-managed protected areas are critical to the survival of threatened Welsh species and priority habitats. The Biodiversity Deep Dive, set up by the Welsh Government to identify key actions for nature recovery, recognised the need to transform the protected site series so that it is better, bigger and more effectively connected[18]. The Welsh Government's Nature Networks Programme, and its supporting 'Nature Networks Map', is a key tool to support this. However, the Deep Dive also recognised that both the success of protected sites, and our efforts to maintain, enhance and restore both common and rare species and habitats also depend on wider landscape and seascape measures (such as sustainable farming and land-use and marine planning) and tackling systemic impacts such as air and water pollution.

Ecosystem restoration

Ecosystem change and degradation in key habitats is one of the direct drivers of biodiversity loss in Wales and ecosystem restoration is the process which aims to reverse the damage. It can simultaneously enhance biodiversity, ecological function and the delivery of ecosystem services. Both global and national policy initiatives are encouraging restoration and protection of natural and semi-natural habitats[58-60]. The post-2020 Global Biodiversity Framework commits to ensuring that 30% of degraded habitats are under effective restoration by 2050 and to restore, maintain and enhance nature's contribution to people, through ecosystem-based approaches and nature-based solutions to the climate emergency. Nature-based solutions involving ecosystem restoration can provide important co-benefits for nature and people, including flood alleviation, improved livelihoods and biodiversity conservation[55]. Restoration should therefore help ecosystems become more resilient and enhance biodiversity, which in turn should enable more effective species conservation. A rapid increase in rates of both ecosystem restoration and targeted species recovery action are necessary; neither on its own will halt and reverse biodiversity loss.

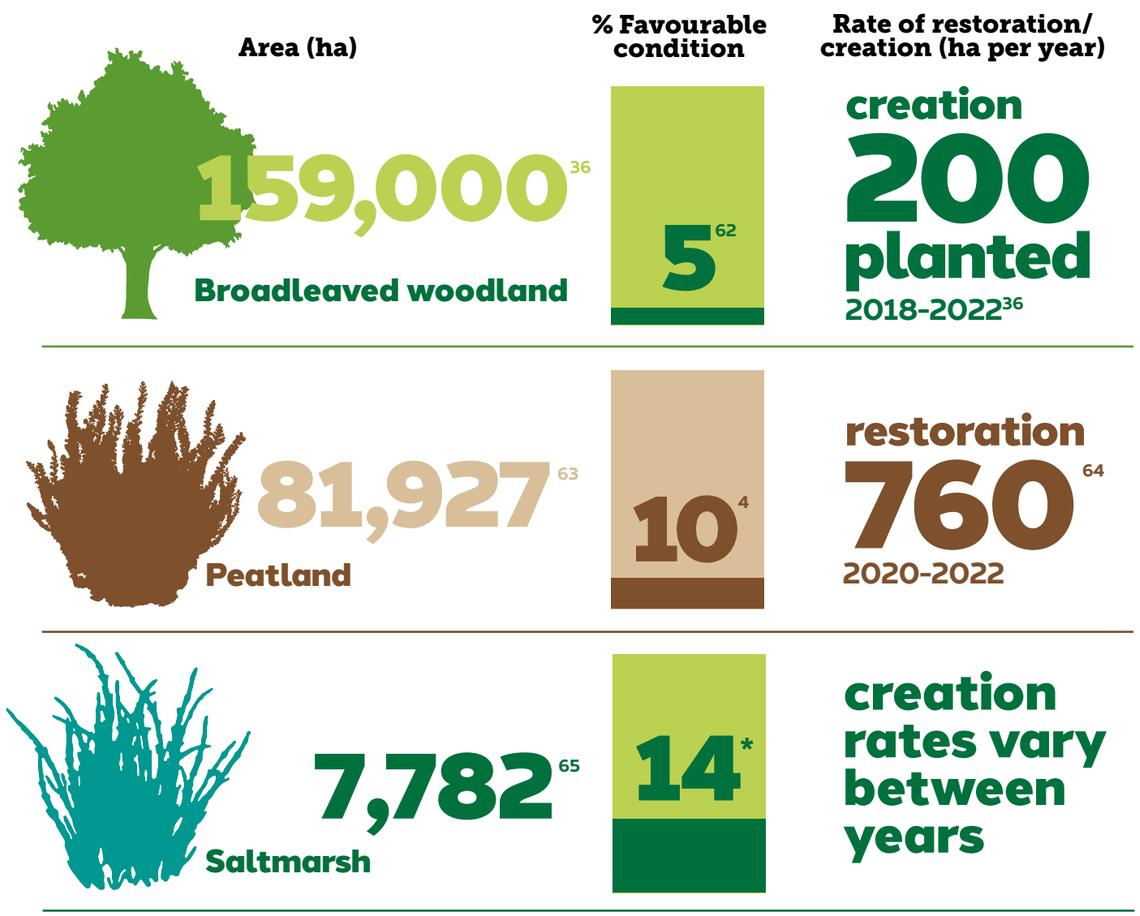


Figure 12: The area, condition and rate of restoration or creation of carbon-rich habitats in Wales. *Much of the remaining saltmarsh habitat is in unknown condition.

Action – condition and rate of restoration of ecosystems

The Article 17 Habitats Directive report collated data on 59 types of UK habitats of European importance in Wales. These are habitats considered to be rare, endangered or vulnerable in Europe[4]. By area, Wales' habitats of European importance are predominantly marine (74%), which reflects the broad nature of some of the Annex I categories including 'reefs'. The remainder comprise of heathlands (10%), wetlands (6%), woodlands (7%), coastal areas (2%), as well as freshwaters, grasslands, and rock (1%). Of these 59 assessed Welsh habitats, 51 are in unfavourable-bad condition, seven are inadequate and one is in favourable condition. Here, unfavourable-bad condition refers to a habitat that has undergone major negative changes in structure or function and/or quality[61].

The most recent assessment, reported in 2020, found less than 5% of native Welsh woodland was in favourable ecological condition[62]. An assessment in 2019 found that no more than 10% by area of the near-natural and modified peatland resource and 14% of Welsh saltmarsh is likely to be in favourable condition[4] (Figure 12). Reduction in anthropogenic pressures and restoration of these habitats would have significant potential benefits for nature and climate. At the current restoration rates only a small additional extent of peatland will be in favourable condition by 2050 (Figure 12).

Impact

There are many ecosystem restoration initiatives in Wales including woodland, peatland, grassland, saltmarsh and marine habitats.

Peatland

The National Peatland Action Programme (NPAP) is a five-year programme of coordinated peatland restoration in Wales. The programme addresses the nature and climate emergencies simultaneously by harnessing the unique coupling which exists between peatlands in good condition and their provision of a wide range of ecosystem services, notably carbon storage and the regulation of greenhouse gas (GHG) emissions. Damaged peatlands release significant amounts of GHGs to the atmosphere, but restoration can greatly reduce this or even result in net sequestration. NPAP is also contributing to climate change adaptation by increasing the resilience of Welsh peatlands to climate change, chiefly through countering erosion, restoring near-surface water table levels, and encouraging the recovery of semi-natural peat-forming vegetation. In the three years since its inception NPAP and its partners have succeeded in restoring over 760 ha of damaged peatland each year[54,64].

Marine and coastal

There are many marine restoration projects currently ongoing in Wales including those focused on native oysters in Milford Haven[66] and in North Wales[67], and those focused on restoring seagrass meadows[20,68].

The Sands of LIFE project (funded by the EU LIFE programme and the Welsh Government) is restoring mobile sand dune habitats at four SACs (10 SSSIs), including by dune slack scraping, dune re-profiling, removing scrub and invasive non-native species, fencing, facilitating rabbit grazing, including by warren creation, and mowing tall grass. Species that could benefit include Fen Orchid[69]. The Dynamic Dunescapes project is delivering similar interventions across 11 sites in Wales. Highlights of this project include the appearance of Green-winged Orchid in an area cleared of Sea Buckthorn at Pembrey[70].

Woodland

Temperate rainforest is found in four areas of Wales: Eryri (Snowdonia), Elan Valley in Powys, Meirionnydd oak woods in Gwynedd, and West Wales. This rare forest is only found in areas close to the sea which have the high rainfall of an oceanic climate.

It provides perfect conditions for specialist lichens, mosses, liverworts and fungi found nowhere else. Summer visitors to this forest include the migrant birds Wood Warbler, Redstart and Pied Flycatcher. Temperate rainforest used to extend across much of western UK and Europe but today covers less than 1% of Britain. Relict patches are a vital part of Wales' ecological and cultural heritage and future. Most are currently in unfavourable ecological condition as a result of poor management over many years, including too much or too little grazing, fragmentation, and invasive species such as *Rhododendron ponticum*. The Celtic Rainforest Wales project aims to reduce invasive *Rhododendron ponticum* and to re-introduce low intensity grazing by cattle and ponies to provide suitable conditions for lower plants such as lobarian lichens, ground nesting birds such as Wood Warbler and natural forest regeneration[71]. Plans are under development to restore Celtic rainforest across other areas of Wales where it was originally found, to be achieved through working with a wide range of organisations and landowners.

Invasive non-native species

Invasive non-native species (INNS) are species that have been introduced by humans beyond their natural range and pose a threat to nature or people. They can damage the environment, the economy and human health by competing for resources with, predating, or hybridising with native species, and they may also carry new diseases. The Our River Wellbeing project in the Dee Catchment focuses on the health and wellbeing of volunteer River Guardians while tackling INNS, and local action groups have been set up to reduce the risks and impacts of INNS across Wales. Delivering the changes needed depends on farmers and other land owners and managers, and businesses using the land and sea, as well as on the right frameworks for regulation and support.

Nature, climate and people

Work to restore nature needs to happen at the same time as work to mitigate and adapt to the impacts of climate change. Furthermore, both must be done while meeting people's needs for food, raw materials, energy and access to nature.

Simultaneous delivery of these multiple goals is not straightforward, but international expert bodies have emphasised the need to ensure that nature and climate goals are pursued in concert[72], requiring a thorough understanding of the synergies and risks associated with different actions. Moreover, action we take domestically could lead to unintentional impacts on nature overseas, so-called 'offshoring', such as if we begin importing more food from highly biodiverse landscapes in other countries.

The post-2020 Global Biodiversity Framework acknowledges these wider pressures. It 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). These targets resonate with the findings of the Deep Dive on Biodiversity led by the Welsh Government[18], (see Box 1).

In addition to biodiversity targets the Welsh Government has to meet the legally binding target to reduce carbon emissions to net zero by 2050[73]. Responding to climate change requires mitigation – measures to reduce further greenhouse gas emissions – and adaptation – measures to prepare for, and cope with current and future change.

Box 1

Biodiversity Deep Dive

The Welsh Government's biodiversity 'Deep Dive'[18] primarily focused on the target to protect and effectively manage 30% of land and sea by 2030 (the '30 by 30' target), but its recommendations recognise the critical role of wider management of activities on land and sea.

1. Transform the protected sites series so that it is better, bigger and more effectively connected.
2. Create a framework to recognise Nature Recovery Exemplar Areas and Other Effective Area-based Conservation Measures (OECMs) that deliver biodiversity outcomes.
3. Unlock the potential of designated landscapes (National Parks and Areas of Outstanding Natural Beauty) to deliver more for nature and the 30 by 30 target.
4. Continue to reform land and marine management and planning (including spatial) to deliver more for both protected sites and wider land or seascapes.
5. Build a strong foundation for future delivery through capacity building, behaviour change, awareness raising and skills development.
6. Unlock public and private finance to deliver for nature at far greater scale and pace.
7. Develop and adapt monitoring and evidence frameworks to measure progress towards the 30x30 target and guide prioritisation of action.
8. Embed nature recovery in policy and strategy in public bodies in Wales.

Well-planned and designed nature-based solutions for mitigation and adaptation are a key opportunity for biodiversity gains.

Adaptation measures can include restoring natural processes, such as river basin management to reduce flooding and storm damage. Protecting and restoring habitats is also critical to help wildlife to adapt – a resilient network of natural habitats, including more, larger and better-connected sites, will not only boost ecosystem services but is essential to accommodate the inevitable range-shifts driven by climate change (see Protected areas).

Mitigation efforts focus on restoration of carbon-rich habitats such as peatlands (see Ecosystem restoration) and habitat creation, particularly afforestation. The Welsh Government has set ambitious targets for new woodland – 43,000 ha by 2030 and 180,000 ha by 2050[74]. The impacts of afforestation for both climate and nature will vary over decades and centuries as woodland matures. These impacts will depend on a range of factors, such as the tree species involved, the soil types, the level of ground disturbance, whether forest expansion is by planting or natural regeneration[75], the end use of any timber that is harvested, and what habitats are being replaced to make space for trees[55,75-77]. Planting trees in inappropriate locations can have negative impacts on nature (eg on open ground habitats and the species dependent on them) and can also conflict with peatland protection and restoration, which is itself important for climate change mitigation. These challenges point to the need for a strategic approach to land use.

Wind turbine, David Woodfall (rspb-images.com)

Scenarios looking at ways to achieve net zero in the land-use sector suggest that wildlife benefits most through maximising nature-based solutions (such as native woodland creation and peatland restoration), but this can involve trade-offs with food production. These trade-offs could be partially mitigated through moderate levels of dietary change and reduced food waste.

Delivering net zero also depends on a rapid transition to renewable energy. The Welsh Government has high ambitions for deployment, as do the UK, Scottish and Northern Irish Governments. Through the British Energy Security Strategy[78], 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[79].

The Welsh Government has recently consulted on increasing its targets for renewable energy generation from equivalent to 70% of our annual electricity consumption by 2030 to 100% by 2035. A large proportion of this is expected to be generated by static and floating offshore wind – The Crown Estate is preparing to lease sites for an initial round up to 4GW in the Celtic Sea, and has indicated a longer term potential for a further 20GW by 2045[80].

This dramatic scale of marine development raises concerns about potential impacts on wildlife, such as Wales' internationally important seabird populations. Furthermore, marine habitats themselves contribute to climate change mitigation by storing 'blue carbon' (see Protected areas). The need for a strategic, spatial approach to marine development planning, to ensure development takes place alongside nature protection and recovery, has now been acknowledged by the Welsh Government[81].

Nature and people: Nature Service Wales

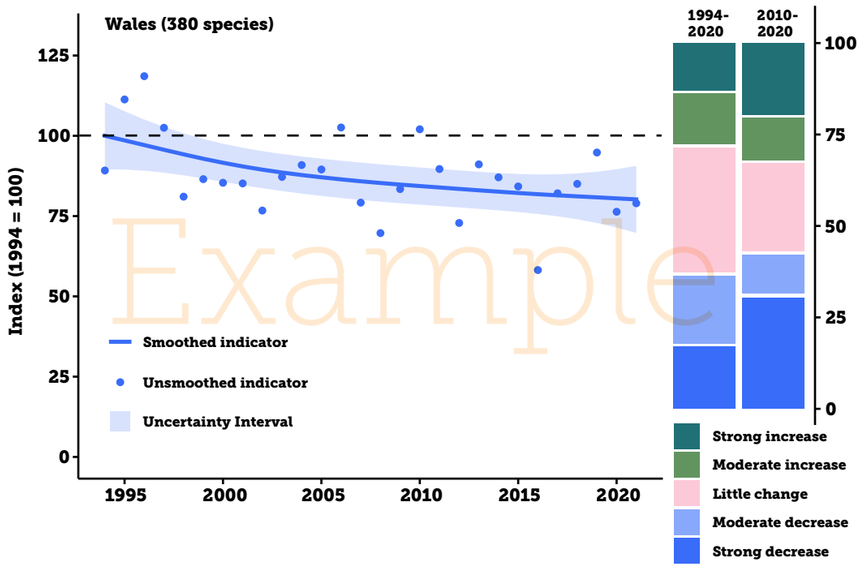
The importance of access to nature to people's health and wellbeing has been recognised, and Wales has a target that no-one should live more than a six-minute walk from their nearest green space. The importance of nature to people was recognised more than ever during the coronavirus pandemic, and discussions about how to secure a Green Recovery in Wales identified a further opportunity.

Over a hundred stakeholders came together to develop proposals for a Nature Service Wales[82] – to provide jobs and skills development opportunities in nature restoration, putting people at the forefront of restoring Wales' natural environment and providing meaningful livelihoods in local communities. Investing in Nature Service Wales will provide upskilling and reskilling opportunities in nature conservation and restoration, and could create 7,000 jobs over the next decade[83].

APPENDICES

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 – 194 of the main report.



Which data have we used?

- We present trends in abundance (for 753 species) and distribution (for around 9,000 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[110]. Distribution trends for vascular plants include species introduced to the UK more than 500 years ago.
- We present assessments of Great Britain Red List status for 7,448 native species, and for Wales Red List status for 3,897 species.
- Details of our data sources and the species they cover are given 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[111] 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[112-114]. Distribution and abundance trends are often related, and there is evidence that they tend to operate in the same direction[115,116]. 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[117,118].

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

What are the graphs telling me?

The measures we present 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 specified in each figure legend.

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 in the Methods section of the main report. 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 known to have occurred in Wales that qualify for each threat category overall, and by different taxonomic groups. We also present data for several taxonomic groups that have been assessed for extinction risk at a Welsh scale.

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.

Biodiversity indicators

We have presented the experimental Wales National Indicator on the status of biological diversity to complement the State of Nature 2023 analyses[93,96].

What time period does this report cover?

In general we show abundance trends in species from 1970 or 1994, 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, abundance trends for seabirds in Wales start in 1986.

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