STATE OF NATURE

2019

state of nature PARTNERSHIP

#STATEOFNATURE

State of Nature 2019 **documents how human impacts are driving sweeping changes in wildlife in the UK. The loss of nature affects us all, but the greatest impacts will be upon the lives of young people and generations yet to come, if they have to live in a world impoverished of nature. In recognition of this, we asked some of the UK's most passionate and committed young conservationists to tell us what nature means to them.**

"Nature provides liberation from the hustle of modern society, allowing our attention to shift away from ourselves and focus on the glorious and the sublime. For me it is not a supplement, it is a necessity."

BELLA LACK, 15

"The revival of the Red Kite, Ospreys bouncing back, breeding Cattle Egrets – many species are bringing new life to the UK but the list of declining species is ever growing. We must unite now to save these species before they're but a distant memory."

DAN ROUSE, 23

"Nature is our life support system. As an autistic teenager, nature has provided a safe space to which I can crawl into, rejuvenate my spirits and keep me going."

DARA MCANULTY, 15

"I wholly believe that it is our duty to protect nature and the environment as a reciprocation to how nature takes care of us every single day. Nature allows us to eat, drink, breathe, live. The least we can do is protect it."

YETUNDE KEHINDE, 17

"Nature is important to me because it reminds me to keep going even when things are hard. The fresh air and petrichor give me space to breathe and let go and make me feel better. Nature always gives a solution, and adapts, always trying hard, and I think we all have something to learn from nature."

ESTHER BIRD, 13

"I have never seen a Hedgehog, although my parents used to see them all the time in the area. Many others my age have had the same experience. I'm worried that we're close to losing them from our countryside forever."

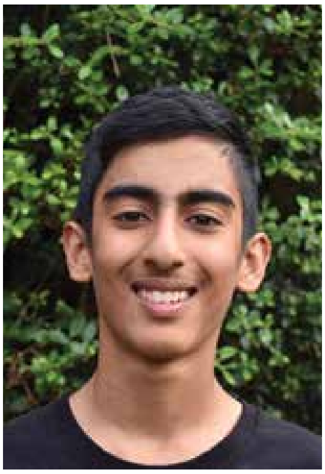
JAMES MILLER, 17

Photo: David J Slater (rspb-images.com)

Swallows

"Thanks to the dedication of schoolchildren and volunteers in the City, wildflower meadows and roof gardens have been created, allowing pollinators, including many butterflies, to thrive in central London. This shows the potential we all have to protect nature, in every place, even in our concrete jungles."

KABIR KAUL,14



"Whenever I have the chance to experience the outdoors, the presence of nature brings a feeling of tranquillity. Seeing the variety of animals and plants that our forests, parks and meadows contain gives me the urge to protect the environment even more."

KHADIJAH HAQ, 14

"My favourite thing about nature is its unmistakable diversity. I am reminded of the woods by the captivating scents of wildflowers; majestic colours of birds soaring high, and simply the soothing symphony of birdsong."

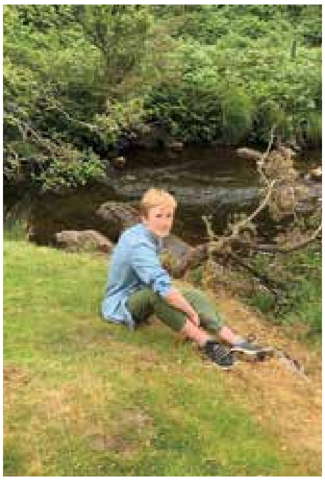
PRINCESS-JOY EMEANUWA, 17

"I worry that people don't recognise how valuable their individual actions are in sparking change. Planting wildflowers, drilling a few holes in bricks, being a bit 'lazier' in the garden, can encourage so much wildlife to your doorstep – it couldn't be easier!"

SOPHIE PAVELLE, 24

"During my GCSE exams, Dartmoor was a refuge – wading through streams, finding bats in hidden caves and making camps under trees. Immersing ourselves in nature like this is the antidote to our dissociation from the earth that has driven the climate crisis."

SOPHIE SLEEMAN, 17



"It is everyone's responsibility to contribute to help the natural environment. Even the smallest of actions can make the biggest of difference, like rewilding your own garden to make it insect, bird and mammal friendly."

XANDER JOHNSTON, 13

STATE OF NATURE 2019

presents an overview of how the country's wildlife is faring, looking back over nearly 50 years of monitoring to see how nature has changed in the UK, its Crown Dependencies and Overseas Territories.

As well as this long-term view, we focus on what has happened in the last decade, and so whether things are getting better or worse for nature.

In addition, we have assessed the pressures that are acting on nature, and the responses being made, collectively, to counter these pressures.

Unless otherwise stated, all photos are from RSPB Images (rspb-images.com).

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Photo: Ben Andrew (rspb-images.com)
Cover photo: Mark Eaton

CONTENTS

This report has been produced by a partnership of more than 70 organisations involved in the recording, researching and conservation of nature in the UK and its Overseas Territories. These include a broad spectrum of recording societies with expertise on a wide range of taxonomic groups, including our best and least known wildlife; research organisations responsible for gathering and analysing data that advances our knowledge of the UK's nature; conservation charities that take action for all elements of our wildlife and habitats; and the country nature conservation bodies for the UK and it's four countries which have provided evidence and advice in the production of this report.

Much of the content of *State of Nature 2019* can be used to inform on the UK's progress towards the Convention on Biological Diversity's (CBD) Aichi 2020 targets – see pages 90–91 or further details. We have used the CBD's icons for the Aichi targets to indicate when report content is relevant to these targets.

6 7 8 9 11 12 20

For guidance on how to interpret the results presented in this report, please refer to pages 92–93.

THE HEADLINES

In this report we have collated the best available data on the UK's biodiversity, with a focus on the trends in species as the key evidence of how nature is faring. In addition to assessing the state of nature we have reviewed the pressures acting upon nature, and the conservation response being made to counter these pressures, in order to give a rounded view of the UK's nature in 2019.

Our statistics demonstrate that the abundance and distribution of the UK's species has, on average, declined since 1970 and many metrics suggest this decline has continued in the most recent decade. There has been no let-up in the net loss of nature in the UK.

Prior to 1970, the UK's wildlife had already been depleted by centuries of persecution, pollution, habitat loss and degradation.

Photo: Ben Andrew (rspb-images.com)

13%
decline in average species' abundance.

Our indicator of average species' abundance of 696 terrestrial and freshwater species has fallen by 13% since 1970; the rate of decline was steeper in the last 10 years, although not statistically significantly so.

5%
decline in average species' distribution.

Our indicator of average species' distribution, covering 6,654 terrestrial and freshwater species over a broad range of taxonomic groups, has fallen by 5% since 1970, and is 2% lower than in 2005.

41%
have decreased in abundance.

More species have shown strong or moderate decreases in abundance (41%) than increases (26%) since 1970, and likewise more species have decreased in distribution (27%) than increased (21%) since 1970.

53%
of species show strong changes.

Our wildlife is undergoing rapid change; the proportion of species defined as showing strong changes in abundance, either increasing or decreasing, rose from 33% over the long term to 53% over the short term.

15%
of species are threatened.

Of 8,431 species that have been assessed using regional Red List criteria, 15% have been classified as threatened with extinction from Great Britain, and 2% are already extinct.

By 2020
most CBD targets won't be met.

An assessment based on the best available data indicates that, although progress has been made, the UK will not meet most of the CBD's 2020 Aichi targets.

The pressures

that have caused the net loss of biodiversity over recent decades continue to have a negative effect.

- Agricultural productivity, linked to the intensification of land management and the decline in farmland nature, is still increasing, although with government funding some farmers have adopted wildlife-friendly farming.
- Average UK temperatures have increased by nearly 1°C since the 1980s with widespread impacts on nature evident already.
- Legislation has driven marked reductions in emissions of some harmful pollutants, although negative impacts remain.
- Thousands of hectares of farmland, woodland and wetland are built on every year to meet the needs of our increasingly urbanised population, although woodland cover has increased, new wetland habitat has been created and heathlands and moors restored.

Photo: Chris Gomersall (rspb-images.com)

The impacts of climate change and fishing

on species' abundance and distribution are evident throughout the UK's seas. At the base of the food web, plankton communities have changed in response to warming seas. While some fish stocks are showing signs of recovery, the impacts of decades of unsustainable fishing persist. The precise impact of other pressures on the marine environment, such as noise and plastic pollution, remain unclear.

Photo: Ian Francis (rspb-images.com)

This report showcases a wide range of exciting conservation initiatives,

with partnerships delivering inspiring results to secure a brighter future for the UK's nature. Public support for conservation continues to grow, with non-governmental organisation (NGO) expenditure up by 24% since 2010/11 and a 46% increase in the time donated by volunteers since 2000. However, public sector expenditure on biodiversity, as a proportion of gross domestic product (GDP), has fallen by 42% since a peak in 2008/09, although the UK's expenditure on international biodiversity has grown.

Photo: Ben Andrew (rspb-images.com)

The UK has a long history of love for, and fascination with, its natural heritage.

Thanks to this, tens of thousands of volunteers collect data on wildlife every year. Without their dedication this report would not be possible; we thank them all.

#STATEOFNATURE

KEY FINDINGS

We are able to present trends in status for more species than ever before in *State of Nature 2019*. This is due to new datasets becoming available and the development of analytical tools which enable a much broader range of taxonomic groups to be represented.

Using multispecies indicators, our goal is to communicate a clear, objective assessment of the state of biodiversity in the UK. The metrics we present show how measures of average species' status have changed over time as well as showing the variation in trends between species.

We focus on measuring change over two periods: the long term, over nearly 50 years, and the short term, the last 10 years.

Our species' status metrics make use of two broad types of data:

Abundance data from a number of well-established monitoring schemes in the UK encompassing c700 species (birds, mammals, butterflies and moths). Many of these species are popular to record and are relatively easy to identify and to observe, making it possible to count individuals to get a measure of relative abundance. Our abundance metrics report the average change in relative abundance across these species.

Occupancy data from large-scale datasets, which we can now use to generate trends for 6,654 species across a wide range 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 effectively report the average change in range for these species.

We show trends for species for our long-term period, from 1970 to 2016 for abundance data and from 1970 to 2015 for occupancy data. Our short-term period covers the final 10-year period of these time series.

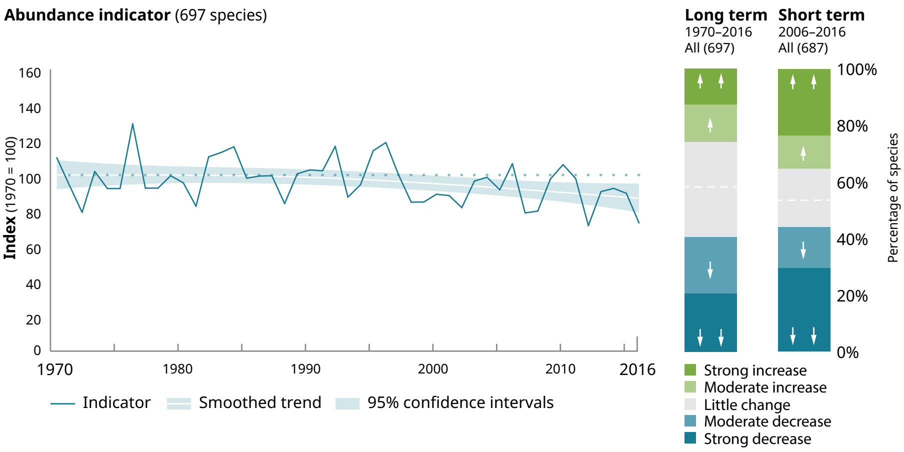
FIND OUT MORE

p92 How to interpret this report

Photo: Mike Read (rspb-images.com)


Stag Beetle

CHANGE IN SPECIES' ABUNDANCE



The abundance indicator for 697 terrestrial and freshwater species shows a statistically significant decline in average abundance of 13% (95% confidence intervals (CI) -22% to -5%) between 1970 and 2016. Over this long-term period, the smoothed indicator fell by 0.31% per year. Over our short-term period, the decline was a statistically non-significant 6%, a rate of 0.65% per year. There was, however, no significant difference in the rate of change between the long and the short term.

The white line with shading shows the smoothed trend and associated 95% CI, the blue line shows the underlying unsmoothed indicator. The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in abundance.

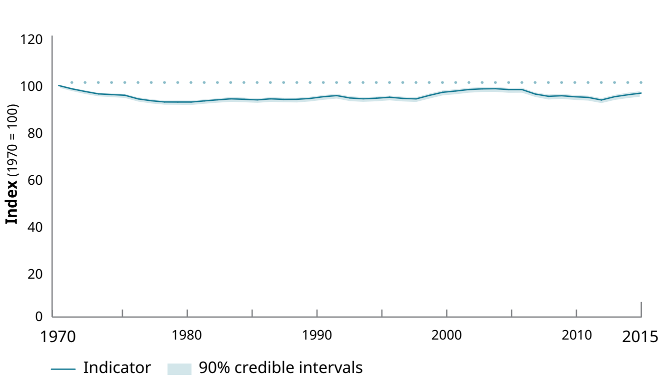
Within multispecies indicators like these there is substantial variation between individual species' trends. To examine this, we have allocated species into trend categories based on the magnitude of population change.

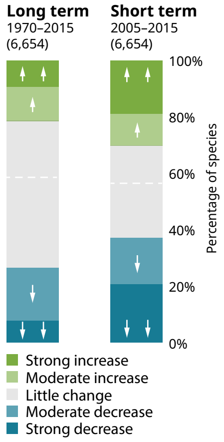
- Over the long term, 41% of species had strong or moderate decreases and 26% had strong or moderate increases; 33% showed little change.
- Over the short term, 44% of species had strong or moderate decreases and 36% had strong or moderate increases; 21% showed little change.
- Over the long term, 33% of species showed a strong change in abundance (either increase or decrease). Over the short term this rose to 53% of species.

Using a different, binary categorisation:

- Over the long term, 58% of species showed negative trends and 42% showed positive trends; over the short term, 53% of species showed negative trends and 47% showed positive trends.

CHANGE IN SPECIES' DISTRIBUTION





The occupancy indicator for 6,654 terrestrial and freshwater species shows that on average species' distributions have declined by 5% between 1970 and 2015. In 2015 the indicator was 2% lower than in 2005. Because species tend to decline in abundance before they disappear from a site, this change of 5% could reflect more severe underlying abundance declines that we are currently unable to quantify.

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

- Over the long term, 27% of species showed strong or moderate decreases and 21% showed strong or moderate increases; 52% showed little change.
- Over the short term, 37% of species showed strong or moderate decreases and 30% showed strong or moderate increases; 33% showed little change.
- Over the long term, 17% of species showed a strong change in distribution (either increase or decrease). Over the short term this rose to 39% of species.

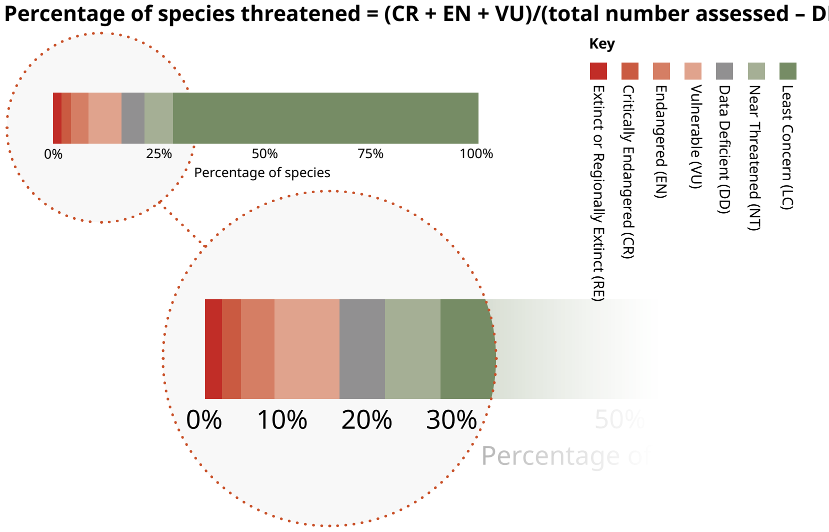
Using a different, binary categorisation:

- Over the long term, 58% of species showed negative trends and 42% showed positive trends; over the short term, 56% of species showed negative trends and 44% showed positive trends.

NATIONAL RED LIST ASSESSMENT

Here we show the percentage of species in Great Britain that have been allocated into each of the International Union for the Conservation of Nature (IUCN) Red List categories. Species assessed as Critically Endangered, Endangered or Vulnerable are formally classified as threatened and therefore at risk of extinction.

Percentage of species threatened = (CR + EN + VU)/(total number assessed – DD – RE).



Of 8,431 species that have been assessed against the IUCN Regional Red List criteria, 1,188 (15%) of the extant species for which sufficient data are available, are classified as threatened and therefore at risk of extinction from Great Britain. In addition, 2% of species are known (133) or considered likely (29) to have gone extinct since 1500, and a further four are extinct in the wild. Most extinctions in Great Britain are historic (1800 to mid-20th century), but losses continue; e.g. two breeding birds (Wryneck and Serin) have been lost this century. Several other species have not been found during recent targeted surveys and will almost certainly be classified as extinct in Great Britain when assessments are updated. An assessment of threatened species in Northern Ireland is given on page 70.

MARINE

Trends in abundance for marine species are shown by broad taxonomic group (see pages 94–97 for more details).

Demersal fish indicators show increases in average abundance in the Celtic and Greater North Seas of 133% and 58% respectively between the early 1980s and 2017.

The UK Breeding Seabird Indicator shows a 22% decline in average abundance for 13 species between 1985 and 2015.

Trends in the abundance of marine mammals, for which we have data, vary by group; cetacean species show stable populations since the early 1990s, and Grey Seal numbers continue to increase while Harbour Seal numbers are decreasing in a number of areas.

Changes in plankton communities are evident across the northern North Sea and the English Channel; the indicator for large copepods shows a 5% increase in the northern North Sea over the last 10 years, compared to a 41% decrease in the English Channel.

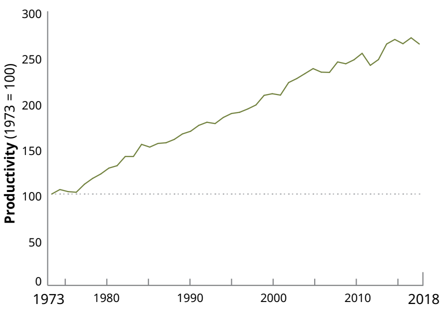
KEY FINDINGS – PRESSURES AND RESPONSES

As well as reporting on the state of the UK's nature, we have sought to identify trends in the key pressures that have caused the net loss of nature, as well as in the responses being made to help nature.

PRESSURES ON NATURE

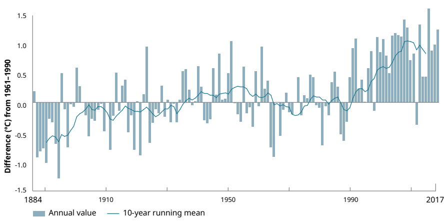
The *State of Nature 2019* reviews the major pressures on the UK's nature; agricultural management, climate change, urbanisation, pollution, hydrological change, invasive non-native species (INNS) and woodland management. Although monitoring change in these pressures, and the impact they have on the UK's biodiversity, has not been systematic, we have sought the most relevant available metrics to convey how the pressures on wildlife are changing.

Agricultural management



The steady increase in agricultural productivity, a product of increased land and resource use efficiency[1], is linked to the intensification of land management, which has had many documented impacts on the farmland wildlife found on 75% of the UK's land area.

Climate change



Climate change is driving widespread changes in the abundance, distribution and ecology of the UK's wildlife, and will continue to do so for decades or even centuries to come. The 21st century so far has been warmer than the previous three centuries. Since the 1980s, average UK temperatures have increased by **nearly 1°C**.

Pollution: emissions of many pollutants have been reduced dramatically in recent decades, although diffuse air and water pollution continues to have a severe impact on the UK's sensitive habitats and freshwaters, and new pollutant threats continue to emerge.

Urbanisation: there was an **8%** increase in proportion of UK population living in urban areas between 1970 and 2018.

Woodland management: woodland cover in the UK increased by **9%** between 1998 and 2018, although only **44%** of woodland is managed sustainably.

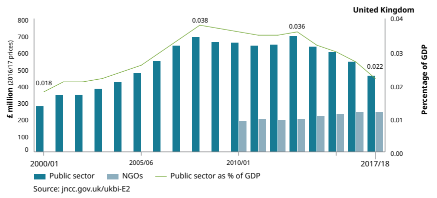
Hydrological change: 1,000 hectares (ha) of UK wetlands were converted to artificial surfaces in six years (2006–2012), although new habitat has been created, for example through post-mineral extraction restoration.

Invasive non-native species: On average **10–12** new non-native species become established in the UK annually, and 10–20% of these cause serious adverse impacts.

RESPONSE FOR NATURE

Conservation in the UK is delivered by a broad coalition of national and local governments, NGOs, businesses, landowners, farmers and private individuals, often working in partnership. There are many notable successes, some highlighted in this report, but as our state metrics demonstrate these have been insufficient as yet to stem or reverse the net loss of nature.

In recent years public sector expenditure on biodiversity conservation in the UK has declined (see figure below), both in absolute terms and as a percentage of GDP – the latter by **42%**, from 0.038% to 0.022%, between 2008/09 and 2017/18. Governmental expenditure on international biodiversity conservation, including in the UK's Overseas Territories (OTs), has increased steadily since 2000/01. A measure of NGO expenditure on biodiversity has increased since 2010/11, indicating growing public support for nature conservation.



Millions of people across the UK love and care for wildlife, as shown by support for wildlife charities, garden bird feeding and television viewing figures. Many show their support by donating time as conservation volunteers; the measure of this has **increased by 46%** since 2000. We estimate that around **7,500,000 volunteer hours** go into collecting biodiversity monitoring data every year.

Exciting and ambitious projects and policy commitments highlighted throughout the report illustrate the wide range of responses for nature in the UK and OTs, including but of course not limited to:

- Nature-friendly farming.
- Climate change mitigation schemes.
- Legally binding limits for pollution emissions.
- Habitat restoration schemes.
- Vast landscape-scale conservation projects to restore ecosystems.
- Community engagement and citizen science projects.
- Reintroduction schemes returning once-lost species.
- Managing problematic non-native species.

Continued monitoring of biodiversity will enable us to determine whether they are delivering the hoped-for recovery in the UK's wildlife.

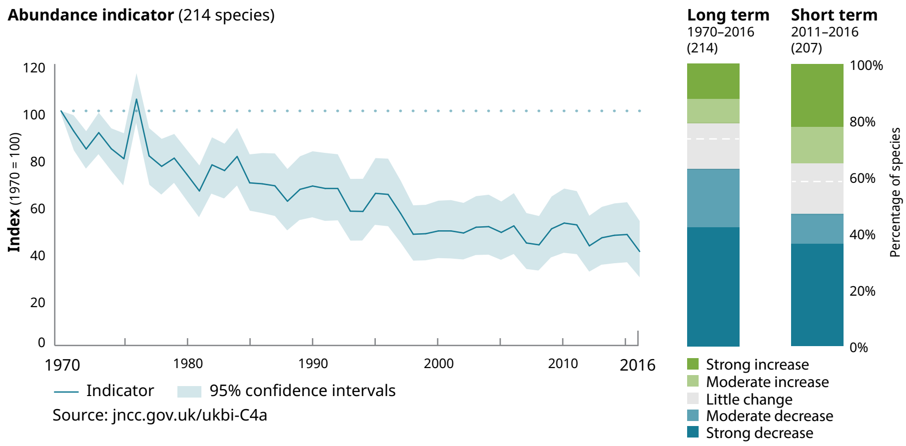
STATUS OF UK PRIORITY SPECIES

The official UK Biodiversity Indicators include two indicators to assess the status of species of greatest conservation concern; the UK's priority species. Of the 2,890 species included as priority species on the combined list for the four UK countries, data are available to assess change in relative abundance for 214 species and change in distribution for 395 species. In addition to the Priority Species Indicator, official UK Biodiversity Indicators are published annually for species groups including birds, butterflies and mammals, as well as other measures of biodiversity status.

We feature these indicators throughout *State of Nature 2019*. Note that the short-term assessments for UK Biodiversity Indicators are over five years, not 10 years as for the State of Nature indicators.

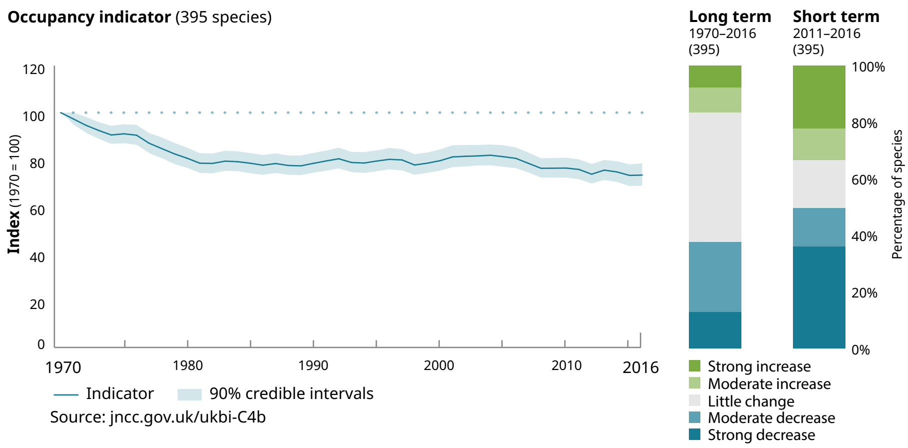
jncc.gov.uk/ukbi

UK Biodiversity Indicator: Change in the relative abundance of UK priority species, 1970 to 2016



- Since 1970, the indicator of abundance for 214 priority species has declined by a statistically significant 60%, and between 2011 and 2016 by 22%.
- Over the long term, 63% of species showed strong or moderate decreases and 22% showed strong or moderate increases; 16% showed little change.
- Over the short term, between 2011 and 2016, 46% of species showed strong or moderate decreases and 35% showed strong or moderate increases; 18% showed little change.

UK Biodiversity Indicator: Change in the distribution of UK priority species, 1970 to 2016



- Between 1970 and 2016, the index of distribution of priority species in the UK declined by 27%. The index was 3% lower in 2016 than in 2011.
- Over the long term, 37% of species showed strong or moderate decreases and 16% showed strong or moderate increases; 46% showed little change.
- Over the short term, between 2011 and 2016, 50% of species showed strong or moderate decreases and 33% showed strong or moderate increases; 17% showed little change.

Photo: Richard Brooks (rspb-images.com)

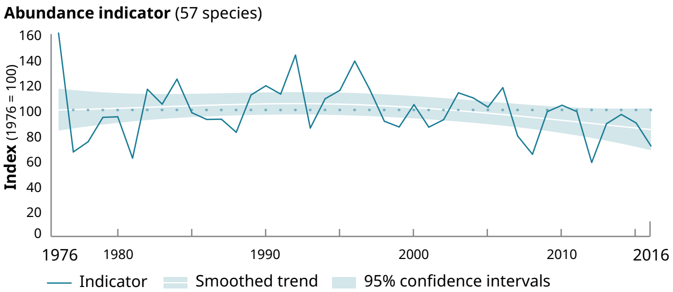
RESULTS IN MORE DETAIL

The composite nature of multispecies indicators means they do not show the variation in trends between individual species and species groups. In order to help understand changes in our *State of Nature 2019* headline abundance and distribution indicators better, we present indicators disaggregated into species groups.

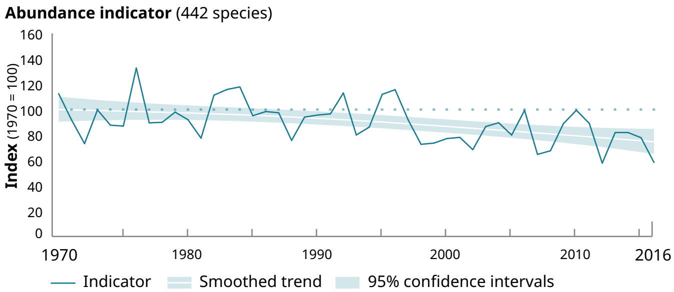
In the graphs shown here, the white line with shading shows the smoothed trend and associated 95% CI, the blue line shows the underlying unsmoothed indicator.

CHANGE IN AVERAGE SPECIES' ABUNDANCE BY TAXONOMIC GROUP

Butterflies, 1976 to 2016



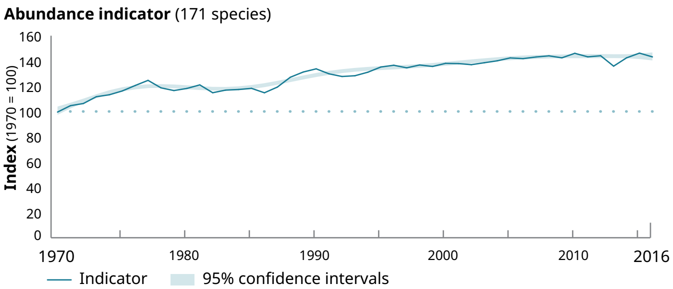
Moths, 1970 to 2016



The long-term decreases in average abundance in butterflies (-16%, CI -32% to 1%) and moths (-25%, CI -35% to -15%) have not slowed; short-term declines are 12% and 9% respectively.

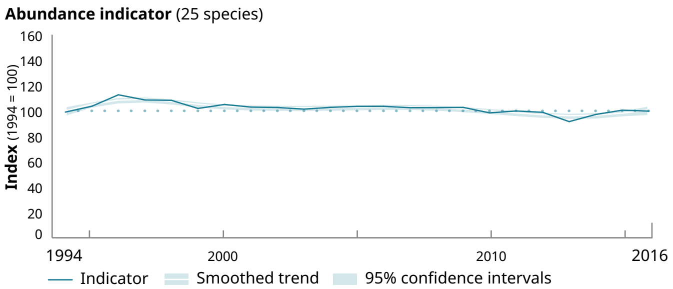
The UK Biodiversity Indicator for habitat specialist butterflies (not shown here; jncc.gov.uk/ukbi-C6) showed an unsmoothed decline of 68% between 1976 and 2018, showing a pattern of greater declines among habitat specialist species than generalists that appears to be prevalent in many taxonomic groups.

Terrestrial and freshwater breeding and wintering birds, 1970 to 2016



The abundance indicator for terrestrial and freshwater breeding and wintering birds shows a 43% (95% CI 39% to 47%) increase in average abundance over the long term but little change over the short term. The increase in this indicator is driven by recovery of some species from very low numbers, the arrival of colonising species, and increasing numbers of wintering waterbirds. These increases mask abundance declines in common and widespread breeding species: it is estimated that the total number of breeding birds in the UK fell by 44 million between 1967 and 2009[2].

Mammals, 1994 to 2016



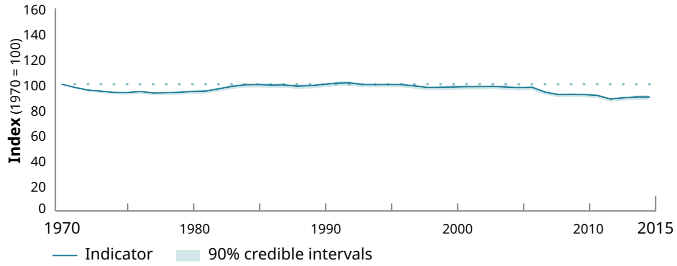
The abundance indicator for mammals starts in 1994 and shows little long-term change in average abundance. Over the short term, the indicator remained stable, just 3% lower in 2016 compared to 2006. Species trends vary and just over two-thirds of species show strong or moderate increases in abundance, some from very low baselines.

CHANGE IN AVERAGE SPECIES' DISTRIBUTION BY TAXONOMIC GROUP

Similarly, the occupancy indicators can be separated to show the change in average species' distribution between 1970 and 2015 for four terrestrial and freshwater groups: insects, bryophytes and lichens, vascular plants and mammals. Some mammal and moth species are included in both our abundance and occupancy indicator, but a number are only included in the latter (see methods).

Insects, 1970 to 2015

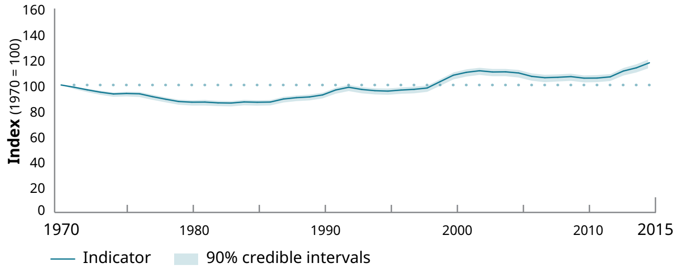
Occupancy indicator (3,162 species)



The occupancy indicator for insects shows a decrease in average distribution of 10% over the long term, and 8% over the short term.

Bryophytes and Lichens, 1970 to 2015

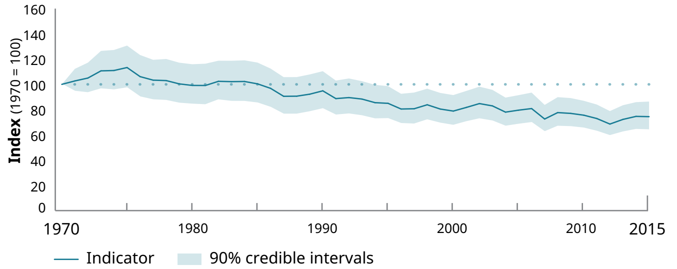
Occupancy indicator (1,265 species)



Over the long term the occupancy indicator for bryophytes and lichens shows a 17% increase in average distribution, having decreased during the 1970s and 80s. The indicator shows an 7% increase over the short term.

Mammals, 1970 to 2015

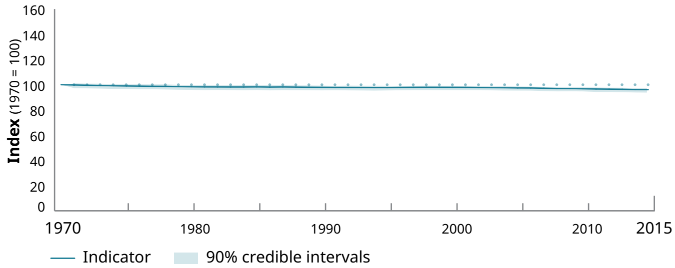
Occupancy indicator (14 species)



Over the long term the average distribution of mammals has decreased by 26% and is 6% lower over the short term.

Vascular plants, 1970 to 2015

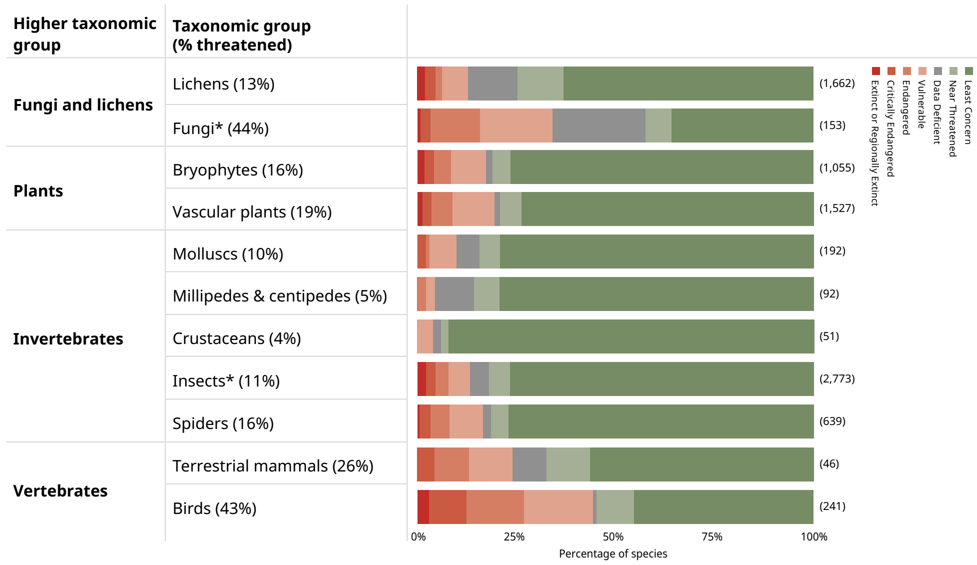
Occupancy indicator (1,351 species)



The occupancy indicator for vascular plants is 4% lower compared to 1970, and shows little short-term change in average distribution.

GREAT BRITAIN RED LIST ASSESSMENT BY TAXONOMIC GROUP

The bars show the percentage of assessed species, in broad taxonomic groups, falling into each of the IUCN Red List categories. Species assessed as Critically Endangered, Endangered or Vulnerable are formally classified as threatened and therefore at risk of extinction. The number of species assessed is shown in brackets.



*1% of fungi and 12% of insects were assessed.

Summarising these results by the main higher taxonomic groups, 440 plants (18%), 232 fungi and lichens (15%), 111 vertebrates (40%) and 405 invertebrates (12%) are classified as being at risk of extinction from Great Britain.

In addition, there are species in each group that are known to have gone extinct from Great Britain already: 32 plants (1.2%), 33 fungi and lichens (1.8%), seven vertebrates (2.4%) and 61 invertebrates (1.6%).

A breakdown of all-Ireland assessments for species in Northern Ireland is given on page 70.

HISTORICAL CHANGE IN BIODIVERSITY

THE GOOD NEWS

ACTION TO HELP NATURE

- The first nature reserve was established in **1821** at Walton Hall, West Yorkshire.

- Wild Birds Protection Act 1876 introduced.
- The RSPB was formed in 1889, the National Trust in **1895** and the first of the Wildlife Trusts in **1912**.

PRESSURES ON NATURE

- The first industrial revolution spanned **1780–1830**.
- 1,000km^2 of wetlands were drained annually between **1840** and **1880**.

- The UK's human population exceeded 30 million in **1871**.
- The introduction of steam trawlers caused a rapid increase in fishing during the **1880s**.

THE BAD NEWS

- The Great Auk was hunted to extinction in the UK in **1840**.
- Salmon disappear from the Thames in **1833**.

- Invertebrate extinctions hit a high in England, with 12 species lost between **1900 and 1910**.
- The loss of Mitten's Beardless Moss from Sussex in **1920** means the species goes extinct globally.

Photos: istock

***State of Nature 2019* focuses on recent changes in biodiversity, and the drivers of these changes, but we must remember that we have been shaping our landscape, and the wildlife within it, for millennia. It is widely accepted that the UK's biodiversity had been massively depleted by centuries of habitat loss, management changes, development and persecution before *State of Nature's* 1970 baseline. We are unable to measure this depletion accurately, but know many of the significant changes which occurred over the last two hundred years.**

- In **1941**, Avocets return to the UK after a 100-year absence.
- Polecats begin a slow recovery in Wales from a low point in the **1930s**.

- The Large Blue butterfly is reintroduced to the West Country in **1985**.
- Salmon return to the Thames after a 125-year absence.
- Fisheries management enables the recovery of Herring stocks.

- Otters returned to every county in the UK by **2011**.
- By **2014**, the Lady's Slipper Orchid was flowering at 11 reintroduction sites.
- Corncrakes return to breed in Northern Ireland in **2016**.

- UK Government's Nature Conservancy established in **1949**.
- First National Park, the Peak District, designated in **1951**.
- Whaling by the UK ended in **1963**.

- Wildlife and Countryside Act **1981** introduced.
- The harmful pesticide DDT was banned in the UK in **1984**.
- Countryside Stewardship Scheme piloted in **1991**.
- The EU Water Framework Directive, addressing water pollution, comes into force in **2000**.

- The global 2020 Aichi targets are adopted in **2010**.
- In **2017**, UK carbon emissions drop to 43% below 1990 levels.
- Beinn Eighe in the Scottish Highlands becomes the UK's first Gene Conservation Unit protecting local Scots Pine lineages.

- The UK's first full-length motorway, the M1, opened in **1959**.
- 97% of wildflower meadows were lost between the **1930s** and **1984**.

- The UK joined the Common Agricultural Policy in **1973**.
- 10,000km² of land were drained in the **1970s**.

- The Central England temperature time series was 1°C warmer in latest decade compared to the pre-industrial period (**1850–1900**).
- The area of crops treated with pesticides increased by 53% between **1990** and **2010**.
- In **2019**, the UK's sixth national report to CBD indicates that the country is on track to meet five of the 20 Aichi targets by **2020**.

- Overfishing led North Sea Herring stocks to decline by over 99% between the **1960s** and **mid-70s**.
- Since the **1950s** wildflowers have been lost at a rate of up to nearly one species per year per county.

- Thirteen species of farmland bird were red-listed as Birds of Conservation Concern in **1996**, including Turtle Dove, Grey Partridge and Corn Bunting.
- The Freshwater Pearl Mussel became extinct from two Scottish rivers per year on average, between **1970** and **1998**.

- The indicator of habitat specialist butterflies down by 68% since **1976**.
- The Birds of Conservation Concern Red List increased from 36 to 67 species between **1996** and **2015**.

DRIVERS OF CHANGE

We have identified the most significant pressures acting on terrestrial and freshwater nature in the UK: agricultural management, climate change, urbanisation, pollution, hydrological change, INNS and woodland management. Here we examine how each of these proximate drivers affects nature, the state of nature as a consequence of this, and the conservation actions being taken in response. We examine marine drivers of change on pages 50–63.

Photo: Mike Read (rspb-images.com)

In the *State of Nature 2016* we reported the most significant drivers of change that have acted on the UK's wildlife since the 1970s, and attempted to quantify the impact these drivers had over that period, both to the benefit and detriment of nature. This research[1] identified that changing agricultural management had the biggest single impact upon nature in the UK over recent decades, with the great majority of that impact being to drive species' populations downwards. The second most significant driver was climate change, which is causing range and population change in sensitive species, alongside landscape-scale alteration to vulnerable habitats. Other important impacts included hydrological change, urbanisation and how woodlands are managed. Positive impacts were detected from wildlife-friendly farming, habitat management and the creation of new wildlife habitats.

Informed by this analysis, in the following pages of *State of Nature 2019* we take a more detailed look at what we believe to be the biggest threats to terrestrial and freshwater nature in the UK currently: agricultural management, climate change, urbanisation, pollution, hydrological change, INNS and woodland management.

Of course, in addition to these pressures, wildlife in the UK benefits from conservation, whether it is targeted action to save threatened species or the everyday actions of farmers and other land managers working to help nature across the country. We finish this section of the report by giving a brief overview of conservation in the UK, and how governments, NGOs, businesses, landowners, farmers and private individuals work together to save nature, showcasing a broad range of the many efforts being taken.

AGRICULTURAL MANAGEMENT

A wide range of changes in agricultural management in recent decades has led to greater food production but they have also had a dramatic impact on farmland biodiversity. For example, populations of farmland birds have more than halved on average since 1970, and similar declines have been seen in many other taxonomic groups. Targeted wildlife-friendly farming, supported by government-funded agri-environment schemes (AES), can halt and reverse these declines, but to date the only successes have been for rare and localised species. The area of land receiving effective agri-environment measures may have helped slow the decline in nature but has been insufficient to halt and reverse this trend.

PRESSURE

Agricultural productivity has increased by over 150% since 1973.

STATE

Farmland bird indicator has fallen by 54% since 1970.

RESPONSE

Area under agri-environment increased to around 3 million ha.

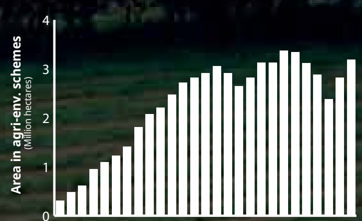


Photo: Andy Hay (rspb-images.com)

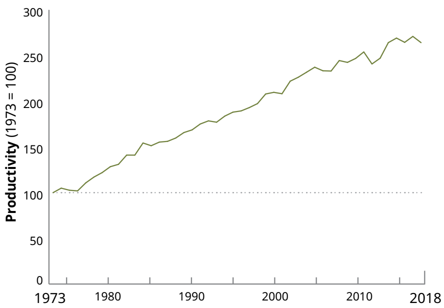
PRESSURES ON NATURE

Agriculture has been the dominant use of land in the UK for centuries, driven by the need to produce food for subsistence or profit since humans moved from hunter-gatherer societies to begin cultivating crops and raising animals. These practices have profoundly shaped historical and cultural perspectives on our landscapes and nature, and continue to do so today. Agricultural change has been identified as the most important driver of biodiversity change over the past 45 years[1], with most effects being negative. There are, however, also a range of species and habitats that largely depend on agricultural management.

Currently, 72% of the UK's land area is managed for agriculture, about one-third arable and two-thirds pastoral (grassland, moor and heath). Half of the arable land is used for cereal crops, while pastoral land is predominantly used to raise sheep (over 30 million) and cattle (over 10 million)[2].

Although historical changes have had massive impacts, it is only since the systematic recording of a suite of wildlife taxa began in the 1970s that we have been able to clearly link specific changes in management to changes in biodiversity. The changes in farmland management over the past 50 years that have had the greatest impact on the UK's nature include the increased use of pesticides and fertilisers; increased stocking rates, changes in crops and cropping patterns (e.g. grasslands managed for silage rather than hay production, with reseeding and drainage, crops sown in the autumn rather than the spring); farm specialisation (e.g. in either arable or livestock enterprises); greater mechanisation and increase in farm size; and loss of nature-friendly features such as field margins, hedgerows, wooded areas and farm ponds[3,4]. Over this period, agriculture has followed a consistent trend of increasing productivity (the ratio of inputs to outputs, a product of increased land and resource use efficiency), with associated consequences for wildlife. Of course, increased productivity does not of itself impact wildlife; it is some of the changes in management that have delivered increased productivity that have had a detrimental effect.

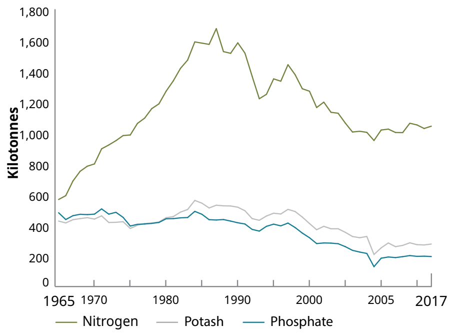
Agricultural productivity in the UK, a measure of intensification, 1973 to 2018[5]



An increasing awareness of the impact of modern farming methods on nature has led to changes in how public funds are used to support the agricultural sector. Since the 1990s a move away from direct production subsidies to area payments, coupled with requirements to meet basic environmental standards (cross-compliance) and the introduction of agri-environment schemes (AES), has aimed to mitigate some of the impacts of farming and help wildlife recover.

Although agricultural productivity continues to increase, the use of fertilisers, particularly nitrogen and phosphates, has decreased since peaking in the 1980s[6]. Numbers of sheep and cattle peaked in the 1970s and 1980s as a result of market trends and Common Agricultural Policy support payments, but have now fallen back. Spring-sown cereals, which can benefit farmland wildlife by providing an overwinter stubble, are also making a slight comeback, in part to combat herbicide-resistant weeds such as Black Grass.

Total quantities of nutrients used in the UK, 1965 to 2017[6]



Reported trends for pesticide use in the UK demonstrate some of the complexities involved in monitoring. Although the total weight of the active ingredient in pesticides has fallen markedly over the past 25 years, the number of hectares treated with pesticides, along with the frequency of treatments, have increased. In addition, there have been increases in the toxicity of pesticides and the variety of pesticides used on a single crop[7].

Trends in pesticide use in the UK, 1990 to 2016[8]

Photo: Colin Wilkinson (rspb-images.com)

THE STATE OF NATURE

One of the clearest examples of how farmland management has affected biodiversity is the trend in farmland birds; the suite of bird species most closely associated with farmland have declined more severely than birds in any other habitat, with a fall of 54% in the Farmland Bird Indicator since 1970[9]. Research has revealed the diverse processes by which species have been affected. For example, the shift to autumn sowing has resulted in a fall in Skylark breeding productivity as cereal crops become too tall and dense in the breeding season[10], and the loss of overwinter stubbles has meant poorer survival for granivores such as Yellowhammer[11]. Increased pesticide use has resulted in less invertebrate food for young Grey Partridges[12], while the drainage of wet grasslands and the loss of mixed farming systems has led to a decline in Lapwings[13].

FARMLAND BIRDS HAVE DECLINED MORE SEVERELY THAN THOSE IN ANY OTHER HABITAT.

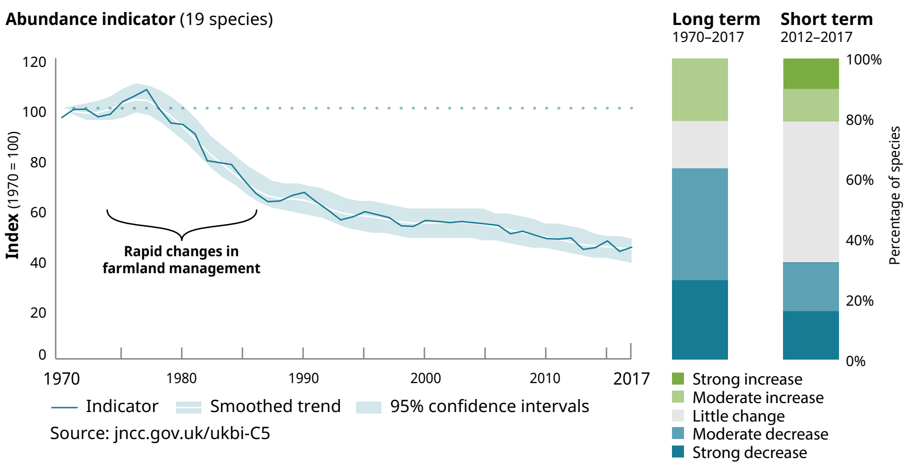
Trends do vary across the UK countries and generally farmland birds are faring better in Scotland, where on average they have increased since the 1990s, than elsewhere. Upland farming has arguably seen less dramatic changes than the lowlands, with some formerly widespread species now restricted to an upland range. However, the recent trends in upland birds show multispecies declines are occurring in these habitats as well[14].

The impacts of management changes are not limited to those on birds. A similar pattern of declines is evident for butterflies in the wider countryside (figure below), though for other insect and invertebrate groups the available data are insufficient to derive broad trends. There is growing concern about pollinators, largely related to use of pesticides such as neonicotinoids (which have seen recent restrictions in permissible use) but also the decrease in plant diversity and flower-rich habitats[15].

Arable plants such as Shepherd's-needle, Corn Buttercup and Pheasant's-eye have shown significant declines attributed to the use of fertilisers and herbicides and a range of management practices that reduce the seed bank or survival through increased crop density and decreased crop diversity[16]. Fertiliser use and conversion to arable have contributed to the loss of 97% of wildflower meadows and other species-rich grasslands in the past century[17].

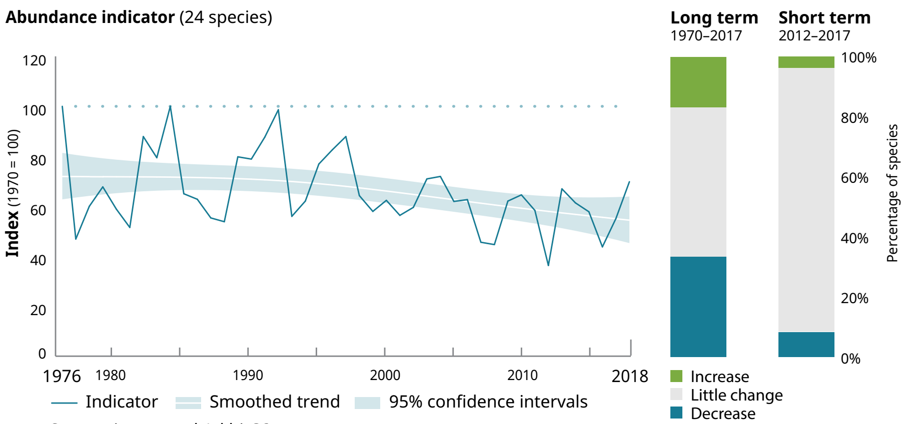
Farming has shaped the countryside for centuries and recent research shows that some current occupants including widespread bumblebees, brambles, Cow Parsley and Spear Thistle have adapted well to this landscape. Along with other adaptable generalists such as Woodpigeons and Jackdaws, some species appear resilient to agricultural intensification and have prospered in recent decades, while specialist species have seen widespread and often continuing decline.

UK Biodiversity Indicator: Trends in breeding farmland birds in the UK, 1970 to 2017



Source: jncc.gov.uk/ukbi-C5

UK Biodiversity Indicator: Insects of the wider countryside, 1976 to 2017 – butterflies

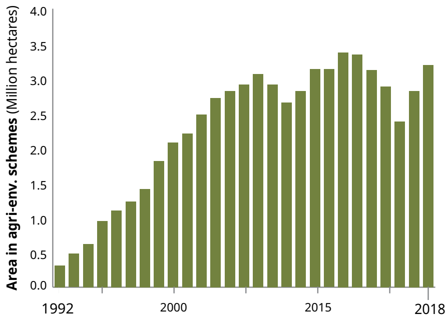


Source: jncc.gov.uk/ukbi-C6

THE RESPONSE FOR NATURE

One of the mechanisms for mitigating the negative impacts of agriculture is through environmentally sustainable farming practices. Although many farmers engage in nature-friendly farming voluntarily due to their own interests or as part of voluntary networks (for example, the Nature Friendly Farming Network and The Farming and Wildlife Advisory Group), government-sponsored AES have provided the main impetus. Although there are challenges to implementing particular actions at a sufficient scale to reverse declines in widespread species, AES provide a mechanism to target the most appropriate conservation actions in the relevant areas.

UK Biodiversity Indicator: Area of land in agri-environment schemes in the UK, 1992 to 2018



Source: jncc.gov.uk/ukbi-B1a

There has been widespread uptake by the farming community, but the effectiveness of AES has been hard to demonstrate. Despite the proven value of many AES options in field trials, a number of broader studies have failed to establish clear cause and effect for population recovery at larger geographical scales, largely as a result of the complex interactions of different factors. Where broad-scale successes have been identified for birds[18], these have been mainly related to the provision of winter food through stubble management and wild bird seed mix. Some moth and bat species have been shown to benefit, at a local scale, from the presence of field margins and boundary features that include mature trees[19,20]. There has, however, been little evidence of benefits to species occupying in-field cropped habitats[21].

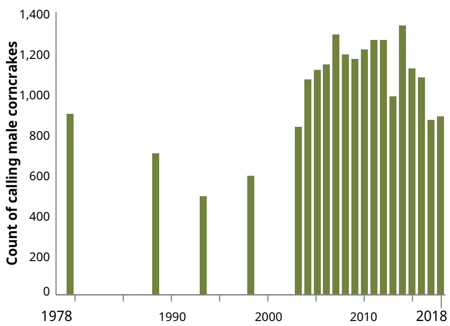
Although agricultural intensification may have slowed since its late 20th century peak, and there have been notable successes in recovering some threatened species such as Cirl Bunting and Stone Curlew, aggregate farmland biodiversity indicators continue to decline despite government commitments to reversing the downward trend and a huge effort from farmers and the conservation sector. This may in part reflect a lag in the response of wild populations to habitat change, meaning that declines can continue even after habitat change has halted or been partly reversed[22]. Research has identified many of the issues contributing to continuing population declines, but a key factor for some species is the lack of implementation of remedial action at a coordinated landscape scale sufficient to make a real difference.

CASE STUDIES

Corncrake recovery

Successes for individual species have been achieved where research has led to the identification of a particular problem and resources deployed at a sufficient scale to tackle it – typically for very rare species with a restricted range, such as the Corncrake in the Scottish islands. Here, farmers and crofters receive targeted advice regarding habitat management and mowing regimes, and receive payments to delay grass cutting. Male Corncrake numbers have risen from a low of under 500 in the early 1990s to 1,289 in 2014. Although this is a success, the population is still tiny with a highly restricted range and is no longer a breeding species on the Isle of Man. Setting this in context, the species was once found in all counties of the UK and in every meadow and cornfield in the north of Ireland, where one late 19th century author reported that "its incessant cry is monotonous if not wearisome"[23]. Since 2014, numbers in the core area fell for three consecutive years, with the 2017 count the lowest since 2003. Alongside unusual spring weather, a reduction in payments to delay mowing and a reduction targeted advice may have contributed to this downturn, highlighting the vulnerability of rare species to changes in policy.

Calling male Corncrakes in Great Britain and Isle of Man, in survey years 1978 to 2018



Land management for butterflies[24]

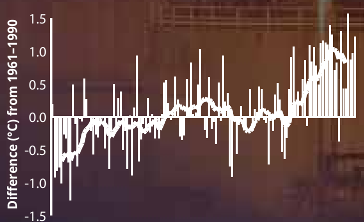
The Marsh Fritillary is one of the fastest declining butterflies in the UK, having lost two-thirds of its colonies between 1990 and 2000. The main cause is the loss of damp tussock-forming grassland, heath and mire that contains Devil's-bit Scabious, the plant that the caterpillars require for food. By working with landowners, Butterfly Conservation and Natural England helped secure Higher Level Stewardship for landholdings on Dartmoor where they were able to introduce butterfly-friendly measures such as controlled grazing, scrub removal, increased connectivity between patches and reintroduction of the larval food plant. By 2010, the area of occupied habitat had almost tripled, and in occupied areas, the counts of larval webs had risen tenfold. Facilitated by AES funding, the project has been a great success, due to strong partnership working between the project officer, Natural England advisors, Dartmoor National Park ecologists and the farmers and volunteers delivering the management. Ongoing management advice is crucial if benefits are to continue, and the follow-on project, All the Moor Butterflies, is producing similar positive results.

CLIMATE CHANGE

Climate change, caused by human activities, is one of the most significant threats to global biodiversity, and is projected to become increasingly severe through the course of this century[1]. While climate change has had the second largest impact (after agricultural change) on UK nature over the last 40 years, impacts on wildlife have been mixed[2]. There is growing evidence that climate change is driving widespread and rapid changes in the abundance, distribution and ecology of the UK's wildlife, causing changes to species communities and will continue to do so for decades or even centuries to come. Conserving and restoring nature-rich areas of the UK will contribute to mitigating climate change and benefit species, while strategies to counter the negative effects of climate change will help species to adapt to its increasing influence in future.

PRESSURE

All the top 10 warmest years since records began have occurred post-1990.



STATE

Climate change has already impacted population trends of moths (explaining 40% of the decline) and aphids (explaining 60% of the increase).

RESPONSE

Protecting nature-rich areas secures carbon, benefits species and provides vital ecosystem services – providing benefits all round.

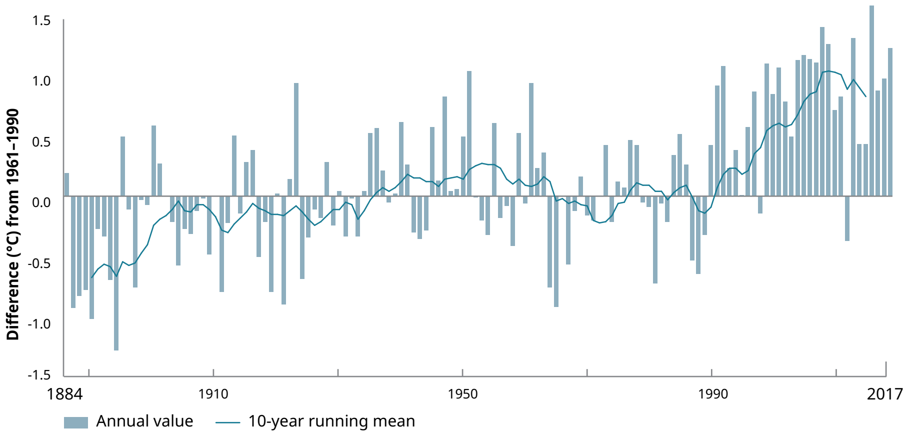
Photo: Peter Cairns (rspb-images.com)

PRESSURES ON NATURE

Increasing temperatures and rising sea levels are just two symptoms of the complex climatic changes that have been apparent in the UK over recent decades.

The graph to the right shows annual mean temperature for the UK, expressed as anomalies relative to the 1961–1990 average. The blue line is a smoothed trend, which is roughly equivalent to a 10-year running mean.

Time series of average UK land temperatures in °C since 1884, expressed as anomalies relative to the 1961 to 1990 average[3]



The UK has experienced significant warming, with mean annual temperature in the most recent decade (2008–2017) nearly 1°C warmer than the 1961–1990 average. These trends are apparent in all countries, and across all seasons, with spring warming being the most pronounced (1.1°C warming). There has been a reduction in the number of days of ground frost and an increase in the number of growing days. There has also been an increase in the amount of sunshine by 6% from 1961–1990 to 2008–2017[3].

Rainfall shows more variability between years, making trends more difficult to spot. However, the most recent decade has been 8% wetter than the 1961–1990 average, with trends being most apparent in winter and summer.

Climate change is also affecting conditions at sea; sea surface temperature has increased by 0.6°C from the 1961–1990 average and the sea level has risen by 16cm since the start of the 20th century. Sea-level rise increases pressure on intertidal habitats and may lead to more severe flooding and coastal erosion by waves[4].

PROJECTIONS FOR 21ST CENTURY CLIMATE

The current predictions of the future UK climate, published most recently in November 2018, are provided by the UK Climate Projections[5,6]. Projections are made for several different emissions scenarios. Given current levels of emissions, we present those for a high emissions scenario.

There is projected to be a greater chance of warmer, wetter winters and hotter, drier summers and by mid-century the chance of hot summers, resembling the 2018 heatwave, will increase from <10% to 10–20%. Rainfall patterns will change significantly; increasing in winter and decreasing in summer. Sea-level rise will occur for all emission scenarios and at all locations around the UK with the associated risk of increased coastal flooding. Extreme weather events, such as drought and flood, will increase in frequency.

20th century climate change – most recent decade 2008–2017 compared to 1961–1990 average

	Temperature	Rainfall
ON LAND	1°C warmer	8% increase

	Temperature	Sea level
AT SEA	0.6°C warmer	16cm rise since start of 20th century

Projections for 21st century climate: by 2070

	Temperature	Rainfall
WINTER	0.7 to 4.2°C warmer	-1% to +35%
SUMMER	0.9 to 5.4°C warmer	-47% to +2%

	Sea surface temperature	Sea level
AT SEA	1.5 to 4°C warmer	c30cm to115cm*

*Relative to 1981–2000.

THE STATE OF NATURE

Temperature, rainfall and other climatic factors consistent with a warming climate affect the abundance and occurrence of individual species, acting on range, population and phenology (the timing of seasonal events)[7,8,9].

DISTRIBUTIONAL CHANGES

Photo: Jeroen Stel (rspb-images.com)

In the UK many species, including birds, butterflies, moths and dragonflies, have moved north over the last four decades. Shifts for these groups averaged 23km per decade between the 1970s and 1990s, and 18km per decade between the 1990s and the mid-2000s[10]. In the marine environment, warming seas have led to changes in plankton and fish distribution resulting in changes to species composition. Such shifts in range rely on there being suitable habitat to permit movement and establishment, and on species' ability to disperse. The threat from climate change therefore interacts directly with other pressures on species, meaning that impacts can be exacerbated[11].

RELATED DRIVERS OF CHANGE

p54 Marine > Climate change

p18 Agricultural management

p26 Hydrological change

CHANGES IN TIMING

The onset of seasonal events is now earlier for a wide range of marine and terrestrial species. Species' responses vary: for terrestrial plants and invertebrates this has been by about four days on average for a 1°C increase in temperature, while for birds the figure is two days on average[12]. Different responses by different parts of the food chain may disrupt ecosystems if the availability of prey and the timing of peak predator requirements do not align. Although there are examples of this impacting particular populations[13] there is, at present, only weak evidence that this mismatch has driven observed long-term declines in predatory species, such as insectivorous birds[14].

POPULATION TRENDS

Photo: Tom Marshall (rspb-images.com)

Our *State of Nature* metrics show declines in moths and butterflies across the UK, although trends in Scotland are, on average, stable. A recent study modelling climate impacts on species' abundance concluded that across all moth species, approximately 40% of the significant decline could be attributed to climate change[15]. Increases in the abundance of flying aphids is probably due to warmer temperatures, which reduce generation time[16], leading to more aphid generations in a year.

There is growing evidence that warming has driven significant changes in plant communities in the Scottish Highlands, with declines in arctic-montane species[17], and in specialist snow-bed species[18]. The impacts of seasonal changes in climate vary across different taxa. Summer drought can have a significant impact on the growth and survival of tree species, leading to major changes in the composition and structure of woodland[19].

Whether an individual species is seen to benefit from, or to be adversely affected by, climate change within a particular geographic region, the resultant shifts in species' distributions will impact on the structure of communities. This can impact community processes and species' interactions (such as predator-prey relationships and competition) which can in turn drive further population change[20].

MANY SPECIES, BOTH ON LAND AND IN THE SEA, HAVE SHIFTED THEIR RANGES NORTHWARDS IN RECENT DECADES.

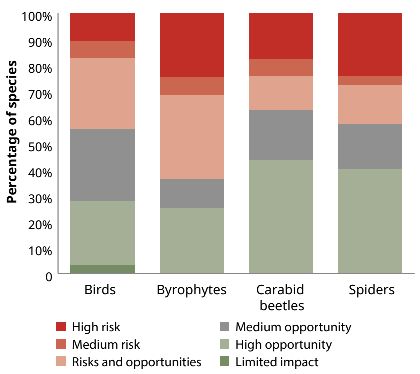
THE RESPONSE FOR NATURE

Responses to combat the negative effects of climate change on species involve planning and conservation action at a range of scales. It will be essential for us to understand the risks and identify areas, habitats and species groups that are most vulnerable.

ASSESSING THE RISKS TO SPECIES IN ORDER TO PRIORITISE RESOURCES

A detailed assessment accounting for potentially confounding and exacerbating factors applied to 402 species suggested that 35% are at risk of range loss, particularly among the bryophytes and vascular plants, while 42% may expand their range. Notably, three-quarters of the upland species considered are predicted to be at risk from climate change[21].

Example results for four taxonomic groups (birds, bryophytes, carabid beetles and spiders) from assessment of climate vulnerability for Great Britain across 17 taxa, separating those species regarded as negatively impacted (medium and high risk), from those with potential opportunities to benefit (medium and high opportunity)[21].



PROTECTING AND ENHANCING THE PROTECTED AREA NETWORK

There is strong evidence that protected areas remain a vital conservation tool in spite of shifting species' distributions. For eight invertebrate taxa, colonisations have occurred on protected sites more often than expected by chance based on the availability of protected areas[22]. More specifically, colonisations by seven butterfly and bird species are over four times more likely in protected areas than expected by chance[23,24] – this is probably because such sites better preserve important areas of semi-natural habitat. There is also some evidence that protected areas reduce the risk of population extinction towards the southern range-margin of species' distributions[24]. This may be because protected areas protect high-quality habitats or because conservation management at those sites reduces negative impacts of climate change. Notwithstanding this, areas projected to have suitable climates would need to be targeted for habitat restoration and creation to provide space for species to move into, and improved habitat connectivity is vital, particularly for less mobile species.

SITE-BASED MANAGEMENT

BogLIFE – Lowland raised bog sites[25]

The Cumbria BogLIFE project is undertaking large-scale restoration works, using specialist contractors and innovative techniques that are:

- Re-creating wetter, boggier ground – by blocking drainage ditches and creating "bunds" (little walls of undamaged, wet peat) that will hold water within the bog.
- Removing some areas of trees that have started to grow in the artificially dry conditions – as bogs do not naturally have trees growing across their surface.
- Reintroducing bog plants to areas with a bare peat surface. This has included growing trials of Sphagnum mosses to replace peat in gardening, with commercial potential across lowland peat agricultural soils.

Butterfly banks

Photo: Patrick Cashman (rspb-images.com)

At an ex-arable farmland site in Wiltshire, 200ha of species-rich grassland has been created for the benefit of specialist plants and butterflies. For butterfly species at the north of their climatic range in the UK, such as the Adonis Blue and Silver-spotted Skipper, varied topography with steep, warm south-facing slopes is essential. To support existing populations and increase connectivity in the landscape, butterfly banks have been constructed by bulldozing chalk up from the field into an S-shaped bank. This ingenious shape ensures that its sides face in all possible directions, providing warm slopes throughout the day and provides a variety of microclimates to support a wide variety of insects. A population of Small Blue butterflies has become established just two years after it was created.

Conserving carbon and conserving species

A recent project mapped the best places for nature across the UK and calculated the amount of carbon contained in the vegetation and top 30cm of soil[26]. Across these nature-rich areas, the amount of carbon, if lost to the atmosphere, would equate (very conservatively) to two gigatons of CO_2, equivalent to four years of the UK's annual overall CO_2 emissions. Only 34% of this carbon is currently protected. Poor habitat condition often means that stored carbon is being lost to the atmosphere – as has been well documented for peatlands[27]. Mapping is the first step to integrating these carbon and nature-rich areas into plans and initiatives to secure their protection, restoration and maintenance to ensure long-term benefits for both nature and people.

HYDROLOGICAL CHANGE

Throughout history humans have sought to alter natural water systems for their benefit – such that there are few pristine freshwater ecosystems remaining in the UK. Many rivers have been straightened, piped and dammed, marshland and agricultural land has been drained, groundwater abstracted and floodplains built upon. Species reliant on the range of wet habitats affected by these changes have seen long-term declines and face ongoing pressures of unsustainable water abstraction and the continuing drainage and conversion of wetlands to other land uses. Recent large-scale projects addressing some of these issues include the rewetting of upland peat bog that had been drained for agriculture and forestry; the re-creation of lowland wetland habitats; river restoration; and pond creation. Despite these landscape-scale projects, the extent of wetland habitats remains greatly reduced compared to the middle of the last century.

PRESSURE

In 2018, just 35% of water bodies had "good" or "high" ecological status.

STATE

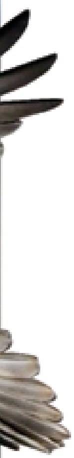
Change in distribution of freshwater invertebrate species, 1970 to 2015.

RESPONSE

Since 2010, the Nature After Minerals partnership has created 2,000ha of wetland through the restoration of minerals sites across the UK.

Photo: Richard Brooks (rspb-images.com)

Marsh Harrier



PRESSURES ON NATURE

Many of the pressures affecting the distribution and quality of freshwater habitats relate to historical land drainage. Drainage of the great fens of East Anglia began in Roman times and continued with further major drainage in the 17th century. Technological innovations introduced during the 19th century transformed seasonally flooded marsh and pasture into the agronomically productive farmland we see today[1]. Field drainage has been a major technical factor in relieving modern farming from previous limitations on production. Improvements to farming productivity have simultaneously led to the loss of other ecosystem services including water regulation and soil stabilisation.

Drainage activity in post-Second World War Britain rose to a peak in the 1970s due to government grant payments – about 1 million ha was drained in that decade alone[2]. An estimated 300,000ha of lowland wet grassland were lost between 1970 and 1985[3], and 1.5 million ha of upland blanket peatland was drained in the mid-century, mainly through the mechanical digging of surface grips (channels designed to lower the water table)[4]. Upland drainage reduces carbon storage and can contribute to lowland flooding, with impacts on people and their livelihoods. The loss of wetlands continues to be a cause for concern; land-cover maps show that between 2006 and 2012 over 1,000ha of wetland was converted to artificial surfaces[5].

Alongside general land drainage, loss of specific wet features on farmland has been substantial. Up to 90% of lowland ponds in the UK were lost in the 20th century, through neglect or direct human intervention[6]. Those that remain face increasing pressure due to agricultural land drainage, pollution, isolation and urban development[7].

Rapid population growth in recent decades has led to an increase in demand for freshwater. This has been particularly apparent in South East and Eastern England where 22% of freshwater is abstracted. These regions are categorised by the Environment Agency as overexploited[8].

Some of the most acute problems of over-abstraction have occurred in lowland chalk stream systems, which are of global ecological importance. The Water Framework Directive (2000)[9] committed EU member states to achieving good qualitative and quantitative status of all water bodies (including marine waters up to one nautical mile from shore) by 2015. Of all of our waters, rivers are perhaps facing the most pressures. Despite the requirements of the WFD, there has been a slight decline in the percentage of water bodies with "good" or "high" ecological status, to 35% in 2018. Diffuse pollution from agriculture remains a key issue[10]. Physical changes to rivers, lakes and estuaries, such as flood defences and weirs, affect the ecology of over a third of our waters, preventing them from functioning naturally. Further pressures on the hydrological network come from climate change (both increasing flood risk and prolonged droughts) and INNS, which have had major impacts on freshwater ecosystems. These issues are discussed further in the relevant sections elsewhere in this report.

RELATED DRIVERS OF CHANGE

p34 Invasive non-native species, pests and pathogens

p38 Pollution

p22 Climate change

Photo: Richard Revels (rspb-images.com)

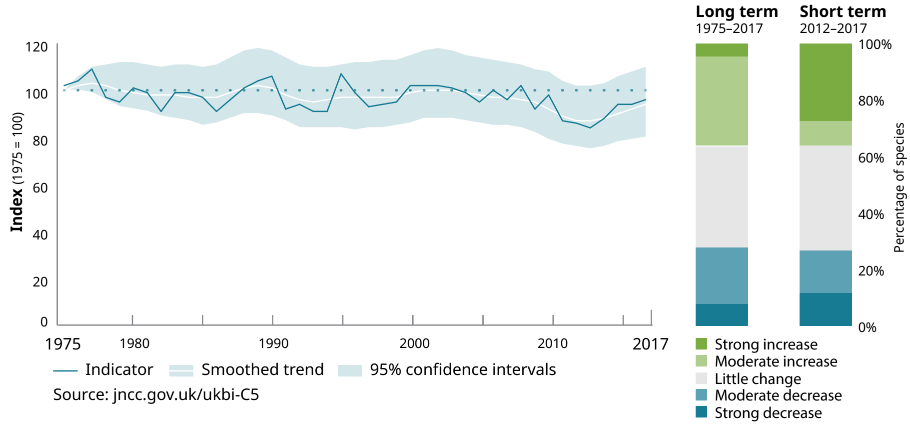
THE STATE OF NATURE

Changes in the populations of water and wetland birds can be closely linked to hydrological changes, although the impacts vary widely across species, and other factors interact and play their part. The breeding water and wetland bird indicator for the UK fell by 6% between 1975 and 2017, but over the short term has increased slightly, by 3%[11].

Within the indicator, species can be split into groups based on breeding habitat. Species associated with slow-flowing and standing water, and with reedbeds, have on average shown increasing trends, with a range of species benefiting from new habitat created through the restoration of gravel pits after extraction has finished and improvements in river management. Conversely, birds of fast-flowing (typically upland) rivers, and wet grasslands, have declined on average. Declines have been most notable in breeding waders of lowland wet grassland such as Lapwing and Snipe, due to habitat loss. Outside Scotland, a large proportion of these species' populations are now confined to sites managed as nature reserves.

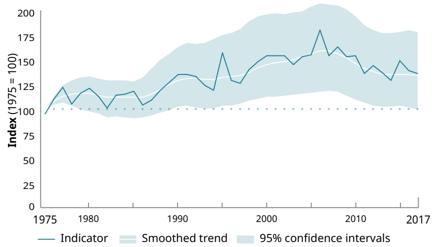
UK Biodiversity Indicator: Breeding water and wetland birds in the UK, 1975 to 2017 – Abundance indicators

All water and wetland birds (26 species)



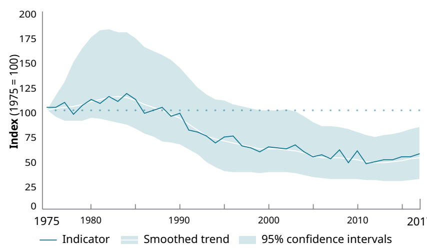
Source: jncc.gov.uk/ukbi-C5

Birds of slow-flowing and standing water (6 species)



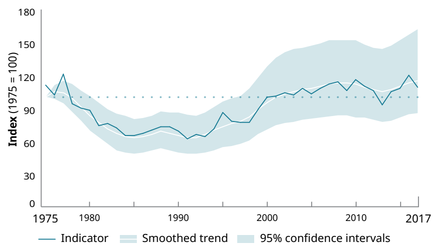
Source: https://www.gov.uk/government/statistics/wild-bird-populations-in-the-uk

Birds of wet grassland (8 species)



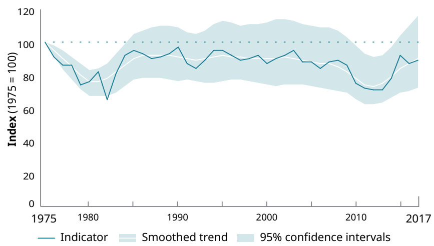
Source: https://www.gov.uk/government/statistics/wild-bird-populations-in-the-uk

Birds of reedbeds (4 species)



Source: https://www.gov.uk/government/statistics/wild-bird-populations-in-the-uk

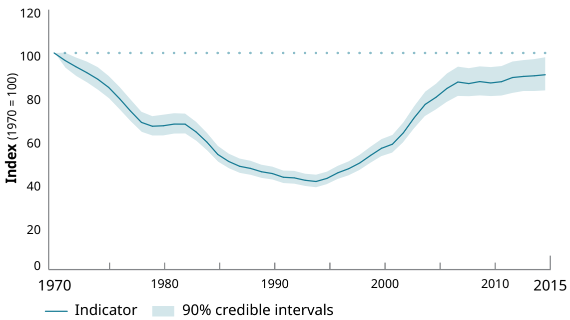
Birds of fast-flowing water (4 species)



Source: https://www.gov.uk/government/statistics/wild-bird-populations-in-the-uk

Change in distribution of freshwater invertebrate species, 1970 to 2015[12]

Occupancy indicator



Occupancy modelling has revealed interesting patterns in the distribution of several groups of aquatic macroinvertebrates. Freshwater invertebrates, Stoneflies (*Plecoptera*), Caddisflies (*Trichoptera*), aquatic bugs (*Hemiptera*), Dragonflies (*Odonata*), Mayflies (*Ephemeroptera*) and freshwater molluscs were recorded at a declining number of sites through the 1970s and 1980s, followed by strong increases in the years since. The drivers for this recovery are not fully understood, and improvements in water quality (such as a recovery from acidification) are likely to have played an important role, but hydrological management to restore rivers, changing river flow conditions and the presence of specific local-scale habitat features may have played a part for some species[13,14,15]. In addition, concerns remain about the status of aquatic macroinvertebrates more generally, including the widespread impacts of sediment and pesticide run-off, as well as the localised impacts of pollution events.

THE RESPONSE FOR NATURE

Given that good hydrological management can bring major benefits for humans through the provision of clean water for consumption and industrial use, and flood prevention, many recent policy actions have primary aims in these areas. However, as good hydrological practices also benefit nature, this is increasingly recognised as having all-round benefits by policymakers.

CASE STUDIES

Creating new wetlands on mineral extraction sites

Photo: Kevin Harwood (rspb-images.com)

The restoration of worked-out sand and gravel extractions to wetlands has become widespread in recent decades and provides an important opportunity for increasing the extent of wetland habitats. Partnerships between conservation organisations and operating companies help to ensure success. For example, as part of the Nature After Minerals project, the RSPB, Natural England, the Mineral Products Association and the British Aggregates Association work alongside quarry companies and planners to create new spaces for nature at worked-out quarries. Transforming previously industrial sites to places where nature can thrive is a powerful symbol of what can be achieved through effective partnerships. Highlights of this approach include:

- Over 8,000ha of new habitat (including 2,000ha of wetland) created and managed since 2010.
- With specialised ecological advice, a range of habitat features can be created to benefit rare species.
- 13% of all the UK's breeding Bitterns now nest in restored mineral sites.
- When training is delivered with and for industry partners, best practice can be shared.

Examples of habitat creation include the UK's largest created reedbed through the Hanson–RSPB Wetland Project in Cambridgeshire and 1,000ha of new habitats created over 10 years through the CEMEX–RSPB partnership.

Bringing back the Eurasian Beaver

Beaver

Photo: Nick Upton (rspb-images.com)

Eurasian Beavers are native to the UK, and were once widespread across Scotland, England and Wales, but were hunted to extinction by the end of the 16th century.

Beavers are well known for their dam-building habits and can be considered as ecosystem engineers, with the ability to rapidly alter the hydrology of the landscape they occupy. By blocking flows, they slow down the passage of water and create pools with diverse structures while modifying the local habitat through natural coppicing, opening of glades and creating deadwood.

Recent efforts to restore Beavers to Scotland were led by the Scottish Wildlife Trust and Royal Zoological Society of Scotland with Scottish Natural Heritage and Forestry Commission Scotland. As a trial, four families of Beavers were released at Knapdale in Argyll in 2009. An intensive programme of monitoring and research assessed the impact of the trial, and of an additional unauthorised release on the Tay at around the same time, on both the natural and the human environment[16]. Conclusions from this work include:

- Beavers have an overall positive influence on biodiversity with a wide range of species benefiting from the habitats created, including fish, amphibians and a wide range of invertebrates.
- Ecosystem services are provided, such as increased groundwater storage, water flow stabilisation and flood prevention.
- A number of species may be adversely impacted, including Aspen woodland lichens, bryophytes, fungi communities and some invertebrates[16].

In England, the five-year River Otter Beaver Trial is being led by Devon Wildlife Trust with research by the University of Exeter and is due to report in 2020. In Wales, plans for a trial are being developed by the Welsh Beaver Project.

The future for Beavers

- There is an estimated 120,000ha of "potential Beaver woodland" – appropriate broad-leaved woodland in suitable proximity to freshwater – in Scotland.
- In 2014, 84% of respondents in a survey of mid-Argyll residents were in favour of Beavers continuing to live in the area[17].
- The monetary value to society of the Knapdale trial has been estimated at up to £6.7 million with the monetary cost of civil engineering impacts and timber loss being put at no more than £44,000[18].
- The Scottish Government concluded in 2016 that Beavers were in Scotland to stay and in May 2019 they were granted European Protected Species status.

With an increasing number of Beavers in the wild and in fenced trial sites in England and Wales, and provided that the right balances can be struck, it may be that this charismatic ecosystem engineer is making a long-awaited return to the UK.

URBANISATION

The end result of urbanisation – the process of making an area more urban – can vary from extensive sprawl, where built land is interspersed with green spaces, to intensively urbanised areas where compact built environments are separated from green space. Urbanisation need not always result in biodiversity loss: the conversion of an intensively managed arable field to a housing estate with gardens, a community orchard and a pond may provide net gain for species diversity and abundance. Conversely, much valuable habitat, including brownfield and semi-natural habitat, has been lost or damaged by development. Management and habitat creation projects can improve habitat diversity, resource availability and connectivity across green spaces within urban environments. As well as helping biodiversity, these can enhance ecosystem function and help human well-being[1].

PRESSURE

There was an 8% increase in the proportion of the UK's population living in urban areas between 1970 and 2018.

STATE

Between 2006 and 2018, 1,600 miles of road were constructed in Great Britain.

RESPONSE

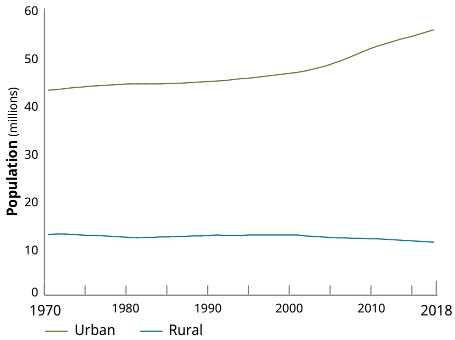
The concept of net gains for biodiversity through development have recently been enshrined in planning policy in England and Wales.

Photo: Andy Hay (rspb-images.com)

PRESSURES ON NATURE

The UK's human population has risen steadily over the last century, mainly centred around urban areas (see figure)[2]. This has required large-scale infrastructure developments, to meet demands for food, goods and human movement. While the increasing intensity of development within specific urban zones potentially reduces impacts on the wider countryside, the biodiversity value of existing urban green spaces and wildlife-rich natural areas can be impacted.

UK urban and rural population, 1970 to 2018



Source: https://population.un.org/wup/Country-Profiles/

Analyses presented in *State of Nature 2016* showed that urbanisation accounted for a greater impact on species than any other habitat conversion[3]. Comprehensive data on habitat loss to urbanisation are not available, but we know that an additional 1,600 miles of road were constructed in Great Britain between 2006 and 2018[4]. Permanent damage to soil function and increased diffuse pollution from urban run-off are two detrimental results of covering land with built, impermeable surfaces. In recognition of this, Scotland has recently introduced a new Environmental Health Indicator for sealed soil, which enables development to be tracked more robustly. Between 2009 and 2018, the area of sealed soil in the Clyde catchment, for example, increased from 4.38% to 5.2%, representing an area of 41,149ha[5].

Urbanisation has direct consequences for wildlife in terms of land use and land cover changes, but it also acts to fragment landscapes by creating barriers between habitats, thus isolating some populations and in turn reducing their genetic fitness[6]. A wide variety of green spaces exist within urban environments, the biodiversity value of which varies with the degree of fragmentation, management, local population density and surrounding land use. Increases in air, light and noise pollution, human disturbance and predation by domestic animals particularly affect biodiversity in urbanised areas.

Nevertheless, most urban environments are not completely covered with built structures but contain a substantial area made up of domestic gardens, parks, allotments, cemeteries, ponds, road verges and brownfield sites. Detailed analysis of four British urban centres (Bristol, Edinburgh, Reading and Leeds) show that over 60% of the total landcover is "green" – with residential gardens making up 24–36% of each city[7]. While much of this area is not managed for the benefit of nature, the value of green infrastructure for biodiversity is worthy of consideration and it is also important for the health and well-being of the human inhabitants.

Photo: David Broadbent (rspb-images.com)

THE STATE OF NATURE

DIRECT HABITAT LOSS

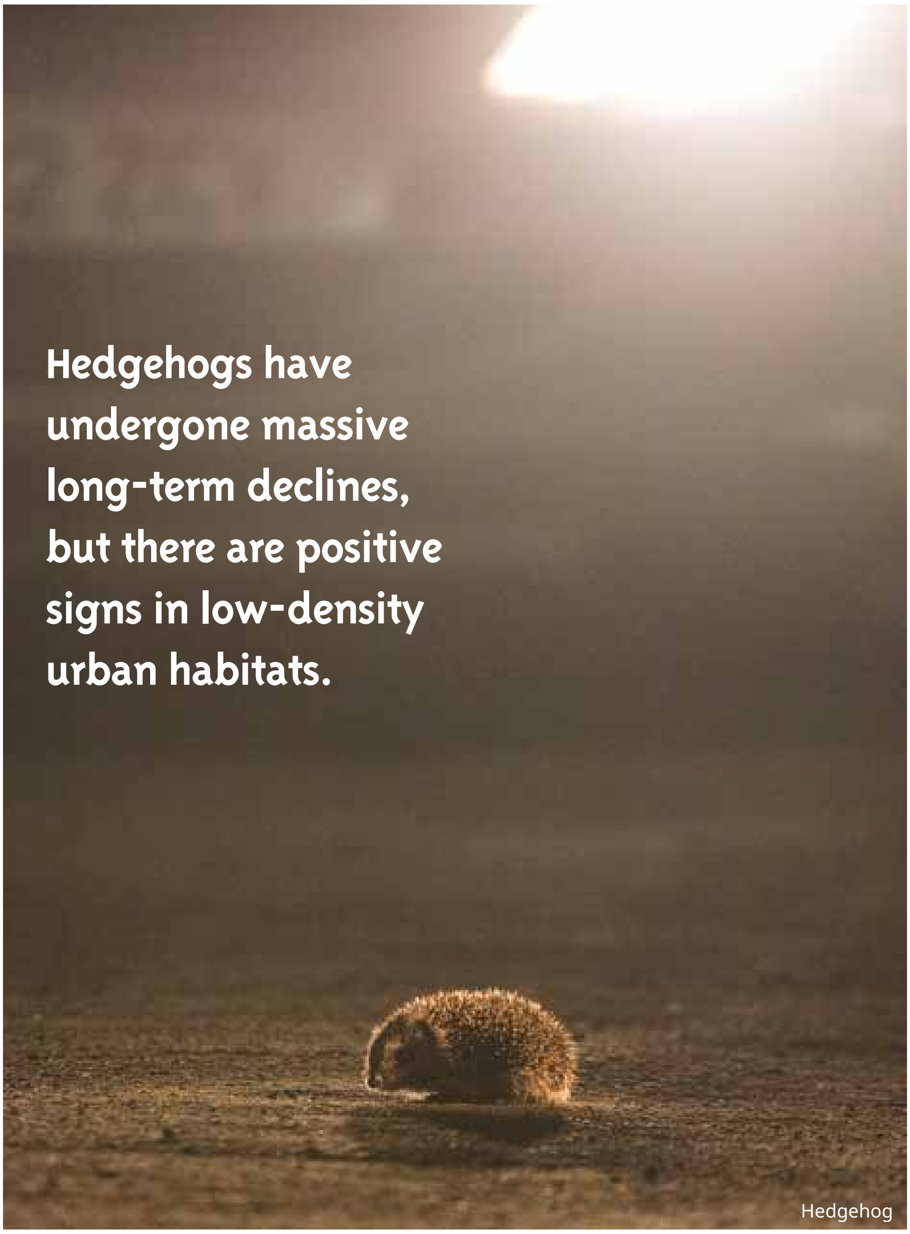
Development for housing, industry and infrastructure projects such as road and rail result in a loss of natural habitats, as well as fragmentation and change to those that remain. Heathland is one of the habitats that has been most impacted by urbanisation. The UK's remaining lowland heathland is distributed predominantly in southern England, and most is in close proximity to expanding urban centres. Direct loss, fragmentation and degradation through nitrogen deposition and disturbance has negatively impacted vulnerable species, including heathland reptiles such as Sand Lizard and Smooth Snake, and rare ground-nesting birds like Nightjar and Woodlark. Although direct loss of heathland habitat through land-use change is now controlled by planning and environmental legislation, it was still occurring until the 1990s[8]. Development in surrounding areas continues to increase the pressure on remaining isolated heathland patches, through increased fire risk, predation by domestic animals and human disturbance.

NATURE IN URBAN AREAS

Urban environments can support high levels of biodiversity and offer opportunities for some species. Low and intermediate levels of urbanisation can increase species' richness for some groups, which has been associated with the mosaic of habitats available[9]. Urban areas have been shown to support higher bee species' richness than non-urban habitats and a recent study found that residential gardens and allotments are pollinator hotspots[10]. Green infrastructure such as sustainable drainage systems can provide habitat for a wide range of species, including amphibians and invertebrates, but many sites do not fulfil their potential as wildlife habitats[11].

Hedgehogs, now classified as Vulnerable to extinction on Great Britain's new Red List for mammals due to long-term declines[12], are showing positive signs in low-density urban habitats. Since 2012, fewer urban Hedgehog sites have been lost and, where populations remain, Hedgehog numbers appear to be growing[13]. Other species appear to have shifted from their traditional habitats; Foxes and Herring Gulls, for example, increasingly occupy the UK's major cities, which can cause conflict with humans. There is concern for the conservation status of both of these species in their traditional habitats, but in urban areas where food is readily available (particularly from refuse) they are able to achieve high population densities.

Many people in urban areas feed wildlife, including birds, Foxes, Badgers, Hedgehogs, and – sometimes unintentionally – invasive non-native Grey Squirrels and Brown Rats. There is more to learn about the impacts of this supplementary food for wildlife conservation, but it is clear that many local populations benefit, and national increases in some familiar birds such as the Goldfinch have been supported by the growth in garden bird feeding[14].



Hedgehog

Photo: David Woodfall (rspb-images.com)

THE RESPONSE FOR NATURE

Unsurprisingly, the UK's urban areas are where most people make a connection with nature. There is therefore enormous potential for engaging people to take action in their own gardens or to act together in local green space projects. This is being supported by policy and planning regulations to ensure best practice in new developments and management of existing green spaces, as well as through empowering citizens to take individual and collective responsibility for the nature on their doorstep.

URBAN PLANNING WITH MULTIPLE AIMS

Recent changes mean that planning policy in England enshrines the concept of net gains for biodiversity through development; similar policies of net benefit were introduced in Wales in 2016. The extent to which this may be achieved is unknown, as there are no robust systems in place yet for before-and-after construction comparisons. For example, a review of a subset of development mitigation for bats in buildings found that, for a range of reasons, mitigation measures varied in their success[15]. There is increasing recognition that urban planning strategies need to be designed to provide maximum benefit for multiple aims; for biodiversity, for wider ecosystem service delivery, and the health and well-being needs of people to access urban green space. However, these aims may not always be aligned and there is a tension between intensive development, providing ecosystem services that need extensive areas (e.g. flood control), and providing accessible green space for recreational needs[16]. One solution is to employ a hierarchy of green infrastructure from larger, more distant places to smaller and more local ones.

ENGAGING WITH GARDEN WILDLIFE

Increasingly, people are being encouraged to garden with wildlife in mind, and there is the potential for substantial biodiversity benefits within the domestic gardens that constitute substantial areas of our cities.

CASE STUDIES

Connecting communities with the nature on their doorstep

Launched in March 2019 by Earthwatch Europe, Naturehood is transforming urban green spaces into wildlife havens by bringing people together.

Naturehood's approach empowers and connects people with both nature and their wider community. Individuals are supported to take action to help and monitor local wildlife in their gardens, balconies or window boxes, while Naturehood's engagement officers work across communities to create connected networks of habitat to support biodiversity.

The first four Naturehoods are now up and running in Oxford and Swindon, with support from the National Lottery Heritage Fund and in collaboration with Wiltshire Wildlife Trust.

Reducing the impact of artificial lighting on bats and insects

Artificial night lighting is one of the most pervasive – and yet under-recognised – causes of environmental pollution. Globally, external lighting is increasing by around 6% per year; in the UK we have more than 9 million street lights, and more and more buildings are illuminated at night on the grounds of security or aesthetics.

Among known impacts on wildlife, such as on night-flying insects, there is now overwhelming evidence that bat communities are profoundly affected by light pollution. Many species – including all but one of those on the Great Britain Red List – avoid lit areas for foraging or commuting, while the illumination of historical buildings (or any roosting site) at night can prevent bats accessing their roosts.

Some local planning authorities are taking steps to decrease light pollution, particularly in areas with sensitive bat species, for example by requiring forms of lighting that direct the illumination to only those areas where it is needed[17]. Individuals can help to lessen light pollution by switching off exterior lights at night, focusing security lights more precisely, choosing bulbs with lower light intensity and avoiding placing outside lights on white walls, where their effect is magnified. Simply closing curtains at night also makes an important difference!

Photo: Andy Hay (rspb-images.com)

INVASIVE NON-NATIVE SPECIES, PESTS AND PATHOGENS

Humans are increasingly moving species around the globe and releasing them, deliberately or accidentally, into the wild. Some will be moved as contaminants of trade. The number of non-native species colonising or becoming established in the UK continues to grow. Around 12% of established non-native species cause adverse economic, environmental or societal impacts and are therefore classed as invasive non-native species (INNS). As impacts often take time to emerge, and INNS establishment and spread will be facilitated by climate change, that figure is likely to rise. While eradications of INNS from islands, for example, can have direct benefits for impacted species, preventing species from establishing in the first place is recognised globally as the best strategy for avoiding environmental damage and minimising the financial cost of subsequent management.

PRESSURE

12% of established non-native species have a demonstrated negative ecological or human impact, and that figure is likely to rise.

STATE

The number of INNS established in Great Britain has increased steadily.

RESPONSE

Simple biosecurity measures can keep INNS off islands. Breeding seabird numbers have shown a rapid positive response to successful rat eradications on UK islands, including Lundy, Canna, Ramsey, the Shiants and the Scilly Isles.

Photo: Craig Churchill (rspb-images.com)

Muntjac Deer

PRESSURES ON NATURE

The impact of non-native species has long been recognised as a major driver of environmental damage. Impacts are evident across all ecosystems, with particularly severe impacts on native woodlands, freshwater habitats and islands – which often have unique floras and faunas, due to their isolation from nearby continents. There are currently around 2,000 non-native species known to be established in Great Britain, and an average of 10–12 new species establish each year; around 12% of these cause serious adverse impacts and are therefore classed as invasive (INNS)[1,2]. Over 1,200 non-native species have been recorded in Ireland.

These figures are likely to increase as climate change proceeds. INNS can have a number of adverse impacts.

- They may outcompete or predate native species, as has happened with American Mink and Water Vole[3].
- INNS may bring with them diseases to which native species have little or no resistance, such as squirrel pox from American Grey Squirrels that is fatal to native Red Squirrels.

Photo: Paul Sawer (rspb-images.com)

Toad

Floating Pennywort

Photo: GBNNSS

- Initially harmless airborne pathogens can become more virulent as the result of hybridising with formerly benign native microbes. Planting of exotic pine stands in the UK appears to have facilitated the introduction of two exotic races of the fungus *Dothistroma septosporum* into Scotland, which now pose a threat to native Scots Pine, both directly and through potential hybridization and introgression with the endemic race[4,5].
- Hybridisation of a novel species with a closely related, native one can also risk effective extinction of the native one by loss of its unique/separate genetic identity, as is currently happening with Scottish Wildcat[6].

Novel pests and pathogens can have impacts beyond the species they directly attack. For example, the spread of Ash dieback is likely to affect the many species that rely upon Ash bark, roots or even its decomposing leaves. Declines in Ash are predicted to lead to the loss of insects, lichens, mosses and liverworts, many of which are found largely or solely on Ash[7].

Amphibian diseases have become a leading cause of the decline and extinction of many amphibian populations around the world[8]. The emerging infectious chytrid fungus *Batrachochytrium salamandrivorans* could be devastating to UK newt populations; current efforts focus on countering the risk of its introduction to the wild via amphibian collections or the international pet trade. It has already caused mass mortality events in continental Europe, leading to the near extinction of the Fire Salamander *Salamandra salamandra* in the Netherlands[9].

INNS can also reduce the benefits we gain from nature. For example, invasive plants can choke up waterways and increase flood risk, while others may cause damage to species of economic importance. In 2010 the total annual cost of INNS to the British economy was estimated at approximately £1.7 billion[10].

ON AVERAGE 10–12 NEW NON-NATIVE SPECIES NOW ESTABLISH EACH YEAR IN GREAT BRITAIN, OF WHICH AROUND 12% WILL CAUSE SERIOUS ADVERSE IMPACTS.

THE STATE OF NATURE

Globally, INNS are one of the main drivers of biodiversity loss and constitute a particular threat to fragile ecosystems, such as those on islands. Of 247 animal extinctions where the cause is known, INNS were implicated in 58%, and in 31% of cases where species have gone extinct in the wild, INNS were the only cause cited[11]. While INNS have been implicated in extinctions from UK OTs, there are none recorded from Great Britain and Ireland.

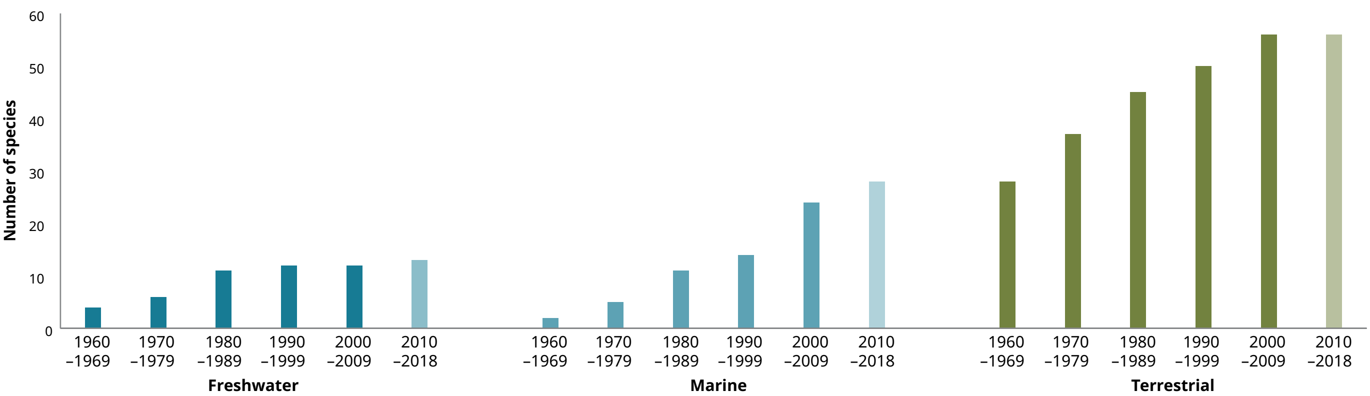
Over 3,200 non-native species have been recorded in Great Britain, with around 2,000 established and reproducing in the wild. Two hundred and thirty-four species have had a documented negative ecological or human impact[12]. The number of terrestrial invasive species becoming established in Great Britain has grown steadily and numbers of marine species have increased even more rapidly, having more than doubled since 1999 (see figure below). The greatest numbers of INNS are found in woodlands and urban ecosystems, followed by coastal, freshwater and grassland habitats[13].

OVER 3,200 NON-NATIVE SPECIES HAVE BEEN RECORDED IN GREAT BRITAIN.

RELATED SECTION

p80 UK Overseas Territories

UK Biodiversity Indicator: Number of new invasive non-native species established in or along 10% or more of Great Britain's land area or coastline, 1960 to 2018 (final columns in each habitat refer to nine years rather than 10)



Source: jncc.gov.uk/ukbi-B6

Photo: John W Anderson

American Mink and Gannet

THE RESPONSE FOR NATURE

While the control of established INNS is important, the GB INNS Strategy emphasises the need for prevention, early detection and rapid response to potential establishment. Stopping problems before they start makes huge savings both in terms of money and ecological damage. The EU and the UK Government have response plans to deal with new threats, and to date these have proved effective at preventing colonisation of some new species.

CASE STUDIES

Removing INNS

Although islands are often seen as being particularly vulnerable to INNS, they have the advantage of offering a contained system from which INNS can be removed. Great Britain and Ireland are archipelagos, and several successful projects to remove non-native species have been carried out here, such as the eradication of rats on the islands of Canna, Lundy, Ynys Seiriol (Puffin Island) and the Shiants. On the British mainland, projects have successfully eradicated Coypu, Muskrat, African Clawed Toad, Fathead Minnow and Black Bullhead. Eradication projects are currently underway on UK OTs, including Gough Island, Bermuda and Gibraltar.

After clearing an INNS from an area, the recovery of the impacted species or habitat can be remarkably quick. South Georgia was declared rat-free in 2018, following the largest eradication

Photo: Kate Lawrence (rspb-images.com)

of its kind. Before baiting began in 2010, numbers of Wilson's Petrel were in the low tens, but five years later hundreds were regularly seen flying over suitable breeding habitat that had been infested with rats for over a century[14]. Such recovery is not true in all cases, however. For example, even 30 years after Rhododendron removal from Scottish Atlantic Oak woodland, the ground flora had not returned to its target condition[15].

Chinese Mitten Crab

Photo: GBNNSS

INNS awareness

Action plans include ways to reduce the risk of zoo escapes, contaminants from angling equipment and introductions via recreational boating. Invasive freshwater plants and animals can spread quickly and impact whole ecosystems. Killer Shrimp, widely considered one of the most damaging INNS in Europe, spread from the Ponto-Caspian region of Eastern Europe. There are three established populations in the UK, elsewhere records are mainly from eastern and central Europe to date. Killer Shrimp can cause population declines of many native species, preying on other shrimp species, fish larvae and eggs[16].

Campaigns such as Check, Clean, Dry and Be Plant Wise[17] aim to improve biosecurity by raising awareness with key stakeholders, anglers and boat users, in order to slow the spread of such invasive freshwater species and prevent their establishment in new areas. However, the latest analyses suggests that public awareness of INNS issues has not increased over the past decade, although awareness has improved among key groups such as anglers and boaters[18].

POLLUTION

A wide range of pollutants, from many sources, threaten wildlife and have an impact on all habitats. Perhaps the most widespread current harm is caused by excess nutrients (phosphate and compounds of nitrogen) in air and water. Legislative control has been successful in reducing emissions of many pollutants and there are signs of a partial recovery in nature, including fish returning to rivers, and lichen and bryophyte species (that are sensitive to air pollution) expanding in range. Sensitive habitats in particular, however, remain vulnerable. New government initiatives, partly in response to international targets, should lead to further improvement. Public concern regarding pollution has been strengthening recently, particularly over the proliferation of plastic waste in the environment, and there is a widespread appetite for positive change.

PRESSURE

Nitrogen and ammonia emissions have decreased since 1970.

STATE

Occupancy trends in lichens and bryophytes suggest some recovery.

RESPONSE

The UK has committed to legally binding limits for sulphur dioxide, reactive nitrogen, ammonia and particulate matter by 2020, and further reductions by 2030.

Photo: Chris O'Reilly (rspb-images.com)

PRESSURES ON NATURE

There are few places left on earth unaffected by the by-products of modern human life. Pollution presents a wide range of threats to the environment and the species that inhabit it, as well as to human health and well-being. Pollutants come in a diverse range of forms, including but not limited to plastic waste; chemicals in water, soil and air; noise and light emitted from cities and transport; and nutrient enrichment of sensitive habitats.

Air pollution and nutrient enrichment affect biodiversity and ecosystem services, harm human health and contribute to climate change. Widespread changes have been recorded to sensitive ecosystems in the UK, with farming, transport and industry being key pollution sources. Eutrophication, acidification and toxic pollution of ecosystems have been shown to drive declines in the presence, abundance and health of sensitive species of plants, lichens and other fungi[1]. There is strong evidence that nutrient enrichment via nitrogen deposition has impacted plant species in a wide range of habitats[2].

Diffuse pollution represents a significant risk to freshwater in the UK, and arises from the run-off of soil, nutrients and pesticides from farming and forestry, contaminated drainage from urban areas and the deposition of pollutants from the air. Point source emissions from industry, sewage treatment works and fish farming add to this pollutant load. High levels of phosphates and nitrates are the most frequent causes of rivers, lakes, estuarine and coastal waters failing EU Water Framework Directive (WFD) water quality objectives[3,4], and impacts can linger for years.

Recent decades have seen reductions in many forms of pollution, most notably point source discharges from industry and water treatment works, but others remain difficult to combat. New threats have arisen with the introduction of novel agrochemical and pharmaceutical products[5]. Emissions of reactive nitrogen (NOx), sulphur and particulates into the atmosphere have decreased since 1970, though NOx remains a key source of nitrogenous pollution to the atmosphere. Ammonia emissions (which contribute to the formation of NOx) fell overall by 11% between 1980 and 2017, but have risen since 2013 and constitute a major short-term threat to sensitive habitats. Dairy and beef cattle, fertiliser application and poultry are major sources of ammonia emissions[6].

Trends in annual emissions of various air pollutants, 1970 to 2017[6]

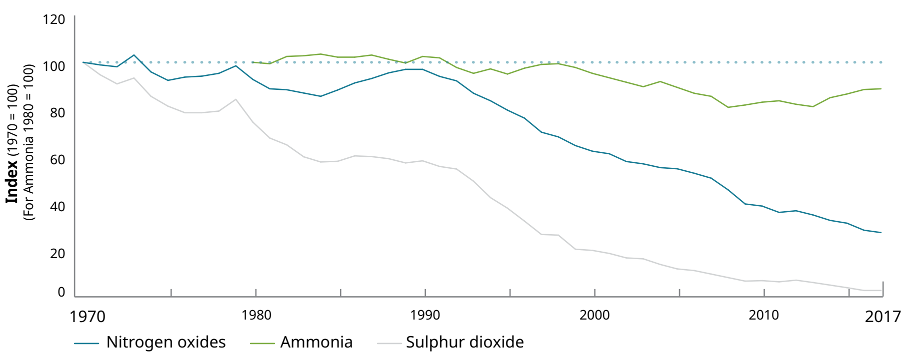
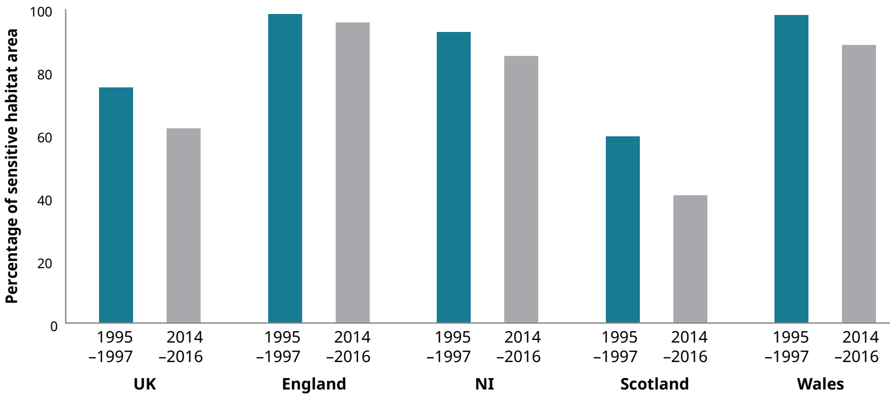


Photo: Ray Kennedy (rspb-images.com)

THE STATE OF NATURE

Most semi-natural habitats, and over two-thirds of our wildflowers (such as Harebell and Betony), require levels of nitrogen to be low[7]. Nitrogen enrichment has led to changes in plant and fungal communities and the declines of individual species, with species that prefer nutrient-poor environments showing a decline in distribution, on average (see graph below). Further up the food chain, moth species whose larvae depend on low nutrient-adapted plants declined strongly between 1970 and 2010[8]. Despite recent progress in input reduction, in 2014–16 62% of all UK sensitive habitats exceeded the recommended "critical nutrient load", above which they are at risk of harmful effects. The figure is 85% for Northern Ireland and for England is close to 100%[9].

UK Biodiversity Indicator: Percentage of nitrogen-sensitive habitat area in UK countries where nutrient nitrogen critical loads were exceeded in 1995–97 and 2014–16

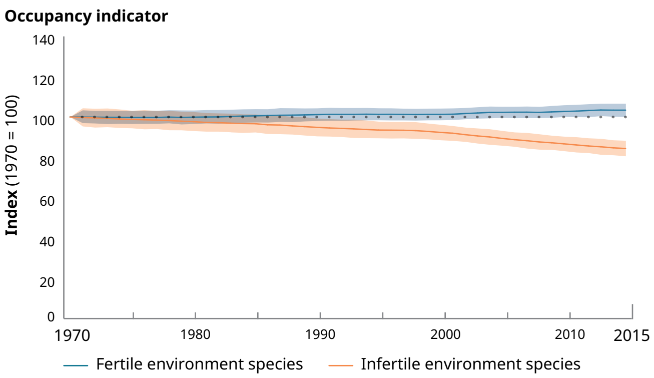


Source: jncc.gov.uk/ukbi-B5a

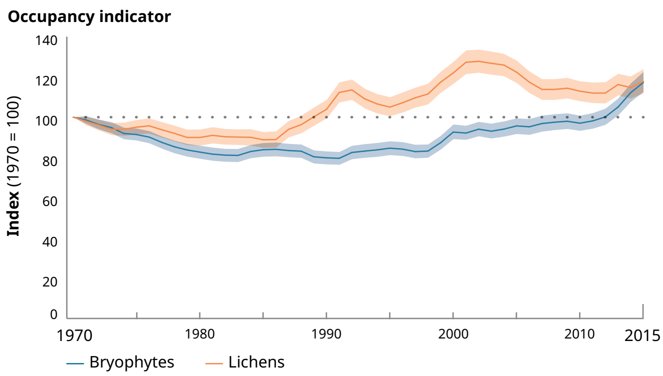
Many waterways are now cleaner than they have been for many years. In 1957, the Natural History Museum declared the lower Thames "biologically dead", with news reports describing it as a vast, foul-smelling drain. Now it is used by a wide variety of fish, with Atlantic Salmon, Brown Trout and River Lamprey all recorded in recent years[10]. However, despite these improvements, only 35% of UK surface water bodies were classed as being in high or good status (based on the WFD combination of biological, chemical and structural measures) in 2018[11], and species such as the Freshwater Pearl Mussel continue to suffer declines related to water quality.

New trends shown here (below) reveal interesting patterns in the distribution of bryophyte and lichen species since 1970. While the drivers of this recovery are not fully understood, the increases in occupancy began in the 1990s, as levels of air pollution started to reduce, and is almost certainly related to the recovery of species sensitive to pollution[12]. This is likely to reflect an increase in the distribution of common species sensitive to acid deposition but tolerant of increasing nitrogen deposition, reflecting changes in air pollution. Evidence suggests, however, that many specialist lichen species continue to decline in abundance as well as distribution[13].

Change in the distribution of species of fertile environments (411 species) and infertile, nutrient poor, environments (524 species) based on Ellenberg N scores



Change in the distribution for bryophytes (569 species) and lichens (696 species) 1970 to 2015



THE RESPONSE FOR NATURE

The marked reductions in many classes of polluting emissions has been driven by broad-scale legislative control, often following coordinated action across the UK and the rest of Europe[14]. Sulphur emissions from coal-fired power stations and industry in the UK, which caused "acid rain" and damaged ecosystems across northern Europe, have been cut by 97% since the 1970s[6]. Further reductions in sulphur emissions are expected when a mandatory 0.5% cap of sulphur content in shipping fuel comes into force on 1 January 2020[15].

The reduction of NOx has been part of government clean air strategies for many years, driven largely by concerns about public health impacts and greenhouse gas emissions. Recently, measures to reduce ammonia emissions from agriculture and other sources have been adopted or are under consideration across all UK countries (for example, the Department for Environment, Food and Rural Affairs (Defra)'s Clean Air Strategy 2019), driven by binding international targets to reduce emissions by 8% by 2020 and 16% by 2030 from a 2005 baseline[16]. All current UK AES now contain options or mandatory cross-compliance obligations to protect watercourses from farming-related diffuse pollution and Nitrate Vulnerable Zone regulations impose additional protection measures in many areas (for example, they cover around 55% of English agricultural land).

CASE STUDIES

Catchment Sensitive Farming

Since 2006, the Catchment Sensitive Farming (CSF) partnership has worked with over 20,000 farmers, covering a third of the farmed area of England to improve water quality. Workshops, farm events and one-to-one advice are targeted in areas designated as high priority for agricultural pollution. Topics covered by the programme include fertilizer and pesticide management; soil health and structure; silage, slurry and fuel oil regulations; and Nitrate Vulnerable Zones. Field officers also provide help and advice with grant applications for farm infrastructure upgrades and capital works. In target areas monitored since Phase 1, nutrient, sediment and faecal indicator organism concentrations have reduced by 5–22% and monitored pesticide concentrations (exceeding 0.1µg/l) by 34%[17].

A key element of the programme aims to develop local farmer–to-farmer learning networks. One example in the Evenlode catchment, Oxfordshire, involves farmers alongside the local community measuring the effectiveness of CSF interventions through FreshWater Watch, Earthwatch's citizen science project. The data collected encourage better catchment management and empower the rural community to act as stewards of the river.

Moninea Bog, Northern Ireland

Moninea Bog, an Area of Special Scientific Interest (ASSI) and Special Area of Conservation (SAC), is a lowland raised bog in the south west of Northern Ireland, which is especially important for its high cover of Sphagnum moss species and the presence of all three native sundew species. In 2007, a field study by the Centre for Ecology & Hydrology showed that ammonia from neighbouring farm operations was causing severe direct damage to the site's vegetation, including algal slime on trees and bleaching of mosses. Following a reduction in the level of farm operations in 2009/2010, further investigation in 2017 found that there was already substantial recovery on the site. The results are now being prepared for publication, but already provide an example that measures to reduce ammonia emissions can be expected to deliver substantial biodiversity benefits within five to 10 years.

BROAD-SCALE LEGISLATIVE CONTROLS HAVE DRIVEN DOWN EMISSIONS OF MANY POLLUTANTS.

Photo: David Genney

Solorina crocea

WOODLAND MANAGEMENT

The area covered by woodland in the UK continues to increase from very low levels a century ago, but its integrity is under threat from invasive plants, pests and diseases. Nature in woodland is under pressure from a lack of management, overgrazing by deer, increasing levels of recreational disturbance and nitrogen pollution. Numbers of many woodland birds and butterflies continue to decline. Of particular importance due to their high nature value and restricted range, the Atlantic oak and hazel woods of the UK's western coasts and Scotland's Caledonian pine forests have both suffered severe loss and fragmentation. Ancient woodlands across the UK have been lost through conversion to plantation forestry and face continued threat from infrastructure and housing development. Addressing the problems facing woodland and trees of the wider countryside is increasingly recognised as a major conservation issue, which is the focus of a wide range of ambitious consortium projects involving both research and conservation action.

PRESSURE

Woodland area in the UK has increased since 1998.

STATE

The UK woodland butterfly indicator has fallen by 50% since 1990.

RESPONSE

Area of woodland sustainably managed, about 44% of the total.

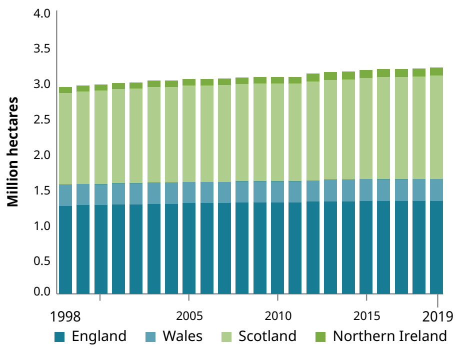
Photo: David J Slater (rspb-images.com)

PRESSURES ON NATURE

Looking back in history woodland cover in the UK declined gradually, largely to make way for agriculture. Estimated at 15% in England at the time of the Domesday survey, it had fallen to 5% by the end of the First World War. In 1919, the Forestry Commission was established to provide a strategic timber reserve and, assisted by policy incentives to encourage private planting, the area of woodland increased rapidly. Although well below the European average of 37%[1], woodlands now cover around 13% of UK land. However, non-native conifers such as Sitka Spruce dominated early restocking, and with limited tree species, age diversity and high-density planting, this benefited only a narrow range of wildlife, and eliminated species that depended on habitats on which these woods were planted on. With growing recognition of the conservation value of native woodland, many new woods and replantings now use diverse tree mixes or allow natural regeneration and follow sustainable management practices, in accordance with the UK Forestry Standard.

UK woodland cover increased by 9% between 1998 and 2018 and is currently estimated at 3.17 million ha. Scotland has seen the largest area increase (156,000ha), while Northern Ireland had the greatest proportional increase (39%) but remains the least wooded UK country. Conifers account for 51% of the UK's woodland area, varying from 26% in England to 74% in Scotland[2]; much of this is commercial plantation of non-native tree species. Ancient woodland, highly important in terms of biodiversity value and supporting a wide range of specialist species is estimated to cover only around 2.4% of UK land and the lack of an up-to-date inventory hampers its protection.

Woodland area by country, 1998 to 2019



The pressures affecting woodland, and trees in the wider countryside, are diverse and dependent on location and species. Changes in management have had major effects. Historic rotational coppice systems were replaced by clear fell and replanting during the 20th century, then followed by a recent move to continuous cover systems, often with very limited management. Many woods have become fragmented, intersected by roads and development that degrade habitat and form barriers to wildlife movement. Increasingly, the prevalence of tree disease is a serious concern. Dutch elm disease resulted in the loss of 20 million trees during the 1970s[3] while Ash dieback and Acute Oak Decline are currently seriously affecting three of our most common and widespread tree species. The pathogen *Phytophthora ramorum* mainly affects Larch within plantations but is known to infect other tree and shrub species; its arrival has led to widescale preventative felling.

Increasing deer numbers (both native species such as Roe and non-natives such as Muntjac), have a heightened impact on woodland and its dependent wildlife as they reduce natural regeneration and alter woodland structure through increased grazing and browsing[4]. Recreational use, particularly in woodland close to urban areas, has detrimental impacts on soils, invertebrates and flora through trampling and compression[5]. Disturbance associated with an increasing variety of leisure activities adversely affects wildlife, including birds and mammals[6]. A changing climate in combination with invasive and native pests and pathogens form a complex and interacting set of threats that will favour some tree species, while making conditions worse for others. Species' distributions are expected to alter as a result, with evidence already pointing to a decline in the abundance and distribution of woodland specialist lichens[7].

Population trend for Muntjac deer – UK Breeding Bird Survey Index, 1995 to 2018

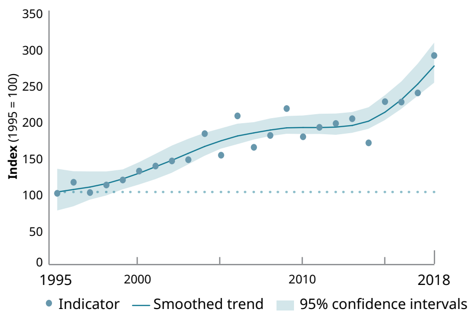


Photo: Norman Russell (rspb-images.com)

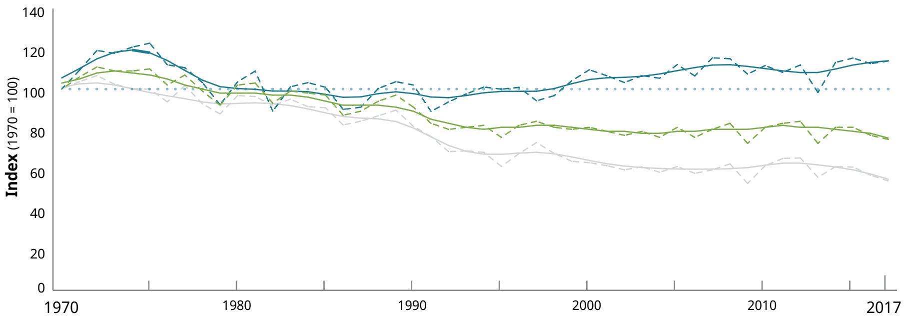
THE STATE OF NATURE

Despite the overall expansion in the area covered by woodland, woodland species continue to decline, as evidenced by the UK woodland bird indicator which fell by 25% between 1970 and 2017.

Declines are most pronounced in woodland specialists such as Lesser Spotted Woodpecker, Spotted Flycatcher and Willow Tit, and suggested causes include a decline in appropriate woodland management, changes in tree species composition and loss of landscape connectivity. Woodlands acquire species at different stages of maturity, with specialist bird species generally occupying woods over 80 years old, and with a high level of structural diversity, while generalist species can exploit younger woodland[8].

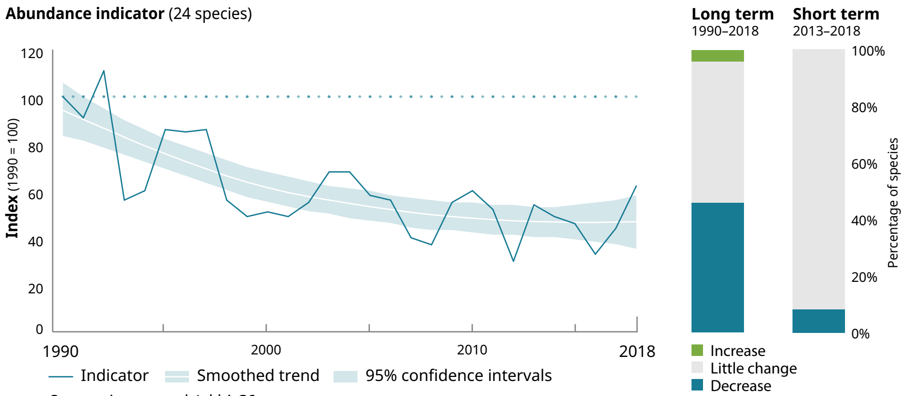
The long-term decline in the UK woodland butterfly indicator, which includes well-known species such as Common Blue, Marbled White and Meadow Brown, is thought to be due to reduced sympathetic management and a decline in open spaces within woods.

Breeding woodland birds in the UK, 1970 to 2017



Source: https://www.gov.uk/government/statistics/wild-bird-populations-in-the-uk

UK Biodiversity Indicator: Change in widespread butterflies in woodland in the UK, 1990 to 2018



Source: jncc.gov.uk/ukbi-C6

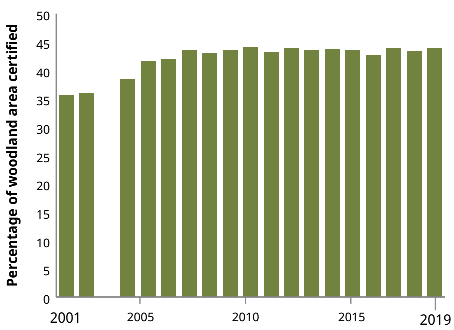
Photo: Colin Wilkinson (rspb-images.com)

THE RESPONSE FOR NATURE

Grants are available to encourage new woodland planting and the sustainable management of existing woodland. For example, funding is available under Rural Development Programmes to deliver local biodiversity objectives (for priority habitats and priority species), water objectives (to improve water quality or help reduce flood risk) and climate change mitigation or adaptation[9,10].

As the figure below shows, the area of woodland managed sustainably (which includes measures relating to maintaining biodiversity, ecological, economic and social functions) has remained level, at around 43% (44% in 2019), over the last decade. The Scottish Government has a stated aim to increase woodland cover from around 18% to 21% of Scottish land area by 2030[11] although much of this will be non-native planting, limiting its biodiversity value. In Wales the latest Government strategy states an ambition to create 100,000ha of new, well-located woodland by 2030 to help Wales meet its carbon emission reduction targets[12]. Planting targets can deliver the greatest benefits if they ensure new woodland is in the right place and not compromising other valuable habitats; priority is given to creating both new native and new mixed woodlands that can deliver multiple benefits.

UK Biodiversity Indicator: UK area of forestry land certified as sustainably managed, 2001 to 2019



Source: jncc.gov.uk/ukbi-B1b

The importance of maintaining, increasing and enhancing woodland for nature conservation alongside a range of ecosystem services is widely recognised in a number of ambitious consortium projects across the UK. Cairngorms Connect aims to enhance habitats, species and ecological processes over 600km² of Scotland's Cairngorms National Park, including Caledonian pinewoods and montane willow communities[13]. In England, the Woodland Trust is leading a consortium project to plant 50 million new trees over 25 years to create a "Northern Forest", spanning the country from Hull to Liverpool[14]. Launched in 2019, the online Woodland Wildlife Toolkit[15] provides woodland managers with a one-stop resource to inform about distributions of important wildlife, assess woodland condition and create appropriate management plans.

CASE STUDIES

Photo: Mike Read (rspb-images.com)

Celtic Rainforest Project

The Celtic rainforests – Atlantic woodlands in Ireland and the UK with an open woodland structure, mild and humid conditions, and rich plant assemblages – comprise a large proportion of Europe's rare temperate rainforest habitat. In the UK they are threatened by invasive non-native plants (particularly Rhododendron), poor grazing regimes, a lack of management and atmospheric nitrogen deposition[16]. By tackling invasive plants, developing restoration techniques and demonstrating best practice, the Celtic Rainforest Project aims to increase resilience, enhance ecosystem function and return woods to a favourable conservation status across four areas of north and mid-Wales. This ambitious EU LIFE-funded project runs from 2018 to 2025 and involves a range of statutory and NGO partners, led by Snowdonia National Park Authority.

Photo: Richard Revels (rspb-images.com)

Ash dieback

Ash dieback (caused by the fungus *Hymenoscyphus fraxineus*) is one of several invasive tree diseases recorded in the UK recently that has the potential to cause major ecological, social and economic impacts. With an estimated 126 million trees within woodland and 60 million in the wider countryside, Ash is the UK's third most common tree[17]. First recorded on imported saplings during 2012, the disease has spread rapidly to all four UK countries. Recent analysis has shown 955 species, ranging from bryophytes to mammals, are associated with Ash, of which 45 are obligate (only occurring on Ash) and a further 62 are highly associated[18,19].

The disease is now well established, and the economic cost has been estimated to be in the order of £15 billion[20]. There are many uncertainties over the prognosis for native Ash woodlands; mature trees die slowly and most populations show some level of tolerance; this has been shown to be strongly heritable. While a worst-case scenario would see loss of a high proportion of Ash, lessons from other epidemic tree diseases suggest that maintaining a wide genetic base and reducing other stressors will maximise tolerance. Guidance[20] focuses on ameliorating the potential impacts and encouraging ecological functioning by retaining existing Ash trees, encouraging natural regeneration of Ash and other native species, reducing herbivore impacts and reducing competition from INNS. Research has sought to establish which other tree species are able to support Ash-associated species and several, including Oak, Elm and Beech (where native), can support at least half[21].

WORKING FOR NATURE: CONSERVATION IN THE UK

The preceding pages have reviewed the biggest drivers of change acting on the UK's nature, how these pressures have changed over recent years and their impact on wildlife, both in the past and now. We have also given examples of some of the inspiring conservation action taken in response to these pressures. Here we look at how conservation acts as a force to help nature, to mitigate against the worst human impacts on nature and to nurture recovery from decades or even centuries of pressure.

Photo: Malcolm Hunt (rspb-images.com)

An analysis of drivers of change, reported in *State of Nature 2016*, estimated that 19% of the total impact (17% positive, 2% negative) on nature in recent decades arose from a wide array of conservation activities such as nature-friendly farming, habitat management and the creation of new wildlife habitat. This demonstrated that the conservation response can work, and is backed up by a number of well-evidenced examples of conservation success (see conservationevidence.com). Harder to assess is the extent to which the state of nature would be worse without this conservation action. We know, for example, that there are continued declines in biodiversity in response to farmland management (see page 20) – but we also know that nature-friendly farming, supported by government-funded AES, can deliver a range of on-the-ground benefits for wildlife. The key, it appears, is a matter of scale and resources. The collective response to the pressures on nature is helping, and should be celebrated, but declines in nature are continuing.

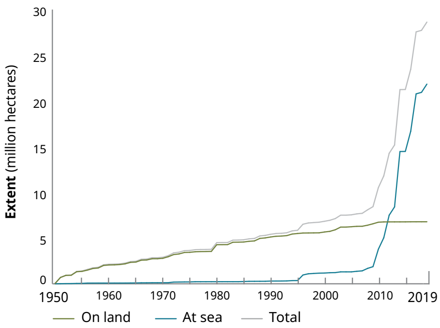
Here, we give a brief overview of just some of the approaches used in the conservation of the UK's wildlife, and the challenges we face in trying to improve the state of nature.

Photo: Colin Wilkinson (rspb-images.com)

CONSERVING SPECIAL PLACES

The UK has a long heritage of preserving special places, with the world's first nature reserve declared in West Yorkshire in 1821. As pressures on the wider environment have increased, with the widespread loss of habitats such as heathland, wetlands and ancient woodland, such reserves have become ever-more important. The State of Nature partnership is collectively responsible for approaching 5,000 individual nature reserves, with a combined area over five times the size of Greater London. In addition, the designation of sites and landscapes of high nature value as ASSIs or Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs) and SPAs provides special legal protection to prevent damaging activities and thus conserve important habitats and species. There has been a massive increase in the area of designated land and sea in the UK, owing to the designation of inshore and offshore Marine Protected Areas (MPAs) since 2013, although designation, of itself, does not ensure effective conservation.

UK Biodiversity Indicator: Extent of UK nationally and internationally important protected areas, 1950 to 2019



Source: jncc.gov.uk/ukbi-C1

Protection is only part of the story: nature reserves and protected areas require careful and nuanced management to enable species and communities to flourish. In 2019, the proportion of protected sites assessed as being in favourable condition was 43% for SACs, 50% for SSSIs and 52% for SPAs, with the majority of non-favourable sites assessed as "unfavourable-recovering". Very few habitats are stable and most require management of grazing levels, woodlands or hydrology, and in some cases management must evolve in response to an improved understanding of the habitat or species' requirements. At the same time, reserves must be able to welcome in people, and thus balance the needs of both visitors and the wildlife they come to experience.

CASE STUDY

Redgrave and Lopham Fen in Suffolk is the largest remaining calcareous valley fen in England, but decades of water abstraction and nutrient enrichment caused huge degradation to the site. Restoration work, funded by the EU and led by the Suffolk Wildlife Trust, relocated the abstracting borehole, removed 77ha of encroaching scrub, and scraped 23ha of fen completely clear to enable recovery. Forty-two ponds were created to help the threatened Fen Raft Spider. The rewetted fen holds 270 plant species and a rich invertebrate community; extinction of the Fen Raft Spider has been avoided and it is now expanding successfully in the new habitat.

RESTORING LANDSCAPES

The need to think big to turn around the fortunes of nature has been increasingly well recognised; such thinking that was crystallised in Professor Sir John Lawton's 2010 report, *Making space for nature*[1], which called for "more, bigger, better, joined" wildlife sites. Vitally, this extends conservation thinking beyond reserves, to the need to reduce fragmentation – whereby nature is stuck in isolated islands in a hostile sea of intensively managed countryside – by creating corridors between sites for wildlife to flow through, or stepping stones to help species jump across. In addition, Lawton called for "buffers" around wildlife sites, softening the intensive management that often runs up to reserve boundaries. Finally, Lawton's call for "better" needs to be addressed. The management of large areas of potentially wildlife-rich semi-natural habitat, such as in the UK's uplands, is unsympathetic to biodiversity.

Photo: David Wootton (rspb-images.com)

CASE STUDY

Great strides are being made to introduce such approaches, and demonstrate partnership working between government, NGOs, businesses, farmers and local communities. For example, in Northern Ireland, NGOs including the RSPB, Ulster Wildlife and Butterfly Conservation are working with local and national government to protect, restore, expand and link wet grassland habitats across 2,000km^2 of the Lough Erne Basin, home to threatened wader populations and rare plants such as the Fen Violet and Irish Lady's-tresses Orchid.

FOCUSING ON SPECIES

While conservation policies to address the pressures on nature, delivered across landscapes, will help, for some species this will not be sufficient. Many of the most celebrated conservation successes of recent years – the return of the Pine Marten to Wales, the restoration of the breeding range of Red Kites, the establishment of Lady's Slipper Orchid at 11 sites in Northern England – have been the consequence of targeted action, based on robust science and conservation best practice. Programmes such as Back from the Brink, in England, have brought numerous partners together to target action for priority species, including the Lesser Butterfly Orchid, Barberry Carpet Moth and Ladybird Spider.

A review of the 1,063 terrestrial and freshwater species listed as priorities on the UK Biodiversity Action Plan (BAP) – which has now been replaced by conservation policies at the devolved country level – found that only 114 of these have been the focus of coordinated and targeted action in at least part of their UK range as part of species recovery projects (SRPs). Most of these had received little or no conservation action aimed explicitly at recovering their populations[2]. However, there are imbalances in the targeting of such efforts. While conservation action targeted at one species can help others – for example, reedbed creation for Bitterns is likely to have benefited a wide range of taxa, including Water Voles and the Reed Leopard moth[3], and agri-environment options intended to boost rare farmland birds such as Stone-curlew have benefits for a range of taxa, including threatened arable plants[4] – our invertebrates and plants are clearly receiving less specific attention than mammals and birds. This contrasts with growing evidence that insects are showing rates of decline that may be greater than other taxonomic groups. Of those species that have been the subjects of SRPs, 61% are vertebrates, despite this group making up just 9.5% of the terrestrial and freshwater species identified as priorities. A further 26% of species with SRPs are invertebrates (mainly butterflies), despite this group representing 39% of priority species, and only 13% of plant and fungi species were identified as having had SRPs, despite this group making up 52% of all species listed as UK BAP priority species[2].

Lady's Slipper Orchid

Steve Knell (rspb-images.com)

BROADER ENVIRONMENTAL POLICY

Our impact on the UK's land and seascapes is pervasive – the impact of climate change is felt everywhere, three-quarters of land is affected directly by farming policies, 33% of quota managed fish stocks are harvested unsustainably, urbanisation is widespread. So, clearly, we need policies that ensure that the need for space to live, work and play, food production, and use of other natural resources is met sustainably, in a way that allows nature to flourish. We have talked, for example, about how policies to encourage wildlife-friendly farming can be integrated with food production and the needs of nature (page 21), and how legislation to control acidifying pollution has enabled the recovery of some bryophytes and lichens (page 41). At sea, policies that prevent the overexploitation of vulnerable fish stocks, encourage fishing techniques that minimise bycatch and habitat damage, and protect the most important areas from fishing are vital to ensure healthy marine ecosystems (page 63).

Photo: Colin Wilkinson (rspb-images.com)

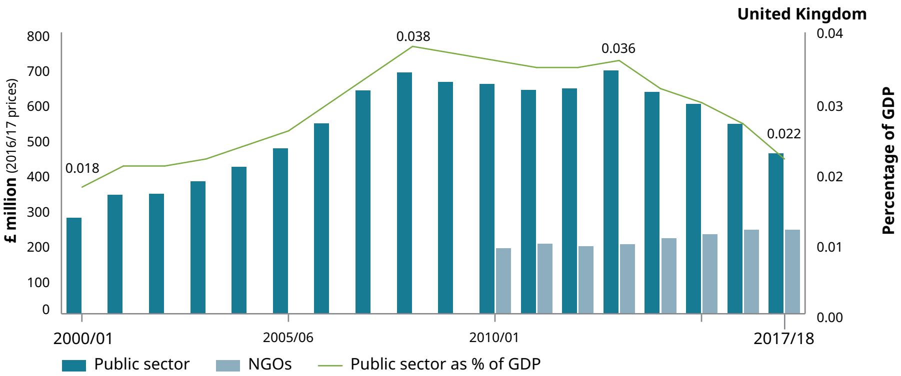
It is well recognised that policies to protect biodiversity and the environment bring huge benefits to human well-being, from clean air and water, healthy soils for food production, and the health and well-being impacts that result from connection with nature. Globally, these issues are recognised by the UN's Sustainable Development Goals[5] and by the CBD. We discuss the UK's progress towards the global 2020 targets (Aichi targets) on pages 90–91. As the parties to the CBD begin to discuss a post-2020 framework, we wait to see whether this will contain policies, and associated goals, that will encourage the transformative change which the recent Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report stated was required to avoid global declines in nature from continuing.

RESOURCES FOR CONSERVATION

Ultimately, our ability to act to conserve the UK's nature is constrained by resources. In 2017/18, an estimated £456 million of UK public sector funding was spent on biodiversity in the UK. This funding has been declining, by 29% over the last five years, and by 34% since a high point in 2008/09. As a proportion of GDP this represents a fall of 42% from 0.038% to 0.022%. It should be noted, however, that the lower level of public sector funding for international biodiversity conservation (£205 million in 2017/18), including that in the UK's OTs, has risen by 111% over the last five years.

By contrast, spending on biodiversity in the UK by NGOs with a focus on biodiversity and/or nature conservation, while not matching government investment, has increased in recent years. It reached £239 million in 2017/18, having increased by 24% over the previous five years.

UK Biodiversity Indicator: Expenditure on biodiversity in the UK, 2000/01 to 2016/17



Source: jncc.gov.uk/ukbi-E2

The increase in NGO spending on conservation provides evidence for increased public concern for the state of nature, and the value which they place on it, as does the rapid increase in volunteering to help nature conservation (page 10). Volunteers donate an immense resource to conservation in the UK; for example, we have estimated that around 7,500,000 volunteer hours go into collecting the biodiversity monitoring data upon which the *State of Nature* reports rely, every year. So, although financial investment is crucial, as are government policy and legislation, we must remember that the most successful conservation action arises from partnerships, across governments, charities, business, landowners and individuals working together.

MARINE KEY FINDINGS

From seabirds and marine mammals at the top of the marine food web to plankton at the bottom, there have been large spatial and temporal changes in species' abundance and distribution in UK seas in recent decades[1].

Monitoring the marine environment is a more logistically challenging task than monitoring terrestrial habitats. Species data are collected across large areas, but geographic coverage varies and long time series are only available for a more limited set of taxa. Monitoring is carried out for seabirds at breeding colonies around the UK and for marine mammals and fish stocks in the Greater North Sea and Celtic Seas.

Other aspects of marine nature are monitored in relation to specific drivers of change in the marine environment. Pressures interact with each other and, in some cases, impacts are difficult to disentangle, often having synergistic and cumulative effects. For this reason, following our key metrics of the state of marine nature, we present metrics for taxonomic groups associated with specific drivers, namely climate change and fisheries, to give an overall picture of the state of marine nature.

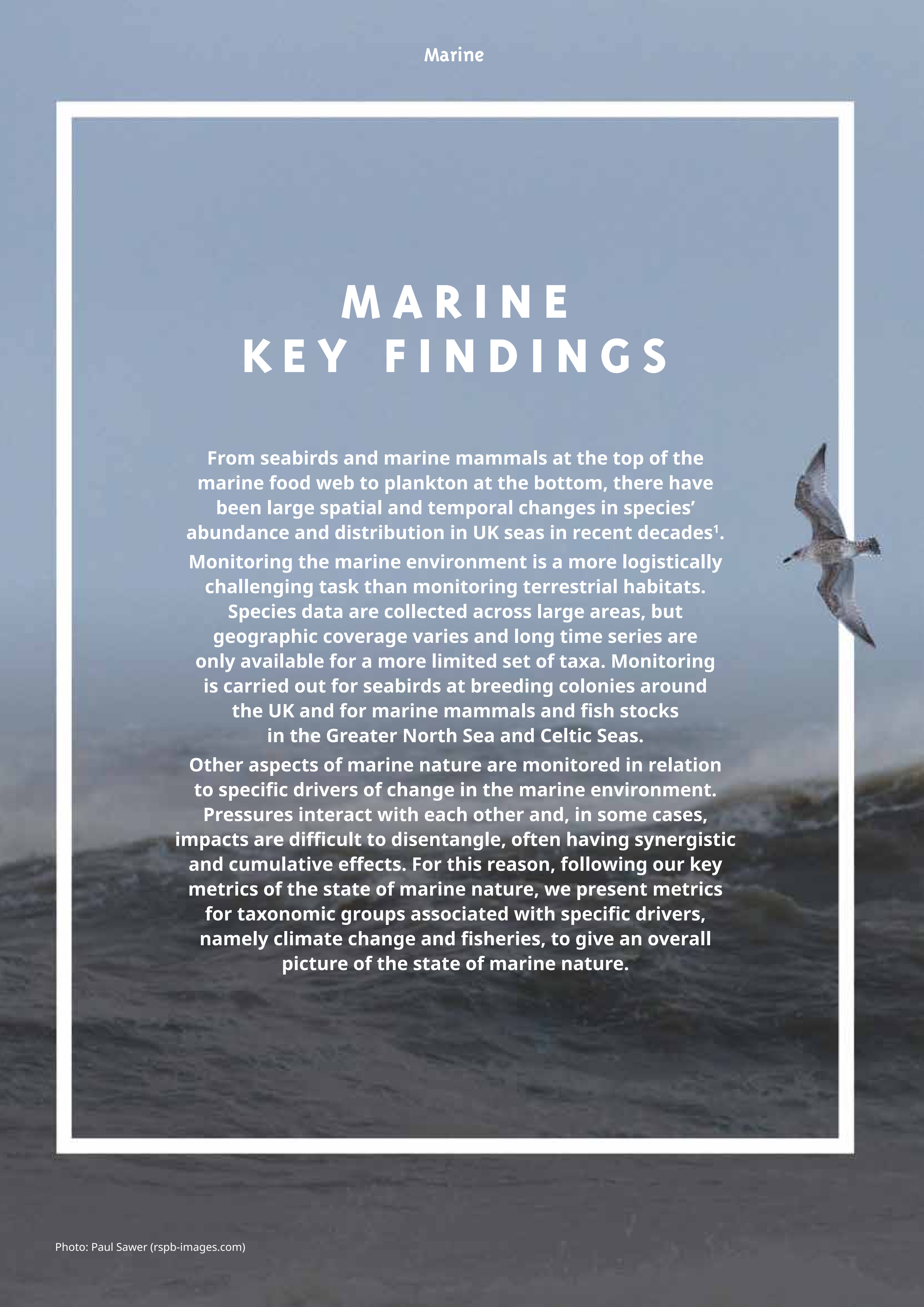


Photo: Paul Sawer (rspb-images.com)

The UK Marine Strategy[1] provides a framework for protecting the UK marine environment while allowing sustainable use of marine resources. The update in 2019 provides a status assessment of marine biodiversity and drivers of change, closely related to broader geographic assessments across the North East Atlantic[2,3]. We draw on these assessments in the *State of Nature 2019* marine section.

MARINE FISH – CELTIC SEAS AND GREATER NORTH SEA

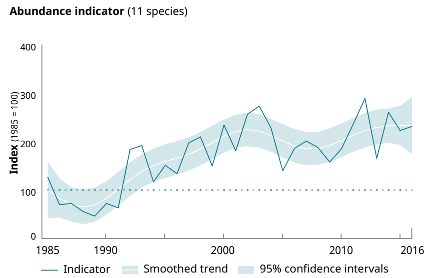
The abundance of marine fish and the composition of marine communities have been influenced by commercial fishing and climate change. Over the long-term period for which data are available (1980s to 2017), increases are evident as a result of warming sea temperatures which have enabled a large proportion of smaller-bodied pelagic fish species (e.g. Sardine and Sprat) to increase in abundance[4]. Through the 1980s and 90s fishing pressure led to declines in a number of larger-bodied species such as Cod[5] (page 59). Over the last 10 years, however, improved fisheries management has allowed some commercially fished species to increase from very low baselines.

The abundance indicators below use data from two trawl surveys[6,7] for a small proportion of the hundreds of demersal fish species that live on or near the sea floor (e.g. Cod, Haddock, Saithe). Very little is known about the vast majority of unmonitored and unregulated fish populations. The Celtic Seas (based on 11 species) and the Greater North Sea (based on nine species) indicators both show increases in average abundance as follows:

Celtic Seas

- Demersal species indicator shows a statistically significant increase of 133% over the long term (1985–2016) and a non-significant increase of 22% over the last 10 years.
- Over the long term 27% of species showed strong or moderate decreases and 64% showed strong or moderate increases; 9% showed little change.

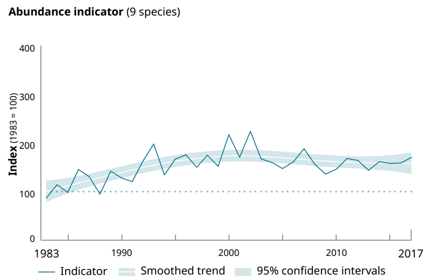
Change in average species' abundance – Celtic Seas demersal fish



Greater North Sea

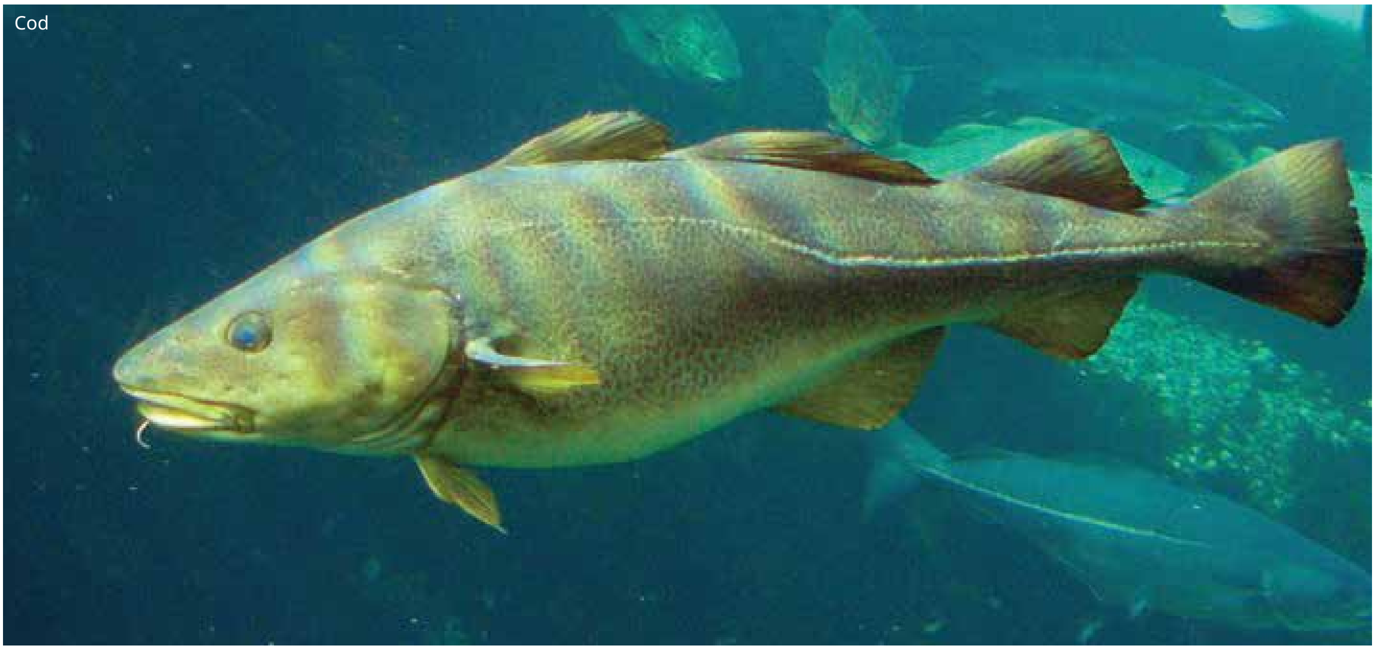
- Demersal species indicator shows a statistically significant increase of 58% over the long term (1983–2017) and non-significant trend of -5% over the last 10 years.
- Over the long term 11% of species showed strong or moderate decreases and 78% showed strong or moderate increases; 11% showed little change.

Change in average species' abundance – Greater North Sea demersal fish



Data for pelagic fish species that live in the water column (e.g. Herring, Blue Whiting and Mackerel) indicate increases in average abundance in both the Celtic and the Greater North Seas over the same period. Groundfish surveys are less reliable for schooling pelagic species and therefore the direction of trend is more appropriate to report than the average magnitude of change.

Photo: Hans-Petter Fjeld


Cod

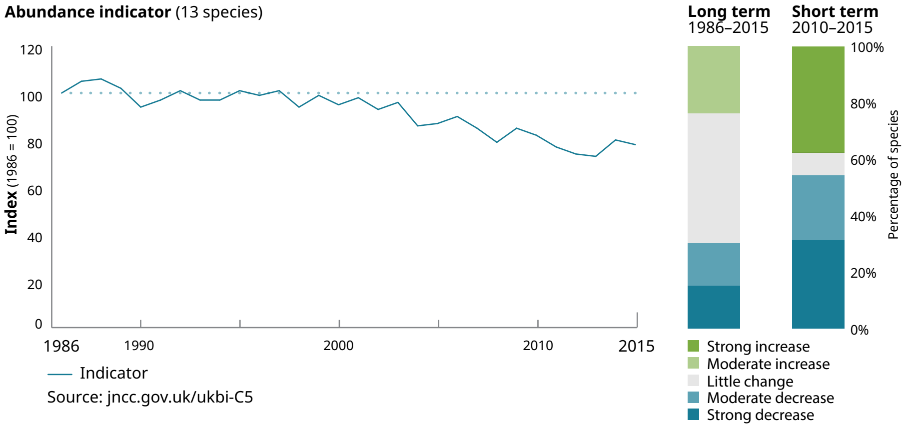
BREEDING SEABIRDS

The last comprehensive census was in 1998–2002 and reported over 8 million seabirds breeding in Great Britain and Ireland annually[8]. The latest census, Seabirds Count, is underway, and will conduct a full survey of nearly 12,000 known breeding colonies. It will provide a comprehensive update on the status of all 25 seabird species breeding in the UK. In order to dedicate time to the census, updates of the annual Seabird Monitoring Programme report have been put on hold for two years, but the most recent update of the Seabird Indicator is presented here.

Since 1986, the Breeding Seabird Indicator for 13 species declined by 22% and by 6% between 2009 to 2014.

Between 1986 and 2015, 31% of species showed strong or moderate decreases in abundance and 23% showed moderate increases; 46% showed little change. Over the short term, between 2009 and 2014, 54% of species showed strong or moderate decreases and 38% showed strong increases; 8% showed little change.

UK Biodiversity Indicator: Breeding seabirds in the UK



Source: jncc.gov.uk/ukbi-C5

Regional differences are apparent for seabird populations, particularly those linked to the impact of climate change and fisheries, and declines appear stronger in the Greater North Sea than the Celtic Seas and the English Channel[9,10,11,12].

MARINE MAMMALS

Marine mammals, particularly cetaceans, are challenging to monitor, but our knowledge of their abundance and distribution is growing. Since 1994, there have been three large-scale surveys to estimate cetacean abundance in European waters, the most recent in 2016 yielding abundance estimates for nine cetacean species that regularly occur in UK waters. There is, however, only sufficient data to calculate trends for three species in the North Sea (Harbour Porpoise, White-beaked Dolphin and Minke Whale). While the areas surveyed are not wholly consistent between surveys and confidence in trends is low, numbers of all three species appear to have remained stable[13,14]. For the other six species for which trends are not available, abundance estimates were similar to or larger than previous estimates for comparable areas.

Seals are easier to survey as they haul out on land to moult (Harbour Seal) or breed (Grey Seal) and consistent monitoring has been carried out regularly for both species around UK coasts since at least the 1990s and 1980s respectively[15]. Trends have been assessed between 1994 and 2014 for the UK Marine Strategy update[16], which reports annual increases in Grey Seal numbers, but trends for Harbour Seals vary. Since 1994, Harbour Seal abundance has decreased in colonies on the north and east coasts of Scotland but increased on the east coast of England and in west Scotland (an area which holds over 20% of UK Harbour Seals). Elsewhere in the Celtic Seas there is insufficient data to assess status.

The wide-ranging nature of these marine mammals means that influences outside of the survey area may affect abundance and distribution. Marked distributional changes have been recorded in Harbour Porpoise; previously found primarily in the northern parts of the North Sea, the centre of their range has shifted southward[14,16].

Photo: Ben Andrew (rspb-images.com)

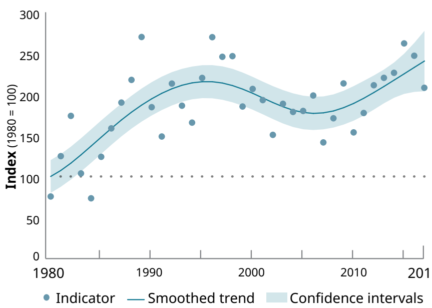
PLANKTON – THE BASE OF THE FOOD WEB

The base of the marine food web is formed by widely varied groups of organisms, including phytoplankton (photosynthetic plant-like microscopic organisms) and zooplankton (animal plankton including copepods and larvae of some commercially important species of crabs and lobsters), which are sensitive to changes in nutrients, salinity and temperatures.

Plankton communities respond rapidly to environmental changes, making them a good indicator of change in marine ecosystems although attributing observed change to specific drivers can be difficult. Plankton communities are undergoing directional change and trends in plankton lifeforms (organisms with the same functional traits, meaning that they occupy a similar niche or feed in a similar way) imply change in plankton community functioning[17].

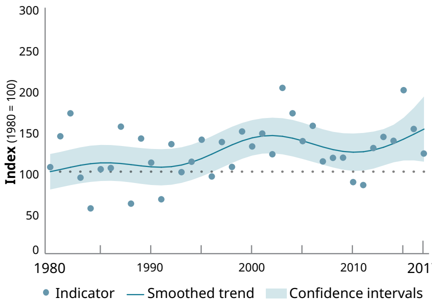
Changes in phytoplankton and zooplankton abundance vary by sea area and by group. Data are available to calculate an indicator of phytoplankton biomass, using a proxy measurement of ocean colour from the Phytoplankton Colour Index (PCI)[18] and relative abundance indicators for phytoplankton (total diatoms and dinoflagellates) and for zooplankton (small and large copepods) since 1958. Graphs on this page show examples of this variability, with contrasting patterns between the northern North Sea and the English Channel.

Phytoplankton Colour Index, Northern North Sea



Over the most recent decade the PCI for the northern North Sea is 67% higher than in the 1960s, and over the last five years is 29% higher than the mid to late 2000s.

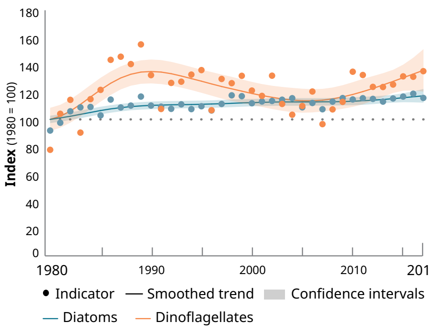
Phytoplankton Colour Index, English Channel



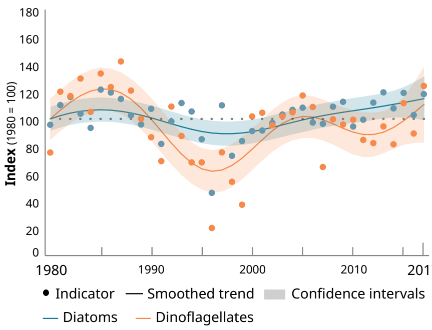
Similarly, in the English Channel the PCI is 95% higher in the last decade and 18% higher in the last five years.

Changes in diatoms and dinoflagellates are associated with changes to trophic pathways and differing roles in the carbon cycle[19]. Increases in the English Channel contrast with periods of decrease and overall stability in the northern North Sea.

Abundance indicator for diatoms and dinoflagellates in the northern North Sea

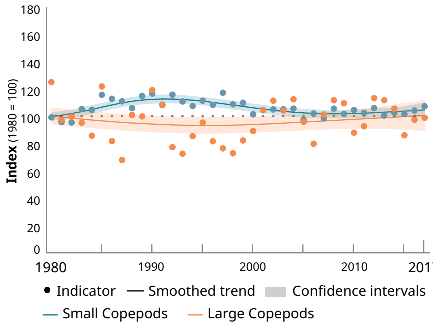


Abundance indicator diatoms and total dinoflagellates in the English Channel

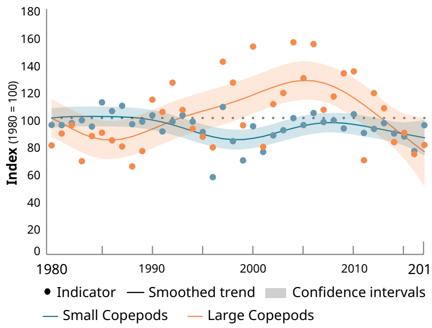


Small copepods are key prey for larval fish and tend to dominate the zooplankton in the southern and central North Sea and so are key trophic links in these areas. Declines in small copepods in the North Sea have been linked to changes in primary productivity[20].

Abundance indicator for small and large copepods in the northern North Sea



Abundance indicator for small and large copepods in the English Channel



Over many decades, the abundance of planktonic larvae – for example, of fish and crustaceans – has increased in most areas associated with increasing temperatures. Although the total abundance of large copepods is more variable, the composition has changed to an increasing dominance of more temperate species as a result of climatic change, highlighting the need to retain taxonomic resolution in monitoring programmes to effectively identify the drivers of change.

RELATED DRIVER OF CHANGE

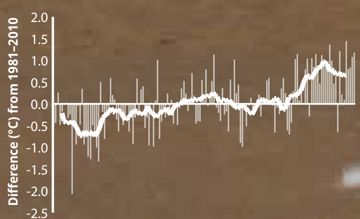
p54 Marine – Climate change

CLIMATE CHANGE AND OCEAN ACIDIFICATION

Our seas are shaped by complex and interacting climatic factors as a result of human activity and the large oceanographic climatic systems which occur in the marine environment over decadal cycles. Our understanding of specific mechanisms continues to improve and there is clear evidence that climate change is causing rising temperatures which are affecting currents, mixing and salinity as well as increased acidification of the seas. Marine ecosystems are consequently impacted through direct and indirect effects on the distribution and abundance of species groups, including plankton, fish, seabirds and marine mammals, as well as on entire habitats – from the intertidal zone to the deepest parts of the seas.

PRESSURE

Eight of the 10 warmest years for UK sea surface temperature have occurred since 2002.



STATE

Ocean processes have been affected and large-scale shifts in distribution revealed throughout the marine food web.

RESPONSE

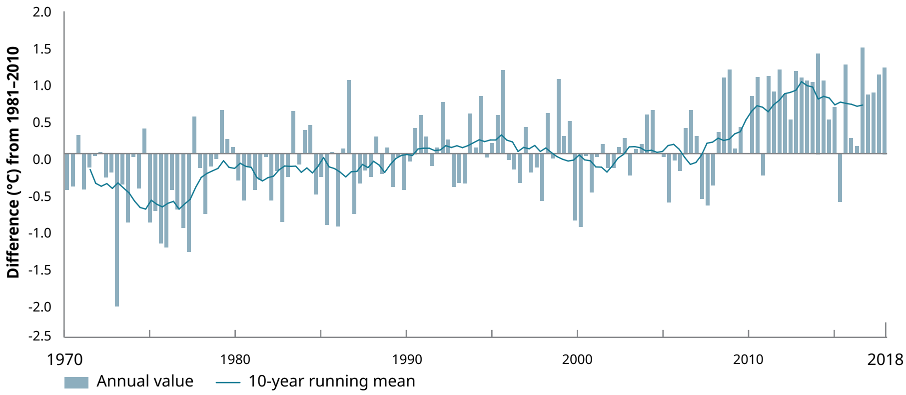
Building resilience in marine systems will help mitigate the effects of climate change on vulnerable species.

Photo: Ernie Janes (rspb-images.com)

The impacts of climate change outlined earlier in this report focused on terrestrial species and habitats. All elements of the marine ecosystem are highly interconnected and climate change causes knock-on effects from primary producers through the food web to predators and even habitats.

ENVIRONMENTAL CHANGES

Time series of average annual sea surface temperatures in °C for UK coastal waters, expressed as anomalies relative to the 1981 to 2010 average[2]



Understanding how the temperature, salinity and pH of our seas are changing is critical, as they all play an important role in marine ecosystem functioning.

- Long-term records show a warming trend in UK waters, despite short-term natural variability. On average, coastal sea surface temperatures have been 0.6°C warmer in the most recent decade compared to the 1961–1990 average[1].

The blue bars show the annual anomalies relative to the 1981–2010 average, shown as the grey horizontal line, and the blue line shows the 10-year running mean.

- The salinity of surface waters to the north and west of the UK has increased since the 1970s. Conversely, salinity in deep waters in the same region decreased between 1960 and 2000, remaining stable in more recent years[3].
- Acidification, caused by the uptake of CO_2, has reduced the pH of waters around Europe, apparently more rapidly so in UK waters than in the North Atlantic as a whole. This has the potential to adversely affect organisms that require calcium carbonate. Acidification is also of particular concern as it could further reduce the rate at which CO_2 is absorbed from the atmosphere, thus aggravating climate change[4].
- On average, the sea level has risen by 16cm since the start of the 20th century, putting increasing pressure on intertidal habitats and increasing the risk of severe flooding and coastal erosion[5].
- Seasonal stratification, which restricts the extent of mixing between shallow, warmer waters and deeper, cooler waters, is occurring earlier on average and lasting longer[6]. Stratification influences plankton growth rates, bloom timing and species composition and distribution, so changes to the timing and strength of mixing have impacts on the distribution and abundance of marine animals that depend on plankton for their food.

Photo: Nick Upton (rspb-images.com)

RESPONSES THROUGH THE FOOD WEB

PHYTOPLANKTON

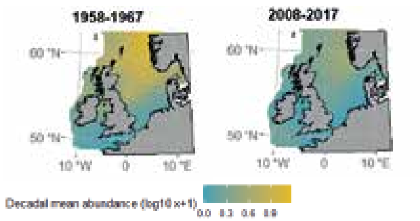
Phytoplankton are at the base of the marine food web. Phytoplankton growth and production can be affected by various factors, including nutrient availability, temperature and light levels. Phytoplankton biomass, as presented in the PCI[7] (page 53), has been used as a proxy for primary production in a number of studies[8,9]. Long-term increases in phytoplankton biomass of 21% and 13% have been reported in the coastal and open North Sea, respectively, between the 1980s and early 2000s[8]. More recently however, estimates of primary production in the North Sea indicate a declining trend as well as changes in species composition and timing of seasonal events, with knock-on effects on zooplankton abundance and fish recruitment[9].

ZOOPLANKTON

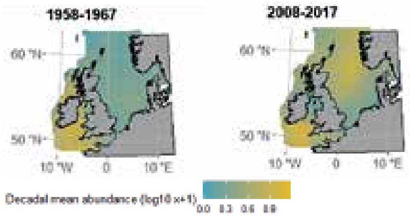
Copepods (small planktonic crustaceans) make up a large proportion of the zooplankton biomass and play a key role in converting energy from primary producers up the food web. Warming temperatures have driven northward shifts in the distribution of zooplankton in the North East Atlantic, from the 1960s to the late 1980s, bringing smaller warm-water copepod species into UK waters[10,11].

An example of this has been the northward shift in the relative proportions of two closely related copepod species, the cold-water *Calanus finmarchicus* and the warmer-water relative *C. helgolandicus* (see map on this page). The implications of these shifts are widespread, not least because of changes to community composition but also because seasonal patterns of production and overall abundance vary between these species. This has consequences for predators of plankton, including fish[12], which in turn can impact on species at higher trophic levels, such as seabirds[13,14,15].

Colder-water species, *Calanus finmarchicus*, moving polewards



Being replaced by warmer-water species, *Calanus helgolandicus*, moving northwards



FISH

Marine fish populations have been influenced by commercial fishing, and in addition, climate change has led to distributional changes[16,17] at rates up to three times faster than those detected for terrestrial species[18]. A large part of the increase in abundance of fish species described in this report has been due to improved fisheries management, allowing some commercially fished species to recover from low baselines. At the same time, 70% of the demersal species studied around the UK have responded to warming sea temperatures by changes in abundance across their distribution[19]. Specifically, this has led to increases in the populations of smaller-bodied, non-commercial species, such as Boarfish in the Celtic Seas[20,21]. For pelagic fish, there is evidence of community change from cold-water assemblages (Herring and Sprat) in the 1960s–80s to warmer-water assemblages (Mackerel, Sardine and Anchovy) from the 1990s onwards, although changes in the distribution of prey, also affected by climate change, may have played a role as well[21,22,17].

Disentangling the drivers of change in the marine environment is complex. The impact of warming seas varies geographically and by species, and by interactions between species. The mismatch of the timing of life history events between predators and prey has the potential to impact fish species through availability of food to larval stages of fish[23]. Impacts of climate change on Cod recruitment via plankton may explain the apparent slow recovery from overfishing and underline that despite recovery in fish stocks, future fisheries management needs to consider climate effects on stock productivity.

TOP PREDATORS

Species at the top of the food web, such as large fish, seabirds and marine mammals, are susceptible to the changes in distribution and timing of seasonal events for plankton and fish species they rely on for food. Sandeels are an important trophic link in the food web, being a key prey species for these predators. There is now good evidence that declines in the abundance and nutritional quality of Sandeels has reduced the breeding success and populations of seabirds such as Kittiwake[24,25,26,27]. The cascade of mechanisms are still being investigated but include the impact of fishing on Sandeel populations as well as increasing sea surface temperature, the timing and strength of ocean stratification, and in mismatch in reproductive timings with availability of prey[28].

Photo: Clement Bardot

Boarfish

Deep-diving seabirds such as Guillemot and Puffin have also been adversely affected, with declines seen at colonies around the North Sea[27], most conspicuously in the Northern Isles[28]. Surface feeding seabirds, or species that depend on them, such as terns, Kittiwakes and Arctic Skuas, are likely to be more sensitive to changes to prey as a result of increasing sea surface temperatures. Indeed, southerly colonies in Europe have already been abandoned or show substantial declines[29].

The impact of climate change on marine mammals remains poorly understood[30]. Changes most likely to be detected will be shifts in distribution of species at the edge of their range as water warms. Species such as the Striped Dolphin may extend their range polewards into UK waters, while the more northerly distributed White-beaked Dolphin may increasingly shift out of UK waters[31].

RESPONSE FOR NATURE

Alongside overarching policies, commitments and action to minimise climate change impacts (by reducing CO_2 emissions to limit temperature rise to no more than 1.5°C) the focus has been to seek to build natural resilience in marine ecosystems through:

- Protecting and recovering sites, habitats and species.
- Creating a well-managed network of habitats to aid the movement of species affected by climate change.
- Reducing the impact of other pressures such as unsustainable fishing[32].

To achieve these things the UK Government has supported the work of the UK Marine Climate Change Impacts Partnership (MCCIP), which includes scientists, government, agencies and NGOs, to provide advice on climate change impacts and a sound evidence base on which to build climate change adaptation plans.

The MCCIP has published a series of report cards[33] on how to manage protected species or habitats known to be vulnerable to climate change impacts. Conservation of these species and habitats will support marine communities, or plants and animals, and store carbon that otherwise would be released into the atmosphere and contribute to climate change effects.

Managing vulnerable habitats

Saltmarsh: over 45,000ha of saltmarsh around the UK coast delivers the natural benefits of carbon sequestration and coastal protection, and supports a wide variety of species. However, saltmarsh is threatened by sea-level rise. Site-based adaptive management plans include interventions such as managed realignment to enhance resilience[34].

Maerl beds: calcareous red seaweeds that form maerl beds, providing homes for diverse communities of plants and animals. They are vulnerable to changes in pH, affecting skeleton formation, and changes in temperature affecting growth and reproduction. Reducing harm from bottom trawling and reducing impacts from freshwater run-off will improve their resilience[35].

Horse mussel beds: large, long-lived and slow-growing bivalve mussels can build up over time to create structurally complex reefs sustaining communities of barnacles, scallops and crabs. As they are very slow to recover after disturbance, reducing or removing human pressures is the most effective method of increasing resilience[36].

Photo: Kevin Sawford (rspb-images.com)

Kittiwake

FISHERIES

Fish populations are complex and precious resources: they are of immense value to the fishing industry and provide food and employment for many people, but they are also an integral part of the marine food web and are vital for the survival of many other species, including seabirds, seals and cetaceans.

As well as directly affecting fish populations, fishing activities have wider impacts on marine species and habitats, including physical damage to the seabed caused by bottom contacting fishing gear and bycatch of seabirds and marine mammals. Bycatch also includes non-target fish species, which in turn introduces the issue of discarding unwanted catch at sea.

In recognition of this, restrictions on fishing practices, effort and equipment use are set, ideally based on scientific evidence, to reduce the environmental damage caused by fishing. Good monitoring information must be available to ensure that decision-making is underpinned by a sound evidence base and takes due account of the trends and status of the marine ecosystem as a whole. Ecosystem-based fisheries management is therefore fundamental to securing the urgent and necessary recovery of marine nature.

PRESSURE

Fishing activity – 33% of quota managed fish stocks are harvested unsustainably.

STATE

Demersal fish communities are recovering from overexploitation in the past, but Good Environmental Status (GES) has not yet been achieved in either the Greater North Sea or the Celtic Seas.

RESPONSE

The UK has a commitment to meet GES for fish and other marine wildlife and habitats by 2020.

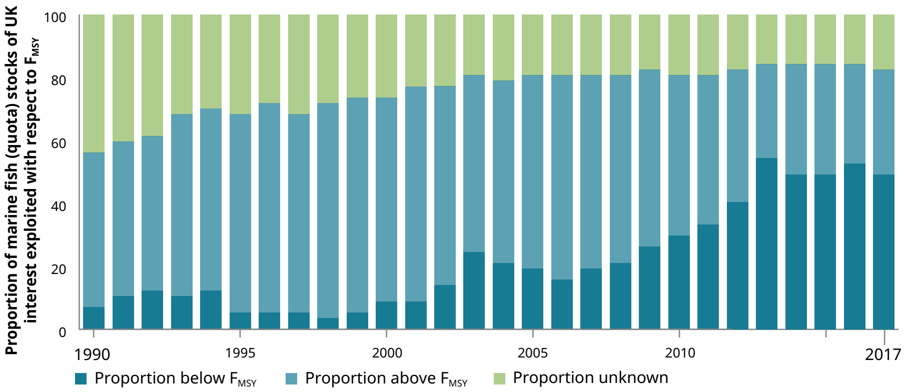
Photo: Chris Gomersall (rspb-images.com)

Marine fish and shellfish are harvested around the UK, representing the most widespread direct human pressure in UK waters[1]. Fish stocks of commercial interest span international boundaries; currently nine nations operate fisheries in the Greater North Sea[2] and 14 in the Celtic Seas[3]. When fish communities are heavily fished, the larger, more profitable fish are removed and the size-mix of the fish stocks is changed. Smaller, less commercially valuable, less reproductive individuals become more dominant, affecting the structure and stability of the ecosystem[4]. Our abundance indicators for marine fish species, both pelagic and demersal, show signs of recovery from a history of overexploitation.

SUSTAINABLE FISHERIES

The UK also has a legal commitment to fish sustainably by 2020 and the assessment of this relies on a measure of the maximum average long-term catch that can be taken from a population without reducing the ability of that population to reproduce itself, termed the Maximum Sustainable Yield (MSY). The official UK Government indicator shows that the percentage of fish stocks fished at or below levels considered to be capable of producing MSY has increased from 7% in 1990 to 49% in 2017, down from a maximum of 54% in 2013, and 33% of quota managed fish stocks are still harvested unsustainably. The UK administration's latest assessment of progress towards Good Environmental Status (GES) under the Marine Strategy Regulations[5] confirmed GES will not be met by 2020 for fish, commercial fish and shellfish, and benthic habitats.

UK Biodiversity Indicator: Proportion of marine fish (quota) stocks of UK interest harvested sustainably



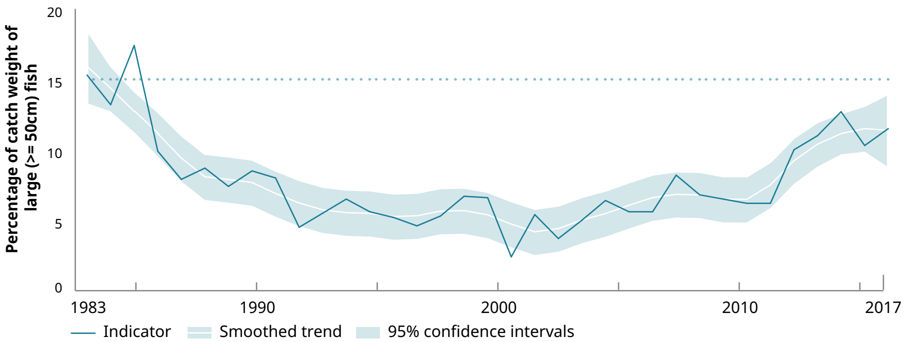
Source: jncc.gov.uk/ukbi-B2

SIZE COMPOSITION OF FISH COMMUNITIES

Indicators of the size composition of fish communities reflect long-term impacts of fishing pressure. One such indicator, the Typical Length Indicator[6], reveals deterioration of the size structure of the fish communities in the North Sea and Celtic Seas between the 1980s and 2000s, such that these communities are now dominated by small-bodied fish. Since 2010 this indicator varies spatially but demersal fish and elasmobranch (shark and ray) communities have shown signs of recovery and the pelagic fish community shows fluctuating trends. The indicator remains low compared to the observed size structure in the early 1980s, and is at record low levels for pelagic and demersal fish in the south-eastern North Sea.

Further evidence for recovery, specifically in the North Sea, is shown by the Large Fish Index. The average percentage of large fish in a catch declined through the 1980s and 90s, to a low of 2% in 2001, but increased subsequently to 12% in 2017. Increases in the indicator could be driven by an increase in a few large commercial fish species[7] and in future is likely to be affected by climate-related changes in species' distributions[8].

UK Biodiversity Indicator: Proportion of large fish (equal to or larger than 50cm), by weight, in the North Sea, 1983 to 2017



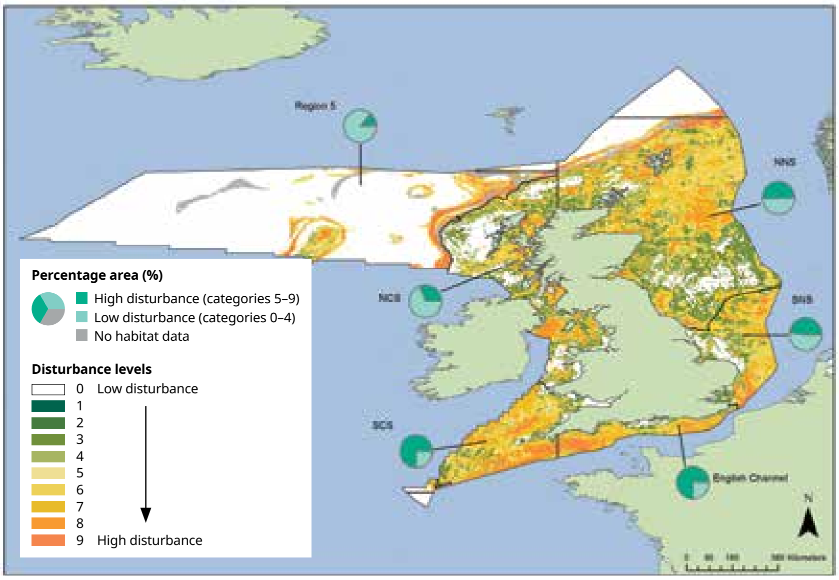
Source: jncc.gov.uk/ukbi-D1a

EXTENT OF PHYSICAL DAMAGE

The most widespread impacts on seafloor habitats occur as a result of frequent use of bottom contacting gear. Physical disturbance can affect seafloor habitats adversely, with shifts in benthic community composition being reported[9]. These shifts are driven by the replacement of larger, long-lived, slow-reproducing species with small, fast-growing species.

In the absence of long-term monitoring datasets to assess the status of marine seafloor species directly, a modelled approach combining habitat sensitivity with impacts from fishing vessels over 12m in length using bottom contacting gear has been used to produce a disturbance map (see opposite)[10]. In this way habitats may be classified as highly disturbed (categories 5–9), either because they are heavily fished or are highly sensitive.

The assessment does not take into account trawling activity prior to 2010 nor the current activity of smaller vessels, so disturbance may be underestimated in some areas. Pressure is modelled evenly across each grid cell so smaller-scale spatial variation in fishing activity may not be represented accurately, which could have an effect on the estimate of overall disturbance.



GSHHG world shore line – Available under GNU Lesser General Public License at www.ngdc.noaa.gov/mgg/shorelines/gshhs.html.

Between 2010 and 2015, the most recent assessment indicates that pressure and disturbance caused by fishing activities are widespread within UK waters, occurring to some degree in 57% of the cells. High-disturbance categories (5–9) accounted for 31% to 75% of the area of assessed UK sub-regional seas, the most disturbed regions being the southern Celtic Seas and the English Channel.

Photo: Laurie Campbell (rspb-images.com)

BYCATCH AND ENTANGLEMENT

Bycatch (the catching of non-target species) can be a serious issue for some species. The most common interactions between cetaceans and fishing gear in the UK involve small cetaceans like Harbour Porpoise and Common Dolphin. It is estimated that 1,500 small cetaceans and 400–600 seals are caught as bycatch each year[11,12,13], as well as an increasing number of cases of Humpback and Minke Whale entanglement off Scotland from ropes to the surface from pots on the seabed[14,15,16].

Annual bycatch mortality for Harbour Porpoise[17], Grey Seal[18] and Common Dolphin[13] in the Celtic Seas and for Humpback Whales around Scotland[15] is assessed to be above precautionary thresholds in relation to population size, suggesting "considerable conservation concern"[19]. Despite this, Grey Seal populations in the Celtic Seas are increasing, thus suggesting wider population mixing between Scottish populations than previously thought[18]. Additional information on bycatch mortality of cetaceans comes from strandings: around 800 cetaceans strand around the UK coast every year, and between 1990 and 2017, 17% of Harbour Porpoise, 43% of Common Dolphin and 36% of Minke Whale strandings were determined as being the result of bycatch[16].

Seabird bycatch hotspots have been identified in areas around the UK where coastal gill nets and other static fishing gear are used, and also in demersal longline fisheries off the west coast of Scotland[11,12]. A risk assessment identified that the seabirds most sensitive to bycatch include species of conservation concern, such as Puffins and Shags[19].

RESPONSE FOR NATURE

REDUCING BYCATCH

The UK has international commitments to reduce cetacean bycatch to as close to zero as possible[20] and yet bycatch of several species remain at levels of considerable conservation concern. Current activities include coordinated stakeholder-led approaches to identify practical, affordable, and effective mitigation and monitoring methods are being developed. These include acoustic and light deterrents, modifications to equipment to improve selectivity and timed closures based on real-time monitoring data[16,21].

Currently between 0.5% and 5% of UK fishing activity is monitored at sea, which varies by activities[16]. Observer programmes are the main source of monitoring data, but other data sources, including cameras, acoustic and satellite options, could be used more effectively to improve monitoring.

Where gill net vessels are equipped with acoustic deterrents known as "pingers", bycatch rates of Harbour Porpoise in UK waters have been much lower, with no clear evidence of habituation, reducing porpoise bycatch by around 15%, to 1,468 individuals in 2014[21].

These problems have been known for over 20 years, and conservation strategies are being developed for cetaceans in each of the UK countries and in 2018 Defra, with the support of the Devolved Administrations, commissioned Joint Nature Conservation Committee (JNCC) to develop a UK Plan of Action (PoA) on Seabird Bycatch, in order to "deliver a coherent approach to understand and where necessary reduce seabird bycatch in UK fisheries". The UK PoA, which is still a work in progress, is in accordance with UK and EU regulations[22,23]. Some best practice already exists, e.g. in the Filey Bay (Yorkshire) inshore gill-net fishery for Sea Trout and Salmon, a combination of a new by-law, regular monitoring, and especially gear modification by introducing higher visibility netting (an innovation of one of the fishermen), has drastically reduced the bycatch of auks but other areas of concern have been identified[24].

DISCARD BAN

A fundamental change in fisheries management has been to tackle the practice of discarding unwanted fish at sea, in some regions accounting for up to 80% of a catch. Not only was this seen as an unacceptable waste of protein with potential economic impacts, but it had significant unintended and negative impacts on some fish stocks as well as distorting marine food webs[25] (which may have included supporting increases in some discard-scavenging seabirds such as Northern Fulmar). The practice was widely condemned and measures under the Common Fisheries Policy introduced a discard ban for commercially harvested stocks which was phased in between 2015 and 2019[26].

However, serious concerns exist that the ban is not being implemented and enforced properly[27,28] and that this could result in overfishing, given levels of unaccounted mortality[29]. Evidence of the continued practice of discarding despite the ban was provided by the DiscardLess project in 2018, stating that "...according to the 2017 data reported to ICES (International Council for the Exploration of the Sea), discards have remained high and landings of undersized fish ... have remained negligible, even for the fish stocks already fully covered by the landing obligation that year"[30].

Best practice avoidance measures to reduce the number of unwanted fish caught, alongside comprehensive remote electronic monitoring with cameras, are vital to avoid overfishing. This will ensure the ban is implemented and will also improve our understanding of the scale of the problem and provide accurate information on the health of fish stocks in order to inform sustainable management and protection of vulnerable species[31].

SUSTAINABLE FISHERIES

While there have been improvements in the sustainability of fisheries over the last decade with North East Atlantic trends for fishing pressure declining and biomass increasing, these positive trends have been challenged in recent years due to a number of factors, including the advent of the discard ban being phased in during 2015–19. Urgent action was advised in the early 2000s to avoid the collapse of the Cod and associated fisheries and harm to the marine environment[32], and while improvements have been made we are once again dealing with the near collapse of Cod stocks in the North Sea[33]. It is clear more needs to be done to ensure all UK fish stocks are diverse, resilient and attain biomass levels that maintain full reproductive capacity. Healthy stocks are vital for a resilient and profitable fishery and for wider marine health.

The UK has a commitment to meet Good Environmental Status (GES) for fish and other marine wildlife and habitats and the pressures impacting upon them by 2020. The recent update of the UK Marine Strategy Part 1 concluded that GES had been achieved for four pressures (e.g. eutrophication and contaminants), was partially achieved for underwater noise and four components of biodiversity and was not achieved for three pressures and three components of biodiversity (including both fish and commercial stocks).

Sustainable fisheries management requires consideration of the broader impacts on habitats, species and trophic interactions, and while these have started to be taken into account through management measures, including through protected areas, progress is slow and often falls short of the ideal. Monitoring and data collection also remains poor, with 12% of stocks being of unknown status[34], including nearly all elasmobranch (shark and ray) stocks; understanding of catches is poor due to low levels of effective monitoring at sea.

PRESSURES ON MARINE NATURE

Fishing and climate change have the most widespread impacts on marine wildlife, but more localised effects come from a range of human activities in the marine environment and these can be categorised into two main categories: 1) pollution, including marine plastics as well as noise and contaminants, and 2) development, including aggregate extraction, port activities and renewable energy developments (e.g. windfarms). Our understanding of the impact of many of these pressures on populations is limited. The spatial distribution and intensity of these activities is important to consider in order to identify hotspots which could be linked to potential environmental pressures.

POLLUTION: MARINE PLASTIC


Harbour Seal

Photo: Mark Hamblin (rspb-images.com)

The issue of plastics in our seas has recently come to the fore and the United Nations Environment Programme has listed it as a critical problem[1]. Incidents of entanglement and ingestion of plastics by marine animals have been widely reported[2] and our understanding of the scale at which microplastics are found in the oceans is growing[3,4]. One long-running study of accumulated plastics in the stomachs of Fulmars, a widespread seabird that forages exclusively at sea, goes some way to show trends in marine litter. In the North Sea, 93% of beached Northern Fulmars investigated between 2010 and 2014 had ingested some plastic, with an average of 33 particles per bird[5]. This is an increase from fewer than 10 particles per bird in the 1970s and 80s[6,7,8]. The English Channel (68%) and East of England (69%) had the highest plastics load with Scottish Islands the lowest, but still at 58%.

POLLUTION: NOISE

Since 2015, data exist on the levels of impulsive (short, sharp) sound from seismic surveys for oil and gas exploration, explosions and pile driving, as well as some naval sonar. In parts of the northern North Sea seismic surveys may have occurred on 146 days in 2015[9]. Such impulsive noise may cause changes in the behaviour of marine mammals, for example by causing the temporary displacement of Harbour Porpoises[10].

POLLUTION: CONTAMINANTS AND EUTROPHICATION


Pintail

Photo: Oliver Smart (rspb-images.com)

Eutrophication, which is caused by excessive amounts of nitrogen and phosphorus entering the water, results in algal blooms which can impact on other organisms, deplete oxygen in the sea and reduce overall water quality. Contamination of marine waters with a range of hazardous substances has reduced in recent years and the worst point sources of pollution have been addressed, including a marked reduction in the frequency of oil spills. However, agricultural run-off into marine habitats remains an issue in some local areas and eutrophication was still observed in 7% of assessed areas – mainly in south-eastern parts of the North Sea and in some coastal waters of the Celtic Seas. Discharges of chemicals from the oil and gas industry decreased by 40% between 2009 and 2014[11].

There are concerns about accumulation of persistent organic pollutants in food webs; one particular group of chemicals, polychlorinated biphenyls (PCBs), have been reported at toxicologically significant levels in 40% of UK-stranded porpoises and shown to threaten long-term viability of Killer Whale populations. While other similar chemicals have declined following international bans, PCBs stopped declining in 1998.

93% OF BEACHED FULMARS IN THE NORTH SEA HAD INGESTED SOME PLASTIC, WITH AN AVERAGE OF 33 PARTICLES PER BIRD.

DEVELOPMENT: ENERGY

Photo: Ray Kennedy (rspb-images.com)

Oil and gas production declined from a peak in 1999 due to decreasing reserves[12]. In line with international targets to reduce climate change, there has been a substantial increase in renewable energy developments in UK waters and offshore wind now represents two-thirds of new installation energy capacity[13]. There is increasing research into the cumulative impact and long-term effects of windfarm developments, with concerns about collision risk for seabirds and displacement of seabirds and cetaceans from foraging grounds[14,15].

EUTROPHICATION WAS OBSERVED IN 7% OF ASSESSED AREAS.

RESPONSE FOR NATURE

MARINE PROTECTED AREA NETWORK

The UK has signed up to international agreements to establish an ecologically coherent network of well managed Marine Protected Areas (MPAs) to protect and enhance complex ecosystems and to ensure sustainable use so that the marine environment is safeguarded for future generations to enjoy.

Since 2016, additional sites have been designated, including five Special Areas of Conservation (SACs) for Harbour Porpoise, and management approaches have been adopted in many areas. As of May 2019, in total, the UK network consists of 355 MPAs which encompass 25% of UK waters[16].

However, management measures have been documented in 60% of MPAs but only fully implemented in 10% of sites[17]. In Scotland, 27 MPAs have specific fisheries measures in place and are being developed with the fishing industry and other stakeholders for a further 12 MPAs[18]. Other area-based measures, including voluntary reserves, restricted fisheries areas and safety exclusions zones around offshore windfarms, are considered to provide a contribution to the Scottish MPA network for vulnerable marine ecosystems and specific species, Blue Ling and Sandeels[19]. However, overall these areas would not make a sufficient contribution to making up the shortfall in the MPA network[20].

The effectiveness of MPAs in European waters is less well reported than for tropical systems, so the monitoring of sites closed to human activity, like Lyme Bay, described below, has been seen as a key element in the evidence base to direct UK and European marine conservation management.

CONSERVATION AND SUSTAINABLE FISHING

Lyme Bay has been noted as being an area of "high species richness that includes rare and threatened species"[21], with high-biodiversity reefs formed of mudstone, limestone and chalk. Key species include the Pink Sea Fan, Ross Coral and the commercially fished Great Scallop.

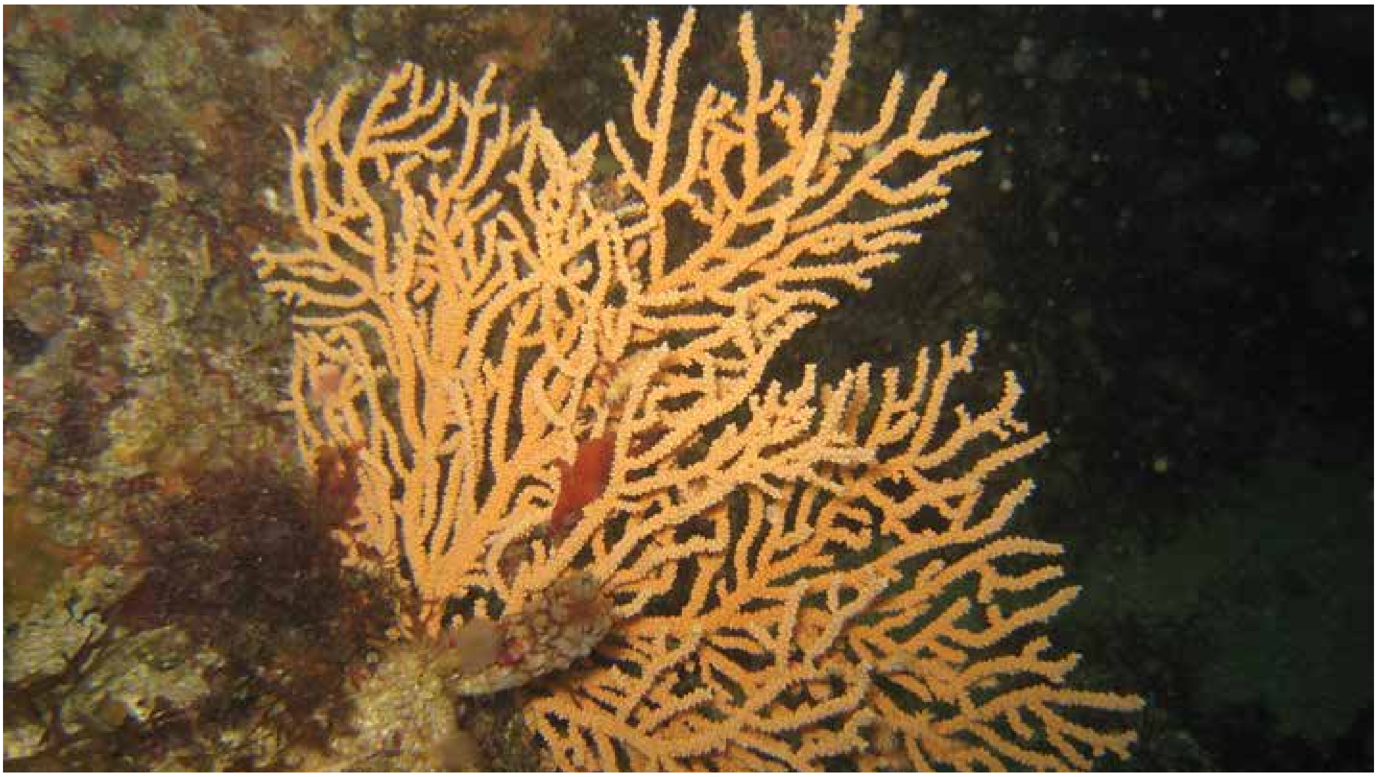
There has been concern for many years about effects of bottom-towed fishing gear on these habitats and the long-term impact on the long-lived, slow-growing reef species[21,22].

In response, voluntary management measures across c22km^2 started in the early 2000s, and Lyme Bay Reefs are now a 236km^2 MPA and SAC. Bottom contact fishing was ended on the reef in 2011 and the area is managed in a collaboration between the local fishing industry, conservationists and scientists to provide benefits for both fishing and conservation.

While the full recovery of marine communities can take many years[23,24], within three years positive responses were seen for species' richness, total abundance and community composition[25]. Recovery was also reported for three indicator species, including the habitat-forming bryozoan, Ross Coral, which plays a key role in formation of the reef and is known to provide the structurally complex habitat essential for juvenile fish[26].

The fishing community benefited from increased income from selling catches under a "Reserve Seafood" label, and increased catches of crabs and scallops, both of which are associated with the protected reef habitat. This is particularly noteworthy for scallops, landings of which have decreased over the same period elsewhere in the UK[27].

Photo: Matthieu Sontag



ENGLAND

England's landscapes have been modified by human activity for millennia. Ever since the clearance of the "wildwood", its associated habitats and eradication of megafauna, biodiversity has undergone major changes. Few, if any, English habitats can be described as truly "wild"; however, human activity has modified and created the semi-natural habitats on which much of the current fauna and flora depend.

Major changes to the landscape have happened through history; for example, the drainage of Fenland started in the 17th century. Through the 20th century the intensification of agriculture has led to loss and fragmentation of semi-natural habitats. Despite this, England still contains a range of internationally important habitats, such as its lowland heathland, ancient woodland and chalk grasslands in the south, the blanket bogs along the Pennines, the coastal estuaries and saltmarshes that provide vital foraging habitat for wintering waterbirds, and the sea cliffs and offshore islands that support internationally important numbers of breeding seabirds.

KEY FINDINGS

1%

decline in average species' abundance.

Our indicator of average species' abundance in England of 241 terrestrial and freshwater species (mainly birds) shows little change since 1970; however, butterflies show significant declines in abundance, while the indicators for birds and mammals show significant increases.

5%

decline in average species' distribution.

Our indicator of average species' distribution in England, covering 5,942 terrestrial and freshwater species over a broad range of taxonomic groups, has fallen by 5% since 1970, and is 1% lower than in 2005.

35%

of species have decreased in abundance.

More species have shown strong or moderate decreases in abundance (35%) than increases (31%) since 1970; likewise more species have decreased in distribution (31%) than increased (24%) since 1970.

46%

of species show strong changes.

England's wildlife is undergoing rapid change; the proportion of species defined as showing strong changes in abundance, either increasing or decreasing, rose from 38% over the long term to 46% over the short term.

13%

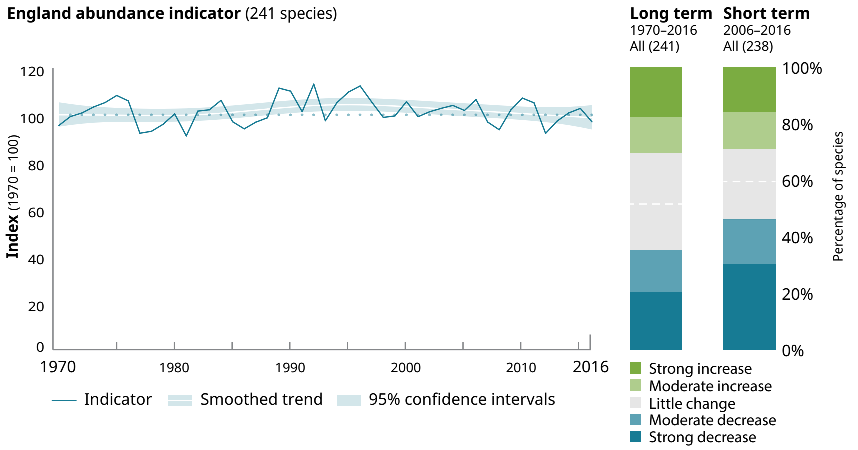
of species are threatened.

Of 7,615 species in England that have been assessed using IUCN Regional Red List criteria, 13% have been classified as threatened with extinction from Great Britain.

Photo: Andrew Mason (rspb-images.com)

COMBINED ABUNDANCE INDICATOR BASED ON ENGLAND-SPECIFIC TRENDS FOR BIRDS (171 SPECIES), BUTTERFLIES (55 SPECIES) AND MAMMALS (15 SPECIES)

It is not appropriate to compare indicator trends between countries as data from different taxonomic groups have been used.



The abundance indicator for 241 terrestrial and freshwater species, for which England-specific data are available, shows a statistically non-significant decline in average abundance of 1% (95% CI -7% to +4%) between 1970 and 2016. Over this long-term period the smoothed indicator fell by 0.03% per year. Over our short-term period, the decline was a statistically non-significant 3%, a rate of 0.29% per year. There was, however, no significant difference in the rate of change between the long and the short term.

The white line with shading shows the smoothed trend and associated 95% CI, the blue line shows the underlying unsmoothed indicator. The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in abundance.

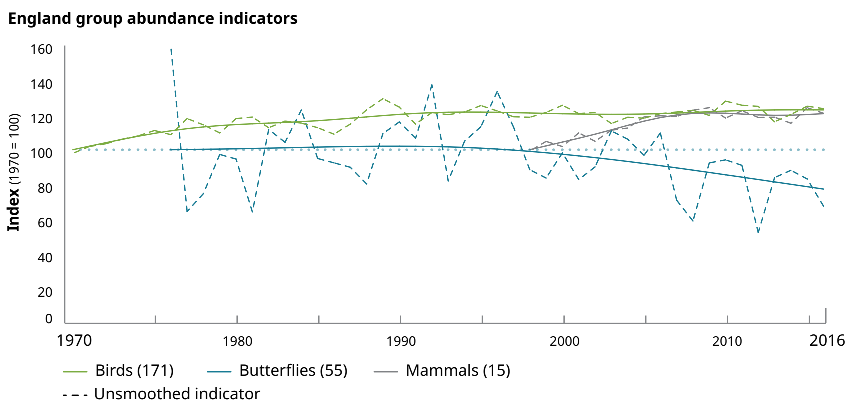
Within multispecies indicators like these there is substantial variation between individual species' trends. To examine this, we have allocated species into trend categories based on the magnitude of population change, over the long and the short-term periods.

- Over the long term, 35% of species showed strong or moderate declines and 31% showed strong or moderate increases; 34% showed little change.
- Over the short term, 46% of species showed strong or moderate declines and 29% showed strong or moderate increases; 25% showed little change.
- Over the long term, 38% of species showed a strong change in abundance (either increase or decrease). Over the short term this rose to 46% of species.

Using a different, binary categorisation of species with positive and negative trends:

- Over the long term, 51% of species showed negative trends and 49% showed positive trends; over the short term, 59% of species showed negative trends and 41% showed positive trends.

ENGLAND-SPECIFIC TRENDS IN ABUNDANCE FOR BIRDS, BUTTERFLIES AND MAMMALS



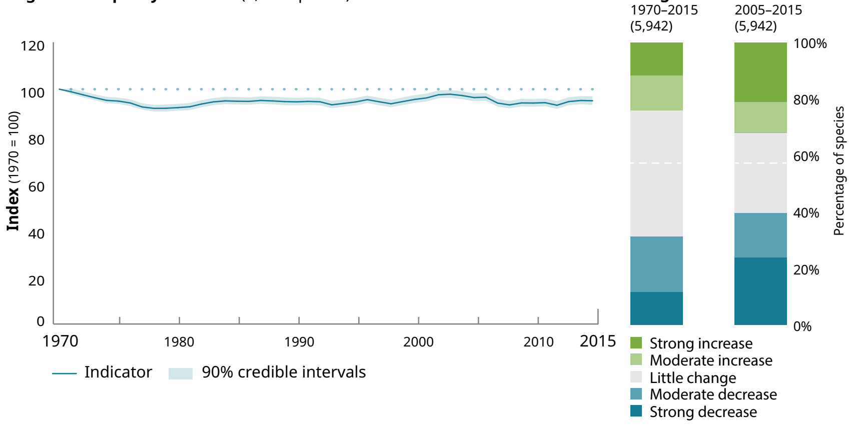
Based on smoothed trends created using England-specific data:

- The abundance indicator for 171 bird species starts in 1970 and overall shows a statistically significant increase in average abundance of 23% (CI +18% to +28%). Over the short term, the indicator was 2% higher in 2016 compared to 2006. The increase in this indicator is driven by the recovery of species from very low numbers, conservation successes and colonising species, as well as increasing numbers of wintering waterbirds.
- The abundance indicator for 55 butterfly species starts in 1976 and overall shows a statistically significant decline in average abundance of 23% (CI -39% to -6%). Over the short term, the indicator was 15% lower in 2016 compared to 2006.
- The abundance indicator for 15 mammal species starts in 1998 and overall shows a statistically significant increase in average abundance of 21% (CI +17% to +25%). Over the short term, the indicator was 2% higher in 2016 compared to 2006.

CHANGE IN SPECIES' DISTRIBUTION IN ENGLAND

The occupancy indicator for 5,942 terrestrial and freshwater species, for which England-specific trends are available, shows a decline in average distribution of 5% between 1970 and 2015. In 2015 the indicator was 1% lower than in 2005. Because species tend to decline in abundance before they disappear from a site, this change of 5% could reflect more severe underlying abundance declines that we are currently unable to quantify.

England occupancy indicator (5,942 species)



The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in distribution (measured as the proportion of occupied sites).

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

- Over the long term, 31% of species showed strong or moderate decreases and 24% showed strong or moderate increases; 45% showed little change.
- Over the short term, 39% of species showed strong or moderate decreases and 32% showed strong or moderate increases; 28% showed little change.
- Over the long term, 23% of species showed a strong change in distribution (either increase or decrease). Over the short term this rose to 45% of species.

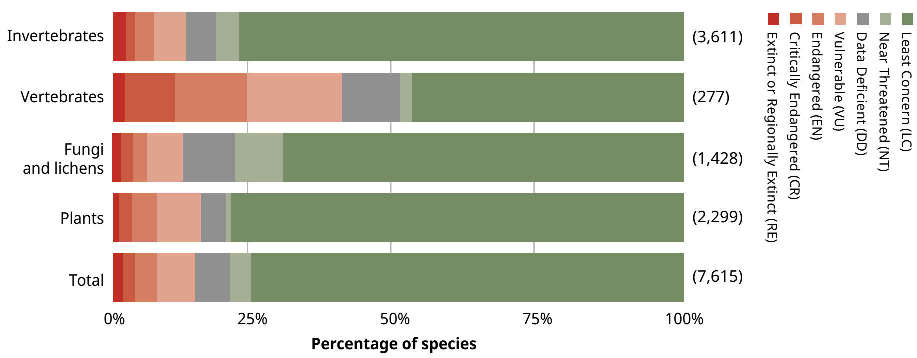
Using a different, binary categorisation:

- Over the long term, 57% of species showed negative trends and 43% showed positive trends; over the short term, 57% of species showed negative trends and 43% showed positive trends.

NATIONAL RED LIST ASSESSMENTS FOR ENGLAND

Here we break down the IUCN Red List assessments for Great Britain to show how the proportion of threatened species, based on the number assessed, varies by broad taxonomic group in England. The bars show the percentage of assessed species falling into each of the IUCN Red List categories. Species assessed as Critically Endangered, Endangered or Vulnerable are formally classified as threatened and therefore at risk of extinction.

Percentage of species threatened = (CR + EN + VU)/(total number assessed – DD – RE). The number of species assessed is shown in brackets.



Of the 7,615 species found in England that have been assessed against the IUCN Regional Red List criteria, 971 (13%) of the extant species, for which sufficient data are available, are formally classified as threatened and therefore at risk of extinction from Great Britain (the scale at which Red List assessments are made).

Of the extant terrestrial and freshwater species found in England, assessed using IUCN Regional Red List criteria, 330 plants (15%), 154 fungi and lichens (12%), 105 vertebrates (40%) and 382 invertebrates (11%) are classified as being at risk of extinction from Great Britain.

ENGLAND-SPECIFIC IUCN RED LIST ASSESSMENTS

In order to maximise comparability between taxonomic groups and countries, this report focuses on IUCN Red List assessments undertaken at a Great Britain or whole Ireland level; however, several taxonomic groups have been assessed for extinction risk just within England. These show that:

- Out of 1,859 vascular plant taxa assessed, 36 have been classed as extinct and a further 370 (21%) of extant species, for which sufficient data are available, are formally classified as threatened and therefore at risk of extinction from England.
- Out of 48 extant terrestrial mammals assessed, for which sufficient data are available, 12 (27%) are formally classified as threatened and therefore at risk of extinction from England.

PRESSURES AND RESPONSES

Nature continues to be under pressure in England. Intensive management of agricultural land, largely driven by policies and incentives since WW2, has been identified as the most significant factor driving species' population change in the UK[1]. As agricultural land constitutes 69% of England's area[2], these changes have had a major detrimental impact on its biodiversity. By 2017, the England farmland bird index had fallen 55% below its 1970 level, while farmland butterflies have declined by 10% on average since 1990[3].

Just 9% of England is wooded. This represents a 45% increase since 1945, but most of this expansion has been through the planting of non-native conifers[4]. Our woodland wildlife is under pressure. In 2016, the breeding woodland bird indicator for England was 24% lower than in 1970, while the indicator for woodland butterflies has fallen by 58% since 1990[3].

Agri-environment schemes (AES) represent the main policy mechanism for reversing widespread declines of farmland wildlife. Research has shown that a targeted approach, such as the Higher Level Stewardship scheme (active between 2005 and 2015), can benefit priority farmland birds[5] and have knock-on benefits for certain wildlife groups; however, their impacts on other species remain unclear[6,7]. In 2017, the total area of land in all higher-level or targeted AES was 1.4 million ha, which represents an increase of 20% over the last decade[3]. However, in order to offset ongoing declines in the UK Government's Farmland Bird Indicator (FBI), it has been estimated that 26–33% of FBI populations would need to be subject to AES-type management[5].

The creation of the EU's LIFE programme brought benefits to England's wildlife; for example, the major wetland habitat creation, restoration and management undertaken through two LIFE projects saw Bitterns increase from 11 booming males in 1997 to 181 in 2018. This habitat creation also benefited colonising wetland species, including invertebrates such as the Fen Wainscot and Marsh Mallow moths, as well as wildlife more generally. The Seabird Recovery LIFE Project in the Isles of Scilly has recently successfully eradicated rats from St Agnes, and both Manx Shearwater and European Storm-petrel have once again bred successfully on the island.

There are many landscape-scale initiatives active in England, funded by NGOs, government agencies or through other sources, like the National Lottery Heritage Fund. Examples include the Great Fen, a 50-year vision to link two fenland reserves in Cambridgeshire; Moors for the Future, which aims to restore and conserve upland habitats in the Peak District and South Pennines; regional forest projects; and the Wallasea Island Wild Coast Project, the UK's largest-ever coastal wetland restoration project. An ambitious collaborative project Back from the Brink was launched in 2017 and aims to save 20 of England's most threatened species from extinction and help a further 200.

Defra launched its 25-year Environment Plan in 2018[8]. This sets out the government's ambitions to help the natural world regain and retain good health in England, including the creation or restoration of 500,000ha of wildlife-rich habitat outside the protected site network.

Photo: Michael Harvey (rspb-images.com)

NORTHERN IRELAND

Northern Ireland's landscape is dominated by agricultural land, which makes up around 75% of the total area[1]. This farmed environment is criss-crossed with a range of special habitats resulting from the wet and mild climate. There are internationally significant areas of blanket bog and large inland and coastal water bodies, including Lough Neagh, the largest freshwater lake in the British Isles, which supports around 100,000 wintering waterbirds, and myriad lakes, fens and raised bogs. Northern Ireland holds species found nowhere else in the UK, including the Irish Hare, Irish Damselfly, Irish Whitebeam, Cryptic Wood White and Pollan. With 650km of coastline, the sea loughs, estuaries and marine environment are a significant component of Northern Ireland's biodiversity.

KEY FINDINGS

66%

increase in average species' abundance of breeding birds.

Our indicator of average species' abundance in Northern Ireland of 41 breeding bird species has increased by 66% since 1994.

38%

decline in average species' abundance of wintering waterbirds.

Our indicator of average species' abundance in Northern Ireland of 36 wintering waterbird species has fallen by 38% since 1988.

43%

decline in average species' abundance of butterflies.

Our indicator of average species' abundance in Northern Ireland of nine butterfly species has fallen by 43% since 2006.

11%

of species are threatened.

Of 2,450 species in Northern Ireland that have been assessed using IUCN Regional Red List criteria, 11% have been classified as threatened with extinction from Ireland as a whole.

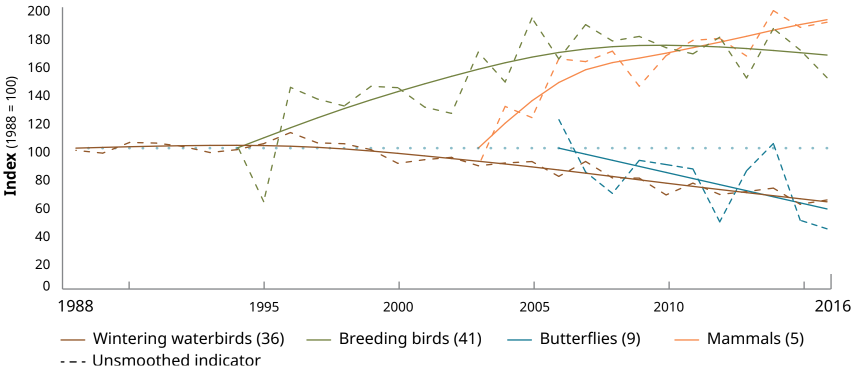
Photo: Andy Hay (rspb-images.com)

NORTHERN IRELAND-SPECIFIC TRENDS IN ABUNDANCE FOR BREEDING BIRDS, WINTERING WATERBIRDS, BUTTERFLIES AND MAMMALS

Due to poor taxonomic coverage of available data, a single combined abundance indicator was not created for Northern Ireland; however, smoothed abundance indicators were calculated for four separate species groups. These were created using Northern Ireland-specific data for all species, except for three of the four bat species which used published trends for all Ireland.

- The abundance indicator for 41 breeding bird species starts in 1994 and overall shows a statistically significant increase in average abundance of 66% (95% CI -45% to +87%). Over the short term, the indicator shows little change in average abundance, being 1% lower.
- The abundance indicator for 36 wintering waterbirds species starts in 1988 and overall shows a statistically significant decline in average abundance of 38% (CI -44% to -33%). Over the short term, the indicator was 27% lower in 2016 compared to 2006.
- The abundance indicator for nine butterfly species starts in 2006 and overall shows a statistically significant decline in average abundance of 43% (CI -67% to -20%).
- The abundance indicator for five mammal species (four bat species and Rabbit) starts in 1998 and overall shows a statistically significant increase in average abundance of 91% (CI +71% to +111%). Over the short term, the indicator was 30% higher in 2016 compared to 2006.

Northern Ireland group abundance indicators



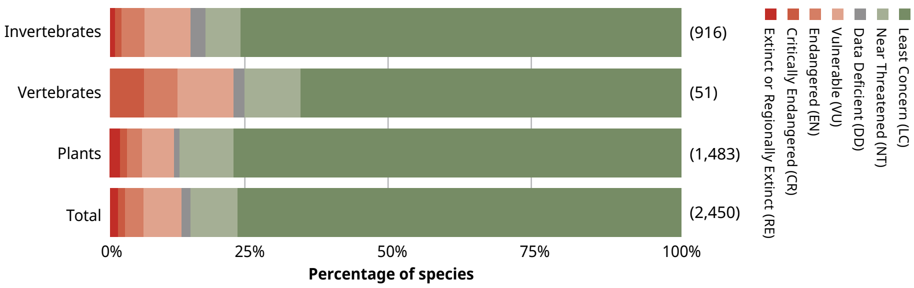
No occupancy-based indicator is currently available for Northern Ireland.

Photo: David Wootton (rspb-images.com)

NATIONAL RED LIST ASSESSMENTS FOR NORTHERN IRELAND

Here we break down the IUCN Red List assessments for the whole of Ireland to show how the proportion of threatened species, based on the number of assessed, varies by broad taxonomic group in Northern Ireland. The bars show the percentage of assessed species falling into each of the IUCN Red List categories. Species assessed as Critically Endangered, Endangered or Vulnerable are formally classified as threatened and therefore at risk of extinction.

Percentage of species threatened = (CR + EN + VU)/(total number assessed – DD – RE). The number of species assessed is shown in brackets.



Of the 2,450 species found in Northern Ireland that have been assessed using the IUCN Regional Red List criteria, 272 (11%) of the extant species, for which sufficient data are available, are formally classified as threatened and therefore at risk of extinction from Ireland as a whole (the scale at which Red List assessments are made).

Of the extant terrestrial and freshwater species found in Northern Ireland, assessed using IUCN Regional Red List criteria, 140 plants (10%), 11 vertebrates (22%) and 121 invertebrates (14%) are classified as being at risk of extinction from Ireland as a whole.

BIRDS OF CONSERVATION CONCERN IN IRELAND

There has also been an all-Ireland bird assessment, which means that Northern Ireland's birds have been assessed alongside those of the Republic of Ireland. The most recent Birds of Conservation Concern in Ireland 2014–2019[2] uses different criteria from the IUCN Red List, assessing each species that breeds or overwinters against a set of objective criteria. These criteria include historical decline, trends in population and range, population size, localisation and international importance, as well as global and European status. Species are placed on the Green, Amber or Red List, indicating an increasing level of conservation concern.

Of the 185 species assessed in an all-Ireland context, 37 (20%) were placed on the Red List, 90 (49%) on the Amber List and 58 (31%) on the Green List. The number of Red-listed species increased by 12 and Amber-listed species by five since the previous review in 2007. New additions to the last Red List include six duck species, as well as a suite of passerines that have undergone population declines and/or range contractions. Populations of breeding waders continue to decline and the long-term future for these species is uncertain.

Photo: Andy Hay (rspb-images.com)

PRESSURES AND RESPONSES

The dominance of farmland within the Northern Ireland landscape means its biodiversity is particularly vulnerable to change in agricultural management. Over recent decades there has been a large-scale move away from mixed farming to a predominantly pastoral system, leading to the loss of semi-natural habitats, overwintering stubbles and hedgerows[1,3]. More than 40% of Northern Ireland's land area now comprises improved grassland[4]. These changes have put pressure on the natural environment and its biodiversity and have led to pollution issues. Northern Ireland produces 12% of the UK's ammonia emissions, mostly from agriculture, while only representing 6% of the land area, and has the greatest percentage of nitrogen-sensitive habitats exceeding critical ammonia levels for both lower and higher plants[5]. Large areas, particularly in County Armagh and County Down, suffer from excessive levels of nitrogen pollution[6] and less than one-third of monitored river water bodies in Northern Ireland were at or above a good standard in 2015[1].

Away from agricultural land, bogs are damaged by peat cutting and heavy grazing, with the latter also affecting heathland[4]. Northern Ireland is one of the least forested regions in Europe and much of what does exist (4.3% of land area) is made up of plantations of non-native Sitka Spruce. These have often been planted in unsuitable areas, such as on blanket bog or in sensitive river catchments, and have had a detrimental impact on important biodiversity. Only 0.04% of the land area comprises ancient woodland[4,7].

Agricultural intensification, driven by UK and European policy, has been identified as the most significant factor driving the decline in species' populations across the UK[8]. Agri-environment schemes (AES) represent the main policy mechanism to turn around losses of farmland wildlife. Since 2018 there has been an increase of nearly 30,000ha in higher-level AES in the country with the launch of the new Environmental Farming Scheme. Prior to this data shows that only 5,000ha were in a higher-level AES in 2017 representing a 90% decline over the last 10 years[9]. Studies have shown mixed results on the impact of AES on biodiversity in Northern Ireland. Assessments of the Environmentally Sensitive Areas scheme identified no benefits for the botanical diversity on moorland or grassland habitats[10], but positive effects for some mammals[11]. Targeted prescriptions, through the Countryside Management Scheme, have been shown to have a positive effect for some priority farmland birds[12].

Photo: Andy Hay (rspb-images.com)


Puffin

Northern Ireland holds several important seabird colonies. Rathlin Island is the largest; however, biodiversity here is threatened by invasive non-native mammals and the island has been identified as one of the high-priority islands in the UK for eradication of vertebrate INNS[13].

Northern Ireland has no National Parks but Areas of Special Scientific Interest (ASSIs) cover 7% of its total area; this figure incorporates Lough Neagh (395km^2). Data published by the Department of Agriculture, Environment and Rural Affairs (DAERA) show recent declines in both ASSI condition and the proportion of protected terrestrial area under favourable management[14]. Within the marine environment, the total Marine Protected Area increased from 269km^2 in 2009/10 to 2,566km^2 in 2016/17. Management plans for the Northern Ireland MPA network are being developed through the EU funded Marine Protected Area Management and Monitoring (MarPAMM) project to bring these sites into favourable condition[14], as only 4.48% of MPAs in Northern Ireland are currently considered to be under favourable management[15].

Conservation management plans are being produced for the Special Areas of Conservation network funded through the Northern Ireland Rural Development Programme and DAERA's Environment Fund, and by NIEA. Two large EU-funded Interreg projects – Co-operation Across Borders for Biodiversity and Collaborative Action for the Natura Network were launched in 2017. Together these aim to produce 25 conservation action plans for designated sites, restore over 4,500ha of blanket bog and save threatened species including Curlew, Hen Harrier, Irish Damselfly, Marsh Fritillary and White-clawed Crayfish.

SCOTLAND

Scotland holds some of the most diverse landscapes in the UK. From the remote montane habitats of the UK's highest peaks and the extensive expanses of blanket bog and upland heath to the West Atlantic oakwoods, Caledonian pine forests, lochs, coasts and seas, Scotland supports a wide variety of wildlife. The landscapes hold species found nowhere else in the UK, including the Wild Cat, Capercaillie and the endemic Scottish Primrose, Northern February Red Stonefly and Scottish Crossbill[1].

The marine environment is a critical component of Scotland's natural history. The area within 12 nautical miles of the coast is greater than its total land area[1]. The deep seas around Scotland host the UK's only underwater mountains, known as seamounts. Scotland is also recognised as being of international importance for its breeding seabird colonies[2] and marine mammals[1].

KEY FINDINGS

24%
decline in the average species' abundance.

Our indicator of average species' abundance in Scotland of 352 terrestrial and freshwater species has fallen by 24% since 1994. Moths show significant declines in abundance, while the indicators for birds and butterflies have remained broadly stable over time.

14%
decline in average species' distribution.

Our indicator of average species' distribution in Scotland, covering 2,970 terrestrial and freshwater species over a broad range of taxonomic groups, has fallen by 14% since 1970, and is 2% lower than in 2005.

49%
of species have decreased in abundance.

More species have shown strong or moderate decreases in abundance (49%) than increases (28%) since 1994, likewise more species have decreased in distribution (33%) than increased (20%) since 1970.

62%
of species show strong changes.

Scotland's wildlife is undergoing rapid change; the proportion of species defined as showing strong changes in abundance, either increasing or decreasing, rose from 45% over the long term to 62% over the short term.

11%
of species are threatened.

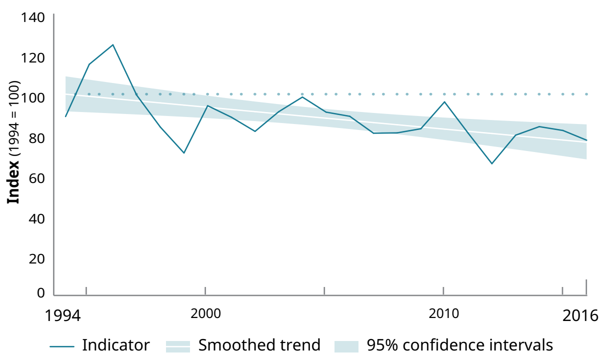
Of 6,413 species in Scotland that have been assessed using IUCN Regional Red List criteria, 11% have been classified as threatened with extinction from Great Britain.

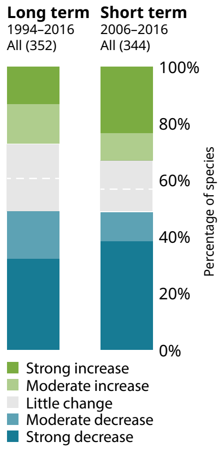
Photo: Mark Hamblin (rspb-images.com)

SCOTLAND-SPECIFIC COMBINED ABUNDANCE INDICATOR BASED ON TRENDS OF MOTHS (175 SPECIES), BIRDS (143 SPECIES), BUTTERFLIES (25 SPECIES) AND MAMMALS (9 SPECIES)

Due to poor taxonomic representation before the mid-1990s, the abundance indicator was created from 1994 onwards. It is not appropriate to compare between countries, as data from different taxonomic groups have been used.

Scotland abundance indicator (352 species)





The abundance indicator for 352 terrestrial and freshwater species, for which Scotland-specific trends are available, shows a statistically significant decline in average abundance of 24% (95% CI -33% to -15%) between 1994 and 2016. Over this long-term period the smoothed indicator fell by 1.2% per year. Over our short-term period, the decline was a statistically non-significant 12%, a rate of 1.3% per year. There was no significant difference in the rate of change between the long and the short term.

The white line with shading shows the smoothed trend and associated 95% CI, the blue line shows the underlying unsmoothed indicator. The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown little change in abundance.

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.

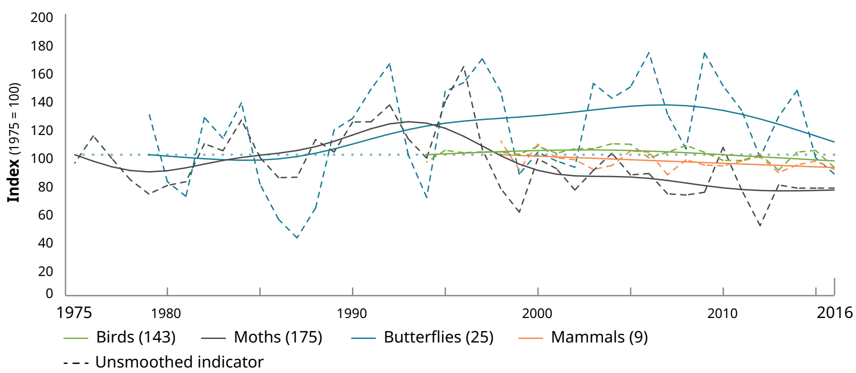
- Over the long term, 49% of species showed strong or moderate declines and 28% showed strong or moderate increases; 24% showed little change.
- Over the short term, 48% of species showed strong or moderate declines and 33% showed strong or moderate increases; 18% showed little change.
- Over the long term, 45% of species showed a strong change in abundance (either increase or decrease). Over the short term this rose to 62% of species.

Using a different, binary categorisation of species with positive and negative trends:

- Over the long term, 60% of species showed negative trends and 40% showed positive trends; over the short term, 56% of species showed negative trends and 44% showed positive trends.

SCOTLAND-SPECIFIC TRENDS IN ABUNDANCE FOR BIRDS, MOTHS, BUTTERFLIES AND MAMMALS

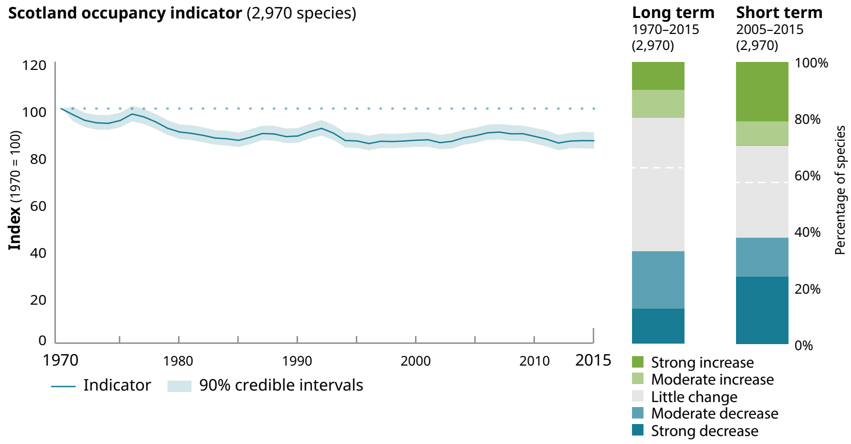
Scotland group abundance indicators



Based on smoothed trends created using Scotland-specific data:

- The abundance indicator for 175 moth species starts in 1975 and overall shows a statistically significant decline in average abundance of 25% (CI -49% to -1%). Over the short term, the indicator was 10% lower in 2016 compared to 2006.
- The abundance indicator for 143 bird species starts in 1994 and has been broadly stable with a statistically non-significant decline in average abundance of 4% (CI -9% to 0%). Over the short term, the indicator was 7% lower in 2016 compared to 2006.
- The abundance indicator for 25 butterfly species has been broadly stable since 1979, with a statistically non-significant increase in average abundance of 9% (CI -27% to +45%). Over the short term, the indicator was 19% lower in 2016 compared to 2006.
- The abundance indicator for nine mammal species starts in 1998 and overall shows a statistically significant decline in average abundance of 9% (CI -14% to -4%). Over the short term, the indicator was 5% lower in 2016 compared to 2006.

CHANGE IN SPECIES' DISTRIBUTION IN SCOTLAND



The occupancy indicator for 2,970 terrestrial and freshwater species, with Scotland-specific data, shows a decline in average distribution of 14% between 1970 and 2015. In 2015 the indicator was 2% lower than in 2005. Because species tend to decline in abundance before they disappear from a site, this change of 14% could reflect larger declines in underlying abundance that we are currently unable to quantify.

The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown no change in distribution (measured as the proportion of occupied sites), based on set thresholds of change.

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

- Over the long term, 33% of species showed strong or moderate decreases and 20% showed strong or moderate increases; 47% showed little change.
- Over the short term, 37% of species showed strong or moderate decreases and 30% showed strong or moderate increases; 33% showed little change.
- Over the long term, 23% of species showed a strong change in distribution (either increase or decrease). Over the short term this rose to 45% of species.

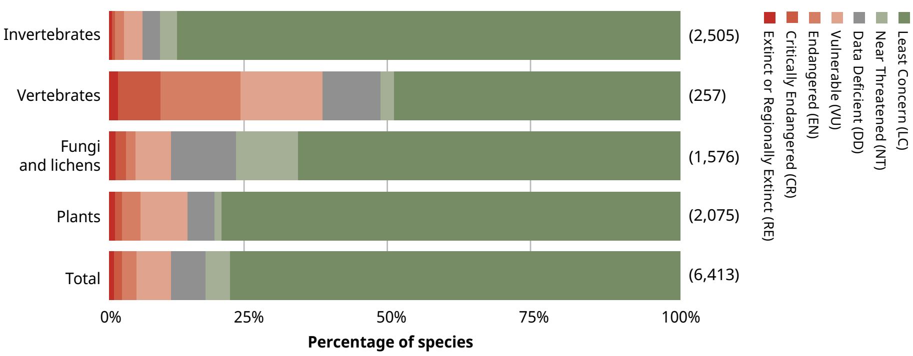
Using a different, binary categorisation:

- Over the long term, 62% of species showed negative trends and 38% showed positive trends; over the short term, 57% of species showed negative trends and 43% showed positive trends.

NATIONAL RED LIST ASSESSMENTS FOR SCOTLAND

Here we break down the IUCN Red List assessments for Great Britain to show how the proportion of threatened species, based on the number of assessed, varies by broad taxonomic group in Scotland. The bars show the percentage of assessed species falling into each of the IUCN Red List categories. Species assessed as Critically Endangered, Endangered or Vulnerable are formally classified as threatened and therefore at risk of extinction.

Percentage of species threatened = (CR + EN + VU)/(total number assessed – DD – RE). The number of species assessed is shown in brackets.



Of the 6,413 species found in Scotland that have been assessed using the IUCN Regional Red List criteria, 642 (11%) of the extant species, for which sufficient data are available, are formally classified as threatened and therefore at risk of extinction from Great Britain (the scale at which Red List assessments are made).

Of the extant terrestrial and freshwater species found in Scotland, assessed using modern IUCN Regional Red List criteria, 265 plants (13%), 153 fungi and lichens (11%), 92 vertebrates (37%) and 132 invertebrates (5%) are classified as being at risk of extinction from Great Britain.

PRESSURES AND RESPONSES

Pressure on Scotland's diverse landscapes has resulted in biodiversity losses and gains. There is evidence that some wildlife has fared better in Scotland over recent decades than in the UK as a whole. The woodland bird and farmland bird indicators increased by 69% and 14%, respectively, between 1994 and 2017; while the all-species' butterfly indicator was classed as stable between 1979 and 2017. However, the number of breeding seabirds decreased by 38% between 1986 and 2016[2], with surface-feeders particularly affected, and upland birds declined by 17% between 1994 and 2017[3].

On land, pressures come from many sources, including agriculture, upland management, land-use change, habitat fragmentation, changes in grazing levels, pollution and invasive non-native species (INNS). Climate change places additional burdens on Scotland's wildlife and sometimes exacerbates the impacts from other pressures. Northern species that directly or indirectly depend on cooler climates for survival, e.g. Mountain Ringlet, Cross Whorl Snail and Dotterel, are particularly vulnerable. Some species, including several butterflies, appear to be expanding north due to a warming climate[4].

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, fisheries, offshore renewables and other developments, are still challenging and there is evidence of change in pelagic habitats and plankton communities.

INNS continue to impact habitats and native species across Scotland and new incursions continue to occur on its islands. Stoats, not native to the Northern Isles, were found on Orkney in 2010 and rats have reinvaded Handa Island[5,6].

Agricultural land constitutes 68% of Scotland's area[7]. Agri-environment schemes (AES) represent the main policy mechanism to reverse declining farmland wildlife. In 2017, 1 million ha of Scotland were in a higher-level AES[8]. Studies have shown AES do benefit some wildlife groups, particularly when targeted to specific species such as Corncrake. These targeted management prescriptions also benefit wider biodiversity[1,9]. However, general monitoring of biodiversity responses to AES in Scotland has been poorly resourced relative to other UK countries.

The area of woodland in Scotland has more than doubled since the 1940s, and now covers 19% of the land area. Much of this increase is due to the planting of non-native conifers[1,10]. Just 6% of the highly fragmented Caledonian forest remains today and measures are in place to increase this. Cairngorms Connect is an ambitious new partnership with a 200-year vision to enhance habitats, species and ecological processes across the Cairngorms National Park. This focus on native tree species occurs elsewhere in Scotland, e.g. the Central Scotland Green Network.

Invasive species are being tackled on some islands. The Shiant Isles, home to around 10% of the UK's Puffins, were declared rat-free in 2018 following a successful eradication programme. The Orkney Native Wildlife Project was launched in 2018 to eradicate the non-native Stoats and the EU-funded Biodiversity for LIFE project recently started to protect against further non-native incursions by producing biosecurity plans and establishing rapid response hubs.

Over the last 10 years there has been a significant change in marine management, with the introduction of marine planning and progress towards completing the Scottish Marine Protected Area network[11].

Photo: Richard Revels (rspb-images.com)

Mountain Ringlet

WALES

From the mountains of Snowdonia and the Brecon Beacons, through enclosed farmland dominated by livestock production, and down the numerous wooded valleys to the estuaries and sea, Wales holds a diverse range of habitats and wildlife. The Welsh Sessile Oak woodlands, regarded as part of the "temperate rainforests" of Europe, hold rich communities of bryophytes, lichens and fungi, while the mountains host rare invertebrates, including the Snowdon Leaf Beetle, and arctic-alpine plants such as Snowdon Lily[1].

The Welsh coastline stretches for over 2,000km. The islands off Pembrokeshire, Anglesey and the Llŷn Peninsula hold seabird colonies of global significance, including the world's largest Manx Shearwater breeding colony and the UK's fourth largest gannetry[2]. Cardigan Bay supports one of the larger semi-resident populations of Bottlenose Dolphin found in the UK.

KEY FINDINGS

52%

decline in the average species' abundance of butterflies.

Our indicator of average species' abundance in Wales of 33 butterfly species has fallen by 52% since 1976; however, widespread breeding birds, wintering waterbirds and mammals (just seven species) show significant increases.

10%

decline in average species' distribution.

Our indicator of average species' distribution in Wales, covering 2,977 terrestrial and freshwater species over a broad range of taxonomic groups, has fallen by 10% since 1970, and is 6% lower than in 2005.

30%

of species have decreased in distribution.

More species have shown strong or moderate decreases in distribution (30%) in Wales than have increased (23%) since 1970.

46%

of species show strong changes.

Wales' wildlife is undergoing rapid change; the proportion of species defined as showing strong changes in distribution, either increasing or decreasing, rose from 24% over the long term to 46% over the short term.

8%

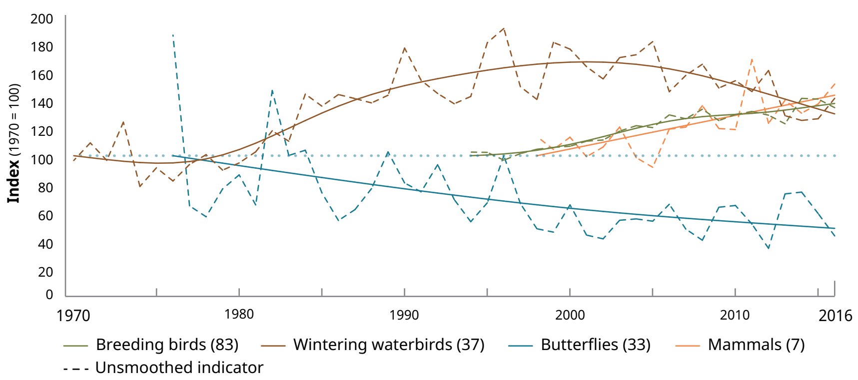
of species are threatened.

Of 6,500 species in Wales that have been assessed using IUCN Regional Red List criteria, 8% have been classified as threatened with extinction from Great Britain.

Photo: Drew Buckley (rspb-images.com)

WALES-SPECIFIC ABUNDANCE INDICATORS FOR BREEDING BIRDS, WINTERING WATERBIRDS, BUTTERFLIES AND MAMMALS

Wales group abundance indicators

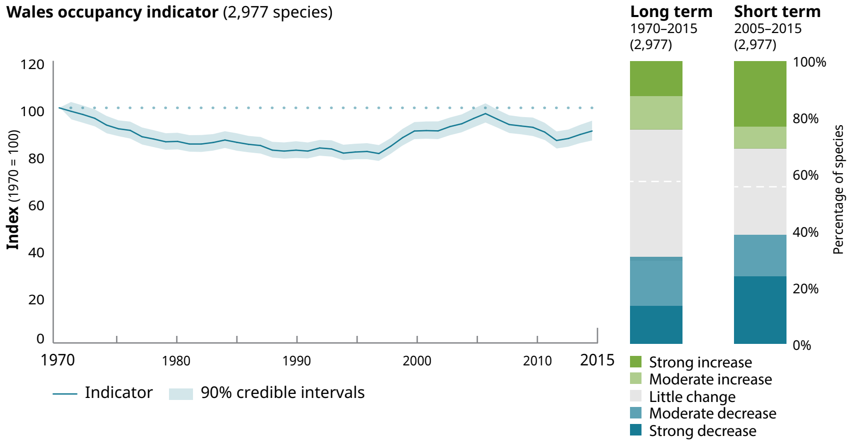


Due to poor taxonomic coverage of available data, a single combined abundance indicator was not created for Wales; however, smoothed abundance indicators were calculated, using Wales-specific data, for four separate species groups.

- The abundance indicator for 83 common and widespread breeding bird species starts in 1994 and overall shows a statistically significant increase in average abundance of 37% (95% CI +31% to +43%). Over the short term, the indicator was 10% higher in 2016 compared to 2006. The increase in this indicator is driven by the recovery of a few species from very low numbers, conservation successes and colonising species; importantly, we have insufficient data on some declining species to include them in the indicator.
- The abundance indicator for 37 wintering waterbird species starts in 1970 and overall shows a statistically significant increase in average abundance of 30% (CI +13% to +46%). Over the short term, the indicator was 20% lower in 2016 compared to 2006.
- The abundance indicator for 33 butterfly species starts in 1976 and overall shows a statistically significant decline in average abundance of 52% (CI -69% to -34%). Over the short term, the indicator was 14% lower in 2016 compared to 2006.
- The abundance indicator for seven of 40 mammal species in Wales (six bat species and Rabbit) starts in 1998 and overall shows a statistically significant increase in average abundance of 43% (CI +31% to +55%). Over the short term, the indicator was 20% higher in 2016 compared to 2006.

CHANGE IN SPECIES' DISTRIBUTION IN WALES

Wales occupancy indicator (2,977 species)



The occupancy indicator for 2,977 terrestrial and freshwater species, with Wales-specific data, shows a decline in average distribution of 10% between 1970 and 2015. In 2015 the indicator was 6% lower than in 2005. Because species tend to decline in abundance before they disappear from a site, this change of 10% could reflect more severe underlying abundance declines that we are currently unable to quantify.

The bar chart shows the percentage of species within the indicator that have increased, decreased (moderately or strongly) or shown no change in distribution (measured as the proportion of occupied sites), based on set thresholds of change.

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

- Over the long term, 30% of species showed strong or moderate decreases and 23% showed strong or moderate increases; 47% showed little change.
- Over the short term, 39% of species showed strong or moderate decreases and 30% showed strong or moderate increases; 30% showed little change.
- Over the long term, 24% of species showed a strong change in distribution (either increase or decrease). Over the short term this rose to 46% of species.

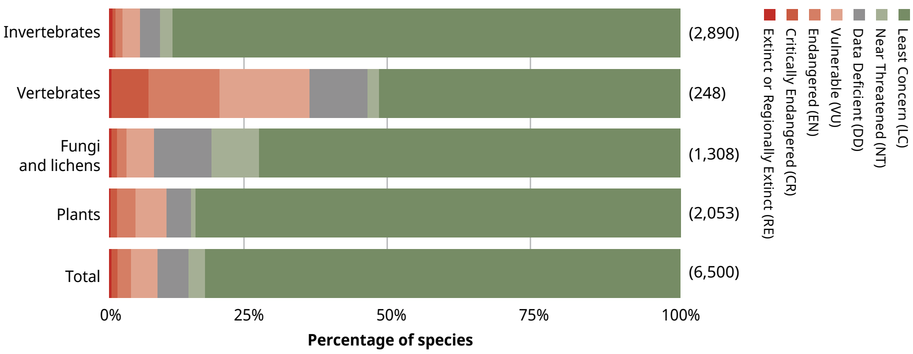
Using a different, binary categorisation of species with positive and negative trends:

- Over the long term, 59% of species showed negative trends and 41% showed positive trends; over the short term, 57% of species showed negative trends and 43% showed positive trends.

NATIONAL RED LIST ASSESSMENTS FOR WALES

Here we break down the IUCN Red List assessments for Great Britain to show how the proportion of threatened species, based on the number of assessed, varies by broad taxonomic group in Wales. The bars show the percentage of assessed species falling into each of the IUCN Red List categories. Species assessed as Critically Endangered, Endangered or Vulnerable are formally classified as threatened and therefore at risk of extinction.

Percentage of species threatened = (CR + EN + VU)/(total number assessed – DD – RE). The number of species assessed is shown in brackets.



Of the 6,500 species found in Wales that have been assessed using the IUCN Regional Red List criteria, 523 (8%) of the extant species, for which sufficient data are available, are formally classified as threatened and therefore at risk of extinction from Great Britain (the scale at which Red List assessments are made).

Of the extant terrestrial and freshwater species found in Wales, assessed using IUCN Regional Red List criteria, 202 plants (10%), 97 fungi and lichens (8%), 86 vertebrates (36%) and 138 invertebrates (5%) are classified as being at risk of extinction from Great Britain.

WALES-SPECIFIC IUCN RED LIST ASSESSMENTS

In order to maximise comparability between taxonomic groups and countries, this report focuses on IUCN Red List assessments undertaken at a Great Britain or whole Ireland level; however, several taxonomic groups have been assessed for extinction risk just within Wales. These show that:

- Out of 1,467 plants assessed, 38 have been classed as extinct and a further 256 (18%) of extant species, for which sufficient data are available, are threatened with extinction from Wales.
- Out of 1,316 lichens assessed, 22 have been classed as extinct and a further 208 (18%) of extant species, for which sufficient data are available, are formally classified as threatened and therefore at risk of extinction from Wales.
- Out of 850 bryophytes assessed, six have been classed as extinct and a further 146 (18%) of extant species, for which sufficient data are available, are formally classified as threatened and therefore at risk of extinction from Wales.
- Out of 225 rust fungi assessed, seven have been classed as extinct and a further 41 (20%) of extant species, for which sufficient data are available, are formally classified as threatened and therefore at risk of extinction from Wales.
- Out of 44 extant terrestrial mammals assessed, for which sufficient data are available, 13 (32%) are formally classified as threatened and therefore at risk of extinction from Wales.

Photo: Graham Eaton (rspb-images.com)

PRESSURES AND RESPONSES

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[3]. With 88% of the Welsh land area utilised for agriculture, nature across the uplands and lowlands has been, and remains, vulnerable to change in farming practices such as grassland and moorland management, livestock type and stocking densities, and a reduction in mixed and arable farming. More than 90% of semi-natural grassland habitats in Wales have been lost since the 1930s[4].

Agri-environment schemes (AES) represent the main policy mechanism to reverse the declines in farmland wildlife. In 2017, 3,500km^2 of Wales was in a higher-level scheme (ESA, Tir Cymen, Tir Gofal or Glastir Advanced), a 21% decline over the previous decade[5].

Evidence to date suggests that Welsh AES have only been partly successful in achieving their biodiversity goals. A recent study points towards Tir Gofal (1999–2012) having positive impacts on wider bird populations[6]. However, other research has pointed towards limited positive benefits for arable plants, grassland fungi, bats, butterflies, Water Voles and Brown Hares[7,8]. Tir Gofal was superseded by Glastir Advanced in 2012.

Again, this has had benefits, such as increases in area and condition of some priority habitat and reduced habitat fragmentation, as well as evidence of increases in generalist woodland and upland breeding birds, but areas of concern remain. These include declines in dwarf shrub heath and the abundance of priority bird species[9].

Around 11% of Wales' land (including much land under agricultural management) is within protected sites for nature, but assessments show that the majority are not in good condition or well managed for the wildlife that depends on them. The Welsh Government's Natural Resources Policy recognises the importance of well-managed protected sites, at the centre of resilient ecological networks, to delivering nature's recovery as well as providing benefits for people.

Woodland cover in Wales has quadrupled to 15% since a low point of 4% in 1918. Most of this increase has been due to the post-World War II planting of non-native conifers. Only 48% of woodlands are considered native and just 14% are classed as ancient and semi-natural. Woodland condition is negatively impacted by grazing pressures from domesticated and wild animals (which can be too little or too much), as well as invasive species, pests and diseases[4].

The EU Celtic Rainforests LIFE project started in 2018 and plans to improve the conservation status of this key woodland habitat, through the control of invasive species and the implementation of active woodland management, grazing and restoration.

Wales' extensive mountains and uplands make an important contribution to its landscape. The Cambrian Mountains have been selected as part of the European Endangered Landscapes Programme. Summit to Sea is a five-year project working with farmers and the local community to bring about ecological, farming and economic benefits in mid-Wales, from the Pumlumon massif down the Dyfi Valley and into Cardigan Bay[10].

The Welsh marine environment is under pressure and the Welsh Government has an obligation to establish a network of Marine Protected Areas (MPAs). To date, 139 MPAs have been designated, covering 69% of Wales' inshore waters[11], but more work is needed to ensure these areas are properly managed for nature. Over recent decades invasive rats have been eradicated from several Welsh islands and a new Biodiversity for LIFE project funded by the EU aims to protect seabirds from future predator incursions by producing biosecurity plans for UK islands, including five in Wales.

Bottlenose Dolphins

THE UK OVERSEAS TERRITORIES AND CROWN DEPENDENCIES

The United Kingdom's responsibilities go far beyond the immediate shores of its constituent countries. The three Crown Dependencies (CDs) lie close to home, while 14 Overseas Territories (OTs) are scattered around the globe. Together they support populations of species of global significance, some found nowhere else on earth.

KEY FINDINGS

Over 32,000

species have been recorded across the OTs, but the actual number of species present is estimated to exceed 100,000 species.

At least 1,549

species are endemic to the OTs. 30% of these are found on St Helena alone.

45

species have become globally Extinct across the OTs and CDs. Most are historic, but three species have formally been assessed as globally Extinct in the 21st century. A further 15 species are classified as Possibly Extinct.

10%

of species are threatened with global extinction.

Of the 5,898 OT and CD species that have been assessed for the global IUCN Red List, 10% are classed as threatened and therefore at risk of global extinction.

40%

of sharks, rays and skates, 36% of reptiles and amphibians, 11% of mammals, 8% of birds and 2% of bony fish found across the OTs and CDs are classified as threatened and therefore at risk of global extinction.

Photo: Alastair Wilson (rspb-images.com)

Wandering Albatross

UNIQUE, GLOBALLY IMPORTANT WILDLIFE

The OTs and CDs hold wildlife populations of global importance. From the wild sub-Antarctic islands of the South Atlantic, to the rainforests of the Caribbean and the tropical islands of the remote Pacific, they hold many unique species and wildlife concentrations found nowhere else in the world.

So far 32,216 native species have been recorded across the OTs; however, information is patchy, and the actual number is estimated to exceed 100,000 species. Many of the OTs are isolated oceanic islands, and as a result they typically hold high numbers of endemic species. At least 1,549 have been documented to date, with 30% found on St Helena alone[1]. This compares to 348 known endemic species in Great Britain[2]. The OTs in the South Atlantic and Antarctic are of global importance for their seabird colonies and contain one third of the world's albatrosses and a quarter of its penguins[1].

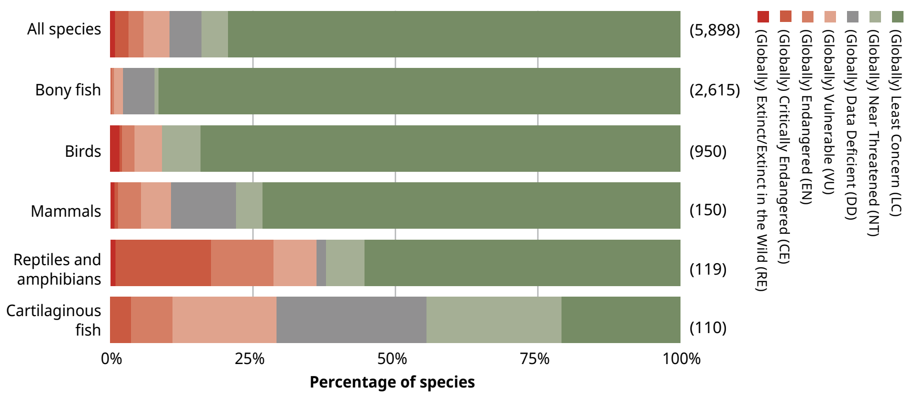
The CDs support a range of wildlife not found in the UK countries. Due to their more southerly location, the Channel Islands have a higher diversity of some wildlife groups, particularly reptiles and amphibians. As islands, the marine environment is an important element of all the CDs.

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.

GLOBALLY THREATENED SPECIES IN THE OTs AND CDs

Here we show the percentage of species found across the OTs and CDs that have been allocated to each of the IUCN Red List categories. All birds and most of the mammals, amphibians, reptiles and bony/cartilaginous fish have now been globally assessed for the IUCN's Red List. More assessments are needed to better understand the true status of other wildlife groups.

Percentage of species threatened = (CR + EN + VU)/(total number assessed – DD – RE). The number of species assessed is shown in brackets.



The IUCN's Red List of Threatened Species represents the world's most comprehensive information source on the global conservation status of species[3]. This documents the global extinction of 45 species across the OTs. Most of these are historic (since 1500 AD) but losses have continued.

Three species were formally assessed as globally Extinct in the 20th century, and three have been added so far this century. A further 15 species are currently classified as Critically Endangered (Possibly Extinct)[3].

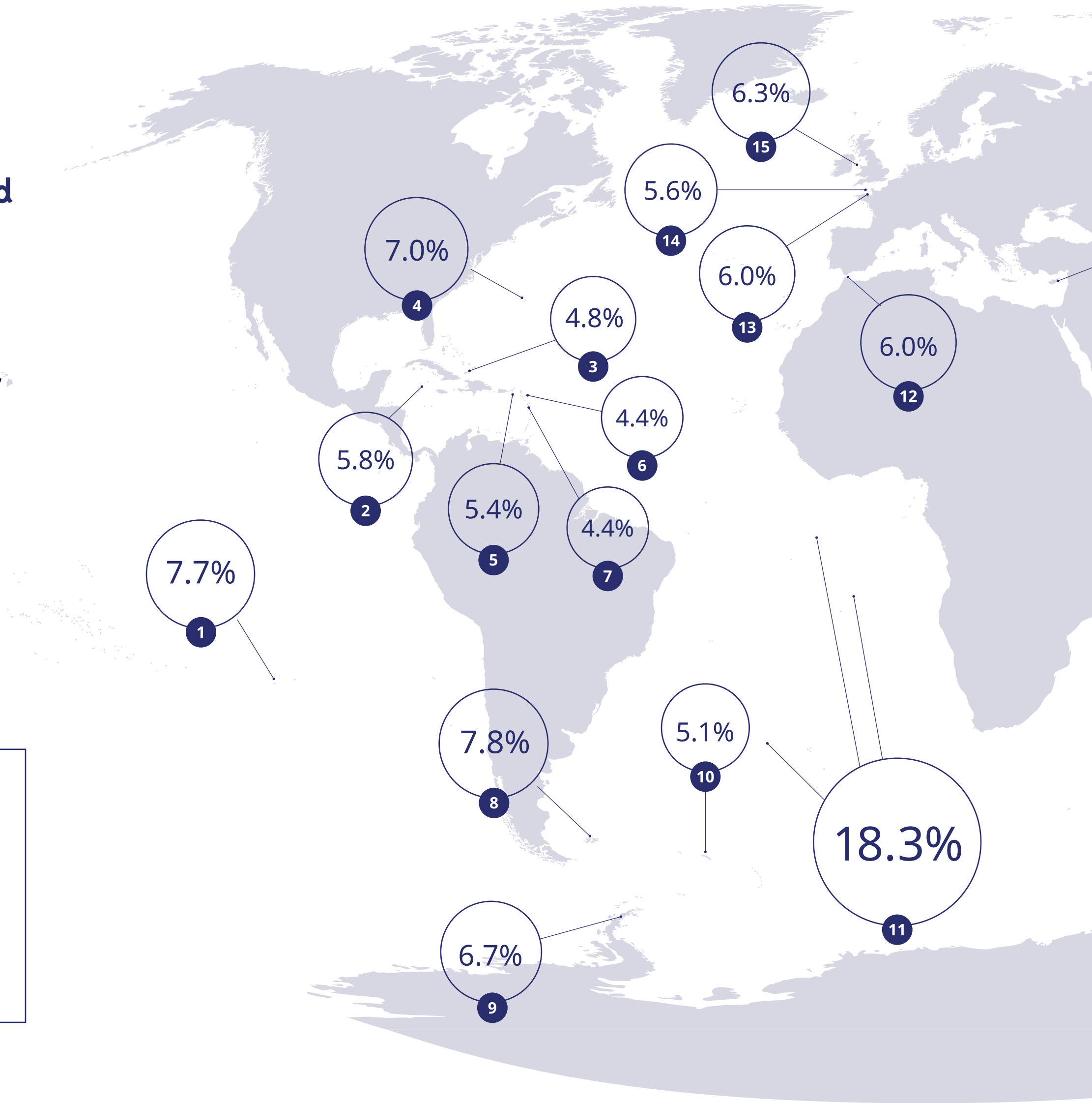
Five thousand eight hundred and ninety-eight OT and CD species have now been assessed against the IUCN global Red List criteria. Of these, 560 (10%) of extant species, for which sufficient data are available, are classified as threatened (Critically Endangered, Endangered or Vulnerable), and therefore at risk of global extinction. Of the different taxonomic groups, 40% of cartilaginous fish – sharks, rays and skates – 36% of reptiles and amphibians, 11% of mammals, 8% of birds and 2% of bony fish are assessed as being threatened with global extinction.

Photo: Alastair Wilson (rspb-images.com)

Bird Island, South Georgia

These pages show the global status of wildlife found across the UK OTs and CDs and a selection of pressures and conservation responses.

Similar proportions of globally threatened species occur across many of the OTs (<10%); however, nearly one in five species on St Helena, Ascension and Tristan da Cunha are formally assessed as being globally threatened with extinction.



The size of the circles denotes the proportion of extant species assessed as globally threatened with extinction on the IUCN Red List (see Methods, page 96).

Photo: Ben Dilley

Gough Island mouse eating seabird chick

Photo: Ben Dilley

King Penguin

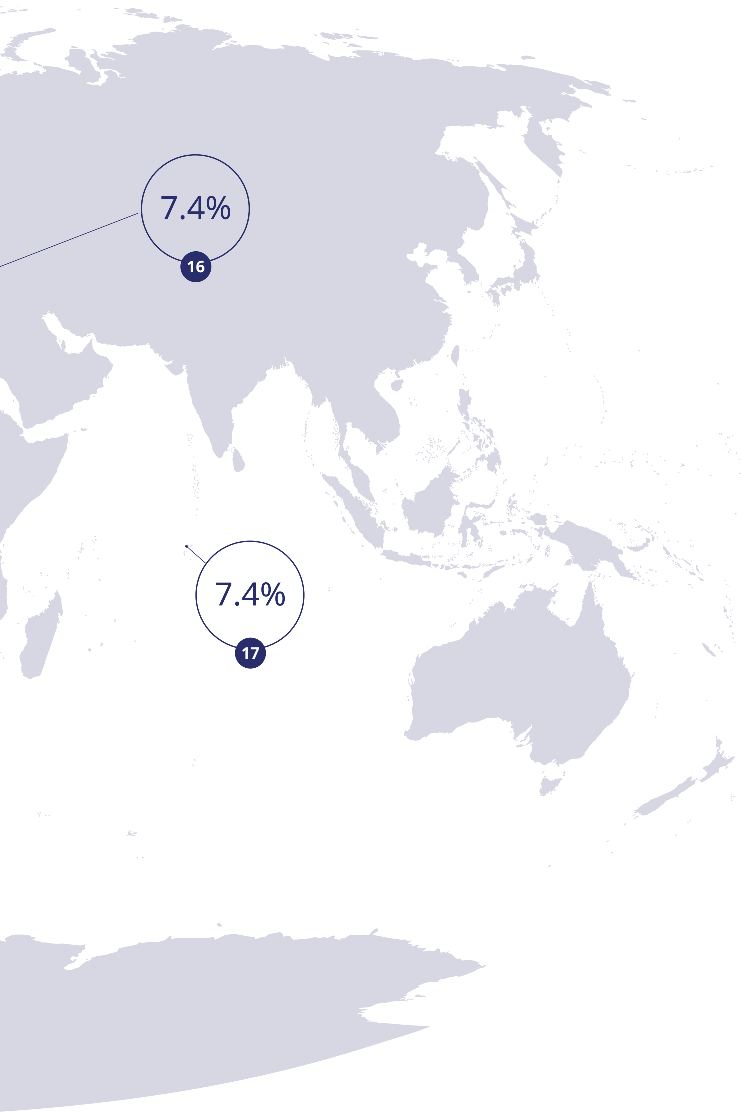
Photo: Roger Tidman (rspb-images.com)

1 The UK and its OTs are together responsible for the fifth largest area of ocean in the world. The Pitcairn Islands Exclusive Economic Zone covers an area of 834,000km² and was declared a no-take MPA in 2016 as part of the Blue Belt programme (see page 84).

15 The Isle of Man is a hotspot for Basking Shark activity around the British Isles. Here researchers are fitting this globally Vulnerable species with satellite tags to better understand their movements and the pressures they face[4].

11 Gough Island, within Tristan da Cunha, is one of the most important global seabird colonies; however, introduced mice are having a devastating impact on native wildlife. Recent estimates put the total number of seabird eggs/chicks lost annually to mouse predation at 1,739,000, including the Critically Endangered Tristan Albatross[5]. Gough has been rated as the island with the third greatest need of eradication action globally[6], and an ambitious project is now in development (see goughisland.com).

10 South Georgia, one of the world's last great wildernesses, was officially declared rodent-free in 2018, following the largest global eradication of its type. Introduced rats were having a devastating effect on seabirds and other wildlife.



	OT/CD	Number of species (Globally) Extinct	(Globally) Extinct in the Wild	(Globally) Critically Endangered	(Globally) Endangered	(Globally) Vulnerable	Total number of species assessed for the global IUCN Red List
1	Pitcairn Islands		1	1	10	36	645
2	Cayman Islands	1		20	25	41	1,570
3	Turks and Caicos Islands			7	21	42	1,525
4	Bermuda	5	1	31	16	39	1,313
5	British Virgin Islands			13	27	46	1,681
6	Anguilla	1		7	16	39	1,472
7	Montserrat			10	14	40	1,522
8	Falkland Islands	1		1	15	15	424
9	British Antarctic Territory				2	3	92
10	South Georgia and the South Sandwich Islands				6	7	264
11	St Helena, Ascension and Tristan da Cunha	36	2	58	50	49	955
12	Gibraltar			3	9	33	790
13	Bailiwick of Jersey	1		8	9	30	824
14	Bailiwick of Guernsey	1		8	6	28	789
15	Isle of Man	1		6	7	26	652
16	Cyprus Sovereign Base Areas			3	12	22	547
17	British Indian Ocean Territory			1	11	78	1,258


Black-browed Albatross

Photo: Ben Dilley


Turks and Caicos Rock Iguana

Photo: Sarah Havery

10 OTs support some of the world's largest albatross colonies. Incidental bycatch in global fisheries represents the main threat to these birds and ongoing declines in three albatross species on South Georgia have been identified[7]. The Albatross Task Force[8] has dramatically reduced bycatch by up to 99% in some areas and is engaging with the Japanese and Taiwanese high seas fleets, which have the highest overlap with South Georgia albatross, to further reduce these impacts.

3 The Caribbean OTs hold 17 Critically Endangered reptiles. The Turks and Caicos Rock Iguana is only found on a few small isolated offshore islands and is suffering further losses due to habitat changes and invasive species. A three-year partnership project, funded by the Darwin Initiative, aims to help secure the species' future by establishing effective controls and biosecurity around remaining populations.

11 St Helena's wildlife has developed in extreme isolation and supports at least 502 endemic species. Much of its threatened wildlife is associated with the island's cloud forest[1]. Only small isolated fragments of this habitat remain. A Darwin Plus-funded project is underway and aims to secure the future of this rare habitat and its endemic invertebrates.

13 14 Although it is extinct on mainland UK, the globally Near Threatened Black-backed Meadow Ant still occurs on Jersey and Guernsey. Here the species is threatened by habitat loss, changes in management and invasive species. Action is being taken to maintain and, where possible, increase the remaining populations. One such project is the reintroduction of grazing on Guernsey's south coast. The species is just about to be legally protected in Jersey.

THE BLUE BELT

The Blue Belt programme is one of the largest conservation initiatives ever undertaken: the UK Government provided almost £20 million for long-term protection for 4 million km^2 of ocean across the OTs between 2016–2020. Large-scale MPAs have already been designated around St Helena, the British Indian Ocean Territory, the Pitcairn Islands, and South Georgia & the South Sandwich Islands, with further protections being scheduled for Ascension (2019) and Tristan da Cunha (2020).

Over 1.76 million km^2 of these MPAs have been designated as IUCN Category I fully protected "no-take zones", while other areas permit some sustainable use of marine resources. The fundamental approach of the Blue Belt programme is to work with OT governments and communities to ensure local priorities for marine conservation management are adopted, and that local capacity is built for monitoring and management. Considerable research is underway to set knowledge baselines and to develop appropriate management plans.

Key environmental assets protected within the Blue Belt programme include the largest coral atoll on earth, the Atlantic's second largest Green Turtle nursery and the world's only known aggregation of male and female Whale Sharks, plus the biggest single penguin colony on the planet. A key enabling factor for the development of large-scale MPAs has been satellite surveillance, which can help deter illegal fishing vessels.

HABITAT RESTORATION OPPORTUNITIES FOR THE UK OTs

The extreme 2017 hurricane events in the Caribbean provided clear evidence of the functional, humanitarian and economic value of the natural environment in mitigating inland flooding and coastal zone storm surges. These events highlighted the importance of not only protecting coastal and inland vegetation but also actively intervening to restore key habitats. This is particularly true of coastal mangrove systems that reduce the impacts of hurricane-generated storm surges.

Work by the Joint Nature Conservation Committee (JNCC), in partnership with OT governments and UK-based consultancy Environment Systems, has modelled storm surge episodes in Caribbean OTs and used pre- and post-hurricane satellite data to specifically identify the role of mangroves in mitigating surge impacts on local communities and infrastructure.

In addition to identifying where mangroves have played this mitigating role, "opportunity spaces", where it might be possible to re-establish a particular habitat, have been identified, to help enhance the resilience of the natural capital on the island. This technique has been applied to Anguilla to identify mangrove restoration possibilities and assess the potential role of newly established mangroves in reducing the risk of flooding, to make the case for restoration for economic and disaster resilience purposes.

This trend to intervene to restore and extend important habitats in the OTs is critical to reverse the pattern of degradation and loss.

Photo: RSPB

Pitcairn Island

INVASIVE SPECIES & THE UK OTs

Introduced INNS are one of the primary threats to biodiversity across the OTs and have been implicated in the global extinction of some of their endemic species. Estimates of the impacts of invasive mice on Gough Island World Heritage Site put the number of seabird chicks/eggs predated at 1.7 million per year, but this figure could exceed 3 million. Feral cats threaten the Critically Endangered Turks and Caicos Rock Iguana, while feral pigs have been recorded digging up turtle nests in Montserrat. It is not only invasive mammals that pose a significant threat – introduced insects threaten the only native tree species in Tristan da Cunha, while introduced plants are invading terrestrial habitats in the Falkland Islands.

A variety of approaches are being used to address this threat, starting with the vital work of preventing further introductions by strengthening biosecurity. An EU BEST-funded three-year biosecurity project has been raising public awareness in the Caribbean territories, while a UK Government project has drafted model biosecurity legislation for territory governments to consider and has undertaken a comprehensive programme of horizon-scanning and pathway analysis across all the OTs.

The removal of invasive species is a major undertaking, but many control and eradication schemes are underway. The most significant recent achievement is the clearance of rodents from South Georgia. Here, the spread of other non-native species, such as plants, is also being tackled.

Fundraising and planning for an attempt to restore Gough Island in 2020 continues, to prevent the extinction of the Tristan Albatross and Gough Bunting. At a cost of over £9 million, this is one of the largest conservation interventions planned across the OTs.

↑ Two endemic bird species, the St Helena Plover and Montserrat Oriole, were down-listed from Critically Endangered to globally Vulnerable by the IUCN, due to conservation action; however, threats to both species continue[3].

↓ Four of St Helena's endemic plants, including the St Helena Tea Plant, have been up-listed to Critically Endangered globally on the IUCN Red List since 2015. These species are threatened by habitat fragmentation and very few individual mature plants remain[3].

↓ The endemic St Helena Giant Earwig was declared globally Extinct in 2014, with the last confirmed adult seen in 1967. Habitat degradation and the impact of non-native species is thought to have contributed to its demise[3].

Photo: Roger S Key

↑ The Fin Whale, which has been recorded in the seas around 13 OTs[1], was down-listed from globally Endangered to Vulnerable on the IUCN Red List in 2018. The global population has approximately doubled since the 1970s, but numbers remain well below pre-industrial whaling levels[3].

↓ Five Caribbean OTs' reptiles, including the Sombrero Ameiva, have been up-listed to Critically Endangered globally on the IUCN Red List since 2013. All these species are being affected by introduced non-native species[3].

↓ The St Helena endemic She Cabbage Tree was up-listed to Extinct in the Wild in 2015 following the death of the last wild specimen in 2012. Some cultivated specimens have been replanted in semi-wild situations[3].

↑ THE GOOD NEWS ↓ THE BAD NEWS

CONNECTION TO NATURE

As wildlife populations decline there is increasing concern about people's willingness to act to reverse this. While social, cultural and political factors influence attitudes and behaviour, and there is a recognised gap between people's values and actions, one reason for this lack of engagement is considered to be disconnection from nature: "Simply put, humans don't protect what they don't know and value."[1]

Insights from disciplines such as psychology and sociology indicate the importance of people's "connection to nature" (henceforth "connection") for motivating behaviour to help. The *State of Nature 2016* report highlighted that, while there was regional variation, most UK children had lower connection than desired for motivating conservation behaviour[2,3]. While the future relies on children, teenage and adult connection must be considered for addressing conservation issues now.

Photo: Tony Hamblin (rspb-images.com)

CONNECTION TO NATURE DESCRIPTION

"Connection to nature" describes an individual's relationship with nature and their perception of belonging to the wider natural community[4]. Connection is a complex and multidimensional characteristic. Connection is not developed just through contact and simply getting people outside does not mean they will grow a wildflower meadow or petition for nature[5]. Instead, connection is made up of emotional, cognitive and behavioural aspects – feelings about nature, knowledge and actions.

Sometimes referred to as nature connectedness or relatedness, it is often discussed in terms of disconnection and reconnection[4].

Research has focused on the how, where and why of connection: types of experience that develop connection, relationship with place or psychological response creating the connection[6]. Most research is on the latter[6], with connection expressed as involving feelings of freedom, safety[7], sense of identity[8,9], enjoyment, oneness, empathy and responsibility[7,9–11].

WHY IS PEOPLE'S CONNECTION IMPORTANT FOR NATURE?

One approach for changing someone's behaviour on a subject is to give that subject personal, emotional value. Increasing people's awareness and concern can help instigate actions supporting nature, as recognised by international conservation targets (e.g. Aichi 1). Low connection leaves people with little attachment to what is, or was, present. Consequently, people may not notice biodiversity loss, or, in what's known as "shifting baseline syndrome", only recognise loss within their experience rather than what has gone before[12]. By connecting people, the hope is they will be engaged by current nature, concerned by the declines and more motivated to act, directly or indirectly, for example through supporting stronger government action.

Photo: Tom Simone (rspb-images.com)

While values do not always match behaviour, in children, higher levels of connection are related to greater likelihood of helping nature[3]. In adults, higher connection is also related to higher likelihood of conservation behaviours, such as reducing electricity use[13], and more positive attitudes towards interventions, for example integral swift bricks in homes[14].

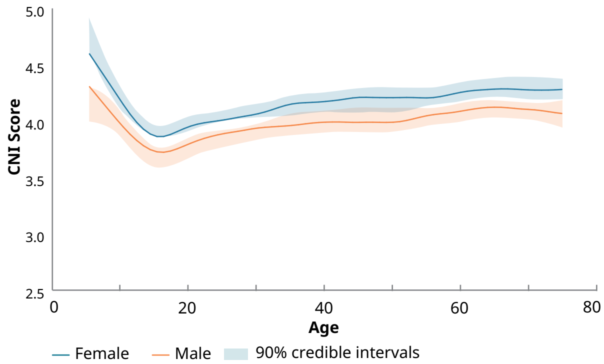
WHO TO CONNECT TO NATURE – RESEARCH SO FAR

Previously, connection was thought fixed in childhood, with studies examining how childhood experiences relate to adult behaviours. For example, how outdoor learning is practiced, its purpose and setting can influence how an ethic of care for nature or understanding of natural processes is developed[15].

However, research from Australia[16] showed that current experiences also increase adult connection. Given this potential flexibility in adulthood connection we need to understand more about connection variation to develop successful interventions. In the UK population, connection differs by gender and age[17].

Females have higher connection scores than males, and connection dips in teenage years[18] (see figure). Thus, developing different interventions for different life stages may improve lifetime connection and behaviour.

Predicted Connection to Nature Index (CNI) scores for ages 5–75 years from generalized additive models (GAMs). CNI scores ranged from 1 to 5



HOW DO WE DEVELOP CONNECTION?

Evidence is building on promising mechanisms for developing connection. One way of initially connecting people is by engaging them with nature in their lives. People often value green spaces because of cultural benefits[19]. Health and well-being benefits can motivate people to take part in nature activities. For example, relaxation is a strong driver for people feeding birds[20] and pleasant green spaces can increase community cohesion[21].

University of Derby research recommends that activities that create emotion, give meaning, showcase nature's beauty, include contact and develop compassion connect people to nature[22]. RSPB research on adults found that, as well as those creating emotion or meaning, activities that involved different senses, included learning and heightened compassion also increased participant's intention to act for nature[23]. Drawing people's attention to details in nature and repeated engagement, key elements of The Wildlife Trusts' 30 Days Wild campaign, help sustain people's connection and maintain behaviour[4].

FUTURE DIRECTIONS – UNDERSTANDING, MONITORING AND EVALUATION FOR CONSERVATION SUCCESS

Photo: Mark Hamblin (rspb-images.com)

Understanding how to influence human behaviour is a priority for conservation. Detailed investigation into what works to connect different audiences across their lifetimes will help long-term conservation action. Measurement of population level trends, for example in England through Natural England's Monitor of Engagement with the Natural Environment surveys[24], are necessary to evaluate large-scale effects. Overall, improving understanding about the relationship between connection and action, how connection varies and consequences for behaviour, is vital for conservation success.

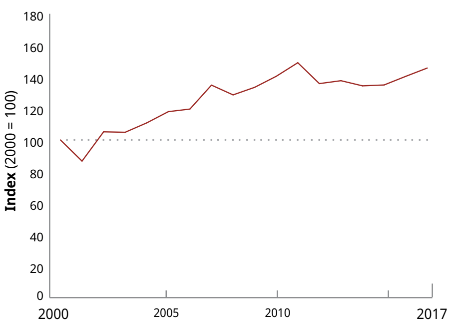
MONITORING THE STATE OF NATURE: WHO, WHAT AND WHY?

This *State of Nature 2019* report, and those published in 2013 and 2016, attempt to assess the state of the UK's nature based on a synthesis of the best available biodiversity data. This would not be possible without the huge effort put into the recording and monitoring of wildlife, most of it done by volunteers.

WHO HELPS MONITOR THE UK'S WILDLIFE?

While professional scientists and conservationists collect much valuable data on biodiversity in the UK themselves, this is outweighed by the huge contribution of volunteers who submit records and take part in structured surveys on a vast range of wildlife. It has been estimated that 18,700 volunteers are involved in structured monitoring schemes that cover bats, birds, butterflies and plants alone, and the financial value of their time contribution has been estimated at £20.5 million per annum[1]. In addition, as many as 70,000 volunteers submit records to national recording schemes and societies (NRSS)[2], or to local environmental records centres (LERCs), for a great range of taxonomic groups. While we do not have precise data on trends in the extent of this volunteer effort, we know that the contributions of time by volunteers (including but not limited to monitoring) to conservation organisations are estimated to have increased by 46% since 2000.

UK Biodiversity Indicator: Index of volunteer time spent in selected UK conservation organisations, 2000 to 2017



Source: jncc.gov.uk/ukbi-A2

The efforts of volunteers reflect the long-standing interest in natural history in the UK, which can be traced back to the expertise of naturalists such as Gilbert White in the late 18th century and John Ray a century before him. Many highly respected experts on the identification and ecology of specific taxonomic groups are volunteers with decades of experience and expertise, without whom recording schemes would not exist.

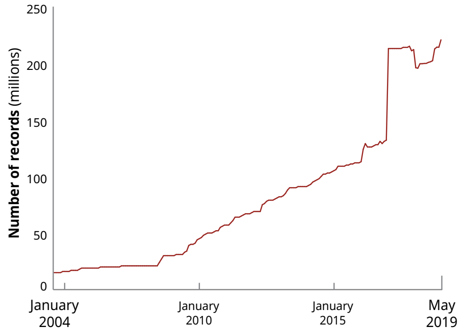
WHAT DO THEY DO?

Broadly speaking, biological data and the schemes that govern its collection can be divided into two categories. Firstly, there are structured surveys that are conducted at predefined sites using a set methodology – such as in the Wider Countryside Butterfly Survey (WCBS)[3]. Data from surveys such as the WCBS are submitted to survey coordinators, increasingly using online forms. Data are analysed using well-established statistical approaches to produce annual trends in abundance, with corrections made to account for biases such as when survey coverage is greater in some regions than others. The robust design and quality assurance procedures of such schemes mean they produce high-quality assessments, and datasets that can be used for numerous research purposes.

The other category is "unstructured" biological records – observations of species at a given time and place that were not collected as part of a structured survey. This means that the methods used and the data collected may vary, and there may be uncontrolled biases associated with the data, for example because observers choose where to go, and so may favour wildlife-rich sites, and are more likely to submit records of rare and special species than more commonplace ones. However, such ad-hoc records cover a huge range of species for which there are insufficient resources, or expert recorders, to run a structured scheme. There are over 90 national recording schemes covering a wide range of taxonomic groups[4] as diverse as slime moulds, stoneworts and leaf-mining moths.

The Biological Records Centre (BRC) curates the datasets compiled by many NRSS, which can be used to map the ranges of species and identify important sites and regions. While structured monitoring schemes remain the "gold-standard", recent statistical developments that account for recording biases[5,6] mean we are now able to use these data to detect trends in the occurrence of species over several decades. These trends play a pivotal role in the *State of Nature* reports, allowing us to report changes in a broad spectrum of the country's wildlife.

UK Biodiversity Indicator: Records added to the NBN, 2004 to 2019



Source: jncc.gov.uk/ukbi-E1

Data from many sources, including the BRC, are made available through the National Biodiversity Network's (NBN) database, the NBN Atlas. The NBN Atlas launched in 2017 and, at the time of writing, holds a remarkable 223,027,119 species' occurrence records, covering 45,448 species in 824 datasets, accessed through the NBN Atlas[7] – and this figure continues to grow rapidly, with jumps caused by the input of new datasets (see above). However, this is still incomplete, with not all data flowing smoothly from surveys, recording schemes, consultancies, scientists and LERCs to the NBN. Furthermore, an unknown but undoubtedly huge volume of data remains in observers' notebooks, photo libraries, social media feeds or simply as fading memories.

Small Tortoiseshell

Photo: Sue Kennedy (rspb-images.com)

WHY IS THIS MONITORING SO IMPORTANT?

Monitoring builds our knowledge of the natural world, and underpins our efforts to conserve it, and to halt and reverse declines in nature. Measures of abundance and/or distribution, particularly those derived from standardised repeated measurements, allow trends to be calculated and species' status to be determined. Formal assessments such as IUCN Red Lists, which use the best available data to place species in categories of threat using a suite of standardised criteria, are used to identify which species most urgently require conservation attention. Given the squeeze on resources for conservation, such prioritisation is essential for ensuring resources are used efficiently.

Furthermore, repositories of species data are essential tools for spatial planning and defending wildlife from inappropriate development. Datasets on the NBN Atlas and those held by LERCS can aid the identification of the most valuable sites for wildlife, and be used to inform Nature Recovery Network maps. This would enable reserve designation, the targeting of conservation management such as AES and woodland grant schemes, and inform local authorities and developers about sensitive sites and special species.

Finally, by combining data across species, we can look at broader patterns in nature – such as shown by the *State of Nature* headlines, and in the UK Government's biodiversity indicators[8]. Trends in wildlife can tell us about the health of the environment more widely, and what impact human activities are having on it. The reporting of the UK's progress in meeting international targets for biodiversity and sustainability (see page 90) relies heavily on volunteer-collected biodiversity data.

Photo: Ben Andrew (rspb-images.com)

PROGRESS TOWARDS INTERNATIONAL COMMITMENTS: THE AICHI TARGETS

SAVING NATURE GLOBALLY

Recent reports[1] have shown that humankind is failing to halt the loss of biodiversity globally, which continues at an alarming rate. The demands of land-use conversion and other pressures now mean that very few habitats on earth are untouched by people, and 1 million species are at risk of extinction[1]. The recent global report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)[1] issued stark warnings, including that:

- Nature and its vital contributions to people, which together embody biodiversity and ecosystem functions and services, are deteriorating worldwide.
- Direct and indirect drivers of change have accelerated during the past 50 years.
- Goals for conserving and sustainably using nature and achieving sustainability cannot be met by current trajectories, and goals for 2030 and beyond may only be achieved through transformative changes across economic, social, political and technological factors.

The Convention on Biological Diversity (CBD)[2] is a global treaty, opened for signatures in 1992, intended to tackle this crisis. The 10-year Strategic Plan for Biodiversity[3] was adopted in October 2010, and includes five strategic goals underpinned by 20 global biodiversity targets – the Aichi Biodiversity Targets, named after the Japanese prefecture in which they were agreed. Parties to the CBD and other multilateral environmental agreements use these targets to set priorities, develop action plans and establish national targets, and are expected to report on their progress at regular intervals. The most recent of these national reports (the sixth) is being used to create a global assessment of progress, *Global Biodiversity Outlook 5*, which is expected to be published in June 2020. This will be the final report on collective global progress over the last decade, and will signal whether national actions have been sufficient to halt biodiversity loss by 2020. Unfortunately, recent predictions[1] suggest that the majority of the Aichi Biodiversity Targets are unlikely to be met at a global scale.

THE UK'S CONTRIBUTION TO THE GLOBAL PICTURE

The UK's sixth national report to the CBD[4] was submitted in March 2019 and drew upon a huge range of information, such as the UK's Biodiversity Indicators[5] (which feature heavily in the *State of Nature 2019* report), as well as many other robust scientific sources. The report assessed that the UK is on track to meet five of the 20 targets. Although progress has been seen towards another 14, this has not been sufficient to meet the targets; one target was not assessed. In addition to this UK reporting, the Scottish Government has published regular reports on Scottish progress towards the targets[6].

The Aichi Biodiversity Targets are often multifaceted, ambiguous, hard to assess objectively, and sometimes lack clear mechanisms for measuring progress. In the UK, governments, advised by the country nature conservation bodies, are responsible for reporting progress against the targets to the Secretariat of the CBD. There have been disagreements between government and some NGO State of Nature partners regarding both the interpretation of data and of the targets themselves, perhaps inevitably given these conditions. It is notable, however, that these differences centre on a minority of the 20 Aichi targets.

The text on the opposite page focuses on those targets which are central to actions to help biodiversity in the UK, and thus the UK's contribution towards the global effort to help biodiversity. Much of the content of *State of Nature 2019* is relevant to these targets, and tells readers about the UK's progress towards them, adding to the text in the UK's sixth national report to the CBD[4].

LOOKING FORWARD – 2020 AND BEYOND

2020 is a crucial year – a new set of global targets will be negotiated, there is expected to be an uplift in national commitments to tackle climate change and it will be a key milestone for the UN Sustainable Development Goals[7]. These moments and commitments have the potential to deliver increased action and ambition for nature, and to strengthen the connections and solutions between the synergetic issues of nature, climate change and sustainable development.

THE UK GOVERNMENT HAS ASSESSED THAT THE COUNTRY IS ON TRACK TO MEET FIVE OF THE 20 AICHI TARGETS BY 2020.

Extinction of threatened species: "By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained." The *State of Nature 2019* shows that 15% of the 8,418 species assessed are regarded as threatened with extinction in Great Britain, although it is not known how this percentage has changed over time. The abundance of species identified as conservation priorities, including many of the species at greatest risk of extinction, has fallen to 40% of its 1970 value, and continues to fall in the short term (by 22% between 2011 and 2016). The status of species more widely continues to fall in response to a wide range of pressures, with a measure of species' abundance down by 13% over the long term, and one of species' distribution down by 5%. While this report demonstrates how targeted conservation action can prevent extinction, and gives examples of wonderful and inspiring successes, it is clear that more needs to be done to address the needs of threatened species and thus meet this target.

Sustainable management of marine living resource – see pages 58–61. Some UK fish stocks are showing signs of recovery in response to sustainable fisheries measures, but not all stocks are fished at sustainable levels, and issues such as bycatch and trawling damage to seabeds persist.

Sustainable agriculture, aquaculture and forestry – see pages 18–21, 26–27 and 42–45. Incentives, such as AES, have been developed to encourage the sustainability of agriculture, aquaculture and forestry in the UK. However, there has been a recent decline in the area of land under higher-level AES, and critically relevant indicators of wild birds show either no recovery from previous depletion (woodland) or continuing decline (farmland).

Pollution reduced – see pages 38–41. Legislative controls have led to dramatic reductions in pollution from point sources in recent decades. Diffuse pollution in air and water remains a key pressure impacting on the status of species and habitats. Some sources remain above safe levels, however, and their influence on sensitive habitats is still considerable.

Invasive alien species prevented and controlled – see pages 34–37. Systems have been developed, at a Great Britain and all-Ireland scale, to prevent colonisation by INNS, and some progress has been made in tackling established species. However, 10–12 new non-native species establish in Great Britain each year on average, and around one in 10 of these causes adverse impacts.

Protected areas increased and improved – see pages 47 and 63. The UK's protected area network covers 25% of the UK's land area and 24% of its sea area. On land, these totals include landscape designations which do not have the primary purpose of conserving biodiversity and ecosystem services. Terrestrial changes since 1995 mainly reflect the establishment of SACs and SPAs, plus the designation of two National Parks in Scotland in 2002/03. There has been a large increase in the extent of MPAs since 1995, but especially since 2010. The proportion of protected sites assessed as in favourable condition has remained stable (43% of SACs, 50% of SSSIs and 52% of SPAs, in 2019), with an increase in the percentage of site features which are recovering (31%, 35% and 27%, respectively); it is recognised that it will take a long time for species and habitats to recover to favourable condition.

Financial resources from all sources increased – see page 49. There has been a substantial short-term decline in public sector spending on biodiversity in the UK, which has fallen by 29%, from £641 million to £456 million, between 2012/13 and 2017/18. Over the same period, however, the UK's expenditure on biodiversity internationally has increased by 111%, from £97 million to £205 million.

HOW TO INTERPRET THIS REPORT

We have included this section to help you understand the different measures presented in the *State of Nature 2019* 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 94–97.

WHAT DATA HAVE WE USED?

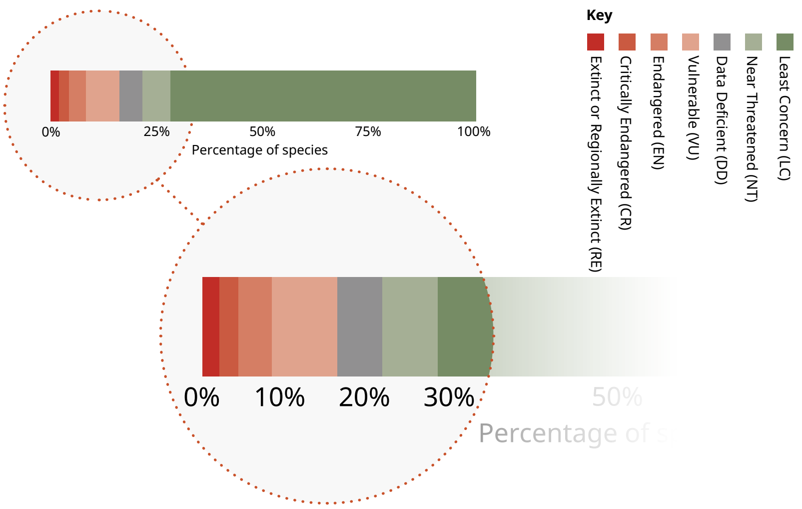
- We present trends in abundance (for 697 species) and occupancy (for 6,654 species) for terrestrial and freshwater species across the UK, and trends in abundance (five taxa) for marine species or species groups.
- Abundance trends are based on changes in the number of individuals at a monitored site, a measure that reflects a species' population size. Occupancy trends are based on changes in the number of sites where a species is present. This is a measure that reflects the range of a species. It is usually measured as site occupation at a 1km² scale.
- These trends came from a wide range of sources, including national monitoring schemes and biological records.
- Abundance trends are for native species only, but, unless otherwise stated, recent colonist and non-native species were included in the occupancy trends. However, due to the low number of these species, as a result of the time period and record number filtering, their impact on the average trend lines is likely to be minimal[1].
- We present assessments of national Red List status for 8,431 native species.
- Details of our data sources and the species they cover are given in the additional online material.

HOW ARE OCCUPANCY 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[2] 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' occupancy trends[3,4,5].

Occupancy and abundance trends are often related, and there is evidence that they tend to operate in the same direction[6,7]. However, the relationship between the two measures of change can be complex. In particular there is evidence that the magnitude of change in occupancy 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 occupancy trends move in opposite directions, but this is less common[8,9].

National Red Lists assessment



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 occurring in a particular country, with the exception of Northern Ireland, where we used all-Ireland Red List assessments. For the OTs and CDs 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 percent of extant species, for which sufficient data are available, classified as Critically Endangered, Endangered or Vulnerable in the latest IUCN Red List assessments.

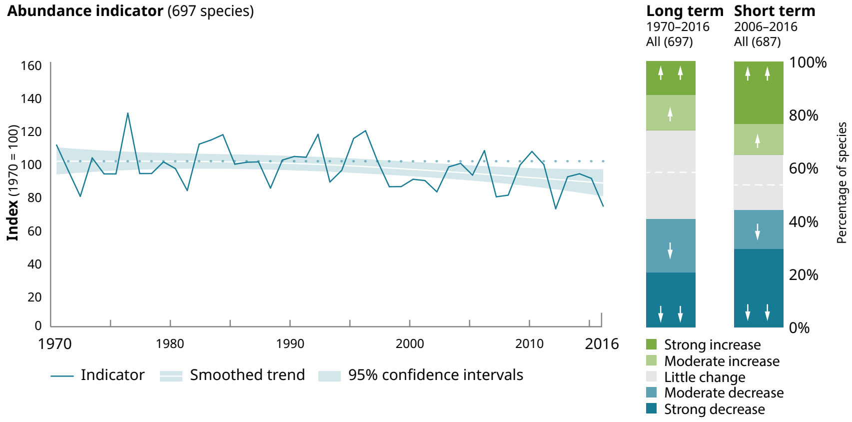
UK Biodiversity Indicators

Where appropriate, trend figures from the official UK Biodiversity Indicators[10] are presented to complement the *State of Nature 2019* analyses. The Priority Species Indicator is made up of two parts: one showing change in species' abundance and one showing change in species' occupancy. All other species-based indicators shown are based on trends in abundance.

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 occupancy data.
- Categories of change
  - The percentage of species in each trend category e.g. 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 occupancy data separately.

Species indicator graphs show the average change in the status of species based on either abundance or occupancy data. The shaded areas show the 95% confidence intervals around the indicator line for the abundance trends and 90% credible intervals for the occupancy trends (see page 96).

Results reported for each figure include:

- Total percentage change in the indicator over the long term and the short term.
- Annual percentage change over the long term and the short term.
- To assess if species' status had on average improved or otherwise in recent years, we compared the rate of change in each abundance indicator before the short-term period to the rate of change during the short-term period.

Categories of change

Each species was placed into one of 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.
- The percentage of species showing strong changes (decreasing and increasing combined) in each time period.
- The overall percentage of species with trends below or above zero in each time period, illustrated by the vertical line across the grey little change segment of the graph.

Thresholds for assigning species' trends to the five categories are given on page 96. A small number of species did not have a short-term assessment as data were unavailable for recent years.

WHAT TIME PERIOD DOES THIS REPORT COVER?

We show abundance trends in species from 1970 to 2016 and occupancy trends from 1970 to 2015. We refer to this as our long-term period. Our short-term period runs from 2006 to 2016 or 2005 to 2015.

Photo: Mark Eaton

METHODS

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

1. **A multispecies indicator, which charts average species' change over time.**
2. **A Categorical Change metric, which describes the proportions of species in five change categories based on the direction and magnitude of average annual change over the long-term and short-term periods.**
3. **A Red List metric, which presents the proportion of species at risk of extinction.**

The methods are based on those used in the second *State of Nature* report and published subsequently in Burns *et al.* (2018)[1].

DATA COLLATION

We collated as many datasets as possible describing population change of native UK species in order to populate the population change metrics (see table on facing page and additional online content). 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 occupancy of species (changes in the number of sites where a species is found, so effectively the change in range of the species). The long-term period was 1970–2016 for abundance time series and 1970–2015 for occupancy time series, due to a time lag in the collation and reporting of biological data. The respective short-term periods were 2006–2016 and 2005–2015.

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 occupancy time series were based on the opportunistic recording data collected by NRS; a full list is available in the additional online content. 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' occupancy time series included in our assessment were extracted from Outhwaite *et al.* (2019)[2], who used hierarchical occupancy modelling in a Bayesian framework[3,4] to help control biases. They modelled occupancy at a 1km^2 scale, and we retained species time series with a minimum of 10 years of reliable estimates, based on at least 50 records with no more than a 10-year gap in records[5,6].

Raw occurrence records were modelled directly for this report for two taxonomic groups, mammals, using the methods described above, and vascular plants, using an alternative approach, Frescalo (details described on facing page).

In addition to datasets of species' population change, we collated national IUCN Red List assessments (see table).

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 2016 and required minor processing following the methods used for previous reports[1]. Data for any years prior to 1970 were removed.

Moth data

Data for 766 moth species were analysed using data from Rothamsted Insect Survey light trap network. The generalised abundance index methodology proposed by Dennis *et al.* (2016)[7] was used to produce UK abundance trends. Four hundred and thirty-two species produced reliable trends based on expert assessment of the underlying data and the analysis results[8].

Summary of the total number of species and the number of species included in each of the UK species' status metrics by taxonomic group. Sources for all contributing datasets are listed in the additional online content.

	Number of species			
	Population change metrics		Red List	UK total
Taxonomic group	Abundance	Occupancy		
FRESHWATER AND TERRESTRIAL				
Birds*	171		241	244
Mammals**	25	20	46	49
Amphibians and reptiles	2			13
Insects***	499 (butterflies and moths)	3,437**	2,773	23,947
Myriapods		50	92	169
Arachnids		402	639	1,560
Crustaceans			51	80
Molluscs		129	192	264
Bryophytes		569	1,055	1,056
Lichens		696	1,662	2,354
Non-lichenised fungi			153	15,195
Vascular Plants		1,351	1,527	1,577
Total	697	6,654	8,431	
MARINE				
Fish	11			
Birds	13			
Mammals	7			
Zooplankton	4 species groups			
Phytoplankton Colour Index	1 species group			
Total	31 species and 5 species groups			

* UK total is regularly occurring breeding and wintering species.
** A proportion of mammal species and moth species were included in both the abundance metrics and the occupancy metrics. See additional online material for species appearing in both metrics.
*** Groups included: aculeates, bugs, beetles, caddisflies, dragonflies, flies, grasshoppers, lacewings, mayflies, moths and stoneflies.

Vascular plant 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. Here, we use data from 1930–2018 to derive broad time-period specific estimates of frequency for 1,351 plant taxa. To achieve this, we divided this period into five broad time segments; four of these were retained for analysis, due to the fact that they were considered to be largely unbiased with respect to species' relative frequencies due to Atlas-focused recording activity. We then applied the "Frescalo" algorithm[9] 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 within each time period. One hundred generalised additive models (GAMs) per species were then fitted to 100 random draws from a species' frequency estimate distribution specified by the Frescalo means and standard deviations. This process enabled us to predict smoothed trends from the 100 GAM fits for a species across all years, while retaining a measure of uncertainty. Finally, the estimated frequency in 1970 was taken as our baseline year, with subsequent values normalised to this point.

To combine these time series with the occupancy time series from other taxa they required conversion to the same scale. The mean and standard deviation from the GAM results were used to generate a distribution of estimates for each species' year combination from which 1,000 random samples were drawn. Estimates were then capped (2, -2) to prevent disproportional contributions from species exhibiting extreme trends and rescaled onto the occupancy scale (0 to 1).

Marine data

Marine fish time series were based on two "bottom trawl" surveys: Greater North Sea International Otter Trawl Q1 and Celtic Seas Scottish Otter Trawl Q1. These datasets have been tidied and refined by Marine Scotland[10,11], giving estimates of abundance per km^2 by length category for each species in each survey visit.

Before creating the population change metrics, for each survey as required we:

- Summarised the average abundance per km^2 for each length category of each species in each year in each survey area.
- Summarised the average abundance per km^2 for each species in each year.
- Retained only species contributing to the first 99% of abundance per km^2 and with a time series spanning at least 10 years, in order to exclude rare or poorly sampled species.
- Coded species as either "demersal" or "pelagic".

The Continuous Plankton Recorder (CPR) Survey dataset provided data for *Calanus* species but also for several zooplankton groups rather than for individual species. Similarly, the PCI gives a representation of ocean colour, which is considered a proxy of the phytoplankton biomass. This means that additional considerations are required in order to interpret how marine biodiversity is changing over time, as a single trend from the CPR may encompass change in a range of individual species.

PRODUCING OUR MEASURES OF SPECIES' POPULATION CHANGE

Separate change metrics were created based on the species' abundance time series and the species' occupancy time series. Previously we have combined these data types into a single metric of change in line with other authors[12]. However, recent research has indicated that the magnitude of these two measures of population change may not be strongly correlated[13,14]. Within the abundance and occupancy datasets the same species contributed to the Species Indicator and the Categorical Change metric.

SPECIES INDICATORS

To create the abundance Species Indicators, all individual species' time series were converted to species indices by expressing each annual estimate as a percent of the first year of the time series and the index was calculated as the geometric mean of the species indices[15]. Species indices starting after 1970 entered the index at the geometric mean value for that year. CI for each Species Indicator were created using bootstrapping across species[16]; in each iteration (N=10,000) a random sample of species was selected with replication and the index was recalculated.

We generated smoothed Species Indicators and associated CI using a generalised additive model[17]. We focus on the total and annual average change in the smoothed Species Indicator in the results and also present the unsmoothed indicator.

Occupancy indicators were created using the methods developed for Indicator C4b of the UK Biodiversity Indicator suite[6] and used the lambda method. This indicator is based on annual growth rates and the credibility intervals are derived from the posterior distribution of the Bayesian occupancy models used to generate the estimates.

The annual average rate of change in each Species Indicator was calculated based on the total change in the long term; the indicator value in its final year, and the short term; the change in the indicator in its last 10 years. If the CI around the final estimate did not contain 100, the long-term change was considered significant. If the CI around the indicator values in the start and end years did not overlap, the short-term change was considered significant.

Testing for change over the period of the indicator

Each abundance Species Indicator was assessed for change between two non-overlapping time periods. Each indicator was modelled using a linear model of the form: in (index) ~ year + year: Period, where "Period" was a binary variable specifying the non-overlapping short-term and prior (1970–2005) time periods[1].

CATEGORICAL CHANGE

For each species we calculated the total change then the average annual change over the entire long-term period and the recent short-term period – although in many cases the start and/or end years did not match these years exactly. Total change was either a published modelled output or the estimate in a smoothed species index in the penultimate year expressed as a proportion of that in the first year, with exceptions[1]. 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 occupancy 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.

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 to 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. It is common practice to use the magnitude and rate of population change, rather than statistical significance, in order to categorise conservation status assessments. Thus, our values are the best available estimates for each species, but we must acknowledge that many species' trend estimates are highly uncertain.

In addition, we presented a binary split of the proportion of species with positive and negative trends, regardless of magnitude.

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[18] 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 occupancy, 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 www.iucnredlist.org (21/07/2019) were used to calculate the number of species assessed under the various threat category 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[19].

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[20].

We have brought together all the national Red Lists for Great Britain that have been produced using the latest guidelines from the IUCN[18,20]. For more details of the Red Lists used, please see the additional online material.

We summarised the global and regional Red Lists to present the percent of species in each category and the percent considered threatened across all species, and at different taxonomic levels. We followed recognised guidelines[21] and used the best estimate (the mid-point) when calculating the percent of extant species, for which sufficient data are available, classified as globally 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 and England, but only at a taxonomic group level for Wales and Northern Ireland.

Occupancy change metrics were produced using the same methodology as the UK level indicator for England, Scotland and Wales. Insufficient data were available to apply the approach to Northern Ireland or to the species sub-groups used at the UK-wide scale.

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.

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. For some species groups estimates are based only on Great Britain and mammal estimates contain some Isle of Man sites. These, however, represent relatively small differences in extent and are likely to only influence the trends of localised species.

We use outputs from hierarchical occupancy models as this method has shown to perform well at dealing with common forms of bias encountered when analysing biological records[4]. As with all modelling approaches, there are several assumptions that should be met when using the approach. Given the number of species included in the analysis, there may be occasions where some of the assumptions are not met, for example intense targeted surveys for certain species may not be fully accounted for in the detection model. However, while the model may not be perfect for all species, it is likely to be better than a model that ignores variation in detectability.

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).

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Agricultural management

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APPENDIX

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PARTNERS

A Focus On Nature
afocusonnature.org

A Rocha
arocha.org.uk

Action for Conservation
actionforconservation.org

Amphibian and Reptile Conservation (ARC)
arc-trust.org

Association of Local Environmental Records Centres (ALERC)
alerc.org.uk

Badenoch & Strathspey Conservation Group
bscg.org.uk

Bat Conservation Ireland
batconservationireland.org

Bat Conservation Trust (BCT)
bats.org.uk

Biodiversity Ireland
biodiversityireland.ie

Biological Records Centre (BRC)
brc.ac.uk

Botanical Society of Britain and Ireland
bsbi.org

British Arachnological Society (BAS)
britishspiders.org.uk

British Bryological Society (BBS)
britishbryologicalsociety.org.uk

British Dragonfly Society (BDS)
british-dragonflies.org.uk

British Lichen Society
britishlichensociety.org.uk

British Mycological Society (BMS)
britmycolsoc.org.uk

British Pteridological Society (BPS)
ebps.org.uk

British Trust for Ornithology (BTO)
bto.org

Buglife
buglife.org.uk

Bumblebee Conservation Trust
bumblebeeconservation.org

Butterfly Conservation
butterfly-conservation.org

Centre for Ecology & Hydrology (CEH)
ceh.ac.uk

Centre for Environmental Data and Recording (CEDar)
nmni.com/CEDaR

Chartered Institute of Ecology and Environmental Management (CIEEM)
cieem.net

Chester Zoo
chesterzoo.org

Conchological Society of Great Britain and Ireland
conchsoc.org

Continuous Plankton Recorder
cprsurvey.org

Durrell Wildlife Conservation Trust (Durrell)
durrell.org

Earthwatch
earthwatch.org.uk

Freshwater Habitats Trust
freshwaterhabitats.org.uk

Friends of the Earth
friendsoftheearth.uk

Froglife
froglife.org

Isle of Man Government
gov.im

iSpot (The Open University)
iSpotnature.org

Jersey Government Department of the Environment
gov.je/Government/Departments/PlanningEnvironment

John Muir Trust
johnmuirtrust.org

Joint Nature Conservation Committee (JNCC)
jncc.gov.uk

Local Environmental Records Centre Wales
lercwales.org.uk

Mammal Society
mammal.org.uk

Manx BirdLife
manxbirdlife.im

Marine Biological Association (MBA)
mba.ac.uk

Marine Conservation Society
mcsuk.org

Marine Ecosystems Research Programme
marine-ecosystems.org.uk

MARINELife
marine-life.org.uk

National Biodiversity Network (NBN)
nbn.org.uk

National Forum for Biological Recording
nfbr.org.uk

National Trust
nationaltrust.org.uk

National Trust for Scotland
nts.org.uk

Natural England (NE)
gov.uk/government/organisations/natural-england

Natural History Museum
nhm.ac.uk

Natural Resources Wales (NRW)
naturalresources.wales

Northern Ireland Bat Group
bats-ni.org.uk

Northern Ireland Environment Agency
daera-ni.gov.uk/northern-ireland-environment-agency

ORCA
orcaweb.org.uk

People's Trust for Endangered Species (PTES)
ptes.org

Plantlife
plantlife.org.uk

Royal Botanic Gardens, Edinburgh
rbge.org.uk

Royal Botanic Gardens, Kew
kew.org

Royal Society for the Protection of Birds (RSPB)
rspb.org.uk

Royal Zoological Society of Scotland
rzss.org.uk

Scottish Badgers
scottishbadgers.org.uk

Scottish Environment Link
scotlink.org

Scottish Natural Heritage (SNH)
nature.scot

Scottish Wild Land Group
swlg.org.uk

Scottish Wildlife Trust
scottishwildlifetrust.org.uk

Shark Trust
sharktrust.org

States of Guernsey
gov.gg

Trees for Life
treesforlife.org.uk

Ulster Wildlife Trust
ulsterwildlife.org

University of Plymouth
plymouth.ac.uk/research/institutes/marine-institute

University of Sheffield
sheffield.ac.uk

Vincent Wildlife Trust
vwt.org.uk

Whale and Dolphin Conservation (WDC)
uk.whales.org

Wildfowl & Wetlands Trust (WWT)
wwt.org.uk

Wildlife Trusts
wildlifetrusts.org

Woodland Trust
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WWF
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www.nbn.org.uk/stateofnature2019