Office for National Statistics

Statistical bulletin

Semi-natural habitat natural capital accounts, UK: 2021

Exploring the size, condition, quantity and value of semi-natural habitats and ecosystem services, as part of the UK Natural Capital accounts. These are our most natural spaces, although they have been altered by human activity.

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Table of contents

1 . Main points

- Our most natural areas of the UK, semi-natural habitats, occupy 32.6% of the land area of the UK with 8.02 million hectares.
- The annual value of services from the UK's semi-natural habitats is estimated at £7.0 billion in 2018.
- There were an estimated 1.7 billion hours spent on recreation in semi-natural habitats in 2018.
- The removal of air pollution by semi-natural habitats in the UK equated to an estimated saving of £634.1 million in health costs in 2018.
- The asset value of UK semi-natural habitats was estimated at £269.8 billion in 2018.

2 . Size of the area covered by semi-natural habitats

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services defines semi-natural habitats as:

"An ecosystem with most of its processes and biodiversity intact, though altered by human activity in strength or abundance relative to the natural state."

The European Investment Bank definition gives more detail on types of modification that could be, "in their composition, balance or function". The definition also gives more detail on how they come about:

"They may have evolved through traditional agriculture, pastoral or other human activities and depend on their continuation to retain their characteristic composition, structure or function."

While definitions vary, the intensive history of human occupation across the UK means even the most natural ecological assemblages are generally described as being, "semi-natural".

As such, a semi-natural natural capital account for the UK can broadly be interpreted as an account of much of its natural spaces. Previous Office for National Statistics (ONS) natural capital publications have been for a single broad habitat, such as woodlands and urban. This publication focuses on a range of habitats that make up the semi-natural landscape as it provides a more holistic narrative than just semi-natural grasslands alone. Enclosed farmland, urban, marine and coniferous woodland are excluded from semi-natural habitats.

Given both the varied definitions of semi-natural and uncertainties in mapping such habitats, calculating their extent in the UK is not easy, meaning there is no definitive answer.

The Land Cover Map 2015 (LCM2015) was created to provide a consistent approach UK-wide (see Figures 1, 2, 3 and 4), and is based on UK Biodiversity Action Plan Broad Habitat definitions. Using the LCM2015 categories, 32.6% of the UK can be considered to be semi-natural (Table 1). Full definitions of each habitat class can be found in the dataset.

Different agencies within the UK use different methods. Wales is assessed by Natural Resources Wales, who estimate that 30.8% (640,827 hectares (ha)) of the land area of Wales is semi-natural. This estimate is from combined analysis of satellite imagery and existing habitat maps. Applying the LCM2015 classification to Wales, 34.9% is classed as semi-natural.

NatureScot intends to adopt the European Nature Information System (EUNIS) habitat classification as its framework for terrestrial habitat data and mapping in Scotland.

The Department of Agriculture, Environment and Rural Affairs (DAERA) in Northern Ireland considers semi-natural habitats that are protected to be old grassland, woodland, scrub, bogs, wetlands and moorland.

There is also an issue around woodlands. Forest Europe defined semi-natural forests are neither a plantation or undisturbed by man and display certain characteristics of the natural ecosystem. As we do not have data on the area of semi-natural woodlands in the UK, we are using the broadleaved woodland land cover category as a proxy.

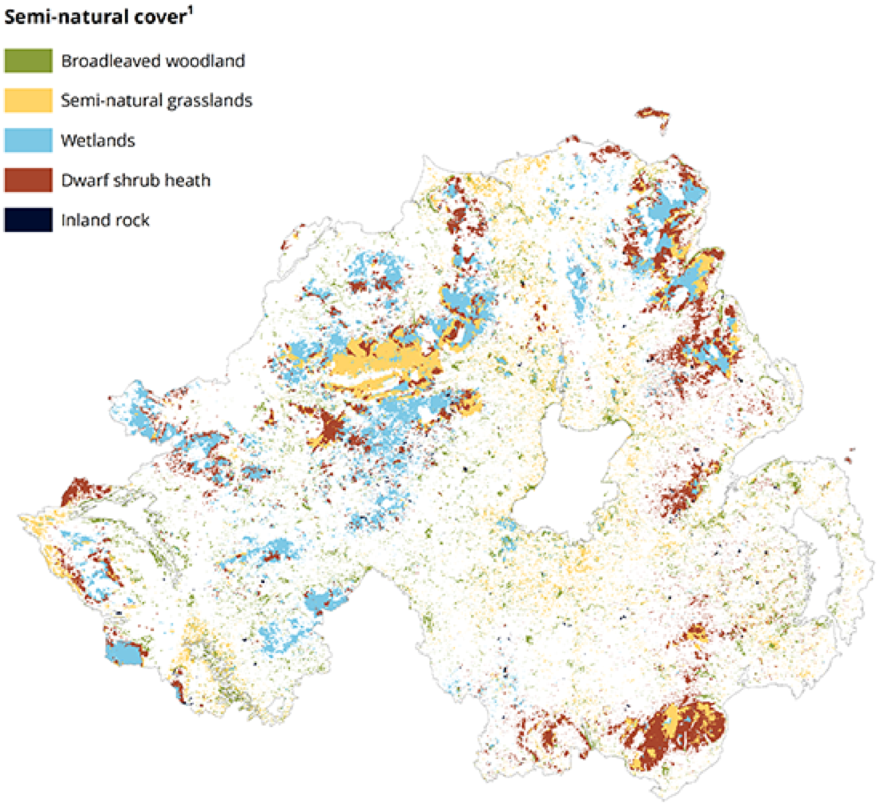
Table 1: Area in hectares of semi-natural habitat based on land cover classifications, UK, 2015

Land cover class	**UK (hectares)**
Broadleaved woodland	1,503,303
Neutral grassland	115,506
Calcareous grassland	83,208
Acid grassland	2,135,472
Fen	18,719
Heather	973,846
Heather grassland	1,542,186
Bog	963,183
Inland rock	182,763
Freshwater	327,987
Supra-littoral rock	32,133
Supra-littoral sediment	59,815
Saltmarsh	79,706
Total area	8,017,827

Source: UK Centre Ecology and Hydrology

Figure 1: Map of inland areas of semi-natural habitat, Northern Ireland, 2015

Semi-natural cover, inland areas, Northern Ireland, 2015



Source: UK Centre for Ecology and Hydrology (UKCEH) Enterprise Data Licence Agreement – 1273, Land Cover Map (LCM)2015 © and database right UKCEH 2011

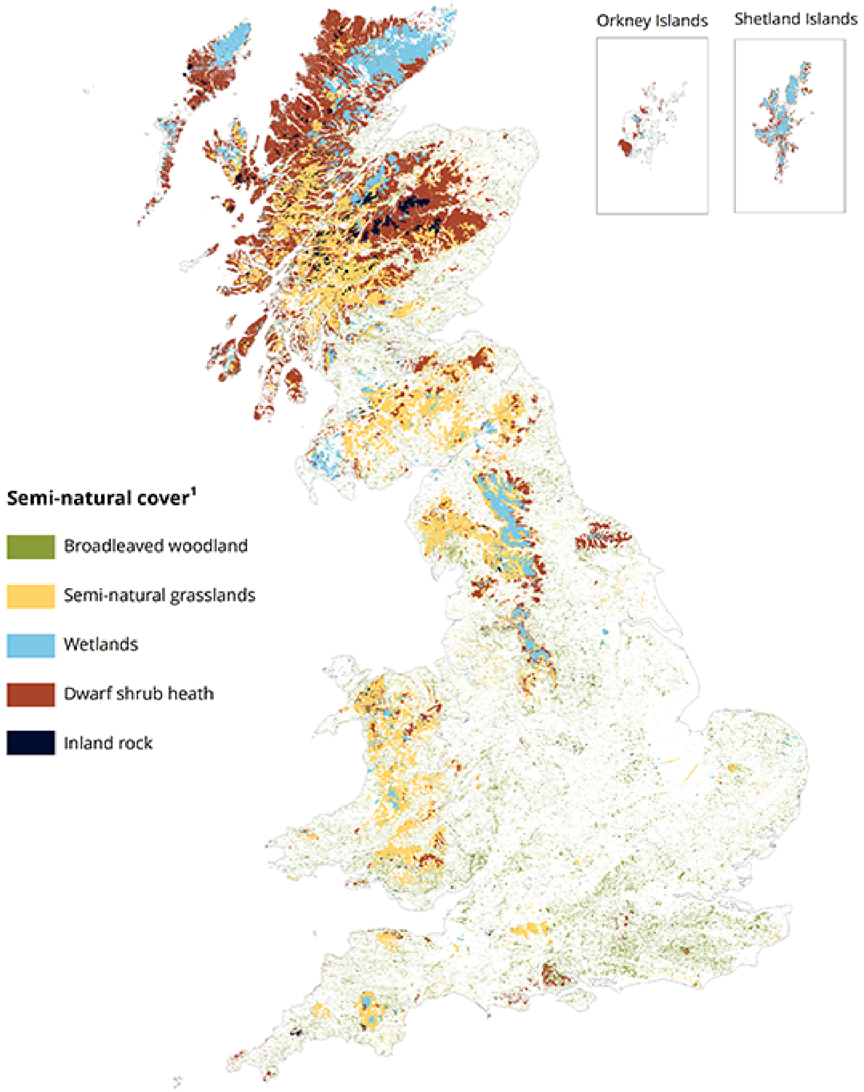
Notes:

1. Graphic created by ONS Geography.

2. Broadleaved woodland includes only itself. Semi-natural grasslands includes acid grassland, calcareous grassland and neutral grassland. Wetlands includes bog and fen, marsh and swamp. Dwarf shrub heath includes heather and heather grassland. Inland rock includes only itself.

Figure 2: Map of inland areas of semi-natural habitat, Great Britain, 2015

Semi-natural cover, inland areas, Great Britain, 2015



Source: Based upon Land Cover Map (LCM)2015 © UK Centre for Ecology and Hydrology 2017

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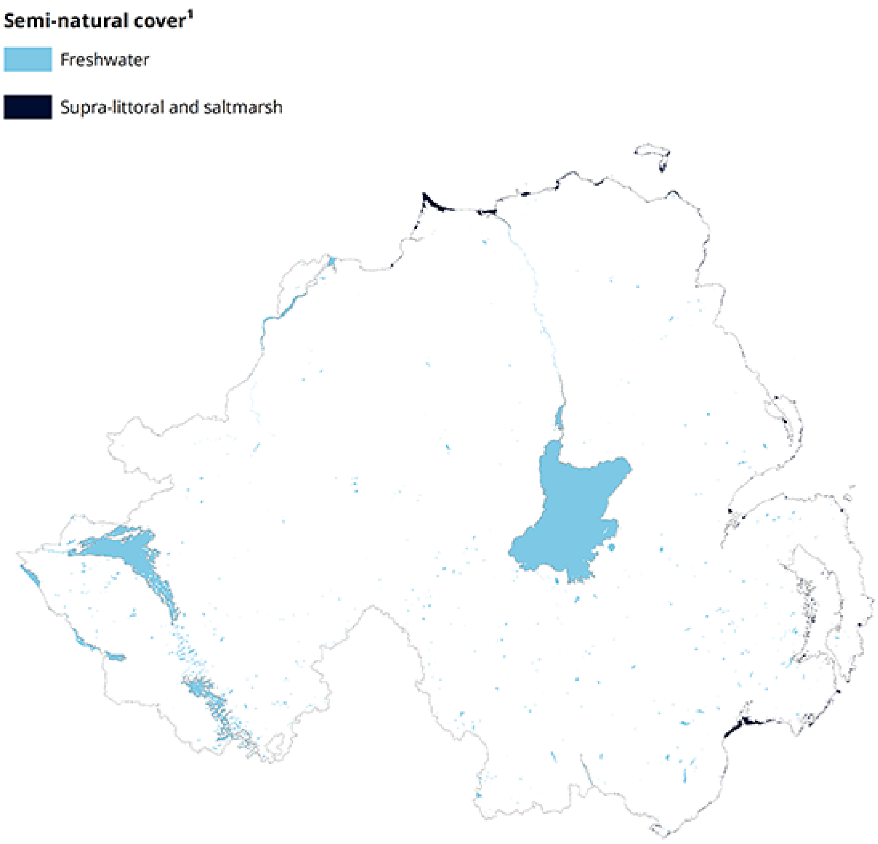
1. Digital Object Identifier (DOI) for LCM2015 Vector data for Great Britain. Contains Ordnance Survey data © Crown Copyright 2007, Licence number 100017572. Contains OS data © Crown copyright 2020. Graphic created by ONS Geography.

2. Broadleaved woodland includes only itself. Semi-natural grasslands includes acid grassland, calcareous grassland and neutral grassland. Wetlands includes bog and fen, marsh and swamp. Dwarf shrub heath includes heather and heather grassland. Inland rock includes only itself.

Figure 3: Map of coastal and inland water areas of semi-natural habitat, Northern Ireland, 2015

Semi-natural cover, coastal areas and inland water, Northern Ireland, 2015



Source: UK Centre for Ecology and Hydrology (UKCEH) Enterprise Data Licence Agreement – 1273 LCM2015 © and database right UKCEH 2011

Notes:

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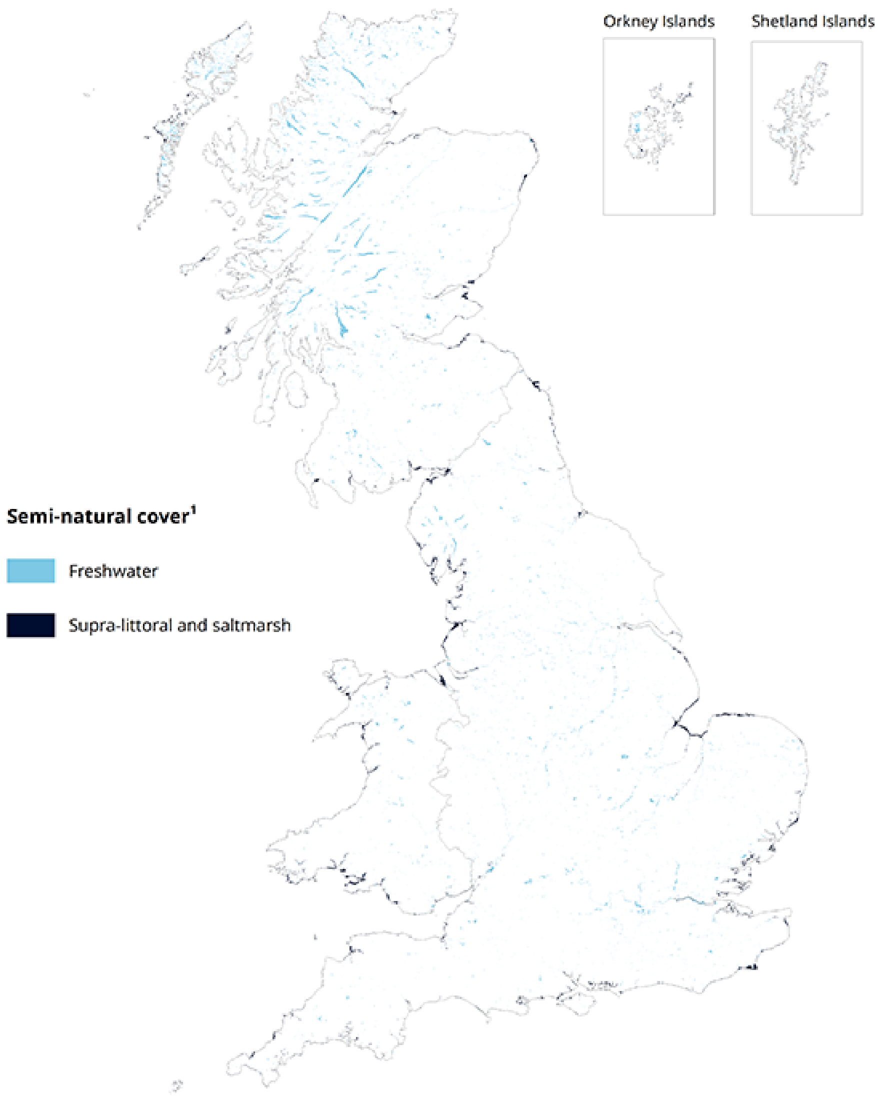
2. Freshwater includes only itself. Supra-littoral and saltmarsh includes saltmarsh, supra-littoral rock and supra-littoral sediment.

Figure 4: Map of coastal and inland water areas of semi-natural habitat, Great Britain, 2015

Semi-natural cover, coastal areas and inland water, Great Britain, 2015



Source: Based upon Land Cover Map (LCM)2015 © UK Centre for Ecology and Hydrology (UKCEH) 2017

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1. Digital Object Identifier (DOI) for LCM2015 Vector data for Great Britain Contains Ordnance Survey data © Crown Copyright 2007, Licence number 100017572. Contains OS data © Crown copyright 2020. Graphic created by ONS Geography.

2. Freshwater includes only itself. Supra-littoral and saltmarsh includes saltmarsh, supra-littoral rock and supra-littoral sediment.

3 . Condition of UK semi-natural habitats

The System of Environmental Economic Accounting (SEEA) defines ecosystem condition as "the overall quality of an ecosystem asset in terms of its characteristics". Suitable condition indicators are needed so there is an understanding of the relationship between the ecosystem condition and the ecosystem services they deliver.

There are a range of metrics for measuring the health of semi-natural habitats, including:

- condition of the soil
- chemistry of the water
- presence of different mammals
- birds, bats and insects as well as the sizes of their populations

All of these metrics reflect ecological health.

Ecologists regularly use a simple set of descriptive words to summarise the overall status of a habitat or species. For instance, "favourable" being good, "unfavourable" being less good, and "destroyed" meaning the habitat at a site is no longer present and there is no prospect of being able to restore it. These descriptors are based on an assessment of an appropriate set of metrics depending on the habitat being measured.

The bird indices on population numbers for woodland and water and wetlands plus butterflies of woodland and semi-natural habitats are in long term decline, with a negative impact on biodiversity. While there has also been a decline in the average numbers of bees counted in the last decade in semi-natural habitats, in the same period the average number of bats counted has increased.

Wildfires in the UK also have a negative impact. There has been a reduction in the area burnt in Scotland between 2009 and 2013, while in Wales, there was an increase in the number primary fires between 2011 and 2019 and in England an increase in area burnt between 2009 and 2017.

The summary of the condition of the UK semi-natural habitats (Table 2 and Table 3) give an overview of the more detailed analysis that follows. The long-term trend looks at the whole time series, while the short-term is the most recent trend and is not a fixed time period and is relative to the length of the time series.

For instance, if a metric has been falling for the last three or five or even seven years within a 30-year dataset (in which the earliest period was actually still lower than the current year), it would have an increasing long-term trend and decreasing short-term trend. Within a five-year dataset the two might not differ.

Table 2: Summary of the condition of UK semi-natural habitats

Condition class	Type	Indicator	Condition	Long term trend	Short term trend
Physical state	Soil	pH	Reduction in acidity all habitats 1978 to 2007	Improving	Improving
	Soil	Carbon	Increase 1978 to 1998, then decline to 2007	Little or no change	
	Soil	Loss of ignition	Reduction in dwarf shrub heath, acid grassland and fen, marsh and swamp and an increase in woodlands, bogs and neutral grassland over long term	Improving woodland, Declining dwarf shrub heath	
	Soil	Bulk density	Data only available one year		
Chemical state	Uplands water	Non-marine sulphate	Concentrations declined from 1996 to 2018	Improving	Little change
	Uplands water	pH	Reduction in acidity	Improving	Improving
	Uplands water	Acid Neutralising capacity	Increasing ability to neutralise acid deposition1989 to 2018	Improving	Improving
	Uplands water	Dissolved organic carbon	Doubled from 1989 to 2018	Declining	Little change
	Uplands water	Nitrate	Gradual long term decline in concentrations	Improving	Little change
	Water Framework Directive	Condition classification	Small increase in % classed as poor 2010 to 2019	Little change	Little change
Compositional state	Birds	Woodland index	Declined 25% between 1970 to 2019	Declining	Declining
	Birds	Lowland dry acid grasslands index	Consistent 1994 to 2019	Little change	Increasing
	Birds	Water and wetlands index	Declined 15% between 1975 and 2019	Declining	Declining
	Birds	Moorland index	Increased 13% between 1994 and 2019	No clear trend	Improving
	Butterflies	Semi-natural specialist index	Declined 59% between 1976 and 2019	Declining	Little change
	Butterflies	Woodland index	Declined 41% between 1990 to 2019	Declining	Increasing
	Moths	Woodland index	Declined 2% between 1990 and 2019	Little change	Little change
	Moths	Moorland index	Increased 80% between 1991 to 2018	Improving	Improving
	Bees	Semi-natural bee count	Declined average number bees counted from 2010 to 2019	Declining	Little change
	Bees	Diseases in bees	Increase in European foulbrood disease in apiaries 2009 to 2020	Declining	Declining

	Bats	Semi-natural index GB	Increased 21% between 1999 and 2019	Improving	Improving
	Fresh water salmonids	Rod caught fish	Declined 53% between 1994 to 2019	Declining	Little change
	Invasive species	Native woodlands GB	National Forestry Inventory first assessment 90% favourable		
	Pest and diseases	Native woodlands GB	National Forestry Inventory first assessment 84% favourable		
	Herbivores and grazing	Native woodlands GB	National Forestry Inventory first assessment 48% favourable		
	Regeneration	Native woodlands GB	National Forestry Inventory first assessment 15% favourable		
	Age distribution	Native woodlands GB	National Forestry Inventory first assessment 20% favourable		
	Deadwood	Native woodlands GB	National Forestry Inventory first assessment 5% favourable		
	Veteran Trees	Native woodlands GB	National Forestry Inventory first assessment 1% favourable		
Functional state	Vertical structure	Native woodlands GB	National Forestry Inventory first assessment 52% favourable		
Landscape level	Habitat connectivity	Functional connectivity England	Increasing connectivity neutral grasslands 1990 to 2007	Improving	Improving
	Habitat connectivity	Functional connectivity England	No significant change connectivity broadleaved woodlands 1990 to 2007	Little change	Little change
	Habitat connectivity	Functional connectivity Scotland	No change over time as data for 2017 only		
	River naturalness	Impact ratio - Wales	2007-8 South East Wales 82.6% had high departure from naturalness		
	River naturalness	Pressures surface water	25% did not reach good condition in 2009		
	River naturalness	Physical limiting factors - England	9,485 rivers limited by physical integrity in 2017		

Source: UK Centre for Ecology and Hydrology[1]

Notes

1. Additional data sources: Countryside Survey, Joint Nature Conservation Committee, Bat conservation trust, Bumble Bee Conservation Trust, National Bee Unit, Department for Environment, Food and Rural Affairs, Rothamsted Research, Forest Research, Environment Agency, Marine Scotland, NatureScot, Welsh Government, Natural England and Natural Resources Wales.

The System of Environmental Economic Accounting (SEEA) is developing a typology of condition for ecosystem accounting. Included is the use of ancillary data, which is classed as data that are not included in the condition accounts, however, they are data that can be used as a proxy for missing metrics. SEEA classes data on protected sites and pressure indicators, such as wildfires, as ancillary data (Table 3.).

Table 3: Summary of ancillary condition indicators of semi-natural habitats, Great Britain

Indicator	Condition	Long term trend	Short term trend
Sites of Special Scientific Interest (SSSI) England	Increase in areas classed as unfavourable 2011 to 2019	Declining	Declining
SSSI/Special Areas of Conservation (SAC) /RAMSAR Scotland	Decrease in sites classed as unfavourable for grasslands, heath, wetlands and coastal 2007 to 2020	Improving	Little change
SAC Wales	Increase in areas classed as unfavourable 2011 to 2012	Declining	Declining
Area burnt England	Increase in area burnt from 572 ha in 2009-10 to 1,216 ha in 2016-17	Declining	Little change
No. primary incidents Wales	Increase in number primary fires from 51 in 2011-12 to 83 in 2018-19	Declining	Declining
Area wildfires Scotland	Reduction in area wildfires from 2,833 ha in 2009-10 to 1,337 in 2012-13	Improving	Improving

Source: Forestry Commission Scotland, Welsh Government, Natural England, NatureScot and Natural Resources Wales

Physical and chemical state condition indicators

Soil indicators

Soil is important for providing many essential ecosystem services. Monitoring trends over time of specific soil indicators provides a suitable condition indicator for semi-natural habitats. The Environment Agency states that soil holds three times as much carbon as the atmosphere, absorbs water and therefore reduces the risk of flooding. It is also a wildlife habitat and delivers 95% of global food supplies. In 2019 the Environment Agency identified:

- almost 4 million hectares of soil that are at risk of compaction (soil particles pressed together)
- more than 2 million hectares of soil are at risk of erosion
- intensive agriculture has caused arable soils to lose about 40% to 60% of their organic carbon
- soil degradation was calculated in 2010 to cost £1.2 billion every year

The Environmental Agency used indicators including:

- pH (acidity) levels
- carbon levels
- loss of ignition (organic matter content)
- bulk density (weight soil in a given volume)

Acidity

The pH levels in soil is a measure of acidity. A low pH level is more acidic and can be damaging for some habitats. Mountains, moorland and heath (MMH) habitats, shown in Figure 5 as dwarf shrub heath and bracken, have always been naturally acidic. Between 1978 and 2007, the average pH level has increased by 8.6% for dwarf shrub heath and 12.3% for bracken, reflecting the recovery from acidification and reductions of sulphur emissions since the 1980s (Figure 5).

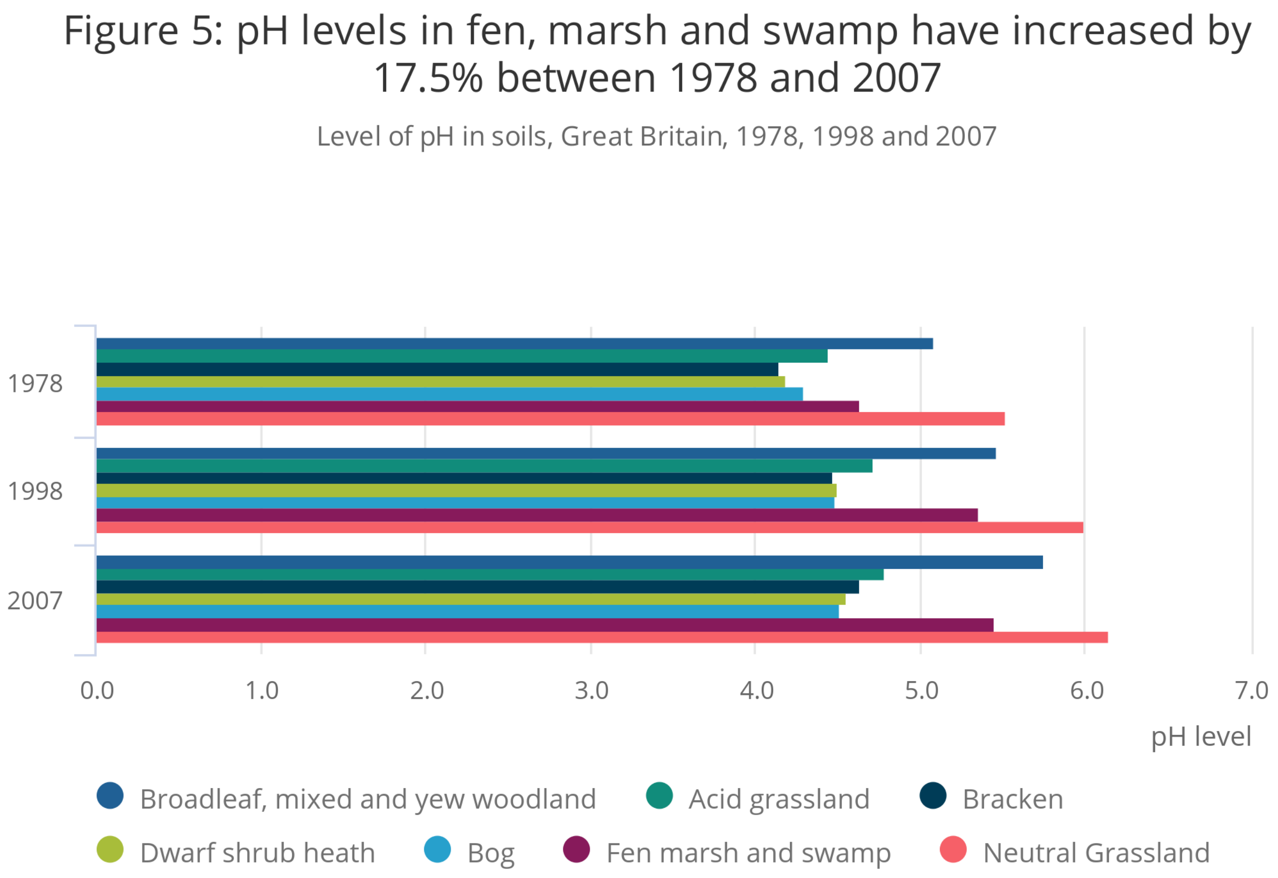
The pH levels of broadleaf, mixed and yew woodland has increased by 13% between 1978 and 2007 (Figure 5). Broadleaved woodlands dominated by oak and birch occur on more acidic and infertile grounds. Broadleaf, mixed and yew woodland pH levels in 1978 were at their lowest level of 5.09 but have since increased to 5.75 in 2007.

Forest Research investigated acidity exceedance and the data for 2004 revealed 69.1% of broadleaved woodland (managed) and 58.6% of unmanaged woodland (ancient and semi-natural) habitat area was exceeded for acidity critical loads. With acid deposition above the critical load there is a risk of damage to the ecosystem.

Neutral grassland and acid grassland have seen increases in pH levels of 11% and 8%. Fen, marsh and swamp have increased pH by 17.5% from 1978 to 2007 and bogs have had a 5.1% rise in the same period (Figure 5).

Figure 5: pH levels in fen, marsh and swamp have increased by 17.5% between 1978 and 2007

Level of pH in soils, Great Britain, 1978, 1998 and 2007



Source: Countryside Survey

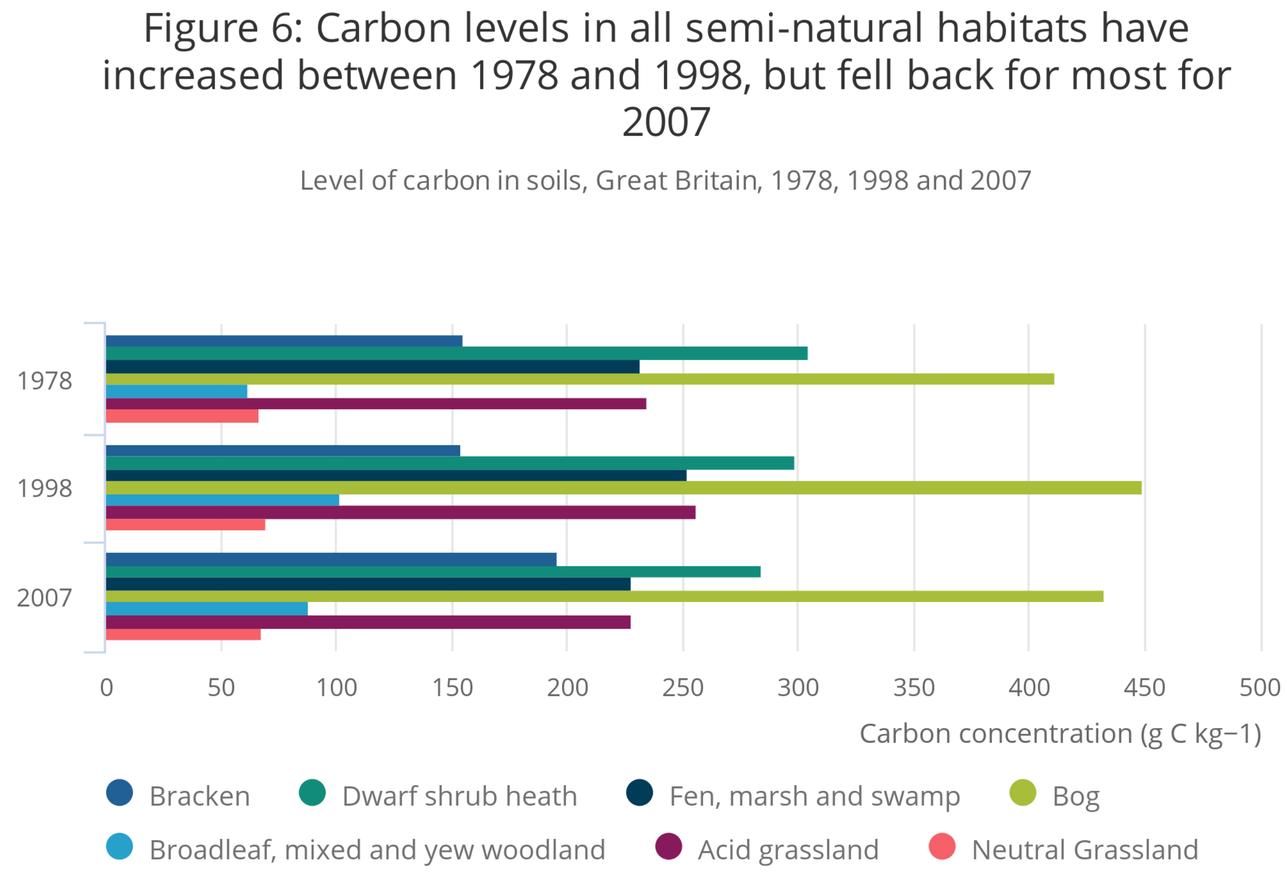
A report carried out on behalf of Natural England investigated soil pH and nutrient status on selected protected sites for acidic grassland, neutral grassland, calcareous grassland and fen, marsh and swamp. A total of 602 soil samples were taken in 2014. The results of the survey suggest that unfavourable condition was a result of high phosphorus and potassium levels in soil.

Carbon

Soil organic carbon is an important indicator of soil quality and it is important for soils to retain their carbon. This plays a critical role in soils maintaining their structure and water retention. Carbon levels in all the semi-natural habitats increased in Great Britain between 1978 and 1998, then decreased between 1998 and 2007. So overall, there was no change in the levels of carbon.

Figure 6: Carbon levels in all semi-natural habitats have increased between 1978 and 1998, but fell back for most for 2007

Level of carbon in soils, Great Britain, 1978, 1998 and 2007



Source: Countryside Survey

Organic matter content

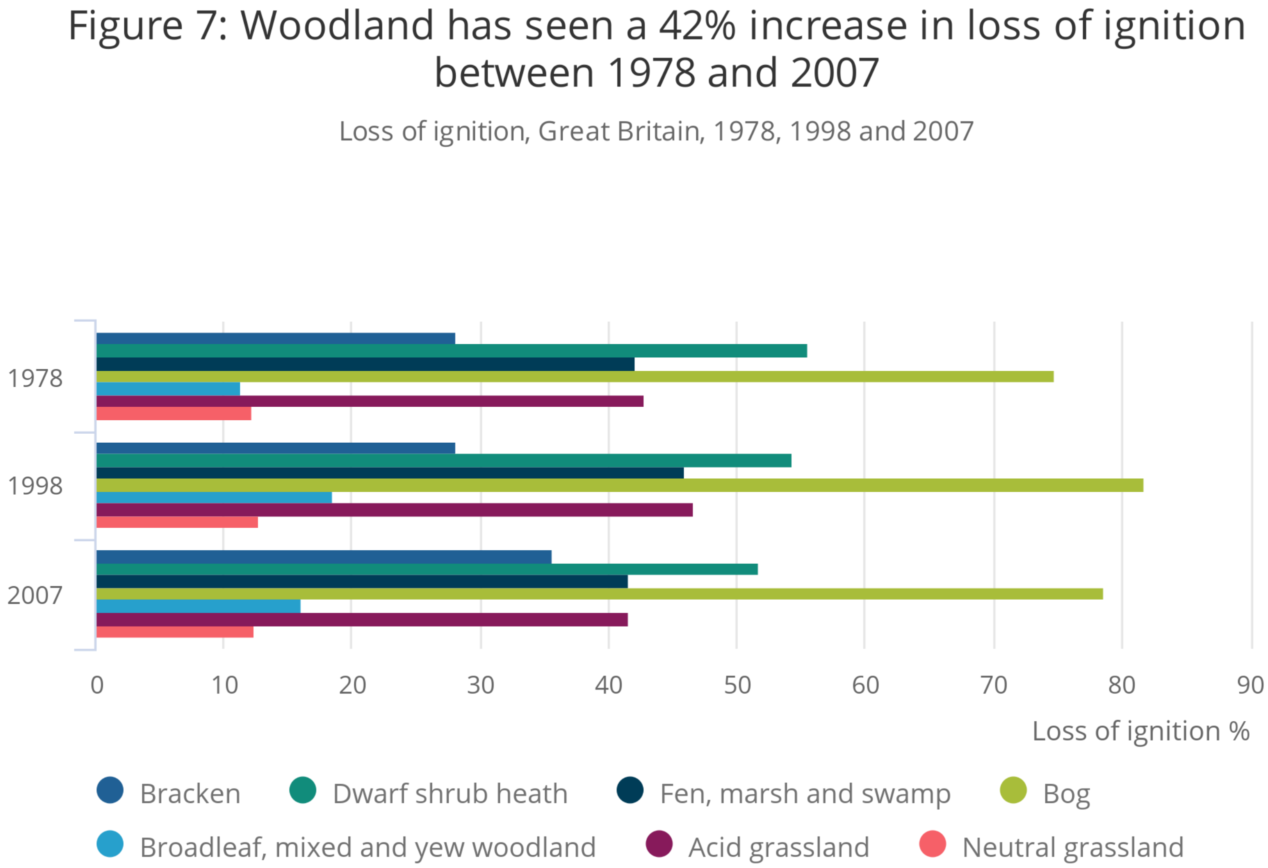
Organic matter content is plant and animal residues in different stages of composition and is another good indicator of the condition of soil.

Ideally, soils should be slowly increasing their levels of organic matter content over time as they have been doing since the last glaciation 11,000 years ago. However, as the climate changes, or grazing pressure, or burning or cutting intensity increases, there can be a loss of organic matter content because of increased decomposition rates of soil organic matter and/or increased erosion of the organic-rich top layer of soil.

Dwarf shrub heath has seen a 7% reduction in loss of ignition from 1978 to 2007 while acid grassland and fen, marsh and swamp have seen a 3% and 1% reduction in loss of ignition respectively during the same time period. Between 1978 and 2007, woodland has seen the largest increase of 42%, with bogs increasing by 5% and neutral grassland by 1%.

Figure 7: Woodland has seen a 42% increase in loss of ignition between 1978 and 2007

Loss of ignition, Great Britain, 1978, 1998 and 2007



Source: Countryside Survey

Bulk density

Bulk density is an indicator of soil compaction and is calculated as the dry weight of soil in a given volume. Compaction of soil prevents plant growth and increases erosion. A high bulk density is an indicator of poor condition as it can restrict root growth and increase soil erosion. The Countryside Survey only has 2007 data available (Table 4) and therefore cannot be used as an indicator of soil condition change over time.

Table 4: pH, loss of ignition and bulk density in semi-natural habitats, Great Britain, 1978, 1998 and 2007

	pH			Loss of Ignition			Bulk density
	1978	**1998**	**2007**	**1978**	**1998**	**2007**	**2007**
Bracken	4.14	4.47	4.64	28.22	28.13	35.62	0.43
Dwarf shrub heath	4.19	4.5	4.55	55.51	54.31	51.8	0.35
Bog	4.29	4.49	4.51	74.87	81.8	78.71	0.17
Fen marsh and swamp	4.64	5.35	5.45	42.13	45.96	41.56	0.45
Broadleaf, mixed and yew woodland	5.09	5.47	5.75	11.35	18.58	16.13	0.78
Acid grassland	4.44	4.72	4.78	42.75	46.67	41.55	0.43
Neutral Grassland	5.52	5.99	6.14	12.2	12.75	12.36	0.9

Source: Countryside Survey and Centre for UK Ecology and Hydrology

Uplands water quality

The UK Acid Waters Monitoring Network was set up in 1988 to investigate the chemical and biological responses of acidified streams and lakes to changes in air quality and "acid rain". It later became the UK Uplands Water Monitoring Network (UWMN) in 2013 and now has a wider remit to also investigate impacts of climate change and land management on these systems.

Among a wide range of variables, the UWMN measures the acidity and acid neutralising capacity (ANC) of these waters, together with dissolved organic carbon (DOC), nitrate and non-marine sulphate. Year-on-year changes in these metrics across a wide range of sites provide a strong indication of how the water quality our upland streams and lakes has been evolving over recent decades.

Currently the UWMN samples around 26 sites regularly for water quality assessment. Sites from mountain, moorlands and heath areas were extracted and data were upscaled to a UK level for the purpose of this report. While the number of sites is limited, they show highly coherent behaviour in the metrics presented. This indicates that the changes observed should be broadly representative of changes in acid-sensitive upland waters more widely.

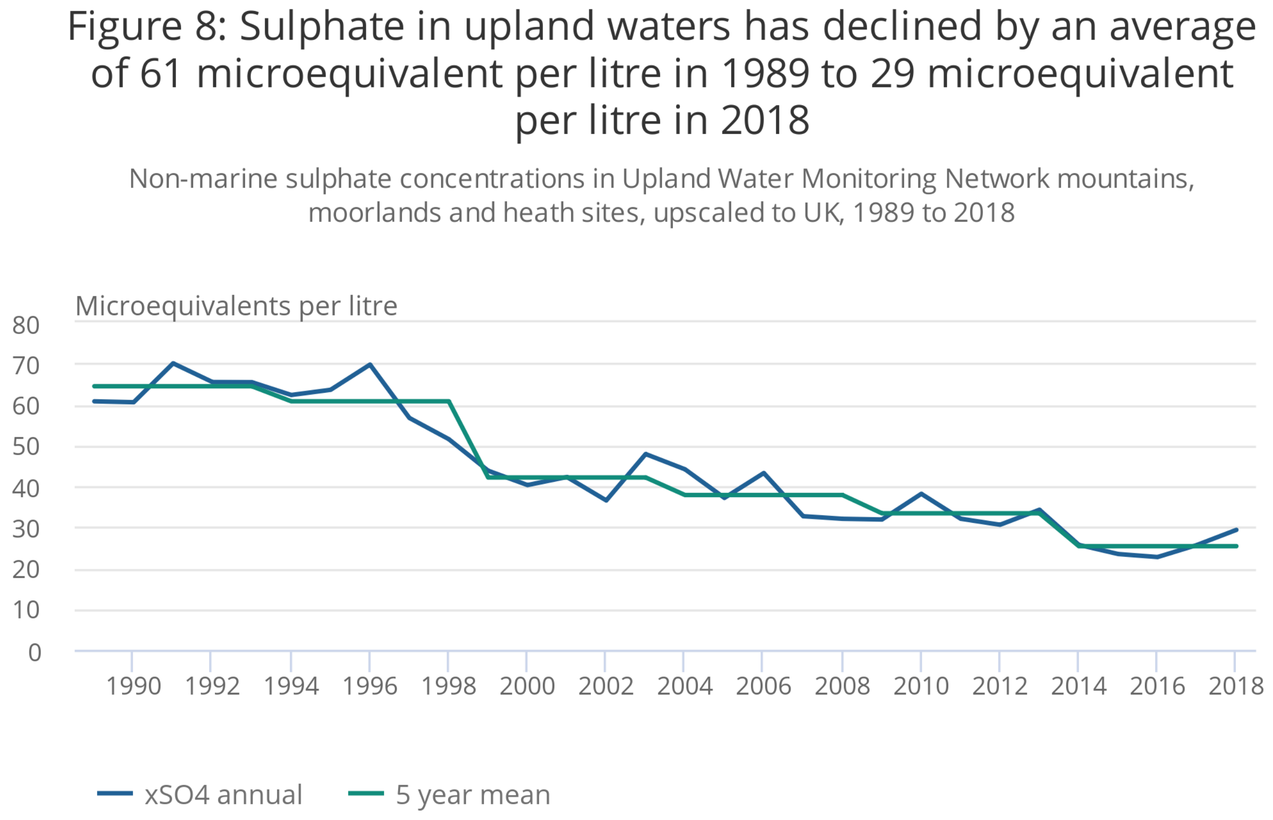
Non-marine sulphate

Non-marine sulphate in upland surface waters represents the chief acidifying anion (a negatively charged ion) and is mostly derived from the burning of fossil fuels by power stations and heavy industry. Upland water condition has improved from the reduction in concentrations of non-marine sulphate from 1996 to 2018, from an average of 61 to 29 microequivalent per litre in our dataset, with the most rapid reduction occurring in the late 1990s (Figure 8).

Climatic events can influence the sulphate pollutant signal in upland waters. During droughts, such as the one experienced in the UK in 1995, previously inert sulphur compounds deep in the catchment soils, can re-oxidise as sulphate, resulting in a temporary increase in sulphate concentrations when the rain returns.

Figure 8: Sulphate in upland waters has declined by an average of 61 microequivalent per litre in 1989 to 29 microequivalent per litre in 2018

Non-marine sulphate concentrations in Upland Water Monitoring Network mountains, moorlands and heath sites, upscaled to UK, 1989 to 2018



Source: UK Centre for Ecology and Hydrology

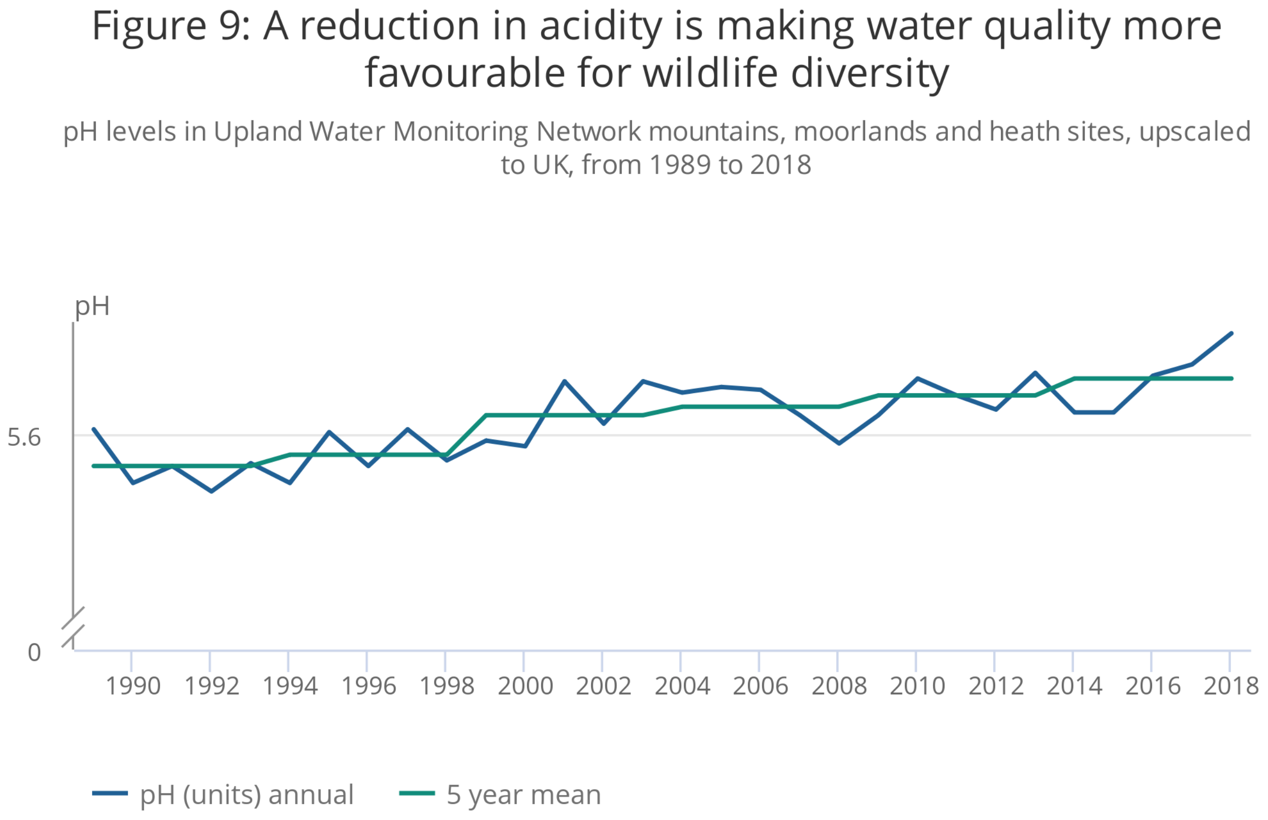
pH

pH is a measure of the acidity or alkalinity of water. It is measured on a scale of pH units between 0 and 14, with low numbers being acidic, seven being neutral and higher values being classed as alkaline. Over the time series (Figure 9) acidity has gradually declined in response to a reduction in acid anions like sulphate.

Figure 9 illustrates the gradual rise in the five-year mean of pH with clear inter-annual variability superimposed. The reduction of acidity is considered to be making these waters more favourable to a range of aquatic organisms, including algae, higher plants, macroinvertebrates and fish.

Figure 9: A reduction in acidity is making water quality more favourable for wildlife diversity

pH levels in Upland Water Monitoring Network mountains, moorlands and heath sites, upscaled to UK, from 1989 to 2018



Source: UK Centre for Ecology and Hydrology

Acid neutralising capacity

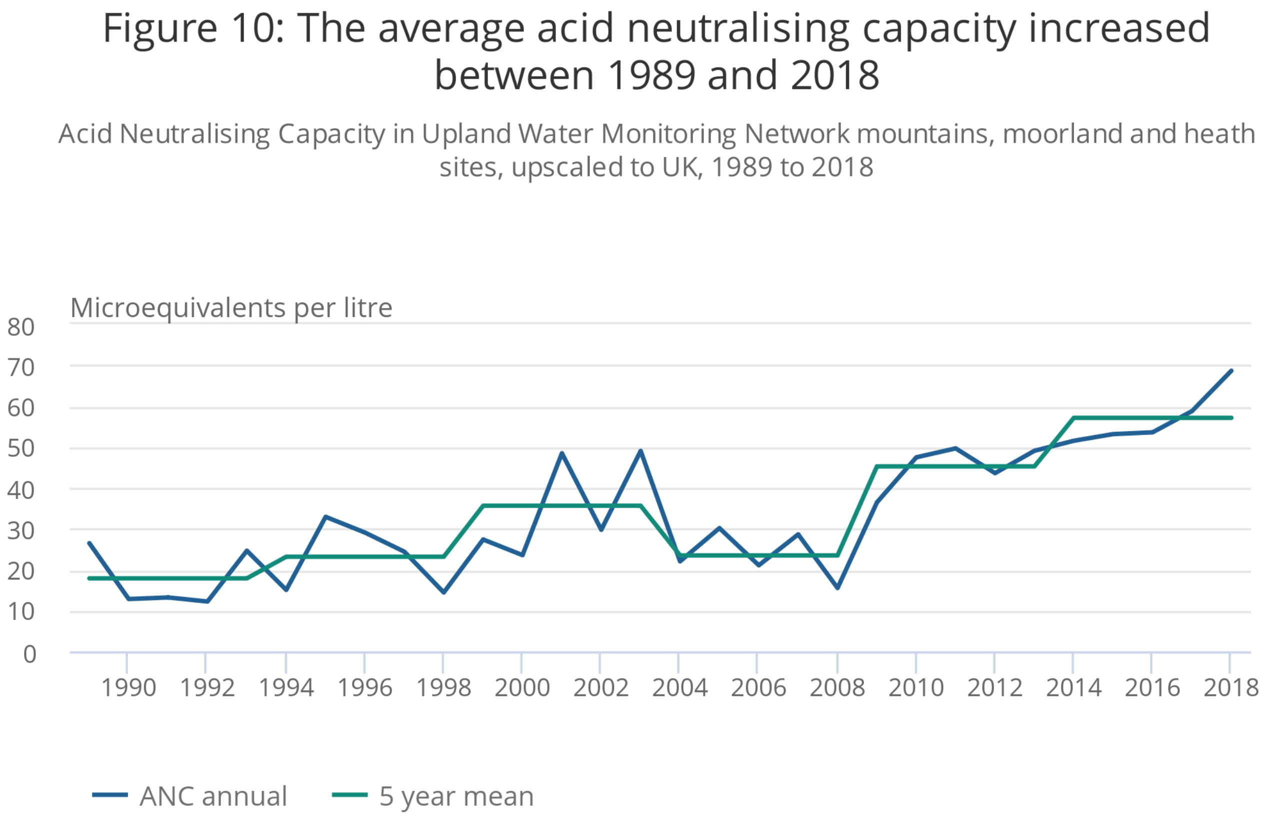
Acid neutralising capacity (ANC) is a measure of the capacity of water to resist changes in pH levels. Catchments whose drainage waters have higher levels of ANC have a greater ability to neutralise acid deposition.

An increase in ANC is favourable for water quality because this represents an increases ability of a system to neutralise acid inputs. The timeseries (Figure 10) shows that on average, the ANC of these waters has increased from 26 to 69 microequivalent per litre, from 1989 to 2018.

Figure 10 shows that superimposed on gradual increase in the long-term mean ANC has shown significant inter-annual variations, much of which can be attributed to changes in rainfall and amounts of sea salt deposited during winter storms.

Figure 10: The average acid neutralising capacity increased between 1989 and 2018

Acid Neutralising Capacity in Upland Water Monitoring Network mountains, moorland and heath sites, upscaled to UK, 1989 to 2018



Source: UK Centre for Ecology and Hydrology

Dissolved organic carbon

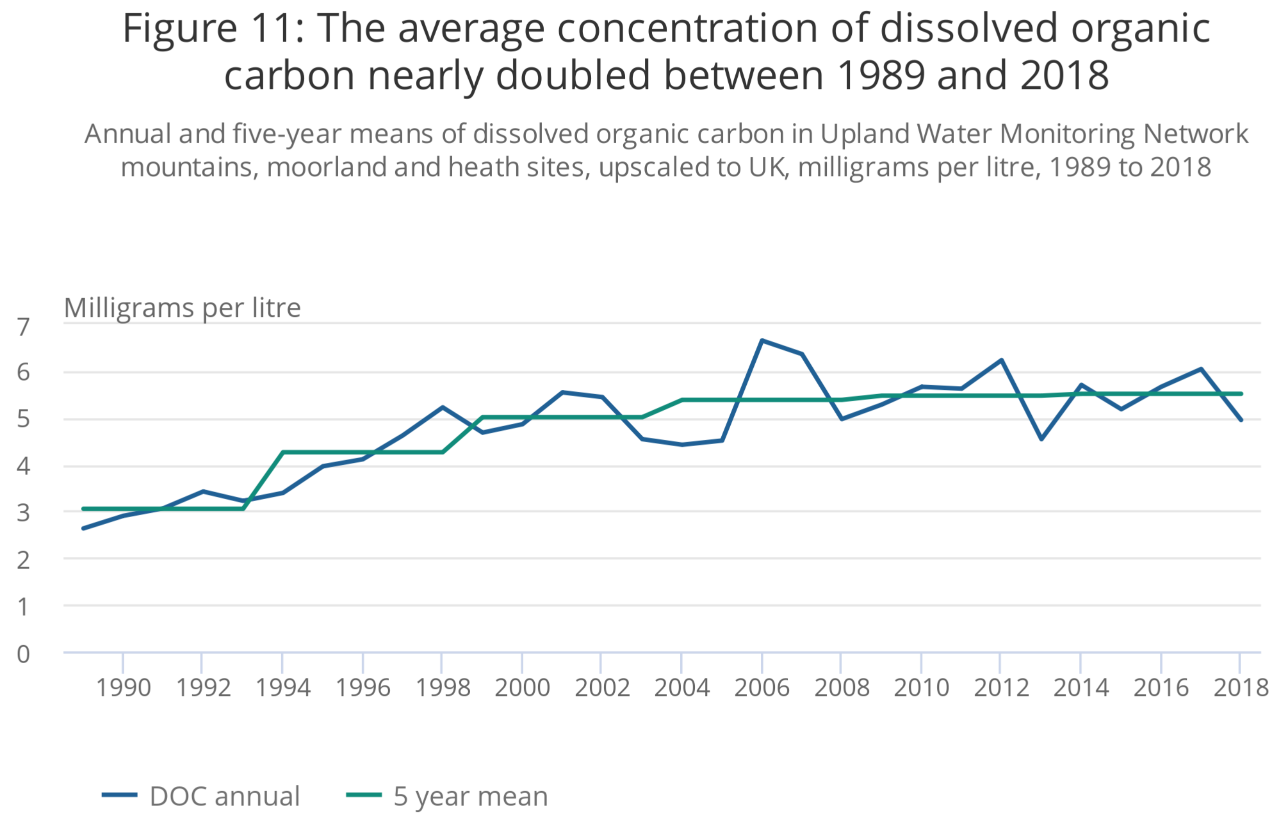
Dissolved organic carbon (DOC) is derived largely from the degradation of plant and soil organic material. It forms a substantial part of dissolved organic matter (DOM) that often causes a brown staining to upland waters. Concentrations of DOC tend to be particularly high in waters draining from peatlands.

A large proportion of the UK's drinking water comes from the uplands and the water industry must remove most of the DOM at an early stage in the treatment process to avoid the creation of potentially toxic disinfection by products. Water that is sourced from degraded peatland has dissolved organic carbon, representing a large cost to water companies to remove it.

As Figure 11 shows, mean concentration of Dissolved Organic Carbon (DOC) in our dataset has roughly doubled from 2.6 milligrams per litre in 1989 to 5.0 milligrams per litre in 2018, however, there is considerable inter-annual variation and it has been flat since 2004. The increase in DOC is thought to be largely because of an increase in the solubility of soil organic matter as upland soils recover from the effects of acidification.

Figure 11: The average concentration of dissolved organic carbon nearly doubled between 1989 and 2018

Annual and five-year means of dissolved organic carbon in Upland Water Monitoring Network mountains, moorland and heath sites, upscaled to UK, milligrams per litre, 1989 to 2018



Source: UK Centre for Hydrology and Ecology

Nitrate

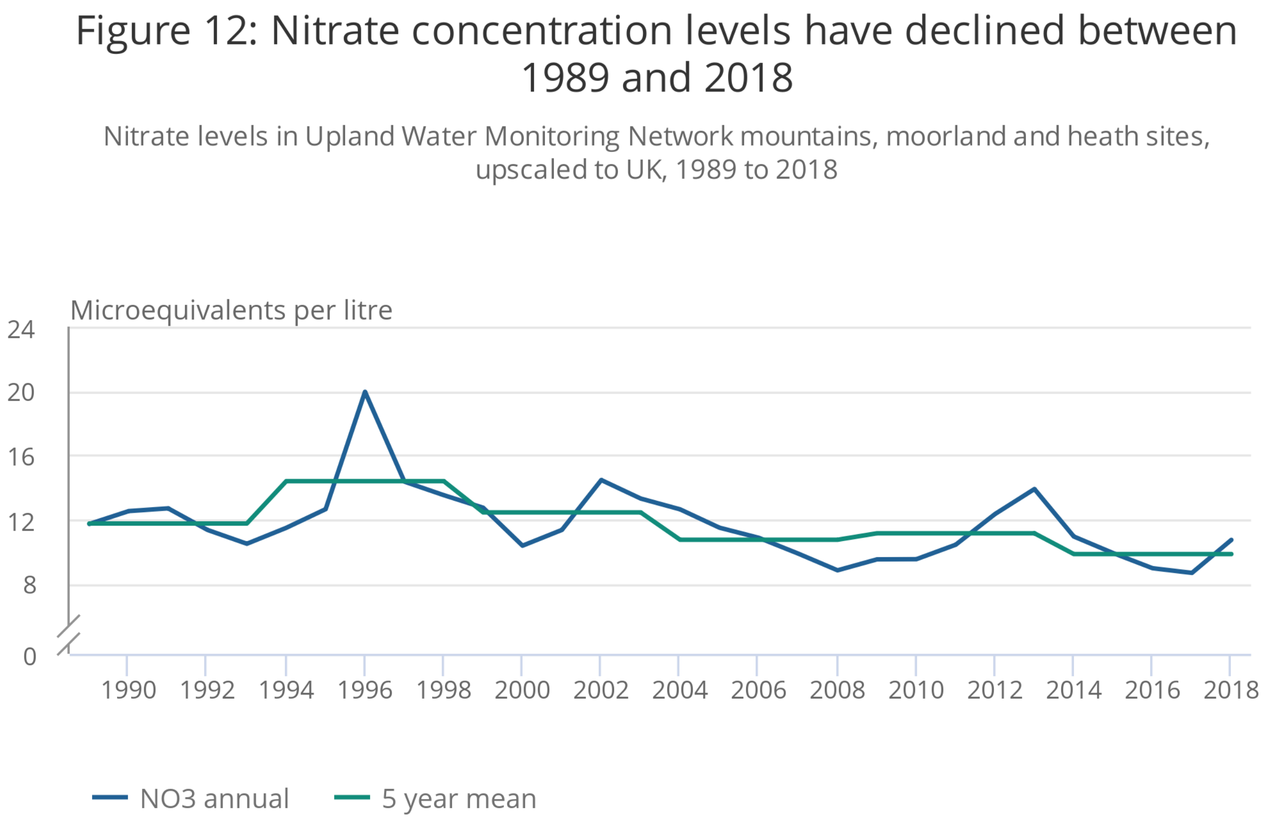
Nitrate concentrations have fluctuated over the time series with substantial inter-annual variations (Figure 12) but also show a gradual long-term decline. This is consistent with a gradual reduction in the atmospheric deposition of nitrogen to these catchments over the monitoring period.

Nitrate concentrations tend to peak during the winter months, when nutrient demands within catchment soils are at a minimum. Analysis by the UKAWMN for data over the period 1998 to 2000 suggested that much of the interannual variation in concentrations could be linked to variations in winter temperatures, with the highest concentrations occurring in the coldest years.

There are health and environmental reasons for concern about the level of nitrates in drinking water. However, the concentrations measured across the Upland Water Monitoring Network (UWMN) are mostly considerably lower than the nitrate concentration limit (50 milligrams per litre) specified under the Drinking Water Directives of 1980 and 1998.

Figure 12: Nitrate concentration levels have declined between 1989 and 2018

Nitrate levels in Upland Water Monitoring Network mountains, moorland and heath sites, upscaled to UK, 1989 to 2018



Source: UK Centre for Ecology and Hydrology

Water quality from Water Framework Directive

The Water Framework Directive (WFD) is an important tool for assessing the water environment across Europe for several types of water bodies, including rivers, lakes and canals. The overall condition of each body of water is examined and categorised into one of five classifications, ranging from "bad" to "high" condition status.

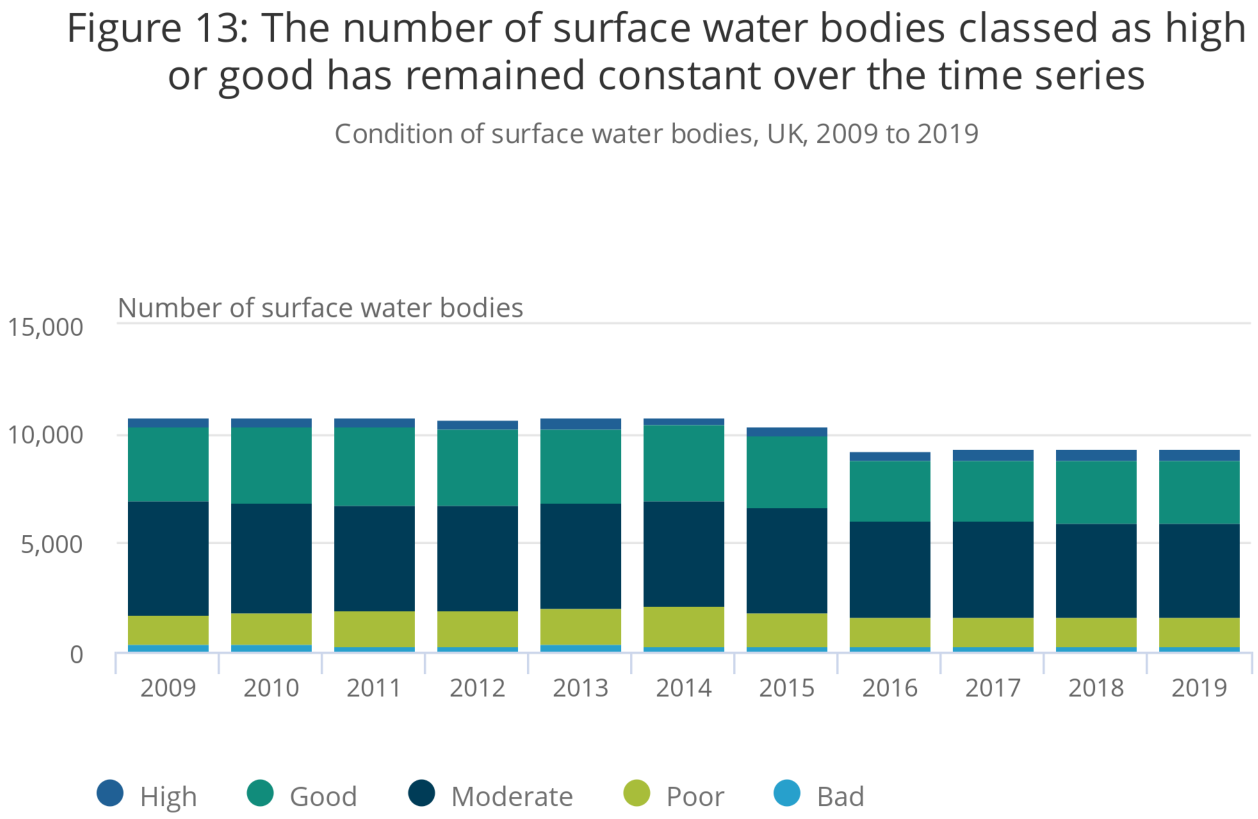
The WFD operates in six-year cycles, with the second (2016 to 2021) cycle currently in effect. This framework helps to classify the quality of water bodies by measuring their ecological and chemical status.

Poor ecological and chemical condition of a surface water body can cause a range of damage, including drinking and bathing water quality, biodiversity, and marine life health. One of the main aims of the WFD, across all surface water bodies in the European Union, is that all bodies of water should be in a "good" condition.

Figure 13 illustrates the number of surface water bodies in the UK and their condition classification (excluding sites classified as "unassessed"). The surface water bodies data are comprised of data from lakes, canals, rivers, estuaries and coastal water bodies. Heavily modified water bodies are also included in this dataset.

Figure 13: The number of surface water bodies classed as high or good has remained constant over the time series

Condition of surface water bodies, UK, 2009 to 2019



Source: Water Framework Directive and Joint Nature Conservation Committee

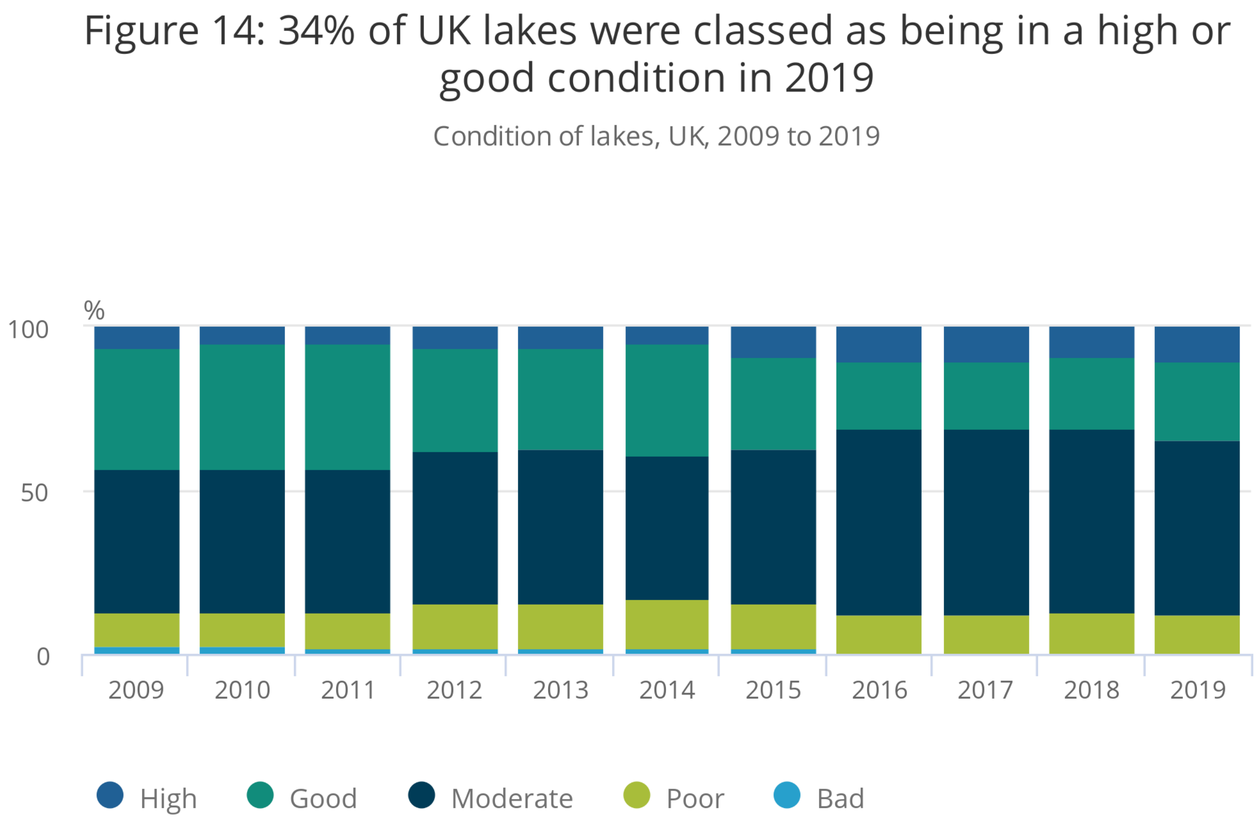
There were 9,301 recorded sites in the UK in 2019, with 2,873 of surface water bodies in "good" condition. From 2016 to 2019, the proportion of sites in a "poor" or "bad" condition remained consistent. There has also been an increase in the number of sites classified as "good" in the period 2016 to 2019, rising by 93 sites. The number of sites classified as "moderate" has fallen in the period 2016 to 2019.

Across the time series shown, there was a decline in the number of water bodies observed from 2015 onwards. This is because of the second phase of the WFD adopting different classification standards and excluding measurement of any water body catchment area that is less than 10 square kilometres.

Figure 14 provides an overview of the condition of UK lakes as a percentage; lakes are a subset of the data in Figure 13. In 2019, approximately a quarter of the monitored lakes were in a "good" condition, while the largest individual proportion of lakes is classed as being in a "moderate" condition (54%). The number of lakes in each classification remains consistent in the period 2016 to 2019 (Phase 2 of WFD enacted for these years).

Figure 14: 34% of UK lakes were classed as being in a high or good condition in 2019

Condition of lakes, UK, 2009 to 2019



Source: Water Framework Directive and Joint Nature Conservation Committee

The Water Framework Directive is one of several approaches that national and local governments are using to monitor water quality. Although the initial aim of the WFD indicated that all surface water bodies should be in a "good" condition by 2015, the data presented indicates that small improvements in water quality have been made.

Compositional state condition indicators

Bird index

Bird populations are thoroughly monitored in the UK. Bird populations are considered as a good indicator of the broad state of the wildlife. Birds occupy a range of habitats and their behaviour responds to environmental pressures. The species are selected for the index if they have a population of at least 300 breeding pairs and are a native species. To find out more about how bird populations are counted, please visit the Breeding Bird Survey, British Trust for Ornithology (BTO) website.

In this subsection we present a range of habitat-based bird population indices. Many are official statistics produced by the RSPB and BTO. Some habitats do not yet have official indexes and where this is the case, we took earlier papers on potential species lists for those habitats and built new indices. ONS-built indices are presented as experimental statistics for information and should not be confused with the official indexes.

Woodland

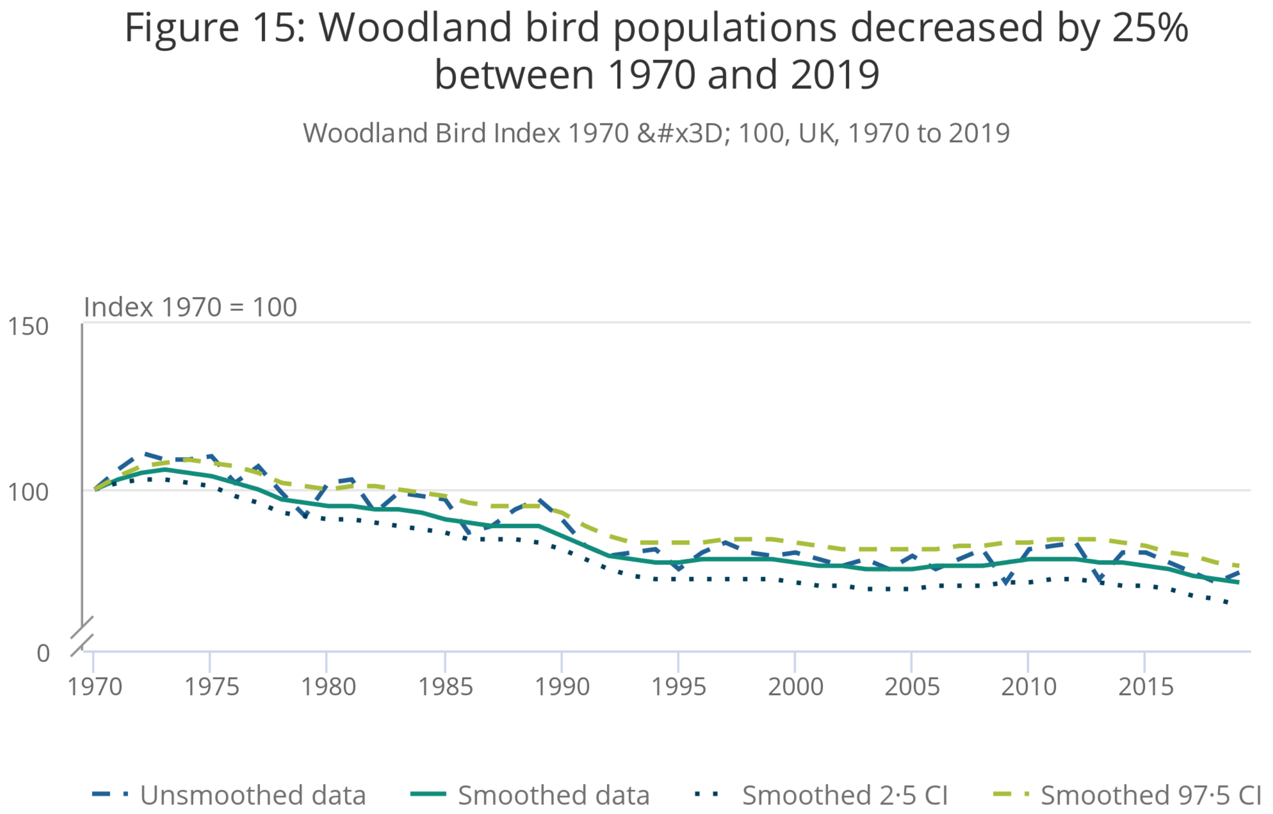
The woodland index covers all woodland including semi-natural broadleaved ones (approximately 55% of total woodland area). The woodland bird populations decreased by 25%, according to unsmoothed data, between 1970 to 2019 (Figure 15). We can see that there was a steep decrease in the early 1990s, then a flattening. Until 2013, when the index began to decline again (Figure 15). Some possible reasons for this decline are outlined in the following, but none of these can be confirmed and the [Royal Society for the Protection of Birds (RSPB) is investigating]() the cause.

Since 1970, 22% of monitored woodland species have increased in population numbers, 32% declined and 46% showed little or no change. Two breeds of bird among those whose populations have increased are the great spotted woodpecker and the nuthatch. According to [Defra's Wild Bird Populations in the UK, 1970 to 2019,]() this decrease may be a result of a lack of woodland management along with increased deer-browsing pressure. Both result in a lack of diversity within woodland and few suitable nesting and foraging habitats.

There has been a decline of more than 80% in five woodland specialist populations since 1970; the lesser spotted woodpecker, lesser redpoll, capercaillie, spotted fly catcher and the willow tit. While the reason for this large decline is unclear, the [RSPB's managing willow tit habitat project]() highlights changes in habitat structures and the drying out of woodland soils as a possible reason.

Figure 15: Woodland bird populations decreased by 25% between 1970 and 2019

Woodland Bird Index 1970 = 100, UK, 1970 to 2019



Source: British Trust for Ornithology; Royal Society for the Protection of Birds; Department for Environment, Food and Rural Affairs – Woodland Bird Index

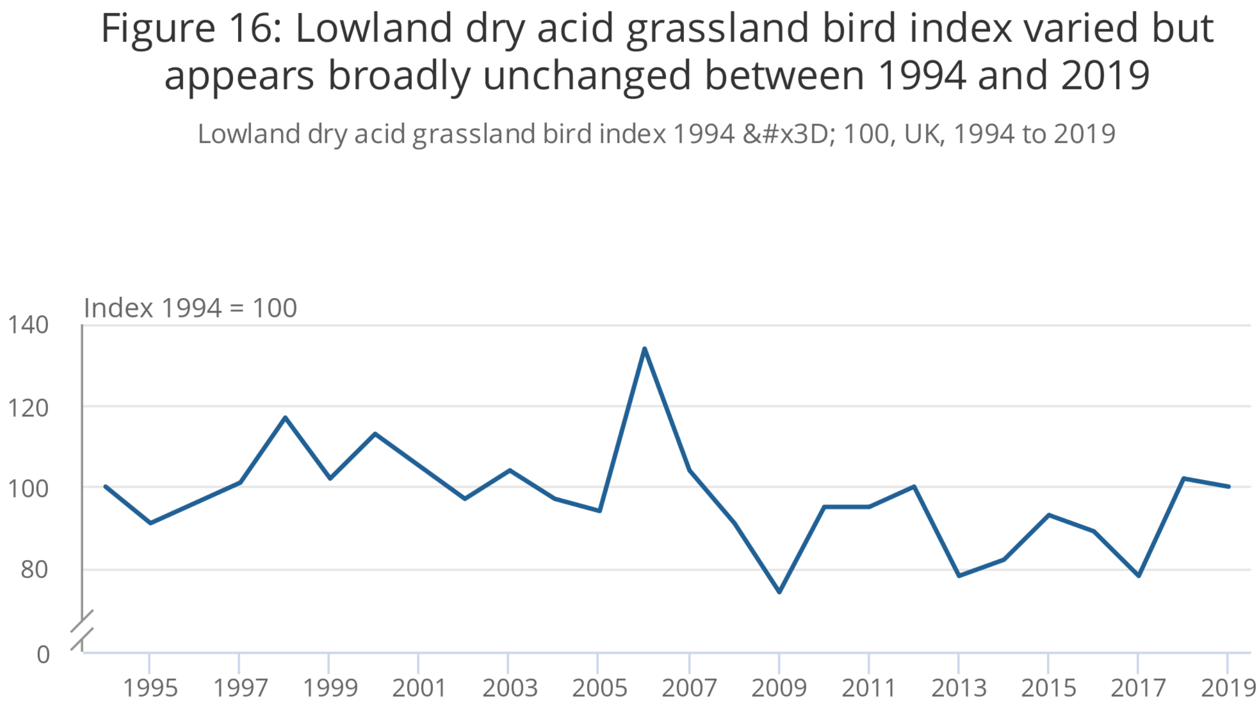
Lowland acid grasslands

The lowland acid grassland bird index, shown in Figure 16, is an unsmoothed index calculated by the Office for National Statistics (ONS) from the Breeding Birds Survey data. The bird species associated with this habitat are similar to other lowland dry grasslands. There has been substantial decline in this habitat during the 20th century which Natural England has attributed this to agricultural intensification.

The index has remained consistent over the long-term. However, there is huge variation in the individual species that are included the index. The chough population, for example, has increased by 152% since 1994 and the hen harrier has increased 57% from 1994 to 2019. The skylark has declined 18% between 1994 and 2019. This has been attributed to changes in farming practices.

Figure 16: Lowland dry acid grassland bird index varied but appears broadly unchanged between 1994 and 2019

Lowland dry acid grassland bird index 1994 = 100, UK, 1994 to 2019



Source: Office for National Statistics and Breeding Birds Survey

Water and wetlands

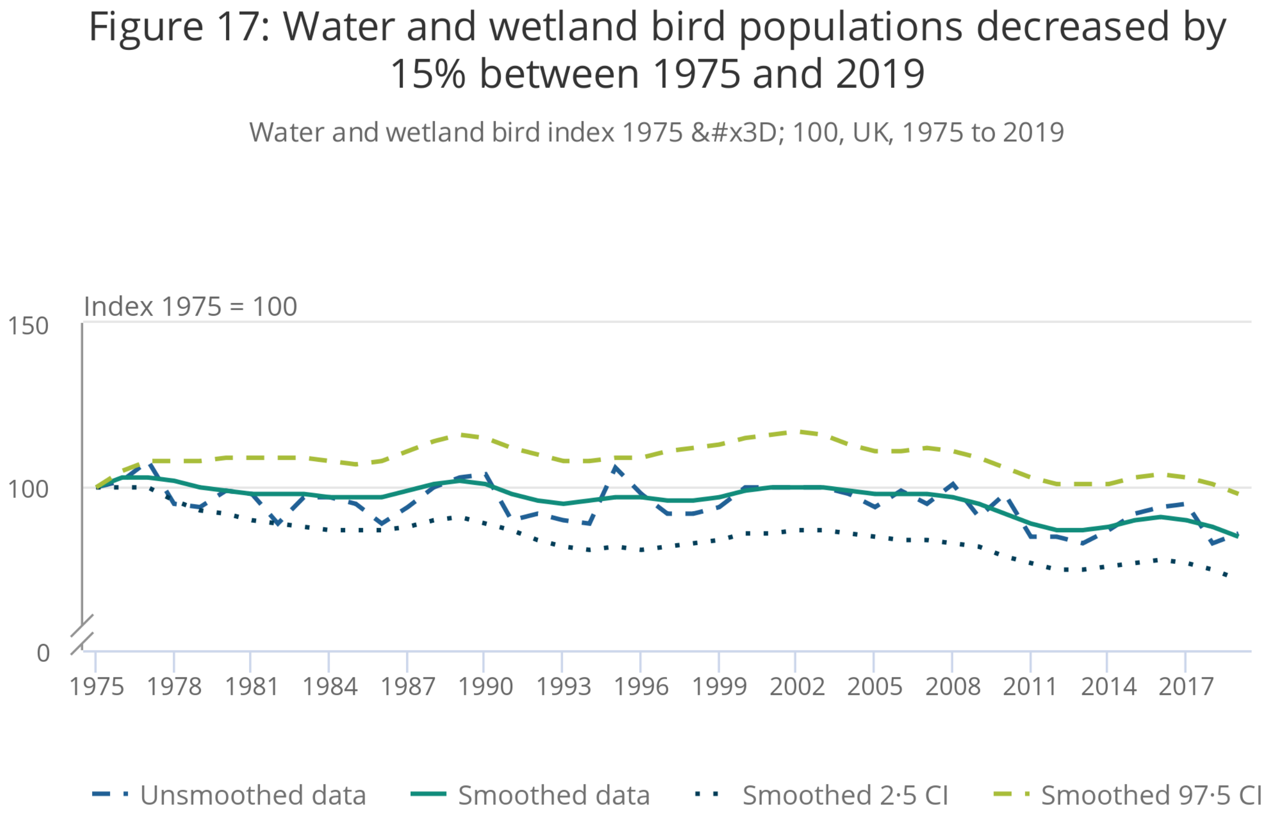
This index includes rivers, ponds, lakes, coastal marshes, reedbeds and other wet grasslands and lowland raised bogs. There are 26 species of birds that live in water and wetland. The bird populations decreased by 15% between 1975 and 2019, according to the smoothed index (Figure 17).

There were declines of 1% in reed bed birds and 52% in wet meadow birds. Those in fast flowing water habitats declined by 25%. The only increase in the index was shown in the slow standing water birds, at 23%.

According to [Defra's Wild Bird Populations in the UK, 1970 to 2019,](#) the decrease in breeding waders may be a result of land management changes. The yellow wagtail has declined by 97% and the snipe by 80% over the long-term. The [British Trust for Ornithology](#) suggests yellow wagtails are in decline because of changes in agricultural practices. However, species associated with bodies of standing water have benefited from the creation of new habitat from restoring gravel pits. The [mallard and tufted duck](#) are two species to have benefited over the long-term and shown an increase; the tufted duck has increased by 65% and mallard almost trebled.

Figure 17: Water and wetland bird populations decreased by 15% between 1975 and 2019

Water and wetland bird index 1975 = 100, UK, 1975 to 2019



Source: British Trust for Ornithology; Royal Society for the Protection of Birds; Department for Environment, Food and Rural Affairs – Water and Wetland Bird index

Moorland

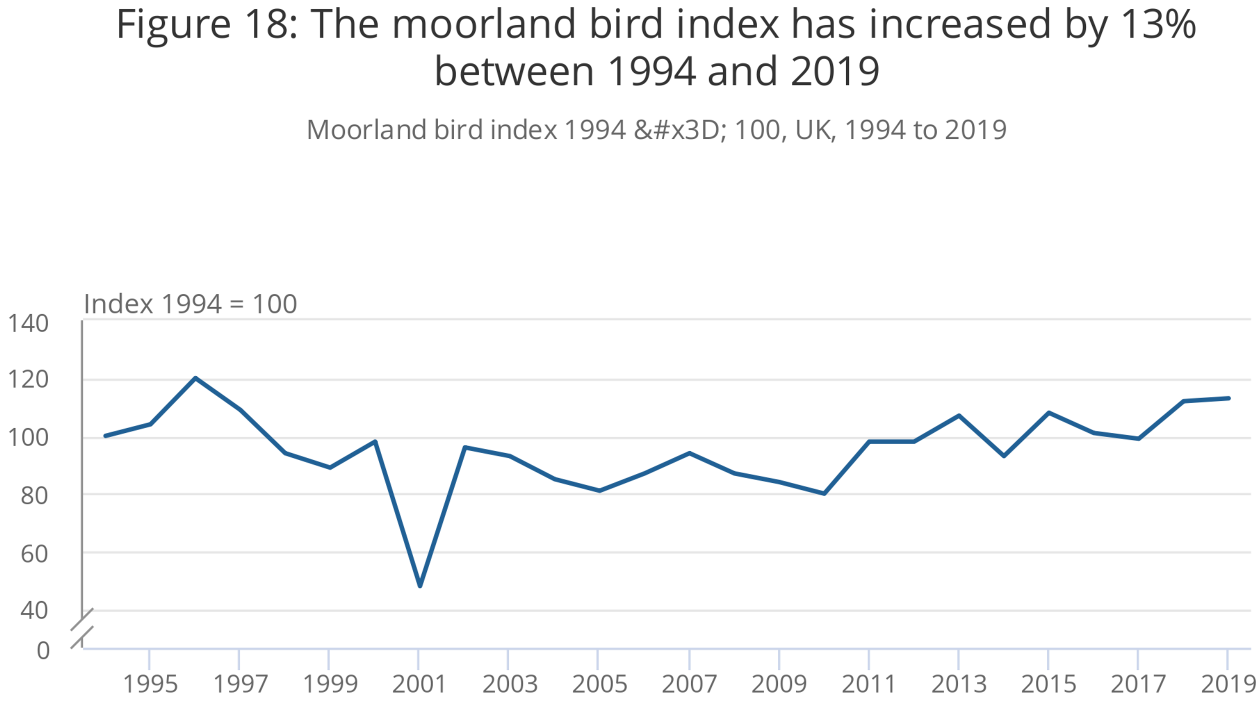
The moorland bird index, shown in Figure 18, is an unsmoothed index calculated by the Office for National Statistics (ONS), using a species list developed in the early stages of potential development of an official index in [UK natural capital: mountains, moorland and heath accounts](#) in 2019. The index between 1994 and 2019 has increased by 13%, with the largest increases being seen in red grouse, raven and hen harrier. There is a noticeable drop in the index in 2001; this is because of reduced monitoring as a result of the foot and mouth outbreak that year when footpaths were closed on moorlands and the number of surveys dropped.

Although the disaggregated index fluctuates, there have been large decreases in some species of whinchat (51%), merlin (36%) and curlew (29%). The hen harrier has seen a 57% increase, helped by the success of Natural England's hen harrier recovery project established in 2002.

Though the hen harrier increases were from a very low baseline and Natural England chairman Tony Juniper stated, “Despite the great progress there is though no cause for complacency. Too many birds still go missing in unexplained circumstances and I urge anyone who is still engaged in the persecution of these magnificent creatures to cease at once.”

Figure 18: The moorland bird index has increased by 13% between 1994 and 2019

Moorland bird index 1994 = 100, UK, 1994 to 2019



Source: Office for National Statistics and Breeding Birds Survey

Butterflies and moths

According to the UK Butterfly Monitoring Scheme, butterflies and moths are good indicators to environmental change as they have short life cycles and react quickly to weather and climate change.

Moths hold vital roles in the wildlife ecosystem with more than 2,500 species present in Britain in a range of habitats. The State of Britain's Larger Moths 2013 report showed the total number of larger moths recorded in the Rothamsted traps national network declined by 28% from 1968 to 2007. Between 1976 and 2017, in the UK, the habitat specialists' butterflies index has reduced by 77% and the abundance of butterflies of the wider countryside has reduced by 46%.

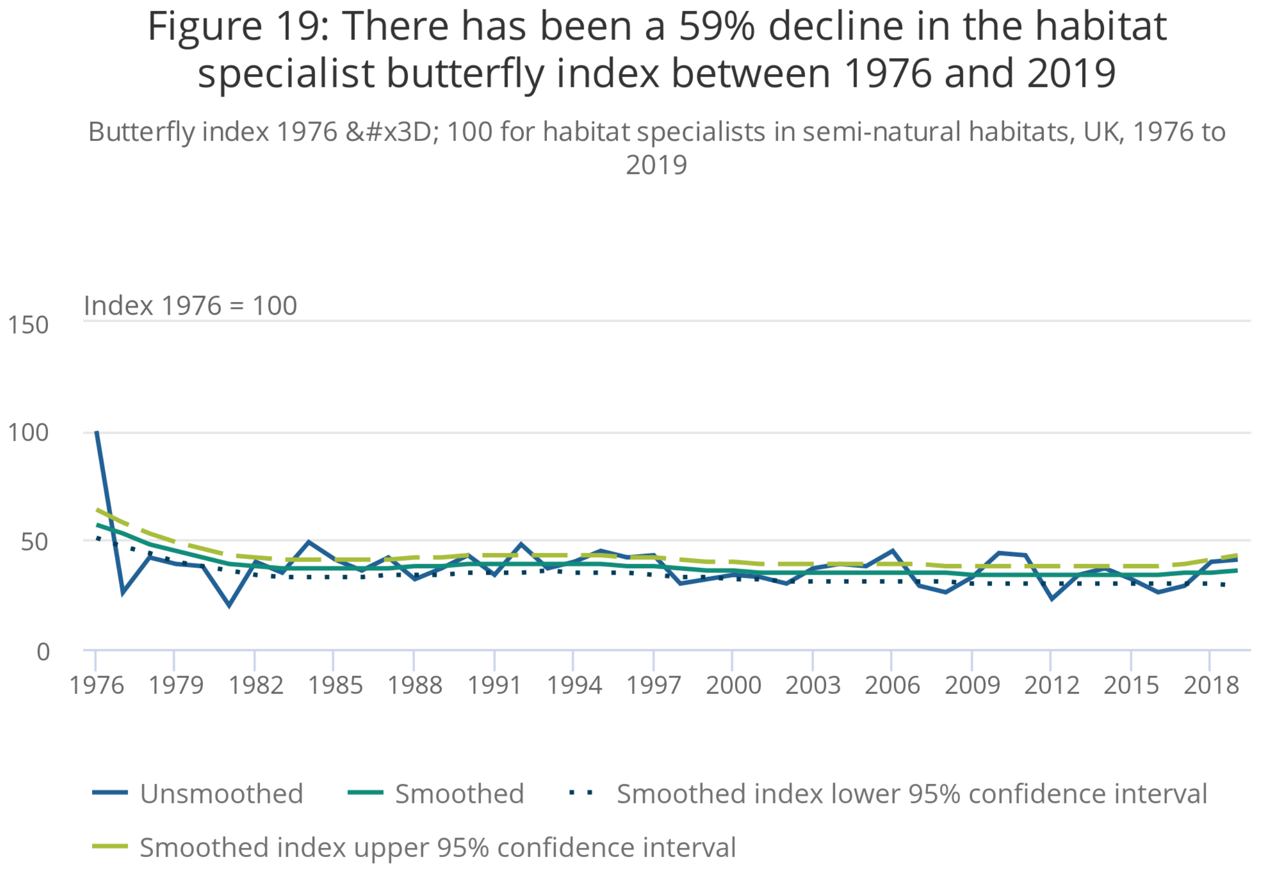
Habitat specialist index

This index includes individual measures for 26 habitat specialist butterflies for low mobility species, restricted to semi-natural habitats. Semi-natural habitat loss and fragmentation has resulted in a decline in habitat specialist butterflies. Habitat fragmentation prevented recovery from the declines experienced in the 1970s, which were mostly to do with the knock-on effects of the drought in 1976.

Figure 19 shows a long-term decline of 59% between 1976 and 2019. The greatest decline since 1976 has been seen in the heath fritillary, Lulworth skipper, wood white, grayling and small pear-bordered fritillary.

Figure 19: There has been a 59% decline in the habitat specialist butterfly index between 1976 and 2019

Butterfly index 1976 = 100 for habitat specialists in semi-natural habitats, UK, 1976 to 2019



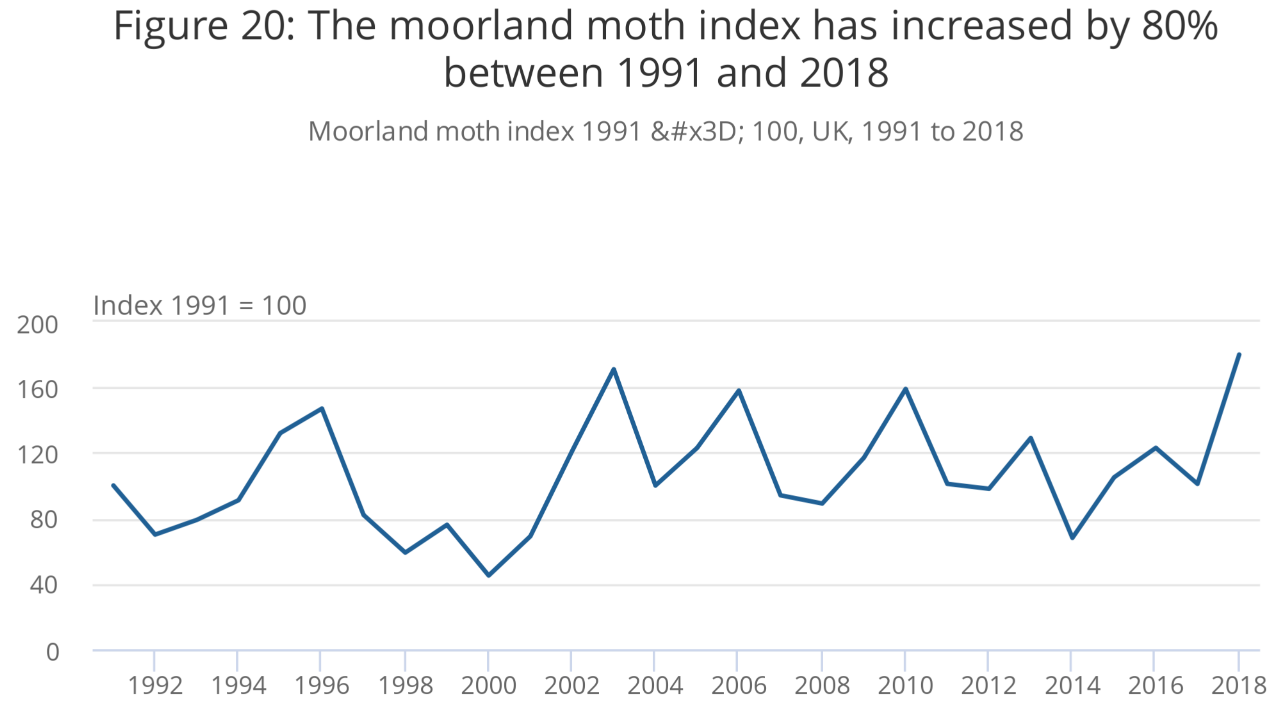
Source: British Trust for Ornithology; Royal Society for the Protection of Birds; Department for Environment, Food and Rural Affairs – Water and Wetland Bird index

Moorland moth index

The unsmoothed index has fluctuated over the time series (Figure 20) for moorland moths, with the highest count of 3,241 recorded in 2018. The index between 1991 and 2018 has increased by 80% from 100 in 1991 to 180 in 2018.

Figure 20: The moorland moth index has increased by 80% between 1991 and 2018

Moorland moth index 1991 = 100, UK, 1991 to 2018



Source: Rothamsted Research

Notes:

1. The Rothamsted Insect Survey, a National Capability, is funded by the Biotechnology and Biological Sciences Research Council under the Core Capability Grant BBS/E/C/000J0200.

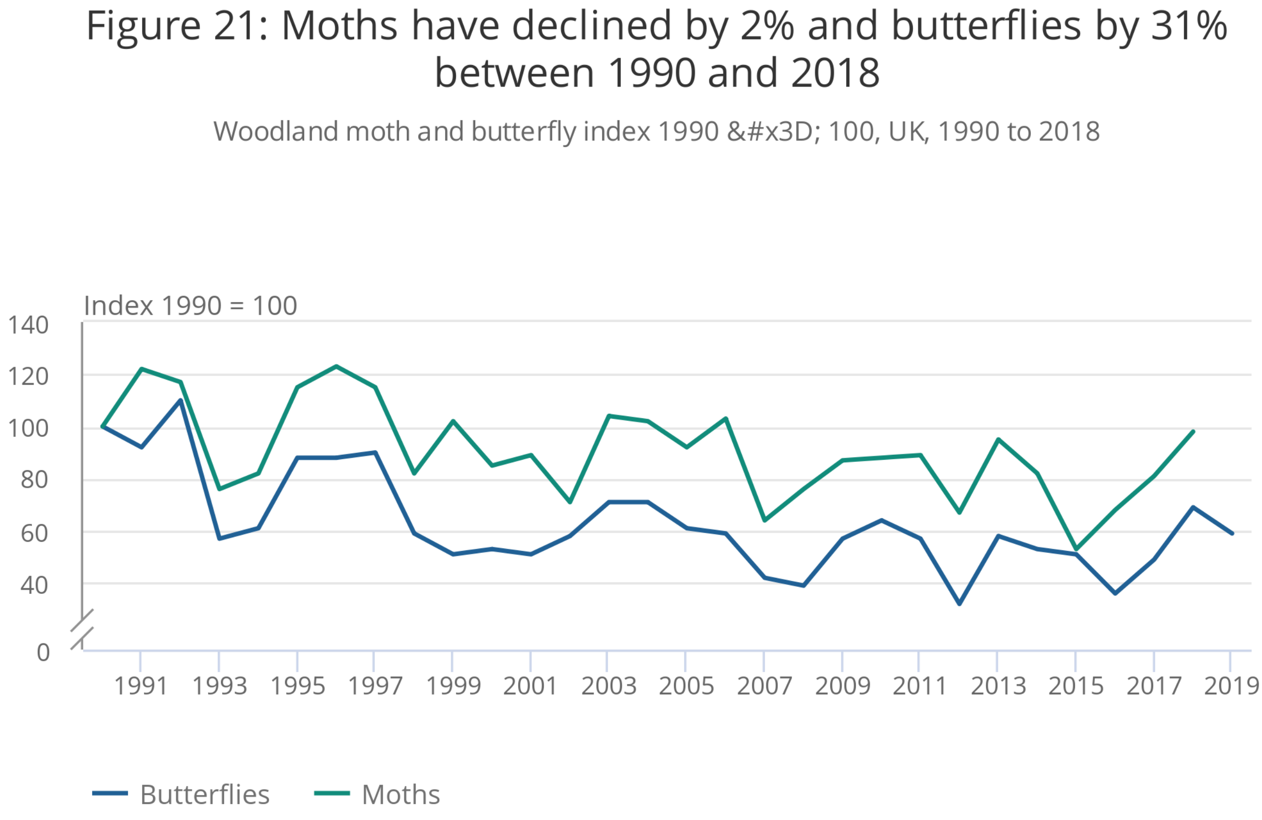
Woodland index

Both woodland moths and butterflies have seen significant declines in the unsmoothed (raw) index in the long-term between 1990 to 2018. Moths have seen a decline of 2% and butterflies have declined by 31% (Figure 21). (Data for butterflies available until 2019 shows a 41% decline).

Changing management practices over recent decades has been suggested for the decline in moths and butterflies in broadleaved woodlands. Reductions in open spaces and increased shade has changed the plant communities, vegetation structure and micro-climates.

Figure 21: Moths have declined by 2% and butterflies by 31% between 1990 and 2018

Woodland moth and butterfly index 1990 = 100, UK, 1990 to 2018



Source: Rothamsted University, Butterfly Conservation; Centre for Ecology and Hydrology; Department for Environment, Food and Rural Affairs – Woodland Butterfly Index

Notes:

1. The Rothamsted Insect Survey, a National Capability, is funded by the Biotechnology and Biological Sciences Research Council under the Core Capability Grant BBS/E/C/000J0200.

Bees

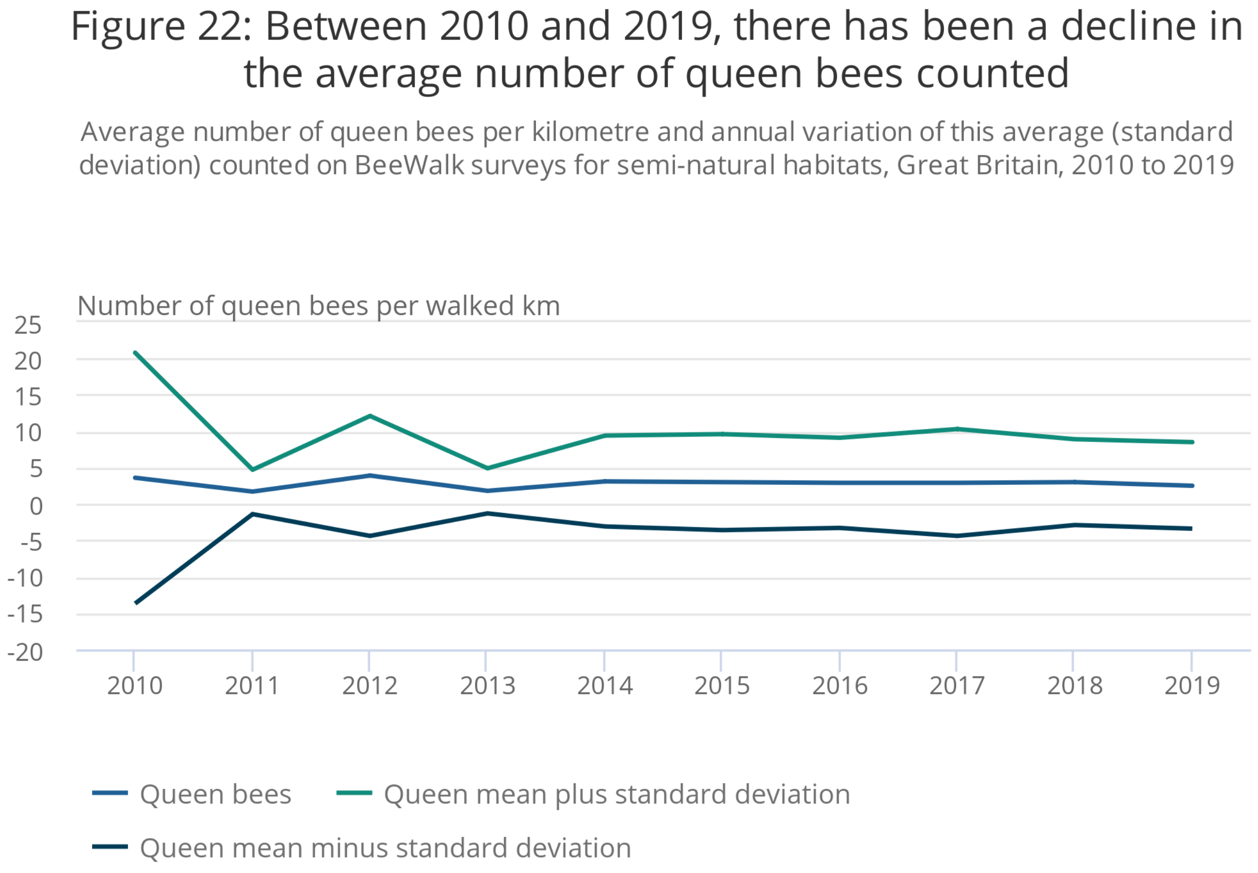
Bees provide a range of ecosystem services as well as being useful indicators of wider ecological health. In particular, bees are one of the main groups of insects responsible for pollination of wildflowers, berries, orchards and crops. As a third of all crops in the UK are pollinator dependent, this is a particularly important service. Habitat loss and degradation is related to a decline in the bee population, making them a useful way of monitoring long-term changes in the condition and health of the environment.

The Bumblebee Conservation Trust runs the BeeWalk Survey Scheme, which uses citizen science volunteers to monitor the number of bumblebees on a monthly walk, along a set route of approximately one mile, from March to October.

The BeeWalk identified worker bees (the most common), drones (fertile males) and [queens](#) (the sole fertile female in any colony). The number of queen bees per kilometre were counted and reported over time (Figure 22). The total number of bees per kilometre (Figure 23) per bee walk acted as indicators of the condition of semi-natural habitats. There was a drop in the average number of bees counted during 2011. This drop corresponds with a year in which England and Wales suffered a significant drought. Over the time series there has been a decline in the average number of bees, counted from 30 in 2010 to 26 in 2019 (Figure 23).

Figure 22: Between 2010 and 2019, there has been a decline in the average number of queen bees counted

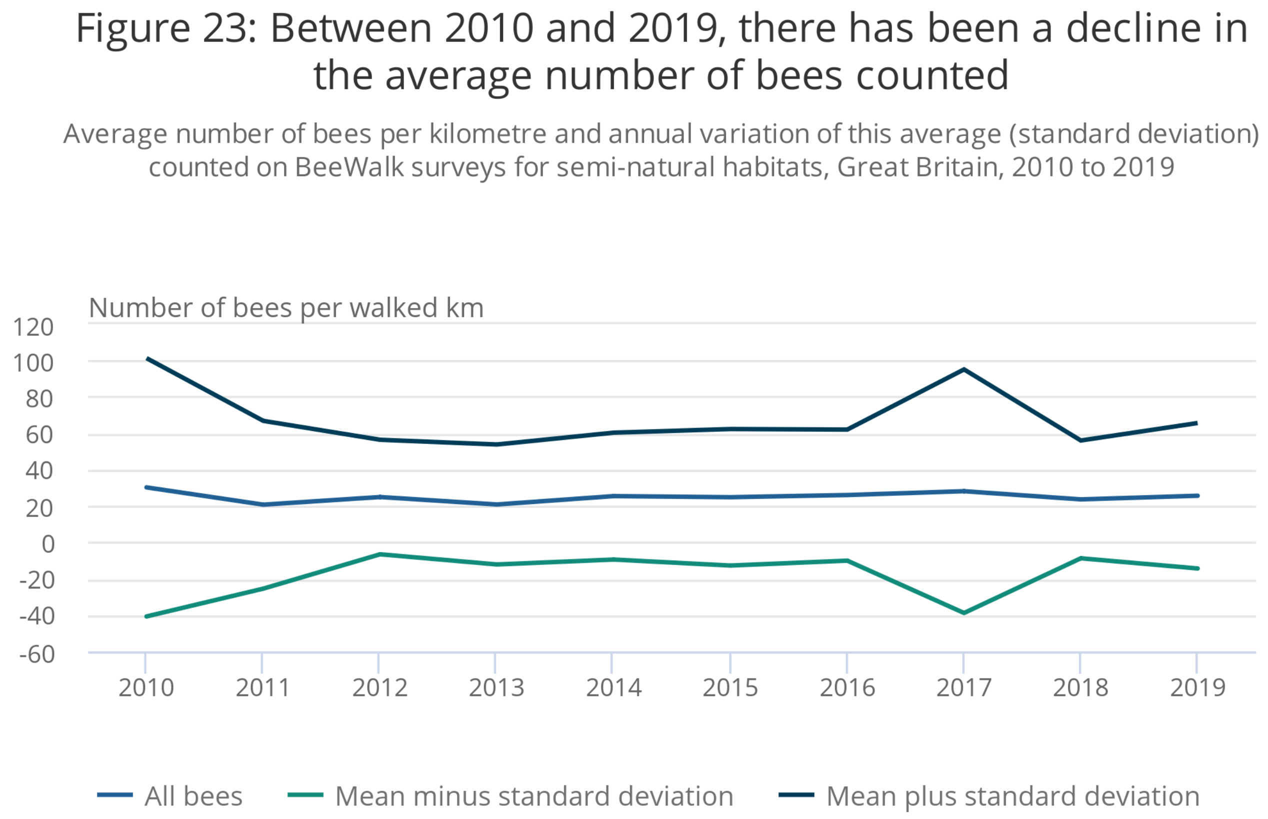
Average number of queen bees per kilometre and annual variation of this average (standard deviation) counted on BeeWalk surveys for semi-natural habitats, Great Britain, 2010 to 2019



Source: Bumblebee Conservation Trust

Figure 23: Between 2010 and 2019, there has been a decline in the average number of bees counted

Average number of bees per kilometre and annual variation of this average (standard deviation) counted on BeeWalk surveys for semi-natural habitats, Great Britain, 2010 to 2019



Source: Bumblebee Conservation Trust

There has been an overall decline in wild bee diversity over the last 50 years in the UK. It is estimated that in the UK 97% of unimproved grassland was lost in Wales and England between 1932 and 1984. This means species-rich grassland in the UK is now fragmented and often degraded. This loss of unimproved flower-rich grassland is attributed as a cause of the decline in many bumblebee species.

Diseases in bees

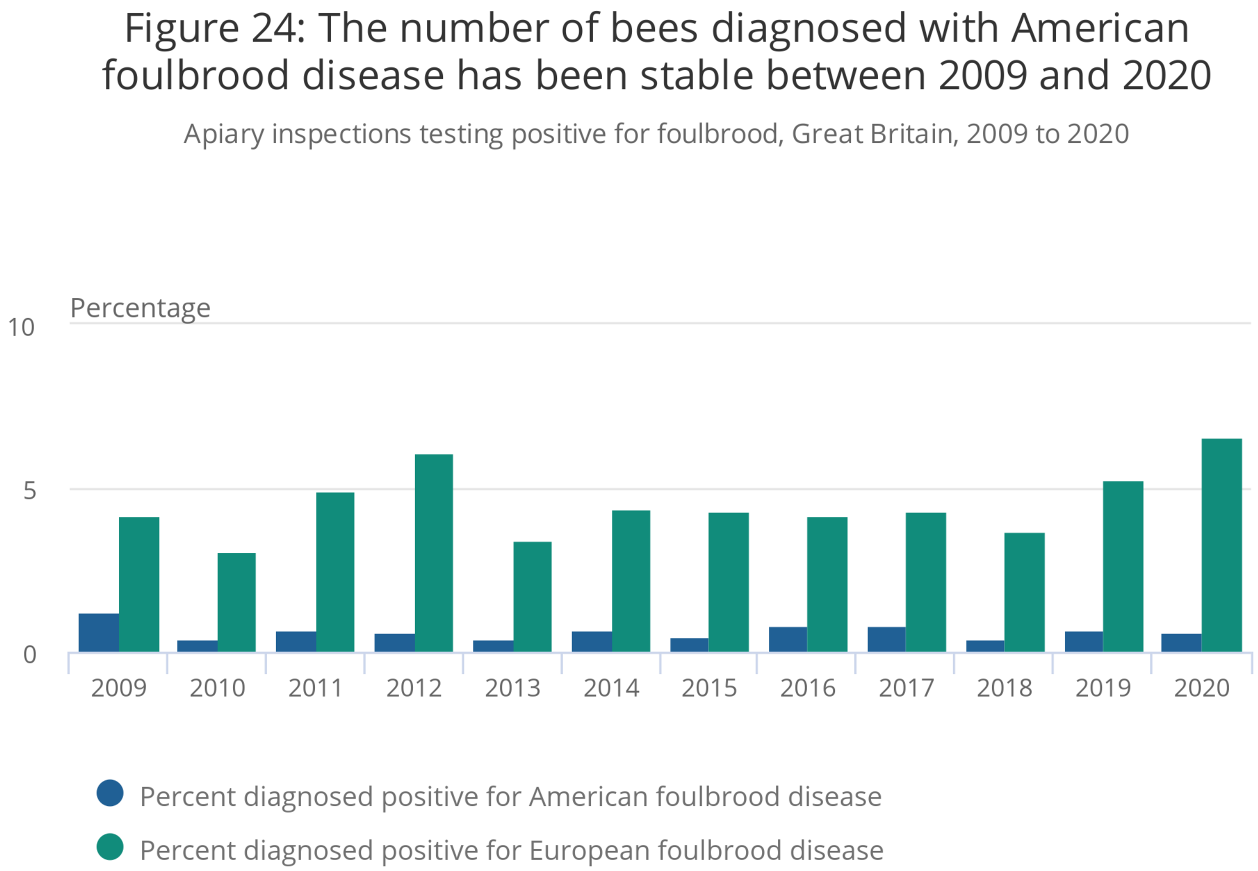
The disease data are based on apiary inspections. However, some honeybee diseases can be spread into the wild bumblebee population, as there is growing evidence that pathogens and parasitic organisms can be shared to the wider pollinator community from managed bees.

The American foulbrood disease (AFB) is a contagious bacterial disease of honeybee larvae, which is spread by spores carried on drifting bees from nearby colonies. The number of bees being diagnosed with American foulbrood disease has been stable over the last 12 years. With the exception of 2009, less than 1% of tested apiaries testing positive (Figure 24).

European foulbrood (EFB) is also a bacterial disease that affects larvae before the capped stage but is not the same as AFB, which is caused by different bacteria and produces different symptoms. By comparison, European foulbrood disease has fluctuated over the same time period, with 2012 and 2020 being greater than 6% (Figure 24).

Figure 24: The number of bees diagnosed with American foulbrood disease has been stable between 2009 and 2020

Apiary inspections testing positive for foulbrood, Great Britain, 2009 to 2020



Source: National Bee Unit

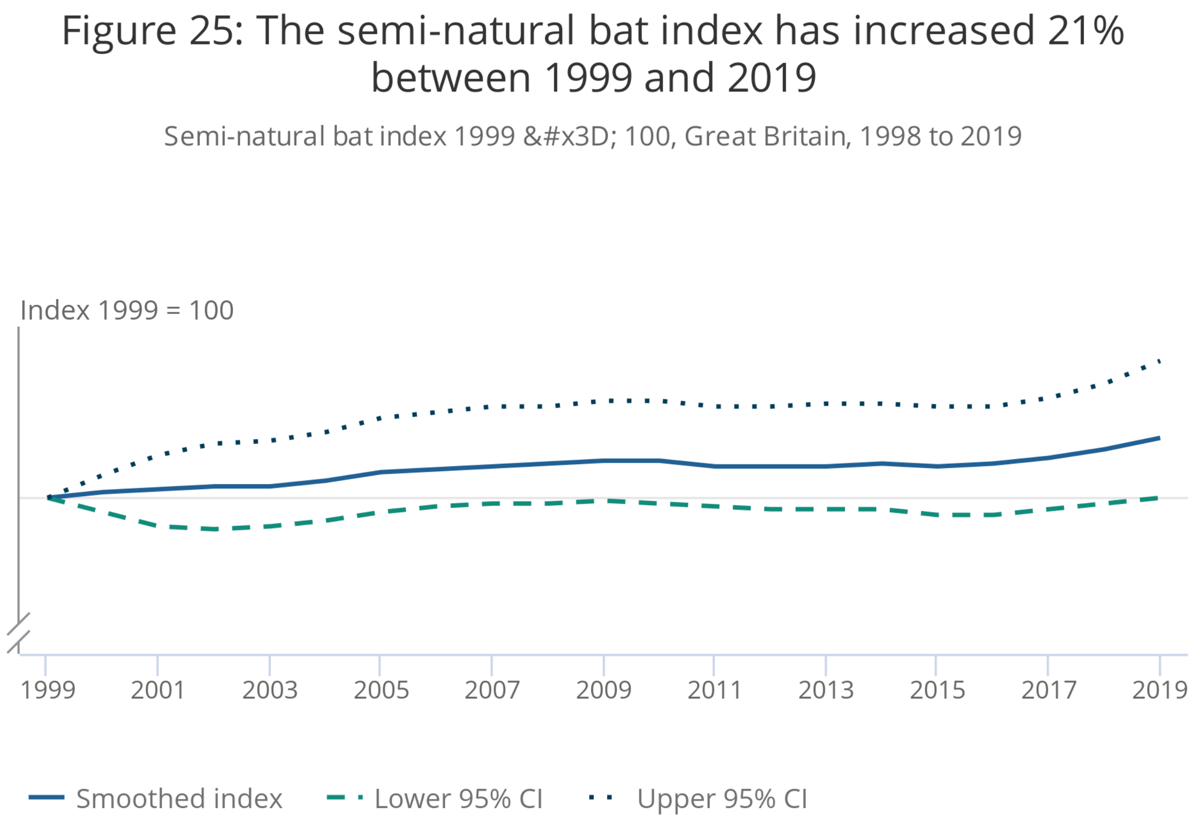
Bats

Bat populations are widely distributed throughout different habitats in the UK, including semi-natural ones. Bats are considered a good indicator of the health of the environment as they depend on a range of habitats, are reliant on insect prey (in the UK) and are sensitive to changes in land use, climate and site management.

Annual surveys of bats are co-ordinated by the National Bat Monitoring Programme, run by the Bat Conservation Trust, which organises volunteers to monitor bats at survey spots and walks. The semi-natural bat index (Figure 25) is a composite of four bat species trends: Daubenton's bat, common pipistrelle, soprano pipistrelle and noctule. It is calculated from survey locations that intersect semi-natural habitats. The semi-natural bat index has increased by 21% from 1999 to 2019 (Figure 25), although this increase is not yet statistically significant.

Figure 25: The semi-natural bat index has increased 21% between 1999 and 2019

Semi-natural bat index 1999 = 100, Great Britain, 1998 to 2019



Source: Bat Conservation Trust 2021, National Bat Monitoring Programme bat indicator for semi-natural habitat, 1999 to 2019 indices and confidence intervals

Fresh water salmonids

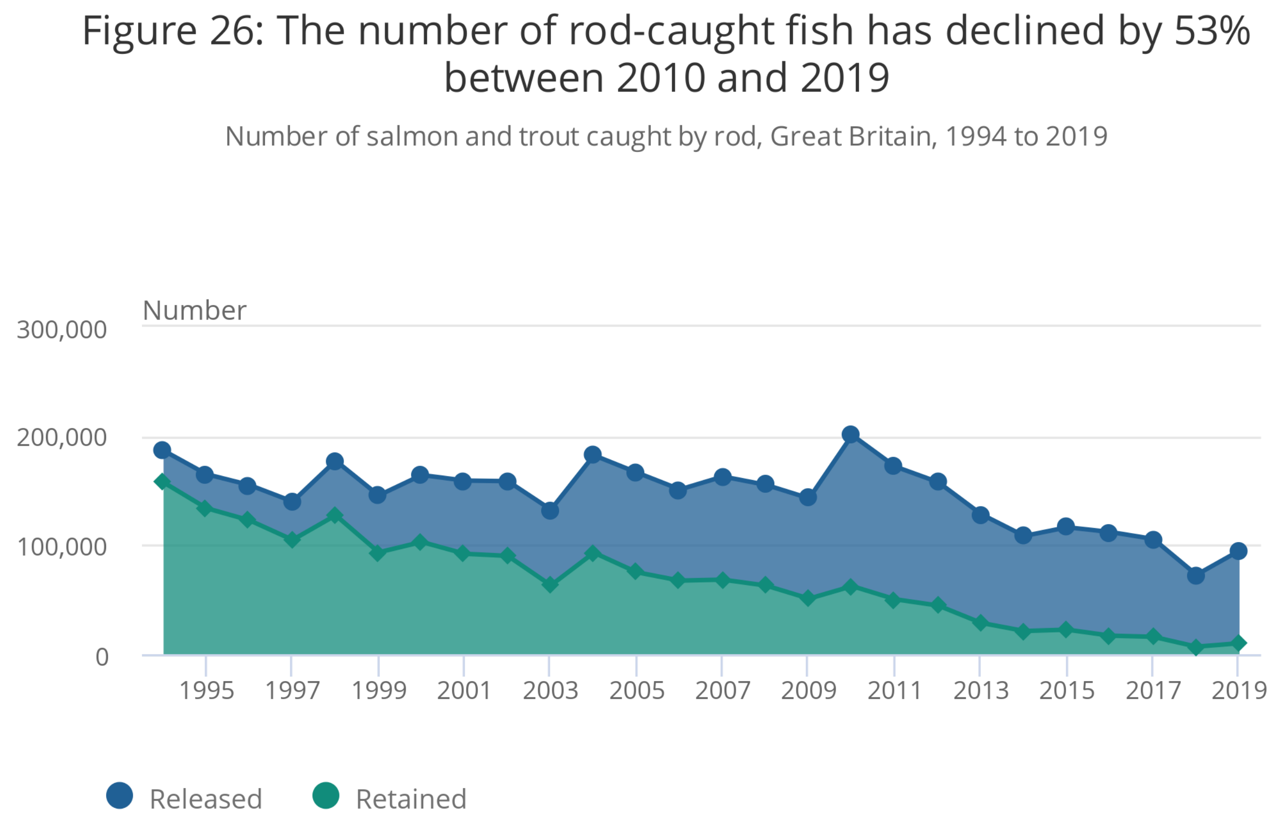
There is an abundance of fresh waters in the UK, which provide extensive recreational fisheries on rivers and lakes. However, very few are commercial fisheries. Evidence of anthropogenic impacts of fresh water is widespread across the UK. A way of measuring the condition of fresh water is the abundance of fish. A proxy for this is to look at the numbers of fish caught in fresh waters.

The Environment Agency and Natural Resources Wales use catch and return data to access and manage salmon and sea trout stocks in a sustainable way. The Environment Agency states that salmon stocks in both England and Wales continue to be of concern, with 39 of 42 principle salmon rivers in England being "at risk" or "probably at risk" and 22 principle salmon rivers in Wales assessed as being "at risk" or "probably at risk".

In 1994, the number of salmon and trout caught by rod in Great Britain was 186,614 and 16% of those were released while 84% were retained. The numbers of fish being caught has fluctuated over the last two and a half decades and peaked at 200,782 in 2010. These numbers have since declined by 53% to 94,907 in 2019, with 89% released and 11% retained.

Figure 26: The number of rod-caught fish has declined by 53% between 2010 and 2019

Number of salmon and trout caught by rod, Great Britain, 1994 to 2019



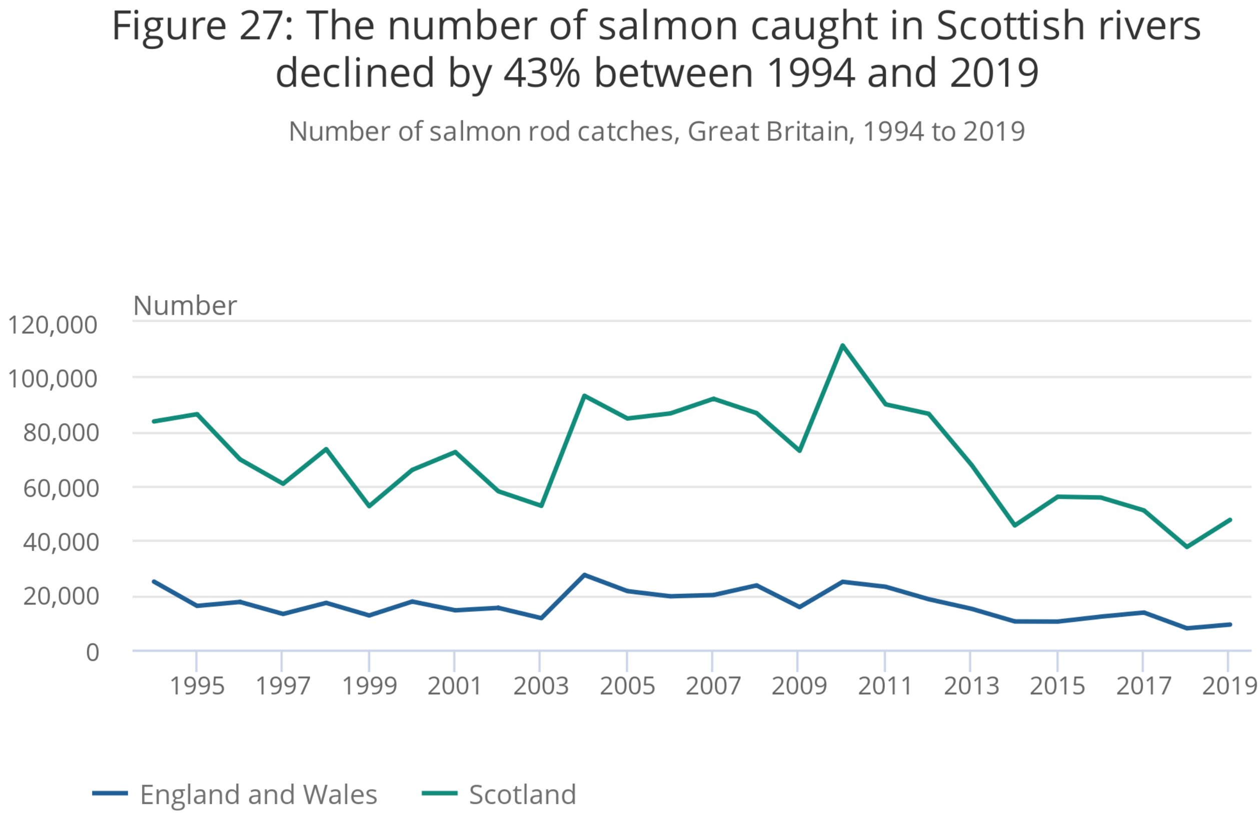
Source: Environment Agency, Natural Resources Wales and Scottish Government

In 2019, the Environment Agency looked at the state of 64 principle salmon rivers in England and Wales and assessed them against the conservation limit, which is the minimum spawning stock level. This conservation limit measured the probability of the river's salmon population exceeding its conservation limit of four years out of five. Results in England showed 57% "at risk", 36% "probably at risk" and only 7% "probably not at risk". For Wales 73% were "at risk" and 27% were "probably at risk".

Between 1994 and 2019, the number of salmon caught in Scottish rivers has seen a decline of 43%. This compares with a 63% decline for England and Wales for the same period. In 1994, 108,476 fish were caught by rods in Great Britain but this has significantly declined by 48% to 56,678. Also, the number of fish retained has declined between 1994 and 2019. In 1994, 91% of the total salmon caught were retained compared with only 4% in 2019.

Figure 27: The number of salmon caught in Scottish rivers declined by 43% between 1994 and 2019

Number of salmon rod catches, Great Britain, 1994 to 2019

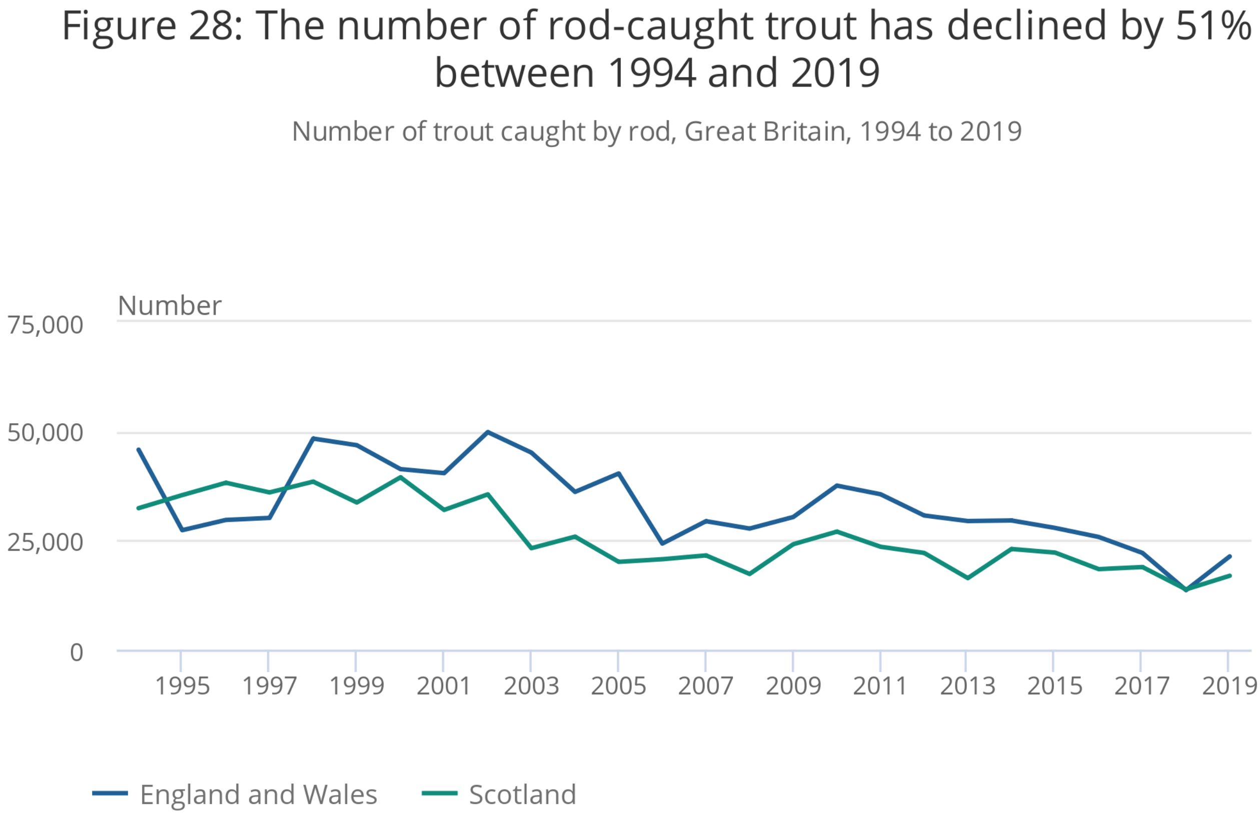


Source: Environment Agency, Natural Resources Wales and Scottish Government

In comparison, the number of rod-caught trout has declined by 51% between 1994 and 2019. In 1994, 75% of trout were retained, with only 25% being released back into the rivers. This has changed significantly in 2019, with 14% being retained and 86% being released.

Figure 28: The number of rod-caught trout has declined by 51% between 1994 and 2019

Number of trout caught by rod, Great Britain, 1994 to 2019



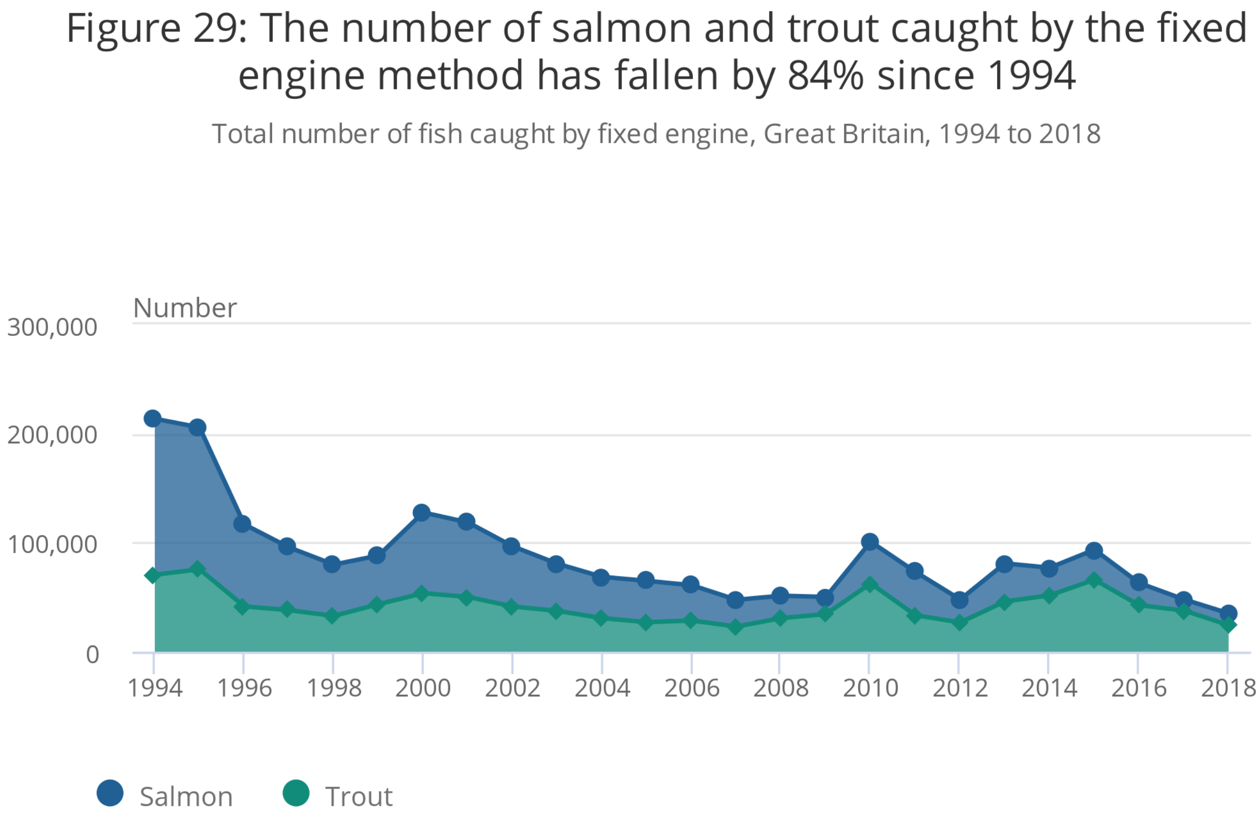
Source: Environment Agency, Natural Resources Wales and the Scottish Government

Fixed engine fishing is an ancient practice used in the UK as a general descriptor of stationary fishing gears, fixed to the bed or bank.

The total amount of salmon and trout caught by fixed engine has fallen by 84% between 1994 and 2018. There was a total of 213,474 fish caught by this method in 1994 and this has decreased 35,170 in 2018. Scotland has seen the largest decrease, with salmon fishing declining by 100% and trout fishing down by 97% between 1994 and 2018. England and Wales have seen smaller declines in the number of fish caught by fixed engine between 1994 and 2018, with declines of 84% for salmon and 60% for trout.

Figure 29: The number of salmon and trout caught by the fixed engine method has fallen by 84% since 1994

Total number of fish caught by fixed engine, Great Britain, 1994 to 2018



Source: Environment Agency, Natural Resources Wales and Scottish Government

Although the numbers for fish caught by fixed engine method in England and Wales have fluctuated between 1994 and 2018 (with large increases in 2000, 2010 and 2015), the trend is downward and is now 73% lower in 2018 than it was in 1994. Scotland has also seen smaller fluctuations between 1994 and 2018 and is now 99% smaller in 2018.

National Forest Inventory (NFI) condition indicators

The National Forest Inventory (NFI) survey is based on data collected between [2009 and 2015] in Great Britain. Full details on the [Forest Research's NFI survey methods] are available. The data presented (Table 5) are for woodlands defined as [native woodland], estimated to be 1,507,105 hectares in Great Britain. These are stands with 50% or more native tree species occupancy in the upper canopy that either form a discrete woodland parcel with a minimum area of 0.5 hectares, or form a woodland stand with a minimum area of 0.1 hectares that is part of a woodland that is 0.5 hectares or larger.

Table 5: Summary of National Forest Inventory condition for native woodland by percentage, Great Britain, 2010 to 2015 survey cycle

Condition	Unfavourable	Intermediate	Favourable
Invasive species	8.9	1.2	89.9
Tree pests and diseases	2.7	13.9	83.5
Herbivores and grazing	41	11.1	47.9
Regeneration	0	84.6	15.4
Age distribution	24.7	55	20.3
Deadwood	80.2	15	4.8
Veteran trees	98.9	0.3	0.8
Vertical Structure	11.4	37	51.6

Source: Forest Research – National Forest Inventory

A varied tree age structure in woodland benefits biodiversity as differently aged trees provide different ecological habitats. For a woodland to be classified as favourable, it needs to have young, intermediate and old trees present.

The vertical structure is defined as the number of canopy storeys present. Woodlands with greater structural diversity provide a wider range of microhabitats and conditions, thus providing greater diversity of trees and other species.

Regeneration is an important indicator of biodiversity to predict the future health of woodlands. It is an assessment of seedlings, saplings and young trees. To be classed as favourable, the woodland areas sampled need to have trees with 4 centimetres to 7 centimetres diameter as well as having saplings and seedlings present.

Tree diseases and pests can have a negative impact on woodland biodiversity. While dead and decaying wood provides more light to reach the forest floor and an important micro-habitat, rapid widespread tree death can harm ecological health.

Landscape condition indicators

Habitat connectivity

Habitat connectivity is all about how well different species can move between habitats in the landscape. One definition is "the degree to which the landscape facilitates or impedes movement among resource patches". There is structural and functional connectivity. The structural is about the distribution of habitat patches across a landscape and the functional is about the ability of species to move around different habitat patches. For instance, birds might happily (functionally) move across a naturally (structurally) fragmented set of habitats many miles or even thousands of miles apart while some terrestrial mammals may struggle if a single road crosses their habitat.

England

A connectivity indicator was developed by Forest Research and the Centre for Ecology and Hydrology using the data from the Countryside Survey in 1990, 1998 and 2007. As this survey did not continue after 2007 it has not been possible to update this indicator, but a new one is under development.

This indicator was developed by looking at bird and butterfly species and their ability to move between patches. This developmental statistic showed an increasing trend in the connectivity of neutral grasslands. However, no significant change was shown in the connectivity of broadleaved, mixed and yew woodland.

Table 6: Functional connectivity value for habitats in England, 1990 to 2007

Habitat	1990	1998	2007
Broad-leaved, mixed and yew woodland	0.0923	0.0695	0.0868
Neutral grassland	0.3272	0.7569	0.8226

Source: UK Centre for Ecology and Hydrology and Forest Research

Notes

1. The mean connectivity value is a measure of the relative connectivity of habitats on a scale of 0 (not connected) to 100 (contiguous habitat). Typical values are between zero and one.

Scotland

A method has been developed to assess functional habitat connectivity at a national and regional scale and applying this method to calculate an indicator of habitat connectivity for Scotland; report contains a full methodology. Metrics were created for 10 catchment areas using Equivalent Connected Area (Probability of Connectivity) or ECA(PC), which shows the higher the value the greater the connectivity. The ECA(PC) as a percentage of total amount of habitat in the region was decided most meaningful way to present the connectivity value. It is not currently possible to detect changes in connectivity over time on a national scale because of inconsistent land cover data over time. However, this method has the ability to measure changes in connectivity at a local level over time.

Habitat connectivity varies considerably across Scotland for the different habitats (Table 7 and 8). Semi-natural grasslands for Forth and the North Highland have similar total areas, 60,359 hectares and 59,281 hectares respectively. However, the Forth has a much higher ECA(PC), indicating this area is better connected.

Table 7: Scottish Equivalent Connected Area (Probability of Connectivity) values per catchment area for fen, marsh and swamp and semi-natural grassland, 2017

	Fen/Marsh/Swamp				**Semi-natural Grassland**			
Catchment	**Area of habitat (ha)**	**No. of patches**	**ECA(PC) (ha)**	**% ECA (PC) of total habitat**	**Area of habitat (ha)**	**No. of patches**	**ECA(PC) (ha)**	**% ECA (PC) of total habitat**
Argyll	1,232	884	135	11	83,985	4,248	5,111	6.1
Clyde	292	256	54	18.5	117,476	8,955	8,639	7.4
Forth	393	169	100	25.3	60,359	6,035	9,285	15.4
Orkney and Shetland	972	664	113	11.6	53,470	5,167	2,506	4.7
North East Scotland	540	146	153	28.3	57,491	11,788	1,342	2.3
North Highland	2,393	630	531	22.2	59,281	7,379	2,391	4
Solway	2,932	348	1010	34.4	132,514	9,035	11,899	9
Tay	586	162	161	27.4	77,574	6,384	6,549	8.4
Tweed	35	24	12	33.7	94,870	5,612	10,113	10.7
West Highland	2,018	1,283	200	9.9	47,344	4,711	2,886	6.1

Source: NatureScot

Table 8: Scottish Equivalent Connected Area (Probability of Connectivity) values per catchment area for heathland and semi-natural woodland, 2017

	Heathland				Semi-Natural Woodland			
Catchment	**Area of habitat (ha)**	**No. of patches**	**ECA(PC) (ha)**	**% ECA (PC) of total habitat**	**Area of habitat (ha)**	**No. of patches**	**ECA(PC) (ha)**	**% ECA (PC) of total habitat**
Argyll	439,609	3,821	70,702	16.1	96,068	10,429	5,552	5.8
Clyde	136,377	3,112	19,741	14.5	91,665	16,356	3,421	3.7
Forth	46,452	1,547	10,357	22.3	50,498	10,887	2,259	4.5
Orkney and Shetland	117,259	1,645	24,381	20.8	255	67	110	43.1
North East Scotland	292,611	3,670	124,813	42.7	71,851	13,475	2,455	3.4
North Highland	799,628	4,152	190,200	23.8	93,187	12,618	4,164	4.5
Solway	74,238	2,824	10,587	14.3	90,922	12,327	4,770	5.2
Tay	275,735	2,307	105,796	38.4	58,861	11,181	2,341	4
Tweed	73,446	1,495	20,779	28.3	33,450	6,393	2,836	8.5
West Highland	702,291	3,861	150,880	21.5	33,786	4,462	3,200	9.5

Source: NatureScot

Wales

Initial research has been undertaken to identify habitat connectivity in Wales. Natural Resources Wales has developed CuRVe to investigate ecosystem resilience. CuRVe is an interactive map with many different layers, including connectivity, ecological networks and connectivity of overall layers. The 2016 State of Natural Resources Report identified that the mountain, moorland and heath habitat in Wales extends over 261,824 hectares. Fragmentation of this habitat has resulted in poor connectivity for lowland examples of mountain, moorland and heath habitats.

River naturalness

River naturalness refers to the extent to which a river has departed from its original state. By examining the chemical, biological, hydrological and physical habitat change indicators, we can begin to predict the overall condition of the river. This is particularly important as the quality of surface water bodies can affect many of the service flows, we, and natural life, derive from them.

A natural river may not create the largest ecosystem service flows and benefits to humans. Alterations, such as dams and weirs (a morphological change), may provide benefits to humans but may reduce the overall naturalness of the river as, for example, the migratory flow of fish up-stream is disrupted. Examining the naturalness of rivers assesses its ecological integrity. This is the river's ability to maintain and support its own ecological processes. Measures that quantify the overall naturalness of a river have been developed.

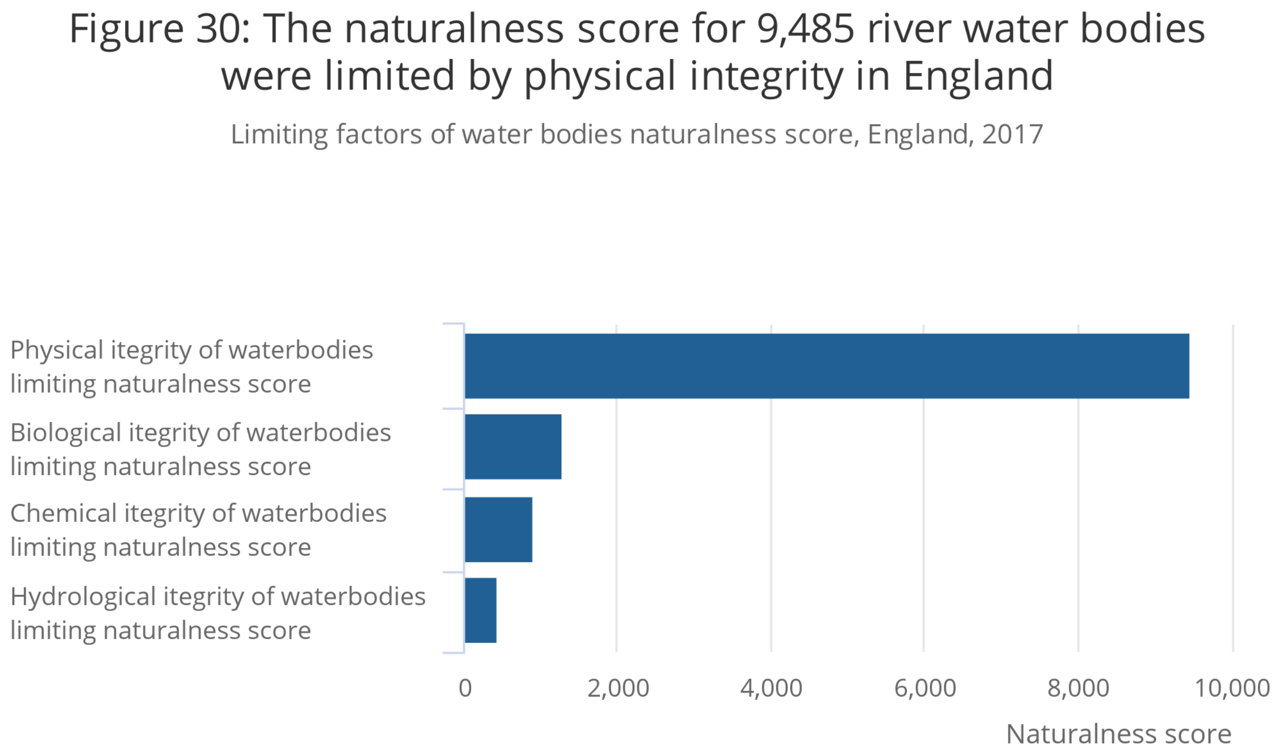
England

Natural England has developed the Priority River Habitat Map to assess the condition of a river. An aggregate score is comprised of hydrological, physical habitat, biological and chemical integrity scores. Each integrity score assesses a core component of a river's condition.

Figure 30 indicates that the naturalness score for 9,485 bodies of river water were limited by physical integrity. The number of river waterbodies limited by biological, chemical and hydrological integrity is 1,281, 897, and 452 respectively. The physical integrity represents the single largest cause of why a river is limited in its naturalness scoring.

Figure 30: The naturalness score for 9,485 river water bodies were limited by physical integrity in England

Limiting factors of water bodies naturalness score, England, 2017



Source: Natural England

Natural England are further developing an assessment of river naturalness and habitat resource. Additional detail of the development of this approach can be found here.

Wales

In Wales the naturalness of rivers was assessed using the Hydromorphological Impact Ratio, which looks at the channel substrate, flow regime, channel vegetation and geomorphic activity. The data were derived from the 2007 to 2008 baseline survey of Welsh rivers. South east Wales and south central Wales had the highest departure from naturalness for rivers (Table 9). These areas are linked to higher levels of urban modification. Generally, the rivers displayed higher levels of naturalness in the more rural settings of mid and north Wales.

Table 9: Comparison of hydromorphological impact ratio categories for Welsh areas, 2007 to 2008

Impact ratio %	Very low	Low	Moderate	High	Very high
Mid Wales	1.8	10.4	35.3	34.4	18.1
North East Wales	0.0	7.0	45.6	26.3	21.1
North West Wales	1.3	6.9	38.8	39.4	13.8
South Central Wales	0.0	8.5	17.0	48.9	25.5
South East Wales	2.2	4.3	10.9	52.2	30.4
South West Wales	2.3	11.6	25.4	41.0	19.7

Source: Natural Resources Wales

A significant proportion of the engineering pressures on the water channels in Wales are from channel and bank resectioning, as shown in Table 10. There are a higher occurrence of engineering structures and resectioning in south Wales compared with north Wales.

Table 10: Occurrence of major bank and channel structures in Wales, 2007 to 2008

	Mid	NE	NW	S Central	SE	SW
Number	**220**	**55**	**161**	**47**	**47**	**174**
	%	**%**	**%**	**%**	**%**	**%**
Weirs	6	7	4	4	13	7
Bridges	3	4	5	13	17	6
Culverts	20	27	27	19	30	22
Realigned	14	18	27	45	53	30
Deepened	14	18	22	36	23	22
Resectioned	27	33	33	55	62	47
Embanked	10	15	20	2	4	22
Poaching	45	47	47	9	30	40

Source: Natural Resources Wales

Northern Ireland

We are currently unable to comment on the naturalness of rivers in Northern Ireland. Northern Ireland has 450 rivers and water bodies, which we hope to provide more statistical detail on in the future. However, data regarding Northern Irish Water Framework Directive assessments have been included in this publication for water quality.

Scotland

Data on the physical status and ecological potential of all Scottish surface water bodies are presented in the Scottish River Basin Management Plans from 2009 and 2015 (SWB).

Table 11 shows that 25% of surface water bodies did not meet the "good" condition status (as targeted in the WFD) because of physical changes to the riverbeds and banks, such as straightening or culverting, and barriers to fish migration, such as dams and weirs.

Table 11: Summary of pressures affecting Scotland’s surface water bodies, 2015

	Total number of surface water bodies	**Percentage of number of surface water bodies**
Surface water bodies (excluding groundwater)	3,233	100%
Surface water bodies at less than good ecological status/potential	1,261	39%
Water bodies at less than good ecological status /potential due to physical changes (including changes to beds and banks, and fish barriers)	860	25%
Water bodies at less than good ecological status /potential due to physical condition of beds and banks	546	17%
Water bodies at less than good ecological status /potential due to barriers to fish migration	375	12%

Source: Scottish Environment Protection Agency and NatureScot

Table 12: Main causes of impacts on the physical condition of bodies of surface water in Scotland, 2015

	Number
Number water bodies changed	255
Modifications for agricultural land use	242
Modifications for forestry	47
Modifications for urban land use	47
Modifications for navigation	3

Source: Scottish Environment Protection Agency and NatureScot

Table 12 shows 255 water bodies in Scotland were substantially impacted in Scotland from modifications. Modifications for agricultural land use altered 242 of Scotland's water bodies, representing the single largest cause for physical change to Scottish rivers. This illustrates a reduction in the naturalness of these water bodies.

Ancillary condition indicators

Protected sites

There are several formal designations, including Special Areas of Conservation (SAC) or a Site of Special Scientific Interest (SSSI) or Areas of Special Scientific Interest (ASSI) in Northern Ireland. The rare fauna or flora present or important geological or physiological features make it an area of interest to science.

In Northern Ireland the area of semi-natural habitat with a protected site designation of ASSI forms 24% of total semi-natural habitat area. Areas of semi-natural habitat with an SSSI designation comprises: 31% in England, 19% in Scotland and 27% in Wales of the total semi-natural habitat area. For the UK, 23% of the semi-natural habitat has an ASSI or SSSI designation.

England saw an increase in all semi-natural habitats area of SSSIs classed as favourable, except for coastal ones, from 2011 to 2019 (Table 13). All habitats had an increase in area classed as unfavourable. Wetlands rose from 3.2% of total area classed as unfavourable in 2011 to 6.6% in 2019. For a full breakdown of each habitat, see the condition supplementary tables.

Table 13: Condition assessment of semi-natural Sites of Special Scientific Interest (SSSI) area in hectares, England, 2011 to 2019

	2011	2012	2014	2015	2016	2017	2018	2019
Wetlands								
Favourable	31,353	32,067	33,158	33,206	32,437	34,041	33,656	33,529
Recovering	177,046	176,789	175,500	173,937	173,236	172,694	172,262	171,693
Unfavourable	6,893	6,442	6,641	7,616	9,755	12,700	12,862	14,537
Grassland								
Favourable	23,607	24,128	25,219	25,299	30,228	27,277	30,822	30,931
Recovering	43,646	43,661	42,625	43,117	37,352	37,511	35,745	35,536
Unfavourable	2,606	2,267	2,336	1,954	2,054	2,435	3,634	3,777
Heathlands and Inland rock								
Favourable	33,571	36,897	38,461	38,054	40,479	42,521	43,140	43,375
Recovering	175,314	172,395	168,928	168,972	166,432	162,963	161,384	160,983
Unfavourable	4,531	4,137	5,764	6,410	6,693	7,690	7,890	9,347
Woodland								
Favourable	38,115	38,981	40,144	40,170	40,870	41,268	41,938	42,658
Recovering	45,892	45,092	43,641	43,654	42,917	42,606	41,562	40,990
Unfavourable	4,919	4,922	5,343	5,339	5,386	5,669	5,819	6,189
Coastal								
Favourable	27,977	27,726	27,390	27,398	27,311	27,264	26,510	26,439
Recovering	13,489	13,534	14,117	14,093	14,275	14,567	14,642	13,590
Unfavourable	2,077	2,296	2,032	2,071	1,974	2,052	2,211	3,201

Source: Natural England

In Scotland, the number of protected sites that have a favourable condition has increased for all semi-natural habitats (Table 14). Broadleaved, mixed and yew woodlands are the only habitat to have increased the number of sites classed as unfavourable, rising from 48 sites in 2007 to 161 sites in 2020.

Table 14: Condition assessments of Sites of Special Scientific Interest, Special Areas of Conservation and RAMSAR sites, number of sites in Scotland, 2007 to 2020

	2007	2010	2015	2018	2020
Grasslands					
Favourable	38	53	67	74	73
Recovering	9	26	41	37	36
Unfavourable	98	62	40	37	39
Broadleaved, mixed and yew woodland					
Favourable	186	229	223	211	203
Recovering	172	131	144	152	59
Unfavourable	48	39	51	59	161
Heathland and inland rock					
Favourable	182	222	240	275	281
Recovering	5	33	65	54	52
Unfavourable	159	144	105	82	78
Wetlands					
Favourable	352	398	427	453	451
Recovering	5	75	82	93	91
Unfavourable	250	144	129	98	102
Coastal					
Favourable	176	197	214	218	216
Recovering	3	21	18	14	14
Unfavourable	84	47	34	34	36

Source: NatureScot

In Wales, the only protected sites regularly monitored are the SACs (Table 15). However, insufficient sites were assessed in the 2013 to 2018 period to show if there has been any change since the 2007 to 2012 period. Most sites are classed as unfavourable, with only 4.7% being favourable when measured between 2001 and 2006, declining to 4.3% favourable in the period 2007 to 2012 for all semi-natural habitats (Table 15).

Table 15: Condition assessment of semi-natural Special Areas of Conservation (SACs) in hectares for Wales for European Commission reporting, 2001 to 2006 and 2007 to 2012

		2001 to 2006	**2007 to 2012**
Wetlands	**Favourable**	636	420
	Recovering	5,351	1,047
	Unfavourable	22,061	26,407
Dwarf shrub heath and inland rock	**Favourable**	3,104	2,941
	Recovering	7,462	4,988
	Unfavourable	40,227	42,657
Calcareous grasslands	**Favourable**	0	0
	Recovering	0	0
	Unfavourable	203	203
Broadleaved, mixed and yew woodland	**Favourable**	546	210
	Recovering	700	567
	Unfavourable	4,913	5,060
Coastal	**Favourable**	253	244
	Recovering	476	78
	Unfavourable	2,889	3,408

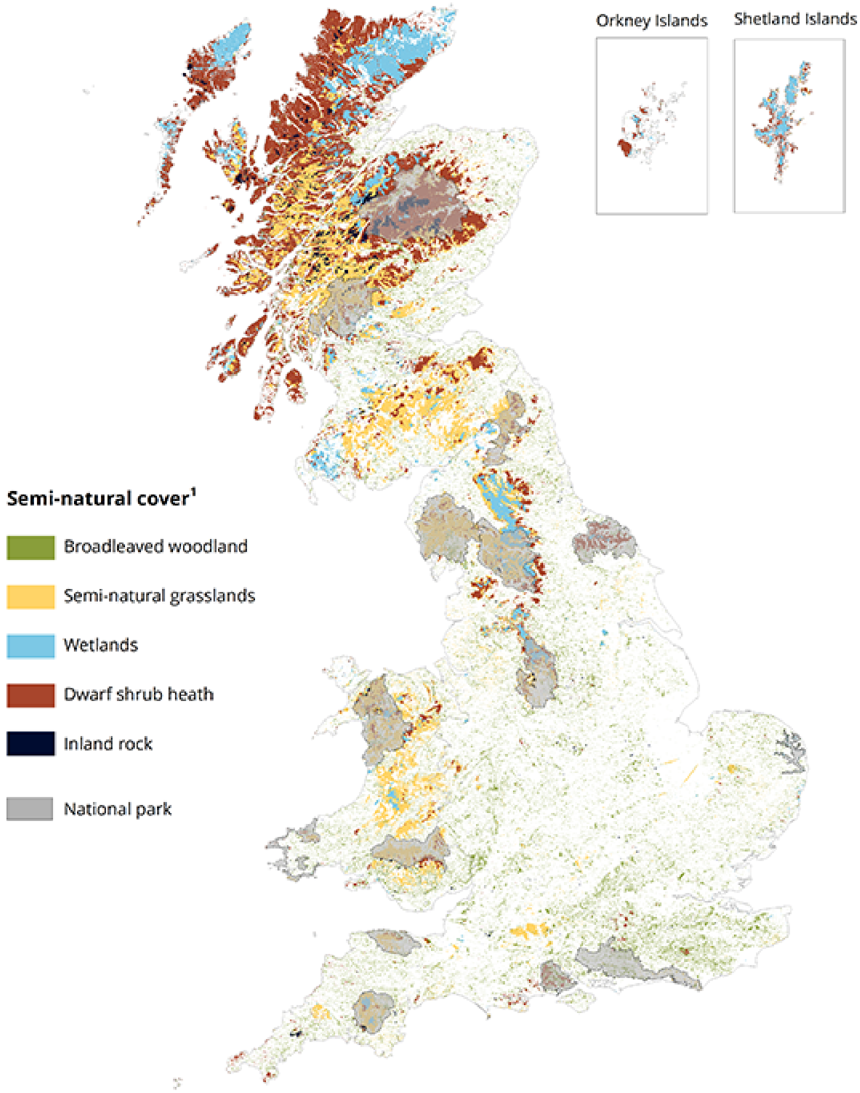
Source: Natural Resources Wales

National Parks

In addition to protected sites, there are 15 National Parks in the UK. There are 10 in England, 3 in Wales and 2 in Scotland and these National Parks are to care for and protect unique habitats, rare wildlife and ancient monuments. Of the total area of National Parks in Great Britain (1.4 million hectares), 19% are semi-natural habitats (Figure 31).

Figure 31: National Parks and inland semi-natural habitats

Semi-natural cover, inland areas, Great Britain, 2015



Source: Based upon Land Cover Map (LCM)2015 © UK Centre for Ecology and Hydrology (UKCEH) 2017

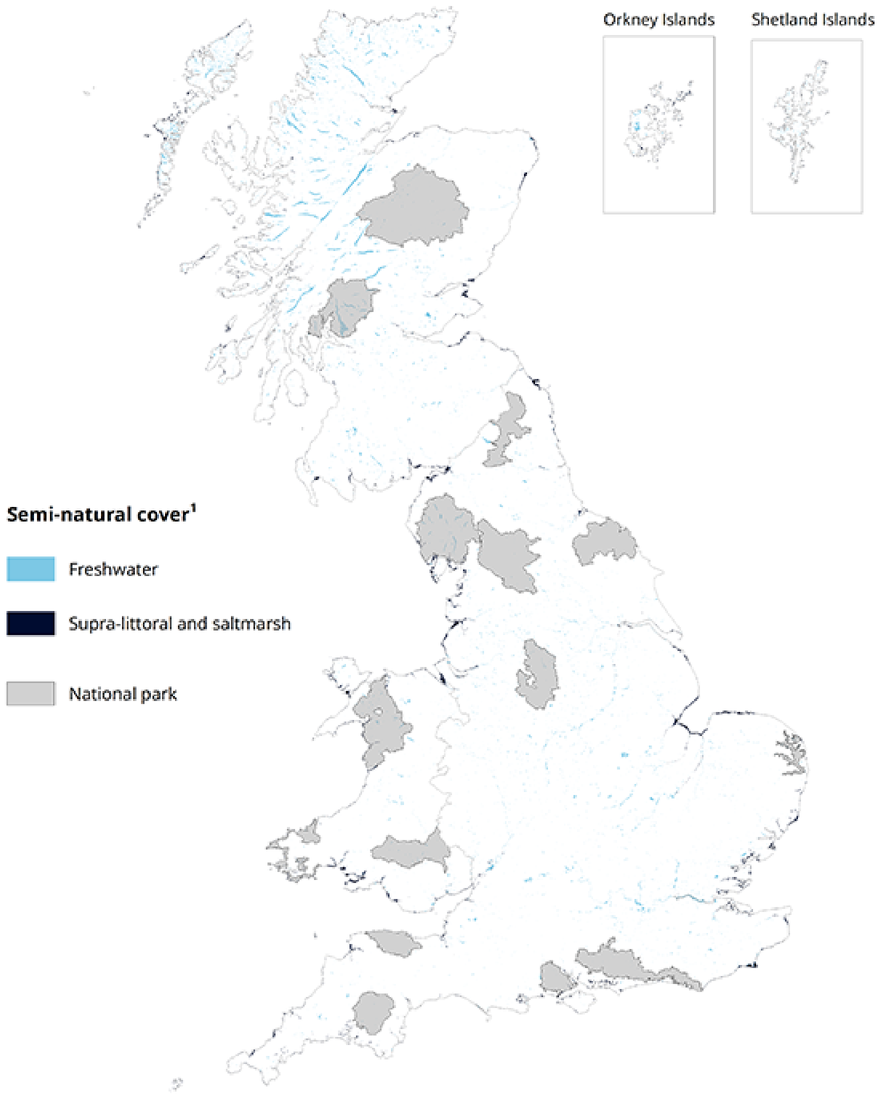
Notes:

1. Digital Object Identifier (DOI) for LCM2015 Vector data for Great Britain. Contains Ordnance Survey data © Crown Copyright 2007, Licence number 100017572. Contains OS data © Crown copyright 2020. Graphic created by ONS Geography.

2. Broadleaved woodland includes only itself. Semi-natural grasslands includes acid grassland, calcareous grassland and neutral grassland. Wetlands includes bog and fen, marsh and swamp. Dwarf shrub heath includes heather and heather grassland. Inland rock includes only itself.

Figure 32: National Parks and coastal and inland water semi-natural habitats

Semi-natural cover, coastal areas and inland water, Great Britain, 2015



Source: Based upon Land Cover Map (LCM)2015 © UK Centre for Ecology and Hydrology (UKCEH) 2017

Notes:

1. Digital Object Identifier (DOI) for LCM2015 Vector data for Great Britain. Contains Ordnance Survey data © Crown Copyright 2007, Licence number 100017572. Contains OS data © Crown copyright 2020. Graphic created by ONS Geography.

2. Freshwater includes only itself. Supra-littoral and saltmarsh includes saltmarsh, supra-littoral rock and supra-littoral sediment.

Pressure indicators

Pressure indicators are defined here as damage inflicted on the landscape by humans. Wildfires can also be considered a pressure indicator. Most wildfires are anthropogenic in origin, with and without intent. In Wales, it was identified in 2018 and 2019 that around 7 out of 10 fires on woodland, grassland and crops were started deliberately.

Fire can be used as a management tool to control habitat diversity and disease control. Rotational burning is used on heather moorland for higher grouse breeding. However, this is controversial with opponents to burning on peatland, noting the impacts on the ecosystem services such as carbon storage and flood protection from burning the moorland.

There are two main sources of data on wildfires: reported fires and satellite data. Reported fires catch wildfires of all sizes attended by England's Fire and Rescue Services but may miss some remote fires that are addressed by land managers. Satellite data capture fires in both built up and remote places but might miss smaller fires under 30 hectares.

Wildfires in England in open habitats (arable, improved grassland, semi-natural grassland, mountain, heath and bog) accounted for more than 70% of the total burnt areas for the financial years 2009 to 2010 to 2016 to 2017, with the exception of 2011 to 2012 where it accounted for 95% of the burnt area. The greatest number of incidents and area burnt occurring on semi-natural habitats (Table 16) occurred in 2011 to 2012, where there were 7,366 incidents over 12,415 hectares. This correlates to the drought in the same period and heat wave alerts in central, eastern and southern England and Wales.

Table 16: Wildfires incidents by land cover class, England, 2009 to 2017

	2009 to 10	2010 to 11	2011 to 12	2012 to 13	2013 to 14	2014 to 15	2015 to 16	2016 to 17
Broadleaved woodland (NFI)	3,792	2,256	5,264	1,361	2,792	1,691	2,435	1,960
Semi-natural Grassland	1,394	1,701	1,596	506	1,164	722	400	250
Mountain, Heath and Bog	392	547	506	142	283	181	201	145
Total semi-natural	5,578	4,504	7,366	2,009	4,239	2,594	3,036	2,355

Source: Forest Research

Table 17: Size of wildfire incidents (area burnt) by land cover class in hectares, England, 2009 to 2017

	2009 to 10	2010 to 11	2011 to 12	2012 to 13	2013 to 14	2014 to 15	2015 to 16	2016 to 17
Broadleaved woodland (NFI)	34	123	62	18	66	55	79	23
Semi-natural Grassland	336	884	872	298	658	54	212	656
Mountain, Heath and Bog	202	2,824	11,481	318	654	769	823	538
Total semi-natural	572	3,831	12,415	634	1,378	878	1,114	1,216

Source: Forest Research

Wildfires in Wales also had a high number of incidents in 2011 to 2012 (Table 18), as well as England. However, the Welsh data are not just for semi-natural grasslands, as they include all grasslands. The Welsh Government identified in July 2018 that there were almost nine times more fires on grassland, woodland and crops compared with July 2017. In July 2018, there were 40% more sunshine hours and half the rainfall that occurred in July 2017.

Table 18a: Primary grassland wildfires in Wales, 2011 to 2019

	2011 to 2012	2012 to 2013	2013 to 2014	2014 to 2015	2015 to 2016	2016 to 2017	2017 to 2018	2018 to 2019
Grassland, pasture, grazing etc	1	0	6	1	9	6	3	10
Heathland or moorland	18	3	8	3	4	4	3	25
Broadleaf woodland	32	8	19	15	14	7	8	48

Source: Welsh Government

Table 18b: Secondary grassland wildfires in Wales, 2011 to 2019

	2011 to 2012	2012 to 2013	2013 to 2014	2014 to 2015	2015 to 2016	2016 to 2017	2017 to 2018	2018 to 2019
Grassland, pasture, grazing etc	1,329	595	1,220	942	1,103	535	635	1,446
Heathland or moorland	736	343	470	349	446	225	310	495

Source: Welsh Government

As with England and Wales, the drought in 2011 caused an increase in the number of wildfires in Scotland (Table 20). Between 29 April and 5 May 2011, the Highland and Island Fire and Rescue Services dealt with 70 significant wildfires. The woodland numbers includes all woodland, not just semi-natural ones.

Table 19: Area of wildfires in forests and important habitats, Scotland, 2009 to 2013

	Area of wildfires (hectares)			
Habitat	**2009 to 2010**	**2010 to 2011**	**2011 to 2012**	**2012 to 2013**
Woodland	60	127	7,966	268
Semi-natural Grassland	893	917	2,022	685
Mountain, heath and bog	1,879	3,123	6,805	384

Source: Incident Reporting System – Forestry Commission Scotland

Table 20: Number of wildfires in forests and important habitats, Scotland, 2009 to 2013

	Number of wildfires			
Habitat	**2009 to 2010**	**2010 to 2011**	**2011 to 2012**	**2012 to 2013**
Woodland	850	1,166	1,050	479
Semi-natural Grassland	354	465	368	203
Mountain, heath and bog	154	211	199	153

Source: Incident Reporting System – Forestry Commission Scotland

Wildfires were investigated in Areas of Special Scientific Interest in Northern Ireland during the unusually dry spring and summer of 2011. A total of 3,801 hectares of designated semi-natural habitats were burnt.

The EU-wide reporting (Table 21) for the UK is based on satellite data. The periods of low wildfires correlate with heavy periods of rainfall in spring and summer, as well as wetter winters. A large number of small fires are excluded from the European Forest Fire Information System (EFFIS), meaning the number of fires is smaller.

Table 21: European Forest Fire Information System (EFFIS) recorded fires UK, 2011 to 2020

Year	**Burnt Areas (ha)**	**Number of fires**
2011 to 2012	17,197	44
2012 to 2013	0	0
2013 to 2014	5,445	16
2014 to 2015	85	1
2015 to 2016	2,127	4
2016 to 2017	1,197	9
2017 to 2018	5,126	19
2018 to 2019	18,031	79
2019 to 2020	29,396	137

Source: European Forest Fire Information System

4 . Overall quantity and value of semi-natural ecosystem services

This section assesses the contribution semi-natural habitats services provides to the economy and society.

Table 22: Semi-natural habitat annual physical flow by service, UK, 2009 to 2018

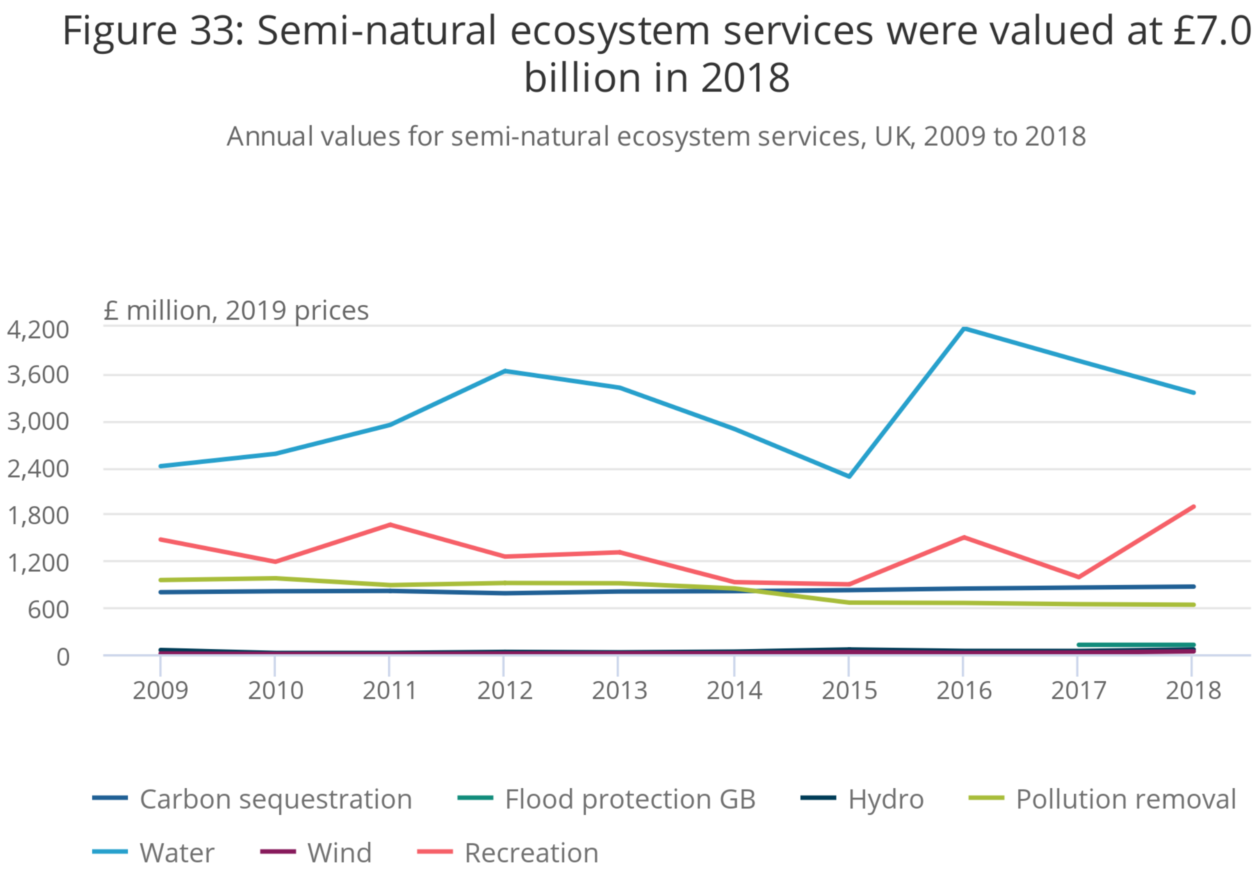
Type service	**Provisioning**			**Regulating**		**Cultural**
Year	**Water (Million cubic metres)**	**Hydroelectricity (Gigawatt hours)**	**Wind (Gigawatt hours)**	**Carbon sequestration (Million tonnes CO2 equivalent)**	**Pollution removal (Thousand tonnes)**	**Recreation (million hours)**
2009	6,679	5,228	1,519	13,033	479	1,236
2010	6,776	3,591	1,508	13,031	455	1,168
2011	6,644	5,692	2,231	12,908	467	1,205
2012	6,629	5,310	2,591	12,244	461	1,237
2013	6,639	4,697	3,539	12,409	478	1,285
2014	6,443	5,861	3,743	12,296	473	1,294
2015	6,519	6,297	4,510	12,310	474	1,382
2016	6,663	5,370	4,035	12,426	452	1,445
2017	6,708	5,882	5,618	12,435	462	1,513
2018	6,796	5,444	6,058	12,420	480	1,669

Source: Office for National Statistics

The value of semi-natural habitats ecosystem services was estimated at £7.0 billion in 2018 (2019 prices), as shown in Figure 33. Data are only available for the seven ecosystem services annual valuations in 2018. This is a partial valuation with exclusions such as tourism, education and flood protection for habitats other than broadleaved woodland.

Figure 33: Semi-natural ecosystem services were valued at £7.0 billion in 2018

Annual values for semi-natural ecosystem services, UK, 2009 to 2018



Source: Office for National Statistics – Semi-natural habitat, natural capital, UK

5 . Provisioning ecosystem services: quantity and value

Provisioning ecosystem services create products. For semi-natural habitats, these include food, water and renewable energies from wind and hydro.

Food

Livestock grazing is one of the most common land uses for peatlands, however, most can only sustain light seasonal grazing. In the Fens, in the East of England, there is widespread use of conservation grazing cattle. Sheep can be farmed in almost every part of Wales because of their hardiness. In the uplands this may be the only feasible option. However, there are relatively low returns to farmers, despite low maintenance and capital costs.

Most livestock holdings in Wales are in Less Favoured Areas (LFA) for farming. A LFA is an European Union designation of an area of poor soils and low agriculture income. A significant proportion of Scottish land quality for agriculture is quite poor, with more than 5.73 million hectares (85%) of farmland classed as LFA. As a result, most of the agriculture is livestock grazing, with 3.6 million hectares classified as rough or common grazing.

The estimate for food from semi-natural habitats is derived from the different land uses data from the Land Cover Map 2015 and data from the Farm Business Survey (FBS). The FBS provides data for England on the outputs from agriculture, which excludes subsidies and agri-environment (a scheme that compensates farmers for the costs of carrying out wildlife friendly management on their land), and costs for agriculture excluding agri-environment activities and data on farm area. A rate is then calculated per hectare and applied to the different land use classifications for the UK. The method of valuing estimates for food from farming are currently being developed using farming rents for a future publication.

Agriculture on semi-natural habitats shows a negative contribution for ecosystem services (Table 23). This is only a crude estimate to give an idea of scale of agriculture on these habitats. Grazing is often used as a conservation management tool for improving the ecology, to provide a range of benefits beyond food production. Natural England identified a need for grazing on grassland, heathland and coastal marshes to maintain their structure and composition.

Table 23: Summary of semi-natural habitat use for agricultural grazing, UK, 2018

LCM2015 classification	UK ha	Agricultural %	Farm type (FBS)	£/ha	£m
Neutral grassland	115,506	100	Grazing livestock (LFA)	-6.2	-0.72
Calcareous grassland	83,208	100	Grazing livestock (Lowland)	-6.7	-0.56
Acid grassland	2,135,472	100	Grazing livestock (LFA)	-6.2	-13.22
Fen	18,719	10	Grazing livestock (Lowland)	-6.7	-0.01
Heather	973,846	50	Grazing livestock (LFA)	-6.2	-3.01
Heather grassland	1,542,186	50	Grazing livestock (LFA)	-6.2	-4.77
Bog	963,183	50	Grazing livestock (LFA)	-6.2	-2.98
Saltmarsh	79,706	33	Grazing livestock (LFA)	-6.2	-0.16
Total	5,911,826				-25.43

Source: Office for National Statistics, UK Centre for Ecology and Hydrology and Farm Business Survey

Water

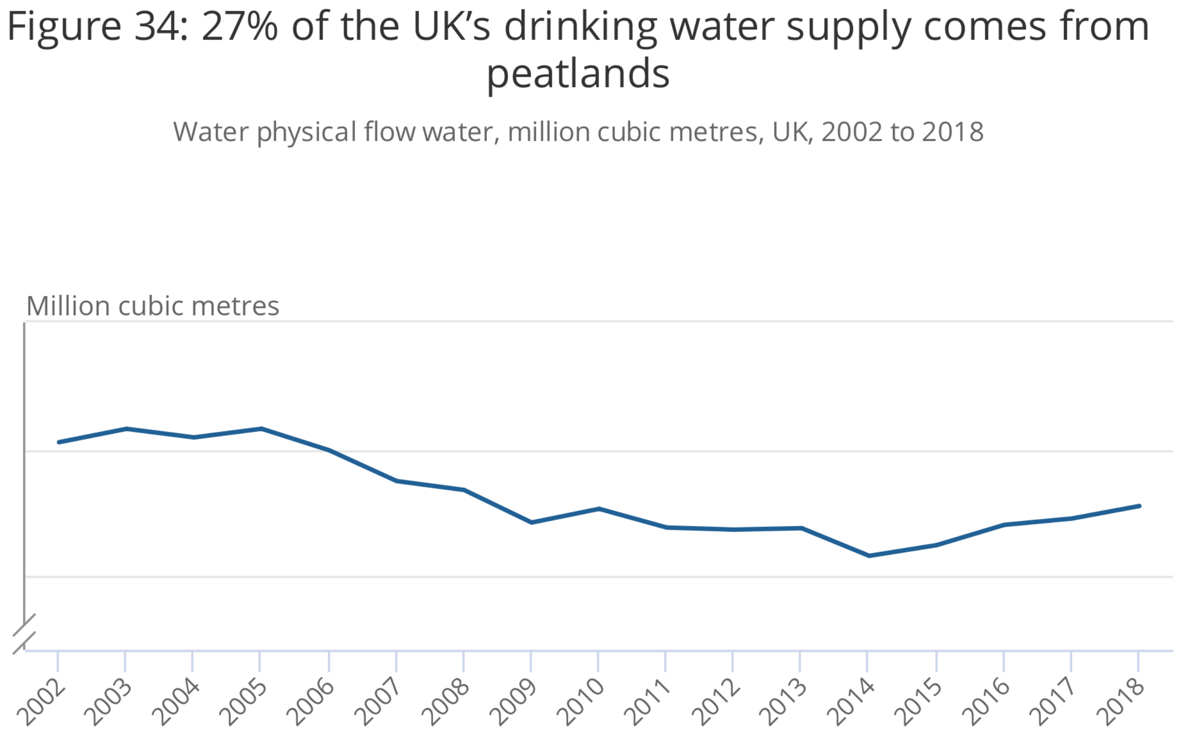
Surface sources such as upland reservoirs and lowland rivers provide around 70% of the UK's drinking water, while 30% is sourced from ground water. The uplands areas have around 80% of the large dams for public water supply.

Peat is dominant on the higher ground in the uplands, therefore, a significant proportion of the UK's water supplies lands or flows through peatlands. It was estimated in the UK Natural Capital for Peatlands that 27% of the UK's drinking water supply was sourced from peatlands. It is currently estimated around 80% of the UK's peatlands are in a damaged and deteriorating condition. Water sourced from degraded peatland has dissolved organic carbon and peat sediment, which represents a large cost to water companies to remove it.

In the UK, water abstraction for public water peaks in 2005 at 7,345 million cubic metres (Figure 34). A possible reason for the decline from 2005 is the more efficient and sustainable use of water, as advocated in the Water Act 2003. However, there has been a steady rise from a series low in 2014 of 6,443 million cubic metres to 6,796 million cubic metres in 2018. This has been driven by an increase in abstraction in England.

Figure 34: 27% of the UK's drinking water supply comes from peatlands

Water physical flow water, million cubic metres, UK, 2002 to 2018



Source: Scottish Government, Natural Resources Wales, Department for Environment, Food and Rural Affairs, Department of Agriculture, Environment and Rural Affairs, Northern Ireland and Drinking Water Inspectorate

Notes:

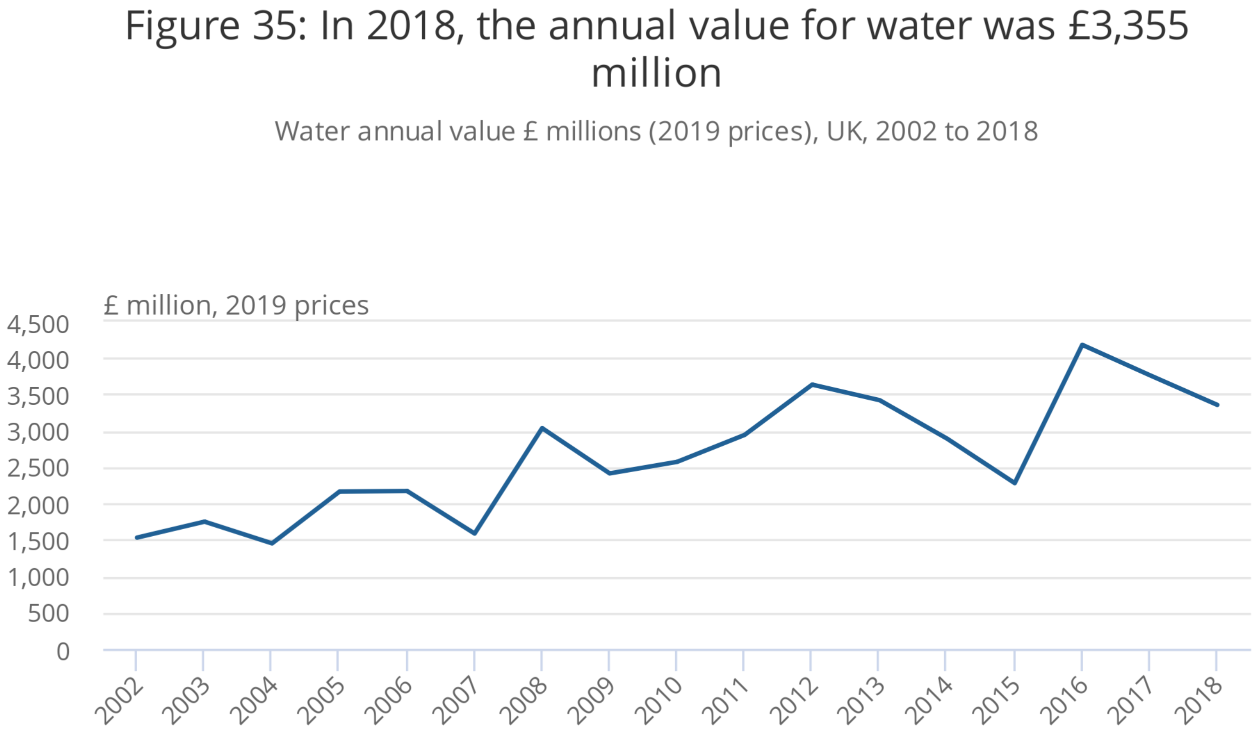
1. 2018 data for England are estimated.

2. 2007 to 2014 provided by Natural Resources Wales and 2015 to 2018 provided by Welsh Water – annual performance reports.

Annual monetary estimates are based on resource rents calculated for the Standard Industrial Classification (SIC) subdivision class: water collection, treatment and supply. The resource rent can be interpreted as the annual return stemming directly from the natural capital asset itself, that is, the surplus value accruing to the extractor or user of a natural capital asset calculated after all costs and normal returns have been considered. The annual value fluctuates over the time series, being valued at £3,355 million in 2018. The UK asset value in 2018 was £98,178 million.

Figure 35: In 2018, the annual value for water was £3,355 million

Water annual value £ millions (2019 prices), UK, 2002 to 2018



Source: Office for National Statistics – Semi-natural habitat, natural capital, UK

Renewable electricity generation

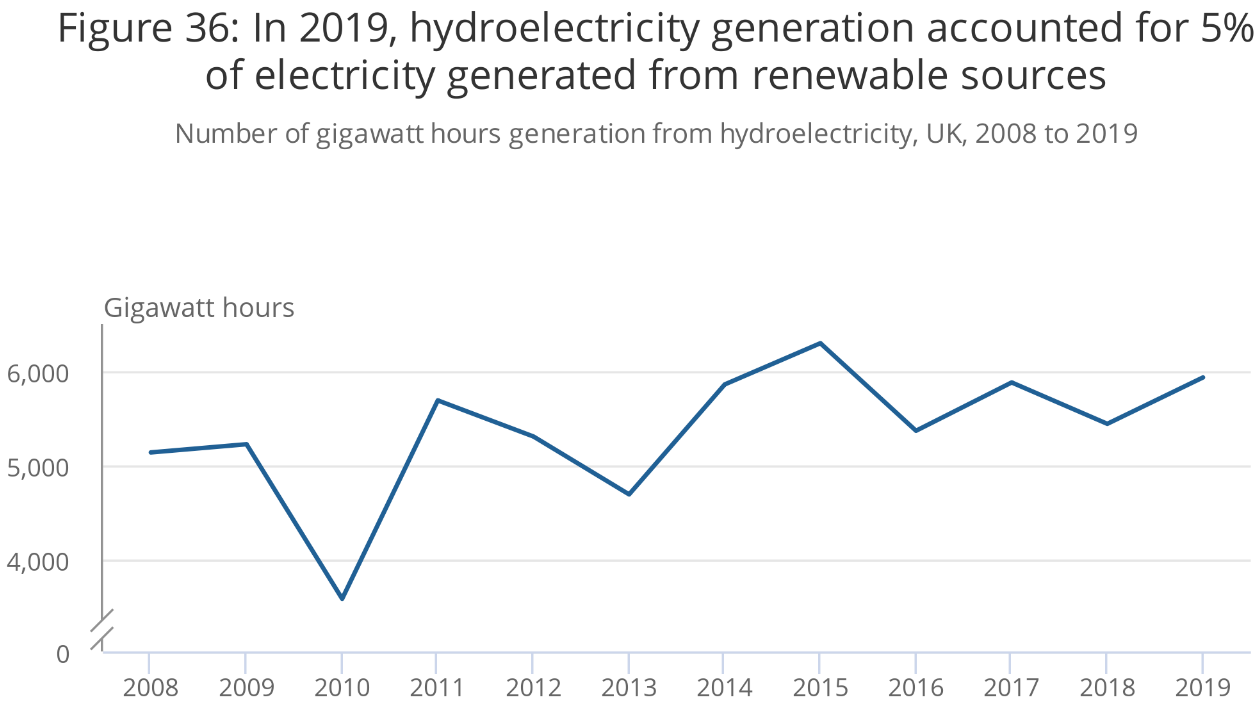
Hydroelectricity

The typical environment favoured for hydro schemes are in semi-natural upland areas. The number of gigawatt hours (GWh) varies over the time series (Figure 36). The reduction in power generated in 2010 (3,591 GWh) is in the year where there was a reduction of 30% in rainfall between 2009 and 2010.

Other factors, in addition to rainfall, also affect the amount of hydro power produced, including the timing of the rainfall and the local groundwater conditions. In 2019, hydro generation accounted for 5% of all the renewable electricity generated in the UK.

Figure 36: In 2019, hydroelectricity generation accounted for 5% of electricity generated from renewable sources

Number of gigawatt hours generation from hydroelectricity, UK, 2008 to 2019



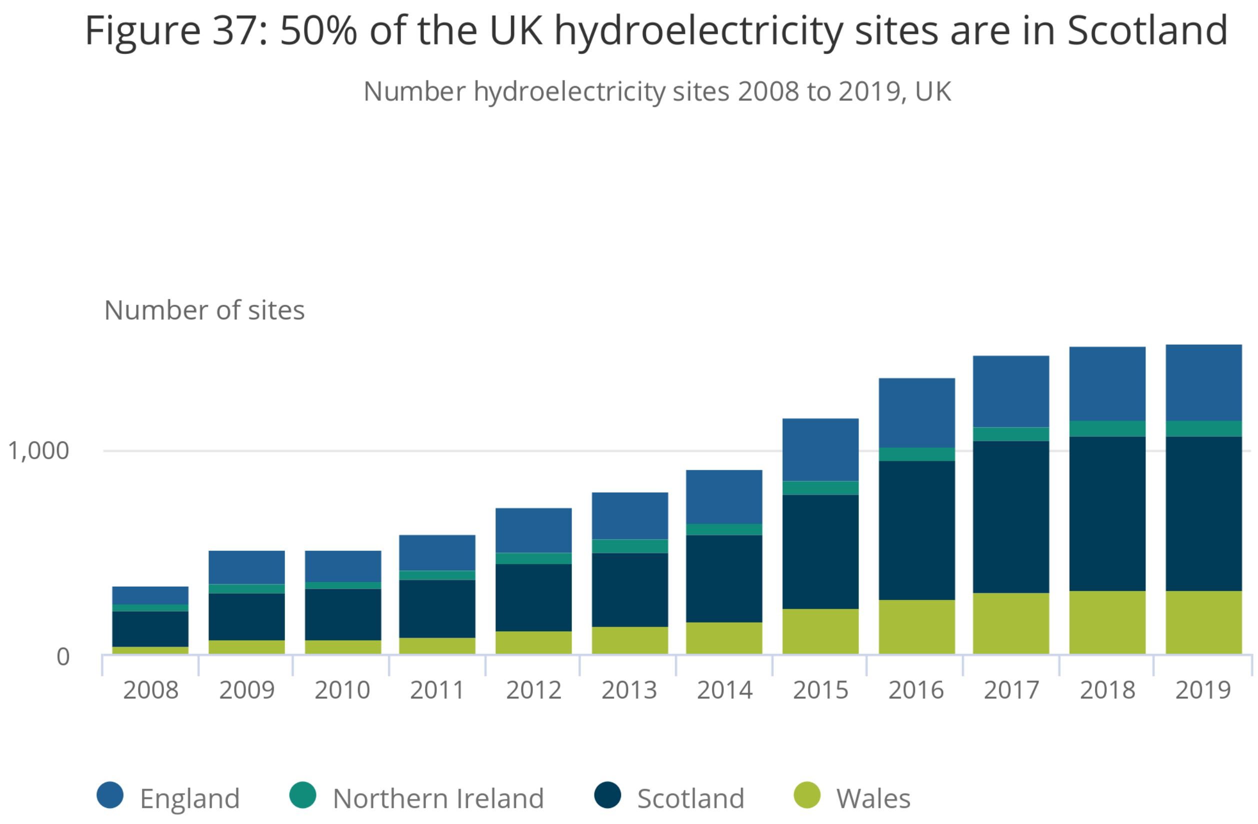
Source: Department for Business, Energy and Industrial Strategy

The number of hydroelectric sites in the UK has increased from 339 in 2008 to 1,520 in 2019, with 50% of those sites in Scotland. This is expected to increase as numerous applications are currently going through the planning process and awaiting construction.

As at September 2020, in Scotland there were three applications submitted, 25 sites were awaiting construction and three sites were under construction. In England, two applications were submitted, eight were awaiting construction and one was under construction. In Wales, one application was submitted, two were awaiting construction and one was under construction.

Figure 37: 50% of the UK hydroelectricity sites are in Scotland

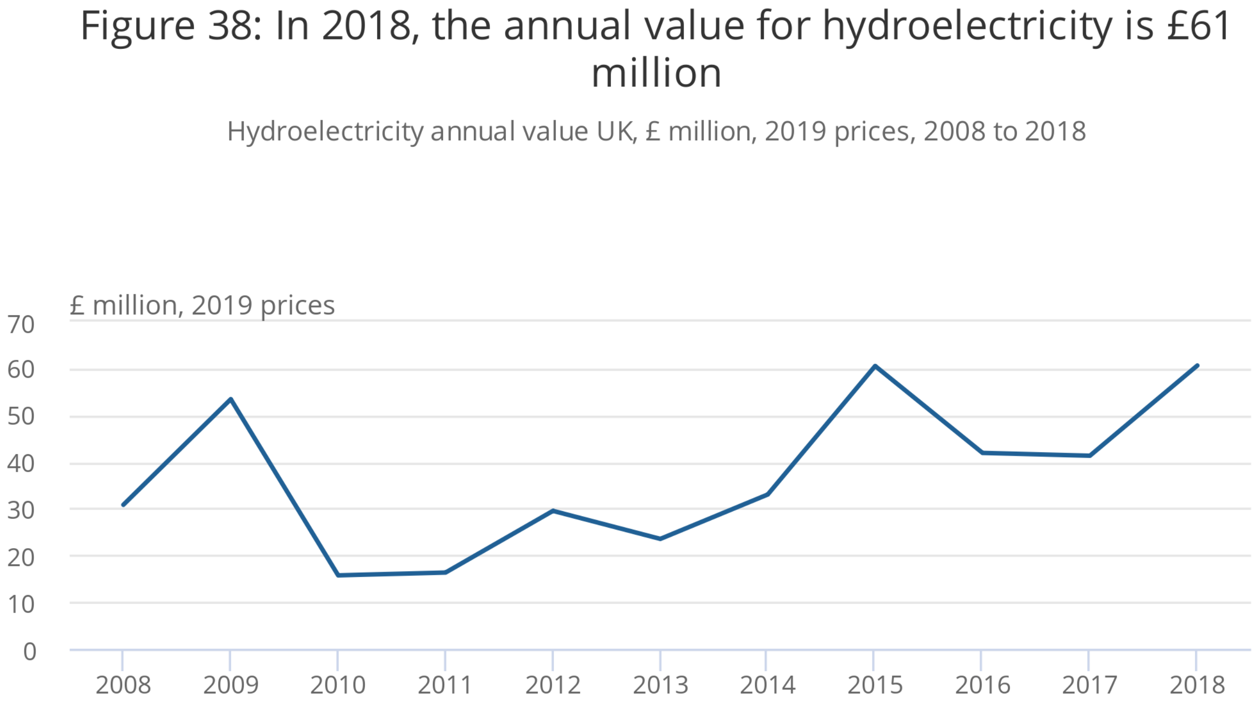
Number hydroelectricity sites 2008 to 2019, UK



Source: Department for Business, Energy and Industrial Strategy

Figure 38: In 2018, the annual value for hydroelectricity is £61 million

Hydroelectricity annual value UK, £ million, 2019 prices, 2008 to 2018



Source: Office for National Statistics

The annual value from hydroelectricity was £61 million in 2018. Part of the annual variation is because of fluctuations in the residual value resource rent approach used (see methodology publication) in addition to variations in the generation of gigawatt hours (GWh) produced. The asset valuation for hydroelectricity has increased by 97% between 2008, when it was £919 million, and 2018, when it was valued at £1,808 million.

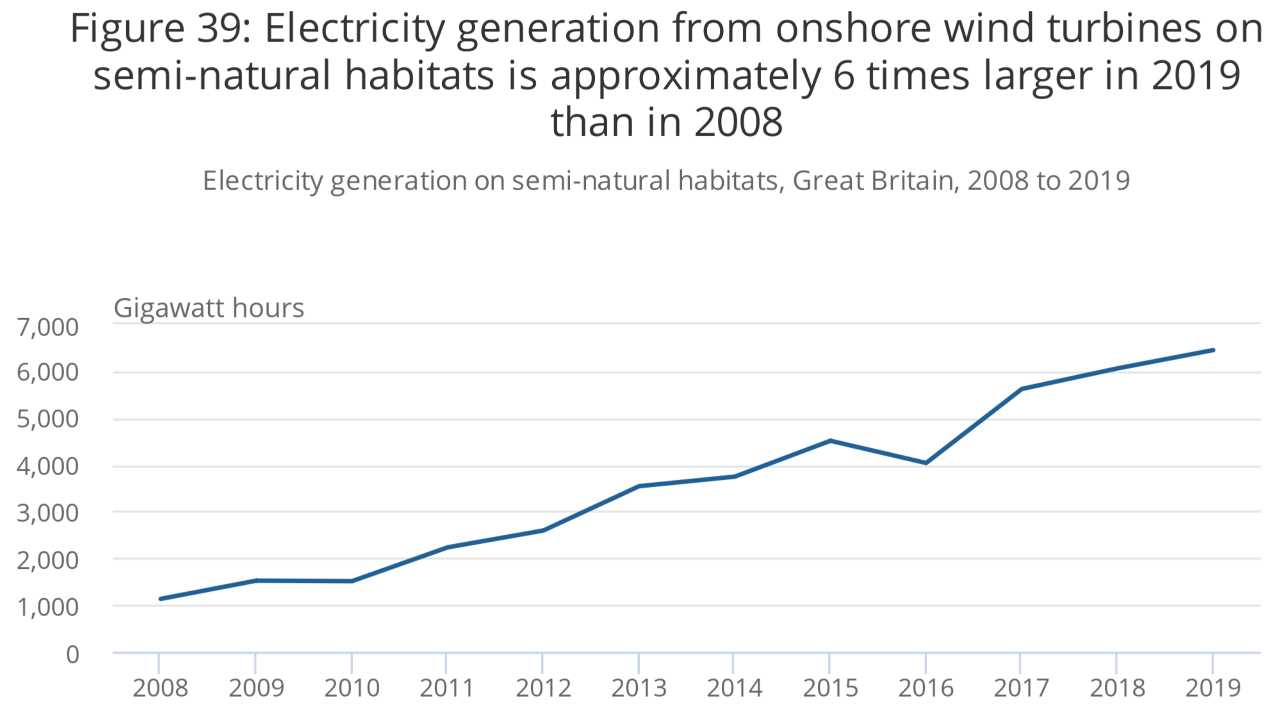
Onshore wind power generation

Electricity generation from onshore wind turbines on semi-natural habitats is approximately six times greater in 2019 than it was in 2008. In 2019, electricity generation on semi-natural habitats was 6,449 gigawatt hours (GWh), a rise from 1,129 gigawatt hours in 2008. The apportioning of onshore wind turbines to semi-natural habitats uses mapping of wind farm locations involving a combination of Department for Business, Energy and Industrial Strategy (BEIS) wind farm points and Ordnance Survey wind turbine points (see methodology publication for full details).

Between 2015 and 2016, there was an 11% reduction in the generation of electricity from wind, which can be attributed to the fall in average wind speeds from 9.4 knots to 8.4 knots. This is also reflected in the wind generation load factor, a measure of generation efficiency being the utilisation of total generation capacity, which decreased from 29% to 24%.

Figure 39: Electricity generation from onshore wind turbines on semi-natural habitats is approximately 6 times larger in 2019 than in 2008

Electricity generation on semi-natural habitats, Great Britain, 2008 to 2019



Source: Office for National Statistics and Department for Business, Energy and Industrial Strategy

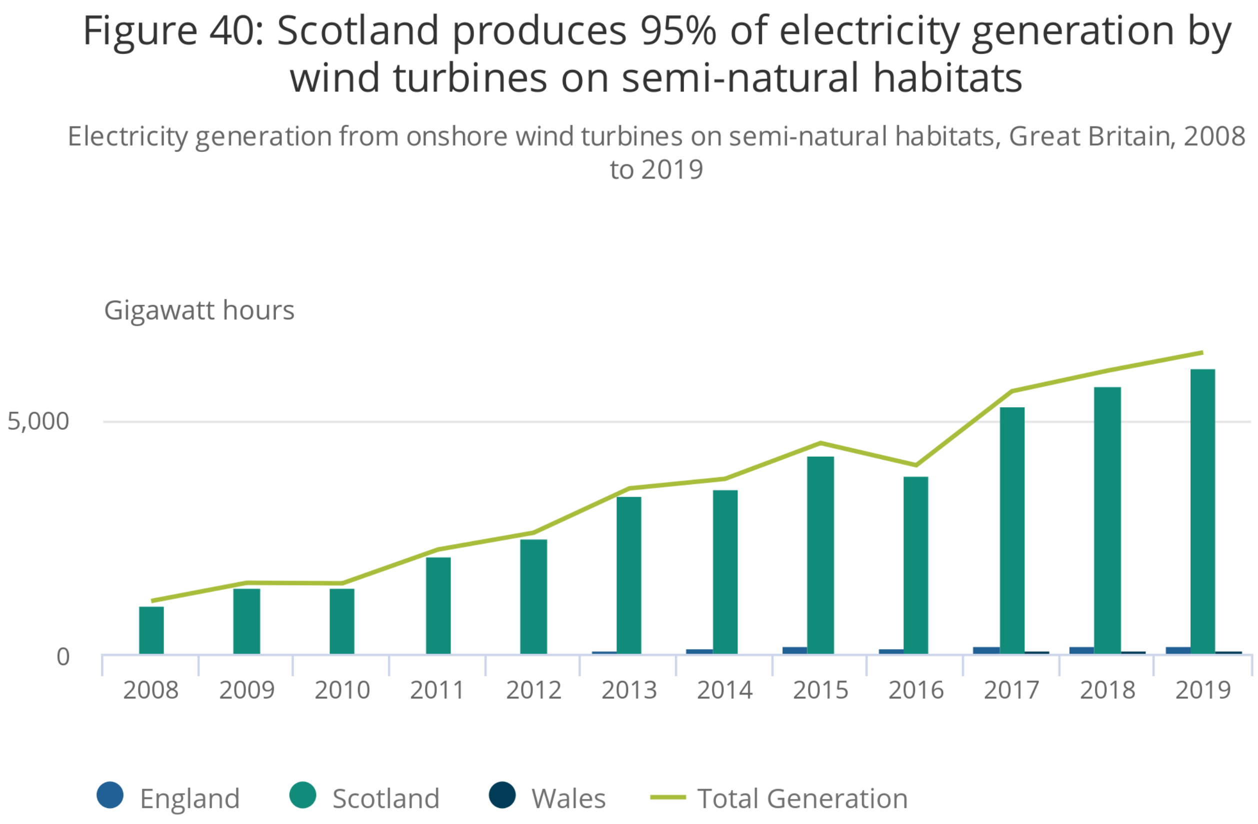
Notes:

1. There are no wind turbines on semi-natural habitats in Northern Ireland.
2. Generation from “other sites” is not included. “Other sites” are sites that have not been attributed to a region so that data related to individual companies are not disclosed.

Scotland generates 95% or 6,138 gigawatt hours (GWh) of the total electricity produced on semi-natural habitats, while England generates 3% or 201 GWh and Wales generates 1% or 109 GWh.

Figure 40: Scotland produces 95% of electricity generation by wind turbines on semi-natural habitats

Electricity generation from onshore wind turbines on semi-natural habitats, Great Britain, 2008 to 2019



Source: Office for National Statistics and Department for Business, Energy and Industrial Strategy

Notes:

1. Total generation excludes Northern Ireland and other sites.

2. Generation from "other sites" is not included. "Other sites" are sites that have not been attributed to a region so that data related to individual companies are not disclosed.

3. No wind turbines on semi-natural habitats in Northern Ireland.

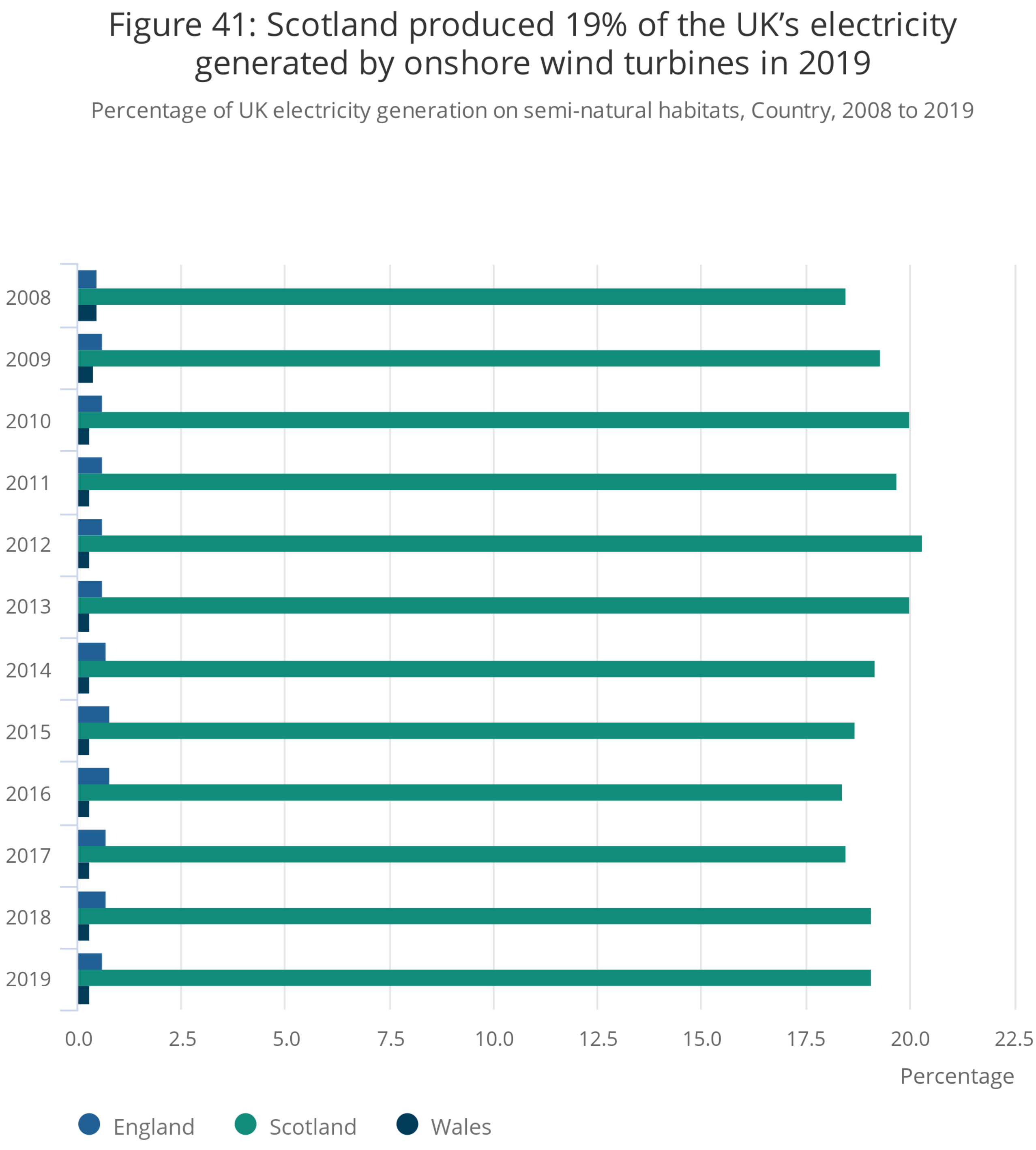
Comparison between onshore wind generation on all sites with semi-natural habitats

Between 2008 and 2019, the electricity generation from semi-natural habitats has been consistent. In 2012, semi-natural habitats produced the highest generation of electricity (at 21.2%) before declining for the next four years to the lowest level of 19.4% in 2016. This has since recovered and in 2019, 20% of electricity was generated on semi-natural habitats.

18% or 1,068 gigawatt hours (GWh) of the UK's electricity generation from onshore wind turbines was produced in Scotland's semi-natural habitats in 2008. This steadily increased and peaked in 2012, at 20.3%, before decreasing again. It then stood at 19% or 6,138 GWh in 2019. Semi-natural habitats in England and Wales produced 1.0% and 0.3% respectively in 2019.

Figure 41: Scotland produced 19% of the UK's electricity generated by onshore wind turbines in 2019

Percentage of UK electricity generation on semi-natural habitats, Country, 2008 to 2019



Source: Office for National Statistics and Department for Business, Energy and Industrial Strategy

Notes:

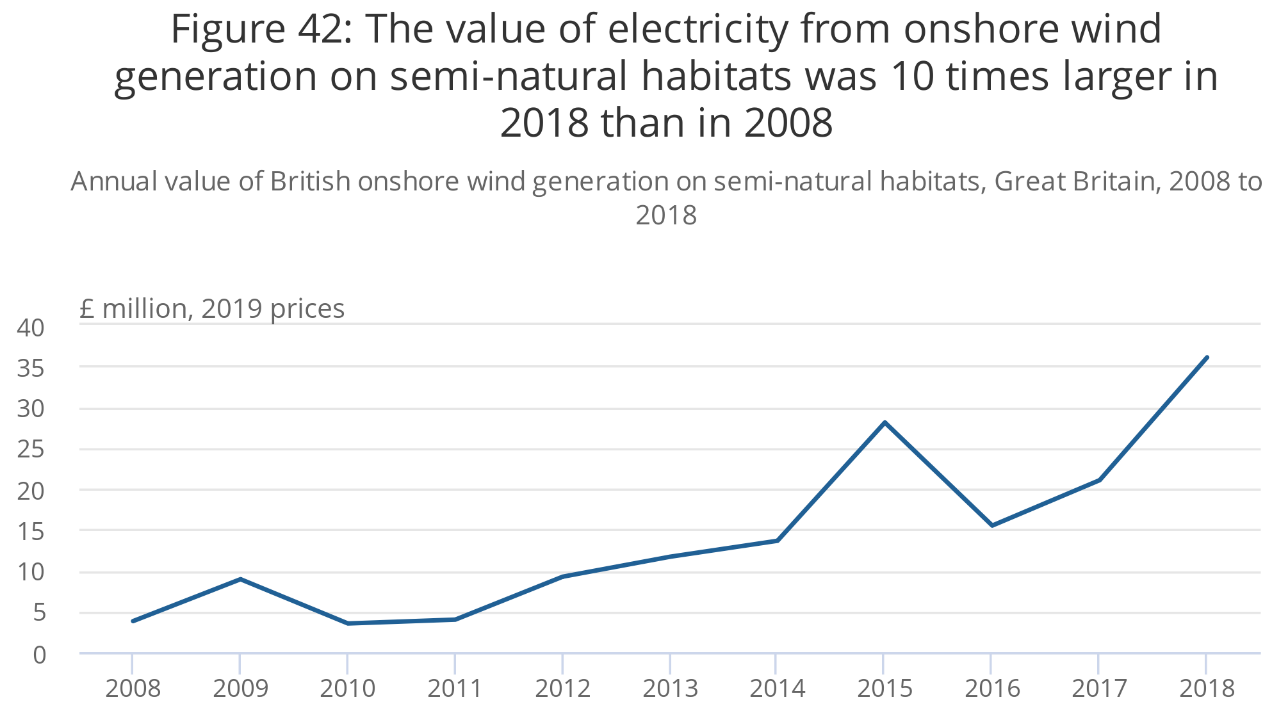
1. There are no wind turbines on semi-natural habitats in Northern Ireland.

Annual value

The annual value of onshore wind generation on semi-natural habitats increased from £3.8 million in 2008 to £36 million in 2018 and is now approximately 10 times larger.

Figure 42: The value of electricity from onshore wind generation on semi-natural habitats was 10 times larger in 2018 than in 2008

Annual value of British onshore wind generation on semi-natural habitats, Great Britain, 2008 to 2018



Source: Office for National Statistics

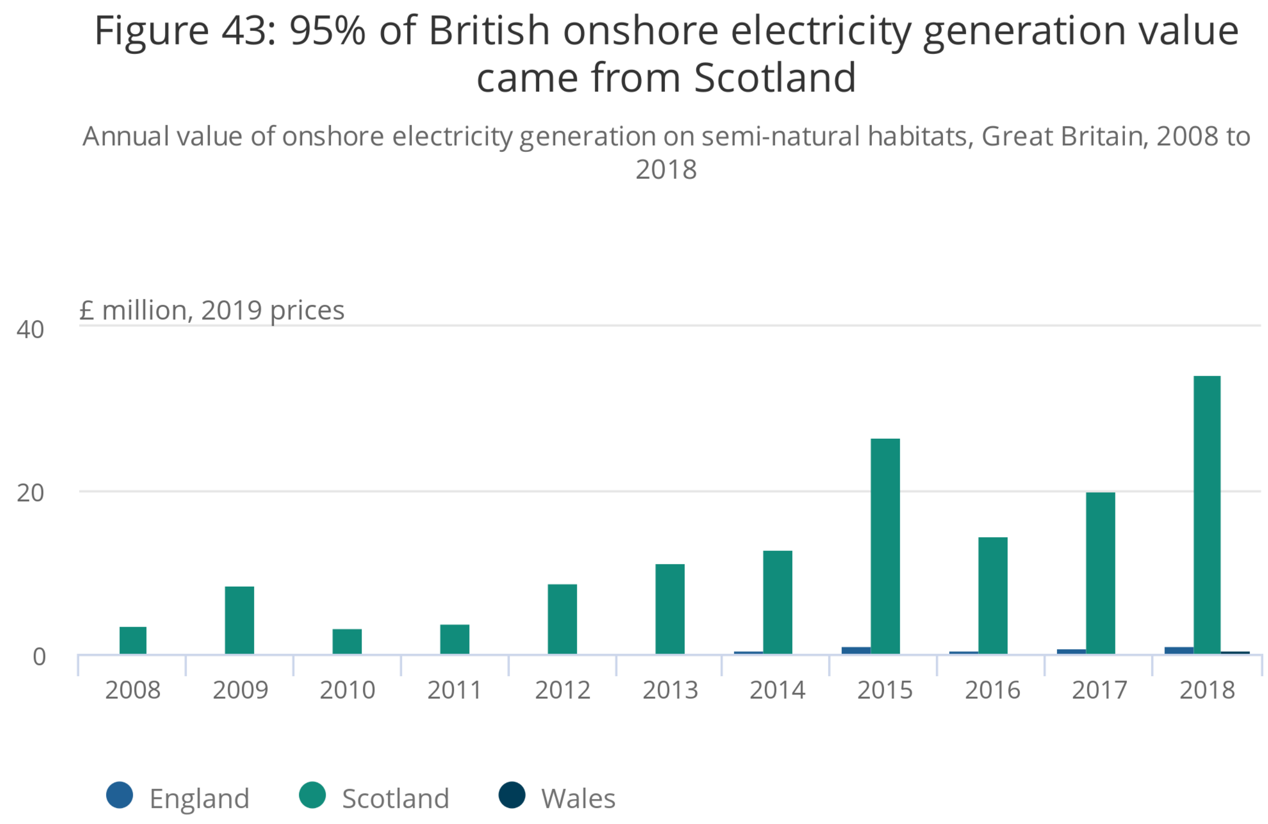
Notes:

1. Annual value is for GB only because there are no onshore wind turbines on semi-natural habitats in Northern Ireland.

Scotland’s proportion of the annual value has increased from £3.6 million in 2008 to £34.3 million in 2018 and accounts for 95% of the total Great Britain valuation. England’s share of the annual value in 2003 was £0.1 million and has increased to £1.2 million in 2018 and accounts for 3.3% of the total valuation. Wales’ share of the annual value has increased from £0.1 million to £0.5 million in 2018 and accounts for 1.5% of the Great Britain valuation.

Figure 43: 95% of British onshore electricity generation value came from Scotland

Annual value of onshore electricity generation on semi-natural habitats, Great Britain, 2008 to 2018



Source: Office for National Statistics

The asset value of onshore wind generation on semi-natural habitats is £535 million in 2018 (2019 prices).

6 . Regulating ecosystem services: quantity and value

This section discusses the benefits provided by the regulation of natural processes, including air quality regulation, climate regulation, pollination and natural hazard regulation such as flood mitigation.

Carbon sequestration

Vegetation can sequester carbon, that is, remove it from the atmosphere. Capacity for vegetation to do this depends on its characteristics. Forests capture the carbon dioxide from the atmosphere and through photosynthesis transform it into biomass (for example, wood) and so carbon accumulates in the form of biomass, deadwood, litter and soils.

We use the Department for Business, Energy and Industrial Strategy's (BEIS) non-traded carbon prices, which approximate to the cost of removing carbon by other means -- including reducing emissions. This valuation does not consider the impacts to global society outside of the UK of carbon sequestration.

The amount of carbon sequestered has risen from 11,871 million tonnes carbon dioxide (CO2) equivalent removed in 1998 to 12,420 million tonnes CO2 equivalent in 2018.

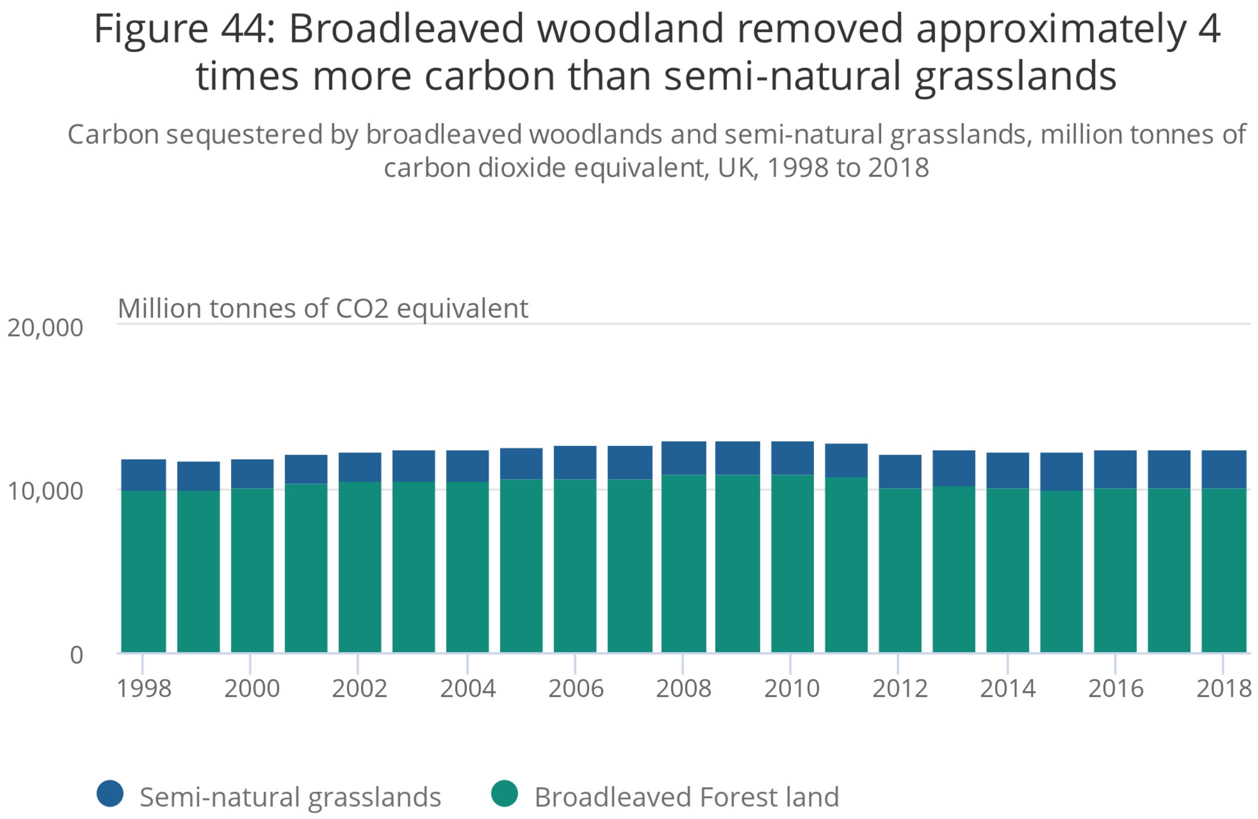
Broadleaved woodland removed approximately four times more carbon in the UK than semi-natural grasslands. The value of carbon has been increasing over time, with the annual value at £867 million in 2018 (Figure 45). The asset value of carbon sequestered by semi-natural lands in 2018 is £44,036 million (2019 prices).

This analysis does not capture all carbon sequestration for all semi-natural habitats. We currently only have data on broadleaved woodlands and semi-natural grasslands. A lack of data means values for sequestration by saltmarsh ecosystems are not included in current estimates.Peatlands, which are a significant source of emissions, are only partially represented in the data.

A report for the Department for Business, Energy and Industrial Strategy (BEIS), estimates that [emissions from damaged peatland (23 million tonnes of CO2 equivalent) negate all terrestrial carbon sequestration in the UK]. For more information on data gaps, please see the [methodology guide].

Figure 44: Broadleaved woodland removed approximately 4 times more carbon than semi-natural grasslands

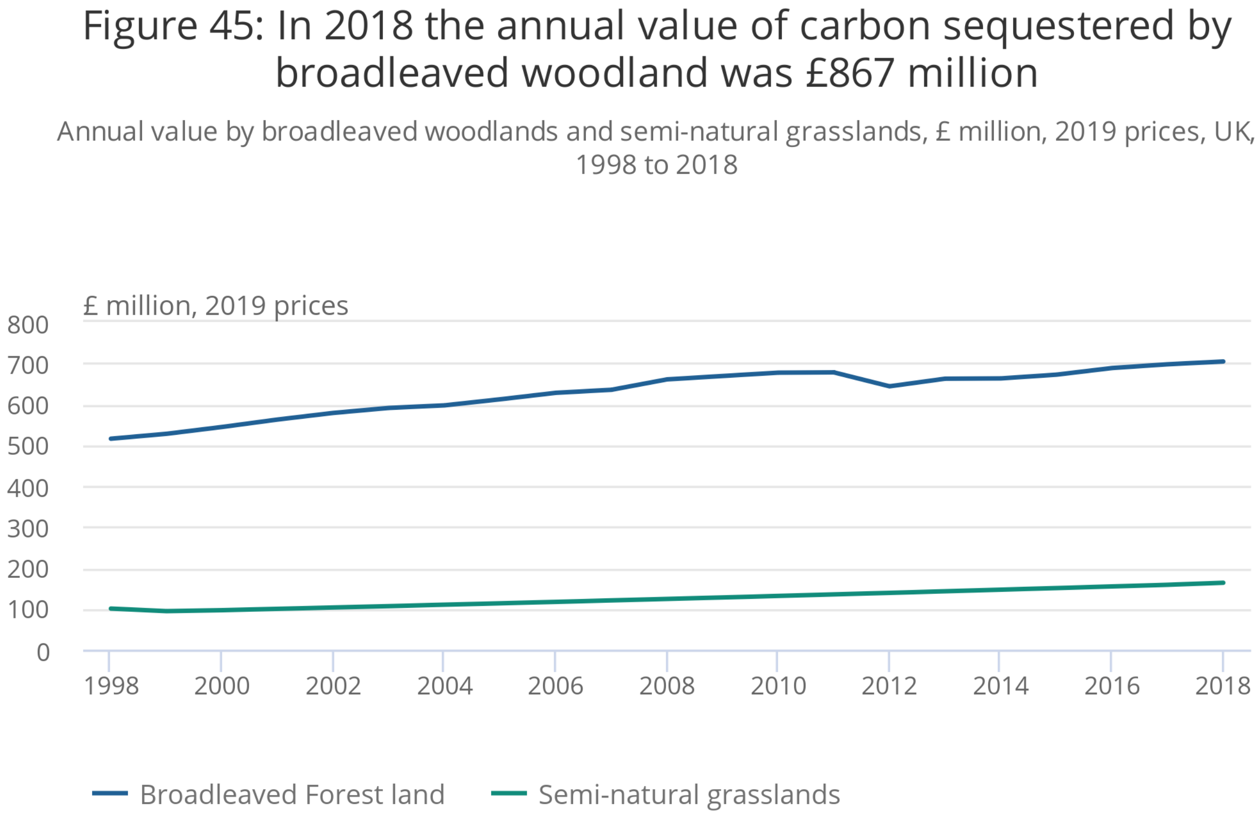
Carbon sequestered by broadleaved woodlands and semi-natural grasslands, million tonnes of carbon dioxide equivalent, UK, 1998 to 2018



Source: Office for National Statistics and UK National Atmospheric Emission Inventory

Figure 45: In 2018 the annual value of carbon sequestered by broadleaved woodland was £867 million

Annual value by broadleaved woodlands and semi-natural grasslands, £ million, 2019 prices, UK, 1998 to 2018



Source: Office for National Statistics, UK National Atmospheric Emission Inventory and Department for Business, Energy and Industrial Strategy

Air pollution removal

The removal of air pollutants by vegetation is measured, in these accounts, in terms of the avoided healthcare costs associated with exposing the public to the pollutants removed. Air pollution is associated with a range of cardio-vascular and respiratory diseases in humans. The pollutants covered in pollution removal are:

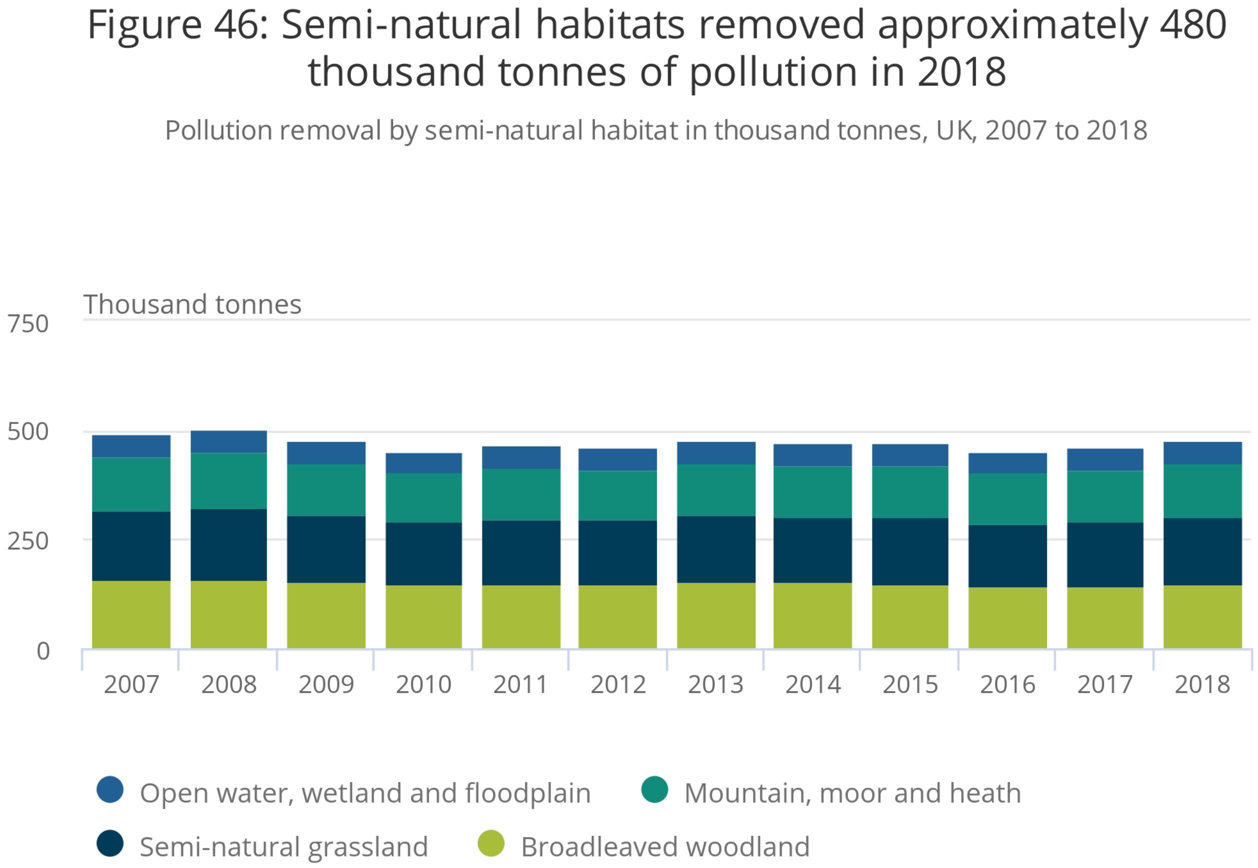
- PM2.5
- PM10 (which includes PM2.5)
- nitrogen dioxide (NO_2)
- ground-level ozone (O_3)
- ammonia (NH_3)
- sulphur dioxide (SO_2)

The most harmful pollutant is PM2.5 (fine particulate matter with a diameter of less than 2.5 micrometres, or 3% of the diameter of a human hair), which can bypass the nose and throat to penetrate deep into the lungs, leading to potentially serious health effects and healthcare costs.

An estimated 480,000 tonnes of pollution was removed in 2018 by semi-natural vegetation (Figure 46).

Figure 46: Semi-natural habitats removed approximately 480 thousand tonnes of pollution in 2018

Pollution removal by semi-natural habitat in thousand tonnes, UK, 2007 to 2018



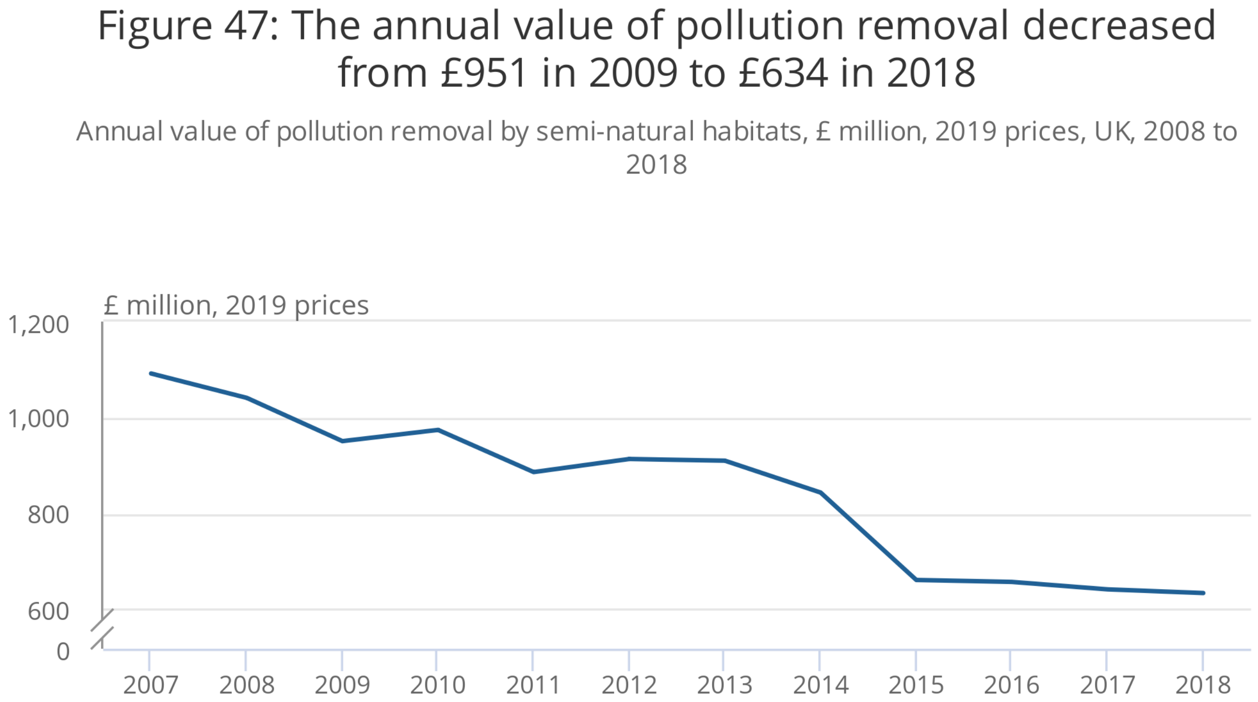
Source: Office for National Statistics and Centre for Ecology and Hydrology

The pollution removal annual value has fallen from £951 million in 2009 to £634 million in 2018 (Figure 47). These changes are not driven by changing conditions or the extent of vegetation but are linked to falls in UK air pollution levels.

Although the removal of PM2.5 represents a small part of total pollution removed, it represents nearly 90% of the avoided health impacts. The physical amount of pollution has remained fairly flat, however, the value of this has declined because of the reductions of PM2.5 in the atmosphere to remove.

Figure 47: The annual value of pollution removal decreased from £951 in 2009 to £634 in 2018

Annual value of pollution removal by semi-natural habitats, £ million, 2019 prices, UK, 2008 to 2018



Source: Office for National Statistics

In 2018, it is estimated that the asset value of pollution removal was £38.9 billion in semi-natural habitats.

Pollinators

Pollination by wild species provides benefits to the UK population through enhanced crop productivity, quality and nutrition, as well as its biodiversity benefits further up the food chain.

The National Pollinator Strategy: 2014 estimated pollinators added approximately £600 million per year to the value of UK crops, through increased yield in oilseed rape and the quality of various fruit and vegetables. A previous study, in 2007, estimated insect pollinators contributed around £430 million in production value to the UK economy or around 8% of the total market value of crop production.

Beyond the direct effects of pollinators on UK market values, movement by pollinating insects from semi-natural habitats to agricultural areas expands the positive externality effects of pollinator presence. Semi-natural habitats support ecosystem services beyond its immediate vicinity to produce additional benefits, including pollination and biological control. The establishment of quality semi-natural habitats, and insect movement from them, provides increased levels of pollination in neighbouring agricultural areas, improving marketable yields.

Flood mitigation

Forests

Forests are known to reduce flood flows, according to a systemic review by the UK Centre for Ecology and Hydrology, which looked at 71 studies. There is broad support for the conclusion that increased tree cover in catchments results in decreased flood peaks, and that decreased tree cover results in increased flood peaks.

To capture the flood regulating service for woodland in Great Britain, Forest Research examined how much it would cost to install equivalent man-made flood water storage (that is, reservoirs) in an area where there was no woodland. For more information on the method, see the methodology report.

An annual average estimated that it would cost £218.5 million per year to create reservoirs able to capture that water if woodland in flood risk catchment (FRC) areas were replaced with grassland. In this study, 83% of the land area in Great Britain fell within an FRC area. The total Great Britain asset valuation of this service over 100 years equated to £6,513 million, in 2018 prices. However, there are a number of caveats with this calculation. For all limitations with this research, see the methodology report.

Semi-natural woodlands formed around 54% of woodlands and a crude estimate of the annual value, at 2019 prices, stands at £120 million, with an asset value of £3,583 million.

Saltmarshes

Saltmarshes provide a range of ecosystem services, such as facilitating waste remediation, carbon sequestration, providing seascapes for individuals to enjoy, and mitigating flood hazards. Further research is required to provide more accurate data on the extent of and ability of saltmarshes to allay flood risk.

We aim to provide estimates on the economic benefits of UK saltmarsh flood mitigation in the future and appropriate methods for their valuation. Research identified three factors for the capacity of a saltmarsh to provide natural hazard protection:

- width of saltmarsh
- distance travelled by waves
- habitat contiguousness and degree of homogeneity

7 . Cultural ecosystem services: quantity and value

Cultural ecosystem services provide non-material benefits, such as enjoyment of the landscape and its wildlife, recreation, education and cultural heritage.

Recreation

The estimates for outdoor recreation refer to people aged 16 years and over and exclude overnight stays. We measure both the physical flow of recreation as the amount of time people spend outdoors as well as how much money people spend to go.

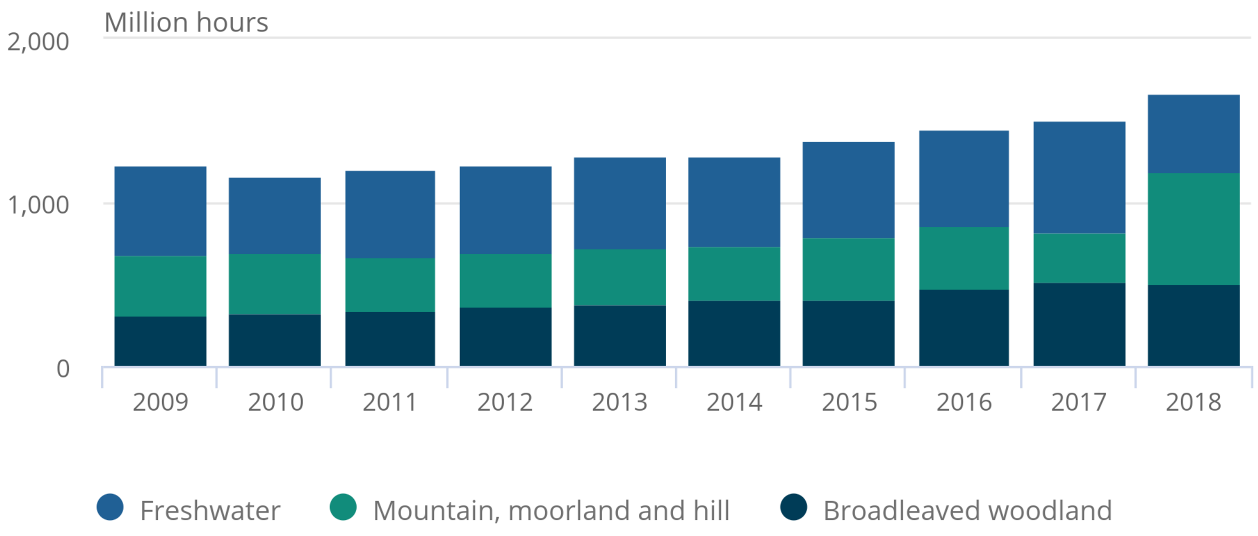
In 2018, it is estimated that 1,670 million hours were spent in the semi-natural habitats of woodland, mountains, moorland and hills and freshwater (Figure 48). This has increased significantly over the time series, from 1,237 million hours in 2009. It is an underestimate as not all semi-natural grasslands are included; we are unable to separate out the visits classed as farmlands that are on grasslands within the farm.

Figure 48: 1,670 million hours were spent in semi-natural habitats in 2018

Flow of outdoor recreation in semi-natural habitats, million hours spent outdoors, UK, 2009 to 2018

Figure 48: 1,670 million hours were spent in semi-natural habitats in 2018

Flow of outdoor recreation in semi-natural habitats, million hours spent outdoors, UK, 2009 to 2018

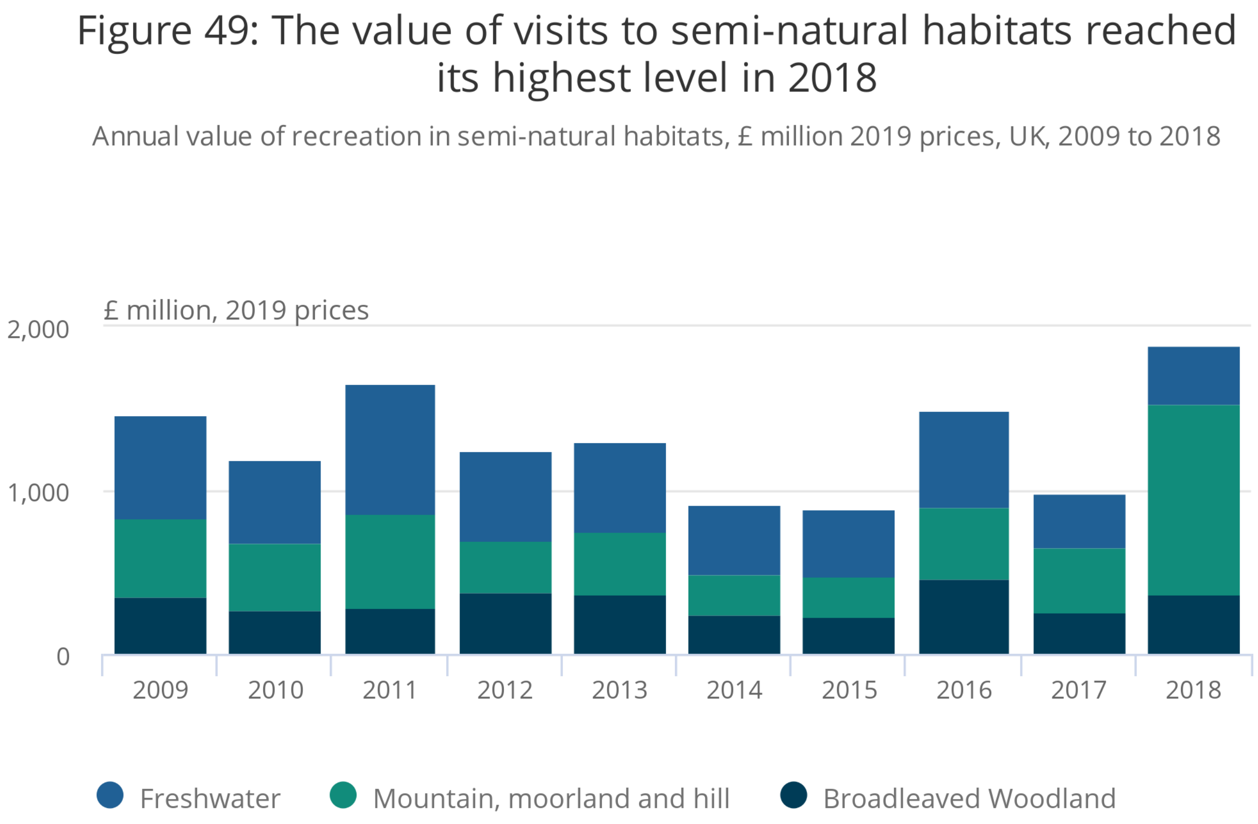


Source: Monitor of Engagement with the Natural Environment Survey, National Survey for Wales, Scotland's People and Nature Survey

The annual monetary value of visits to semi-natural habitats fluctuates over time. This is because of reductions in expenditure per visit, with travel costs declining and people choosing cheaper outdoor activities. Semi-natural habitat visits in 2018 were estimated to be worth £1,893 million, excluding visits to semi-natural grasslands that may have been classed as visits to farmland. The majority of the value of visits is in mountains, moorland and hill areas (£1,164 million).

Figure 49: The value of visits to semi-natural habitats reached its highest level in 2018

Annual value of recreation in semi-natural habitats, £ million 2019 prices, UK, 2009 to 2018



Source: Monitor of Engagement with the Natural Environment Survey, National Survey for Wales, Scotland’s People and Nature Survey

The asset value of recreation in semi-natural habitats was estimated to be £82,742 million in 2018. That is the valuation of the stream of services that are expected to be generated over the lifetime of the asset.

8 . Asset value of semi-natural habitats

The asset account includes selected semi-natural habitats ecosystem services, valued at £270 billion in 2018 (Table 24). See methodology publication for full details.

Table 24: Semi-natural habitats ecosystem asset values, £ million (2019 prices), UK, 2018

Service	2018
Water	98,178
Hydroelectricity	1,808
Wind	535
Carbon sequestration	44,036
Pollution removal	38,910
Flood protection	3,583
Recreation	82,742
Total	269,792

Source: Office for National Statistics – Semi-natural habitat, natural capital, UK

9 . Semi-natural habitat, UK data

Semi-natural habitats, condition indicators
Dataset | Released 10 February 2021
A short summary of the dataset and what it covers.

Semi-natural habitats, ecosystem services
Dataset | Released 10 February 2021
Physical (non-monetary) and monetary estimates of the ecosystem services provided by natural assets in the UK between 1998 and 2019.

10 . Glossary

Asset

Asset valuation is an estimate of the stream of services that are expected to be generated over the life of the asset. It looks at the pattern of expected future flows and the time period over which the flows of values are expected to be generated.

Ecosystem services

Ecosystem services are the flows of benefits that people gain from natural ecosystems. This includes provisioning services such as food and water; regulating services such as flood protection and pollution removal; and cultural services such as recreational and heritage.

Natural capital

Natural capital is a way of measuring and valuing the benefits that the natural world provides society. These benefits from natural resources include food, cleaning the air of pollution, sequestering carbon and cleaning fresh water.

11 . Measuring the data

In this release, the semi-natural habitat accounts are presented in four sections:

- the size of the area covered by semi-natural (extent account)
- indicators of the quality of the semi-natural ecosystem and ability to continue supplying services (condition account)
- quantity and value of services supplied by the semi-natural ecosystem (physical and monetary ecosystem service flow accounts)
- value of semi-natural habitat as an asset, which represents the stream of services expected to be provided over the lifetime of the asset (monetary asset account)

The data underpinning semi-natural habitats, natural capital, UK come from a range of sources with different timeliness and coverage. This release is based on the most recent data as at December 2020.

Data sources include:

- Bat Conservation Trust
- British Trust for Ornithology (BTO)
- Bumblebee Conservation Trust
- Butterfly Conservation (BC)
- Countryside Survey
- Department for Business, Energy and Industrial Strategy (BEIS)
- Department for Environment, Food and Rural Affairs (Defra)
- Environment Agency
- European Forest Fire Information System (EFFIS)
- Forest Research
- Forestry Commission Scotland
- Forestry England
- Joint Nature Conservation Committee (JNCC)
- Natural England
- NatureScot
- Marine Scotland
- Natural Resources Wales
- Rothamsted Research
- UK Centre for Ecology and Hydrology
- UK National Atmospheric Emissions Inventory (NAEI)

The Office for National Statistics' (ONS's) natural capital accounts are produced in partnership with the Department for Environment, Food and Rural Affairs (Defra).

Department
for Environment
Food & Rural Affairs

12 . Strengths and limitations

Data quality

The ecosystems services are Experimental Statistics. Currently, there is no single data source for the UK for the individual ecosystem services. They are calculated from data from the four countries with different timeliness.

Ecosystems provide a diverse range of services and not all have been included in this publication, either owing to unavailability of data or the need for new methods of evaluation. We intend to continue to develop our ability to report on all services.

13 . Related links

Semi-natural habitat natural capital accounts methodology, UK: 2021
Methodology | Released 10 February 2021
How the natural capital semi-natural habitat accounts are measured and developed, including the specific methods used to value individual components of natural capital and physical and monetary data sources.

Ecosystem Accounting
Webpage | Updated as necessary
The System of Environmental Economic Accounting (SEEA) constitutes an integrated statistical framework for organising biophysical data, measuring ecosystem services, tracking changes in ecosystem assets and linking this information to economic and other human activity.

Woodland natural capital accounts, UK: 2020
Statistical bulletin | Released on 28 February 2020
Natural capital accounts containing information on ecosystem services for woodlands in the UK.

UK natural capital accounts: 2020
Statistical bulletin | Released on 19 November 2020
Estimates of the financial and societal value of natural resources to people in the UK.

UK natural capital: mountains, moorland and heath accounts
Statistical bulletin | Released on 22 July 2019
Ecosystem accounts for the mountains, moorlands and heath (MMH) environment in the UK. This is the first iteration of the MMH ecosystem account.

UK natural capital: peatlands
Statistical bulletin | Released on 22 July 2019
Natural capital accounts for peatlands measures the ecosystem services which nature provides from this dramatic landscape, including water, carbon sequestration, food and recreation.