

UK Biodiversity Indicators 2019

This document supports
D1b. Removal of greenhouse gases by UK forests

Fiche

For further information on D1b. Removal of greenhouse gases by UK forests visit jncc.gov.uk/ukbi-D1b

For further information on the UK Biodiversity Indicators visit jncc.gov.uk/ukbi

D1. Biodiversity and ecosystem services

D1b. Removal of greenhouse gases by UK forests

Type: Benefit indicator

Summary

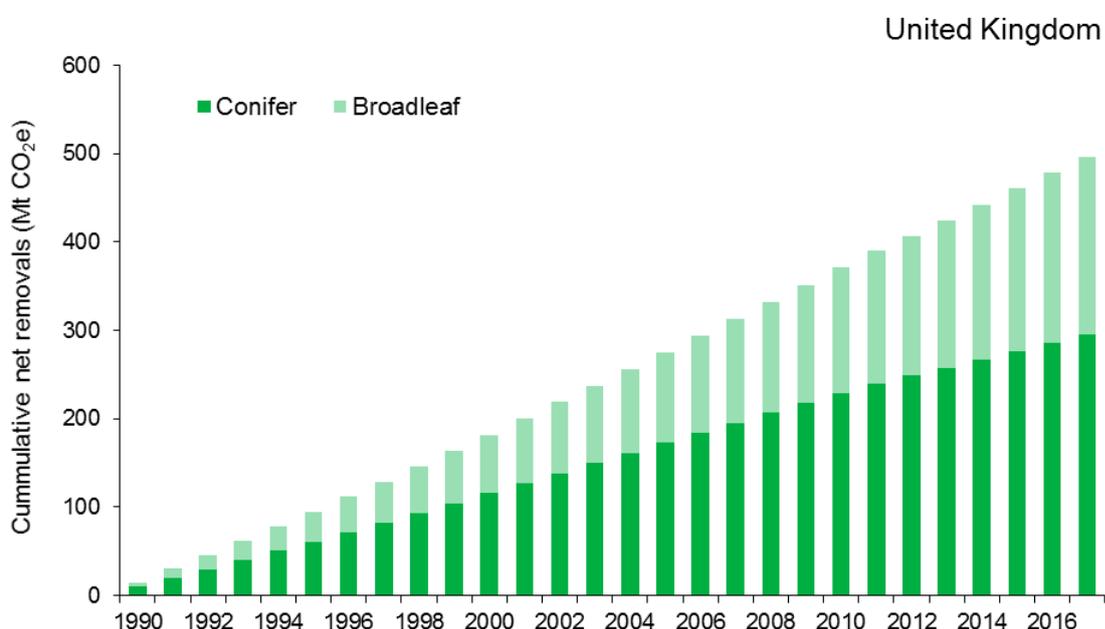
It is estimated that since 1990, forests in the UK have (cumulatively) removed the equivalent of 497 million tonnes of carbon dioxide (Mt CO₂e) from the atmosphere (Figure D1bi). In 2017, UK forests are estimated to have removed 18 Mt CO₂e (Figure D1bii).

The proportion of greenhouse gases removed from the atmosphere by broadleaf woodland has increased since the time series began, accounting for 49% (8.8 Mt CO₂e) of the estimated annual removals in 2017 compared to 35% (5.1 Mt CO₂e) of removals in 1990 (Figure D1bii).

Indicator Description

Forests are a large store of carbon and also act as an active carbon 'sink', removing carbon dioxide (CO₂), a greenhouse gas, from the atmosphere and storing it as carbon in living biomass, leaf litter and forest soil. This sequestration of CO₂ is an essential ecosystem service. This indicator shows the cumulative net removal of greenhouse gases from the atmosphere by UK forests since 1990. It is split between type of woodland (conifer and broadleaf). Showing greenhouse gas removals by type of woodland is interesting from a biodiversity perspective as it allows a clearer presentation of the contribution made to greenhouse gas removals by broadleaf woodland, most of which constitutes priority habitat.

Figure D1bi. Cumulative net removals of greenhouse gases by UK forests, 1990 to 2017.



Notes:

1. Estimated cumulative net removals of greenhouse gases (carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O)) from the atmosphere by forests in the UK, expressed as million tonnes of CO₂ equivalent (Mt CO₂e).
2. Revised in 2015 to reflect improved modelling of greenhouse gas emissions and removals.
3. Revised in 2017 due to improvements made to the forestry sector of the 1990 to 2015 Land Use, Land Use Change and Forestry (LULUCF) greenhouse gas inventory.

D1b. Removal of greenhouse gases by UK forests

4. Revised in 2018 due to improvements in the CARBINE model used to calculate the forest carbon stock figures for the 1990 to 2016 LULUCF greenhouse gas inventory.
5. Revised in 2019 due to further improvements in the CARBINE model (see background section for more details).
6. These results are therefore not directly comparable with those in previous publications.

Source: Department of Business, Energy & Industrial Strategy – Land Use, Land Use Change and Forestry (LULUCF) greenhouse gas inventory.

Assessment of change in cumulative net removal of greenhouse gases			
	Long term	Short term	Latest year
Cumulative net removal of greenhouse gases by forests	 1990–2017	 2012–2017	Increased (2017)

Note: Long and short-term assessments are based on a 3% rule of thumb. The base years for these assessments use a 3-year average. See [Assessing Indicators](#).

Indicator description

The data presented here are from the UK's Land Use, Land Use Change and Forestry (LULUCF) greenhouse gas inventory, which provides estimates of the annual rate of emissions and removals of greenhouse gases (carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O)) from the atmosphere by forests in the UK between 1990 and 2017 (Figures D1bi and D1bii). LULUCF emissions and removals are given in terms of carbon dioxide equivalent (CO₂e). The CO₂e of a mixture of greenhouse gases is the quantity of CO₂ that would have the same global warming potential.

Relevance

The benefits that humans receive from the environment have become more widely recognised. The Millennium Ecosystem Assessment and the more recent UK National Ecosystem Assessment both highlighted that ecosystems and the services they deliver underpin our very existence. We depend on them to produce our food and timber, regulate water supplies and climate, and breakdown waste products. We also value them in less obvious ways: contact with nature gives pleasure, provides recreation and is known to have a positive impact on long-term health and happiness. Measuring the status of ecosystem services is therefore a critical aim of the indicator set. Greenhouse gas removal is a regulating service that contributes to reducing the scale and future impacts of climate change (climate change mitigation).

Background

National Inventories of human-induced sources and sinks of greenhouse gases are submitted by Parties, including the UK, to the United Nations Framework Convention on Climate Change (UNFCCC) every year. This system was set up to meet the reporting obligations of the Convention and is used to report on progress in meeting Kyoto Protocol commitments. The Kyoto Protocol, which entered into force in 2005, obliges industrialised countries that have ratified the accord to reduce their emissions of 6 greenhouse gases, the major contributors being CO₂, CH₄ and N₂O. The LULUCF greenhouse gas inventory covers emissions and removals of these 3 greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities. The LULUCF estimates are compiled for the Department of Business, Energy & Industrial Strategy (BEIS) by the Centre for Ecology & Hydrology (CEH) and Forest Research (FR).

D1b. Removal of greenhouse gases by UK forests

The forestry figures in the 1990 to 2017 LULUCF inventory have been revised and therefore the figures presented here are not directly comparable to those in previous publications. These revisions are due to improvements in the FR CARBINE model used for calculating changes in forest carbon stocks that include:

- Corrections to the double counting of deadwood inputs in the year of harvesting;
- Changes to the post-harvest calculations for turnover of foliage, branches and roots to ensure there is no double-counting; and
- Minor adjustments to the volume calculations for managed non-clearfell areas.

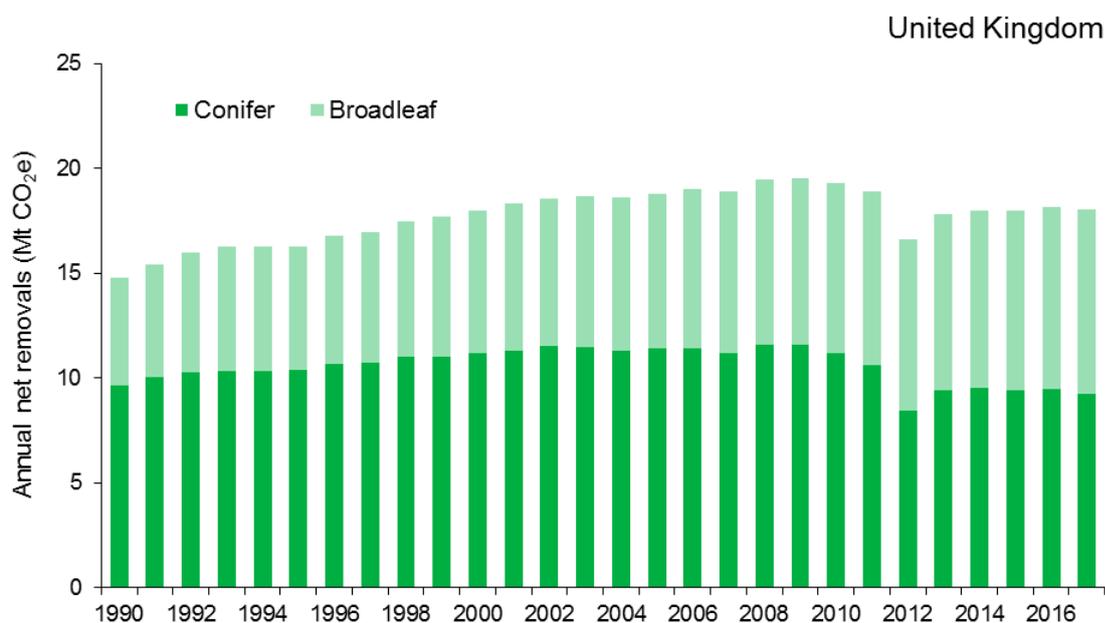
There have also been improvements to the process for allocating forest management activities. These improvements have led to changes in assumptions about the proportions of forest area allocated to new planting and felling over time. The reported area of forest has varied slightly over time as has the proportion of forest on mineral and organic soils.

The result of these model changes is a decrease in both the broadleaf and conifer forest sinks for all years between 1990 and 2016. More specifically, decreases to the conifer sink were of a greater magnitude than those to the broadleaf sink and decreases to both sinks are more pronounced in the later years of the time series.

Figure D1bii shows the annual breakdown of the cumulative removals shown in Figure D1bi. Although the indicator is assessed as improving in both the long term and short term since cumulative greenhouse gas removals have continued to increase, it should be noted that annual rates of removal have remained relatively static in recent years. It is also worth noting that the proportion of removals attributed to broadleaf woodland has been steadily increasing since the time series began in 1990.

Showing greenhouse gas removals by type of woodland is interesting from a biodiversity perspective as it allows a clearer presentation of the contribution made to greenhouse gas removals by broadleaf woodland, most of which constitutes priority habitat.

Figure D1bii. Annual net removals of greenhouse gases by UK forests, 1990 to 2017.



Notes:

1. Estimated annual net removals of greenhouse gases (carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O)) from the atmosphere by forests in the UK, expressed as million tonnes of CO₂ equivalent (Mt CO₂e).

D1b. Removal of greenhouse gases by UK forests

2. The step change in 2012 arises from modelling challenges in matching estimates of wood production. The National Forest Inventory (NFI) has a base year of 2011 and prior to this the felled area is constrained based on wood production. After the base year the felled area is driven by rotation lengths and the assumed percentage of forest managed for no-thin or no-fell. One of the aims for the next inventory is to develop a robust methodology to smooth these transitions.
3. Revised in 2015 to reflect improved modelling of greenhouse gas emissions and removals.
4. Revised in 2017 due to improvements made to the forestry sector of the 1990 to 2015 Land Use, Land Use Change and Forestry (LULUCF) greenhouse gas inventory.
5. Revised in 2018 due to improvements in the CARBINE model used to calculate the forest carbon stock figures for the 1990 to 2016 Land Use, LULUCF greenhouse gas inventory.
6. Revised in 2019 due to further improvements in the CARBINE model (see background section for more details).
7. These results are therefore not directly comparable with those in previous publications.

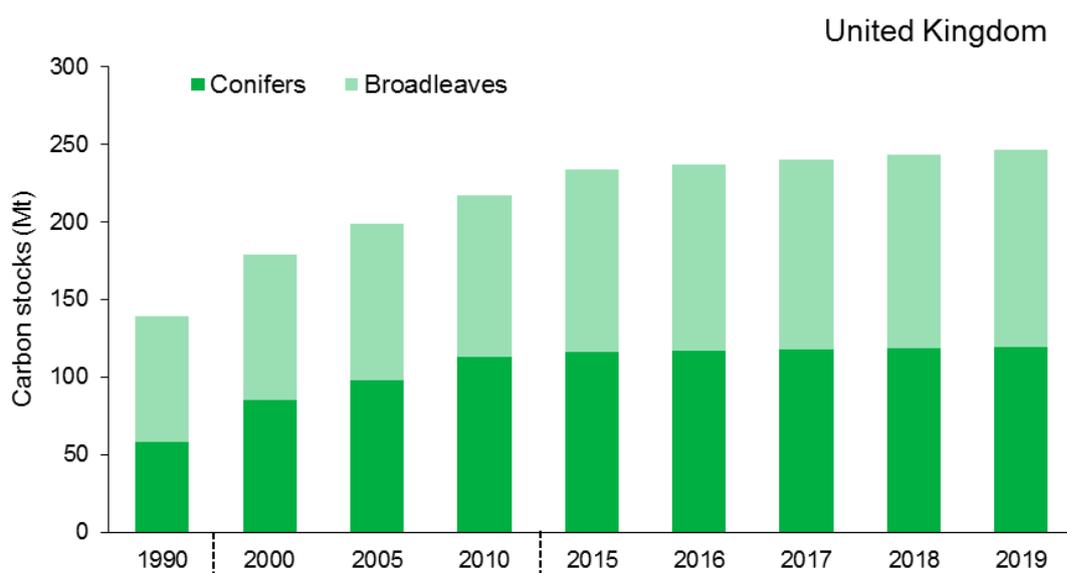
Source: Department of Business, Energy & Industrial Strategy – Land Use, Land Use Change and Forestry (LULUCF) greenhouse gas inventory.

National Forest Inventory

The estimated carbon stock of woodland trees in the UK can be used as a complementary measure of carbon storage. Information on current carbon stocks of forests in the UK were first gathered in 2014 using [National Forest Inventory](#) (NFI) data, based on a sample of woodlands equal to or greater than 0.5 hectares in size.

The total carbon stock of all species of tree within forests in the UK, at 31 March 2019, was estimated to be 247 Mt of carbon (904 Mt CO₂e) (see Figure D1biii). Broadleaved trees, with an estimated carbon stock of 127 Mt (467 Mt CO₂e), are responsible for a slightly greater proportion of the total UK carbon stock than conifer trees, which are estimated to have a total stock of 119 Mt (438 Mt CO₂e). This difference reflects the fact that in the UK, the total 'growing stock volume' (as opposed to the total area) of broadleaved woodland covered by the NFI is slightly greater than that of conifer woodland.

Figure D1biii. Total carbon stocks in living conifer and broadleaved woodland trees in the UK, 1990 to 2019.



Notes:

1. Estimated total carbon in all living trees within woodlands of England, Scotland, Wales and Northern Ireland (in million tonnes, Mt).
2. The time series is non-linear (indicated by the dashed vertical lines on the x axis).

D1b. Removal of greenhouse gases by UK forests

Source: Forestry Commission – National Forest Inventory.

Fieldwork for the current NFI began in 2009 and is being conducted on a 5 year cycle. The assessment of woodland carbon stocks from this inventory has formed a new baseline for carbon accounting within British forests and woodlands. Estimates of carbon stocks are determined by the total growing stock volume of woodland; a function of:

- Woodland area; and
- Woodland characteristics (e.g. number of trees, tree height and tree diameter) within this area.

Table D1bi shows a comparison of the estimated amount of carbon in living woodland trees in the UK and in each of the 4 individual countries as at 31 March 2019. England was estimated to have a total of 123 Mt of carbon in living trees (50% of the total for the UK); Scotland, an estimated 95 Mt (38% of the UK total); Wales, an estimated 24 Mt (10% of the UK total); and Northern Ireland, an estimated 5 Mt (2% of the UK total).

Table D1bi. Total carbon stocks in coniferous and broadleaved woodland trees in the UK, by country, as at 31 March 2019 (Mt carbon).

	All conifers	All broadleaves	All species*
England	29.6	93.7	123.3
Scotland	74.5	20.4	94.9
Wales	10.8	12.8	23.5
Northern Ireland	4.4	0.5	4.9
United Kingdom	119.3	127.3	246.6

Note: * Totals may not add due to rounding.

The current NFI fieldwork cycle began in 2015 and will run until 2020. The NFI assessment of woodland carbon stocks was used in the development of the reporting on [LULUCF emissions and removals](#). However, as there are differences in both the scope and the data sources used for LULUCF (sequestration) and NFI (stock) figures, they are not directly comparable. More information can be found in the [Forest Research Report](#) (PDF, 1.29Mb).

Goals and targets

Aichi Targets for which this is a primary indicator

Strategic Goal D. Enhance the benefits to all from biodiversity and ecosystems.



Target 14: By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.



Target 15: By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15% of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.

Aichi Targets for which this is a relevant indicator

Strategic Goal B. Reduce the direct pressures on biodiversity and promote sustainable use.



Target 7: By 2020, areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.

Web links for further information

Reference	Title	Website
Forestry Commission	Carbon in live woodland trees in Britain: National Forest Inventory Report	https://www.forestresearch.gov.uk/documents/2726/FCNFI113.pdf (PDF, 1.29 Mb)
	Understanding the carbon and greenhouse gas balance of forests in Britain	https://www.forestresearch.gov.uk/documents/953/FCRP018.pdf (PDF, 7.24 Mb)
Millennium Ecosystem Assessment	Millennium Ecosystem Assessment Reports	http://www.millenniumassessment.org/en/index.html
National Atmospheric Emissions Inventory	LULUCF Greenhouse Gas Inventory	http://naei.beis.gov.uk/reports/reports?report_id=981
UK National Ecosystem Assessment	Home page	http://uknea.unep-wcmc.org/

Full details of this indicator, including a datasheet are available at: jncc.gov.uk/ukbi-D1b

Last updated: September 2019

Latest data available:

Greenhouse gas removals by UK forests (LULUCF) – 2017

Carbon stocks of UK forests (NFI) – 2019