

Tree cover outside woodland in Great Britain

National Forest Inventory Report

Issued by: National Forest Inventory
Forest Research
231 Corstorphine Road
Edinburgh
EH12 7AT

Date: April 2017

Enquiries: Ben Ditchburn,
Tel. 0300 067 5064
NFI@forestry.gsi.gov.uk

Statistician: Alan Brewer
alan.brewer@forestry.gsi.gov.uk

Website: www.forestry.gov.uk/inventory

Summary

The National Forest Inventory provides a record of the size and distribution of forests and woodlands in Great Britain and information on key forest attributes. This report provides estimates of the amount of tree cover outside NFI woodland areas¹ in the form of small woods, groups of trees and lone trees, as at January 2016. It includes estimates for England, Scotland and Wales, broken down by NFI Regions and by urban and rural land categories.

- There are 742 thousand hectares of tree cover outside areas of NFI woodland in Britain; 565 thousand hectares in England, 84 thousand hectares in Scotland and 93 thousand hectares in Wales.
- 546 thousand hectares (74%) of tree cover outside woodland are found in rural areas and 196 thousand hectares (26%) in urban areas. Non-woodland tree cover amounts to 11% of land area in urban areas and 3% in rural areas.
- Total tree cover, including both woodland tree cover and tree cover outside woodland is 16.5% in urban areas and 16.7% in rural areas.
- Small woods of over 0.1 hectare in extent cover 390 thousand hectares in Britain; 295 thousand hectares in England, 46 thousand hectares in Scotland and 49 thousand hectares in Wales.
- Groups of trees of less than 0.1 hectare in extent cover 255 thousand hectares in Britain; 193 thousand hectares in England, 29 thousand hectares in Scotland and 33 thousand hectares in Wales.
- There is estimated to be a total canopy cover of 97 thousand hectares associated with lone trees² in Britain. The country breakdown of this total is 78 thousand hectares in England, 9 thousand hectares in Scotland and 10 thousand hectares in Wales.

Definitions of the terms used in this report can be found in the Glossary of this report and in the supporting *Statistical Report*.

¹ Woodland is tree cover over half a hectare in extent and greater than 20 metres in width.

² Trees over 2 metres in height, unless in hedgerows, for which the minimum height is 3 metres.

Introduction

National forest inventories are carried out by the Forestry Commission to provide accurate, up-to-date information about the size, distribution, composition and condition of the forests and woodlands in Great Britain (GB). In tandem with the inventory of woodlands, the Forestry Commission has undertaken 'Small Woods' assessments since 1951 to provide statistics on the amount and composition of tree cover outside woodlands, such as those associated with smaller woods, groups of trees and lone trees.

The first five-year cycle of the current National Forest Inventory (NFI) began in 2010 and was completed in 2015. It is a multi-purpose operation that has involved the production of a forest and woodland map for GB and a continuing programme of sample field surveys of the mapped forest and woodland areas. Information and data collected by the National Forest Inventory is used for a number of purposes, including current estimates and long-term forecasts of forest metrics such as:

- Standing volume, increment and future timber availability;
- Carbon storage and biomass; and
- Aspects of the ecological properties and social value of forests and woodlands.

This NFI Report sets out the results (as at January 2016) of the current 'Small Woods' survey, which contain the areas of tree cover outside woodland, broken down into areas of small woods, groups of trees and lone trees. For the purposes of this report, categories of woodland and of trees outside woodland have been categorised as:

- NFI woodland – over 0.5 hectare in extent and greater than 20 metres in width.
- Small woods – non-NFI wooded areas of over 0.1 hectare in extent.
- Groups – clusters and linear tree features of less than 0.1 hectare in extent.
- Lone trees.

In addition, in the course of this work, areas that qualify as NFI woodland that were not captured in earlier versions of the NFI woodland assessment and map have been identified. Estimates of these revised areas are included in the woodland area set out in this report to provide an overall view of the total areas of woodland and trees in Britain.

A companion *Statistical Report* provides a more detailed breakdown of the statistics, including further sub-categorisation of small woods and groups of trees into linear and non-linear features; and lone trees into boundary trees, isolated trees and hedgerow trees. Estimates of the total length and areas of hedgerows are also available in the *Statistical Report* and are available from www.forestry.gov.uk/inventory.

How the estimates were derived

The current assessment of tree cover outside woodland uses the National Tree Map™ (NTM™), produced by Bluesky International Limited and a NFI programme of field surveys and hand mapping of non-woodland tree cover, used for calibrating and correcting areas derived from the NTM™ map. The NTM™ map was derived using interpretive algorithms applied to aerial photography, near infra-red data and digital elevation data. The hand-mapping survey involved the identification of tree and hedgerow features from on-screen interpretation of aerial photography within a sample of 267 one-by-one kilometre squares randomly located throughout Britain. In addition to the hand-mapping exercise, field work was undertaken in a sub-sample of 35 one-by-one kilometre sites across Britain to assess all tree and hedgerow features, including trees under 3 metres in height (which NTM™ excludes). In Scotland, a comprehensive map of trees outside woodland was not available and the estimates in this report are based solely on field work and hand-mapping of features at a series of one-by-one kilometre sample squares.

Preparation of the estimates involved a combination of analysis and processing of spatial datasets using Geographical Information Systems (GIS) software, and subsequent statistical analysis of the outputs from these spatial analyses. Since the nature of the data sources and statistical approaches differed between Scotland and the other countries, the precision of the estimates within different countries varies.

GIS analysis was used to mask areas on the 2013 NFI woodland map to restrict the results to areas outside NFI woodland areas, differentiating land areas into rural and urban land based on the Ordnance Survey Strategi® dataset, thereby identifying small woodlands, groups of trees and hedgerow features as being within either rural or urban areas, and to assign various other attributes to these plotted tree features. Figure 1 shows an example of the range of types of tree formations outside woodland and the associated datasets from the NTM™ map and the hand-mapped sample.

Figure 1 An example of a surveyed one-by-one kilometre square in Devon



Estimates of areas of small woods, groups and trees in England and Wales were derived from a double-calibration exercise, firstly using the hand-mapped sample data to calibrate the areas on the NTM™ map relative to the hand-mapping results, and secondly using the sub-sample of fieldwork data to calibrate the hand-mapping data to the results of the fieldwork, resulting in final estimates based upon fieldwork results.

For Scotland, a full digital map of wooded features over 0.1 hectare in extent, which was created for the Native Woodland of Scotland Survey (NWSS)³ from aerial photographic interpretation in 2006-2009, was used as reference data in the design and selection of the hand-mapped sample. This required a different form of statistical analysis to generate estimates from the hand-mapped sample data, which were then calibrated to the fieldwork results.

A fuller description of the datasets used and the various statistical analyses performed is given in the *Statistical Report* available from www.forestry.gov.uk/inventory.

³ This product was not used in the final NWSS report.

Results

Estimates are available for the total areas of tree cover within Great Britain, individual countries (England, Scotland and Wales), and individual NFI regions within countries. Within each country and region, separate estimates are provided for urban and rural areas, as identified in the OS Strategi[®] spatial dataset.

Table 1 provides context to the main results on tree cover outside woodland with an overview of total land areas and areas of woodland and trees outside woodland in Great Britain. Table 2 provides a breakdown of tree cover outside woodland into the main classes of features (small woods, groups of trees and lone trees) by country and NFI region. Table 3 provides an alternative breakdown of these classes of features at country and GB level into areas of cover within rural and urban areas.

Having been derived using sample survey data, the estimates presented are subject to sampling errors and in all cases (apart from the areas derived from the NFI woodland map) the precision of the estimates is shown in percentage terms as relative standard errors, being the standard error of the estimate expressed as a percentage of the value of the estimate. At country and GB level, the estimates for England and GB are generally lower (in relative terms) than those for Scotland and Wales. This is due to the relative sizes of the populations being estimated and the size of the sample fraction, but also, in the case of Scotland, due to the different nature of the data used for deriving the Scottish estimates. The standard errors of the regional estimates are mostly higher, indicating that many of these should be interpreted with a degree of caution and any estimates with relatively large standard errors (>25%) are shown in **amber** in the tables.

In Tables 1 to 3, estimated values may not sum to the marginal totals. This is either due to rounding, or because each estimate, including those of totals and sub-totals, were individually estimated with associated standard errors.

In addition to the information in Tables 1 to 3, a summary analysis was undertaken to investigate the numbers of small woods, groups and lone tree features in lowland and upland areas, defined as land below and above 200 metres in altitude respectively (see Glossary). This found that 91% of such features occurred in lowland areas and 9% in upland areas (see *Statistical Report* for estimates).

Table 1 Areas of woodland and tree cover outside woodland as a percentage of total land area

| Region | Total land area | NFI woodland | | Tree cover outside woodland | | | Total area of woodland and tree cover |
|--------------------------|-----------------|----------------|----------------|-----------------------------|----------------|-----------|---------------------------------------|
| | (000 ha) | (000 ha) | % of land area | (000 ha) | % of land area | SE% | % of land area |
| Great Britain | 22,895.4 | 3,074.6 | 13.4 | 742.3 | 3.2 | 5 | 16.7 |
| England | 13,030.8 | 1,336.4 | 10.3 | 565.0 | 4.3 | 5 | 14.6 |
| North West England | 1,410.5 | 120.0 | 8.5 | 51.4 | 3.6 | 6 | 12.2 |
| North East England | 857.4 | 117.0 | 13.6 | 21.4 | 2.5 | 9 | 16.1 |
| Yorkshire and the Humber | 1,540.5 | 117.2 | 7.6 | 43.9 | 2.8 | 8 | 10.5 |
| East Midlands | 1,562.3 | 100.9 | 6.5 | 57.0 | 3.6 | 6 | 10.1 |
| East England | 1,911.9 | 156.4 | 8.2 | 80.4 | 4.2 | 6 | 12.4 |
| South East and London | 2,064.5 | 332.9 | 16.1 | 123.8 | 6.0 | 6 | 22.1 |
| South West England | 2,383.7 | 265.7 | 11.1 | 113.0 | 4.7 | 7 | 15.9 |
| West Midlands | 1,299.8 | 126.2 | 9.7 | 74.2 | 5.7 | 8 | 15.4 |
| Scotland | 7,791.0 | 1,429.0 | 18.3 | 84.5 | 1.1 | 13 | 19.4 |
| North Scotland | 1,744.4 | 237.4 | 13.6 | 10.8 | 0.6 | 42 | 14.2 |
| North East Scotland | 1,142.0 | 236.9 | 20.7 | 13.0 | 1.1 | 23 | 21.9 |
| East Scotland | 866.8 | 140.2 | 16.2 | 19.6 | 2.3 | 28 | 18.4 |
| South Scotland | 1,997.4 | 435.2 | 21.8 | 34.3 | 1.7 | 14 | 23.5 |
| West Scotland | 2,040.5 | 379.3 | 18.6 | 6.9 | 0.3 | 28 | 18.9 |
| Wales | 2,073.6 | 309.3 | 14.9 | 92.7 | 4.5 | 7 | 19.4 |

Table 2 Summary of area of woodland and tree cover outside woodland

| Region | Total NFI woodland | Small woods | | Groups of trees | | Lone trees | | Total area of woodland and tree cover | |
|--------------------------|--------------------|--------------|-----------|-----------------|-----------|-------------|-----------|---------------------------------------|----------|
| | (000 ha) | (000 ha) | SE% | (000 ha) | SE% | (000 ha) | SE% | (000 ha) | SE% |
| Great Britain | 3,074.6 | 390.2 | 7 | 255.4 | 6 | 97.1 | 6 | 3,817.4 | 1 |
| England | 1,336.4 | 294.8 | 6 | 192.6 | 6 | 78.2 | 7 | 1,901.9 | 1 |
| North West England | 120.0 | 24.2 | 8 | 18.5 | 8 | 8.9 | 12 | 171.7 | 2 |
| North East England | 117.0 | 12.1 | 13 | 6.6 | 10 | 2.7 | 15 | 138.5 | 1 |
| Yorkshire and the Humber | 117.2 | 22.8 | 12 | 12.7 | 10 | 8.4 | 10 | 161.2 | 2 |
| East Midlands | 100.9 | 25.8 | 10 | 23.8 | 8 | 7.8 | 11 | 158.3 | 2 |
| East England | 156.4 | 39.3 | 8 | 31.5 | 8 | 9.7 | 11 | 236.9 | 2 |
| South East and London | 332.9 | 65.3 | 9 | 43.5 | 8 | 14.9 | 13 | 456.6 | 2 |
| South West England | 265.7 | 64.7 | 11 | 34.7 | 8 | 13.3 | 10 | 378.5 | 2 |
| West Midlands | 126.2 | 40.7 | 12 | 21.1 | 9 | 12.4 | 11 | 200.3 | 3 |
| Scotland | 1,429.0 | 46.2 | 21 | 29.5 | 12 | 8.9 | 15 | 1,513.5 | 1 |
| North Scotland | 237.4 | 6.4 | 63 | 3.1 | 39 | 1.3 | 58 | 248.2 | 2 |
| North East Scotland | 236.9 | 6.8 | 34 | 5.2 | 28 | 1.0 | 34 | 249.9 | 1 |
| East Scotland | 140.2 | 10.4 | 45 | 6.7 | 27 | 2.5 | 32 | 159.8 | 3 |
| South Scotland | 435.2 | 18.9 | 21 | 11.9 | 15 | 3.5 | 16 | 469.4 | 1 |
| West Scotland | 379.3 | 3.8 | 38 | 2.7 | 39 | 0.5 | 36 | 386.2 | 0 |
| Wales | 309.3 | 49.2 | 8 | 33.4 | 9 | 10.1 | 17 | 401.9 | 1 |

Table 3 Areas of major categories of tree cover outside woodland by rural and urban land categories

| Land category | Total NFI woodland | Small woods | | Groups of trees | | Lone trees | | Total area of woodland and tree cover | |
|----------------------|--------------------|--------------|-----------|-----------------|-----------|-------------|-----------|---------------------------------------|-----------|
| | (000 ha) | (000 ha) | SE% | (000 ha) | SE% | (000 ha) | SE% | (000 ha) | SE% |
| Great Britain | 3,074.6 | 390.2 | 7 | 255.4 | 6 | 97.1 | 6 | 3,816.9 | 5 |
| Rural | 2,984.4 | 316.5 | 8 | 165.1 | 6 | 64.3 | 6 | 3,530.4 | 6 |
| Urban | 90.2 | 73.7 | 12 | 90.3 | 13 | 32.8 | 15 | 286.5 | 10 |
| England | 1,336.4 | 294.8 | 7 | 192.6 | 6 | 78.2 | 7 | 1,901.4 | 5 |
| Rural | 1,271.3 | 238.0 | 8 | 125.2 | 9 | 52.0 | 6 | 1,686.3 | 5 |
| Urban | 65.1 | 56.8 | 12 | 67.3 | 13 | 26.2 | 15 | 215.1 | 11 |
| Scotland | 1,429.0 | 46.2 | 21 | 29.5 | 12 | 8.9 | 15 | 1,513.5 | 13 |
| Rural | 1,412.9 | 41.0 | 24 | 22.7 | 14 | 7.3 | 17 | 1,484.0 | 15 |
| Urban | 16.0 | 5.2 | 24 | 6.7 | 26 | 1.6 | 31 | 29.5 | 18 |
| Wales | 309.3 | 49.2 | 8 | 33.4 | 9 | 10.1 | 17 | 402.0 | 7 |
| Rural | 300.2 | 37.5 | 9 | 17.1 | 8 | 5.0 | 11 | 360.1 | 7 |
| Urban | 9.1 | 11.7 | 20 | 16.3 | 17 | 5.0 | 32 | 41.9 | 14 |

The results show that there are more trees and tree cover outside woodland in Great Britain than previous evaluations had indicated. There are 742 thousand hectares of tree cover outside woodland in total, representing 19.4% of all tree cover (both woodland and outside woodland) and 3.2% of all land area. The distribution of tree cover outside woodland varies considerably across Britain, ranging from 4.5% of land area in Wales to 1.1% of land area in Scotland.

What the results tell us

The large area of non-woodland tree cover observed in this work will include long established tree cover, small scale and non-grant aided tree planting arising over recent decades and natural regeneration on abandoned farmland and brownfield land. Tree establishment alongside transport routes and that associated with built developments will also have contributed. Improved detection and reporting of these features has become possible through the application of new techniques and technologies in earth observation, Geographic Information Systems and statistics. These new techniques are more capable of identifying and quantifying smaller features such as lone trees and small groups of trees.

The results show that the distribution of tree cover outside woodland is highly uneven across Britain, with very different amounts and proportions of tree cover outside woodland found between the rural and urban land categories, upland and lowland environs, between the east and west and north and south of Britain. Most non-woodland tree features are found in the lowlands, there are higher levels of non-woodland tree cover in urban areas as opposed to rural and higher levels exist in the west than the east of Britain and there are higher levels located in the South as opposed to the North.

Further information, including more detailed statistics and a more in-depth description of the methodology can be found in the *Statistical Report* available at www.forestry.gov.uk/inventory.

Commentary

The current distribution of tree cover outside woodland is a result of a history of woodland clearance, historic land husbandry, land use economics, boundary marking and the planting and establishment of trees, the latter in particular in the 20th century. This history helps to explain the highly uneven distribution of non-woodland tree cover found across Britain and is explored in more depth in the *Statistical Analysis* report.

Glossary

| | |
|---------------------------------|--|
| Forest (and woodland) | National Forest Inventory (NFI) woodland is defined as land with a minimum area of 0.5 hectare under stands of trees, and tree crown cover of at least 20%, or the potential to achieve this. The minimum width for woodland is 20 metres. |
| Forestry Commission (FC) | The government department responsible for the regulation of forestry, implementing forestry policy and management of state forests in England and Scotland. Forestry policy is devolved, with the exception of common UK or GB issues. |
| Group of trees | A configuration of 2 or more trees of less than 0.1 hectare in extent. |
| Lone trees | A single tree, greater than 3 metres tall located in a hedgerow or greater than 2 metres tall elsewhere, of which the canopy does not touch that of another tree. |
| Urban and rural land areas | The urban land category is defined by the Ordnance Survey Strategi [®] 1:250,000 urban layer. All other land area outside the urban layer is designated as rural area. |
| National Forest Inventory (NFI) | An inventory run by the Forestry Commission, set up in 2009, to provide a record of key information about GB woodlands. |
| Small woods | Areas of tree cover greater than 0.1 hectare in extent that is too small or too narrow to qualify as NFI woodland (see above). |
| Tree cover | The area of land covered by the crowns of trees. |
| Upland and lowland Britain | For the purposes of this report, this is land above and below 200 metres in altitude respectively (based on Bartholomew 1:200,000 Contour Data). |

NFI national reports

This is a summary report of the main *Statistical Report*. The *Statistical Report* contains a wider range of statistics and breakdowns of the estimates provided in this report. It also provides estimates of the length and area of hedgerows. It contains a full account of the methodology and further clarification of the terms used in both reports. The full title is:

- Tree cover outside woodland in Great Britain (2017) - *Statistical Report*.

Further materials to support both reports are also provided:

- An Excel spreadsheet with the tables and charts included in the two reports, plus supplementary charts.
- PDF maps of tree cover across Britain, for each NFI region.

Other NFI reports that contain related information are:

- NFI Woodland Area Statistics, Great Britain, England, Scotland, Wales (2011).
- Preliminary estimates of the changes in canopy cover in British woodlands between 2006 and 2015 (2016).

The NFI also produces reports on aspects of the composition of British forests and woodlands, and forecasts of how these may change over time, including:

- NFI preliminary estimates of quantities of broadleaved species in British woodlands, with special focus on ash (2012);
- Carbon in live woodland trees in Britain (2013);
- 50-year forecast of softwood timber availability (2014);
- 50-year forecast of hardwood timber availability (2014);
- 25-year forecast of softwood timber availability (2016).

The *Statistical Report* and all the above documents and data can be found on the NFI website www.forestry.gov.uk/inventory.

Official Statistics

This is an Official Statistics publication. More information about Official Statistics and the UK Statistics Authority is available at www.statisticsauthority.gov.uk.