

Preliminary findings of the extent, composition, health and nature of woodland oak in Britain

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231 Corstorphine Road, Edinburgh, EH12 7AT

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Enquiries: Ben Ditchburn, 0131 314 6208,
NFI@forestry.gsi.gov.uk

Statistician: David Ross

Website: www.forestry.gov.uk/inventory
www.forestry.gov.uk/forecast

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 preliminary National Forest Inventory Report provides estimates of the stocked area, numbers of trees, standing volume, carbon stocks, biomass, mortality rates, tree health and geographic distribution of Oak trees within forests and woodlands in Great Britain as at 31 March 2016. Information in this report includes estimates for England, Scotland and Wales, and individual regions within England and Scotland, each broken down by Forestry Commission and private sector ownership. Definitions of terms used in this report can be found in the Glossary at the end of this report.

Key Findings

- Oak is estimated as 8% of total stocked area (17% of broadleaved stocked area), 11% of standing volume (27% of broadleaved standing volume) and 5% of the number of trees (9% of the number of broadleaved trees).
- Oak accounts for 31 million tonnes of carbon and 61 million oven dried tonnes of biomass.
- The age class that most represents oak trees is the 81 to 100 year class
- The diameter class that most represents oak trees is the 15–20 cm mean stand diameter class.
- Oak species are distributed throughout the British Isles, favouring the Southern and Western parts of Britain.
- Pedunculate Oak, otherwise known as the English Oak, is found mostly distributed within England.
- The Sessile Oak is mostly found to the West and Wales.
- There appears to be clustering of oak health issues in the South and West of Britain.
- Mortality rates of oak across Britain appear to be within a range consistent with a population that is stable and is comparable to other species.
- There are wide geographic variations in yield class reflecting differences in rainfall, exposure, altitude, latitude and longitude and soil type.
- Increment in oak for the next five years will account for approximately 1 million cubic metres of timber per annum and 0.5 million tonnes of carbon per annum sequestered.

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Introduction

Oak comprises one of the largest components of broadleaved tree cover in Great Britain, ranking third after Birch and Hazel respectively (Brewer and Ditchburn, 2014; Maskell et al., 2018). In addition oaks are foundation species in many ecosystems, are associated with a rich biodiversity and provide a variety of ecosystem services, however, oak condition in the future is uncertain due to a variety of threats. Modelling studies suggest that future climate change impacts on oak growth will vary across the country (Broadmeadow et al., 2005; Petr et al., 2014; Sáenz-Romero et al., 2016), with areas of improved yield in the uplands, but worsening suitability in southern England. Empirical data is needed to assess the validity of these predictions and ensure that trends are understood. It is believed that the National Forest Inventory (NFI) could form part of a programme of activities to gather this evidence.

Action Oak is a new initiative to protect our oak trees. The programme of activities which the Action Oak Partnership has identified to protect oak trees covers a number of areas including:

- Working with owners and managers of oak trees and woodlands to help to protect the trees from a range of threats.
- Funding research to improve our understanding of the threats to our oak trees and to inform best management practices.
- Using established professional and citizen science networks to record changes in the distribution, age and health of our oak trees to identify priority areas for action.
- Encouraging organisations to join the Action Oak Partnership and people to support Action Oak.

As part of these activities a sound understanding of the existing distribution of oak within Great Britain is required and an investigation into the suitability of site conditions within this distribution. The NFI supplies data on the former within woodlands and can contribute to the evaluating the latter.

National forest inventories are carried out by the Forestry Commission (FC) to provide accurate, up-to-date information about the size, distribution, composition and condition of the forests and woodlands in Great Britain (GB). In this report forests and woodlands are defined as land predominately covered in trees with a minimum area of 0.5 hectares and minimum width of 20 metres. (See the Glossary for a fuller definition.) This information is essential for developing and monitoring policies and guidance to support sustainable forest management. The current National Forest Inventory (NFI), which began in 2009 and was completed in late 2015, is a multi-purpose operation that has involved the production of a forest and woodland map for GB and a continuing

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programme of field surveys of the mapped forest and woodland areas. Information and data collected by the National Forest Inventory will be used for a number of purposes, including current estimates and 25-year forecasts of forest metrics such as:

- Standing volume
- Stocked areas
- Numbers of trees
- Timber availability
- Tree growth and increment
- Carbon storage
- Biomass

Estimates of aspects of the biodiversity and social value of forests and woodlands will also be provided by the NFI in future reports to be published in 2018. Further information on these planned reports and other National Forest Inventory outputs are available from [National Forest Inventory \(Forest Research\)](#). This data set should answer many questions about oak at the population level, and has already revealed that oak timber volume will increase greatly in the near future due to the large areas of planting and replanting after WWII (Brewer and Ditchburn, 2014).

Description of metrics estimated

Stocked area

The NFI woodland map provides information on the spatial location and extent of woodland. Summing the areas of woodland defined in the map will provide a gross estimate of woodland areas in GB, countries and regions. The NFI reports on woodland area statistics published in May 2011 (available from [What our woodlands are like today \(Forest Research\)](#)) give an estimated total area of woodland of 2.98 million hectares, derived from the 2010 version of the NFI woodland map. This was an estimate of gross forest area, and included clearfell sites, assumed woodland area (according to grant scheme records), and integral areas of open space of less than 0.5 hectares.

Estimates of stocked area represent the area of woodland currently covered by trees of the relevant species or group of species, in this case particular species of oak or the group of oak species regarded as native. Total stocked area across all species (inclusive of both conifer and broadleaves) will therefore differ from total woodland area as estimated from the woodland map, since it will not include current areas of clearfell and most areas of open space of less than 0.5 hectares. On the other hand, it may include estimates derived from areas of woodland located outside the NFI woodland map.

Care needs to be taken in the interpretation of stocked areas of individual species, since many woodlands contain an intimate mix of species, and in such cases procedures are used to “share” the total area covered by the woodland into the areas occupied by its constituent species. The total stocked area of a given species does not therefore conceptually represent discrete areas of land covered by pure stands of the species, but to a greater or lesser extent may represent the sum of shares of areas of mixed woodland allocated to it by these procedures.

Standing volume

This present report, in addition to providing the latest overall estimates of total volume, gives a breakdown of volume by age class and size class, and by country and National Forest Inventory regions. NFI region boundaries can be seen on Map 1.

Standing volume is defined as the live stemwood and useable branchwood of trees to a minimum of 7 cm top diameter. It excludes roots, below-ground stump material, small branches, foliage and deadwood. For private sector woodland only, it also excludes standing volume in trees in woodlands of less than 0.5 hectare in extent. See the Glossary for further explanations of the terms used in this report.

Numbers of trees

Estimates are provided in this report of the current numbers of live oak trees in GB woodland. In order to compile such estimates, a minimum tree size needs to be defined. Due to the nature of the data available on the two forest sectors in GB, the estimates for FC woodland and private sector woodland in this report differ with respect to these cut-off sizes. For the private sector, a live tree is considered countable once it has grown to a size at which its diameter at breast height (DBH – see the Glossary) has reached at least 4 centimetres, while for the FC estate, the estimates represent trees that have achieved a minimum size of 7 centimetres DBH. Therefore, for the FC estate, the estimated numbers do not include trees in the size range of 4-6 cm DBH. Windblown trees are included in these estimates, but not standing dead trees. It may be noted that broadleaf species on the FC estate are a relatively minor proportion of all broadleaves in GB, so the missing estimated count of trees in the size range of 4-6 centimetres DBH is unlikely to be a large proportion of the totals across both sectors.

For the private sector only, this report also provides preliminary estimates of numbers of saplings and seedling. Seedlings are defined as young trees of up to 0.5 metres in height and saplings are defined as young trees of at least 0.5 metres in height but less than 4 centimetres DBH. The estimates provided in this report cover numbers of such plants found on non-FC land that is mapped as woodland in the 2016 NFI woodland map [What our woodlands are like today \(Forest Research\)](#).

Note that for the purposes of this report, measurable stems arising from coppice stools are counted as separate trees when calculating the estimated tree numbers. The use of this definition varies from the convention of regarding a single coppice stool with many measurable stems as a single tree. This will not impact upon the stocked area and standing volume estimates, but will affect the estimates of tree numbers.

Geographic distribution of oak trees

The distribution of live oak trees across Great Britain is provided showing both the presence of oak species but also the growth potential of a site. The latter is represented by calculating the yield classes associated with oak trees found in the survey and plotting this as a heat map where the strength of the colour/symbol represents a more optimal site for growth of oak trees.

Yield class

Yield class is an index of the productivity of main-stem wood volume from a stand of trees enabling predictions of yield, a fundamental of forestry management for wood production. It can also be used as a proxy index of how well suited an individual tree species is to a particular site or region in terms of suitability on rainfall, soil,

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temperature, latitude, longitude etc., with higher yield classes indicating better suitability for that species than lower.

Carbon

Estimates of carbon stored in living oak trees, measured in tonnes assuming a dry carbon weight. Carbon is defined as carbon stored in all living material in both the above and below parts of the tree (including major roots, stems, branches, twigs and foliage) in stands with a mean diameter (at breast height) of 7cm or more. The estimates do not include carbon in young stands with a mean diameter of less than 7cm. Also excluded is carbon stored in standing dead trees, growing seedlings and saplings, shrubs, other ground vegetation, lying dead wood, litter, soil and harvested wood products.

Biomass

Estimates of biomass in living oak trees, measured in oven-dry tonnes assuming a dry carbon weight. Biomass is defined as all living plant material in both the above and below parts of the tree (including major roots, stems, branches, twigs and foliage) in stands with a mean diameter (at breast height) of 7cm or more. The estimates do not include biomass in young stands with a mean diameter of less than 7cm. Also excluded is biomass in standing dead trees, growing seedlings and saplings, shrubs, other ground vegetation, lying dead wood and harvested wood products.

Increment

The volume or weight gain made through tree growth over time measured in key forest metrics, such as timber, carbon and biomass.

Health

General tree health parameters such as tree mortality crown dieback, leaf loss, resin bleed and insect boring as observed by NFI field staff. Specific plant health pests and diseases as observed by NFI field staff.

Data sources

Forestry Commission sub-compartment database

The Sub-compartment database (SCDB) is a record of all land managed by the Forestry Commission. Each stand of trees is represented spatially, together with information on individual stand characteristics (for example species, planting year, spacing and yield class) which is periodically updated. As new surveys of stands are conducted (e.g. for operational purposes), survey results are also recorded against the stands. In addition, the SCDB contains details of how the stands are being managed – in particular, the planned frequency and type of thinning operations and a 'due date' for felling.

National Forest Inventory

The National Forest Inventory is composed of two elements: a woodland map and a field survey. The woodland map covers all forests and woodlands over 0.5 hectares with a minimum of 20% canopy cover (or the potential to achieve it), including new planting, clearfelled sites and restocked sites. It is based upon 25 cm resolution colour aerial photography for England and Scotland and 40 cm resolution aerial photography for Wales. The map was validated and updated using satellite imagery (available up to 2009), which gave an independent crosscheck of woodland present. Satellite imagery was also used to identify areas of recently felled forests and woodland.

Field survey work is used to refine the map-based estimates of woodland and clearfelled areas and to measure detailed aspects of the forest. Field surveys are being carried out between 2009 and 2014 to estimate standing volume, stocked areas, numbers of trees and other forest metrics. This involves the ground surveying of one-hectare sample squares that are partially or entirely covered by forest, including clearfelled areas and areas of assumed woodland, according to the 2010 NFI woodland map. Further details of the mapping work and the derivation of forested areas can be found in the 2010 Woodland Area reports at www.forestry.gov.uk/inventory.

Forest yield tables

The Forest Yield tables have been developed for use in British forestry. They present estimates of stand growth and yield, based on data collected by the Forestry Commission since the 1920s. Yield tables have been constructed for all the major forest species in Britain using data gathered from a network of permanent sample plots and thinning and spacing experiments for a wide variety of management prescriptions. The yield tables are designed mainly for application to even-aged silvicultural systems and so a level of caution should be used when interpreting the results of their application to forest stands with more complex structure and silvicultural practice.

Yield class itself is an index used in Britain of the potential productivity of a stand of trees. It is based on the maximum mean annual increment of cumulative timber volume achieved by a given tree species growing on a given site and managed according to a standard management prescription. It is measured in units of cubic metres per hectare per year ($\text{m}^3 \text{ ha}^{-1} \text{ yr}^{-1}$). Forest Yield tables have been formed that can be applied to around 150 tree species currently growing in Great Britain.

Derivation of estimates

The estimates in this report have been derived separately for the Forestry Commission estate and for the private sector estate (for all aspects except health and yield class). They are based on the same principles but use different data sources. For the Forestry Commission estate, information on woodland area and woodland characteristics has been extracted from the Forestry Commission's long-established Sub-compartment database. For the private sector estate, the estimates have been derived from results obtained to date from the National Forest Inventory. For health and yield class NFI data was used to derive the estimates across all woodlands.

Estimates for the Forestry Commission / NRW estate

The sub-compartment database (SCDB) in Britain is a record of all land managed by the Forestry Commission and Natural Resources Wales (NRW). Each stand of trees is represented spatially, together with information on individual stand characteristics (e.g. species, planting year, spacing and yield class) which is periodically updated. As new surveys of stands are conducted (e.g. for operational purposes), survey results are also recorded against the stands. In addition, the database contains details of how the stands are planned to be managed – in particular, the planned frequency and type of thinning and a date for felling. These prescriptions are recorded in the FC/NRW forest design plans. Forest design plans are prepared and maintained by FC/NRW staff throughout Britain. These plans form the basis of the harvesting regimes used to derive the estimates for the FC/NRW forecasts of increment etc.

Information from the SCDB was used to estimate standing volume, stocked areas and numbers of trees at the reference date of 31 March 2016 on a stand-by-stand basis. These were then aggregated to produce the estimated totals across a defined geographic area for particular types of stand (classified, for example, by species, tree age or tree size class). For each stand, if an operational survey had been carried out close to the reference date, information from that survey was used to estimate the current state of the stand. Otherwise, projected estimates were made of the current state, normally involving the application of standard Forestry Commission growth and yield models that

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take into account the past management of the stand. Estimates of current standing volume, stocked areas and numbers of trees of greater than or equal to 7 centimetres DBH are outputs of this stand modelling process.

Individual stand records in the SCDB express areas and other stand characteristics in terms of gross forested areas, including unstocked areas occupied by roads, rides, integral open space and other small non-forested features within the mapped area of the stand. In order to account for this, a gross to net area conversion factor (usually 15%) is applied to the area of the stand and, through this, to the derived stand characteristics, including standing volumes, stocked areas and numbers of trees.

Because the resulting estimates are based on a full record of data from the SCDB, there is no sampling error involved in the estimation process, therefore no sampling standard error is calculated. However, the nature of the estimation process within each individual stand does introduce estimation error, with variable contributions from stand to stand, due to the type, age and accuracy of the information held in the SCDB. These estimation errors have not been quantified in this report.

Estimates for the private sector estate

The National Forest Inventory is composed of two elements: a woodland map and a field survey. The woodland map covers all forests and woodlands of over 0.5 hectare with a width of 20 metres and a minimum of 20% canopy cover (or the potential to achieve it), including new planting, clearfelled sites and restocked sites. It is based upon interpretation of 25 cm resolution colour aerial photography for England and Scotland and 40 cm resolution aerial photography for Wales. The map was validated and updated using satellite imagery (available up to 2014), which gave an independent crosscheck of woodland present. Satellite imagery was also used to identify areas of recently felled forests and woodland. Particular attention was paid to identifying areas of woodland loss verified as being due to the establishment of wind farms or the restoration of habitats.

Field survey work was then used to refine the map-based estimates of woodland and clearfelled areas and to measure detailed aspects of the forest. Field surveys carried out between 2010 and 2013 were used to estimate standing volume (and other forest metrics). This involved the ground surveying of 1 hectare sample squares that were partially or entirely covered by forest, including clearfelled areas, according to the woodland map.

In the course of the field survey work some 15,000 sample squares were surveyed in Britain and these were located in both private and public sector woodland. The resulting data have been used to produce the results in this report. These surveyed sample squares represent the planned 15,000 statistically representative squares covering all

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woodland in Britain that has been surveyed during the first cycle of the National Forest Inventory field surveys (completed in late 2015).

At each sample square, the area was stratified into forest and non-forest and the forested area was further stratified into different woodland types or stands, where information on species, age, management and a range of other parameters was collected. Typically, sample squares covered parts of different forest stands, resulting in circa 20,000 stands being assessed across Britain. Within each stand, field-based computer systems were used to locate two or three randomly located 100 m² (0.01 hectare) circular plots, within which all trees of greater than or equal to 4 cm diameter at breast height (DBH) were mapped, species and age identified, stocking assessed and diameters measured. A total of 600,000 trees were measured in across Britain. For 105,000 of these trees across Britain, additional measurements of tree height and crown dimensions were taken for yield class assessment and for other purposes. The resulting data were used to estimate the standing volume of the trees that provided the initial values of timber present in the stand from which forecasts of future timber availability were projected. All squares were marked on the ground with metal pegs and GPS data of their location were recorded for checking and future measurement.

In addition to the sampling procedures used to quantify the forest metrics for trees of greater than or equal to 4 centimetres DBH, in most cases a line transect sample of up to ten metres in length was randomly located in each stand. Along this line transect, numbers of seedlings classified by species found within 0.5 metres distance from the transect line, and numbers of saplings, also classified by species, within one metre of the transect line, were observed and recorded. These observations have been scaled up to provide estimates of numbers of seedlings and saplings present in each surveyed stand, and these in turn have been scaled up to total forest areas in the NFI map to provide the estimated numbers of seedlings and saplings present in private sector woodland that are quoted in this report.

All measurements were subject to office-based checks and 7% were re-measured in the field by an independent quality assurance team to ensure consistency and high standards of data quality.

The results for individual surveyed squares were aggregated and scaled up to the areas identified by the woodland map, using standard statistical survey methodology, to produce the estimates in this report. Along with these estimates, associated sampling standard errors have also been calculated and reported. The sampling standard error will account for random variation arising from the selection of the sample, and random measurement errors, but not from any systematic biases in the field measurements. However, because of the quality assurance process it is thought unlikely that any substantial biases of this nature are present in the survey data. The sources of error that are not accounted for in the reported standard errors will be those deriving from use of

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empirical models to estimate standing volumes from the recorded survey data and, in some cases, the use of Forestry Commission growth and yield models (where these are used to project the results from an earlier survey to 31 March 2016 – the reference date used for the figures in this report).

Estimates for all woodland ownerships

For health and yield class NFI data was used to derive the estimates across all woodlands. These estimates were derived as the private sector approach described above.

Derivation of estimates of current stocks

This report provides estimates of the net area under canopy (referred to as stocked area), the standing volume, the timber increment, the carbon increment, the number of trees, and the biomass and carbon stocks in live trees in England's woodlands.

Stocked area

The National Forest Inventory (NFI) woodland map provides information on the spatial location and extent of woodland. Summing the areas of woodland defined in the map provides a gross estimate of woodland areas in GB, countries and regions. Which includes clearfell sites, assumed woodland area (according to grant scheme records), and integral areas of open space of less than 0.5 hectares.

Estimates of stocked area represent the area of woodland currently covered by trees of the relevant species or group of species. Total stocked area across all species (inclusive of both conifer and broadleaves) will therefore differ from total woodland area as estimated from the woodland map, since it will not include current areas of clearfell and most areas of open space of less than 0.5 hectares. On the other hand, it may include estimates derived from areas of woodland located outside the NFI woodland map.

Care needs to be taken in the interpretation of stocked areas of individual species, since many woodlands contain an intimate mix of species, and in such cases procedures are used to allocate the total area covered by the woodland into the areas occupied by its constituent species. The total stocked area of a given species does not therefore represent discrete areas of land covered by pure stands of the species, but may represent the sum of shares of areas of mixed woodland allocated to it by these procedures.

Standing volume

Standing volume is defined as the live stemwood and useable branchwood to a minimum of 7 cm top diameter. It excludes roots, below-ground stump material, small branches, foliage and deadwood. It is reported in cubic metres overbark standing.

Standing volume in trees in woodlands of less than 0.5 hectares in extent is not included.

Standing volume is the baseline for the forecasts of softwood and hardwood availability presented in this report.

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Numbers of trees

Estimates are provided in this report of the current numbers of live trees in England's woodland. In order to compile such estimates, a minimum tree size needs to be defined. Due to the nature of the data available on the two forest sectors, the estimates for FC woodland and private sector woodland in this report differ with respect to these cut-off sizes. For the private sector, a live tree is considered countable once it has grown to a size at which its diameter at breast height (DBH) has reached at least 4 centimetres, while for the FC estate, the estimates represent trees that have achieved a minimum size of 7 centimetres dbh. Therefore, for the FC estate, the estimated numbers do not include trees in the size range of 4-6 cm dbh. Windblown trees are included in these estimates, but not standing dead trees.

For the purposes of this report, measurable stems arising from coppice stools are counted as separate trees when calculating the estimated tree numbers. The use of this definition varies from the convention of regarding a single coppice stool with many measurable stems as a single tree. This will not impact upon the stocked area and standing volume estimates, but will affect the estimates of tree numbers for those species that tend to be coppiced, such as sweet chestnut and hazel.

Biomass stocks

The biomass estimates in this report are for total biomass in living trees in stands that have achieved a mean diameter at breast height (DBH) of 7 centimetres or more. The estimates do not therefore include biomass in young stands that have not grown to this minimum mean diameter, nor, for example, in stands of coppice in which stems are harvested before reaching this minimum diameter. The estimates incorporate both above- and below-ground parts of the tree, including major roots, stump, stem, branches, twigs and foliage. Included in the estimates are all trees within areas defined by the National Forest Inventory as areas of woodland. This definition of woodland excludes trees in small copses, hedgerows, and individual isolated trees.

The geographic scope of the estimates is Great Britain, comprising of England, Scotland and Wales, and the report provides breakdowns of total biomass estimates for each individual country and for regions within each country. Breakdowns of the total estimates are provided for the FC estate and the private sector estate, for conifers and broadleaves separately, and for principal species growing in Great Britain.

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Carbon stocks

Carbon is defined in this report as carbon stored in all living plant material in both the above and below ground parts of trees (including major roots, stumps, stems, branches, twigs and foliage) in stands with a mean diameter (at breast height) of 7 cm or more. The estimates do not include carbon in young stands that have not grown to this minimum mean diameter nor, for example, carbon in the stems of coppice that are harvested before reaching this minimum mean diameter. Also excluded is carbon in standing dead trees, growing saplings and seedlings, shrubs (except shrubs growing with the morphology of trees), other ground layer vegetation, lying deadwood, litter, soil, harvested wood products and substitution effects (e.g. avoided emissions by using timber in place of steel).

Estimates of current stock for the FC estate

Information from the sub-compartment database was used to estimate standing volume and other attributes of stands at the reference date of 31 March 2012 on a stand-by-stand basis. For each stand, if an operational survey had been carried out close to the reference date, information from that survey was used to estimate the state of the stand at the reference date. Otherwise, an estimate was made of the state of the stand, normally involving the application of standard Forestry Commission growth and yield models that take into account the past management of the stand. These data formed the basis of the estimates of current stocks for each of the metrics described above.

Estimates of current stock for the Private sector estate

The estimates of current stocks for each of the metrics described above were calculated for individual surveyed squares and then aggregated and scaled up to the areas identified by the woodland map, using standard statistical survey methodology, to produce the estimates in this report. Along with these estimates, associated sampling standard errors have also been calculated and reported. The sampling standard error will account for random variation arising from the selection of the sample, and random measurement errors, but not from any systematic biases in the field measurements. However, because of the quality assurance process it is thought unlikely that any substantial biases of this nature are present in the survey data. The sources of error that are not accounted for in the reported standard errors will be those deriving from use of empirical models to estimate standing volumes from the recorded survey data and, in some cases, the use of [Forestry Commission growth and yield models](#) (where these are used to project the results from an earlier survey to 31 March 2012 – the reference date used for the figures in this report).

Derivation of increment in timber and carbon stocks

Yield classes

The mean yield class estimates for the private sector are based on the top height / age relationship measured in the NFI sample squares. Young stands are excluded from this assessment. The estimates for the FC estate are derived from the top height / age relationship where possible, however the majority of yield classes are taken from the values recorded in the sub-compartment database.

How increment forecasts are derived

Forecasts of increment are derived by assessing:

- woodland area
- woodland characteristics (e.g. age, species) within this area
- how quickly the trees are growing (yield class)
- when the trees will be harvested

Timber is defined in this report as the volume of stemwood to 7 cm top diameter in m³ overbark standing (obs), including stump (above ground) and usable branchwood (of minimum 3 m length and 7 cm top diameter). It should be noted that, in this report, the forecast of timber increment is the amount of timber increase.

Forecast estimates for the FC/NRW estate

Information from the sub-compartment database was used to estimate standing volume and other attributes of stands at the reference date of 31 March 2016 on a stand-by-stand basis. For each stand, if an operational survey had been carried out close to the reference date, information from that survey was used to estimate the state of the stand at the reference date. Otherwise, an estimate was made of the state of the stand, normally involving the application of standard Forestry Commission growth and yield models that take into account the past management of the stand. These data formed the basis of the volume forecasts.

Forestry Commission growth and yield models were then used to 'grow' the stands, based upon inventory data and yield class estimates. The stands were grown taking account of harvesting events that either thinned or felled a stand over the forecast period, producing the standing volume, increment and production volumes projected by the forecasts. The timing and scale of thinning and felling events was taken from FC/NRW forest management plans, which set prescriptions for harvesting across

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productive forest area on the FC/NRW estate. This was then aggregated to produce the estimated total production across a defined geographic area for particular types of stand (classified, for example, by species, age or size class). The stands were then restocked according to country-level prescriptions (details on restocking can be found in the section on assumptions used in the forecast). The FC production forecast is an output of this stand modelling process.

Because the resulting estimates are based on a full record of data from the sub-compartment database, there is no sampling error involved in the estimation process, therefore no sampling standard error is calculated. However, the nature of the estimation process within each individual stand does introduce estimation error, with variable contributions from stand to stand, due to the type, age and accuracy of the information held in the sub-compartment database. These estimation errors have not been quantified in this report.

Forecast increment estimates for the Private sector estate in Britain

The inventory data for the Private sector estate was run against the headline scenario described in the *50-year forecast of softwood timber availability* (2014). Under this scenario, Private sector forests are managed under a regime designed:

- to maximise productivity (biological potential), within which it is assumed that timber will be harvested in the year of maximum Mean Annual Increment (MAI);
- to take account of thinning and wind constraints with stands being thinned unless they are assessed with a DAMS (Detailed Aspect Methodology Score) score of 16 or greater in which case they are treated as no thin and a top height at clearfell of 25 m is applied;
- to harvest a proportion of overdue stands (i.e. stands that have exceeded the prescribed age for felling according to the scenario), where overdue stands are handled according to overdue timber allocation option 1 described in Table D2 in the *50-year forecast of softwood timber availability* (2014);
- to restock stands which are currently felled and to restock any stands felled within the forecast period according to the country-level restocking options described in the NFI report *50-year forecast of hardwood timber availability* (2014).

This scenario, selected after consultation with Private sector woodland owners and timber processors, aims to maximise timber production in a way that involves relatively straightforward and transparent management prescriptions.

This report concentrates on the headline scenario. Alternative harvesting scenarios and their impact on timber availability are explored in the *50-year forecast of softwood timber availability* (2014).

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The increment forecast results for individual surveyed squares were aggregated and scaled up to the areas identified by the woodland map, using standard statistical survey methodology, to produce the estimates in this report. Along with these estimates, associated sampling standard errors have also been calculated and reported. The sampling standard error will account for random variation arising from the selection of the sample, and random measurement errors, but not from any systematic biases in the field measurements. However, because of the quality assurance process it is thought unlikely that any substantial biases of this nature are present in the survey data.

There are four classes of error or uncertainty that are not accounted for or contained in the quoted sampling standard errors:

1. Errors in standing volume estimates arising from random variation about, and systematic bias in, the empirical models used to estimate standing volumes from mensuration data. It is not thought that this will contribute a large source of additional error.
2. Random variation about, and biases in, the growth and yield models used to project the future growth of stands. It is known that biases exist in these models, some of which have recently been quantified, and both these biases and annual random variation about the growth model projections will contribute accumulating errors in the longer term forecasts such that errors contributed by these sources will eventually become a larger source of error than sampling error.
3. The forecasts are conditional upon future conditions of growth being equal to those experienced in the past. The quoted sampling standard errors do not therefore take account of any major sudden events that significantly impact upon the tree stock, such as meteorological conditions of a type not experienced in the past, or of more gradual deviation from past conditions, such as the possible accumulating impact of climate change. These sources of error will impact more heavily on forecasts further into the future rather than on short-term forecasts.
4. It is important to also note that in the statement above that the forecasts are 'conditional upon the underlying assumptions'. This means in effect that it is assumed that every stand is managed in the future exactly as prescribed by the future management scenario being analysed. In practice there will be considerable uncertainty and variation in the future management of forest stands. This is a major source of future uncertainty and therefore another major source of error in longer term forecasts.

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Incorporation of these unaccounted sources of error in future forecasts would require a different forecasting model that is beyond current capacity to implement. The effect would be that the magnitude of standard errors fully accounting for all sources of variation in the forecasts would be close to the sampling standard errors for short-term forecasts, but would then continuously expand for forecasts further into the future. However, the advantage of the semi-deterministic forecasts used in this report are that the comparative effects of alternative management scenarios on future production and state of the woodland resource can be easily identified, even if the forecast values themselves are subject to increasing uncertainty the further they project into the future.

Assumptions used in this increment forecast

Management prescriptions

The timing and scale of thinning and felling events was taken from the approved forest design plans compiled by local planning foresters in Forest Enterprise in England, Scotland and NRW and sets out the prescriptions for harvesting across the productive forest area on the FC estate.

Ownership

Forests and woodlands are harvested differently under different ownership types. Given that forecasts are largely based on the assumptions made about harvesting prescriptions, the rate of change of ownership is important. In the *25-year forecast of softwood timber availability* (2012) assumptions were made about changes in future forest ownership and thus how stands would be harvested over the forecast period. For simplicity, this current forecast assumes that there will be no future transfer of ownership.

Restocking

Both the softwood and hardwood forecasts restock currently clearfelled land; in addition the softwood forecast reduces the stocked area at restock, as well as altering the species mix. The softwood forecast assumes that 5% of conifer stocked area is converted to broadleaved stocked area at time of restock this assumption has an impact upon the hardwood forecast.

These assumptions do not impact greatly within the first 25 years of either forecast, but in the second half of a 50-year forecast the impacts are evident. As there are around 9,800 hectares of currently clearfelled sites in the private sector and thousands of hectares of future conifer clearfell sites generated by the forecast, this has the effect of adding a significant amount of broadleaved stocked area over time and will thus increase hardwood production potential in the long term.

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The prescriptions for which tree species will be replanted during restocking of woodland felled within the forecast period are described in the NFI report *50-year forecast of hardwood timber availability* (2014). The same prescription applies to restocking currently clearfelled land. They also set out the assumption for the reduction in net conifer stocked area as a percentage of current net stocked conifer area.

This restock scenario is only one of many possible future scenarios for restocking.

Currently clearfelled areas

The assumption used for restocking precludes the restocking of the areas classed as clearfelled at 31 March 2016. This is similar to the approach taken in the 25-year forecast of softwood availability (2012), in which areas that were in a clearfell state at the start of the forecast period were not restocked, but differs from that applied to the 25-year forecast of softwood timber availability (2016).

Overdue timber

In the forecast, overdue timber is timber contained within stands that, at the start of the forecast period, are already over the age prescribed for felling according to the management scenario used for the forecast.

Hardwood

These 'overdue' stands represent a significant area of land and volume of hardwood timber, which will impact on a longer term timber forecast, and special provision has now been made for them.

The prescriptions for handling overdue timber were developed in consultation with the private sector and are set out below.

The overdue timber prescriptions take into account tree species, age of stand in relation to age of maximum MAI and current market practice in harvesting:

- For oak stands above maximum MAI but below 80 cm mean dbh, intermediate thin until fell at 80 cm mean dbh.
- For oak stands between 80 cm and 100 cm mean dbh, clearfell evenly over a 20 year period with intermediate thinning.
- For oak stands over 100 cm mean dbh, fell evenly over 10 years.

These prescriptions were formulated with particular reference to mean stand dbh per species, with different species achieving optimal commercial value at different sizes.

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All areas felled as overdue were restocked in the forecast according to the restocking prescription, in common with any other stand felled in the forecast period. Subsequent restocking of these stands is carried out according to the like-for-like scenario.

Impact of harvesting on standing volume

The level and frequency of thinning and felling will have an impact on standing volume and increment over time. If removals exceed increment then standing volumes will be reduced and vice versa.

A large determinant in the forecast for total standing volume in Britain is the underlying age class structure of the forests in England, where the majority of broadleaves are less than 100 years of age and most are less than 40 years of age. This is evidently due to the reestablishment of broadleaved woodland after the devastation of woodland that occurred during the two world wars and the preceding centuries, which seriously depleted GB woodlands. This has driven a broadleaved resource that is in 'recovery', one which has developed from a largely unstocked phase through to a current predominantly immature phase that is in the process of development into a more mature phase. This history is reflected in the age class structure of broadleaves found by the NFI and previous surveys. The forecasts presented in this document show that, without a significant increase in removals in the future, standing volumes of broadleaves will be expected to almost double in the forecast period.

This contrasts with forests of a more evenly distributed age found in most other countries, which result in a more even evolution of total standing volume, increment and production through time. Any comparisons of level of cut to increment should account for this. It should also be noted that the core 50-year forecast of this report is a limited projection of standing volume of broadleaves through time, focussing on a 50 year period, which represents a fraction of the life cycle of GB forests.

Impact of future events

In addition to the impact of harvesting decisions, there are other unpredictable external factors that are likely to have an impact on increment over the period of the forecast. For example, pest and disease outbreaks, economic factors, severe weather events (windthrow), changes in land use (wind farms and habitat restoration) and changes in government policy (affecting for example grants and regulation, land sales and forest management) will all have impacts.

The increment forecasts in this report make no assumptions about the impact of pests and diseases. The volumes set out in the main reports assume no impact on availability or production occurring from current or potential outbreaks of pests and diseases. This

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'neutral' approach was taken since reliably predicting the rate of spread and impact of the pests and diseases currently of concern was considered to be impractical at this time.

Derivation of tree health estimates

The tree health estimates provide estimates of the amounts of tree mortality, crown dieback and other tree health issues found in upper canopy trees. NFI surveyors assess all trees within the sample squares for key forest pest and diseases, plus general health indicators. Most factors are recorded at stand level, but levels of mortality are recorded at the sample plot and individual tree level.

Note on the estimates

The values in the tables have been independently rounded, so may not add to the totals shown. In some breakdowns of Private sector estimates, the estimates in the body of the table may not sum to the quoted total because each individual value, including the total, has been independently generated by the estimation procedure used for results from the NFI sample survey. Sampling standard errors attached to Private sector estimates are expressed in relative terms (%) to the right of the relevant estimate and as \pm error bars in the figures. Percentages in the pie charts may also not sum to 100 due to rounding.

Due to biological and sampling constraints, for example where there is a very small population of a species within a particular region, the estimates may have a high associated standard error. Since this indicates a high level of uncertainty around those estimates then caution should be used when drawing any conclusions from these values as the estimate may not be representative of the real population. Such estimates have been 'lowlighted' in the tables.

Further details can be found in the NFI reports published on the [NFI web pages](#).

Results

The figures in the tables have been independently rounded, so may not add to the totals shown. Sampling standard errors (SE) attached to private sector estimates are expressed in relative terms (%) to the right of the relevant estimate.

It should be noted that the categories used to describe and classify the oak woodland such as age class, size class and stocked area are not necessarily discrete entities within woodlands.

As noted in the description of stocked areas, many individual woods and stands within woods are composed of trees of many species, ages and size. Such mixed populations within individual stands have been stratified, characterised and aggregated prior to analysis and presentation in the separate categories presented. The results as presented may give the impression of woodlands that are physically sub-divided into stands of even age and species, whereas in reality most broadleaved woods form a much more complex structure.

This structure of woodlands has particular implications with regard to reported size classes. For reporting woodlands broken down into separate size classes, the mean DBH of the stand (or component of a stand) has been used to classify the whole stand. Very often, there will be a wide range of values of DBH for individual trees within such components, so a single value of mean DBH will not properly characterise the distribution of tree sizes within the component. For this reason, although the breakdown of a tree population by mean DBH class might be used as a proxy for the distribution of individual sizes of trees, it will not always follow that the distribution of individual tree sizes in the same population will exactly follow this pattern.

There will also be a similar, but less pronounced, effect of this sort in the classification of oak tree populations into age classes. In some instances, a component of trees will have been assigned a single planting year (which determines age at the reference date of 31 March 2016) but the individual trees themselves, particularly if they have been established from natural regeneration, may have originally established themselves over a range of years. However, of greater importance in the interpretation of the reported age class distributions is that planting years and ages of stands in NFI (but less so in SCDB data) are mainly those that have been estimated by the surveyor at the time of assessment of the stand. These surveyor assessments have been statistically adjusted, using information on actual planting years retrieved for a sample of stands, but these adjusted estimates of age can still vary considerably from actual stand age. This should therefore be borne in mind in the interpretation of the age class distributions reported in these results.

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In the breakdowns of numbers of trees by DBH class and by age class, the estimates relate only to counts of trees of measurable size (4cm DBH for the private sector and 7cm DBH for the FC estate). In the smallest mean DBH class of 0-7 centimetres the estimated numbers are consequently low (but mostly non-zero, because stands with a mean DBH of 7 cm or less may still have some trees within them of at least 7 cm DBH). Also, for the youngest age class of 0-10 years old there are often few trees that will have reached these minimum sizes.

In the figures Native oak is the sum of oak, pedunculate oak and sessile oak. Stands may contain a mixture of these oaks and hybridisation is common meaning that oak is recorded unless there is clear identification of the particular species. Other oak species are additional.

The results presented in this report are estimates of standing volumes and stocked areas at 31 March 2016. The data sources used for the compilation of these estimates are the same as described in the National Forest Inventory reports the *50-year forecast of hardwood availability* (2014). Most estimates for the Forestry Commission (FC) and NRW estate are derived from the FC's and NRW's sub-compartment database, while those for the private sector (i.e. non-FC) estate are derived from information collected in the NFI field survey. Estimates for health and yield class are all derived from NFI sample data. A fuller description of these data sources and how they are used in the production of estimates, including sampling standard errors attached to the private sector estimates, is provided in the earlier sections of the report.

The values in the tables have been independently rounded, so may not add to the totals shown. In some breakdowns of Private sector estimates, the estimates in the body of the table may not sum to the quoted total because each individual value, including the total, has been independently generated by the estimation procedure used for results from the NFI sample survey. Sampling standard errors (SE) attached to Private sector estimates are expressed in relative terms (%) to the right of the relevant estimate.

Caution needs to be applied in the interpretation of estimates with high relative standard errors. Such estimates cannot be relied upon to provide a value close to the actual value in the population reported on, and should be regarded as indicative values of the general level of the actual population value. Estimates and their standard errors with relative standard errors exceeding 25% are shown in amber in the tables as an indication that these estimates need to be treated with such caution. More precise estimates of these statistics would require further samples focused on the particular population of interest.

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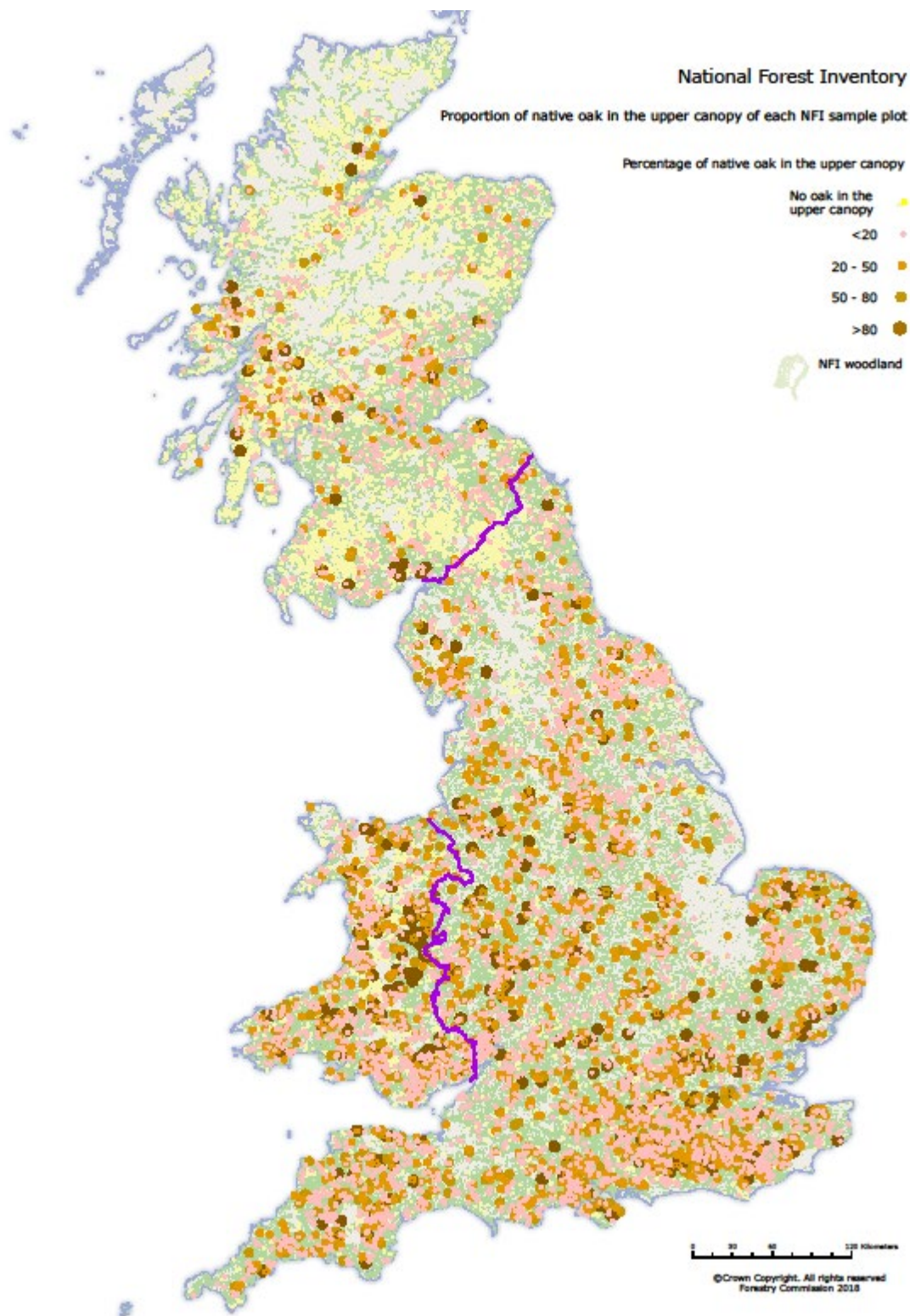
Where the standard error is high this indicates that the estimate should be interpreted with a degree of caution. Any estimate with a relatively large standard error is shown in **amber** in the tables.

These standard errors depend on the combination of a number of factors but broadly:

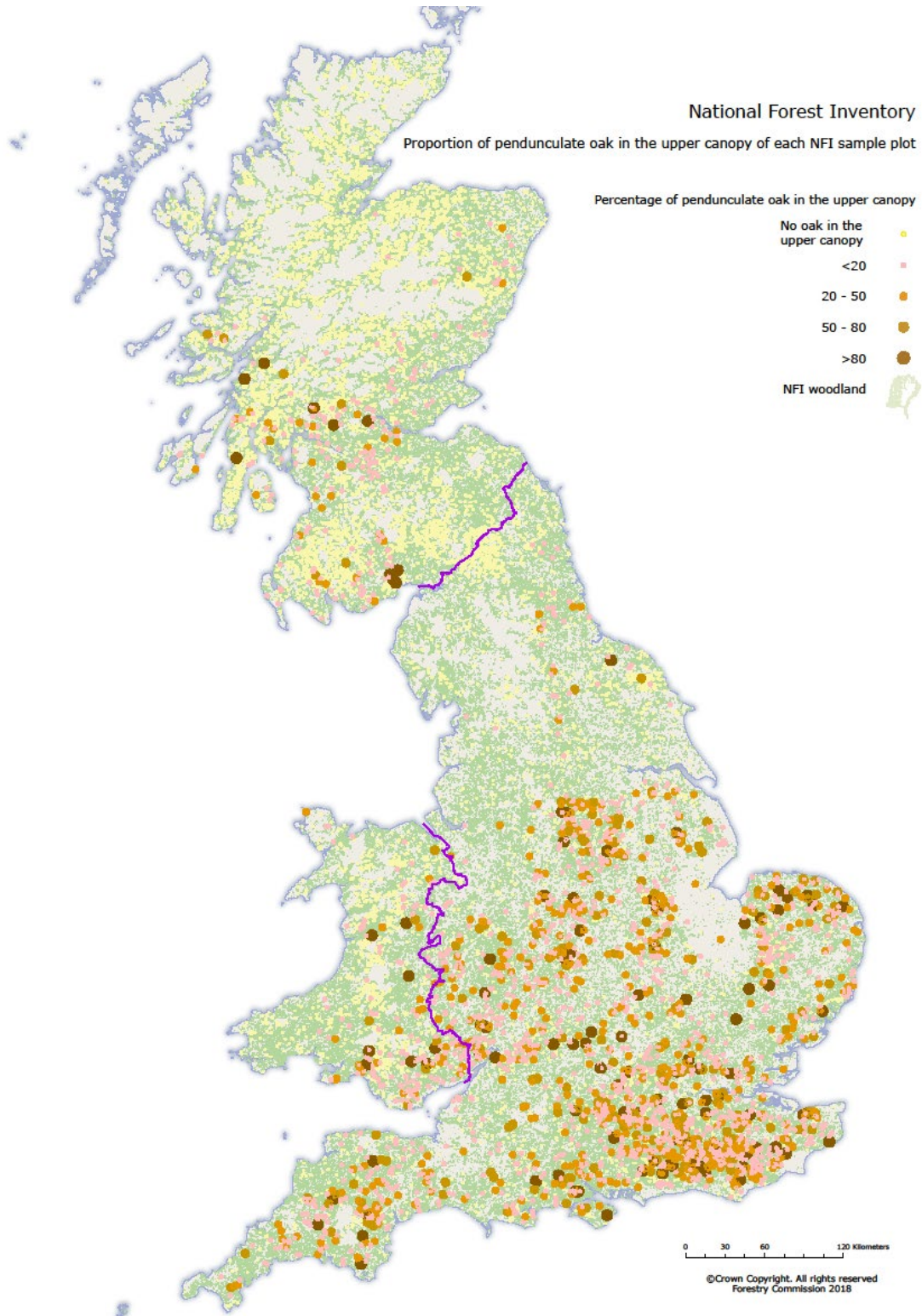
- The more woodland that is within the area of interest the more samples that will have been selected, generally leading to lower standard errors
- Increasing the number of categories and sub-categories used (e.g. conifers and broadleaves then sub-divided into species groupings) may well result in higher standard errors, especially for the categories that occur less frequently such as minor species
- More variability will also result in higher standard errors; for instance if a species is usually more evenly stocked when compared with another then its standard error will tend to be lower than the latter species.

Oak distribution maps

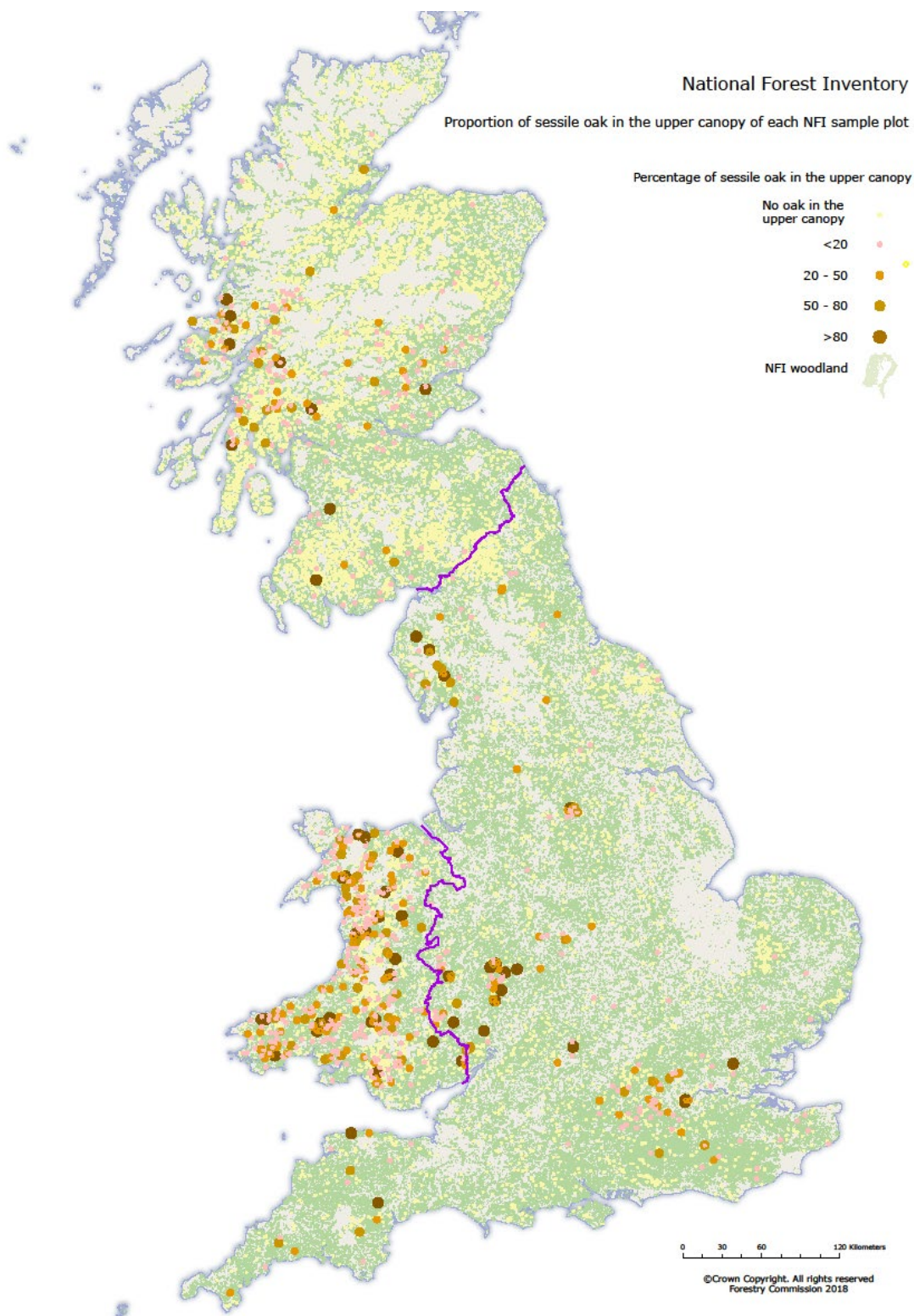
Map 1 Distribution of native oak in GB



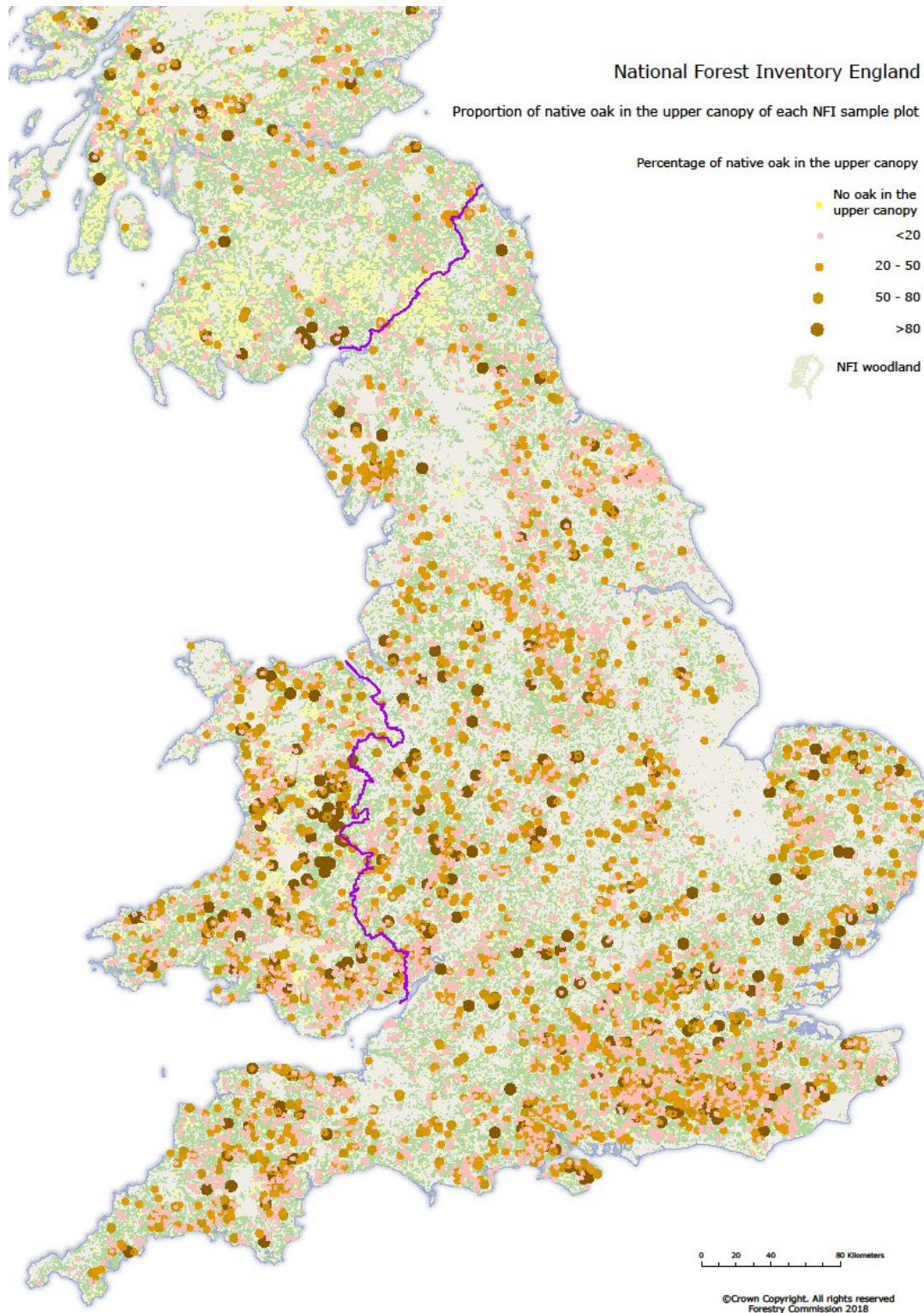
Map 2 Distribution of pedunculate oak in GB



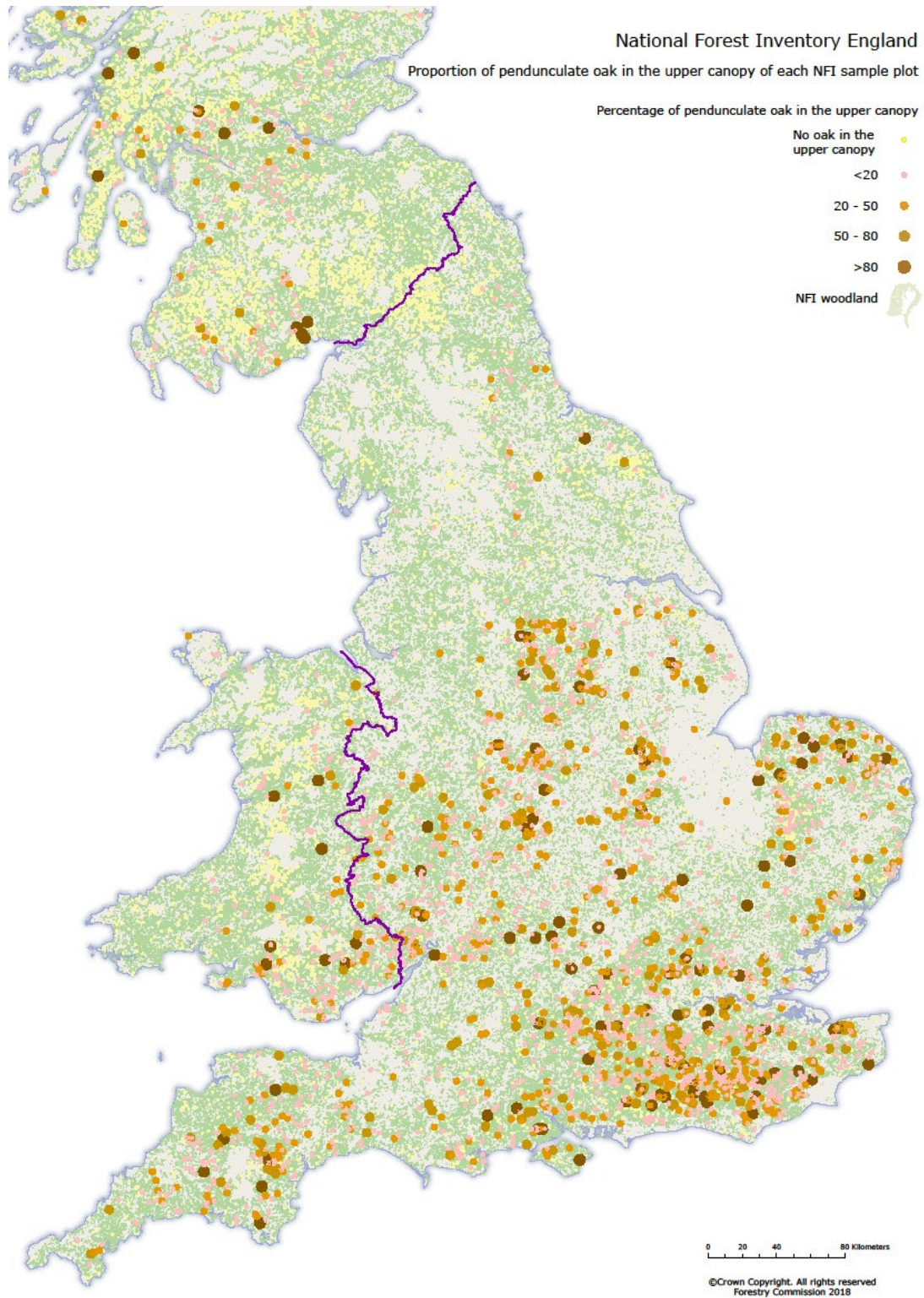
Map 3 Distribution of sessile oak in GB



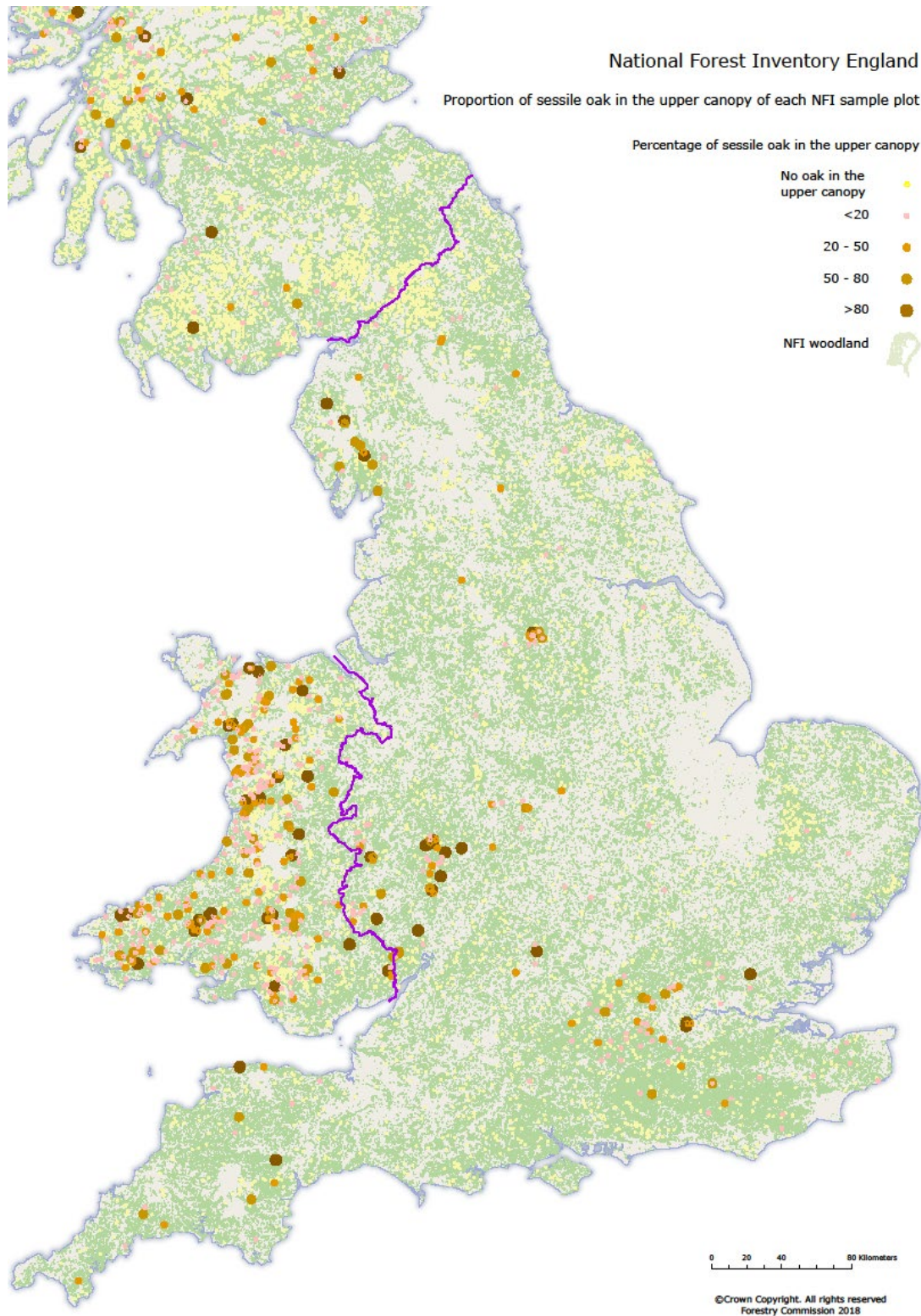
Map 4 Distribution of native oak in England



Map 5 Distribution of pedunculate oak in England

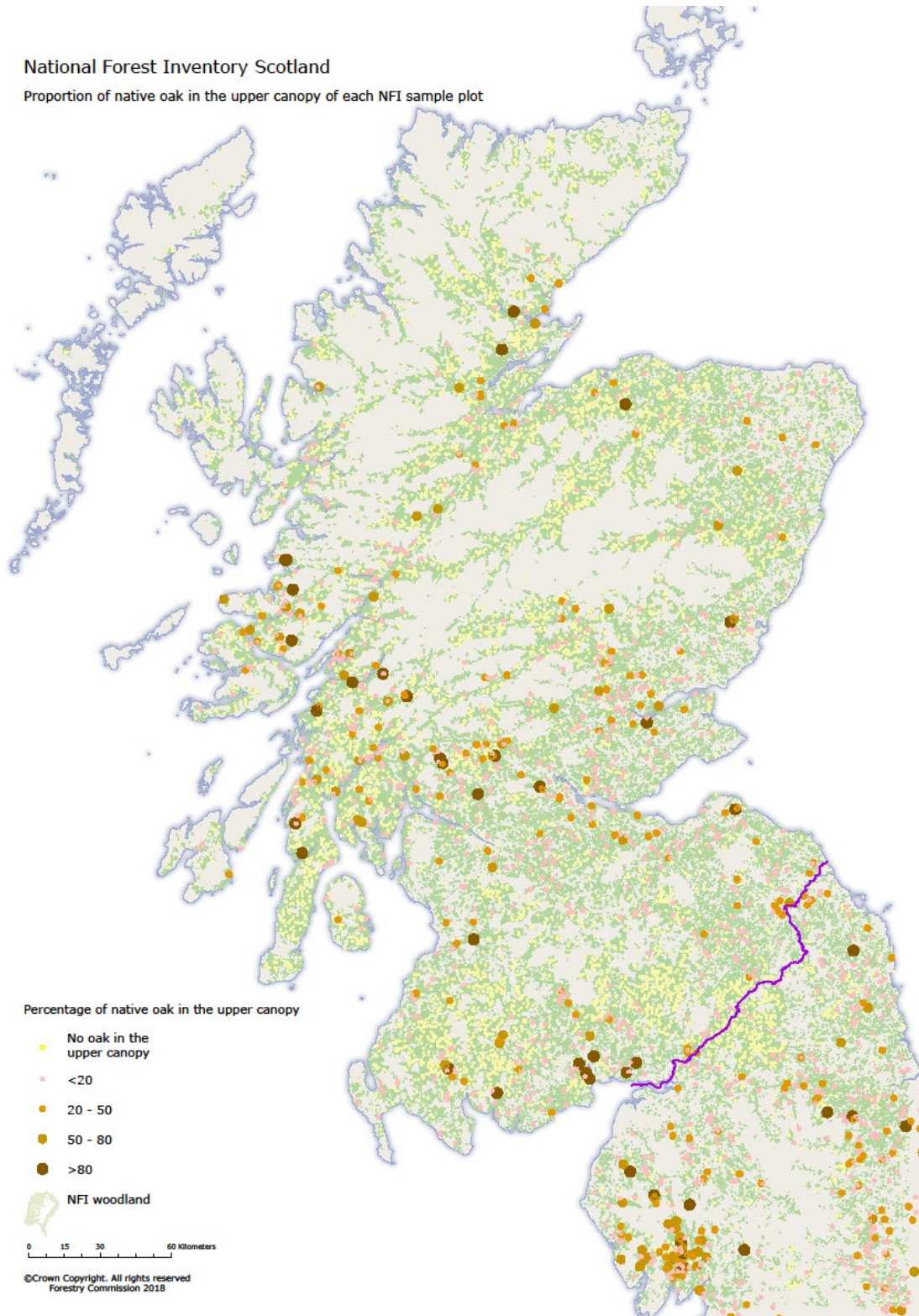


Map 6 Distribution of sessile oak in England



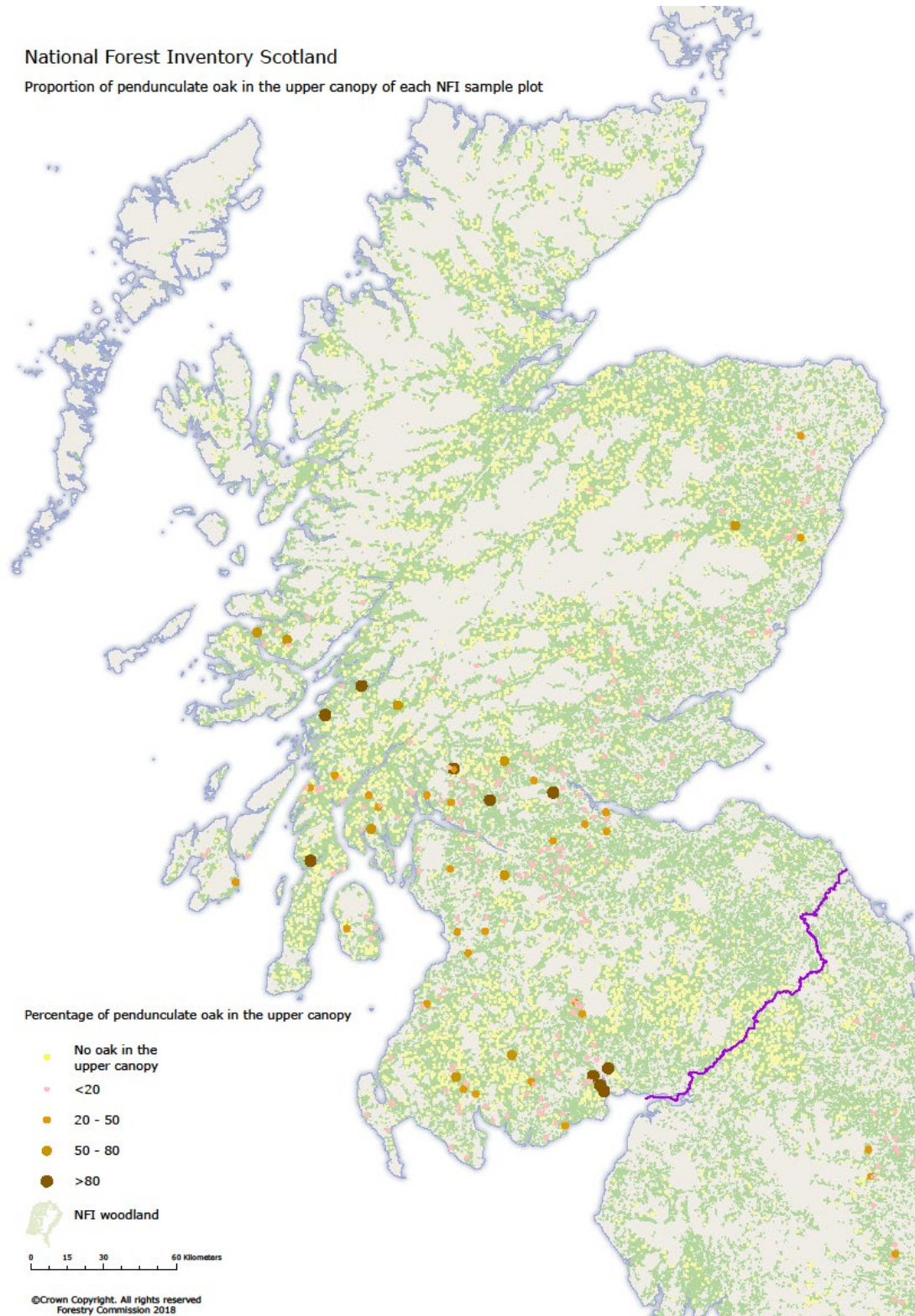
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Map 7 Distribution of native oak in Scotland

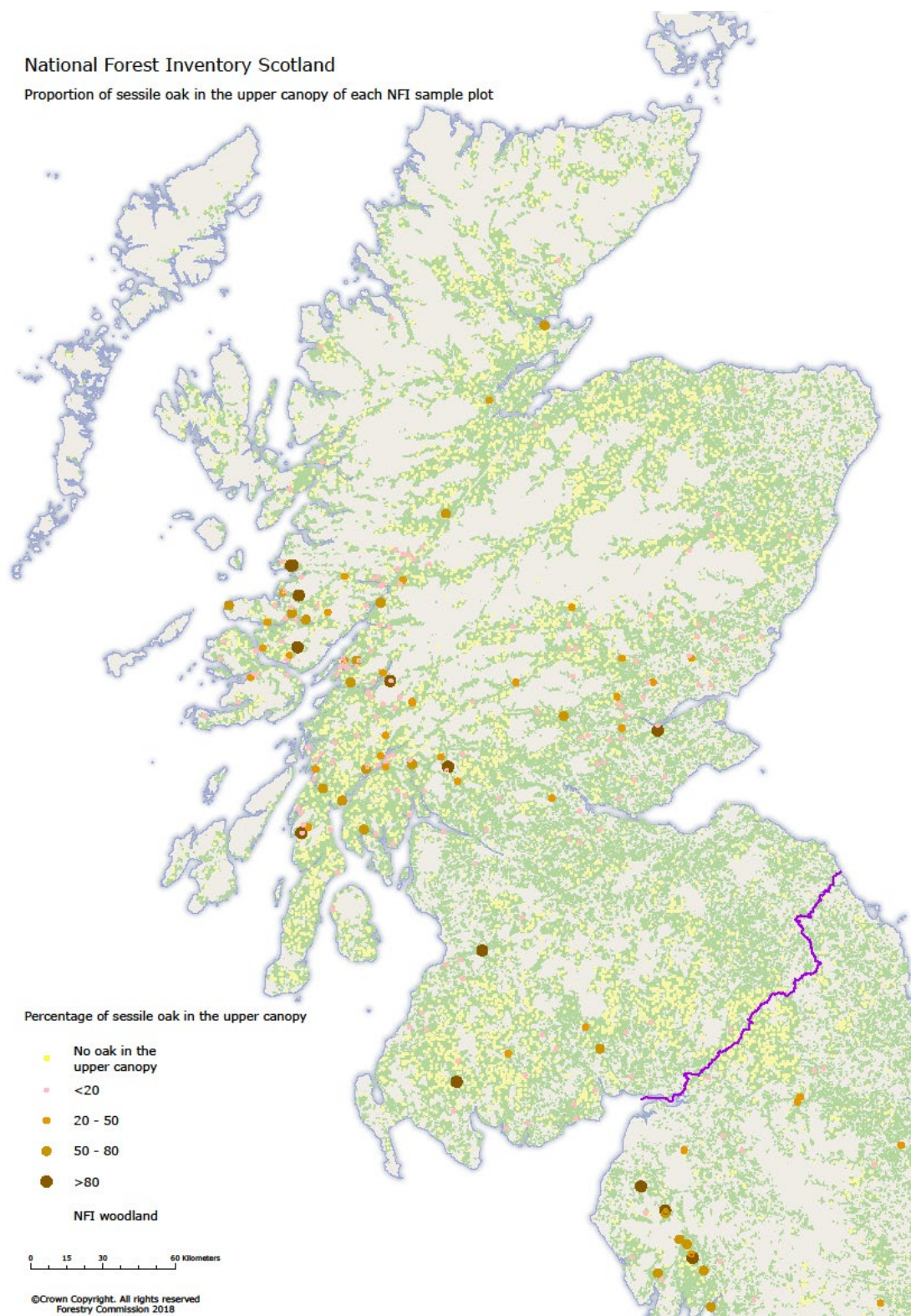


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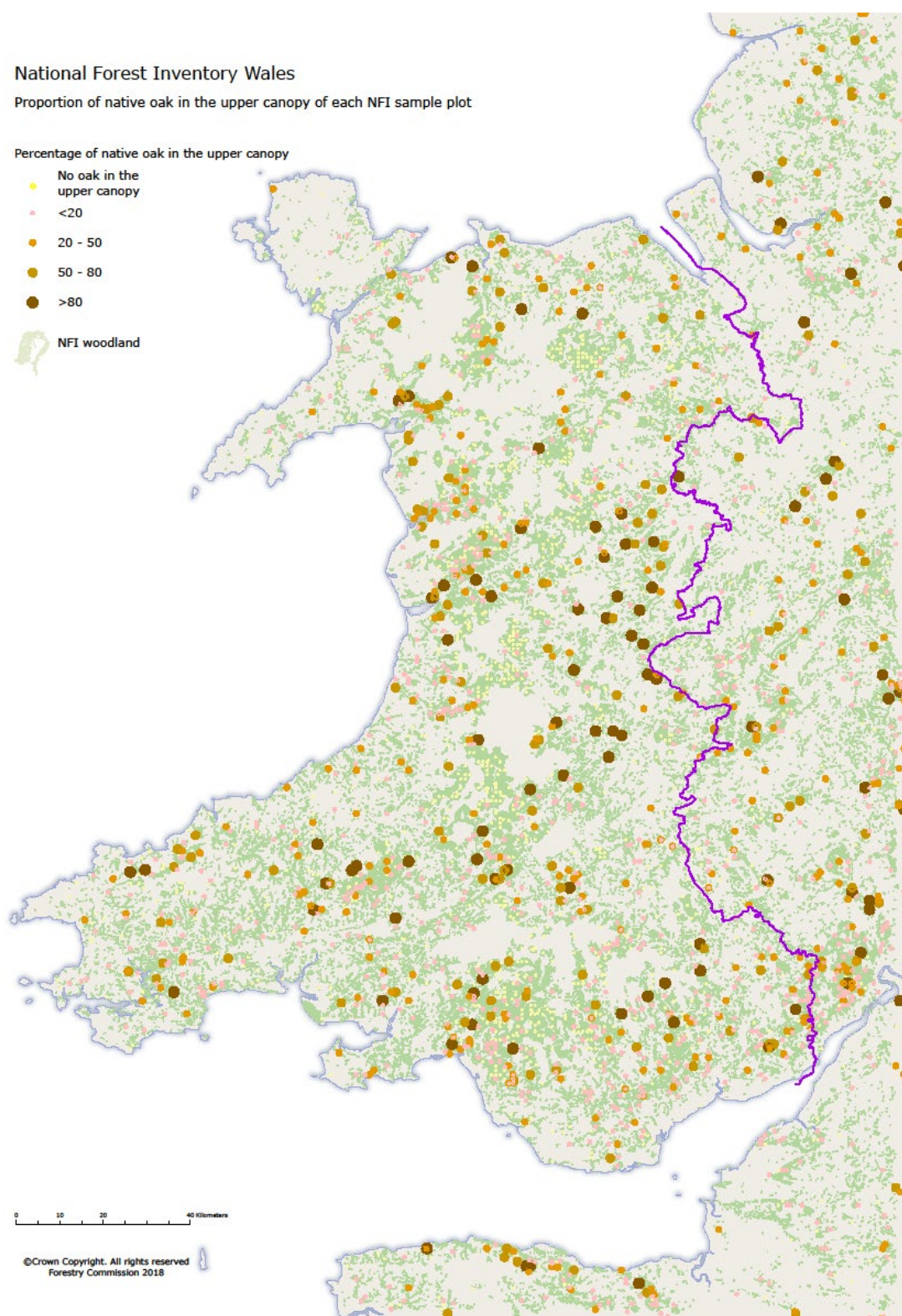
Map 8 Distribution of pedunculate oak in Scotland



Map 9 Distribution of sessile oak in Scotland

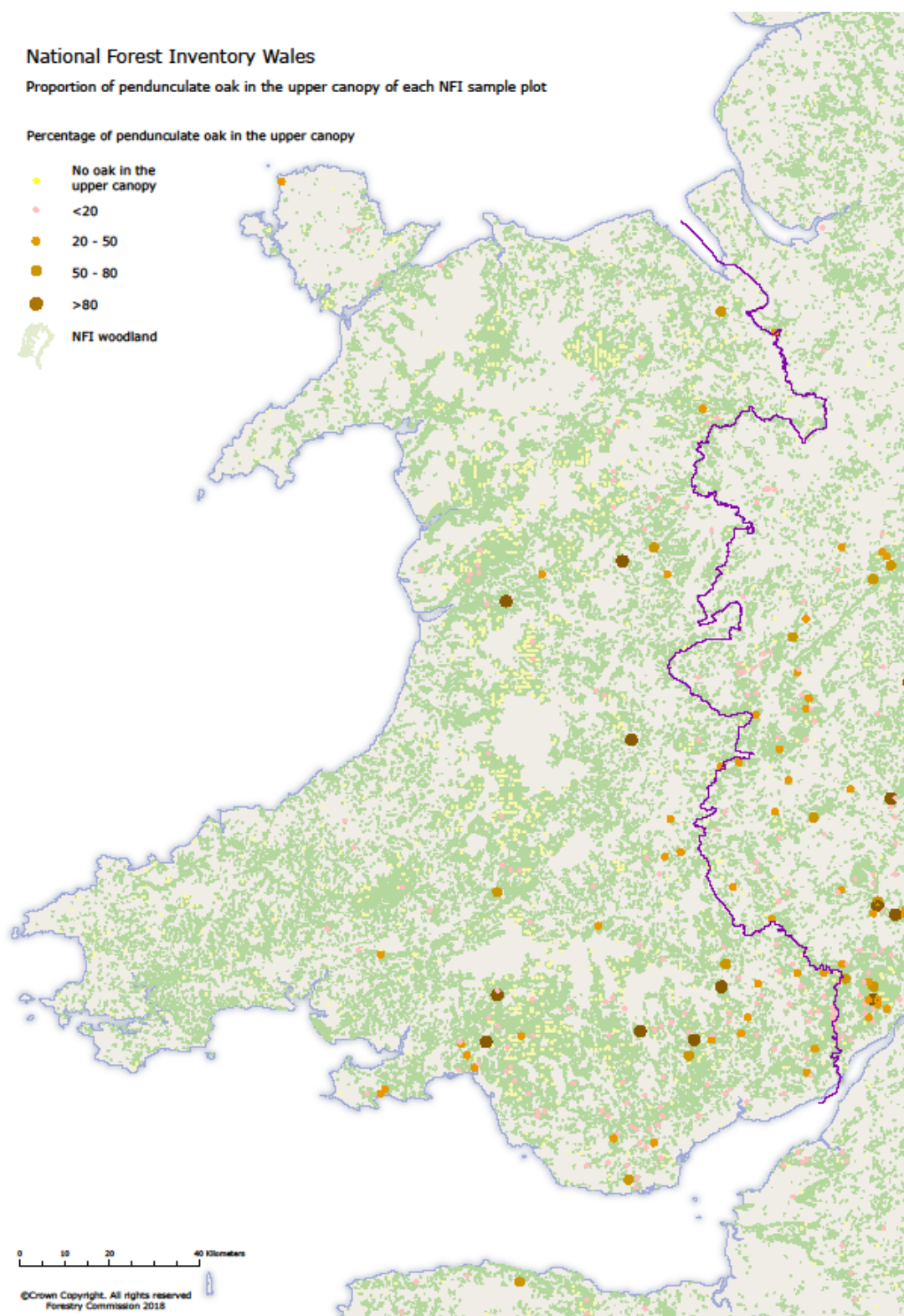


Map 10 Distribution of native oak in Wales



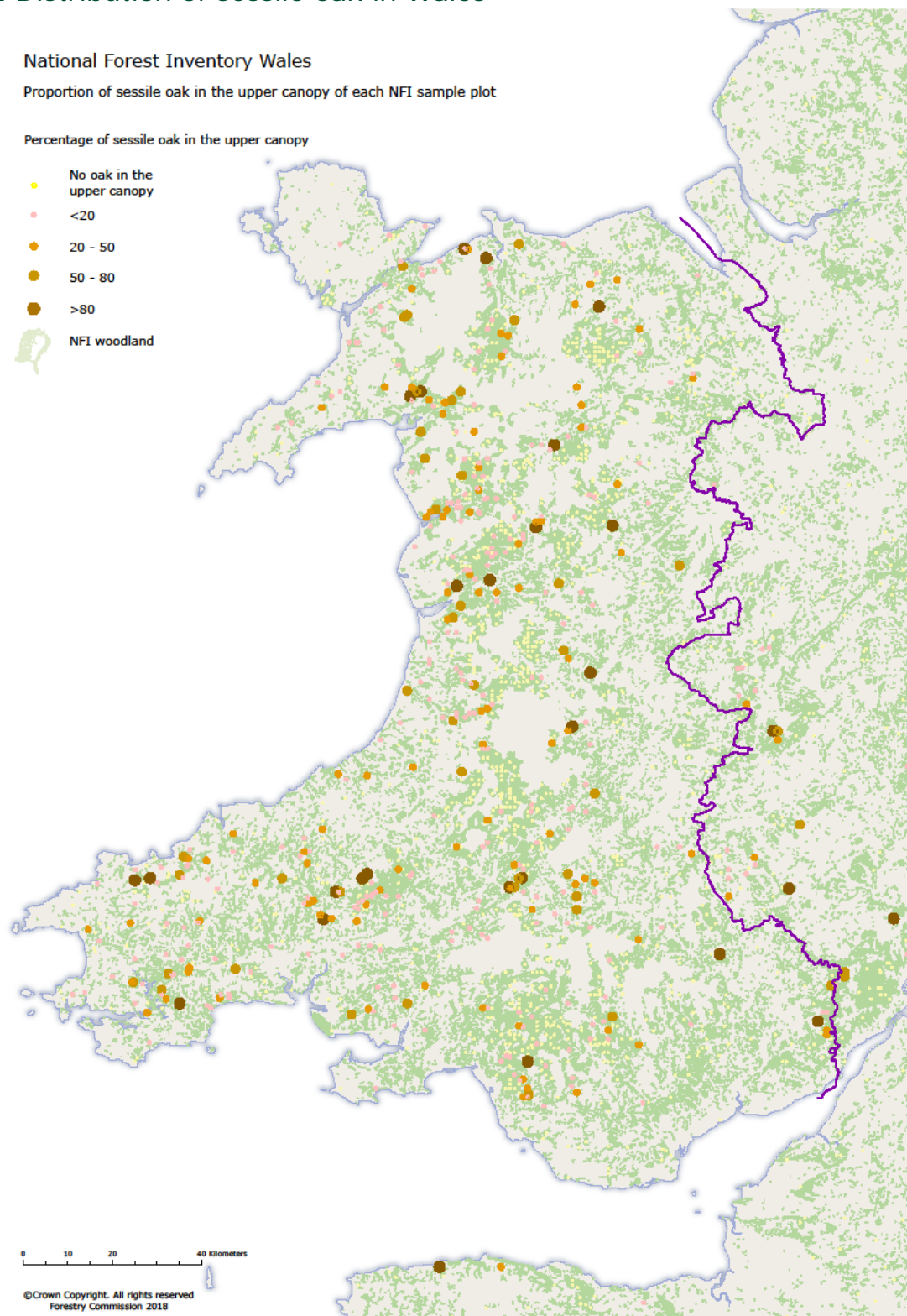
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Map 11 Distribution of pedunculate oak in Wales



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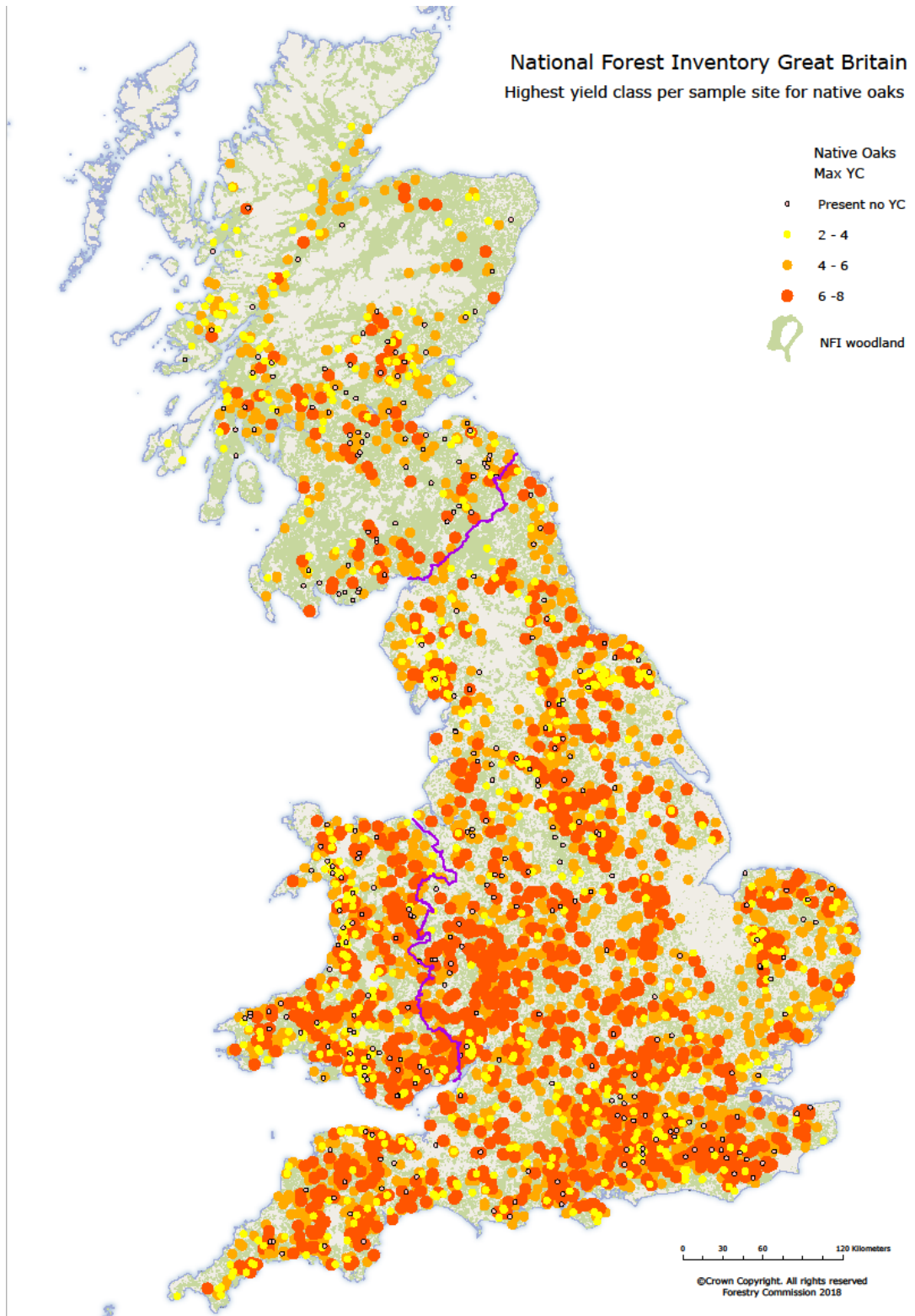
Map 12 Distribution of sessile oak in Wales



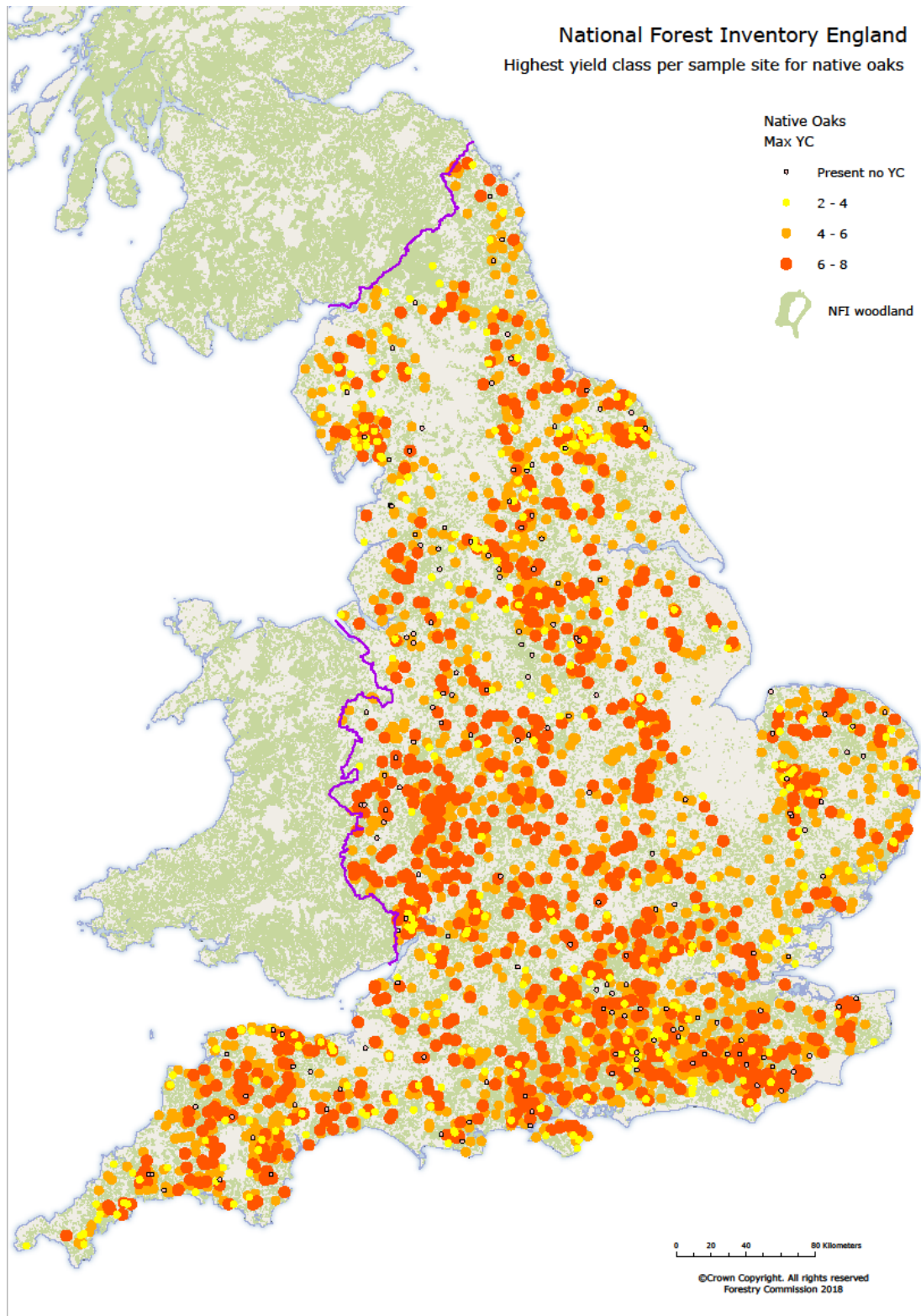
Maps for each region are available in accompanying documents.

Yield class heat maps

Map 13 Yield class heat map of native oak in GB

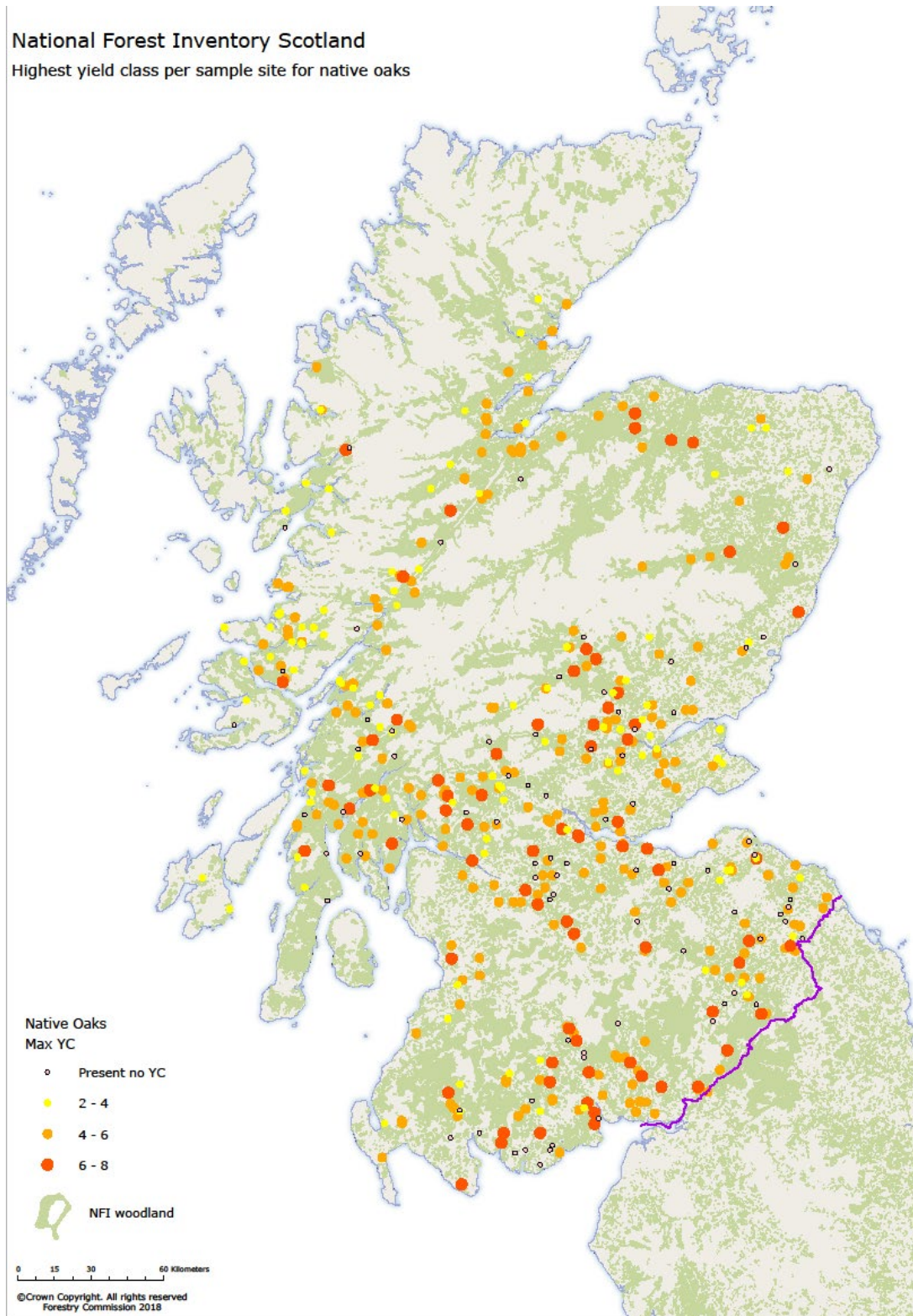


Map 14 Yield class heat map of native oak in England



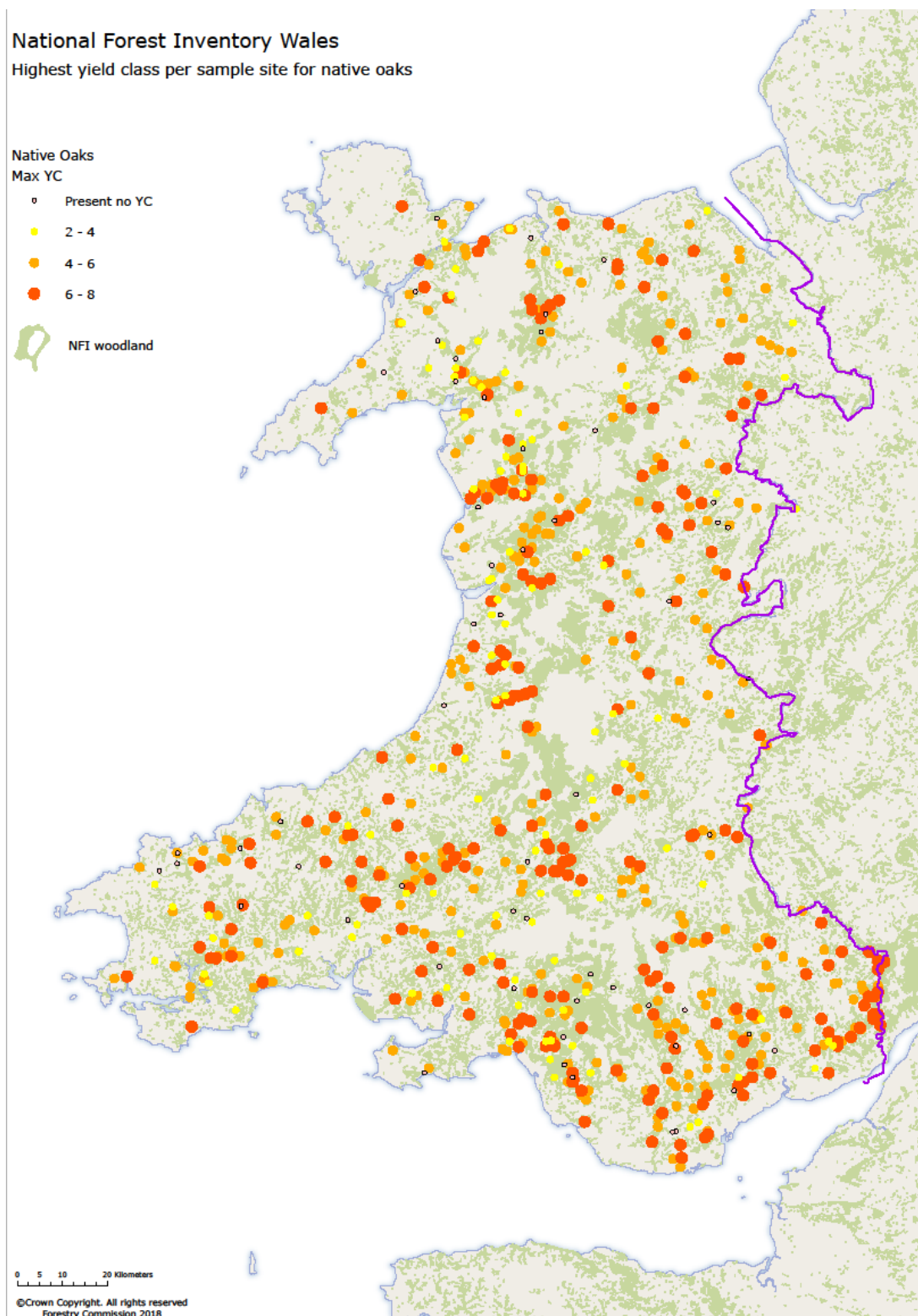
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Map 15 Yield class heat map of native oak in Scotland



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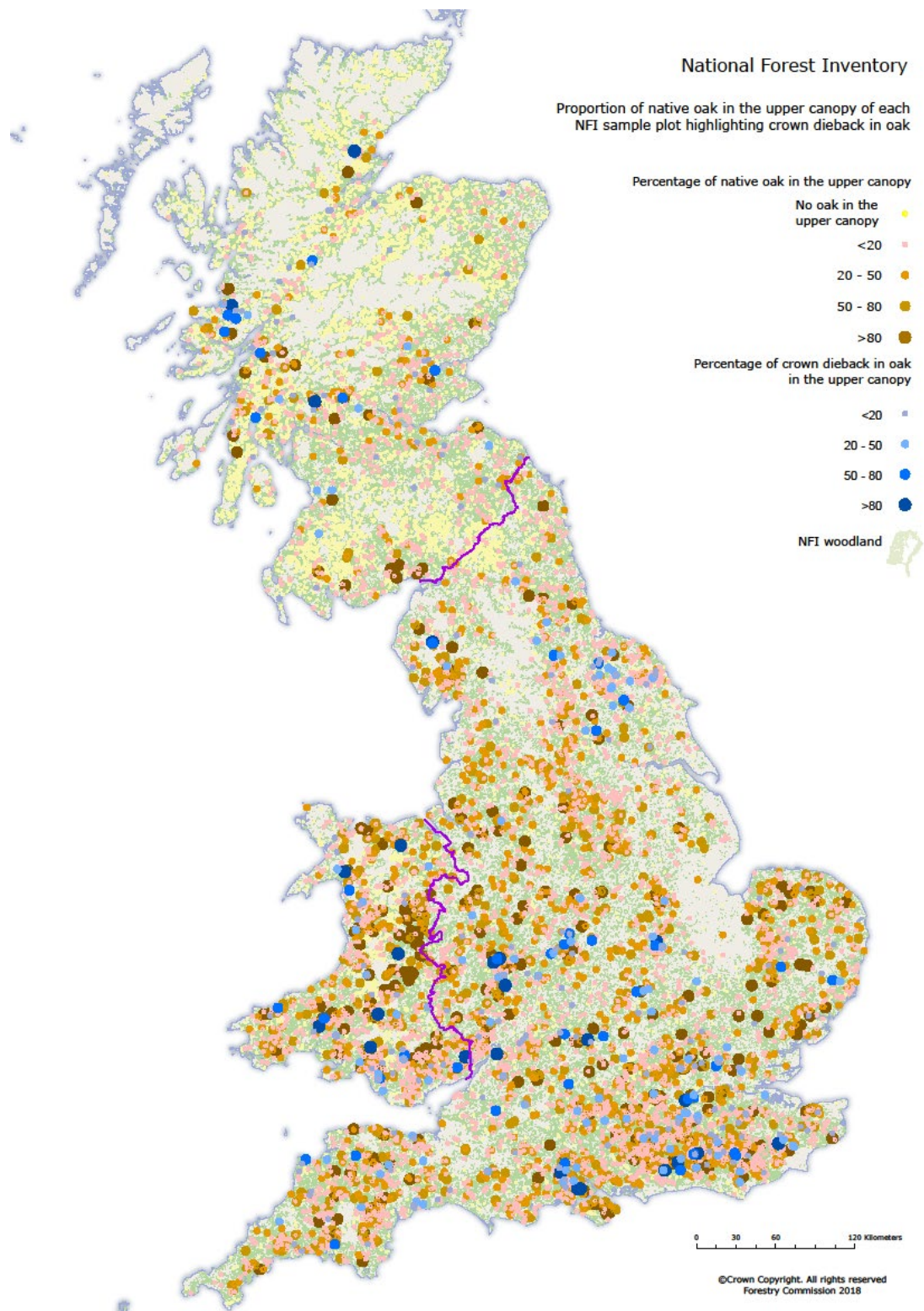
Map 16 Yield class heat map of native oak in Wales



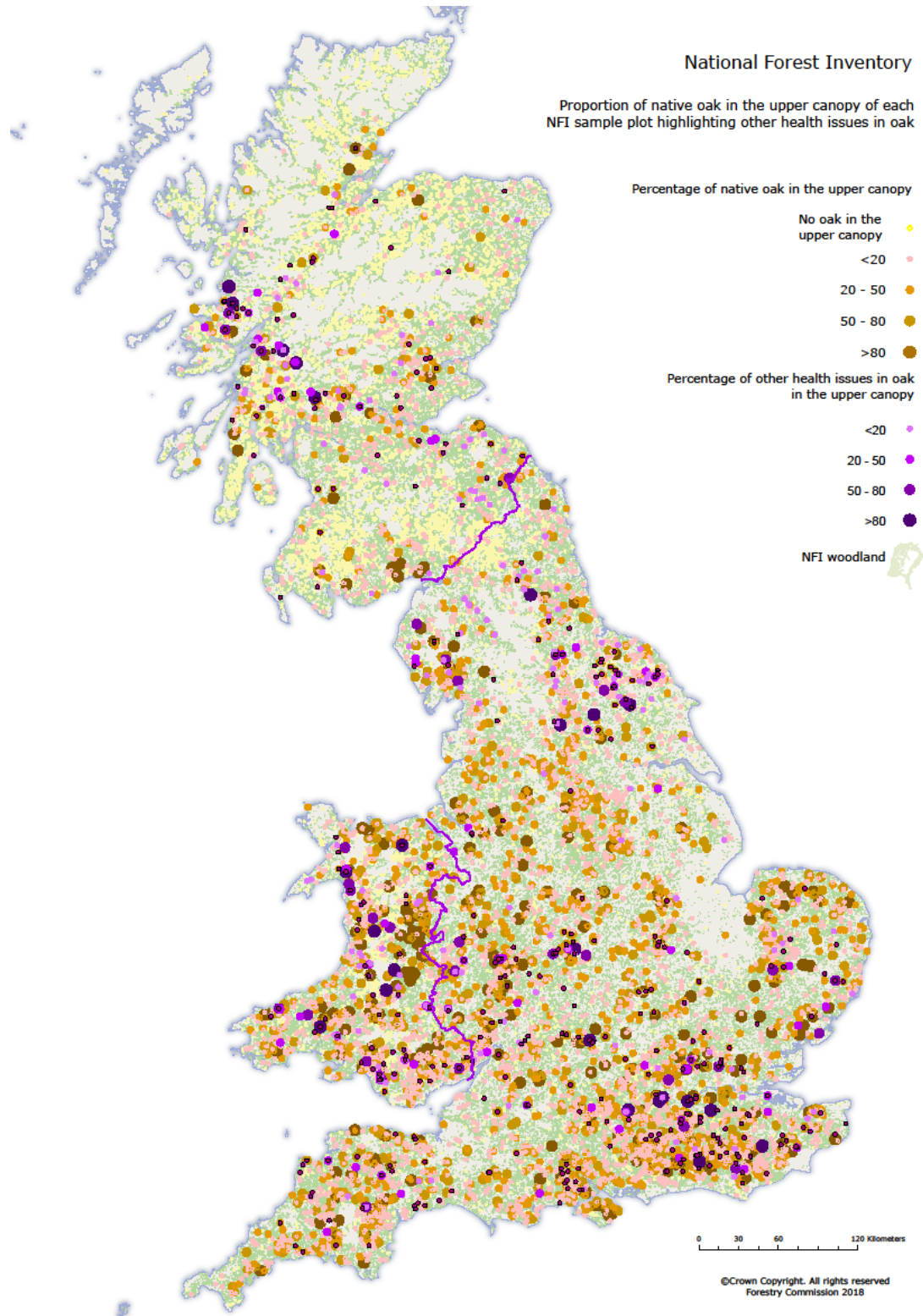
Maps for each region are available in accompanying documents.

Oak health maps

Map 17 Native oak in GB with evidence of crown dieback



Map 18 Native oak in GB with evidence of other health issues



Net area under canopy

Stocked area of oak

Table 1 Stocked area of oak by country

	Species	FC/NRW	Private sector		Total
		000 ha	SE %		
GB	Native oak	22.3	196.3	2	218.6
	Oak	20.7	102.9	3	123.6
	Pedunculate oak	0.2	71.6	4	71.7
	Sessile oak	1.4	21.8	9	23.2
	Other oaks	0.6	2.9	16	3.5
England	Native oak	15.6	149.3	3	164.9
	Oak	15.3	77.7	4	93.0
	Pedunculate oak	0.1	64.7	4	64.8
	Sessile oak	0.2	6.9	17	7.0
	Other oaks	0.3	2.9	16	3.2
Scotland	Native oak	3.6	24.1	8	27.8
	Oak	2.7	9.6	12	12.3
	Pedunculate oak	< 0.1	5.4	18	5.5
	Sessile oak	0.9	9.1	13	10.0
	Other oaks	< 0.1	< 0.1	51	< 0.1
Wales	Native oak	3.0	22.9	8	25.9
	Oak	2.7	15.6	10	18.3
	Pedunculate oak	< 0.1	1.4	31	1.5
	Sessile oak	0.3	5.8	18	6.1
	Other oaks	0.2	< 0.1	84	0.2

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Table 2 Stocked area of oak in England by region

	Species	FC	Private sector		Total
		000 ha	SE %		
North West England	Native oak	0.9	13.7	9	14.6
	Oak	0.8	12.7	9	13.5
	Pedunculate oak	< 0.1	< 0.1	83	< 0.1
	Sessile oak	< 0.1	1.0	36	1.1
	Other oaks	< 0.1	< 0.1	61	< 0.1
North East England	Native oak	0.2	5.0	17	5.1
	Oak	0.2	2.8	19	3.0
	Pedunculate oak	0.0	0.6	33	0.6
	Sessile oak	< 0.1	1.5	41	1.5
	Other oaks	< 0.1	< 0.1	104	< 0.1
Yorkshire and the Humber	Native oak	0.5	10.9	8	11.4
	Oak	0.4	9.4	9	9.8
	Pedunculate oak	< 0.1	1.4	23	1.4
	Sessile oak	< 0.1	0.1	64	0.1
	Other oaks	< 0.1	0.2	79	0.2
East Midlands	Native oak	3.0	11.7	10	14.7
	Oak	3.0	3.9	18	6.8
	Pedunculate oak	< 0.1	7.8	12	7.9
	Sessile oak	0.0	< 0.1	59	< 0.1
	Other oaks	0.1	< 0.1	40	0.2
East England	Native oak	1.0	19.3	8	20.3
	Oak	1.0	5.3	16	6.3
	Pedunculate oak	< 0.1	13.9	10	13.9
	Sessile oak	< 0.1	0.1	68	0.1
	Other oaks	< 0.1	0.3	31	0.4
South East England	Native oak	5.6	44.4	5	50.0
	Oak	5.5	17.5	8	23.1
	Pedunculate oak	< 0.1	24.8	6	24.8
	Sessile oak	< 0.1	2.1	27	2.2
	Other oaks	< 0.1	1.1	29	1.2
South West England	Native oak	3.6	27.9	6	31.5
	Oak	3.6	19.5	7	23.0
	Pedunculate oak	< 0.1	8.2	11	8.2
	Sessile oak	< 0.1	0.3	54	0.3
	Other oaks	< 0.1	0.9	28	1.0
West Midlands	Native oak	1.2	16.4	9	17.6
	Oak	1.2	6.7	15	7.8
	Pedunculate oak	< 0.1	8.1	12	8.1
	Sessile oak	< 0.1	1.7	38	1.7
	Other oaks	< 0.1	< 0.1	52	0.2

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Table 3 Stocked area of oak in Scotland by region

	Species	FC	Private sector		Total
		000 ha		SE %	
North Scotland	Native oak	0.3	1.7	36	2.0
	Oak	0.2	1.3	44	1.5
	Pedunculate oak	< 0.1	0.0	-	< 0.1
	Sessile oak	< 0.1	0.5	59	0.5
	Other oaks	0.0	0.0	-	0.0
North East Scotland	Native oak	0.2	1.7	33	1.9
	Oak	0.2	1.2	42	1.4
	Pedunculate oak	< 0.1	0.4	64	0.4
	Sessile oak	< 0.1	0.1	103	0.1
	Other oaks	0.0	0.0	-	0.0
East Scotland	Native oak	0.2	3.3	20	3.5
	Oak	0.2	1.1	34	1.3
	Pedunculate oak	0.0	0.2	31	0.2
	Sessile oak	< 0.1	2.0	27	2.1
	Other oaks	< 0.1	0.0	-	< 0.1
South Scotland	Native oak	0.9	8.7	12	9.5
	Oak	0.8	5.3	15	6.1
	Pedunculate oak	< 0.1	2.3	21	2.3
	Sessile oak	< 0.1	1.0	32	1.1
	Other oaks	< 0.1	< 0.1	51	< 0.1
West Scotland	Native oak	2.1	8.7	15	10.8
	Oak	1.3	0.7	40	2.0
	Pedunculate oak	< 0.1	2.6	31	2.6
	Sessile oak	0.8	5.4	18	6.2
	Other oaks	< 0.1	0.0	-	< 0.1

Stocked area of oak by age class

Table 4 Stocked area of oak in GB by age class

Species	Ownership		Age class (years)						
			0 to 10	11 to 20	21 to 40	41 to 60	61 to 80	81 to 100	100+
Native oak	FC/NRW	000 ha	2.5	1.0	1.5	1.2	4.5	2.9	8.6
	PS		8.0	10.6	26.3	31.1	35.1	46.8	38.4
	S.E. %		13	7	5	6	6	5	6
	total	000 ha	10.5	11.6	27.8	32.3	39.6	49.7	47.1
Oak	FC/NRW	000 ha	1.8	1.0	1.4	1.2	4.5	2.9	8.0
	PS		4.8	5.7	13.5	15.2	15.2	24.9	23.6
	S.E. %		17	11	7	8	9	7	7
	total	000 ha	6.5	6.7	14.9	16.4	19.7	27.8	31.6
Pedunculate oak	FC/NRW	000 ha	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	PS		2.1	4.4	10.2	10.9	14.7	18.9	10.4
	S.E. %		19	10	9	9	9	8	10
	total	000 ha	2.2	4.4	10.2	10.9	14.7	18.9	10.4
Sessile oak	FC/NRW	000 ha	0.6	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.6
	PS		1.1	0.5	2.6	4.9	5.2	3.0	4.5
	S.E. %		43	24	21	20	18	20	21
	total	000 ha	1.7	0.6	2.6	4.9	5.2	3.1	5.1
Other oak	FC/NRW	000 ha	< 0.1	< 0.1	< 0.1	0.1	0.4	< 0.1	< 0.1
	PS		0.1	0.1	0.5	0.5	0.7	0.6	0.5
	S.E. %		52	41	25	28	33	36	42
	total	000 ha	0.1	0.1	0.5	0.6	1.0	0.6	0.5

Table 5 Stocked area of oak in England by age class

Species	Ownership		Age class (years)						
			0 to 10	11 to 20	21 to 40	41 to 60	61 to 80	81 to 100	100+
Native oak	FC	000 ha	0.8	0.6	1.0	1.0	3.7	2.4	6.1
	PS		4.2	7.7	20.8	22.9	26.7	39.1	27.9
	S.E. %		15	8	6	6	7	6	7
	total	000 ha	5.0	8.2	21.8	23.9	30.4	41.5	34.1
Oak	FC	000 ha	0.6	0.5	1.0	1.0	3.7	2.4	6.1
	PS		2.3	3.6	10.8	12.1	12.0	20.9	16.0
	S.E. %		23	12	8	9	10	8	8
	total	000 ha	2.9	4.1	11.8	13.1	15.7	23.3	22.1
Pedunculate oak	FC	000 ha	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	PS		1.7	3.9	9.4	9.8	12.7	17.1	10.2
	S.E. %		21	11	9	10	9	9	10
	total	000 ha	1.7	3.9	9.4	9.8	12.7	17.1	10.2
Sessile oak	FC	000 ha	0.1	< 0.1	0.0	0.0	0.0	0.0	< 0.1
	PS		0.2	0.2	0.6	1.0	2.0	1.1	1.8
	S.E. %		63	55	39	39	29	30	38
	total	000 ha	0.4	0.2	0.6	1.0	2.0	1.1	1.8
Other oak	FC	000 ha	< 0.1	< 0.1	< 0.1	0.1	0.2	< 0.1	< 0.1
	PS		0.1	0.1	0.5	0.5	0.7	0.6	0.5
	S.E. %		52	42	26	28	33	36	42
	total	000 ha	0.1	0.1	0.5	0.6	0.8	0.6	0.5

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Table 6 Stocked area of oak in Scotland by age class

Species	Ownership		Age class (years)						
			0 to 10	11 to 20	21 to 40	41 to 60	61 to 80	81 to 100	100+
Native oak	FC	000 ha	1.0	0.2	0.3	< 0.1	0.3	0.1	1.7
	PS		2.6	2.4	3.5	4.7	4.3	3.0	3.7
	S.E. %		25	20	18	19	20	24	22
	total	000 ha	3.6	2.5	3.7	4.8	4.5	3.2	5.4
Oak	FC	000 ha	0.8	0.1	0.2	< 0.1	0.2	0.1	1.1
	PS		2.0	1.8	1.4	1.2	0.8	0.2	2.2
	S.E. %		30	25	29	30	37	63	30
	total	000 ha	2.8	2.0	1.6	1.3	1.0	0.3	3.3
Pedunculate oak	FC	000 ha	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.0
	PS		0.4	0.4	0.5	0.9	1.9	1.2	0.2
	S.E. %		44	19	23	40	34	42	68
	total	000 ha	0.4	0.4	0.5	0.9	1.9	1.2	0.2
Sessile oak	FC	000 ha	0.2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.6
	PS		0.2	0.2	1.6	2.7	1.6	1.6	1.3
	S.E. %		67	26	28	27	30	31	36
	total	000 ha	0.4	0.2	1.6	2.7	1.6	1.6	1.9
Other oak	FC	000 ha	< 0.1	< 0.1	< 0.1	0.0	0.0	< 0.1	< 0.1
	PS		0.0	< 0.1	0.0	0.0	0.0	0.0	0.0
	S.E. %		-	51	-	-	-	-	-
	total	000 ha	< 0.1	< 0.1	< 0.1	0.0	0.0	< 0.1	< 0.1

Table 7 Stocked area of oak in Wales by age class

Species	Ownership		Age class (years)						
			0 to 10	11 to 20	21 to 40	41 to 60	61 to 80	81 to 100	100+
Native oak	NRW	000 ha	0.7	0.3	0.2	0.1	0.6	0.3	0.7
	PS		1.2	0.6	2.0	3.4	4.1	4.7	6.8
	S.E. %		38	21	22	20	22	19	15
	total	000 ha	1.9	0.9	2.3	3.5	4.7	5.0	7.6
Oak	NRW	000 ha	0.4	0.3	0.2	0.1	0.6	0.3	0.7
	PS		0.5	0.3	1.3	1.9	2.4	3.8	5.4
	S.E. %		39	25	25	22	29	22	17
	total	000 ha	0.9	0.6	1.5	2.0	3.0	4.1	6.2
Pedunculate oak	NRW	000 ha	< 0.1	< 0.1	< 0.1	0.0	< 0.1	< 0.1	0.0
	PS		< 0.1	0.1	0.3	0.3	0.1	0.6	< 0.1
	S.E. %		76	51	55	58	69	50	113
	total	000 ha	< 0.1	0.1	0.3	0.3	0.1	0.6	< 0.1
Sessile oak	NRW	000 ha	0.3	< 0.1	0.0	< 0.1	0.0	0.0	< 0.1
	PS		0.6	0.2	0.5	1.2	1.6	0.3	1.4
	S.E. %		63	43	56	43	35	53	36
	total	000 ha	0.9	0.2	0.5	1.2	1.6	0.3	1.4
Other oak	NRW	000 ha	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.0	< 0.1
	PS		0.0	0.0	< 0.1	0.0	0.0	0.0	0.0
	S.E. %		-	-	84	-	-	-	-
	total	000 ha	< 0.1	< 0.1	< 0.1	< 0.1	0.2	0.0	< 0.1

Tables showing the stocked area of oak by age class by region are available in the accompanying spreadsheet (worksheet StockedArea_AgeClass).

Standing volume

Standing volume of oak

Table 8 Standing volume of oak by country

	Species	FC/NRW	Private sector		Total
		000 m³ obs	SE %		
GB	Native oak	3,859	68,130	3	71,990
	Oak	3,619	34,359	4	37,978
	Pedunculate oak	12	26,908	5	26,921
	Sessile oak	228	6,863	11	7,091
	Other oaks	118	978	19	1,096
England	Native oak	2,727	54,382	4	57,108
	Oak	2,714	27,520	5	30,234
	Pedunculate oak	10	24,583	6	24,593
	Sessile oak	2	2,279	19	2,281
	Other oaks	58	977	19	1,035
Scotland	Native oak	673	5,824	11	6,497
	Oak	446	1,558	18	2,004
	Pedunculate oak	2	1,947	22	1,948
	Sessile oak	225	2,319	16	2,544
	Other oaks	7	< 1	51	7
Wales	Native oak	460	7,925	10	8,385
	Oak	459	5,281	12	5,740
	Pedunculate oak	< 1	379	33	379
	Sessile oak	< 1	2,266	20	2,266
	Other oaks	53	1	71	55

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Table 9 Standing volume of oak in England by region

	Species	FC	Private sector		Total
		000 m³ obs	SE %		
North West England	Native oak	121	3,779	12	3,899
	Oak	120	3,390	12	3,510
	Pedunculate oak	< 1	< 1	83	1
	Sessile oak	< 1	388	41	388
	Other oaks	< 1	31	64	32
North East England	Native oak	21	1,267	21	1,288
	Oak	21	764	24	785
	Pedunculate oak	0	91	48	91
	Sessile oak	0	411	47	411
	Other oaks	< 1	< 1	104	< 1
Yorkshire and the Humber	Native oak	70	2,940	12	3,010
	Oak	63	2,486	12	2,550
	Pedunculate oak	7	448	37	454
	Sessile oak	< 1	6	66	6
	Other oaks	5	36	64	41
East Midlands	Native oak	483	3,179	13	3,663
	Oak	483	1,119	23	1,602
	Pedunculate oak	< 1	2,057	16	2,058
	Sessile oak	0	3	75	3
	Other oaks	19	20	47	39
East England	Native oak	151	6,281	11	6,433
	Oak	151	1,708	20	1,859
	Pedunculate oak	< 1	4,565	13	4,565
	Sessile oak	0	9	75	9
	Other oaks	3	152	45	155
South East England	Native oak	1,072	17,393	6	18,465
	Oak	1,069	6,791	9	7,860
	Pedunculate oak	< 1	9,864	8	9,865
	Sessile oak	2	738	31	739
	Other oaks	4	333	36	337
South West England	Native oak	582	12,270	8	12,852
	Oak	580	8,477	9	9,057
	Pedunculate oak	1	3,754	15	3,755
	Sessile oak	< 1	40	63	40
	Other oaks	8	388	32	397
West Midlands	Native oak	228	7,272	13	7,500
	Oak	228	2,784	20	3,012
	Pedunculate oak	< 1	3,804	18	3,804
	Sessile oak	0	685	40	685
	Other oaks	15	17	67	31

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Table 10 Standing volume of oak in Scotland by region

	Species	FC	Private sector		Total
		000 m ³ obs		SE %	
North Scotland	Native oak	25	306	47	331
	Oak	25	279	51	304
	Pedunculate oak	< 1	0	-	< 1
	Sessile oak	< 1	27	59	27
	Other oaks	0	0	-	0
North East Scotland	Native oak	8	322	63	330
	Oak	8	67	63	75
	Pedunculate oak	< 1	173	104	173
	Sessile oak	< 1	83	104	83
	Other oaks	0	0	-	0
East Scotland	Native oak	21	719	31	740
	Oak	21	247	59	268
	Pedunculate oak	0	15	36	15
	Sessile oak	< 1	457	36	457
	Other oaks	< 1	0	-	< 1
South Scotland	Native oak	121	2,207	18	2,327
	Oak	120	821	21	941
	Pedunculate oak	< 1	1,077	30	1,078
	Sessile oak	< 1	309	46	309
	Other oaks	< 1	< 1	51	< 1
West Scotland	Native oak	499	2,269	16	2,768
	Oak	273	143	41	417
	Pedunculate oak	< 1	682	33	683
	Sessile oak	225	1,444	20	1,669
	Other oaks	6	0	-	6

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Standing volume of oak by size class

Table 11 Standing volume of oak in GB by size class

Species	Ownership		Mean stand diameter class (cm)								
			0–7 cm	7–10 cm	10–15 cm	15–20 cm	20–30 cm	30–40 cm	40–60 cm	60–80 cm	80+ cm
Native oak	FC/NRW	000 m ³	4	92	217	528	2,149	475	318	66	9
	PS		1,552	6,318	6,404	17,932	13,433	12,476	4,550	2,810	2,191
		S.E. %	10	7	8	6	7	10	15	17	18
	total	000 m ³	1,556	6,410	6,621	18,460	15,581	12,952	4,868	2,877	2,201
Oak	FC/NRW	000 m ³	4	91	211	466	1,978	475	318	66	9
	PS		848	3,575	3,530	9,228	7,189	5,604	2,415	1,218	584
		S.E. %	13	9	11	8	10	14	23	23	19
	total	000 m ³	852	3,666	3,740	9,694	9,167	6,079	2,733	1,285	593
Pedunculate oak	FC/NRW	000 m ³	< 1	< 1	2	7	3	< 1	< 1	< 1	< 1
	PS		646	2,501	2,481	7,725	4,964	5,948	948	591	854
		S.E. %	17	12	12	9	12	16	33	36	27
	total	000 m ³	645.7	2,501.4	2,482.5	7,732.4	4,967.4	5,947.9	947.8	591	854
Sessile oak	FC/NRW	000 m ³	< 1	1.1	4.5	54.7	167.3	< 1	0.0	0	0
	PS		58.5	242.1	393.9	978.6	1,279.5	924.8	1,187.2	1,001	754
		S.E. %	46	44	31	29	26	29	22	31	39
	total	000 m ³	58.5	243.2	398.3	1,033.3	1,446.8	925.2	1,187.2	1,001	754
Other oak	FC/NRW	000 m ³	< 1	< 1	5.8	20.4	49.2	37.0	4.5	< 1	< 1
	PS		66.4	112.2	249.2	195.7	100.6	203.1	0.0	4	9
		S.E. %	34	32	39	40	53	52	-	42	35
	total	000 m ³	66.4	113.1	255.0	216.1	149.8	240.1	4.5	5	9

Table 12 Standing volume of oak in England by size class

Species	Ownership		Mean stand diameter class (cm)								
			0–7 cm	7–10 cm	10–15 cm	15–20 cm	20–30 cm	30–40 cm	40–60 cm	60–80 cm	80+ cm
Native oak	FC	000 m ³	3	72	177	322	1,397	415	269	63	9
	PS		1,495	6,209	6,222	17,097	11,545	10,390	0	237	722
		S.E. %	11	7	8	6	8	11	-	9	9
	total	000 m ³	1,498	6,281	6,400	17,419	12,942	10,805	269	299	731
Oak	FC	000 m ³	3	72	176	315	1,393	415	269	63	9
	PS		812	3,521	3,455	8,634	6,204	4,255	0	123	347
		S.E. %	14	9	11	8	11	17	-	13	13
	total	000 m ³	814	3,592	3,631	8,949	7,596	4,670	269	186	356
Pedunculate oak	FC	000 m ³	< 1	< 1	< 1	7	2	0	< 1	< 1	< 1
	PS		629	2,479	2,469	7,621	4,825	5,834	0	111	365
		S.E. %	17	12	12	9	12	16	-	14	13
	total	000 m ³	629	2,479	2,470	7,628	4,827	5,834	< 1	111	365
Sessile oak	FC	000 m ³	< 1	0	< 1	0	2	< 1	0	0	0
	PS		54	210	299	842	516	300	0	3	11
		S.E. %	50	50	40	33	46	56	-	62	29
	total	000 m ³	54	210	299	842	518	301	0	3	11
Other oak	FC	000 m ³	0	< 1	3	8	16	28	2	< 1	< 1
	PS		66	112	249	195	100	203	0	4	9
		S.E. %	34	32	39	40	54	52	-	42	35
	total	000 m ³	66	113	252	202	117	231	2	5	9

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Table 13 Standing volume of oak in Scotland by size class

Species	Ownership		Mean stand diameter class (cm)								
			0–7 cm	7–10 cm	10–15 cm	15–20 cm	20–30 cm	30–40 cm	40–60 cm	60–80 cm	80+ cm
Native oak	FC		< 1	11	17	93	528	9	13	< 1	0
		000 m ³	50	55	106	322	570	632	2,085	951	1,053
	PS	S.E. %	17	35	25	28	24	27	19	30	30
	total	000 m ³	51	66	123	415	1,099	642	2,098	951	1,053
Oak	FC		< 1	10	12	38	363	9	13	< 1	0
		000 m ³	33	14	28	174	132	359	471	180	168
	PS	S.E. %	23	26	44	45	32	42	36	46	56
	total	000 m ³	33	24	40	211	495	369	484	180	168
Pedunculate oak	FC		< 1	< 1	< 1	< 1	< 1	< 1	0	0	0
		000 m ³	14	17	10	87	115	81	833	359	431
	PS	S.E. %	29	38	32	44	34	51	36	55	49
	total	000 m ³	14	17	11	87	116	81	833	359	431
Sessile oak	FC		< 1	1	4	55	165	0	0	0	0
		000 m ³	3	25	68	62	323	192	781	412	454
	PS	S.E. %	39	73	34	47	39	38	24	47	47
	total	000 m ³	3	26	72	117	488	192	781	412	454
Other oak	FC		< 1	< 1	0	< 1	7	0	0	0	0
		000 m ³	< 1	0	0	0	0	0	0	0	0
	PS	S.E. %	51	-	-	-	-	-	-	-	-
	total	000 m ³	< 1	< 1	0	< 1	7	0	0	0	0

Table 14 Standing volume of oak in Wales by size class

Species	Ownership		Mean stand diameter class (cm)								
			0–7 cm	7–10 cm	10–15 cm	15–20 cm	20–30 cm	30–40 cm	40–60 cm	60–80 cm	80+ cm
Native oak	NRW		1	9	23	114	223	51	36	3	< 1
		000 m ³	7	53	76	512	1,317	1,454	2,465	1,623	417
	PS	S.E. %	27	26	26	34	20	21	23	23	52
	total	000 m ³	8	63	98	626	1,540	1,505	2,501	1,627	417
Oak	NRW		1	9	22	114	223	51	36	3	< 1
		000 m ³	3	41	47	420	853	989	1,944	915	69
	PS	S.E. %	30	33	30	39	22	23	27	30	61
	total	000 m ³	5	50	69	534	1,075	1,040	1,980	918	70
Pedunculate oak	NRW		< 1	< 1	< 1	< 1	< 1	0	< 1	< 1	0
		000 m ³	3	6	2	18	24	32	115	122	58
	PS	S.E. %	61	49	89	79	62	90	52	67	113
	total	000 m ³	3	6	2	18	24	32	115	122	58
Sessile oak	NRW		0	0	< 1	0	< 1	0	0	0	0
		000 m ³	1	7	27	75	441	433	406	586	289
	PS	S.E. %	37	45	50	87	43	45	43	41	70
	total	000 m ³	1	7	27	75	441	433	406	586	289
Other oak	NRW		< 1	< 1	3	13	26	9	2	0	0
		000 m ³	0	< 1	0	1	< 1	0	0	0	0
	PS	S.E. %	-	113	-	95	103	-	-	-	-
	total	000 m ³	< 1	< 1	3	14	27	9	2	0	0

Tables showing the standing volume of oak by size class by region are available in the accompanying spreadsheet (worksheet StandingVolume_SizeClass).

Number of trees

Number of measureable trees

Table 15 Number of measurable oak trees by country

	Species	FC/NRW	Private sector		Total
		000 trees	SE %		
GB	Native oak	22,751	146,924	3	169,676
	Oak	21,478	77,087	4	98,565
	Pedunculate oak	141	57,180	5	57,321
	Sessile oak	1,132	12,658	12	13,790
	Other oaks	491	2,765	16	3,256
England	Native oak	16,095	112,582	4	128,677
	Oak	15,926	56,935	5	72,860
	Pedunculate oak	109	52,100	6	52,210
	Sessile oak	60	3,547	21	3,607
	Other oaks	223	2,739	16	2,962
Scotland	Native oak	3,787	18,945	10	22,732
	Oak	2,696	9,355	14	12,051
	Pedunculate oak	26	4,039	16	4,065
	Sessile oak	1,065	5,551	20	6,617
	Other oaks	41	7	51	48
Wales	Native oak	2,870	15,397	10	18,267
	Oak	2,857	10,797	11	13,654
	Pedunculate oak	6	1,041	37	1,047
	Sessile oak	7	3,559	24	3,566
	Other oaks	227	19	74	246

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Table 16 Number of measurable oak trees in England by region

	Species	FC	Private sector		Total
		000 trees	SE %		
North West England	Native oak	833	9,561	11	10,394
	Oak	811	9,187	11	9,998
	Pedunculate oak	16	< 1	83	16
	Sessile oak	5	374	40	379
	Other oaks	3	33	64	36
North East England	Native oak	138	4,504	21	4,642
	Oak	138	2,766	25	2,903
	Pedunculate oak	0	1,413	43	1,413
	Sessile oak	0	326	37	326
	Other oaks	< 1	143	104	144
Yorkshire and the Humber	Native oak	437	10,378	10	10,816
	Oak	395	8,777	10	9,173
	Pedunculate oak	41	1,577	23	1,618
	Sessile oak	< 1	24	63	25
	Other oaks	15	55	56	70
East Midlands	Native oak	3,603	12,896	11	16,498
	Oak	3,560	4,769	20	8,329
	Pedunculate oak	43	8,072	13	8,114
	Sessile oak	0	55	64	55
	Other oaks	58	160	43	217
East England	Native oak	816	14,096	10	14,912
	Oak	812	3,099	16	3,911
	Pedunculate oak	4	10,767	12	10,771
	Sessile oak	0	230	68	230
	Other oaks	10	595	38	605
South East England	Native oak	5,698	30,612	7	36,309
	Oak	5,688	11,566	11	17,255
	Pedunculate oak	5	18,113	10	18,117
	Sessile oak	5	933	28	937
	Other oaks	28	945	26	974
South West England	Native oak	3,617	18,882	8	22,499
	Oak	3,557	12,137	9	15,694
	Pedunculate oak	6	6,430	15	6,436
	Sessile oak	54	315	56	369
	Other oaks	24	690	33	713
West Midlands	Native oak	1,087	11,654	12	12,741
	Oak	1,086	4,633	19	5,720
	Pedunculate oak	< 1	5,729	16	5,729
	Sessile oak	0	1,292	47	1,292
	Other oaks	45	117	50	163

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Table 17 Number of measurable oak trees in Scotland by region

	Species	FC	Private sector		Total
		000 trees		SE %	
North Scotland	Native oak	125	880	43	1,005
	Oak	124	497	47	621
	Pedunculate oak	< 1	0	-	< 1
	Sessile oak	< 1	383	77	384
	Other oaks	0	0	-	0
North East Scotland	Native oak	156	560	45	716
	Oak	148	401	56	549
	Pedunculate oak	6	140	76	145
	Sessile oak	2	20	104	21
	Other oaks	0	0	-	0
East Scotland	Native oak	212	2,365	20	2,576
	Oak	209	670	41	880
	Pedunculate oak	0	770	37	770
	Sessile oak	2	925	27	927
	Other oaks	19	0	-	19
South Scotland	Native oak	833	10,897	13	11,730
	Oak	811	7,573	17	8,385
	Pedunculate oak	16	2,482	21	2,498
	Sessile oak	5	842	32	847
	Other oaks	3	7	51	10
West Scotland	Native oak	2,462	4,244	24	6,705
	Oak	1,402	214	41	1,616
	Pedunculate oak	4	647	30	651
	Sessile oak	1,055	3,382	29	4,438
	Other oaks	19	0	-	19

Number of seedlings and saplings

Table 18 Average number of oak seedlings and saplings per hectare

Species	Average in sections of broadleaved woodland	Average in sections where seedlings and saplings of species is present
Oak	67	3,246

Biomass stocks in live woodland trees

Above and below ground biomass stocks

Table 19 Above and below ground biomass stocks in oak by country

	Species	FC/NRW	Private sector		Total
		000 odt	SE %		
GB	Native oak	3,633	57,690	3	61,324
	Oak	3,417	29,351	4	32,767
	Pedunculate oak	12	22,448	5	22,459
	Sessile oak	205	5,892	10	6,097
	Other oaks	108	850	19	957
England	Native oak	2,603	45,730	3	48,334
	Oak	2,592	23,342	5	25,934
	Pedunculate oak	10	20,434	5	20,444
	Sessile oak	2	1,953	19	1,956
	Other oaks	54	848	19	902
Scotland	Native oak	611	5,118	10	5,729
	Oak	407	1,390	17	1,798
	Pedunculate oak	2	1,683	21	1,685
	Sessile oak	202	2,044	16	2,247
	Other oaks	6	< 1	51	6
Wales	Native oak	418	6,842	10	7,261
	Oak	418	4,618	12	5,035
	Pedunculate oak	< 1	330	32	331
	Sessile oak	< 1	1,894	20	1,895
	Other oaks	48	2	74	49

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Table 20 Above and below ground biomass stocks in oak in England by region

	Species	FC	Private sector		Total
		000 odt		SE %	
North West England	Native oak	112	3,293	11	3,406
	Oak	111	2,951	12	3,062
	Pedunculate oak	< 1	< 1	83	1
	Sessile oak	< 1	342	41	342
	Other oaks	< 1	29	64	29
North East England	Native oak	19	1,175	21	1,195
	Oak	19	697	23	716
	Pedunculate oak	0	93	45	93
	Sessile oak	0	385	47	385
	Other oaks	< 1	1	104	2
Yorkshire and the Humber	Native oak	65	2,590	11	2,655
	Oak	59	2,180	12	2,239
	Pedunculate oak	6	403	36	409
	Sessile oak	< 1	7	65	7
	Other oaks	5	32	65	36
East Midlands	Native oak	453	2,681	13	3,135
	Oak	453	955	22	1,408
	Pedunculate oak	< 1	1,723	15	1,724
	Sessile oak	0	3	65	3
	Other oaks	17	18	46	35
East England	Native oak	142	5,316	10	5,458
	Oak	141	1,485	20	1,626
	Pedunculate oak	< 1	3,821	12	3,822
	Sessile oak	0	10	73	10
	Other oaks	3	137	44	140
South East England	Native oak	1,075	14,484	5	15,559
	Oak	1,073	5,703	8	6,776
	Pedunculate oak	1	8,174	7	8,175
	Sessile oak	2	607	30	608
	Other oaks	4	292	35	296
South West England	Native oak	536	10,341	7	10,877
	Oak	535	7,171	9	7,706
	Pedunculate oak	1	3,131	14	3,132
	Sessile oak	< 1	38	60	38
	Other oaks	8	325	31	332
West Midlands	Native oak	205	5,849	12	6,054
	Oak	205	2,199	19	2,404
	Pedunculate oak	< 1	3,088	17	3,088
	Sessile oak	0	562	40	562
	Other oaks	14	15	65	29

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Table 21 Above and below ground biomass stocks in oak in Scotland by region

	Species	FC	Private sector		Total
		000 odt		SE %	
North Scotland	Native oak	22	291	47	313
	Oak	22	264	52	286
	Pedunculate oak	< 1	0	-	< 1
	Sessile oak	< 1	27	59	27
	Other oaks	0	0	-	0
North East Scotland	Native oak	8	280	61	288
	Oak	8	67	62	75
	Pedunculate oak	< 1	145	103	145
	Sessile oak	< 1	67	104	68
	Other oaks	0	0	-	0
East Scotland	Native oak	20	611	29	631
	Oak	20	200	56	220
	Pedunculate oak	0	19	35	19
	Sessile oak	< 1	391	35	391
	Other oaks	< 1	0	-	< 1
South Scotland	Native oak	112	1,907	17	2,019
	Oak	111	731	20	843
	Pedunculate oak	< 1	911	29	912
	Sessile oak	< 1	264	42	264
	Other oaks	< 1	< 1	51	< 1
West Scotland	Native oak	449	2,030	16	2,479
	Oak	247	128	40	374
	Pedunculate oak	< 1	608	32	608
	Sessile oak	202	1,294	20	1,496
	Other oaks	6	0	-	6

Above ground biomass stocks

Table 22 Above ground biomass stocks in oak by country

	Species	FC/NRW	Private sector		Total
		000 odt		SE %	
GB	Native oak	2,827	47,677	3	50,504
	Oak	2,656	24,123	4	26,779
	Pedunculate oak	9	18,727	5	18,736
	Sessile oak	162	4,826	11	4,988
	Other oaks	85	694	19	779
England	Native oak	2,013	37,930	3	39,943
	Oak	2,003	19,260	5	21,263
	Pedunculate oak	7	17,067	5	17,075
	Sessile oak	2	1,603	19	1,605
	Other oaks	42	693	19	735
Scotland	Native oak	483	4,176	11	4,659
	Oak	321	1,131	17	1,452
	Pedunculate oak	1	1,389	22	1,391
	Sessile oak	160	1,656	16	1,816
	Other oaks	5	< 1	51	5
Wales	Native oak	332	5,570	10	5,902
	Oak	331	3,733	12	4,064
	Pedunculate oak	< 1	271	33	271
	Sessile oak	< 1	1,567	20	1,567
	Other oaks	38	1	72	39

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Table 23 Above ground biomass stocks in oak in England by region

	Species	FC	Private sector		Total
		000 odt		SE %	
North West England	Native oak	88	2,677	11	2,765
	Oak	87	2,400	12	2,487
	Pedunculate oak	< 1	< 1	83	< 1
	Sessile oak	< 1	277	41	277
	Other oaks	< 1	23	64	23
North East England	Native oak	15	939	21	954
	Oak	15	560	23	575
	Pedunculate oak	0	73	44	73
	Sessile oak	0	306	48	306
	Other oaks	< 1	1	104	1
Yorkshire and the Humber	Native oak	51	2,111	12	2,162
	Oak	46	1,780	12	1,826
	Pedunculate oak	5	326	36	331
	Sessile oak	< 1	5	64	5
	Other oaks	4	26	64	29
East Midlands	Native oak	355	2,226	13	2,581
	Oak	355	791	22	1,146
	Pedunculate oak	< 1	1,433	16	1,433
	Sessile oak	0	3	64	3
	Other oaks	13	14	46	28
East England	Native oak	110	4,399	11	4,509
	Oak	110	1,207	20	1,316
	Pedunculate oak	< 1	3,185	12	3,185
	Sessile oak	0	8	73	8
	Other oaks	2	114	44	116
South East England	Native oak	808	12,053	6	12,860
	Oak	806	4,718	8	5,524
	Pedunculate oak	< 1	6,825	8	6,826
	Sessile oak	1	509	31	511
	Other oaks	3	234	35	237
South West England	Native oak	424	8,576	8	9,000
	Oak	423	5,931	9	6,354
	Pedunculate oak	< 1	2,615	15	2,616
	Sessile oak	< 1	30	60	30
	Other oaks	6	269	31	275
West Midlands	Native oak	163	4,950	12	5,114
	Oak	163	1,874	19	2,038
	Pedunculate oak	< 1	2,610	17	2,610
	Sessile oak	0	466	40	466
	Other oaks	11	12	65	23

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Table 24 Above ground biomass stocks in oak in Scotland by region

	Species	FC	Private sector		Total
		000 odt		SE %	
North Scotland	Native oak	18	225	47	243
	Oak	18	204	51	221
	Pedunculate oak	< 1	0	-	< 1
	Sessile oak	< 1	21	59	21
	Other oaks	0	0	-	0
North East Scotland	Native oak	6	229	62	235
	Oak	6	52	62	58
	Pedunculate oak	< 1	119	103	120
	Sessile oak	< 1	57	104	57
	Other oaks	0	0	-	0
East Scotland	Native oak	16	505	29	521
	Oak	15	169	57	184
	Pedunculate oak	0	16	36	16
	Sessile oak	< 1	321	35	321
	Other oaks	< 1	0	-	< 1
South Scotland	Native oak	88	1,585	17	1,673
	Oak	87	604	20	692
	Pedunculate oak	< 1	763	29	764
	Sessile oak	< 1	218	44	218
	Other oaks	< 1	< 1	51	< 1
West Scotland	Native oak	355	1,631	16	1,986
	Oak	195	102	41	297
	Pedunculate oak	< 1	491	32	491
	Sessile oak	160	1,039	20	1,199
	Other oaks	4	0	-	4

Below ground biomass stocks

Table 25 Below ground biomass stocks in oak by country

	Species	FC/NRW	Private sector		Total
		000 odt		SE %	
GB	Native oak	806	10,014	3	10,820
	Oak	761	5,227	4	5,988
	Pedunculate oak	2	3,720	5	3,723
	Sessile oak	43	1,066	10	1,109
	Other oaks	22	156	18	178
England	Native oak	591	7,800	3	8,391
	Oak	588	4,083	4	4,671
	Pedunculate oak	2	3,367	5	3,369
	Sessile oak	< 1	350	18	351
	Other oaks	12	155	18	167
Scotland	Native oak	129	942	10	1,070
	Oak	86	260	18	346
	Pedunculate oak	< 1	294	21	294
	Sessile oak	42	388	15	430
	Other oaks	1	< 1	51	1
Wales	Native oak	87	1,272	9	1,359
	Oak	86	885	11	971
	Pedunculate oak	< 1	59	31	60
	Sessile oak	< 1	328	19	328
	Other oaks	10	< 1	78	10

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Table 26 Below ground biomass stocks in oak in England by region

	Species	FC	Private sector		Total
		000 odt	SE %		
North West England	Native oak	24	617	10	641
	Oak	24	551	11	575
	Pedunculate oak	< 1	< 1	83	< 1
	Sessile oak	< 1	65	40	65
	Other oaks	< 1	6	63	6
North East England	Native oak	4	237	21	241
	Oak	4	138	24	142
	Pedunculate oak	0	20	48	20
	Sessile oak	0	79	44	79
	Other oaks	< 1	< 1	104	< 1
Yorkshire and the Humber	Native oak	14	479	11	493
	Oak	13	400	11	413
	Pedunculate oak	1	77	34	78
	Sessile oak	< 1	2	65	2
	Other oaks	1	6	67	7
East Midlands	Native oak	98	455	12	553
	Oak	98	164	21	262
	Pedunculate oak	< 1	290	14	290
	Sessile oak	0	< 1	72	< 1
	Other oaks	4	3	46	7
East England	Native oak	31	918	10	949
	Oak	31	279	20	310
	Pedunculate oak	< 1	637	11	637
	Sessile oak	0	2	73	2
	Other oaks	< 1	24	42	24
South East England	Native oak	267	2,431	5	2,699
	Oak	267	985	8	1,251
	Pedunculate oak	< 1	1,349	7	1,349
	Sessile oak	< 1	97	28	98
	Other oaks	< 1	58	33	59
South West England	Native oak	112	1,764	7	1,876
	Oak	112	1,240	8	1,352
	Pedunculate oak	< 1	516	13	516
	Sessile oak	< 1	8	60	8
	Other oaks	2	56	29	57
West Midlands	Native oak	41	899	11	940
	Oak	41	325	16	367
	Pedunculate oak	< 1	478	16	478
	Sessile oak	0	95	39	95
	Other oaks	3	3	64	6

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Table 27 Below ground biomass stocks in oak in Scotland by region

	Species	FC	Private sector		Total
		000 odt		SE %	
North Scotland	Native oak	5	66	49	70
	Oak	5	60	54	65
	Pedunculate oak	< 1	0	-	< 1
	Sessile oak	< 1	6	60	6
	Other oaks	0	0	-	0
North East Scotland	Native oak	2	51	59	52
	Oak	2	15	60	17
	Pedunculate oak	< 1	26	103	26
	Sessile oak	< 1	10	104	10
	Other oaks	0	0	-	0
East Scotland	Native oak	4	105	28	110
	Oak	4	31	51	36
	Pedunculate oak	0	3	32	3
	Sessile oak	< 1	71	35	71
	Other oaks	< 1	0	-	< 1
South Scotland	Native oak	24	321	16	345
	Oak	24	127	19	151
	Pedunculate oak	< 1	148	28	148
	Sessile oak	< 1	46	36	46
	Other oaks	< 1	< 1	51	< 1
West Scotland	Native oak	94	399	16	493
	Oak	52	26	41	78
	Pedunculate oak	< 1	117	32	117
	Sessile oak	42	255	19	298
	Other oaks	1	0	-	1

Carbon stocks in live woodland trees

Above and below ground carbon stocks by species

Table 28 Above and below ground carbon stocks in oak by country

	Species	FC/NRW	Private sector		Total
		000 t		SE %	
GB	Native oak	1,817	28,845	3	30,662
	Oak	1,708	14,675	4	16,384
	Pedunculate oak	6	11,224	5	11,230
	Sessile oak	103	2,946	10	3,049
	Other oaks	54	425	19	479
England	Native oak	1,302	22,865	3	24,167
	Oak	1,296	11,671	5	12,967
	Pedunculate oak	5	10,217	5	10,222
	Sessile oak	1	977	19	978
	Other oaks	27	424	19	451
Scotland	Native oak	306	2,559	10	2,865
	Oak	204	695	17	899
	Pedunculate oak	< 1	842	21	842
	Sessile oak	101	1,022	16	1,123
	Other oaks	3	< 1	51	3
Wales	Native oak	209	3,421	10	3,630
	Oak	209	2,309	12	2,518
	Pedunculate oak	< 1	165	32	165
	Sessile oak	< 1	947	20	947
	Other oaks	24	< 1	74	25

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Table 29 Above and below ground carbon stocks in oak in England by region

	Species	FC	Private sector		Total
		000 t		SE %	
North West England	Native oak	56	1,647	11	1,703
	Oak	56	1,476	12	1,531
	Pedunculate oak	< 1	< 1	83	< 1
	Sessile oak	< 1	171	41	171
	Other oaks	< 1	14	64	15
North East England	Native oak	10	588	21	597
	Oak	10	349	23	358
	Pedunculate oak	0	47	45	47
	Sessile oak	0	193	47	193
	Other oaks	< 1	< 1	104	< 1
Yorkshire and the Humber	Native oak	33	1,295	11	1,328
	Oak	29	1,090	12	1,119
	Pedunculate oak	3	202	36	205
	Sessile oak	< 1	3	65	4
	Other oaks	2	16	65	18
East Midlands	Native oak	227	1,341	13	1,567
	Oak	226	478	22	704
	Pedunculate oak	< 1	862	15	862
	Sessile oak	0	2	65	2
	Other oaks	9	9	46	17
East England	Native oak	71	2,658	10	2,729
	Oak	71	743	20	813
	Pedunculate oak	< 1	1,911	12	1,911
	Sessile oak	0	5	73	5
	Other oaks	1	69	44	70
South East England	Native oak	538	7,242	5	7,780
	Oak	536	2,852	8	3,388
	Pedunculate oak	< 1	4,087	7	4,088
	Sessile oak	< 1	303	30	304
	Other oaks	2	146	35	148
South West England	Native oak	268	5,170	7	5,438
	Oak	267	3,586	9	3,853
	Pedunculate oak	< 1	1,566	14	1,566
	Sessile oak	< 1	19	60	19
	Other oaks	4	162	31	166
West Midlands	Native oak	102	2,925	12	3,027
	Oak	102	1,100	19	1,202
	Pedunculate oak	< 1	1,544	17	1,544
	Sessile oak	0	281	40	281
	Other oaks	7	8	65	14

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Table 30 Above and below ground carbon stocks in oak in Scotland by region

	Species	FC	Private sector		Total
		000 t		SE %	
North Scotland	Native oak	11	145	47	156
	Oak	11	132	52	143
	Pedunculate oak	< 1	0	-	< 1
	Sessile oak	< 1	14	59	14
	Other oaks	0	0	-	0
North East Scotland	Native oak	4	140	61	144
	Oak	4	34	62	38
	Pedunculate oak	< 1	73	103	73
	Sessile oak	< 1	34	104	34
	Other oaks	0	0	-	0
East Scotland	Native oak	10	305	29	315
	Oak	10	100	56	110
	Pedunculate oak	0	10	35	10
	Sessile oak	< 1	196	35	196
	Other oaks	< 1	0	-	< 1
South Scotland	Native oak	56	953	17	1,009
	Oak	56	366	20	421
	Pedunculate oak	< 1	455	29	456
	Sessile oak	< 1	132	42	132
	Other oaks	< 1	< 1	51	< 1
West Scotland	Native oak	225	1,015	16	1,239
	Oak	123	64	40	187
	Pedunculate oak	< 1	304	32	304
	Sessile oak	101	647	20	748
	Other oaks	3	0	-	3

Mortality in oak

Table 31 Percentage mortality by proportion of basal area for native oak species and all broadleaves

	Age class	All ages	15–25	26–59	51–75	76–100	> 100
	Planting year range		1991–2001	1966–1990	1941–1965	1916–1940	pre 1916
North West England	Native oak	1.8	6.7	5.0	3.0	0.7	0.3
	All broadleaves	2.3	3.0	2.6	3.4	1.1	0.9
North East England	Native oak	1.7	0.7	6.1	1.5	1.1	0.1
	All broadleaves	3.5	3.8	3.9	2.0	5.1	0.6
Yorkshire and the Humber	Native oak	2.0	2.6	3.7	2.5	1.6	0.2
	All broadleaves	2.6	3.8	3.9	2.4	1.1	1.0
East Midlands	Native oak	1.5	3.0	2.5	1.4	0.3	2.2
	All broadleaves	3.0	3.6	3.5	2.9	1.6	4.3
East England	Native oak	6.5	1.3	2.0	4.1	5.1	13.2
	All broadleaves	5.4	6.7	5.1	4.8	3.8	10.8
South East England	Native oak	2.8	8.2	4.2	4.4	2.1	1.5
	All broadleaves	3.9	7.5	5.4	3.8	2.2	2.3
South West England	Native oak	4.0	3.7	6.9	5.9	3.1	2.8
	All broadleaves	3.7	5.5	4.5	3.6	2.7	2.6
West Midlands	Native oak	3.9	6.9	3.4	0.9	7.1	0.6
	All broadleaves	3.6	7.0	3.8	2.0	5.0	1.5
North Scotland	Native oak	2.0	-	2.5	-	-	3.3
	All broadleaves	5.9	7.2	6.9	5.6	2.6	3.5
North East Scotland	Native oak	5.9	9.4	-	3.5	-	n/a
	All broadleaves	9.2	5.5	15.9	3.1	1.5	1.4
East Scotland	Native oak	3.2	0.1	6.4	1.1	9.4	1.0
	All broadleaves	3.9	3.3	5.7	1.6	3.0	3.6
South Scotland	Native oak	2.7	0.5	6.3	4.4	0.9	0.5
	All broadleaves	3.1	4.1	4.1	2.2	1.5	0.9
West Scotland	Native oak	5.8	6.0	12.8	4.4	3.4	6.9
	All broadleaves	6.0	6.7	7.6	4.0	3.4	5.3
Wales	Native oak	3.7	13.8	5.2	3.5	1.8	2.7
	All broadleaves	3.9	6.0	4.5	3.5	2.1	2.7

Note: insufficient samples in Native oak older than 100 years in North East Scotland.

Increment in oak

Volume increment

Table 32 Volume increment in oak in GB; average annual volume within period

	Native oak			Other oak		
	FC	Private sector		FC	Private sector	
	volume (000 m ³ obs)		SE%	volume (000 m ³ obs)		SE%
2017–2021	44	1,007	3	3	17	17
2022–2026	45	1,016	3	3	17	17
2027–2031	51	992	3	3	17	17
2032–2036	58	961	3	3	16	16
2037–2041	63	937	3	3	16	16
2042–2046	72	919	3	3	16	17
2047–2051	79	899	3	3	15	17
2052–2056	86	872	3	3	14	17
2057–2061	93	851	3	3	14	17
2062–2066	98	830	3	3	14	18

Table 33 Volume increment in native oaks in GB; average annual volume within period

	Oak			Pedunculate oak			Sessile oak		
	FC	Private sector		FC	Private sector		FC	Private sector	
	volume (000 m³ obs)		SE%	volume (000 m³ obs)		SE%	volume (000 m³ obs)		SE%
2017–2021	55	484	4	< 1	408	4	1	116	11
2022–2026	56	492	4	< 1	410	4	1	115	11
2027–2031	60	485	4	< 1	397	4	2	110	11
2032–2036	67	476	4	< 1	379	4	3	105	11
2037–2041	72	469	3	< 1	367	4	3	101	11
2042–2046	82	466	3	< 1	356	4	3	97	10
2047–2051	89	465	3	< 1	342	4	4	92	11
2052–2056	96	460	3	< 1	323	4	4	89	11
2057–2061	104	457	3	< 1	308	4	4	85	11
2062–2066	111	454	3	< 1	295	4	3	80	11

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Table 34 Volume increment in oak in England; average annual volume within period

	Native oak			Other oak		
	FC	Private sector		FC	Private sector	
	volume (000 m ³ obs)		SE%	volume (000 m ³ obs)		SE%
2017–2021	31	795	3	2	17	17
2022–2026	31	789	3	2	17	17
2027–2031	32	765	3	2	17	17
2032–2036	33	733	3	2	16	16
2037–2041	35	710	3	1	16	16
2042–2046	38	693	3	1	16	17
2047–2051	39	674	3	1	15	17
2052–2056	41	649	3	1	14	17
2057–2061	44	631	3	1	14	17
2062–2066	46	616	3	2	13	18

Table 35 Volume increment in native oaks in England; average annual volume within period

	Oak			Pedunculate oak			Sessile oak		
	FC	Private sector		FC	Private sector		FC	Private sector	
	volume (000 m ³ obs)		SE%	volume (000 m ³ obs)		SE%	volume (000 m ³ obs)		SE%
2017–2021	43	380	4	< 1	379	4	< 1	36	20
2022–2026	43	380	4	< 1	375	4	< 1	34	20
2027–2031	44	370	4	< 1	361	4	< 1	33	20
2032–2036	45	358	4	< 1	344	4	< 1	31	20
2037–2041	47	348	4	< 1	333	4	< 1	30	20
2042–2046	50	342	4	< 1	324	4	< 1	28	18
2047–2051	53	336	4	< 1	311	4	< 1	27	19
2052–2056	55	327	4	< 1	294	4	< 1	27	20
2057–2061	59	322	4	< 1	282	4	< 1	28	21
2062–2066	62	318	4	< 1	271	4	< 1	27	21

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Table 36 Volume increment in oak in Scotland; average annual volume within period

	Native oak			Other oak		
	FC	Private sector		FC	Private sector	
	volume (000 m ³ obs)		SE%	volume (000 m ³ obs)		SE%
2017–2021	5	99	10	< 1	< 1	51
2022–2026	5	112	9	< 1	< 1	51
2027–2031	8	115	8	< 1	< 1	51
2032–2036	12	119	8	< 1	< 1	51
2037–2041	16	123	8	< 1	< 1	51
2042–2046	20	127	7	< 1	< 1	51
2047–2051	24	129	7	< 1	< 1	51
2052–2056	27	132	6	< 1	< 1	51
2057–2061	30	133	6	< 1	< 1	51
2062–2066	33	134	6	< 1	< 1	51

Table 37 Volume increment in native oaks in Scotland; average annual volume within period

	Oak			Pedunculate oak			Sessile oak		
	FC	Private sector		FC	Private sector		FC	Private sector	
	volume (000 m ³ obs)		SE%	volume (000 m ³ obs)		SE%	volume (000 m ³ obs)		SE%
2017–2021	4	35	15	< 1	22	24	1	43	16
2022–2026	4	42	13	< 1	26	18	1	44	15
2027–2031	7	47	12	< 1	27	17	1	42	15
2032–2036	11	52	11	< 1	26	17	2	40	15
2037–2041	14	59	11	< 1	26	16	2	39	15
2042–2046	18	65	10	< 1	25	16	2	37	14
2047–2051	22	71	9	< 1	23	16	2	35	14
2052–2056	26	77	8	< 1	21	17	2	33	14
2057–2061	29	82	7	< 1	20	17	2	31	14
2062–2066	32	86	6	< 1	19	16	1	29	14

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Table 38 Volume increment in oak in Wales; average annual volume within period

	Native oak			Other oak		
	FC	Private sector		FC	Private sector	
	volume (000 m ³ obs)		SE%	volume (000 m ³ obs)		SE%
2017–2021	7	113	11	1	< 1	89
2022–2026	8	115	10	1	< 1	83
2027–2031	10	112	10	1	< 1	82
2032–2036	12	109	10	1	< 1	82
2037–2041	13	103	10	1	< 1	82
2042–2046	14	99	10	1	< 1	82
2047–2051	16	95	10	1	< 1	83
2052–2056	17	91	10	1	< 1	82
2057–2061	18	86	9	1	< 1	81
2062–2066	19	81	9	1	< 1	82

Table 39 Volume increment in native oaks in Wales; average annual volume within period

	Oak			Pedunculate oak			Sessile oak		
	FC	Private sector		FC	Private sector		FC	Private sector	
	volume (000 m ³ obs)		SE%	volume (000 m ³ obs)		SE%	volume (000 m ³ obs)		SE%
2017–2021	7	69	11	< 1	7	37	< 1	36	24
2022–2026	8	70	11	< 1	8	30	< 1	37	22
2027–2031	9	68	11	< 1	9	29	< 1	35	21
2032–2036	11	66	11	< 1	9	29	1	34	21
2037–2041	12	62	11	< 1	8	29	1	33	21
2042–2046	13	59	11	< 1	8	29	1	32	21
2047–2051	14	58	11	< 1	8	29	1	30	21
2052–2056	16	56	10	< 1	7	29	1	28	21
2057–2061	17	53	10	< 1	7	29	1	27	22
2062–2066	17	50	10	< 1	6	29	1	25	22

Tables showing the volume increment in oak by region are available in the accompanying spreadsheet (worksheet VolumeIncrement_Tables).

Carbon increment

Table 40 Volume increment in oak in GB; average annual carbon within period

	Native oak			Other oak		
	FC	Private sector		FC	Private sector	
	carbon (000 t)		SE%	carbon (000 t)		SE%
2017–2021	27	424	3	1	7	17
2022–2026	28	417	3	1	7	17
2027–2031	34	396	3	1	7	17
2032–2036	39	382	3	1	6	16
2037–2041	38	372	3	1	6	17
2042–2046	45	370	3	1	6	17
2047–2051	46	362	3	1	6	17
2052–2056	48	343	3	1	6	17
2057–2061	51	336	3	1	5	17
2062–2066	54	326	3	1	5	18

Table 41 Carbon increment in native oaks in GB; average annual carbon within period

	Oak			Pedunculate oak			Sessile oak		
	FC	Private sector		FC	Private sector		FC	Private sector	
	carbon (000 t)		SE%	carbon (000 t)		SE%	carbon (000 t)		SE%
2017–2021	26	209	4	< 1	168	4	< 1	47	11
2022–2026	27	206	4	< 1	163	4	1	48	11
2027–2031	31	198	4	< 1	154	4	2	45	11
2032–2036	36	196	4	< 1	145	4	2	41	11
2037–2041	36	191	3	< 1	141	4	2	40	11
2042–2046	43	194	3	< 1	138	4	2	38	10
2047–2051	44	194	3	< 1	133	4	2	36	11
2052–2056	46	186	3	< 1	122	4	2	34	11
2057–2061	49	186	3	< 1	117	4	2	33	11
2062–2066	52	182	3	< 1	113	4	2	31	11

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Table 42 Carbon increment in oak in England; average annual carbon within period

	Native oak			Other oak		
	FC	Private sector		FC	Private sector	
	carbon (000 t)		SE%	carbon (000 t)		SE%
2017–2021	21	332	3	< 1	7	17
2022–2026	21	318	3	< 1	7	17
2027–2031	21	302	3	< 1	7	17
2032–2036	23	291	3	< 1	6	16
2037–2041	23	280	3	< 1	6	17
2042–2046	26	279	3	< 1	6	17
2047–2051	26	272	3	< 1	6	17
2052–2056	27	253	3	< 1	6	17
2057–2061	29	248	3	< 1	5	17
2062–2066	30	242	3	< 1	5	19

Table 43 Carbon increment in native oaks in England; average annual carbon within period

	Oak			Pedunculate oak			Sessile oak		
	FC	Private sector		FC	Private sector		FC	Private sector	
	carbon (000 t)		SE%	carbon (000 t)		SE%	carbon (000 t)		SE%
2017–2021	21	162	4	< 1	156	4	< 1	15	20
2022–2026	20	155	4	< 1	149	4	< 1	14	20
2027–2031	21	148	4	< 1	140	4	< 1	14	19
2032–2036	22	146	4	< 1	132	4	< 1	12	20
2037–2041	22	140	4	< 1	128	4	< 1	12	20
2042–2046	26	141	4	< 1	126	4	< 1	11	19
2047–2051	26	139	4	< 1	121	4	< 1	11	20
2052–2056	26	130	4	< 1	112	4	< 1	11	20
2057–2061	28	129	4	< 1	107	4	< 1	12	22
2062–2066	29	127	4	< 1	104	5	< 1	11	22

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Table 44 Carbon increment in oak in Scotland; average annual carbon within period

	Native oak			Other oak		
	FC	Private sector		FC	Private sector	
	carbon (000 t)		SE%	carbon (000 t)		SE%
2017–2021	3	46	10	< 1	< 1	51
2022–2026	3	51	9	< 1	< 1	51
2027–2031	6	49	8	< 1	< 1	51
2032–2036	9	49	8	< 1	< 1	51
2037–2041	9	52	7	< 1	< 1	51
2042–2046	11	53	7	< 1	< 1	51
2047–2051	12	54	6	< 1	< 1	51
2052–2056	13	54	6	< 1	< 1	51
2057–2061	14	55	5	< 1	< 1	51
2062–2066	15	54	5	< 1	< 1	51

Table 45 Carbon increment in native oaks in Scotland; average annual carbon within period

	Oak			Pedunculate oak			Sessile oak		
	FC	Private sector		FC	Private sector		FC	Private sector	
	carbon (000 t)		SE%	carbon (000 t)		SE%	carbon (000 t)		SE%
2017–2021	2	19	15	< 1	9	25	< 1	18	16
2022–2026	2	22	13	< 1	11	18	< 1	18	15
2027–2031	6	22	11	< 1	10	17	< 1	17	15
2032–2036	9	23	11	< 1	10	17	< 1	16	15
2037–2041	8	27	9	< 1	9	17	< 1	15	15
2042–2046	10	29	8	< 1	9	17	< 1	15	15
2047–2051	11	32	7	< 1	8	17	< 1	14	14
2052–2056	12	33	7	< 1	8	17	< 1	13	15
2057–2061	14	35	6	< 1	7	17	< 1	12	14
2062–2066	15	36	5	< 1	7	16	< 1	11	14

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Table 46 Carbon increment in oak in Wales; average annual carbon within period

	Native oak			Other oak		
	FC	Private sector		FC	Private sector	
	carbon (000 t)		SE%	carbon (000 t)		SE%
2017–2021	3	46	10	< 1	< 1	91
2022–2026	4	48	10	< 1	< 1	85
2027–2031	6	45	10	< 1	< 1	83
2032–2036	7	42	10	< 1	< 1	84
2037–2041	6	40	10	< 1	< 1	83
2042–2046	7	38	9	< 1	< 1	84
2047–2051	8	37	9	< 1	< 1	84
2052–2056	8	36	9	< 1	< 1	83
2057–2061	8	34	9	< 1	< 1	83
2062–2066	8	31	9	< 1	< 1	82

Table 47 Carbon increment in native oaks in Wales; average annual carbon within period

	Oak			Pedunculate oak			Sessile oak		
	FC	Private sector		FC	Private sector		FC	Private sector	
	carbon (000 t)		SE%	carbon (000 t)		SE%	carbon (000 t)		SE%
2017–2021	3	28	11	< 1	3	35	< 1	15	23
2022–2026	4	29	11	< 1	4	30	< 1	16	23
2027–2031	5	27	12	< 1	3	30	< 1	15	23
2032–2036	6	26	11	< 1	3	29	< 1	12	21
2037–2041	6	25	11	< 1	3	30	< 1	12	21
2042–2046	7	23	11	< 1	3	29	< 1	12	21
2047–2051	7	23	11	< 1	3	30	< 1	11	21
2052–2056	7	23	10	< 1	3	30	< 1	11	21
2057–2061	7	21	10	< 1	2	30	< 1	10	21
2062–2066	8	19	9	< 1	2	28	< 1	9	21

Tables showing the carbon increment in oak by region are available in the accompanying spreadsheet (worksheet CarbonIncrement_Tables).

Discussion

The aim of the report was to bring together the most recent statistics on the nature, composition, extent and location of oak species with Britain.

The result is the largest collection of statistics on the oak species that has existed within Britain to date. At present the report represents the most up-to-date and most accurate source of information on quantities and distribution of oak in British history.

There are several areas of statistics within the report that have not previously been available such as geographic distributions of oak health issues, geographic oak yield class distributions, oak increment, forecasts of oak carbon stocks over time and oak mortality rates per age class, to name a few.

It is hoped that this work demonstrates the national capability that the NFI has in monitoring oak species and how the NFI may form part of the basis for future monitoring of oak species and how it may support the Action Oak initiative.

This discussion could make many observations upon the individual findings within the reports, but will err on the side of brevity and leave it to the reader to make their own interpretations. It is hoped that researchers will utilise this data to underpin other research into oak species.

This report has built on the reports published 2011 to 2017 by the National Forest Inventory.

Future work

NFI will make further observations of oak and woodland ecological health in future reports.

Glossary

Age class	A grouping of trees into specific age ranges for classification purposes.
Area (forest/woodland)	Area (forest/woodland): forest and woodland area is divided into net forest area – the land area actually covered by trees (in the National Forest Inventory defined to the drip line of the canopy); and gross forest area – which includes both the area covered by trees and the small open spaces (of less than 0.5 hectares) within the forest boundary (e.g. rides, glades, ponds).
Broadleaves	Trees and shrubs that belong to the angiosperm division of the plant kingdom (as distinct from the gymnosperm division that includes conifers). Most in the UK have laminar leaves and are deciduous. Sometimes referred to as 'hardwoods' but not all produce hardwood timber.
Canopy	The mass of foliage and branches formed collectively by the crowns of trees.
Clearfelling	Cutting down of an area of woodland (if it is within a larger area of woodland it is typically a felling greater than 0.25 hectares). Sometimes a scatter or small clumps of trees may be left standing within the felled area.
Conifers	Trees and shrubs that belong to the gymnosperm division of the plant kingdom (as distinct from the angiosperm division that includes broadleaves). Conifers mostly have needles or scale like leaves and, with the exception of larch, all are evergreen. Sometimes referred to as 'softwoods', they produce softwood timber.
DBH (diameter at breast height)	The diameter of a tree (overbark) at breast height, which is usually defined as 1.3 m along the axis of the stem from the ground.
Forest (and woodland)	Land predominately covered in trees (defined as land under stands of trees with a canopy cover of at least 20%, or the ability to achieve this, and with a minimum area of 0.5 hectares and minimum width of 20 m), whether in large tracts (generally called forests) or smaller areas known by a variety of terms (including woods, copses, spinneys or shelterbelts).

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Forestry Commission	The government department responsible for the regulation of forestry, implementing forestry policy and management of state forests in Great Britain. Forestry policy is devolved, with the exception of common issues addressed on a GB or UK basis, such as international forestry, plant health and forestry standards.
Forestry Commission estate	Forests, woodlands, open land and other property managed by the Forestry Commission.
Great Britain (GB)	England, Scotland and Wales.
NRW	Natural Resources Wales.
Overbark	A term used in measurements of wood volume that include the bark.
Private sector estate	Forests and woodlands in GB not managed by the Forestry Commission. In the context of the National Forest Inventory, 'private sector' is used for convenience although it includes land owned or managed by bodies such as local authorities and charities.
Production forecast	A forecast of timber availability from the Forestry Commission (GB), the Forest Service, an agency within the Department of Agriculture and Rural Development in Northern Ireland) and potential timber availability from the private sector (UK).
Saplings	Young plants of tree species that have attained a height of at least 0.5 metres but have not yet attained a diameter at breast height of 4 centimetres. They may have grown from seed through natural regeneration or have originally been raised in a nursery and planted out as seedlings or saplings.
Seedlings	Young plants of tree species that have not yet attained a height of 0.5 metres. They may have grown from seed through natural regeneration or have been raised in a nursery and planted out.
Softwood	Wood of coniferous trees or the conifers themselves.

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Stand	A collection of trees, generally contained within a contiguous area of land, of relatively uniform structure. The structure of a stand may be of a simple nature, such as that composed of a single even-aged storey of a single species, or complex, involving multiple storeys or heights, variable ages and multiple species.
Standard error (SE)	The measure of the margin of error associated with an estimate as a result of sampling from a population with statistical variability. Larger standard errors indicate less precision in the estimate. Standard errors in this report are quoted in relative terms (i.e. as percentages of the value of the estimate).
Standing volume	A measurement of timber volume within standing trees (but also including windblown trees), usually expressed as cubic metres overbark standing (m ³ obs). In this report, standing volume is defined as live stemwood and branchwood to 7 cm top diameter and at least 3 m in length. It excludes roots, below ground stump material, small branches, foliage and deadwood. For private sector woodland only, it also excludes standing volume in trees in woodlands of less than 0.5 hectares. In this report, standing volume is used as a measure of the physical size of a tree or population of trees. In the context of production forestry, it is indicative of the volume of usable timber in standing trees.
Stemwood	The volume of wood in stems, with stems being defined internationally as the above-ground part of the main shoot (or offshoots) with apical dominance. In GB stemwood includes wood from the stump up to 7 cm top diameter of the main stem and sometimes branchwood at least 3 m in length with a minimum top diameter of 7 cm.
Stocked area	The area stocked with living trees. The stocked areas in this report are quoted in gross terms for the Forestry Commission estate and in net terms for the private sector estate (see definitions of Area above).

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Sustainable forest management	The stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity and vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions at local, national and global levels, and that does not cause damage to other ecosystems.
Thinning	The removal of a proportion of trees in a forest after canopy closure, usually to promote growth and greater value in the remaining trees.
Top diameter	Diameter of the smaller (top) end of a log, often used to define different categories of wood products (e.g. sawlogs, roundwood, pulp) and merchantable timber.
Top height	The mean total height of the 100 largest dbh trees per hectare.
Yield class (YC):	A classification based on tree species, height growth (top height) and tree age, used to assess the volume production of a stand of trees. It reflects the potential productivity of the site for the tree species growing on it.

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