



**An Roinn Talmhaíochta,
Bia agus Mara**
Department of Agriculture,
Food and the Marine

Ireland's National Forest Inventory 2017

Main Findings



Ireland's National Forest Inventory 2017 – Main Findings

Covering the third National Forest Inventory, 2015 to 2017

Published by:

Forest Service
Department of Agriculture, Food and
the Marine
Johnstown Castle Estate
Co. Wexford
Ireland
Y35 PN52

An tSeirbhis Foraoise
Roinn Talmhaíochta, Bia agus Mara
Eastát Chaisleán Bhaile Sheonach
Co. Loch Garman
Éire
Y35 PN52

To be purchased from:

Government Publications
52 St. Stephen's Green
Dublin 2
Ireland
(Tel: 076 1106 834 or Email:
publications@opw.ie)
or through any bookseller

Foilseacháin Rialtais
52 Faiche Stiabhna
Baile Átha Cliath 2
Éire
(Teil: 076 1106 834 nó Riomhphost:
publications@opw.ie)
nó trí aon díoltóir leabhar

ISBN 978-1-4064-2981-7

Price: €5.00

The Department of Agriculture, Food and the Marine is Ireland's national forest authority. It is responsible for the regulation of the forestry sector, the administration of forestry grant schemes, forest protection, the control of felling and the promotion and support of forest research.

Acknowledgements

The Department of Agriculture, Food and the Marine would like to express its appreciation to all those involved in the completion of the NFI. Sincere thanks are due to all landowners for facilitating access to their lands during the course of the NFI data collection.

Update

Table 2 was updated in December 2022 to correct a date entry mistake with the 2017 results.

Spatial Data

All spatial data presented is authorised under Ordnance Survey Licence No. EN 0076413. Copy right Ordnance Survey Ireland/Government of Ireland.

Table of Contents

1 Key Findings.....	1
2 Introduction.....	2
3 Survey methods.....	3
4 Interpretation of results.....	5
4.1 Presentation of Results.....	5
4.2 Accuracy of Results.....	5
4.3 Species Composition.....	6
4.4 Forest Area.....	6
5 Results.....	8
5.1 Summary.....	8
5.2 Land-use type change.....	10
5.3 Forest Area.....	11
5.3.1 Forest Open Area.....	15
5.3.2 Forest Ownership.....	15
5.3.3 Availability of Wood for Supply.....	17
5.4 Species Composition.....	18
5.4.1 Age class.....	21
5.5 Forest Classification.....	23
5.5.1 European Forest Type.....	23
5.5.2 Nativeness.....	24
5.5.3 Establishment type.....	25
5.5.4 Development stage.....	26
5.5.5 Thin Status.....	27
5.6 Site conditions.....	28
5.6.1 Soil Type.....	28
5.6.2 Environmental Designations.....	29
5.7 Growing stock volume and Basal Area.....	31
5.7.1 Basal Area.....	31
5.7.2 Growing Stock Volume.....	31
5.8 Increment and Fellings.....	34
5.8.1 Gross Volume Increment.....	34
5.8.2 Fellings.....	38
5.8.3 Fell Mean Tree Volume.....	40
5.9 Forest Carbon.....	41
5.9.1 NFI Carbon Stocks.....	41
5.9.2 Net greenhouse emissions and removals from forests.....	44
5.10 Health and Vitality.....	46
5.10.1 Forest Damage.....	46
5.10.2 Biotic.....	47
5.10.3 Abiotic.....	48
5.11 Diversity and Deadwood.....	49
5.11.1 Tree Diversity.....	49
5.11.2 Plant Diversity.....	50
5.11.3 Deadwood.....	51

List of Abbreviations

CI	Confidence Interval
Dbh	Diameter at breast height
FAWS	Forest Available for Wood Supply
FPM	Fresh-water Pearl Mussel
HLNA	Higher Likelihood Nesting Areas
IFER	Institute of Forest Ecosystem Research
NFI	National Forest Inventory
NHA	National Heritage Area
OLL	Other Long-Lived Species
OSL	Other Short-lived species
SAC	Special Area of Conservation
SFM	Sustainable Forest Management
SPA	Special Protection Area

1 KEY FINDINGS

This section summarises ten key findings of the third National Forest Inventory completed in 2017:

- The national forest estate is still expanding and has now reached 11% of the total land area, with a wide variety of forest types present. The total forest area has increased from 697,842 hectares (ha) in 2006 to 770,020 ha in 2017. The increase in area is a result of afforestation and the inclusion of pre-existing forests for the first time during the third NFI cycle.
- Over half (50.8%) of forests are in public ownership and 378,663 ha (49.2%) are in private ownership. The share of private forests in the national forest estate has increased by over 6% since 2006.
- Leitrim is the county with the highest percentage of forest cover (18.9%), while Cork has the largest forest area (90,020 ha).
- Conifer species are the dominant species present, representing 71.2% of the stocked forest area while broadleaved species accounted for 28.7% of the area. The share of broadleaf species in the national forest estate has increased by 3% between 2013 and 2017.
- In general, the forest estate is young with nearly half (44.9%) of the stocked forest estate less than 20 years of age.
- The total growing stock volume of Irish forests is estimated to be over 116 million m³, an increase of over 19 million m³ on 2012. Gross mean annual volume increment between 2013 and 2017 was 8.5 million m³ per year, while the mean annual standing volume felled within this period was 4.9 million m³ per year.
- Since 2013, 36,447 ha of forest were thinned for the first time. Overall, the area thinned and clearfelled between 2013 and 2017 increased by 11% and 17%, respectively, which is a positive trend for wood mobilisation.
- The national forest estate is an important and expanding sink for carbon, at 312 million tonnes. Based on the NFI data, Ireland's forests have removed an average of 3.8 Mt of carbon dioxide equivalents per year from the atmosphere over the period 2007 to 2016. This carbon resource has proven to be of pivotal significance in Ireland achieving its Kyoto target under the first commitment period of 2008-2012.
- There is an important biodiversity resource within Irish forests, with many non-tree plant species and lichens frequent across the forest estate. Large quantities of deadwood are present within the forest, with over 10.4 million m³ of deadwood present.
- Overall, the forest estate appears healthy. While nearly half (44.1%) of stocked forest areas displayed signs of forest damage present, the severity of the damage was low.

2 INTRODUCTION

The purpose of the NFI is to record and assess the extent and nature of Ireland's forests, both public and private, in a timely, accurate and reproducible manner. Reliable, current and consistent information is required to inform domestic forest policy, to support forest research and fulfil national and international reporting commitments.

Between 2004 and 2006 the Forest Service carried out the first NFI of Ireland's forests, with results published in 2007. The 2006 NFI was the first purely statistical approach to forest inventory undertaken in Ireland to provide an assessment of growing stock in both the public and private national forest estates.

In order to assess changes in the state of Ireland's forests over time, Ireland's NFI was designed using permanent sample plots which facilitated a repeat measurement programme. This robust reporting strategy was adopted to provide credible information to address strategic objectives and reporting commitments (Figure 1). The fieldwork for the second cycle of the NFI began in 2009 and was completed in 2012. Data collection for the third NFI began in 2015 and was completed in 2017.



Figure 1. International reporting obligations.

The NFI provides information to monitor Sustainable Forest Management (SFM) and data to support forest policy, specifically in relation to:

- Growing stock;
- Harvesting;
- Increment;
- Carbon;
- Forest area;
- Species composition;
- Forest biodiversity; and
- Forest health and vitality.

This document presents a compact and comprehensive overview of the results of the third NFI cycle along with a comparison of results with the two previous NFIs. Two other NFI publications are available, namely:

- NFI Field Procedures and Methodology;
- NFI Results.

Both documents are available at: <http://www.agriculture.gov.ie/nfi/>.

3 SURVEY METHODS

The NFI involved a detailed survey of permanent forest sample plots based on a randomised systematic grid sample design (Figure 2). A grid density of 2km x 2km provided sufficient forest plots to achieve a national estimate of volume with a precision of $\pm 5\%$, at the 95% confidence level. This grid density equated to 17,423 points nationally, each representing approximately 400 hectares (ha). Each circular NFI sample plot measures 25.24 metres (m) in diameter, comprising 500 m², and is permanent in nature to allow future re-sampling as required.

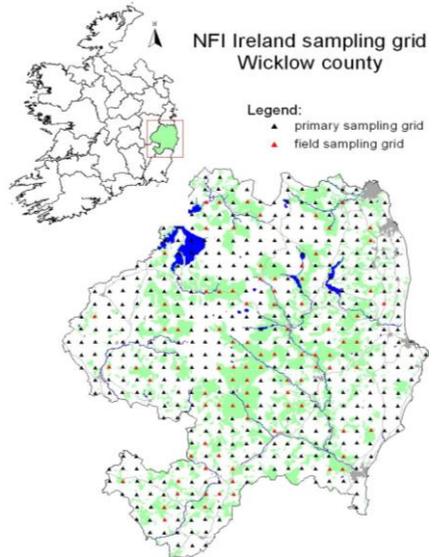


Figure 2. NFI grid design.

An initial desk study was carried out to identify land-use type, including forest areas, at each of the sample points using aerial photos and existing digital maps of forests (Figure 3). As the grid is permanent, it allows for the re-assessment of these primary sample points at future dates, to monitor forest land-use change e.g. afforestation.



Figure 3. Aerial photo interpretation.

In the field survey at each sample plot a variety of primary attributes were assessed, from the tree top to the soil underneath. For example, information was collected on: tree growth and development, the diversity of plant species and soil type.

The underlying technology used in the NFI, Field-Map, consisted of an integrated system of hardware and software developed by the Institute of Forest Ecosystem Research Ltd (IFER). It allowed for the preparation of a NFI database, background maps, and plot generation. This in turn allowed for the creation of projects for field teams, which facilitated the field data collection process (Figure 4).

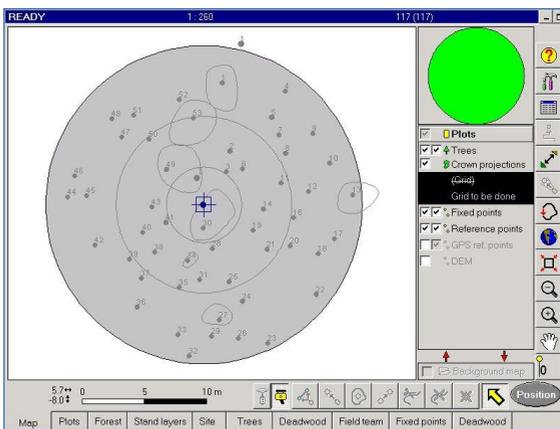


Figure 4. NFI field data collection software.

To carry out the field data collection, six professional foresters were recruited to work in teams of two (Figure 5). In total, 1,827 forest plots were assessed throughout the country in the 2012 NFI. Due to the expansion of the forest estate, additional plots were assessed in the 2017 NFI; bringing the total number of NFI plots to 1,923. Training, field team support, validation and other quality control procedures were undertaken by two staff to ensure data quality and the smooth running of field operations.



Figure 5. Field data collection.

Following the completion of field data collection work, primary data pre-processing and data analysis were completed. During data pre-processing the validity of the data was checked and data values were amended where necessary. Secondary variables, such as volume increment, were also calculated. Forest attributes (e.g. ownership) are used to classify evaluated variables (e.g. area) through the calculation of statistics (e.g. totals and/or means).

4 INTERPRETATION OF RESULTS

The analysis and results generation for the third NFI cycle were undertaken in 2017 by the Forestry Inspectorate, in close collaboration with the IFER. During this third NFI, all forest sample plots were re-assessed which not only provided current estimates for forest attributes but also allowed direct comparison with the previous NFI results.

4.1 PRESENTATION OF RESULTS

The analysis software (Field-Map Inventory Analyst) produces standardised tables and charts for reporting purposes. As errors are associated with all forms of sampling, most tables detail the calculated statistics with associated confidence intervals ($\alpha=0.05$). The confidence interval quantifies the sampling uncertainty of a measurement by specifying the range of values within which the true value for the whole population lies. As a 95% confidence interval is used for the NFI analysis, there is a 95% probability that the true value for the population lies within the range of values. Only sampling error is included in the confidence interval, modelling errors (e.g. volume estimation) and measurement errors (e.g. Dbh data) are not incorporated in the confidence intervals. Sub-totals are provided where a variable is classified by more than one attribute. The proportion of the variable in each classifier class is also included. Interpretation of the results is aided by the use of charts and graphs.

4.2 ACCURACY OF RESULTS

The confidence interval quantifies the uncertainty in measurement by specifying the range of values within which the true value for the whole population lies.

Attributes that occur less frequently tend to have lower levels of accuracy. The problem can be exacerbated through classification. Classification by small geographic areas, results in higher error margins for those areas e.g. small counties. For example the mean annual volume increment per ha for Co. Dublin is $11.4 \text{ m}^3 \pm 7.2 \text{ m}^3$, while the figure for Co. Cork is $14.1 \text{ m}^3 \pm 2.2 \text{ m}^3$. As Co. Dublin has a much smaller area of forest than Co. Cork, far fewer sample plots contribute to the result for Co. Dublin. In turn fewer plots result in a larger error margin.

Assessment of the NFI results should always be done in conjunction with the evaluation of the confidence interval presented with the statistic, which indicates the reliability of the results. This document provides an overview of the main findings. For more detailed statistics, including confidence intervals, please refer to the more comprehensive publication; *Ireland's National Forest Inventory 2017 – Results*.

4.3 SPECIES COMPOSITION

Careful consideration is needed in the interpretation of stocked areas of individual species presented, since many forests contain an intimate mixture of species. The total stocked area of a given species therefore does not represent distinct areas of land covered by pure stands of the species, but represent the sum of shares of areas of mixed forest apportioned to it.

Since the NFI uses a plot design that incorporates concentric circles, not all trees present on the plot were assessed (Figure 6). Tree data on the inner sub-circles was expanded over the entire plot by weighting individual tree data by the respective concentric circle size. This expansion assumes that what is observed in the inner sub-circles for smaller Dbh trees can be replicated over the whole plot.

In order to enable area related calculations, such as species composition, a procedure for the calculation of the so-called representative area of a tree is used. The area of each inventory plot was distributed among the trees proportionate to their size. Larger trees were allocated larger areas. The sum of all the individual tree representative areas within the plot is equal to the total plot area of 0.05ha. These total representative areas are used to scale up from plot to national species composition estimates.

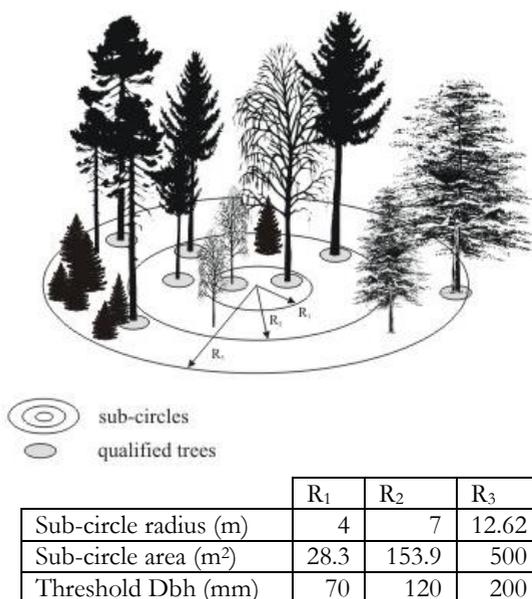


Figure 6. Plot design.

4.4 FOREST AREA

Forest area statistics are presented in three different ways in the results. As it is not possible to collect the same level of information on every plot (e.g. species) the total forest area is not always presented. For example, forest open area plots will have no trees present, resulting in no species composition data for this plot. As a result, there are three main types of forest area presented in the NFI (Figure 7):

1. Total Forest Area, 770,020 ha. - Encompasses all forest land.
2. Forest area, 687,525 ha - Excludes forest open area.
3. Stocked forest area, 673,112 ha - Excludes forest open area and temporarily unstocked areas.

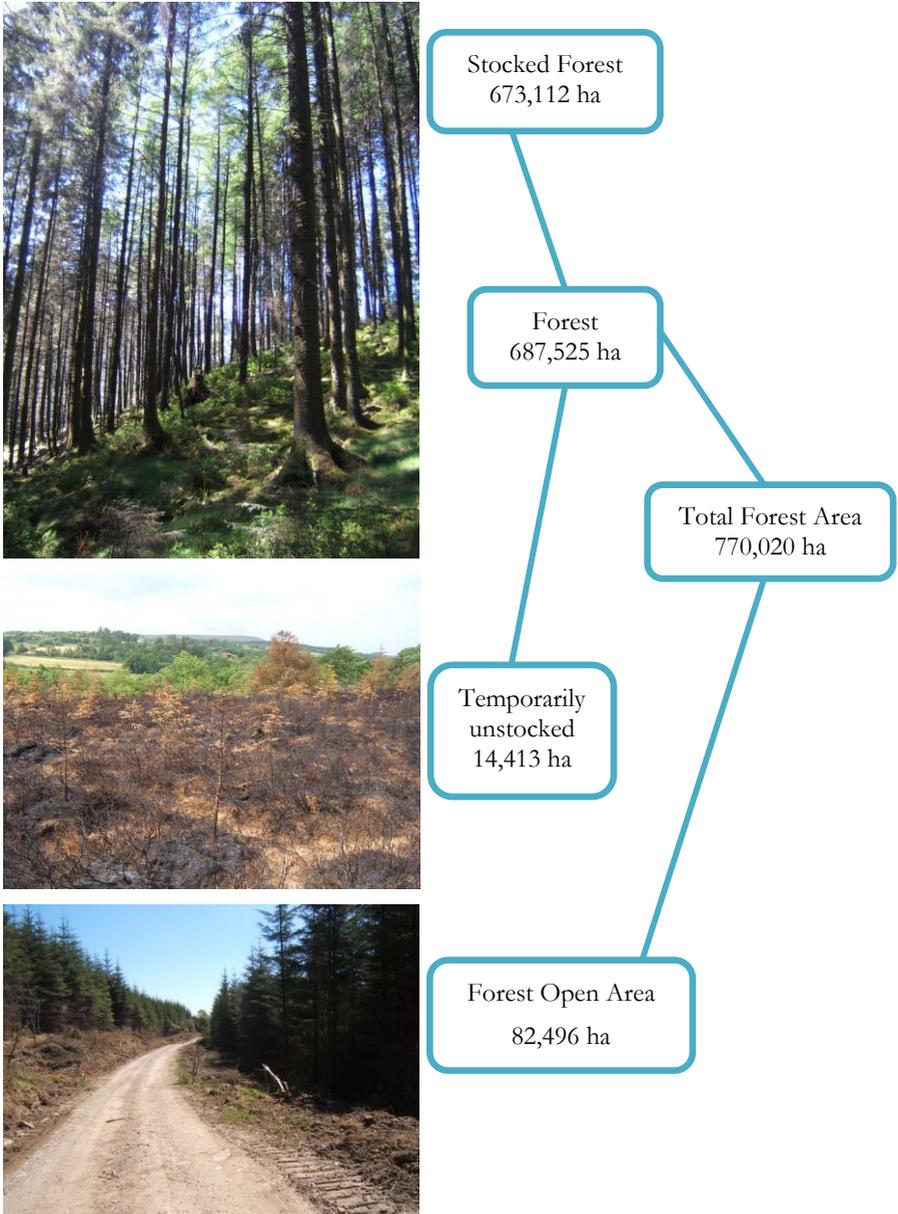


Figure 7. Forest area (ha) types reported in the NFI.

5 RESULTS

5.1 SUMMARY

The 2006 National Forest Inventory (NFI) was the first statistical and multi-resource inventory carried out on the national forest estate. In order to assess changes in the forest estate over time repeated assessments are required. The second NFI was completed in 2012 and the third in 2017. On all occasions multi-resource information was recorded including information on forest area and species composition, growing stock (m³), biodiversity, health, and carbon content; for the entire national forest estate. The repeated NFI cycles have provided results on aspects such as forest area change, volume increment and latest felling volume estimates. This facilitates the assessment of changes in the state of Ireland's forests over time.

The national forest estate is still expanding and has now reached 11% of the total land area, with a wide variety of forest types present. The total forest area has increased from 697,842 ha in 2006 ha to 770,020 ha in 2017. Between 2013 and 2017 the forest area has increased by 38,368 ha as a result of afforestation and the identification of pre-existing forests for the first time during the third NFI cycle.

Over half (50.8%) of forests are in public ownership and 378,663 ha (49.2%) are in private ownership. The share of private forests in the national forest estate has increased by over 6% since 2006. Leitrim is the county with the highest percentage of forest cover (18.9%), while Cork has the largest forest area (90,020 ha).

Conifer species are the dominant species present, representing 71.2% of the stocked forest area while broadleaved species accounted for 28.7% of the area. The share of broadleaf species in the national forest estate has increased by 3% between 2013 and 2017. Nearly half (44.9%) of the stocked forest estate is less than 20 years of age, consisting of over half (59.4%) the private (grant aided) and 40.1% of the public estate.

The total growing stock volume of Irish forests is estimated to be over 116 million m³, an increase of over 19 million m³ on 2012. The private forests share of the total growing stock volume has increased from 38% in 2012 to 44% in 2017. The total growing stock volume consists mostly of spruce and pine species however there is a significant quantity of growing stock present in older broadleaf forests.

The balance between gross increment and fellings is an important indicator of SFM in a country as it describes the sustainability of wood production over time, the current availability of wood and the potential for the future. Gross annual volume increment between 2013 and 2017 was 8.5 million m³ per year. The mean annual standing volume felled within this period was 4.9 million m³ per year, a significant increase over the period 2006-2012 when mean annual volume felled was 3.6 million m³. Over half (58%) of the gross annual increment was felled between 2012 and 2017.

In terms of the f thinning status, 16.5% of forests have been thinned or re-spaced at least once. Nearly half (45.7%) of forests are juvenile (i.e. at a maturity stage where they could not be thinned) and a further 12.7% was also deemed not suitable for thinning as

it was classified as semi-natural or low stocking. One quarter (25.1%) of forests are categorised as “no thin”, which in theory is defined by the forest maturity stage where it could be thinned but has not been thinned due to a variety of factors such as high windthrow risk, economic factors, owner intentions or thinning may be imminent.

The NFI results indicate that the national forest estate is an important and expanding sink for carbon, at 312 million tonnes. Based on the NFI data, Ireland's forests have removed an average of 3.8 Mt of carbon dioxide equivalents per year from the atmosphere over the period 2007 to 2016. This carbon resource has proven to be of pivotal significance in Ireland achieving its Kyoto target under the first commitment period of 2008-2012.

There is an important biodiversity resource within Irish forests, with many non-tree plant species and lichens frequent across the forest estate. Nearly half (49.3%) of the forest area has vegetation coverage of greater than 90%. There are significant proportions of open areas and areas with natural regeneration present, the latter particularly so in the older private forest estate. Nearly three quarters (74.1%) of Ireland's forests have two or more tree species present. Large quantities of deadwood are present within the forest, with over 10.4 million m³ of deadwood present.

Overall, the forest estate appears healthy. While nearly half (44.1%) of stocked forest areas displayed signs of forest damage present, the severity of the damage was low. Abiotic damage was recorded on 19.9% of the forest area and biotic damage was recorded on 16.1% of the forest area. Both abiotic damage and biotic damage was recorded on 8.1% of the forest area. Damage caused by animals (e.g. browsing by deer) was the most common type of biotic damage, followed by vegetation and harvesting operations. In terms of abiotic damage, climatic factors (e.g. windthrow) were the most common type of damage, followed by nutrient deficiency and anthropogenic factors.

Over the last 40 years, fewer forests are being afforested on peatland. The proportion of minerotrophic peat being afforested has remained relatively static overtime, largely as a result of the afforestation of land that was reclaimed for agriculture. Afforestation of ombrotrophic peat is declining, reflecting a shift away from the unenclosed land type.

An overview of the main results for the third NFI cycle are presented in Table 1, along with results from the previous two NFIs.

Table 1. Overview of the main NFI results 2006-2017.

	2006	2012	2017
Total Forest Area (ha)	697,842	731,652	770,020
Mean Basal Area (m ² /ha)	20.2	25.3	27.5
Mean Growing stock (m ³ /ha)	112	148	170
Growing stock (million m ³)	71.9	97.5	116.5
Gross Increment Volume (million m ³ yr ⁻¹)	not available	7.69	8.53
Gross Fell Volume (million m ³ yr ⁻¹)		3.62	4.90

5.2 LAND-USE TYPE CHANGE

Aerial photo interpretation of all 17,423 grid points was carried out in 2006, 2012 and again in 2017, with the primary aim of identifying forest plots. Other land-use types were also recorded allowing for trend analysis in land usage over time. Much higher quality aerial photos became available from 2012 onward, leading to some of the significant shifts in land-use types over time.

The total forest area has increased from 697,842 ha in 2006 to 770,020 ha (Table 2). Between 2013 and 2017 the forest area increased by 38,368 ha which comprises newly afforested areas and areas of existing forests that were identified for the first time during the third cycle. During the same time (2013 and 2017) period, 6,432 ha went from forest to non-forest, which included deforestation and forest areas that were misclassified in earlier cycles. In terms of tree cover; Other Wooded Land (OWL) has increased from 47,681 ha to 68,136 ha and the area of hedgerows has also increased from 271,912 ha to 273,144 ha. The increase in both these areas resulted from the removal of the “scrub” category from the classification in 2017. The adoption of the OWL definition of the Food and Agriculture Organization (FAO) negated the need to have a separate “scrub” category.

Table 2. Land use and land use change (2006-2017).

Land-use type	2006		2012		2017	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Forest	697,842	10.0	731,652	10.5	770,020	11.0
Other Wooded Land	50,878	0.7	47,681	0.7	68,136	1.0
Hedgerow	276,460	4.0	271,912	3.9	273,144	3.9
Scrub	89,030	1.3	82,606	1.2	not available	
Bare Rock	76,124	1.1	73,684	1.1	74,481	1.1
Bog and Heath	923,037	13.2	916,415	13.1	975,193	14.0
Built Land (Rural)	113,704	1.6	128,854	1.8	139,245	2.0
Built Land (Urban)	63,303	0.9	70,599	1.0	71,716	1.0
Crop & cultivated land	379,748	5.4	352,262	5.0	347,651	5.0
Cutaway Peat (Domestic)	101,767	1.5	101,760	1.5	97,756	1.4
Cutaway Peat (Industrial)	69,322	1.0	67,715	1.0	63,295	0.9
Grassland	3,776,999	54.2	3,725,092	53.4	3,665,613	52.4
Green Space (Rural)	57,348	0.8	84,562	1.2	89,337	1.3
Green Space (Urban)	24,827	0.4	28,026	0.4	27,202	0.4
Quarry	8,417	0.1	12,019	0.2	12,031	0.2
Road (Paved)	84,911	1.2	92,103	1.3	97,307	1.4
Track (Unpaved)	19,607	0.3	22,812	0.3	32,419	0.5
Water Body	141,616	2.0	144,376	2.1	146,766	2.1
Sea & Coastal Complex	21,182	0.3	21,980	0.3	24,799	0.4
Total	6,976,112	100	6,976,112	100	6,976,112	100

5.3 FOREST AREA

Forest is defined as land with a minimum area of 0.1 ha, a minimum width of 20 m, trees higher than 5 m and a canopy cover of more than 20% within the forest boundary, or trees able to reach these thresholds *in situ*.

The area of forest in Ireland in 2017 was 770,020 ha or 11% of the land area excluding inland water bodies (Table 3). Between 2013 and 2017 the forest area has increased by 38,368 ha as a result of afforestation and the identification of pre-existing forests for the first time during the third NFI cycle. These pre-existing forests are predominantly semi-natural broadleaf forests, which were not apparent during previous NFI aerial photo interpretation exercises, due to the lower resolution aerial photos available at that time.

Co. Cork has the highest share of national forest area at 90,020 ha or 11.6% of the total forest estate (Figure 7). A map of forest cover in Ireland is presented in Figure 8.

Table 3. Total forest area

	2006		2012		2017	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
Forest	697,842	10.0	731,652	10.5	770,020	11.0
Non-forest	6,278,270	90.0	6,244,460	89.5	6,206,092	89.0
Total	6,976,112	100	6,976,112	100	6,976,112	100

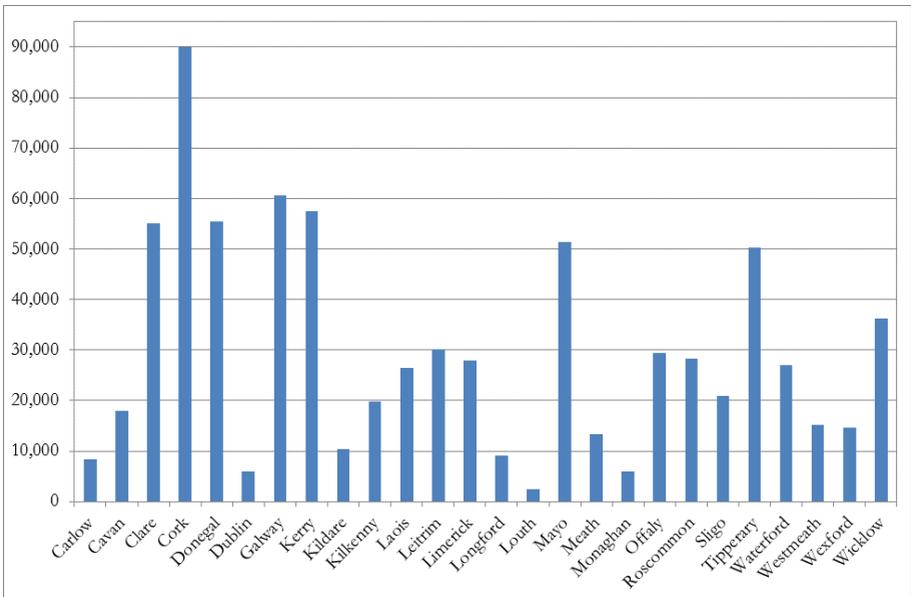


Figure 7. Total forest area (ha) by county.

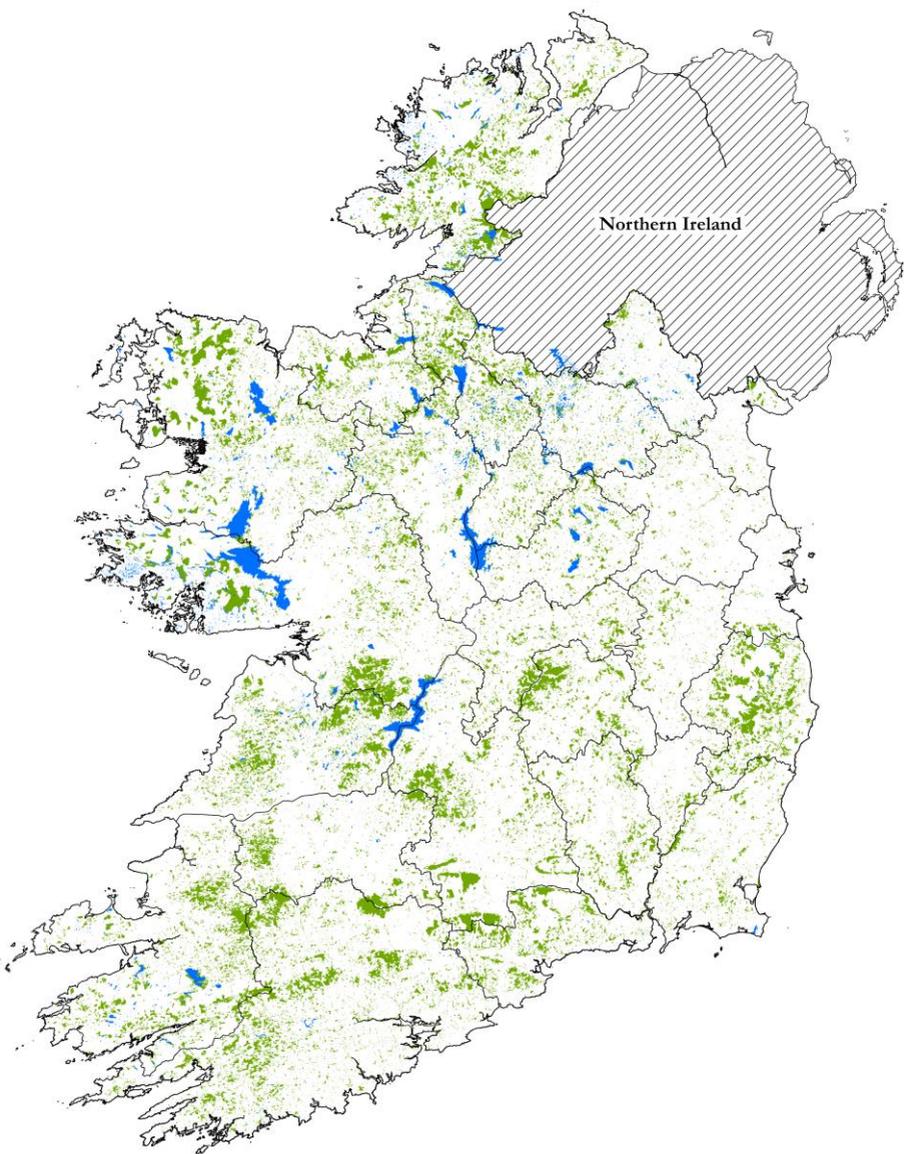


Figure 8. Map of forest cover in Ireland, 2017.

Counties with the highest proportion of national forest area are primarily distributed along the western and south-western seaboard (Figure 10).

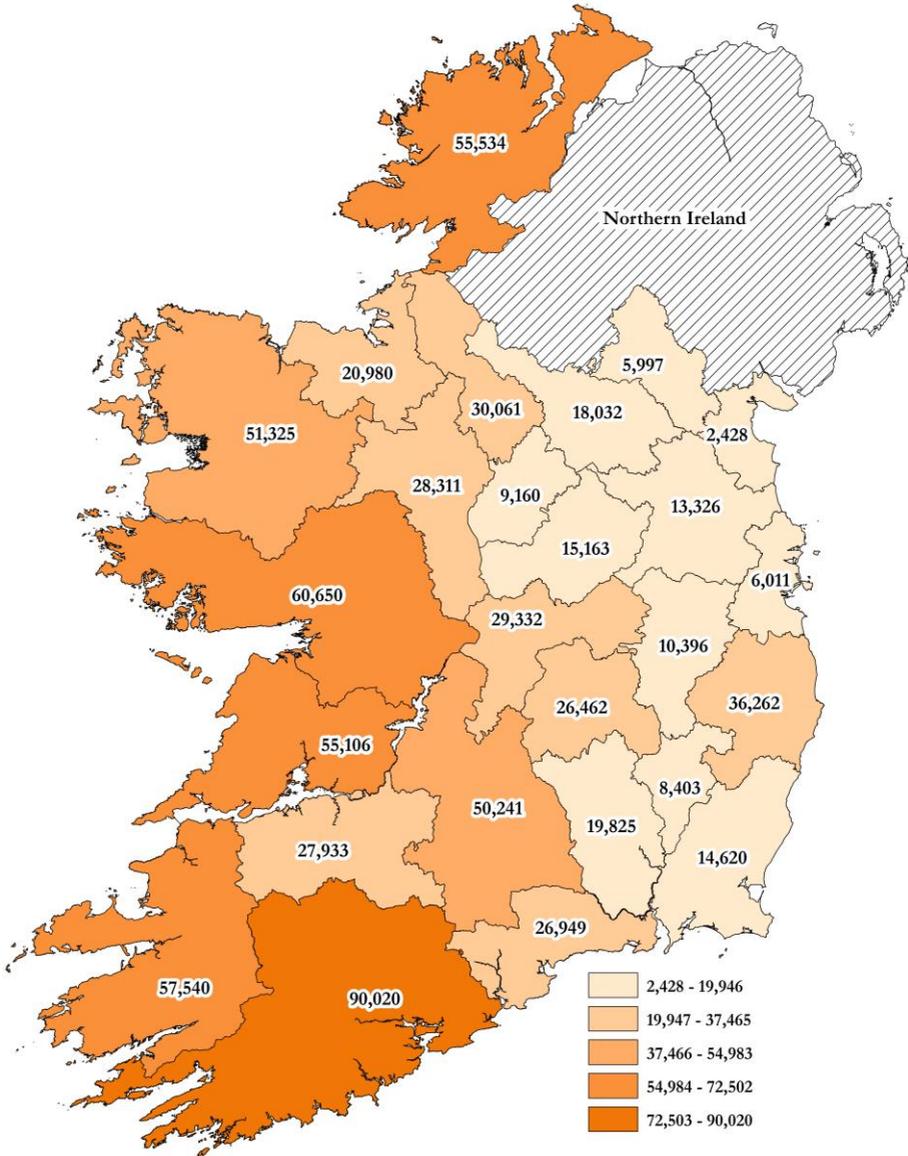


Figure 10. Total forest area per county (ha).

5.3.1 Forest Open Area

Forest open areas (e.g. firebreaks) are integral to the forest and constitute 10.7% of the total forest area (Figure 11). The Private (grant aided) estate has 14.8% forest open area, compared to 8.7% in the Public forest. As the majority of the private estate has yet to be roaded, the forest open area differential between the two ownership types will continue to increase over time.

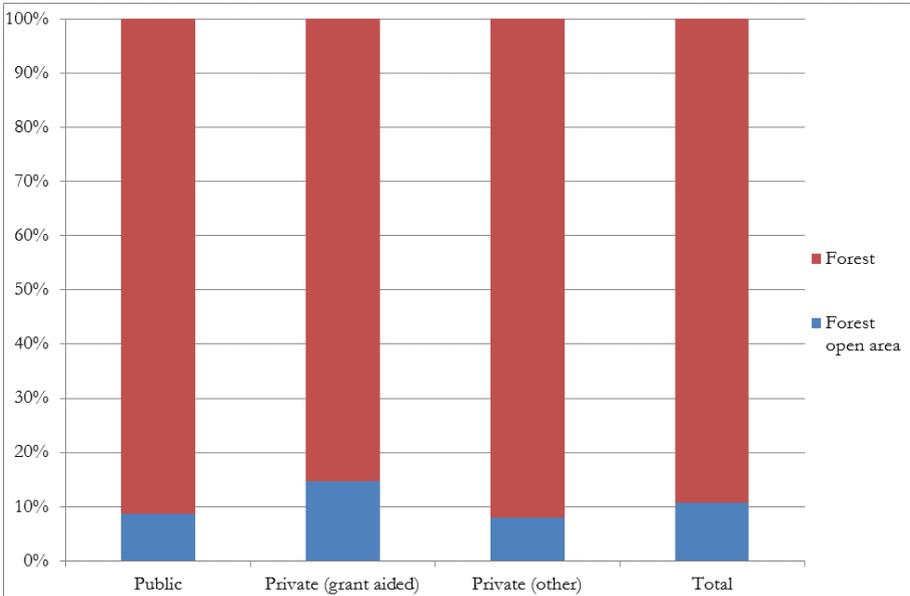


Figure 11. Proportion of forest open area in the total forest area by ownership.

5.3.2 Forest Ownership

Forest ownership refers to land ownership in the NFI. Over half (50.8%) of forests are in public ownership and 378,663 ha (49.2%) are in private ownership (Table 4 and Figure 12). The private forest estate is in effect comprised of two distinct forest types; the older non grant aided forests, referred to as Private (other), and the younger grant aided forests categorised as Private (grant aided), planted post 1980. The share of private forests in the national forest estate has increased by over 6% since 2006.

Table 4. Total forest area by ownership

Ownership	2006		2012		2017	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
public	397,463	57.0	389,356	53.2	391,358	50.8
private (grant aided)	212,202	30.4	248,554	34	268,100	34.8
private (other)	88,177	12.6	93,742	12.8	110,563	14.4
Total	697,842	100	731,652	100	770,020	100

5.3.3 Availability of Wood for Supply

The classification of Forest Available for Wood Supply (FAWS) describes the relative importance of the national forest estate in terms of timber supply. The majority (76.4%) of forests in Ireland have no restrictions on timber supply (Figure 13). A small portion (0.7%) of the estate is considered not available due to the National Parks and Nature Reserves designations.

A significant portion (22.9%) of the national forest estate is considered unlikely to contribute to wood supply (Figure 13). Nearly three-quarters (74.6%) of the Private (other) estate is classified as unlikely to contribute to wood supply, primarily due to the presence of semi-natural broadleaf forests.

The factors considered when assessing availability of wood for supply are detailed in Figure 14. Factors relating to site constraints, physical productivity or wood quality are the most significant limitations.

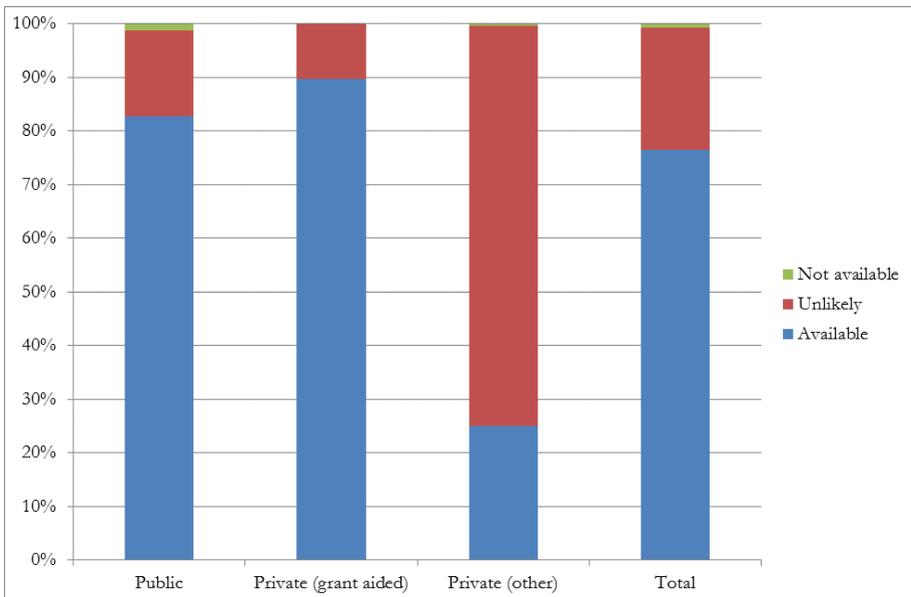


Figure 13. Proportion of the stocked forest area by ownership and Forest Available for Wood Supply.

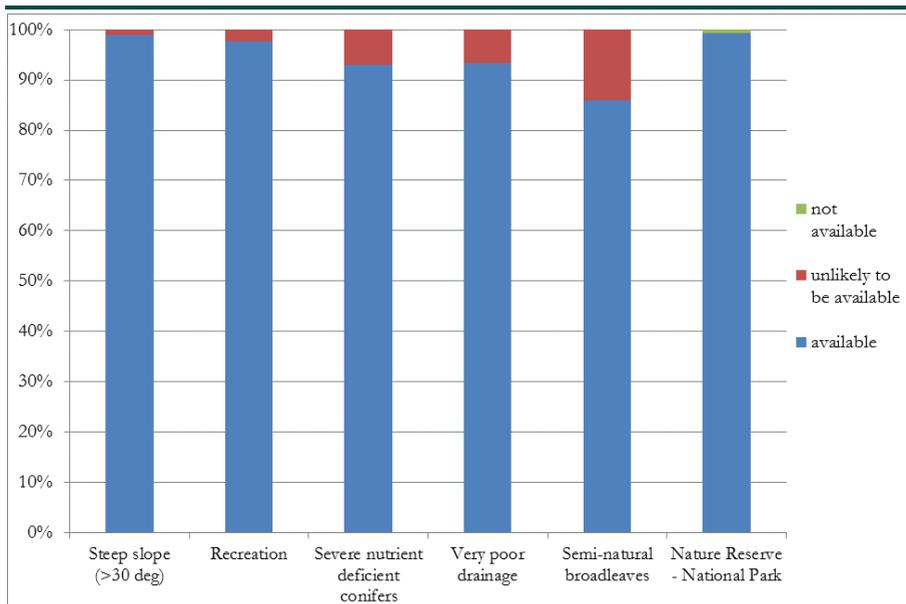


Figure 14. Proportion of the stocked forest area by Availability of Wood Supply and Availability Restriction Class.

5.4 SPECIES COMPOSITION

The portion of the forest estate that has tree cover or is available for planting is 687,525 ha. At any one time a portion of this will be temporarily un-stocked due to events such as felling or fire. The removal of these temporarily unstocked areas leaves 673,112 ha with tree cover present.

Conifer species are the dominant species present, type representing 71.2% of the stocked forest area while broadleaved species accounted for 28.7% of the area. (Figure 15 & 16). The share of broadleaf species in the national forest estate has increased by 3% between 2013 and 2017. Pre-existing semi-natural broadleaf forests, identified for the first time in this NFI cycle, has contributed to the increase in the proportion of broadleaf species.

The main tree species is Sitka spruce occupying 343,311 ha or 51.1% of the area (Figure 16). Other pines, composed primarily of lodgepole pine, accounted for 9.6%. The most common broadleaf species present were Other short living broadleaves¹ (OSL), which includes species such as willow and hazel, representing 7.9% of the area. Birch is the next most common broadleaf species occupying 7.0% of the area.

¹ OLL Broadleaves are Other Long Living broadleaves e.g. Sweet chestnut, Holly, and Lime. OSL are Other Short Living broadleaves e.g. Willow & Hazel.

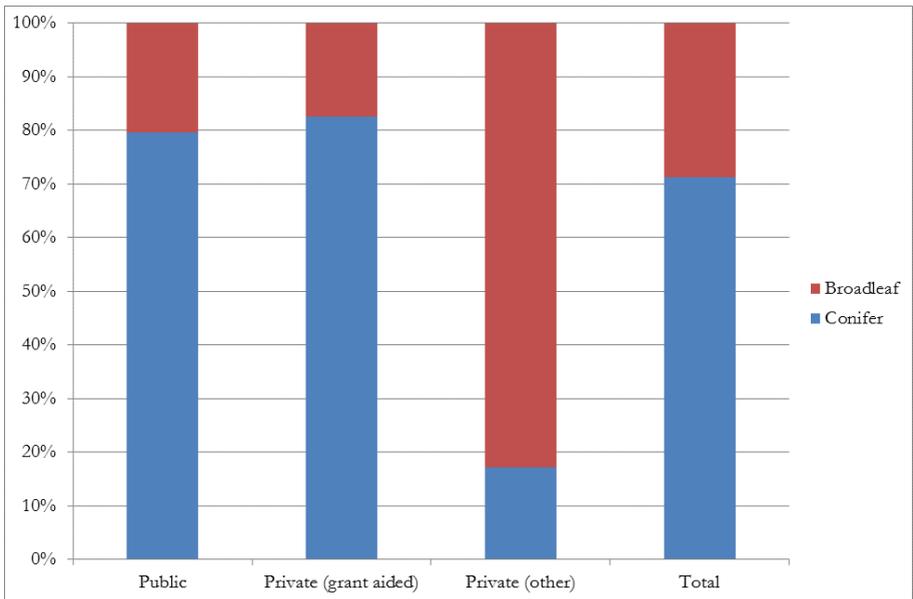


Figure 15. Proportion of the stocked forest area by ownership and species group.

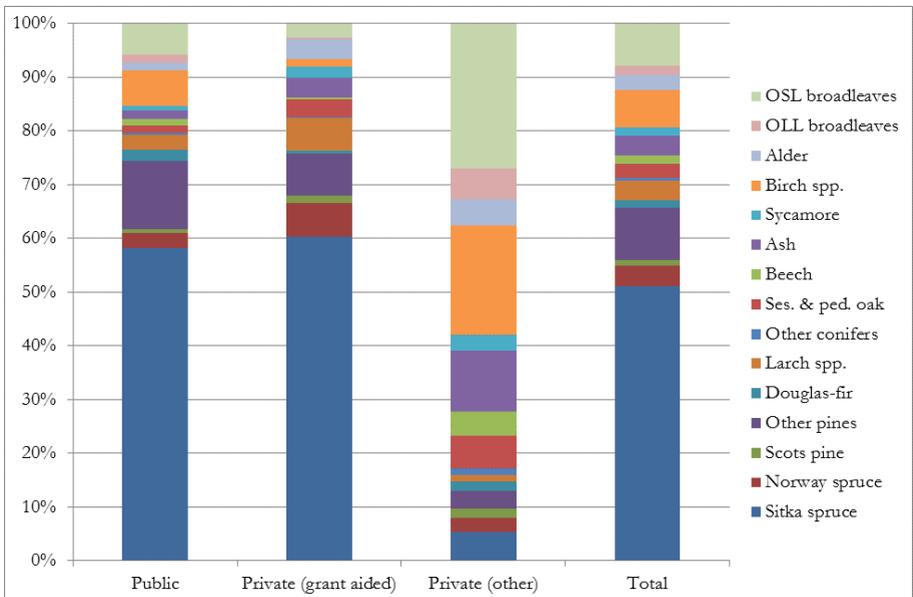


Figure 16. Proportion of the stocked forest area by ownership and species group.

The proportion of the stocked forest area by county and species group is detailed in Figure 17.

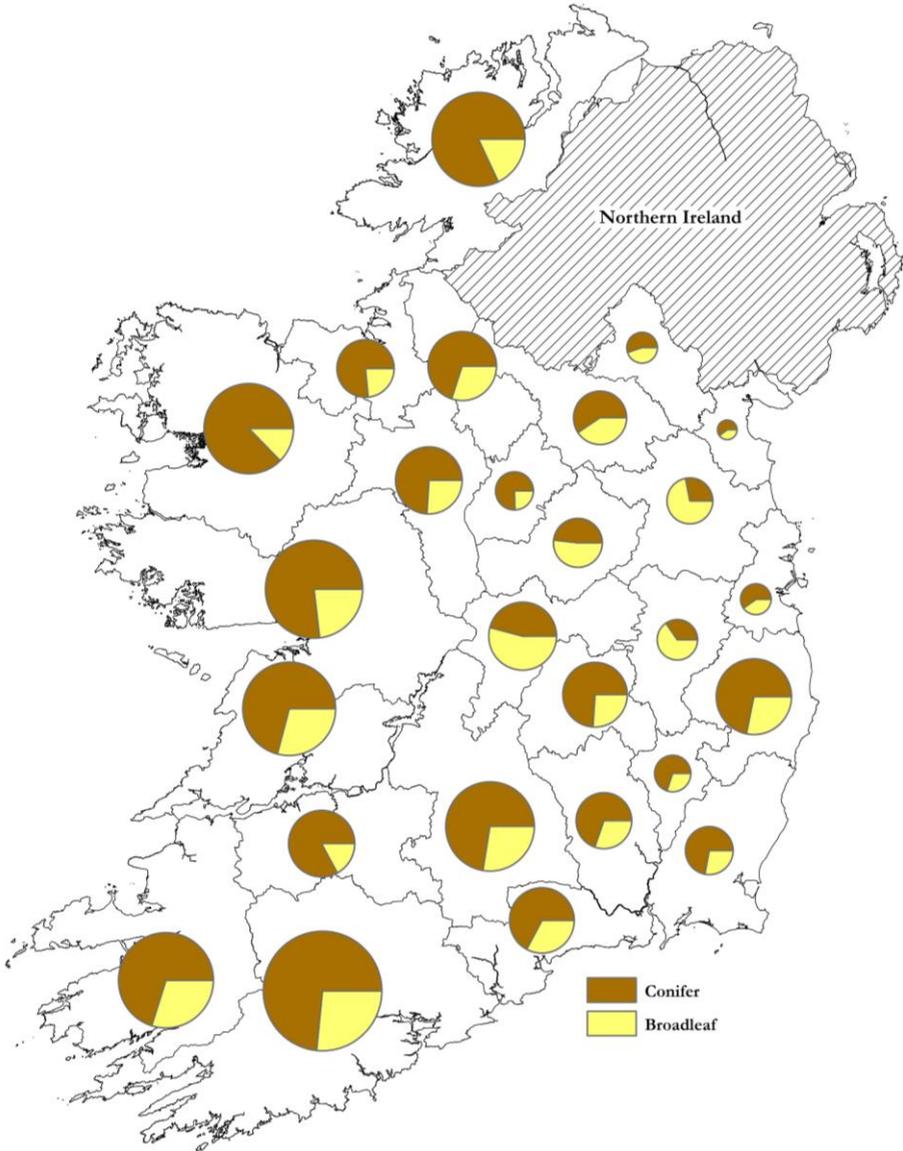


Figure 17. Proportion of the stocked forest area by county and species group.

5.4.1 Age class

The age of a forest is described as the number of growing seasons since initial planting or natural regeneration. Nearly half (44.9%) of the stocked forest estate is less than 20 years of age (Figure 18). The private (grant aided) forest estate has a younger age profile compared to the public estate, with 59.4% compared to 40.1%. The Private (grant aided) forests are predominantly less than 30 years old. Private (other) forests are evenly distributed across the range of age classes with a dominance in the 51 years plus category, reflecting their partial composition of the older private estates.

In general, there is a higher proportion of broadleaves in young forests due to higher levels of broadleaf afforestation over recent decades and natural regeneration (Figure 19).

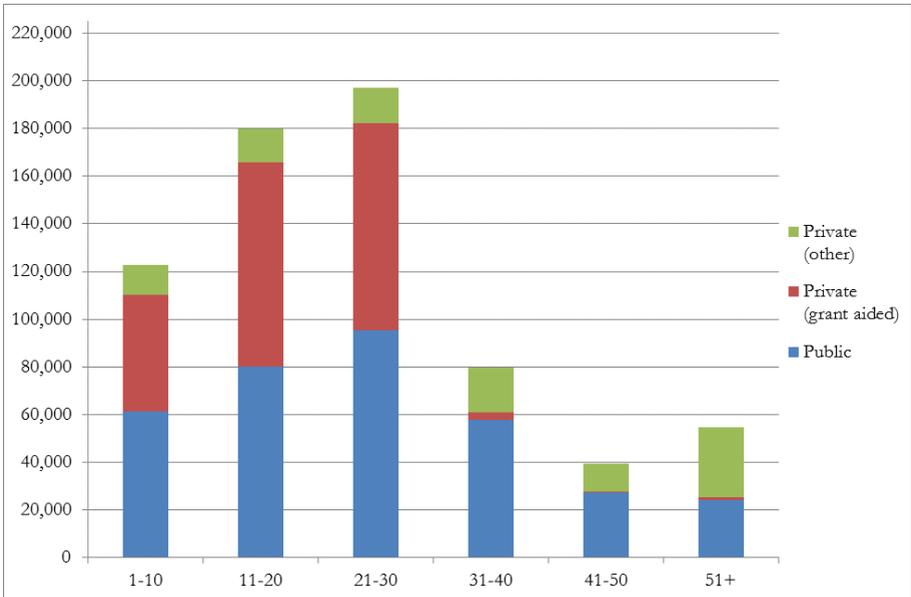


Figure 18. The stocked forest area by age class and ownership.

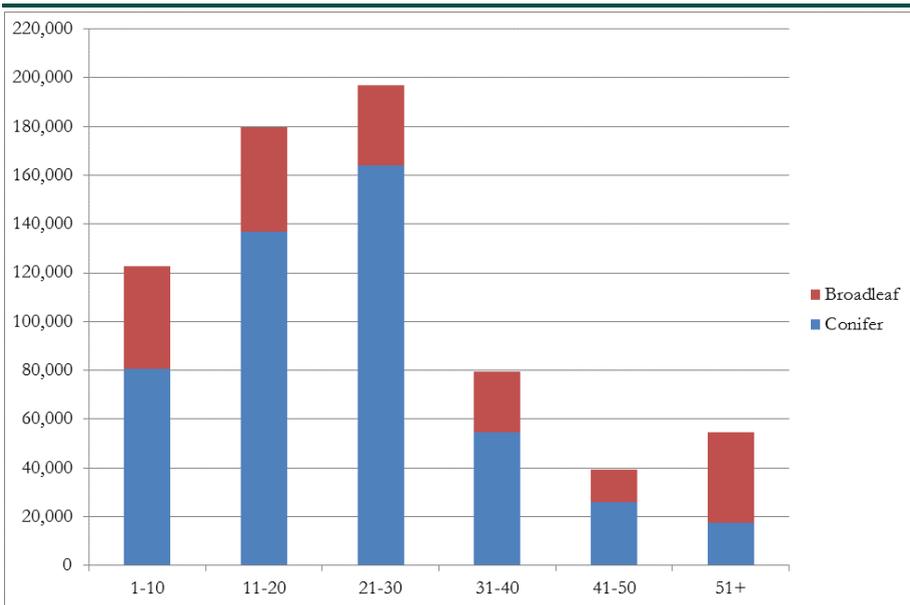


Figure 19. Total stocked forest area by age class and species group

5.5 FOREST CLASSIFICATION

The following sub-sections describe the structure of the national forest estate.

5.5.1 European Forest Type

European forest type applies a broad species class at forest level, as opposed to the broadleaf/conifer classification presented in the previous section which is derived from tree species class. Two-thirds (65.7%) of the stocked forest area is composed of forests with conifer species predominating (Figure 20), which is a reduction of 3.3% since 2012. The Private (other) forests are composed of forests with broadleaf species predominating.

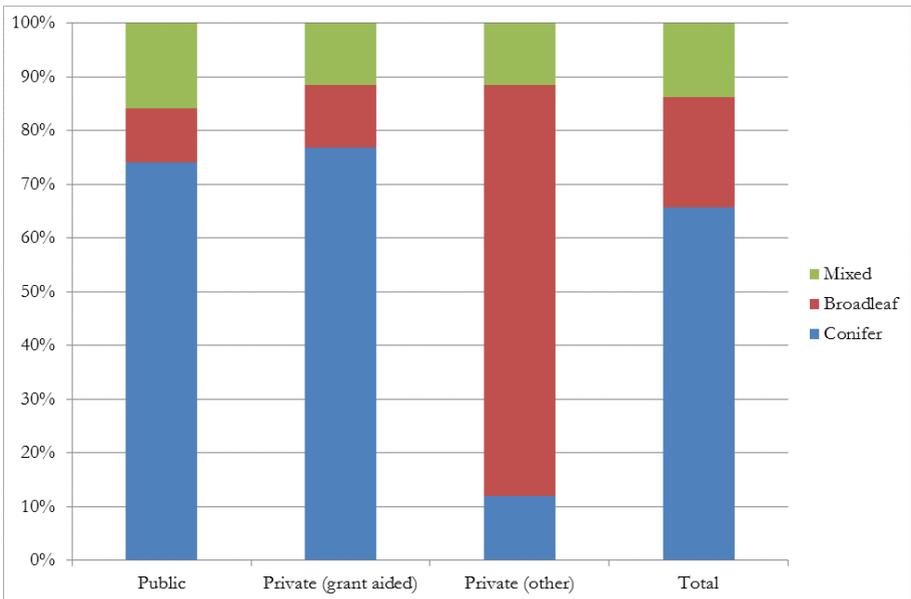


Figure 20. Proportion of the stocked forest area by European forest type and ownership.

5.5.2 Nativeness

A number of different native forest types are found across Ireland, each influenced by soil type, climate and other physical factors. Native tree species are trees that have arrived and inhabited an area naturally, without deliberate assistance by man. For NFI purposes the species list of natives trees recorded is primarily based on the list of species eligible for inclusion in Ireland's Native Woodland Scheme².

Native and mixed forests comprise 31.7% of Ireland's forests (Figure 21), which is an increase of 3% on 2012. Native tree species predominate in Private (other) forests while non-native tree species predominate in both Private (grant aided) and public forests.

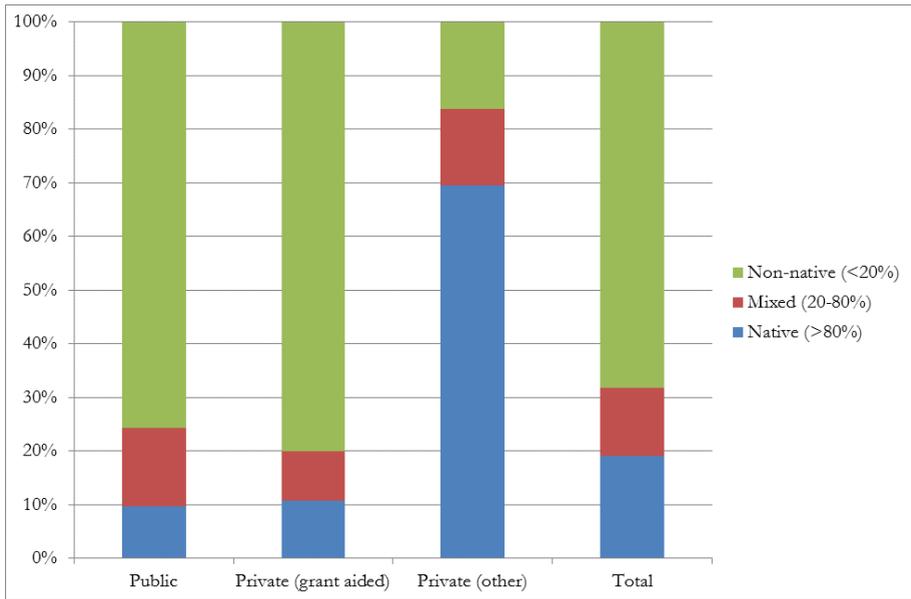


Figure 21. Proportion of total stocked forest by nativeness by ownership.

²Anon., 2008. Native Woodland Scheme Manual. Forest Service, Department of Agriculture, Food and the Marine, Johnstown Castle Estate, Co. Wexford, Ireland.

5.5.3 Establishment type

Afforestation is the man-made establishment of new forests on treeless lands which did not carry forest in contemporary history. Afforestation dominates as the main method by which forests have become regenerated with 57.7% of forests established in this way (Figure 22). Reforestation, the man-made establishment of trees on lands that have been cleared of forest within the relatively recent past, comprises 28.1% of forests.

Semi-natural forests, which are forests established by natural regeneration, occupy 14.2% of forests. Private (grant aided) forests are almost entirely established as afforestation reflecting their contemporary nature since 1980. A large proportion (71.4%) of semi-natural forests occupy the Private (other) forests while Public forests have the largest share (50.2%) of reforestation.

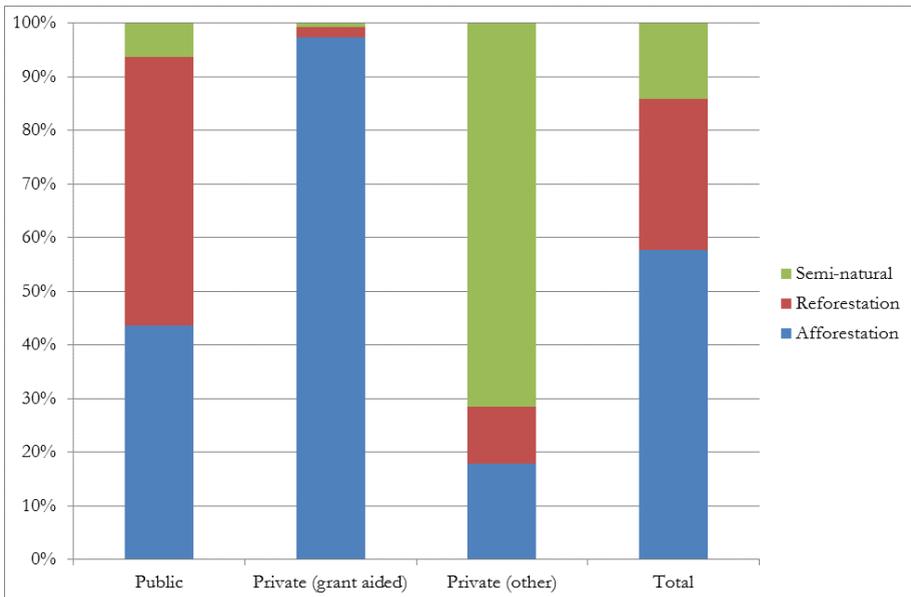


Figure 22. Proportion of total stocked forest by establishment type and ownership.

5.5.4 Development stage

Development stage categorises the maturity classes of the forest estate. The stages range from young post establishment forests to over-mature forests along with multi-storied forests.

In the ownership class Private (grant aided) a high proportion of small-pole and pole stage forests occur, indicating their readiness for thinning (Figure 23). Multi-storied forests comprise the largest element of Private (other) forests while the Public forests display a relatively high proportion of the high forest area.

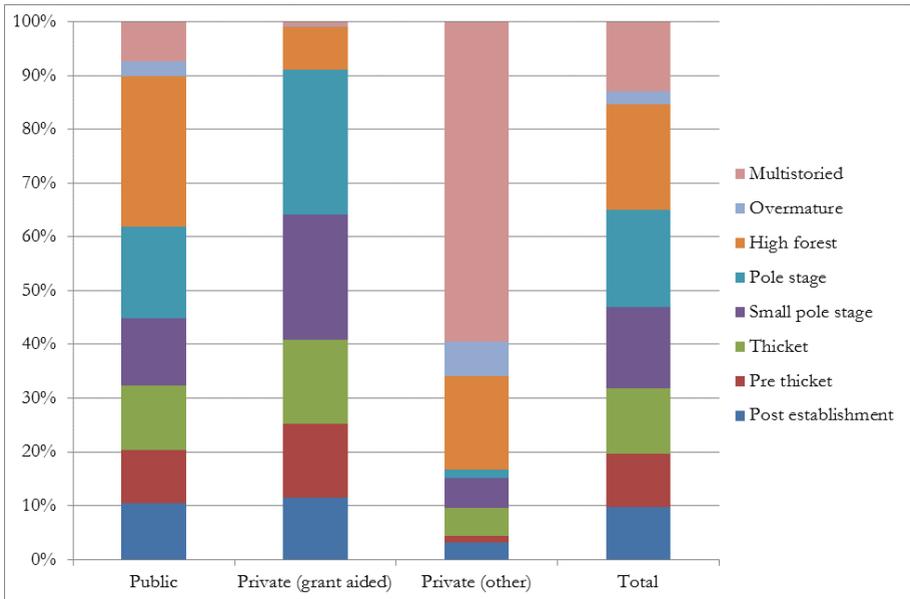


Figure 23. Proportion of the stocked forest by development stage by ownership.

5.5.5 Thin Status

Thin status describes the extent of thinning operations or absence of thinning operations in the national forest estate.

In terms of the thinning status, 16.5% of forests in the current rotation have been thinned or re-spaced at least once. Nearly half (45.7%) of forests are juvenile (i.e. at a development stage where they could not be thinned) and a further 12.7% was also deemed not suitable for thinning as it was classified as semi-natural forest or forest with a low stocking.

One quarter (25.1%) of forests are categorised as “no thin” (Figure 24). “No thin” is defined as the forest being at a development stage where it could be thinned in theory (taking into account species, height, basal area and stocking), but has not been thinned due to a variety of factors such as high windthrow risk, economic factors/considerations; or thinning may be imminent. Apart from the limiting factors described, these “no thin” forests generally offer the best potential for thinning.

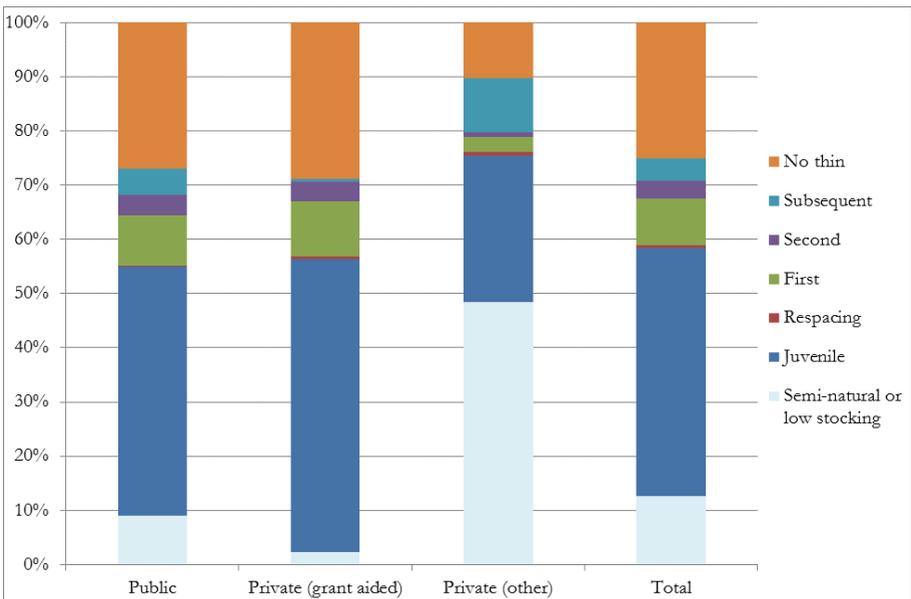


Figure 24. Proportion of the stocked forest by thin status and ownership.

5.6 SITE CONDITIONS

Site conditions in the forest estate are described in this section.

5.6.1 Soil Type

The majority (60.8%) of forests occur on mineral soils, with the remaining 39.2% on peats (Figure 25). Nearly, one-quarter of all forests are growing on highly productive gley soils while 40.4% of Private (grant aided) forests occur on these soils, reflecting forestry's move onto more productive soils since the mid to late 1980's.

Over the last 40 years, fewer forests are being afforested on peat (Figure 26). The proportion of minerotrophic peat being afforested has remained relatively static overtime, largely as a result of the afforestation of land that was reclaimed for agriculture. Afforestation of ombrotrophic peat is declining, reflecting a shift away from the unenclosed land type.

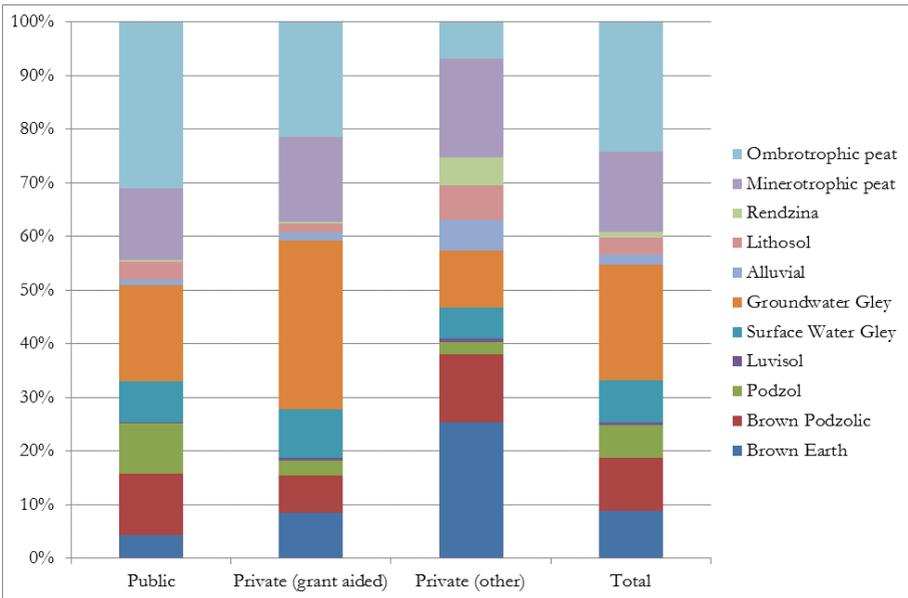


Figure 25. Proportion of the stocked forest by soil group by ownership.

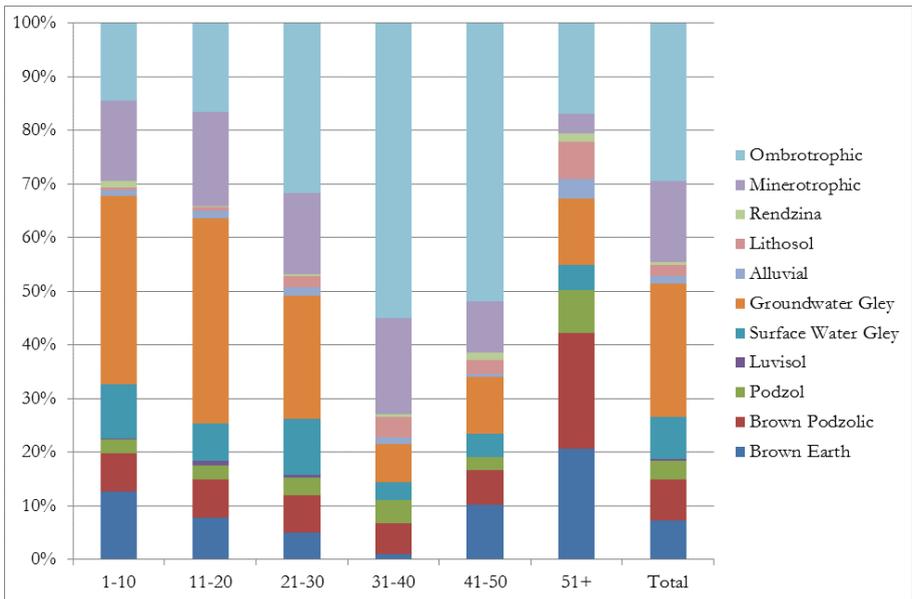


Figure 26. Proportion of total afforested area by age class (10 year) and soil group.

5.6.2 Environmental Designations

There are a number of environmental designations³ that affect forest management but do not significantly restrict timber harvesting. Over half (50.4%) of the forest area had one or more environmental designation (Figure 27).

Nine environmental designations are included with some having greater affects than others in terms of restricting forest management operations (Figure 28). The increase in hen harrier SPA designations has resulted in considerable areas being designated since 2006. Restrictions on the timing of felling, in relation to the protection of Hen Harriers, occurs within the Higher Likelihood Nesting Areas (HLNA), which include 3.8% of the total forest area.

³ Designations include: Special Area of Conservation (SAC); Special Protection Area (SPA); National Heritage Area (NHA); Fresh Water Pearl Mussel (FPM); Nature Reserve; National Park; Fisheries Sensitive, Acid Sensitive and Hen Harrier Higher Likelihood Nesting Area (HLNA).

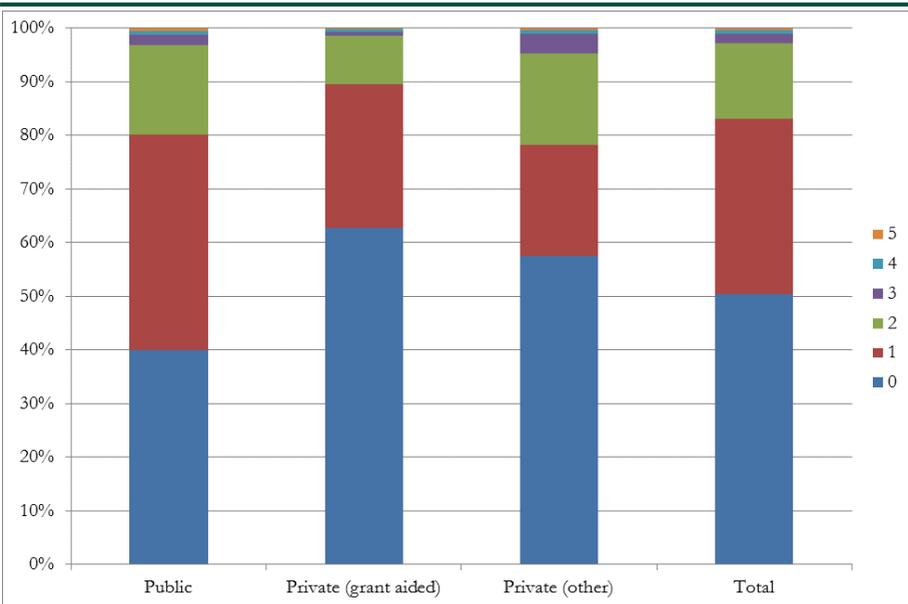


Figure 27. Proportion of total forest area by ownership and number of environmental designations.

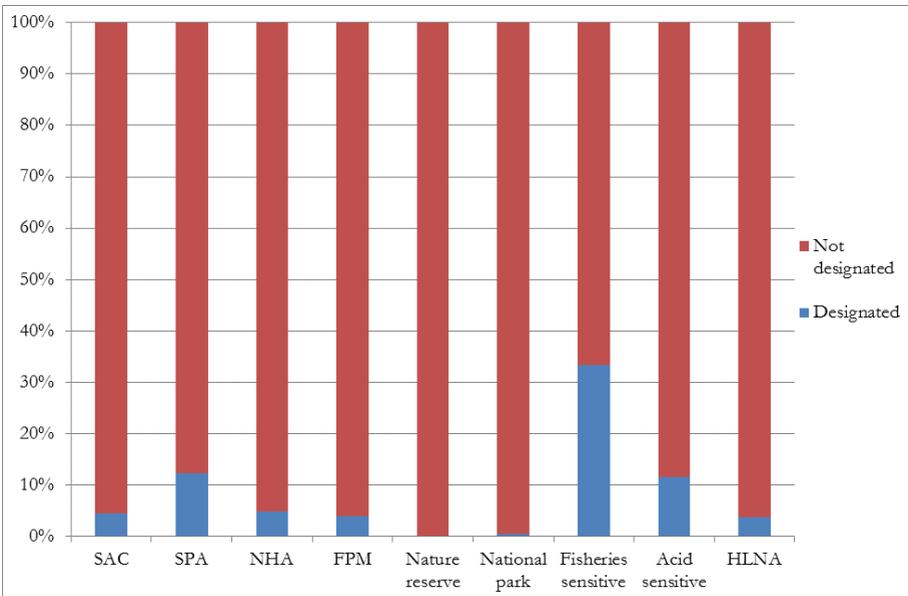


Figure 28. Total forest area by environmental designations.

5.7 GROWING STOCK VOLUME AND BASAL AREA

Information on growing stock and basal area provide essential information about the actual production of the forest estate.

5.7.1 Basal Area

Basal area is the term used in forest management that defines the area of a given section of land that is occupied by the cross-section of tree stems at height of 1.3 m from the tree base. The average basal area for all Irish forests is 27.5 m² per ha. The Private (grant aided) estate basal area increased from 21 m² per ha to 27.1 m² per ha between 2012 and 2017, due to the rapid growth phase of these forests and the low levels of harvesting (Table 5).

Table 5. Basal area (m²/ha) by ownership (2006 to 2017).

Ownership	2006	2012	2017
Public	24.1	27.0	27.1
Private (grant aided)	10.7	21.2	27.1
Private (other)	26.3	29.6	27.8
Total	20.2	25.3	27.5

5.7.2 Growing Stock Volume

The total standing growing stock volume is estimated to be over 116 million m³, an increase of over 19 million m³ on the 2012 volume; while the share of growing stock volume has nearly tripled in the Private (grant aided) forests over this same time period. The gap between public and private forest growing stock volume has been closing in, with the latter's share expanding from 28% in 2006 to 44% in 2017 (Table 6).

Table 6. Growing stock (1000's m³) by ownership (2006 to 2017).

Ownership	2006		2012		2017	
	1000's m ³	%	1000's m ³	%	1000's m ³	%
Public	51,713	72.0	60,405	62	64,783	55.6
Private (grant aided)	7,490	10.4	21,824	22.4	34,090	29.3
Private (other)	12,658	17.6	15,247	15.6	17,651	15.1
Total	71,860	100	97,476	100	116,525	100

In terms of broad species groups, 80.6% of growing stock volume refers to conifer species, while 19.4% is contained in broadleaf species. Sitka spruce contains 58.5% of the growing stock, followed by other pines at 9.4% (Figure 29). Counties in the west of Ireland have the highest proportion of growing stock, with Co. Cork having the highest volume at 14.4 million m³ (Figure 30 and 31).

Note:

The difference in growing stock between time periods does not represent the total increment, as the increment of trees which have been felled or have died during the reference period are not included. See Section 5.8.1 for details on gross volume increment.

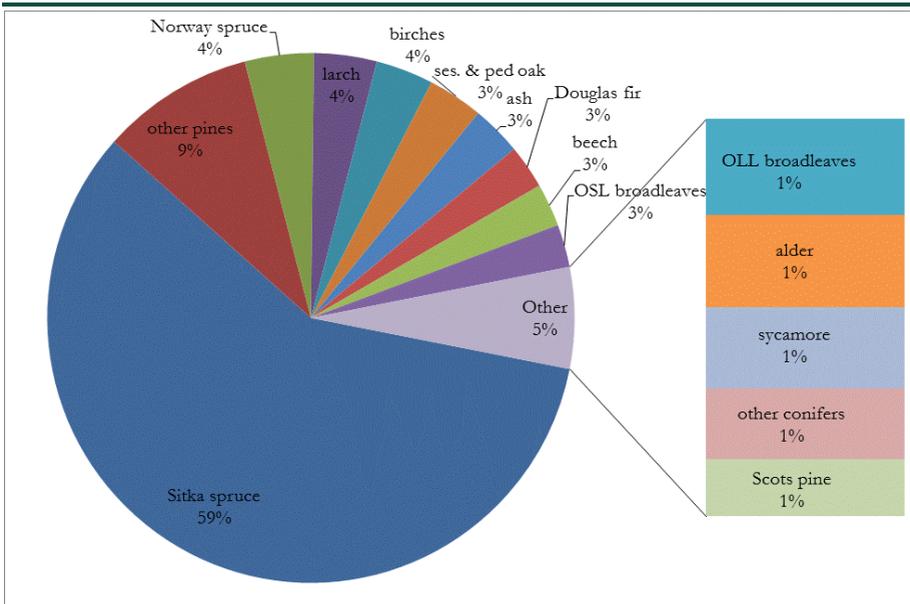


Figure 29. Proportion of growing stock (m³) by species group.

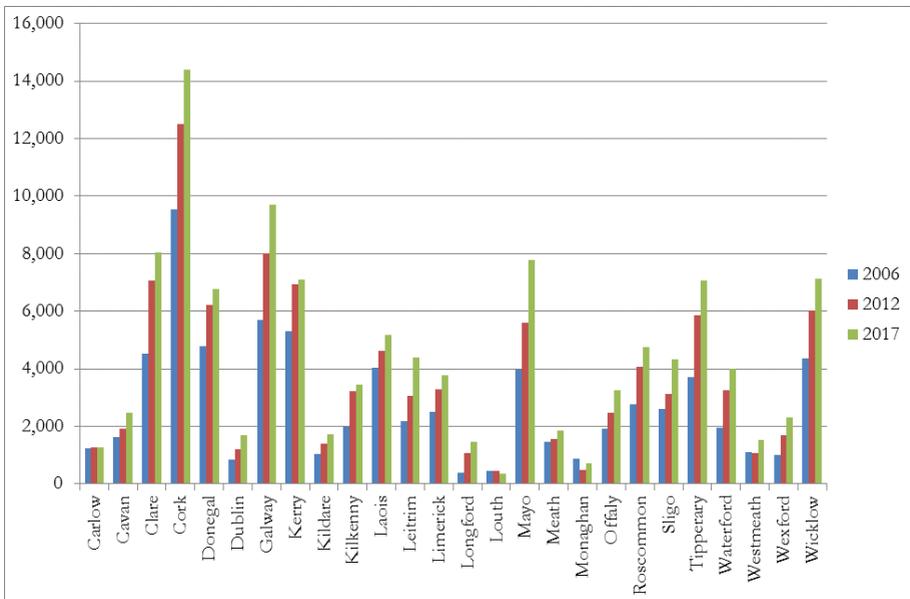


Figure 30. Total growing stock (1,000's m³) by county (2006 to 2017).

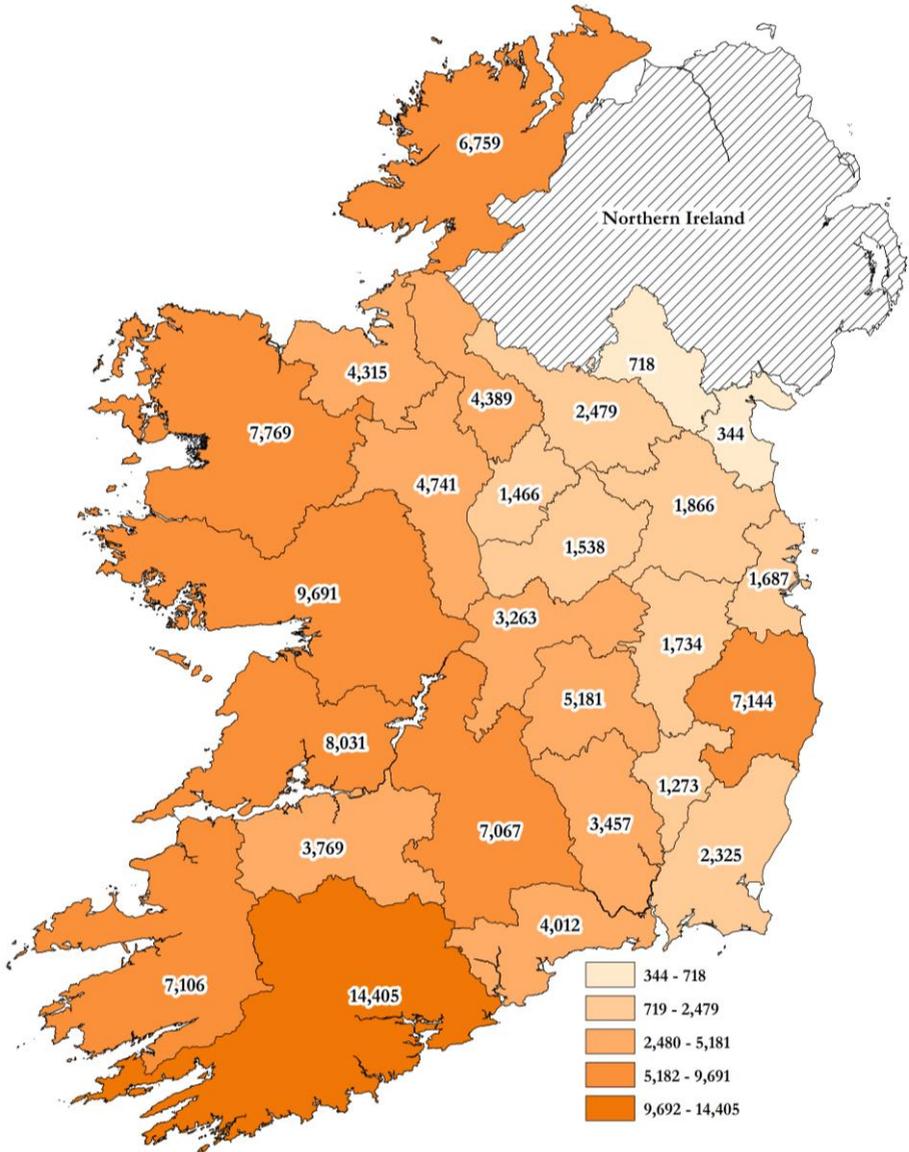


Figure 31. Distribution of growing stock volume (1,000's m³) by county.

5.8 INCREMENT AND FELLINGS

The balance between increment and fellings is an important indicator of SFM in a country as it describes the sustainability of wood production over time, the current availability of wood and the potential for the future. The completion of three NFI cycles creates a time-series to assess forest increment and felling in Ireland for the entire forest estate over a 10-year period.

5.8.1 Gross Volume Increment

Gross volume increment is defined as the volume growth on trees ≥ 7 cm Dbh and includes the increment of trees which have been felled or have died during the reference period.

Gross annual volume increment between 2013 and 2017 was 8.5 million m³ per year. Over half (54.6%) of the increment occurred in the Public forest estate (Table 7). The counties with most significant growing stock increment are distributed on the western and south western seaboard (Figure 32).

Table 7. Gross annual volume increment by ownership (2006 to 2017).

Ownership	2006-2012		2013-2017	
	1000's m ³	% Total	1000's m ³	% Total
Public	4,702	61.2	4,656	54.6
Private (grant aided)	2,392	31.1	3,373	39.5
Private (other)	591	7.7	503	5.9
Total	7,685	100	8,532	100

Sitka spruce dominates the volume increment in terms of species groups comprising 71.8 % of the annual volume increment followed by other pines at 7.5 % (Figure 33).

The mean net annual increment is 12.1 m³/ha/year in the stocked forest estate. Public forests average 12.5 m³/ha/year and Private (grant aided) 14.8 m³/ha/year, with Private (other) significantly lower at 4.5 m³/ha/year (Figure 34). The differences are due to a combination of age, species composition and soil type.

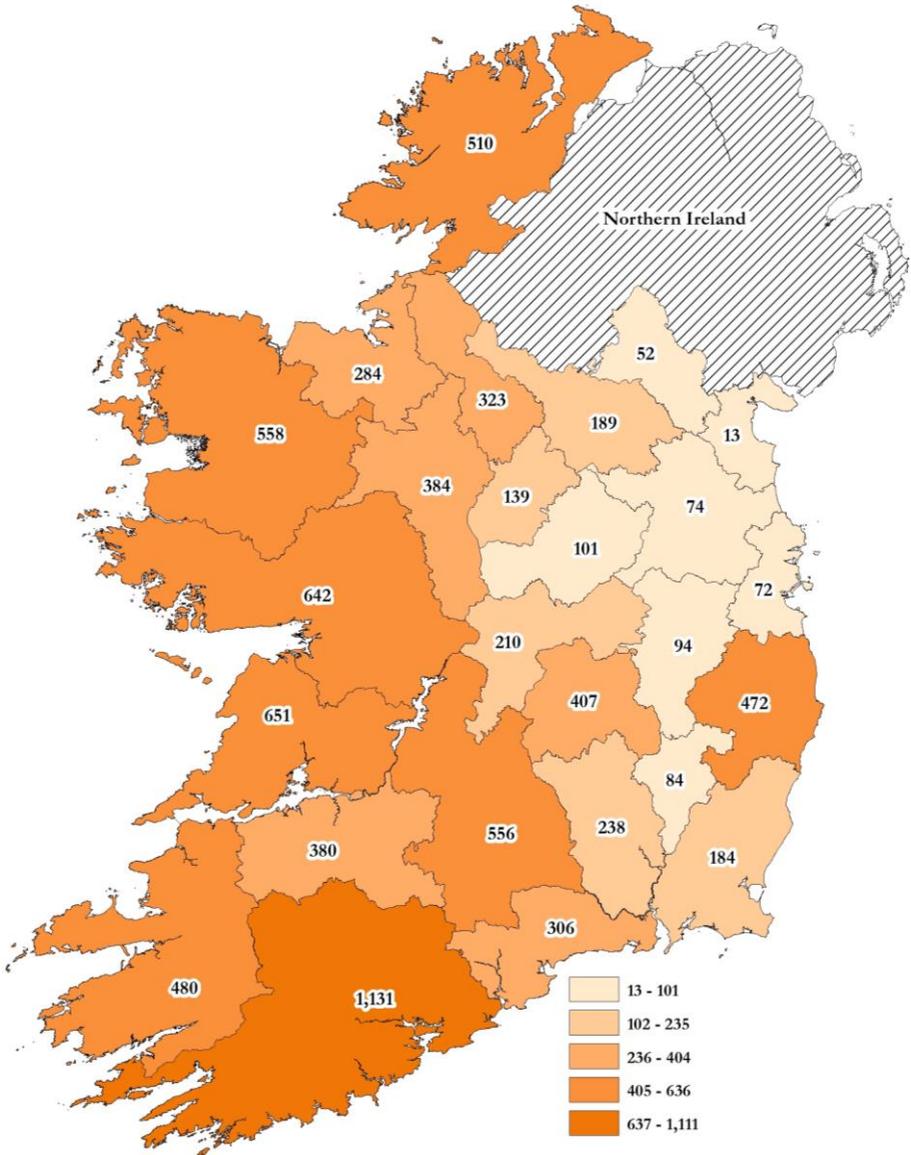


Figure 32. Distribution of gross annual volume increment (1,000's m³) by county.

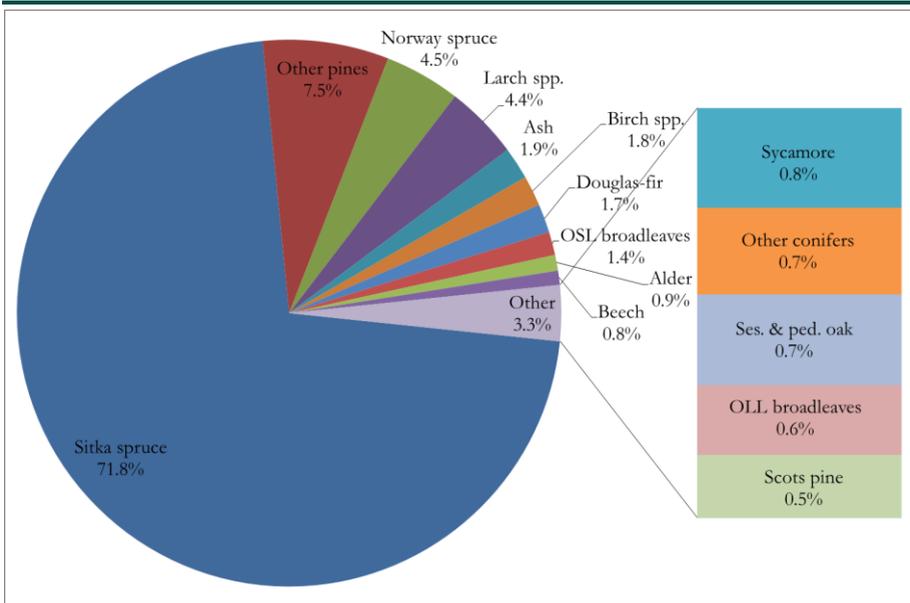


Figure 33. Gross volume annual increment by species group.

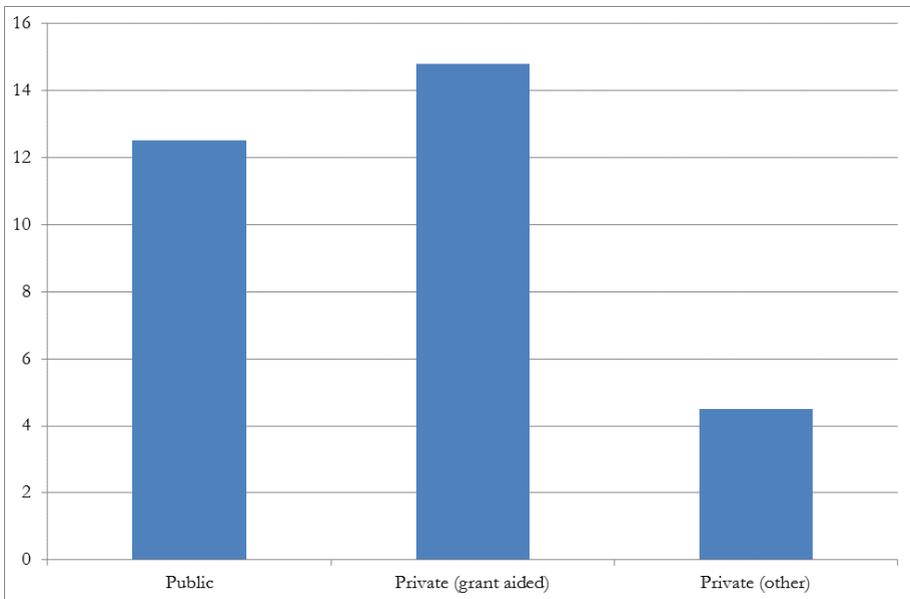


Figure 34. Mean net annual volume increment per hectare by ownership (m³/ha/year).

The county with the highest mean annual volume increment is Longford at 17.3 m³/ha/year (Figure 35). Low increment levels result from one or more of the following factors; high proportion of broadleaves, very young forest and low productivity sites.

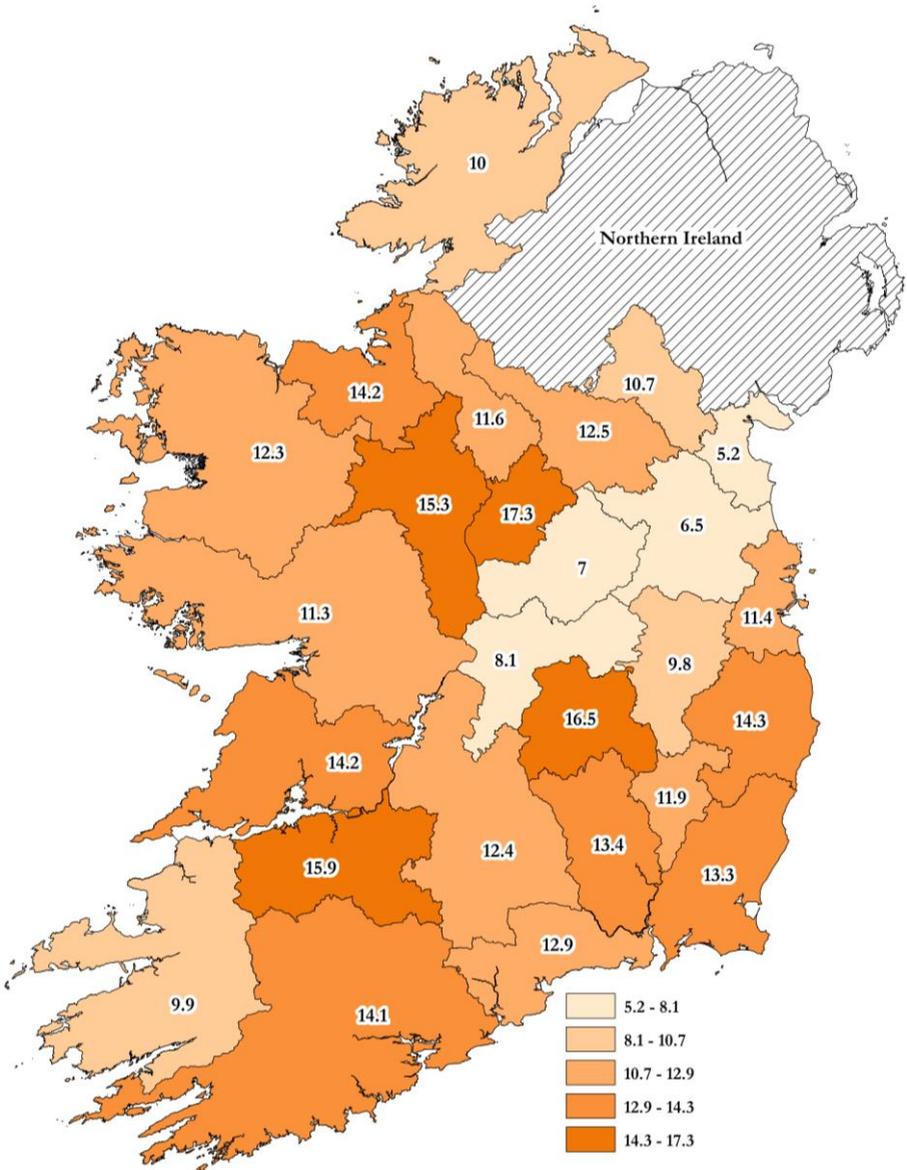


Figure 35. Mean net annual volume increment per hectare per county (m³/ha/year).

5.8.2 Fellings

The extent of felling interventions that occurred within the forest between NFI cycles is detailed in Table 8. It is important to note that the timespan within each cycle differs, from 5.95 years (2006-2012) to 4.66 years (2013-2017), which means any change in the later period is more significant in real terms. The area clearfelled has increased by 5,985 ha, which is a significant increase. Also, first thinning area has increased between 2012 and 2017, which is a positive trend for wood mobilisation.

Table 8. Forest area by felling intervention (2006-2017).

Felling intervention	2006-2012		2013-2017	
	Area (ha)	% Total	Area (ha)	% Total
no intervention	561,471	85.8	582,598	84.8
first thinning	34,441	5.3	36,446	5.3
second thinning	7,618	1.2	16,841	2.4
subsequent thinning	14,412	2.2	9,616	1.4
clearfell	36,038	5.5	42,023	6.1
Total	653,980	100	687,525	100

The mean annual standing volume felled between 2013 and 2017 is 4.9 million m³ per year (Table 9), which represents over half (58%) of the gross annual increment. The volume felled between 2013-2017 showed an increase of 1.28 million m³ over the period 2006-2012, which is a positive indicator of wood mobilisation.

Table 9. Mean annual volumes felled by ownership (2006-2017).

Ownership	2006-2012		2013-2017	
	1000's m ³	% Total	1000's m ³	% Total
Public	3,152	87.1	3,780	77.2
Private (grant aided)	208	5.8	792	16.2
Private (other)	256	7.1	324	6.6
Total	3,616	100	4,896	100

The estimate of mean annual standing volume felled between 2013 and 2017 from the NFI is significantly higher when compared to other published estimates. For the period 2013-2016, the annual average roundwood harvest is estimated to be 3.189 million m³ by COFORD⁴. The primary difference between these two estimates is the NFI volume estimate is standing in the forest, whereas the COFORD estimate represents the roundwood available for processing or in other words what crosses the sawmill weighbridge. This difference is represented by the losses associated with harvesting, which could range from 5 to 25% depending on the type of forest being harvested. Further analyses will be required to get a full understanding of the reasons for the differential between the NFI and COFORD estimates.

⁴ Knaggs, G. and O'Driscoll. 2016. Woodflow and forest-based biomass energy use on the island of Ireland (2016). Coford Connects Note Processing/Products No. 48. COFORD Dublin.

Clearfelling - the felling of a continuous block of trees - is the dominant harvest type for all ownership groups, accounting for 75.8% of the fell volume in the national forest estate (Figure 37).

First thinning accounts for 13.2% of the fell volume, and is particularly prevalent in the Private (grant aided) forests representing nearly one-third of the volume felled.

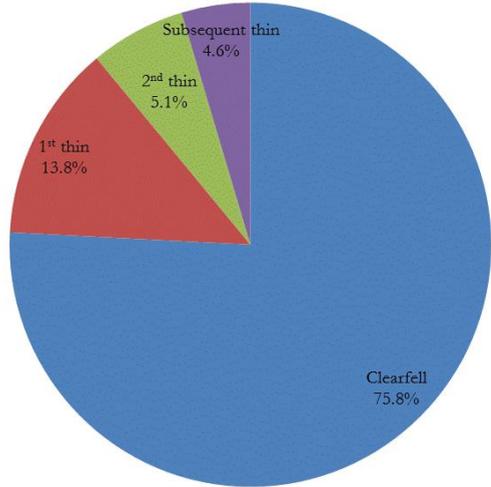


Figure 37. Fell volume by harvest type.

Fell volumes are concentrated in Public forests which accounted for 77.2% of mean annual volume felled between 2012 and 2017. In terms of broad species categories 96.5% of the mean annual volume felled comes from coniferous species (Figure 36). Sitka spruce accounted for 81.3% of the share of the mean annual felled volume, followed by others pines at 5% and Norway spruce comprising 3.1%.

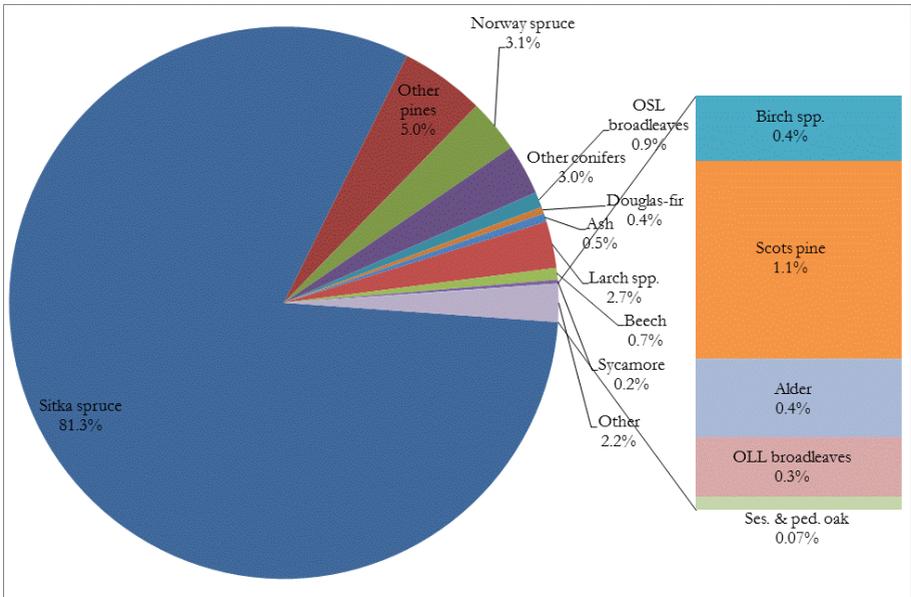


Figure 36. Proportion of total fell volume by species group.

5.8.3 Fell Mean Tree Volume

The mean tree volume of felled trees in Irish forests is 0.37 m³. The felled mean tree, according to harvest type, ranges from 0.20 m³ in first thinning operations to 0.47 m³ at clearfell (Table 10).

Table 10. Fell mean tree volume by harvest type.

Harvest Type	1 st thin	2 nd thin	Subsequent thin	Clearfell	All
Tree Volume (m ³)	0.20	0.27	0.38	0.47	0.37

In terms of mean tree volume size, over half (51.1%) of the total clearfell volume comes from trees 0.5 m³ or less. In 1st thinning, 82% of the volume comes from trees that are 0.24 m³ or less (Figure 38).

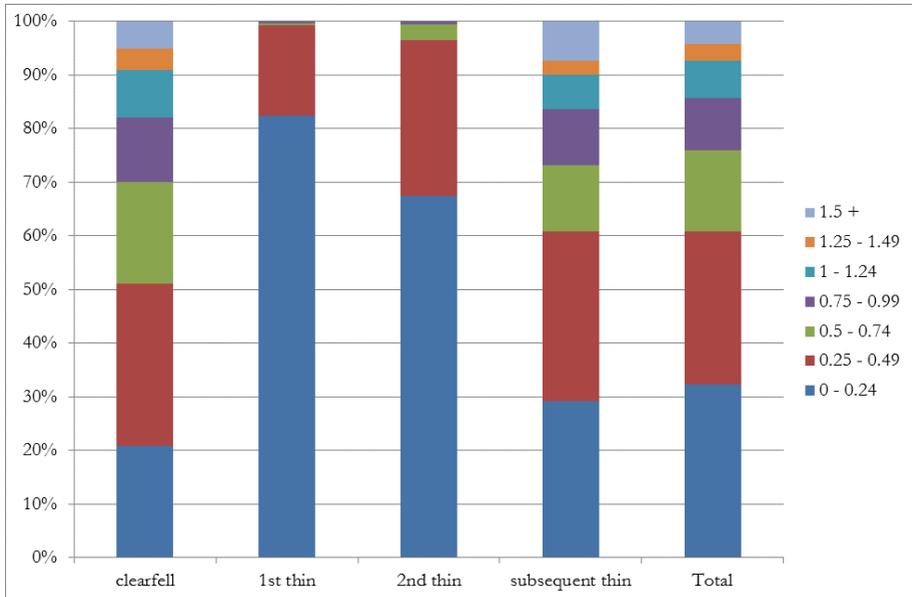


Figure 38. Mean annual standing volume (m³) felled by harvest type and mean tree volume (m³) class.

5.9 FOREST CARBON

Forests play an important role in mitigating climate change by sequestering and storing atmospheric carbon dioxide (CO₂). Sequestration is the net removal of CO₂ from the atmosphere, and storage in plant biomass, deadwood and harvested wood product pools (Figure 39). CO₂ is taken up during photosynthesis and stored as biomass accumulates. Some carbon is released back into the atmosphere due to autotrophic respiration and from the forest deadwood, litter and soils pool due to decomposition. Sustainably managed forests are a net absorber of carbon. However, unmanaged and degrading forests eventually become a net emitter of carbon back into the atmosphere. Large emissions can also occur during catastrophic disturbance events, such as fires and windthrow. About half of carbon in harvested timber is stored in wood products (HWPs) but these carbon stores are eventually released back into the atmosphere unless it is recycled or used for bioenergy. Use of wood for bioenergy replaces fossil fuel use and reduces overall emissions. Fossil fuel emissions can also be reduced by substituting energy intensive materials with wood products (i.e. product substitution).

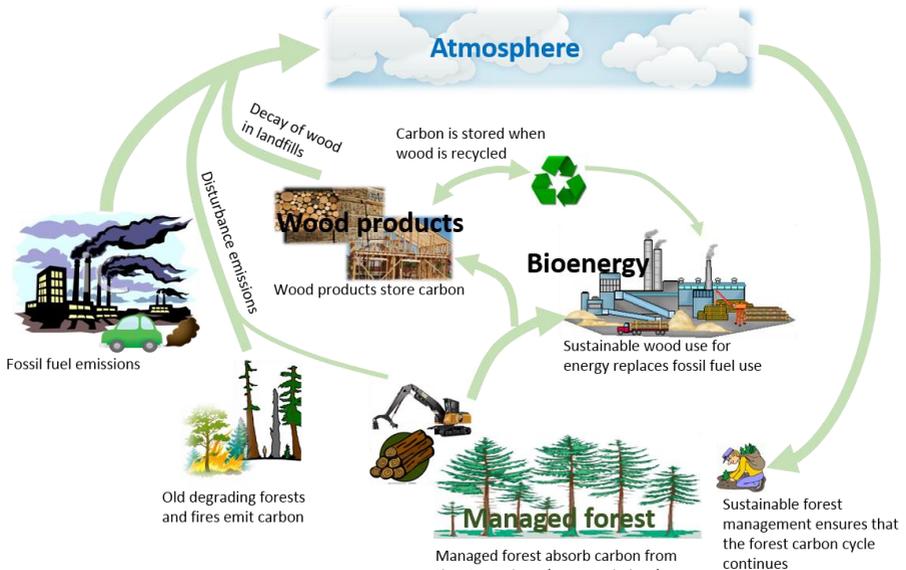


Figure 39. The role of forests and harvest wood products in the carbon cycle.

5.9.1 NFI Carbon Stocks

The amount of carbon (C) present in forests (i.e. the C stock) provides an estimate of the total accumulation of C to a specific point in time. The NFI measures C stocks in the forest pool, which include aboveground biomass (stems, leaves and branches), belowground biomass (Stumps and roots to a minimum diameter of 5 mm), litter (fallen

needles/leaves and branches >7cm diameter), deadwood (harvest residue, dead trees) and soils.

The estimates of C stock for each plot were calculated using Ireland's carbon reporting system, CARBWARE (Duffy et al., 2017⁵, Black, 2016⁶). This system was developed to meet reporting requirements to the United Nations Framework Convention on Climate Change (UNFCCC).

Note:

Since 2012 changes have arisen in the NFI methodology and, biomass estimation techniques. More accurate biomass equations, new classification systems and associated C stock values were introduced for soil and deadwood . Therefore the 2017 data are not comparable with the C stock estimates from 2006 and 2012.

The results presented in Table 11 show the forest C stock in the five different pools. The carbon stock in forest soils is the dominant component, accounting for 79.1% of the carbon stock in the forest estate in 2017. Biomass C pools represent a small proportion of the total C stock, but these are subject to the largest variation from year to year due to harvesting and disturbance events (e.g. fires and windthrow). Total living tree biomass amounts to 17.9% of the total carbon stock, while deadwood, including logs, stumps and standing dead trees along with litter constitutes the remaining 3%.

Table 11. Forest Carbon stock 2006 - 2017.

Carbon Stock	2006		2012		2017	
	Million tonnes	% Total	Million tonnes	% Total	Million tonnes	% Total
Above-ground	30.6	8.9	39.7	10.4	45.6	14.6
Below-ground	6.7	1.9	8.8	2.3	10.3	3.3
Deadwood	1.2	0.4	2.5	0.6	2.1	0.7
Litter	2.5	0.7	6.3	1.6	7.1	2.3
Soil	304.9	88.1	323.7	85.1	246.6	79.1
Total	345.9	100	381.0	100	311.7	100

The carbon stock in the living tree biomass was 55.9 million tonnes in 2017, with Sitka spruce and 'other pine' species the predominant contributors (55.9%) (Figure 40). From an ownership perspective, the Public, Private (grant aided) and Private (other) forest estates account for 52.7%, 34% and 13.3% respectively of the carbon stock in the living tree biomass (Figure 41).

⁵ Duffy, B. Hyde, E. Hanley, O'Brien, P. J. and Black, K. 2017. National inventory report greenhouse gas emissions 1990 – 2015 Reported to the United Nations Framework Convention On Climate Change, EPA, Dublin.

⁶ Black K. 2016 Description, calibration and validation of the CARBWARE single tree-based stand simulator. Forestry 86(1):55-68.

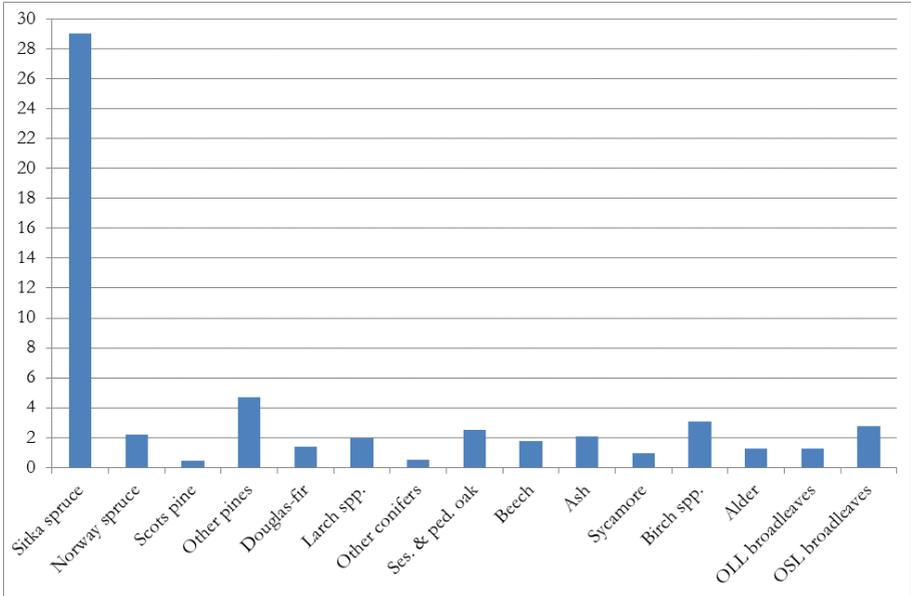


Figure 40. Total living tree carbon stock (Million tonnes) by species group (2017).

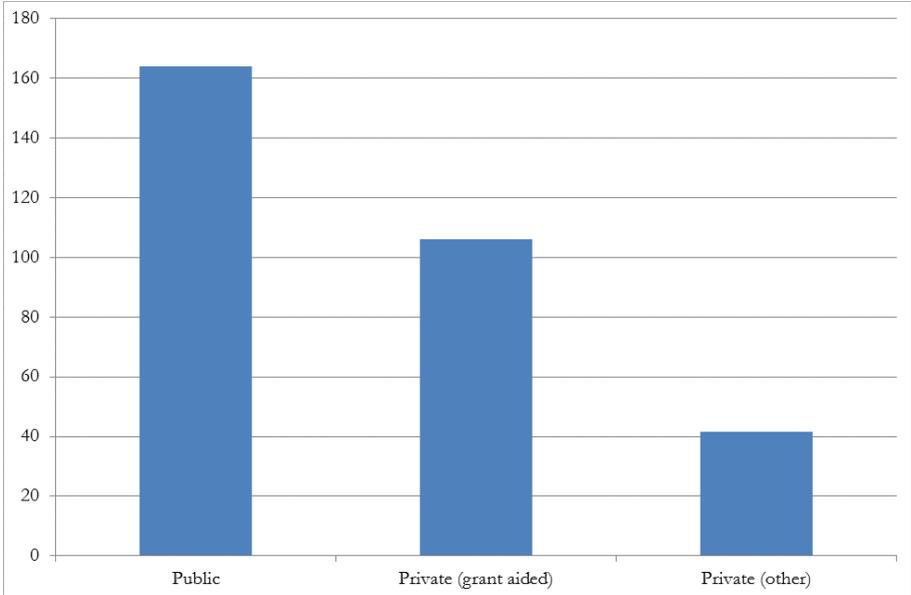


Figure 41. Total carbon stock (Million tonnes) by ownership type (2017).

5.9.2 Net greenhouse emissions and removals from forests

CARBWARE was designed to use NFI data as input variables to estimate C stock and C stock changes at a national level. It is important to note that C stock changes or net removal or emission of C (net C sequestration) from the national forest estate is dependent on other factors which are not measured in the NFI. These include CO₂ and non-CO₂ emissions from fires, drained organic soils, application of fertilisers. Therefore, the estimation of these factors was derived from other data sources (Duffy et al., 2017).

Data from the NFI, such as individual tree information, soils, deadwood, amount of harvest removed and area deforested, has been incorporated into the CARBWARE model software to produce annual estimates of greenhouse gas (GHG) emissions/removals since 2006 (Figure 42). The annual estimates are used to report Ireland's national forest emission removals to the UNFCCC and the Kyoto protocol (Duffy et al., 2017). The estimates include emissions for fires, organic soils, fertilisation, harvest mortality, and decomposition of litter and deadwood and removals due to biomass growth and accumulation of litter and deadwood. Removals by harvested wood products (HWP) are derived using FAO and EUROSTAT data, but these results are not presented in this report (for full description of GHG estimates see Duffy et al., 2017).

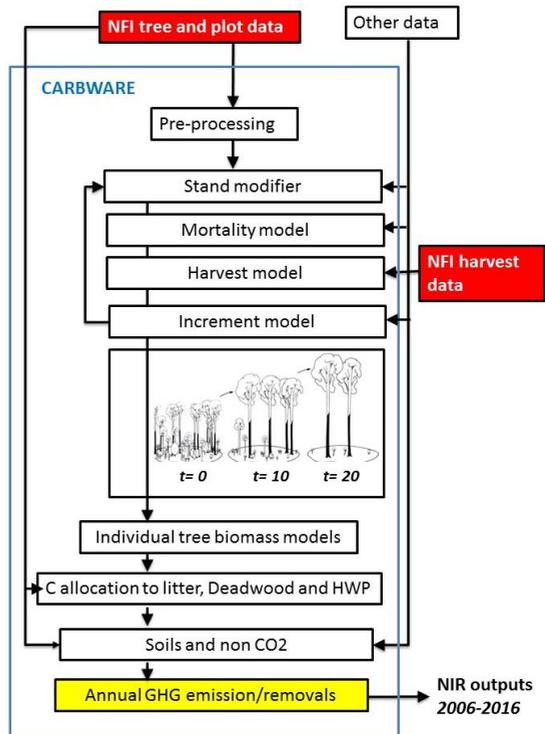


Figure 42. Description of the CARBWARE model inputs from the NFI and outputs from the software for annual estimation of forest GHG emissions/removals (Adapted from Black, 2016).

Based on the NFI data, Ireland's forests have removed (sequestered) an average of 3.8 Mt of Carbon dioxide equivalents (CO₂ eq.) per year from the atmosphere over the period 2007 to 2016 (Table 12). These estimates exclude HWP and emissions for deforestation. The trends in forest GHG removals are related to the level of annual harvest, tree mortality, extent of historical afforestation and changes in the age class structure of the national forests over time (see Black et al., 2012⁷). Negative CO₂ values represent a net removal of CO₂, but negative C values represent a net loss of C. Mineral soils are currently assumed to result on a zero C stock change. NFI information on forest management interventions will also be critical in determining the Irish forest management reference levels in efforts to meet the CO₂ emission reduction targets of the 2015 Paris Agreement.

Table 12. Changes in C fluxes for biomass, litter and deadwood and soil C pools and net CO₂ emissions (positive) or removals (negative) from 2007-2016.

Year	Carbon Stock Changes (million tonnes C)					Removals (million tonnes CO ₂ eq.)		
	Living biomass			Litter & Dead- wood	Organic soils	CO ₂	non- CO ₂	Total
	Gain	Loss	Net	Net	Net			
2007	3.74	-2.77	0.98	0.24	-0.25	-3.56	0.23	-3.33
2008	3.89	-2.49	1.40	0.20	-0.25	-4.96	0.23	-4.72
2009	4.02	-2.67	1.35	0.27	-0.25	-5.02	0.23	-4.79
2010	4.15	-3.05	1.10	0.33	-0.25	-4.33	0.26	-4.07
2011	4.15	-3.12	1.03	0.33	-0.25	-4.08	0.25	-3.83
2012	4.13	-3.34	0.78	0.40	-0.25	-3.43	0.24	-3.19
2013	3.97	-3.13	0.84	0.44	-0.25	-3.76	0.25	-3.51
2014	3.96	-3.33	0.62	0.58	-0.25	-3.49	0.25	-3.24
2015	3.97	-3.29	0.68	0.62	-0.25	-3.86	0.25	-3.61
2016	4.04	-3.24	0.80	0.51	-0.25	-3.88	0.25	-3.64

⁷ Black, K., Hendrick, E., Gallagher, G., Farrington, P. (2012). Establishment of Ireland's projected reference level for Forest Management for the period 2013-2020 under Article 3.4 of the Kyoto Protocol. *Irish Forestry* 69: 7-32.

5.10 HEALTH AND VITALITY

The NFI is the only systematic national assessment of forest damage in Irish forests. Information is collected on forest damage at the individual tree and plot level. Forest health and vitality is affected by both abiotic (e.g. wind) and biotic (e.g. deer) factors. The types of forest damage recorded are those which are most common or cause most damage to Ireland's forests.

5.10.1 Forest Damage

In the NFI, damage to forest health is considered to be an alteration of the normal growth pattern of the trees. This definition therefore encompasses a wide range of factors, some of which would not have been traditionally considered as damage agents (e.g. nutrition).

Over half (56%) of stocked forest areas have no forest damage present (Figure 43). Abiotic damage was recorded on 136,547 ha or 19.9% of the forest area and biotic damage was recorded on 110,448 ha or 16.1% of the forest area. Both abiotic damage and biotic damage was recorded on 55,704ha or 8.1% of the forest area.

While nearly half of stocked forest areas displayed signs of forest damage present, the following sub-sections will show that the overall severity of the damage was low.

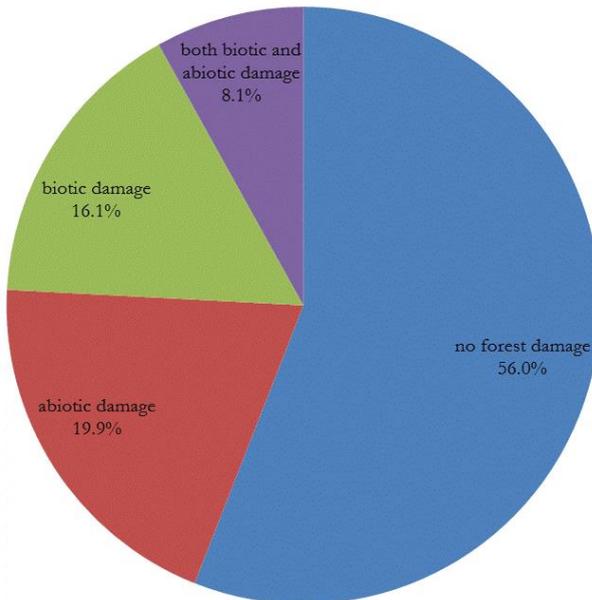


Figure 43. Damage presence in Ireland's forest estate.

5.10.2 Biotic

Biotic damage was recorded on 166,152 ha or 24.2% of the forest area. Damage caused by animals (e.g. browsing by deer) was the most common type of biotic damage, followed by vegetation competition and harvesting operations (Figure 44).

Phytophthora ramorum was first detected in Japanese larch in 2010 and at the end of 2016 was confirmed present in this tree species at a total of 48 locations. The first detection of *Hymenoscyphus fraxineus* (previously referred to as *Chalara fraxinea*) in Ireland was in October 2012. At the end of 2016 the disease had been confirmed present on ash at a total of 322 plantations, distributed over 24 counties. Despite the widespread nature of these diseases, the total area affected is small and only one forest plot was classified as having a disease present. The systematic nature of NFI sampling grid is not conducive to accurately report on such small areas statistics.

Note that forest areas may have more than one type of biotic damage present. Therefore, if the forest area associated with each damage agent is added together, the overall total will be higher than the 166,152 ha stated above due to duplication.

In terms of damage severity, 3.3% of the areas with biotic damage present display critical levels of damage. This indicates that the damage agent has critically impacted tree growth and the damage agent is expected to kill trees in the future.

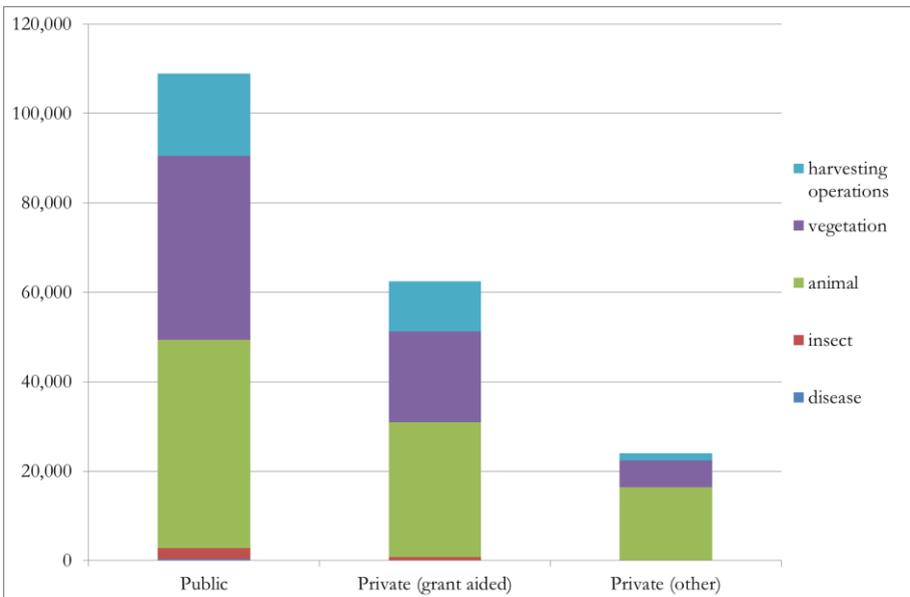


Figure 44. Overview of forest area (ha) by ownership effected by biotic damage agent.

5.10.3 Abiotic

Abiotic damage was recorded on 192,251 ha or 28.2% of the forest area. Damage caused by climatic factors (e.g. windthrow) was the most common type of damage, followed by nutrient deficiency and anthropogenic factors (Figure 45).

Note that forest areas may have more than one type of biotic damage present. Therefore if the forest area associated with each damage agent is added together, the overall total will be higher than the 192,251 ha stated above due to duplication.

In terms of damage severity, 25.6% of the areas with abiotic damage present display critical levels of damage. This indicates that the damage agent has critically impacted tree growth and the damage agent is expected to kill trees in the future.

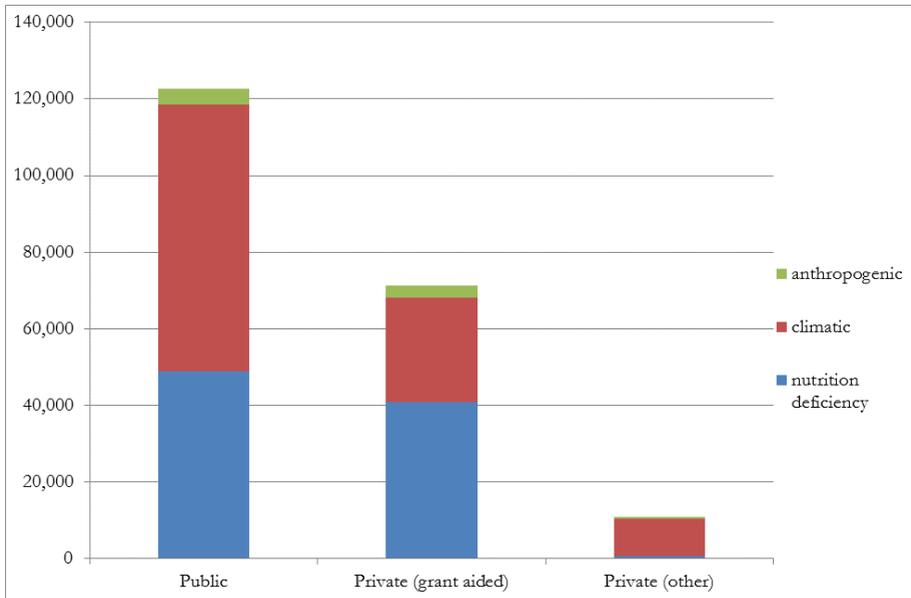


Figure 45. Overview of forest area effected by abiotic damage by ownership (ha).

5.11 DIVERSITY AND DEADWOOD

Ireland, positioned at mid-latitudes, is warmed by the Gulf Stream and experiences a very favourable climate promoting plant growth and diversity.

5.11.1 Tree Diversity

Tree species diversity in our forests enhances the appearance of the landscape, creates wildlife habitats, protects forest health and provides a variety of timbers that can be used in a wide range of end uses.

The range of tree species in Irish forests is influenced by inherent site characteristics. Given the significant proportion (39.2%) of the national forest estate growing on peats, there are limitations on the range of tree species that can be grown.

Nearly three quarters (74.1%) of Ireland's forests have two or more tree species present (Figure 46). In terms of tree diversity, the most diverse cohort of Ireland's forests are the Private (other) category, comprising of at least four or more tree species in 57.9% of the area.

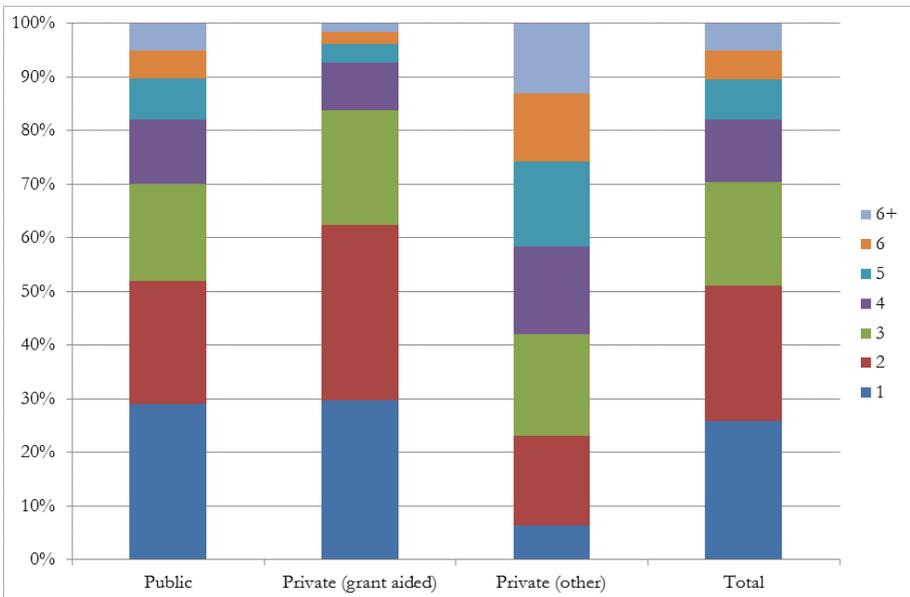


Figure 46. Proportion of the forest area by ownership and number of tree species.

5.11.2 Plant Diversity

The assessment of plant diversity is an important indicator which can be used in the monitoring of SFM. The structure and range of the vegetation present will also be indicative of the insect diversity.

Nearly half (49.3%) of the forest area has vegetation coverage of greater than 90%, excluding the tree species present. The Private (other) cohort contains the most diversity with 80% of the area having nearly a vegetation coverage of greater than 75% (Figure 47).

The range of plant species in Irish forests is influenced by the inherent site characteristics and the type of forest present. All stocked forest areas have at least 1-5 different plant species present and over 80.5% have between 6 and 21+ plants species present (Figure 48).

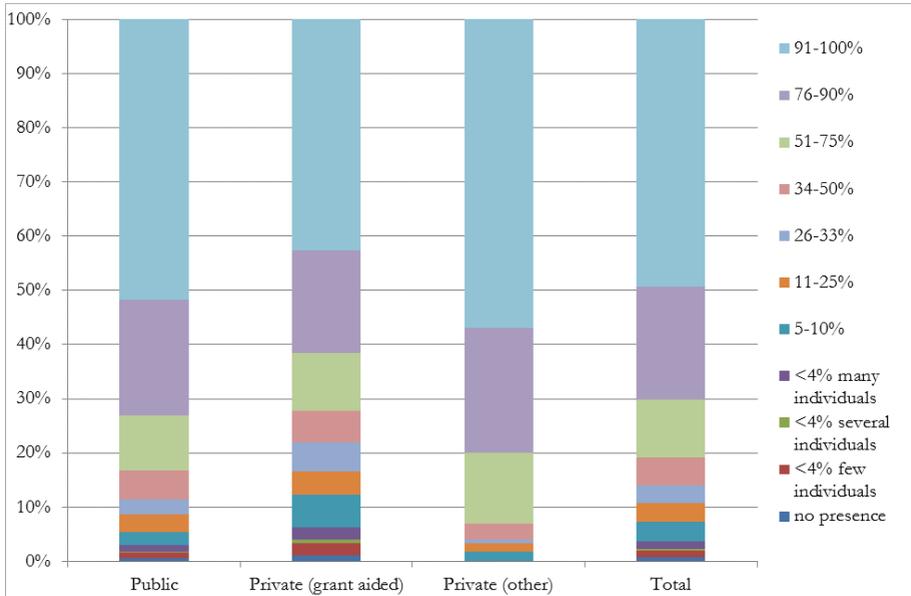


Figure 47. Proportion of the forest area by ownership and occurrence of vegetation cover.

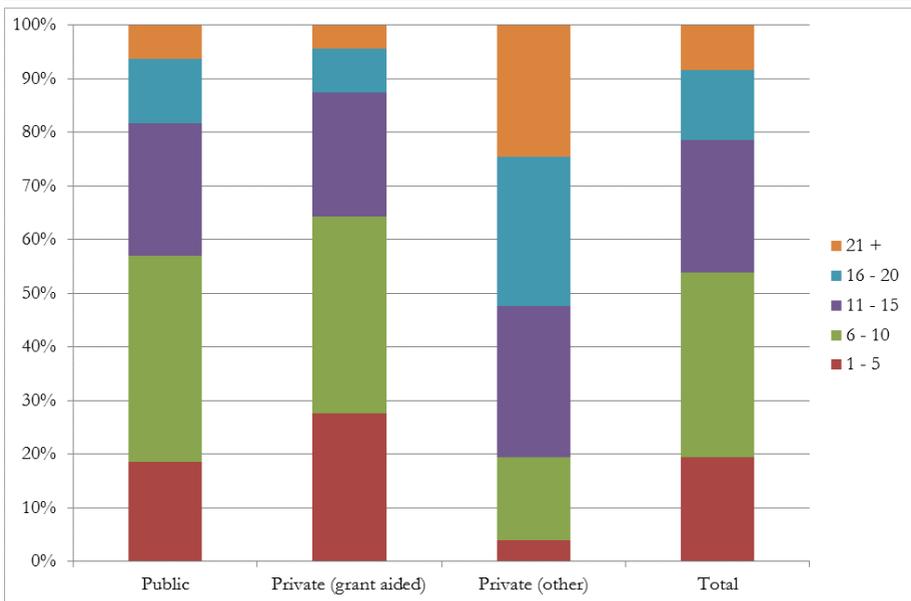


Figure 48. Proportion of forest area by ownership and number of plant species.

5.11.3 Deadwood

Large woody material contains very significant stores of carbon and energy and is the foundation of an important forest food web. This large material usually decays more slowly and therefore provides a steady input of energy and longer-lasting structures for the ecosystem. Deadwood also provides habitat for plants, animals and insects and a source of nutrients for soil development.

There are 10.4 million m³ of deadwood in the forest estate. Nearly half (48.97%) of all deadwood is lying on the forest floor (Figure 49).

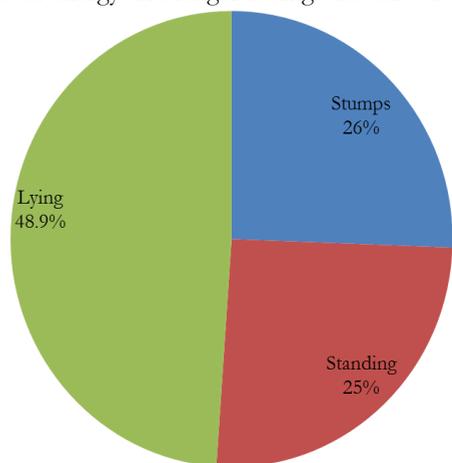


Figure 49. Proportion of deadwood volume by deadwood type.

The Public forest estate has the majority (76.3%) of the deadwood, due primarily to the relatively high level of harvesting occurring in these forests (Figure 50). As the Private (grant aided) estate is only entering the production phase, deadwood amounts are low.

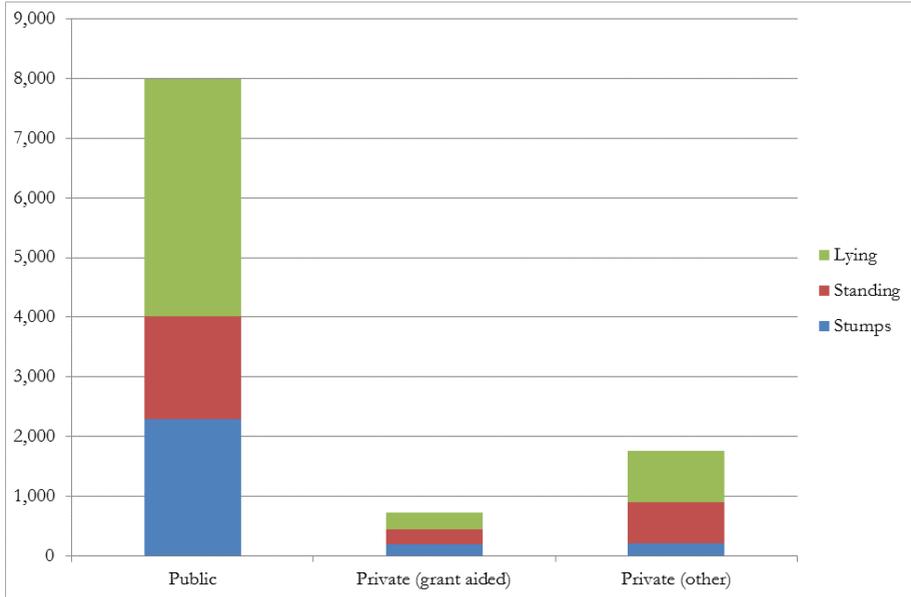


Figure 50. Total deadwood volume by ownership (1,000's m³).

Glossary

Age	The number of growing seasons since initial planting or natural regeneration.
Afforestation	The man-made establishment of new forests on treeless lands which did not carry forest in contemporary history. Implies a transformation from Non-Forest to Forest.
Basal Area	The cross-sectional area of a tree measured at 1.3m from the ground, or the sum of the basal areas of trees in a specified area, expressed in m ² .
Broadleaves	Trees with broad, flat leaves, e.g. oak, ash, beech and sycamore. Growth is not in whorls but almost always diffusely branched. Usually deciduous.
Carbon pool	A system with the capacity to accumulate or release carbon, expressed in mass units (tonnes C).
Clearfell	A continuous block of trees that have been felled.
Conifers	Trees which bear cones and have needle-like leaves. They are usually, but not always, evergreen.
Confidence Interval	The confidence interval quantifies the uncertainty in measurement by specifying the range of values within which the true value for the whole population lies. As a 95% confidence interval is used for the NFI analyses, there is a 95% probability that the true value for the population lies within the range of values.
Diameter at breast height (Dbh)	The Dbh of a tree is the stem diameter at 1.3 m from ground level.
Forest	Forest is defined as land with a minimum area of 0.1 ha, a minimum width of 20 m, trees higher than 5 m and a canopy cover of more than 20% within the forest boundary, or trees able to reach these thresholds <i>in situ</i> .
Gross Annual Volume Increment	Mean annual volume of tree increment over the period 2006-2012 of trees ≥ 7 cm Dbh. Includes the increment of trees which have been felled or have died during the reference period.
Growing stock volume	The overbark volume of living trees (Dbh ≥ 7 cm) from stump to 7cm top diameter.
High forest	A forest that has a high proportion of sawlog approaching or at normal rotation length.
Multistoried forest	Forest with trees present at various stages of development, i.e. height.
Native species	Species that have arrived and inhabited an area naturally, without deliberate assistance by man. For trees in Ireland usually taken to mean those present after post-glacial

	recolonisation and before historic times. For NFI purposes the species list of natives trees recorded is based on the list of species eligible for inclusion in Ireland's Native Woodland Scheme.
Ownership	Specifies land ownership.
Overmature forest	A forest retained beyond its normal rotation length, resulting in the presence of large trees.
Pole stage	A forest at a stage where it could be thinned or in the early stages of thinning.
Post establishment stage	A recently established forest that is not at free growing stage.
Pre-thicket stage	The forest is established, but the green branches are not yet touching.
Private (grant aided)	Private afforested land which was or is in receipt of grant and/or premium over the period 1980 to present.
Private (other)	Private forest land which was not established with grant aid since 1980. This category includes estate planting and natural succession land.
Public	Forest land owned by the Irish State e.g. Coillte, National Parks and Wildlife Service, Bord na Mona.
Semi-natural woodland	Forests established by natural regeneration, i.e. greater than 80% of the tree species regenerated naturally
Sustainable Forest Management (SFM)	Sustainable Forest Management as a central principle of Irish forest policy, whereby forests are managed to provide economic, social and environmental benefits on a sustainable basis for both current and future generations.
Small pole stage	Forest where the canopy has fully closed and the lower branches are dead.
Thicket stage	Forest where the canopy has closed but the lower branches are mainly green.
Thinning	Periodic removal of trees in a stand which are competing with those better trees which are expected to form the final crop. The object is to benefit the final crop trees, and to get income from the thinnings before they die.



**An Roinn Talmhaíochta,
Bia agus Mara**
Department of Agriculture,
Food and the Marine

ISBN 978-1-4064-2981-7



9 781406 429817