Forestry Commission

NFI Technical Report

Survey of the impact of the 2013 St. Jude's day storm on woodland in Southern England

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Introduction

Following the St. Jude's day storm event on 28 October 2013, the National Forest Inventory (NFI) conducted a sample survey to assess the extent of damage to woodlands in the impacted areas. The area of coverage of the survey was decided from initial reports of areas that had reportedly experienced damage from high winds during the storm. On this basis, a list of English counties was selected for inclusion in the survey, and the number of samples selected within each county was based on the area of NFI woodland within the county according to the 2012 NFI woodland map.
A total of 57 cluster samples, comprising 169 survey sites, were selected within 18 counties (including Greater London as a single county), resulting in an average of just over 3 cluster samples and 9 survey sites per county. Each sample consisted of a cluster of three sites at fairly close proximity, each of which was visited by NFI surveyors and the extent and nature of any storm damage was assessed and recorded. The survey field work was conducted between 1st and 16th November 2013.

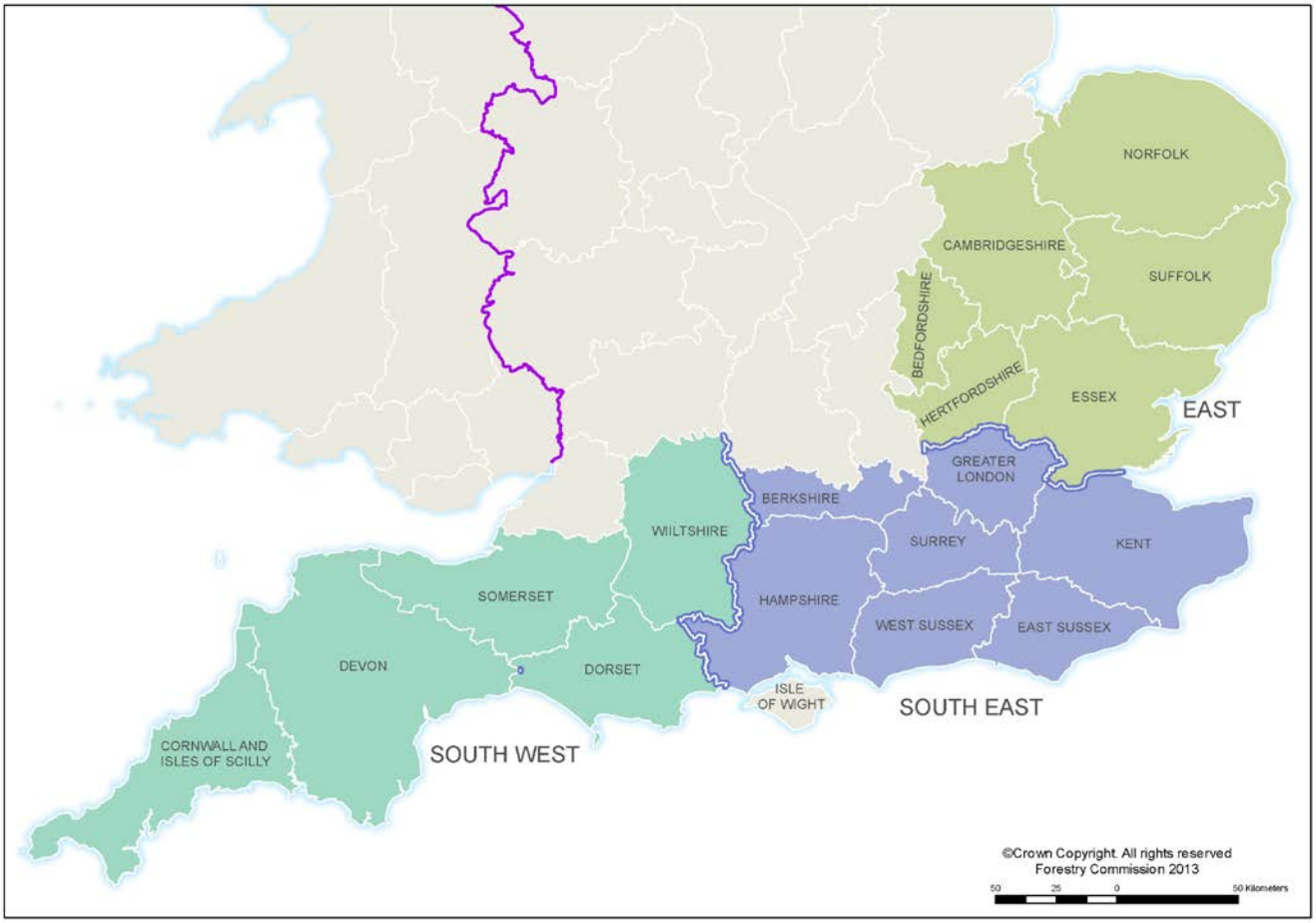
For the purposes of analysis of the results of the survey, the sampled area was stratified into three broad regions of southern and eastern England, comprised of the counties:
South-West Region, consisting of;
Cornwall, Devon, Dorset, Somerset, Wiltshire
South-East Region, consisting of;
Hampshire, Berkshire, Surrey, Greater London, Kent, East and West Sussex
East Region, consisting of;
Essex, Hertfordshire, Bedfordshire, Cambridgeshire, Suffolk and Norfolk

A map of the area covered by the survey and the stratification into these three regions is provided in **Map 1**.

Main findings

- Across the region surveyed, crown damage, windsnap, windthrow or lean occurred across an estimated total of 30,800 hectares of stocked woodland area impacting an estimated 35.5 million trees. This represents 5.5% of the tree stock across the area surveyed.
- Of the 30,800 hectares of damage, 2,700 hectares were windsnaped and 5,600 hectares were windthrown.
- The highest rates of damage occurred in the South-East region, where damage occurred to an estimated 9.2% of the tree stock. The estimated rate of damage in the South-West region was 2.7%, while the estimated rate of damage in the East Region was 0.9%.
- The most common form of damage was to the crowns of trees, which was observed at 58% of the sites surveyed. Occurrences of windthrow were observed at 33% of the sites, and occurrences of windsnap were seen at 30% of the sites surveyed.
- Stands of mature trees suffered higher rates of damage than either pole stage or over-mature trees.

Map 1 Counties covered in the St. Jude's Day storm damage survey



Survey design and analysis

Site selection

The survey design was stratified by county and by ownership type (Forestry Commission (FC) and other (non-FC)) and the number of samples selected for survey for each combination of county and ownership type was based on the amount of woodland area on the 2012 NFI woodland map within each combination.

Each sample consisted of a cluster of three individual sites to be assessed. The 'core' site of a cluster was randomly selected from a list of all individual woodland polygons on the NFI map within the selection area, independent of size of polygon. A circle of 3 kilometre radius was then drawn around the centroid of each selected core site, and a random woodland polygon intersecting this circle was chosen as the second site of the cluster. The third polygon of the cluster was then selected as the polygon intersecting the circle that was closest to the point on the circle diametrically opposite the second selected polygon.

For all selected woodland polygons, if the polygon was less than six hectares in extent then the whole woodland represented by that polygon was selected as the sample site. If the polygon was larger than six hectares, a square of four hectares in size (200 metres square) was selected with its centroid randomly selected within the polygon.

Assessment protocol

Surveyor assessment at each sample site consisted firstly of assessment of the composition of the stand in terms of percentage occupancy of trees at different life stages of growth. The three categories of growth identified were:

- "pole stage" indicating grown but young trees not yet fully established;
- "mature" indicating fully grown trees; and
- "overmature" indicating trees that had passed the age at which they would normally have been felled for the purposes of timber production.

In multi-storey stands, occupancy of each life stage within the stand was assessed independently, so in some cases the total occupancy of all life stages exceeded 100% of the area of the site.

The stand was also assessed in terms of species type composition of its uppermost storey. The four categories of assessment used were:

- "Conifer" – representing 80% or more of conifer species

- "Mixed, predominantly conifer" – representing mixtures containing between 50% and less than 80% of conifer species
- "Mixed, predominantly broadleaf" – representing mixtures containing over 50% and less than 80% of broadleaved species
- "Broadleaf" - representing 80% or more of broadleaved species

Assessment of storm damage at each site was recorded for each of the life stages present in the stand. Estimated percentages of the trees and area belonging to the life stage were assessed into six mutually exclusive categories (therefore adding to 100% of the life stage occupancy of the site):

1. No damage
2. Crown damage only
3. Tree roots lifted/tree leaning only
4. Windsnapped
5. Windthrown
6. Both crown damage and tree roots lifted/tree leaning

Analysis of results

The survey results were post-stratified into three larger regions of South-West England, South-East England and East England, each comprising of the counties listed in the introduction[*]. This was in order that meaningful statistical results could be calculated from the survey, since the number of survey samples assessed within individual counties was generally too small for estimation of statistics with sufficiently reliable accuracy. The number of clusters and the number of sites across the survey area as a whole and within each region are shown in **Table 1**.

Table 1 Numbers of clusters and assessment sites in the survey

Area/Region	No. of clusters	No. of survey sites
Survey region	**57**	**169**
East	**14**	**42**
South-East and London	**25**	**75**
South-West	**18**	**52**

Note: Only one assessment site was visited in one cluster in Wiltshire (South-West region) due to accessibility problems. Three sites per cluster were assessed at all other locations.

[*] The South-West and South-East England regions differ from the NFI reporting regions of the same name, since not all counties within the NFI reporting regions of "South-West England" and "South-East England and London" were included in the area surveyed in this exercise.

The pre-stratification into ownership types was ignored in the analysis since most woodland in the area covered by the survey is non-FC ownership, and as a result there were few FC ownership samples in the survey. The classification of woodlands into broadleaf and conifer was also ignored in the analysis of results, and the results quoted here relate to woodlands as a whole. It can be noted, however, that the woodland in the regions sampled, and in the sample itself, is predominantly composed of broadleaved species (see Appendix).

The results of the survey were analysed in terms of the incidence of survey sites that were assessed to contain each of the categories of damage (including any of the categories of damage), and in terms of estimates of the percentage of woodland area that had experienced the different categories of damage. The former indicates the extent of woodland stands that showed evidence of having sustained some damage of that category, while the latter provides estimates of the actual overall amount of damage of that category within woodlands of the regions sampled.

Estimates of area of damaged woodland as a percentage of total woodland area are then used to estimate the actual woodland area, the standing volume and the number of trees that this represents, using estimates of totals of these in each region sampled. These are obtained from the NFI field survey results to date for non-FC woodland, and from information in the Forestry Commission's sub-compartment database for FC woodland, and are shown in the Appendix.

Results

Table 2 provides a summary of results for all trees and trees within each growth stage of the incidence of damage and the area of damage in percentage terms within the sample. Results are presented for the sample as a whole across the whole surveyed region, and for each of the three individual regions. For the "All trees" category, the "% of sites with damage" line refers to the sites for which there is damage to any of growth stages present on the site and is therefore greater than the growth stage categories individually, whereas the "% of area damaged" line is the percentage of the whole area occupied by the trees in all three growth stages and is therefore a weighted mean of the equivalent estimates of the individual growth stages.

Figure 1 and **Figure 2** show respectively the overall differences in damage rates between regions and the difference in damage rates across growth stages.

Table 2 Storm damage incidence and extent by tree growth stage and by region

Growth stage	Region:	South-West Estimate	*se*	South-East Estimate	*se*	East Estimate	*se*	All regions Estimate	*se*
Pole stage	% of sites with damage	12%	*5%*	62%	*6%*	28%	*8%*	41%	*4%*
	% of area damaged	1.9%	*1.3%*	9.3%	*1.9%*	0.7%	*0.2%*	5.3%	*1.2%*
Mature trees	% of sites with damage	52%	*7%*	77%	*5%*	31%	*8%*	59%	*4%*
	% of area damaged	3.0%	*1.3%*	9.4%	*2.0%*	1.1%	*0.5%*	5.7%	*1.2%*
Over-mature trees	% of sites with damage	41%	*12%*	63%	*8%*	38%	*13%*	54%	*6%*
	% of area damaged	2.8%	*1.6%*	7.4%	*3.0%*	1.1%	*0.7%*	4.7%	*1.5%*
All trees	% of sites with damage	55%	*7%*	83%	*4%*	40%	*8%*	64%	*4%*
	% of area damaged	2.7%	*1.2%*	9.2%	*1.8%*	0.9%	*0.3%*	5.5%	*1.1%*

Figure 1 Percentage damage per region

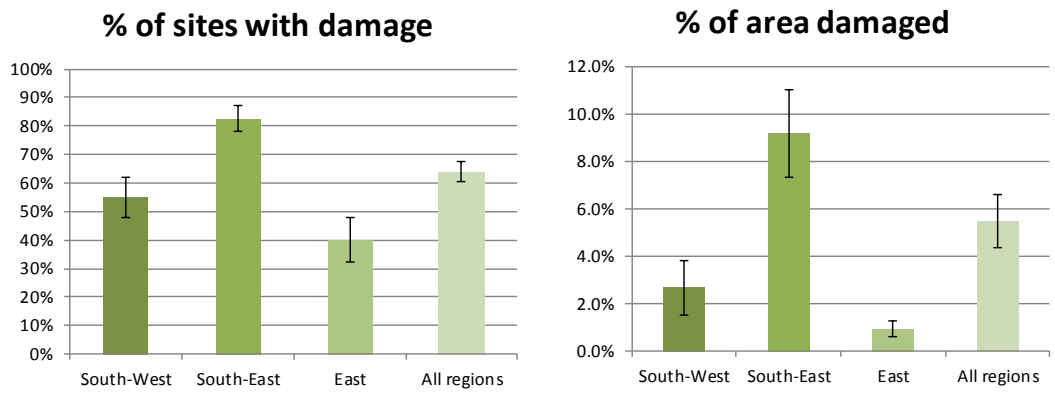
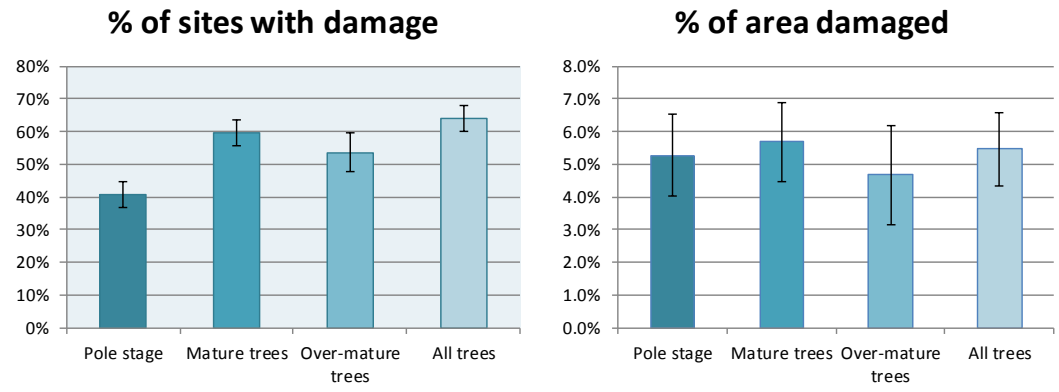


Figure 2 Percentage of storm damage by tree growth stage



These results indicate that the South-East region sustained the largest incidence of storm damage, with evidence of storm damage recorded on 83% of the survey sites in this region, affecting 9.2% of the woodland area. The South-West region sustained the second highest incidence of damage, with the East region sustaining the least damage. Over the survey area as a whole, there was evidence of storm damage on 64% of the survey sites, affecting 5.5% of the woodland within the surveyed areas.

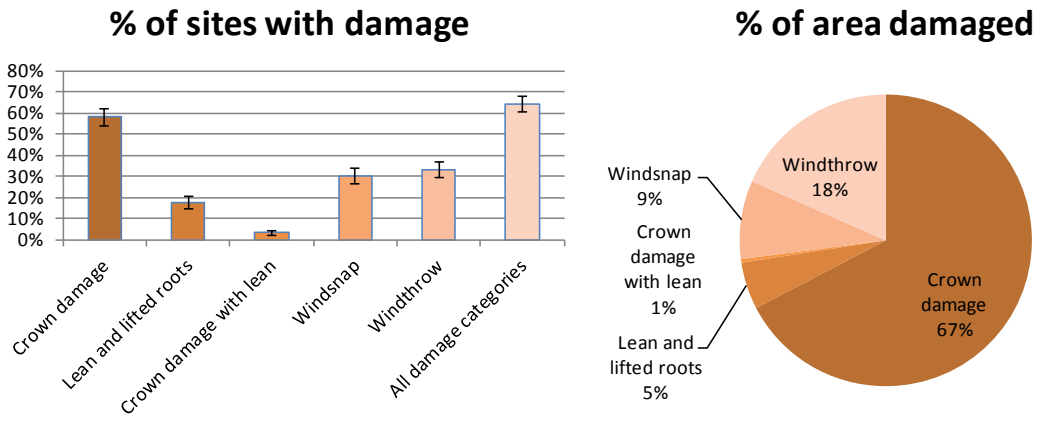
Among the growth stages of the trees, it was observed that mature trees appeared most susceptible to storm damage, with the highest percentages of sites with damage and the highest percentage of area damaged. Pole stage trees had the least percentage of sites with damage, but over-mature trees had the lowest percentage of area damaged. This suggests that, between these two categories, when pole-stage stands sustain storm damage, the extent of the damage tends to be more extensive.

Table 3 shows the breakdown into the various damage categories recorded in the survey, by survey region and across the survey area as a whole. **Figure 3** presents the results for damage categories across the survey area as a whole.

Table 3 Storm damage incidence and extent by damage category and by region

Damage category	Region:	South-West Estimate	*se*	South-East Estimate	se	East Estimate	se	All regions Estimate	se
All damage categories	% of sites with damage	55%	*7%*	83%	*4%*	40%	*8%*	64%	*4%*
	% of area damaged	2.7%	*1.2%*	9.2%	*1.8%*	0.9%	*0.3%*	5.5%	*1.1%*
Crown damage	% of sites with damage	43%	*7%*	81%	*4%*	33%	*7%*	58%	*4%*
	% of area damaged	1.9%	*1.1%*	6.2%	*1.4%*	0.4%	*0.1%*	3.7%	*0.9%*
Lean and lifted roots	% of sites with damage	14%	*5%*	25%	*5%*	8%	*4%*	18%	*3%*
	% of area damaged	0.2%	*0.1%*	0.4%	*0.1%*	0.1%	*0.1%*	0.3%	*0.1%*
Crown damage with lean	% of sites with damage	0%	-	3%	*2%*	8%	*4%*	3%	*1%*
	% of area damaged	0.0%	-	0.0%	*0.0%*	0.1%	*0.05%*	0.0%	*0.0%*
Windsnap	% of sites with damage	14%	*5%*	48%	*6%*	15%	*6%*	30%	*4%*
	% of area damaged	**0.2%**	*0.1%*	0.8%	*0.2%*	0.1%	*0.1%*	0.5%	*0.1%*
Windthrow	% of sites with damage	27%	*6%*	45%	*6%*	18%	*6%*	33%	*4%*
	% of area damaged	0.3%	*0.1%*	1.8%	*0.5%*	0.2%	*0.1%*	1.0%	*0.3%*

Figure 3 Incidence and extent of the categories of storm damage



These results show that, overall, damage to the crowns was the most prevalent form of storm damage, with this form of damage recorded at 58% of the survey sites across the whole survey area, affecting 3.7% of the woodland area. Either windsnap or windthrow damage were recorded at a similar number of survey sites (63%) but only affected a total of 1.5% of the woodland area. The incidence of lean or lifted roots (with or without simultaneous crown damage) was relatively low, having been recorded at 21% of the sites and affecting 0.3% of the woodland area.

Table 4 expresses the results for areas of damage shown in **Table 3** in terms of the estimated amounts of woodland that sustained damage across each of the regions and across the whole survey area. Quantities of damaged woodland are expressed in terms of stocked areas, standing volumes and numbers of trees and are derived from scaling up the results of the survey to the population totals for each of the sub-regions and the survey region as a whole. These population totals are estimates derived from records in the Forestry Commission's sub-compartment database (SCDB) for Forestry Commission woodland, and from the main NFI field survey for private sector woodland and are shown in Appendix 1, broken down by principal species within each region.

Table 4 Estimates of storm damage in terms of stocked areas, standing volumes and numbers of trees

Damage category	Region:	South-West Estimate	*se%*	South-East Estimate	*se%*	East Estimate	*se%*	All regions Estimate	*se%*
All damage categories	Stocked area ('000 hectares)	5.3	*43%*	24.2	*20%*	1.33	*34%*	30.8	*17%*
	Standing volumes ('000 m^3 obs)	1,361.5	*44%*	5,138.2	*20%*	261.78	*34%*	6,761.6	*18%*
	Numbers of trees (millions)	6.0	*43%*	28.3	*20%*	1.20	*34%*	35.5	*18%*
Crown damage	Stocked area ('000 hectares)	3.8	*56%*	16.4	*23%*	0.60	*35%*	20.7	*21%*
	Standing volumes ('000 m^3 obs)	963.2	*56%*	3,476.7	*23%*	117.89	*36%*	4,557.8	*21%*
	Numbers of trees (millions)	4.2	*56%*	19.1	*23%*	0.54	*36%*	23.9	*21%*
Lean and lifted roots	Stocked area ('000 hectares)	0.5	*50%*	1.0	*35%*	0.14	*57%*	1.7	*27%*
	Standing volumes ('000 m^3 obs)	122.8	*50%*	220.8	*35%*	26.49	*57%*	370.1	*27%*
	Numbers of trees (millions)	0.5	*50%*	1.2	*35%*	0.12	*57%*	1.9	*27%*
Crown damage with lean	Stocked area ('000 hectares)	0.0	-	0.0	*93%*	0.10	*67%*	0.1	*55%*
	Standing volumes ('000 m^3 obs)	0.0	-	8.3	*93%*	19.70	*67%*	28.0	*55%*
	Numbers of trees (millions)	0.0	-	0.0	*93%*	0.09	*67%*	0.1	*55%*
Windsnap	Stocked area ('000 hectares)	0.4	*44%*	2.0	*24%*	0.21	*42%*	2.7	*20%*
	Standing volumes ('000 m^3 obs)	114.2	*44%*	433.4	*25%*	41.90	*43%*	589.5	*20%*
	Numbers of trees (millions)	0.5	*44%*	2.4	*25%*	0.19	*43%*	3.1	*21%*
Windthrow	Stocked area ('000 hectares)	0.6	*28%*	4.7	*29%*	0.28	*35%*	5.6	*24%*
	Standing volumes ('000 m^3 obs)	161.3	*28%*	999.1	*29%*	55.80	*35%*	1,216.2	*24%*
	Numbers of trees (millions)	0.7	*28%*	5.5	*29%*	0.26	*35%*	6.5	*25%*

These results show that, if the extent of the survey effectively covered the whole area that was impacted by the St. Jude's storm, the stocked area of woodland that was damaged by the storm across all categories of damage amounted to an estimated 30 800 hectares (se=17%). This comprised an estimated standing volume of 6 761 600 m^3 obs (se=18%) and the estimated number of trees that sustained storm damage was 35.5 million (se=18%). The majority of this damage was restricted to crown damage, which was present on an estimated 20 700 hectares of stocked area (se=21%), with more severe forms of damage on the remainder of the damaged stocked areas.

Discussion

The results begin to illuminate a broader picture of how wind impacts upon woodlands, especially when read in comparison to earlier studies, such as Forestry Commission Bulletin 87[*]. The results show that the distribution of wind damage to woodland is as important as the overall scale of damage when assessing the consequences of a storm event on woodlands in terms of its impact on society and industry. The results from this study indicate that the St. Jude's day storm caused damage to comparable amounts of trees as each of the other four major storms to hit Britain since the 1950's, but the impact of this storm damage has been of a different nature and less conspicuous than the earlier events.

The results show that the scale of damage from the St Jude's storm, at an estimated 9.6 million trees that were windthrown or snapped, and 1.8 million cubic metres of snapped or fallen timber, was of a comparable magnitude to the damage of the 'great' 1987 storm with an estimated 15 million trees damaged and 3.9 million cubic metres of timber damaged. The volume of damage to woodlands attributable to the St Jude's storm was of the same order as that of the three major storms previous to 1987; Jan 1953 (in north-east Scotland); January 1968 (in the west Highlands and the central belt of Scotland); and January 1976 (in Wales, the Midlands and East Anglia). These three storms blew down altogether an estimated 4.1 million cubic metres of timber.

However, the St Judes's storm damage did not impact as strongly as that of the other storms since the damage was more sparsely distributed over a larger area, unlike the clustering pattern of damage from the other storms. The thinly distributed nature of damage across the woodlands resulting from the St. Jude's storm should lead in the main to the woodlands recovering in timber productivity terms. On the other hand, due to the wide but sparse distribution of blown or snapped trees, the timber from these damaged trees is less likely to be economically recoverable.

If this degree of damage had been concentrated in one area (for example the New Forest), this would have been viewed as a nationally significant event with significant impacts on the biodiversity, recreation and timber value of the woodlands concerned. The conclusion that may be drawn is that it is not the volume of storm damage *per se* that has a negative impact on woodlands; it is the distribution of damage, whether locally concentrated or more evenly spread, that is of more importance.

The findings also show that windblow and windsnap account for only part of the impact of the storm on woodland; crown damage and root lifting account for more damage by

[*] Forestry Commission Bulletin 87, *The 1987 Storm Impacts and Responses,* Grayson, A.J. (Editor, HMSO, 1989

area. As damaged crowns and roots will recover over time, the majority of damage to standing trees arising from the St Jude's storm is transient in nature. A small loss of stems within a stand to windthrow and windsnap (say 1-2%) is unlikely to depress timber productivity of that stand in the long term, so in such cases the longer-term impact of the storm in terms of timber productivity is expected to be negligible.

A question that would be of relevance to a full impact assessment of the storm's effect is the extent to which the damage from the St. Jude's storm may have increased the vulnerability of the affected woodlands to subsequent storm events. For example, to what extent is a tree that has suffered lifted roots as a result of this storm vulnerable to further damage in the shorter term from subsequent high winds, before it self-repairs and re-anchors its roots? Such indirect consequences of this storm event are potentially more accessible to quantify from these survey results, which have included observations of the incidence of tree lean and lifted roots. These have not been recorded before in post-storm surveys of this type, but further research would be required to investigate such indirect effects.

A storm such as the St. Jude's day storm results in risks to future timber productivity from the affected woodlands, but simultaneously provides potential benefits from a biodiversity standpoint. Fallen material from crowns and damaged or windblown stems results in lying deadwood that enhances the value of the woodland in habitat terms. Since, in general, British woodlands are considered to contain relatively low levels of lying deadwood, the biodiversity impacts accruing from events such as this may be very beneficial.

St Judes's was the first large storm of a series of storms during the winter of 2013/14. Future NFI reports will provide statistics on the level of wind throw arising from the whole series of winter storms experienced in this period.

Appendix

Estimates of population values of woodland within the regions covered by the St. Jude's storm survey

Tables A1 to **A3** provide estimates of population totals within each of the regions surveyed, and across the whole area covered by the St. Jude's storm damage survey. The tables express these estimated population totals in terms of stocked areas, standing volumes and numbers of trees respectively, broken down into conifers, broadleaves and principal species. These estimates are derived from records in the Forestry Commission's sub-compartment database (SCDB) for Forestry Commission woodland, and from the main NFI field survey in combination with the 2012 NFI woodland map for private sector woodland.

Table A1 Stocked area by principal species for regions in the St. Jude's storm survey area

Principal species	FC	Private sector		Total
	area (000 ha)	area (000 ha)	*SE%*	area (000 ha)
Storm survey region				
All conifers	**42.5**	**87.7**	***3***	**130.2**
Sitka spruce	4.9	8.6	*16*	**13.5**
Scots pine	7.0	23.8	*9*	**30.8**
Corsican pine	19.4	10.6	*14*	**30.0**
Norway spruce	1.6	8.7	*12*	**10.2**
Larches	1.9	12.1	*10*	**14.0**
Douglas fir	5.1	11.4	*12*	**16.5**
Lodgepole pine	0.2	0.1	*77*	**0.3**
Other conifers	2.5	12.4	*11*	**14.9**
All broadleaves	**26.0**	**448.8**	***1***	**474.8**
Oak	8.0	89.0	*4*	**97.1**
Beech	9.8	33.8	*7*	**43.6**
Sycamore	0.4	32.9	*8*	**33.3**
Ash	0.9	56.5	*5*	**57.4**
Birch	1.7	48.6	*6*	**50.3**
Sweet chestnut	0.4	21.7	*10*	**22.1**
Hazel	0.1	47.3	*6*	**47.4**
Hawthorn	0.0	22.7	*8*	**22.7**
Alder	0.2	12.3	*13*	**12.5**
Willow	0.0	18.5	*11*	**18.5**
Other broadleaves	4.6	65.8	*5*	**70.4**
All species	**68.5**	**536.7**	***1***	**605.2**
South West England				
All conifers	**14.3**	**35.4**	***5***	**49.8**
Sitka spruce	4.9	7.5	*17*	**12.4**
Scots pine	1.1	4.5	*20*	**5.7**
Corsican pine	2.2	1.7	*35*	**3.9**
Norway spruce	0.8	3.2	*19*	**4.0**
Larches	1.1	6.0	*16*	**7.1**
Douglas fir	3.1	8.1	*14*	**11.2**
Lodgepole pine	0.1	0.0	*109*	**0.2**
Other conifers	1.0	4.4	*19*	**5.4**
All broadleaves	**5.8**	**142.4**	***3***	**148.2**
Oak	1.0	28.9	*8*	**30.0**
Beech	2.3	12.1	*12*	**14.4**
Sycamore	0.1	13.0	*11*	**13.1**
Ash	0.3	23.2	*8*	**23.5**
Birch	0.2	8.1	*12*	**8.3**
Sweet chestnut	0.1	3.1	*24*	**3.1**
Hazel	0.0	18.4	*9*	**18.4**
Hawthorn	0.0	6.9	*16*	**6.9**
Alder	0.0	5.2	*18*	**5.2**
Willow	0.0	9.1	*14*	**9.1**
Other broadleaves	1.8	15.6	*11*	**17.4**
All species	**20.1**	**178.3**	***2***	**198.5**

Table A1 (continued) Stocked area by principal species for regions in the St. Jude's storm survey area

Principal species	FC	Private sector		Total
	area (000 ha)	area (000 ha)	*SE%*	area (000 ha)
East England				
All conifers	**17.4**	**19.9**	***9***	**37.4**
Sitka spruce	0.0	0.4	*71*	**0.4**
Scots pine	3.1	8.3	*17*	**11.4**
Corsican pine	13.2	4.8	*22*	**18.0**
Norway spruce	0.1	1.6	*29*	**1.7**
Larches	0.3	2.3	*23*	**2.6**
Douglas fir	0.5	0.8	*33*	**1.3**
Lodgepole pine	0.0	0.0	-	**0.0**
Other conifers	0.3	1.7	*33*	**2.0**
All broadleaves	**3.9**	**101.7**	***3***	**105.6**
Oak	0.9	18.5	*12*	**19.5**
Beech	0.9	5.4	*20*	**6.3**
Sycamore	0.1	13.7	*15*	**13.8**
Ash	0.2	11.1	*13*	**11.3**
Birch	0.5	9.6	*18*	**10.1**
Sweet chestnut	0.1	5.6	*25*	**5.6**
Hazel	0.0	4.6	*26*	**4.6**
Hawthorn	0.0	3.8	*18*	**3.8**
Alder	0.1	3.4	*33*	**3.4**
Willow	0.0	4.5	*28*	**4.5**
Other broadleaves	1.0	21.5	*10*	**22.5**
All species	**21.3**	**121.6**	***2***	**142.9**
South East and London				
All conifers	**10.7**	**32.3**	***5***	**43.1**
Sitka spruce	0.0	0.7	*47*	**0.8**
Scots pine	2.7	11.1	*11*	**13.7**
Corsican pine	4.0	4.1	*20*	**8.1**
Norway spruce	0.7	3.9	*19*	**4.6**
Larches	0.5	3.9	*17*	**4.4**
Douglas fir	1.5	2.5	*23*	**4.0**
Lodgepole pine	0.0	0.0	*108*	**0.1**
Other conifers	1.2	6.3	*15*	**7.5**
All broadleaves	**16.3**	**204.7**	***2***	**221.0**
Oak	6.0	41.6	*6*	**47.6**
Beech	6.6	16.3	*10*	**22.9**
Sycamore	0.1	6.2	*16*	**6.3**
Ash	0.4	22.2	*8*	**22.5**
Birch	1.0	31.0	*8*	**32.0**
Sweet chestnut	0.2	13.1	*12*	**13.3**
Hazel	0.0	24.3	*8*	**24.3**
Hawthorn	0.0	12.0	*12*	**12.0**
Alder	0.1	3.7	*21*	**3.9**
Willow	0.0	4.8	*17*	**4.8**
Other broadleaves	1.8	28.7	*7*	**30.5**
All species	**27.1**	**236.7**	***1***	**263.8**

Table A2 Standing volume by principal species for regions in the St. Jude's storm survey area

Principal species	FC	Private sector		Total
	volume (000 m^3 obs)	volume (000 m^3 obs)	*SE%*	volume (000 m^3 obs)
Storm survey region				
All conifers	**9,877**	**27,965**	***4***	**37,842**
Sitka spruce	987	2,605	*21*	**3,592**
Scots pine	1,958	7,256	*9*	**9,215**
Corsican pine	3,697	3,176	*14*	**6,873**
Norway spruce	483	2,761	*14*	**3,244**
Larches	331	4,056	*12*	**4,387**
Douglas fir	1,427	4,250	*18*	**5,677**
Lodgepole pine	42	28	*82*	**70**
Other conifers	952	3,944	*13*	**4,896**
All broadleaves	**5,454**	**91,854**	***3***	**97,307**
Oak	2,135	32,054	*6*	**34,189**
Beech	2,297	11,271	*10*	**13,569**
Sycamore	57	6,603	*11*	**6,660**
Ash	134	13,395	*6*	**13,529**
Birch	162	5,851	*7*	**6,012**
Sweet chestnut	62	5,440	*12*	**5,502**
Hazel	6	3,340	*9*	**3,346**
Hawthorn	0	1,088	*11*	**1,088**
Alder	34	3,047	*18*	**3,080**
Willow	0	2,207	*17*	**2,207**
Other broadleaves	568	8,525	*10*	**9,093**
All species	**15,331**	**119,587**	***2***	**134,918**
South West England				
All conifers	**3,394**	**12,497**	***7***	**15,891**
Sitka spruce	973	2,383	*22*	**3,356**
Scots pine	266	1,295	*22*	**1,561**
Corsican pine	562	581	*35*	**1,143**
Norway spruce	233	1,391	*23*	**1,623**
Larches	176	2,218	*17*	**2,393**
Douglas fir	796	3,073	*23*	**3,869**
Lodgepole pine	32	9	*109*	**41**
Other conifers	356	1,602	*21*	**1,959**
All broadleaves	**914**	**34,059**	***6***	**34,973**
Oak	156	13,118	*11*	**13,274**
Beech	457	4,895	*19*	**5,352**
Sycamore	18	2,848	*15*	**2,866**
Ash	42	5,457	*9*	**5,498**
Birch	20	1,150	*14*	**1,170**
Sweet chestnut	10	1,412	*28*	**1,422**
Hazel	1	1,285	*16*	**1,286**
Hawthorn	0	342	*20*	**342**
Alder	1	1,268	*22*	**1,269**
Willow	0	1,118	*21*	**1,118**
Other broadleaves	210	1,801	*18*	**2,011**
All species	**4,308**	**46,552**	***5***	**50,860**

Table A2 (continued) Standing volume by principal species for regions in the St. Jude's storm survey area

Principal species	FC	Private sector		Total
	volume (000 m^3 obs)	volume (000 m^3 obs)	*SE%*	volume (000 m^3 obs)
East England				
All conifers	**3,372**	**4,776**	***9***	**8,148**
Sitka spruce	0	35	*69*	**35**
Scots pine	790	1,929	*16*	**2,719**
Corsican pine	2,290	1,300	*23*	**3,590**
Norway spruce	17	369	*33*	**386**
Larches	42	603	*25*	**646**
Douglas fir	128	240	*38*	**368**
Lodgepole pine	4	0	-	**4**
Other conifers	99	300	*34*	**400**
All broadleaves	**565**	**19,325**	***7***	**19,890**
Oak	151	5,588	*15*	**5,739**
Beech	160	1,690	*22*	**1,851**
Sycamore	20	2,602	*22*	**2,622**
Ash	37	2,454	*19*	**2,491**
Birch	55	991	*22*	**1,047**
Sweet chestnut	13	1,091	*32*	**1,104**
Hazel	3	224	*26*	**226**
Hawthorn	0	94	*20*	**94**
Alder	11	617	*54*	**628**
Willow	0	549	*52*	**549**
Other broadleaves	115	3,425	*21*	**3,540**
All species	**3,937**	**24,101**	***5***	**28,038**
South East and London				
All conifers	**3,111**	**10,692**	***6***	**13,804**
Sitka spruce	14	188	*49*	**201**
Scots pine	902	4,033	*14*	**4,935**
Corsican pine	845	1,295	*22*	**2,140**
Norway spruce	233	1,001	*20*	**1,234**
Larches	113	1,235	*19*	**1,348**
Douglas fir	502	937	*24*	**1,439**
Lodgepole pine	5	20	*108*	**25**
Other conifers	497	2,041	*19*	**2,538**
All broadleaves	**3,974**	**38,469**	***3***	**42,444**
Oak	1,828	13,348	*7*	**15,176**
Beech	1,680	4,686	*12*	**6,366**
Sycamore	20	1,153	*21*	**1,173**
Ash	55	5,485	*10*	**5,539**
Birch	86	3,709	*9*	**3,796**
Sweet chestnut	39	2,937	*14*	**2,976**
Hazel	2	1,831	*12*	**1,833**
Hawthorn	0	651	*14*	**651**
Alder	22	1,162	*27*	**1,183**
Willow	0	540	*19*	**540**
Other broadleaves	243	3,299	*11*	**3,542**
All species	**7,086**	**48,934**	***3***	**56,020**

Table A3 Numbers of trees by principal species for regions in the St. Jude's storm survey area

Principal species	FC	Private sector		Total
	number of trees (thousands)	number of trees (thousands)	*SE%*	number of trees (thousands)
Storm survey region				
All conifers	**32,175**	**67,684**	***5***	**99,859**
Sitka spruce	4,319	11,032	*20*	**15,351**
Scots pine	3,074	12,302	*10*	**15,376**
Corsican pine	17,834	8,037	*17*	**25,871**
Norway spruce	758	8,326	*16*	**9,084**
Larches	1,552	7,455	*12*	**9,007**
Douglas fir	3,062	11,571	*18*	**14,633**
Lodgepole pine	209	88	*80*	**297**
Other conifers	1,367	8,795	*14*	**10,162**
All broadleaves	**18,750**	**541,484**	***3***	**560,235**
Oak	6,147	40,354	*6*	**46,501**
Beech	4,857	22,314	*8*	**27,170**
Sycamore	179	35,002	*9*	**35,181**
Ash	594	53,995	*7*	**54,589**
Birch	2,096	67,672	*8*	**69,768**
Sweet chestnut	369	34,731	*17*	**35,100**
Hazel	133	129,226	*6*	**129,359**
Hawthorn	0	35,098	*10*	**35,098**
Alder	246	12,270	*14*	**12,516**
Willow	2	23,266	*12*	**23,268**
Other broadleaves	4,127	87,405	*6*	**91,531**
All species	**50,925**	**609,773**	***2***	**660,698**
South West England				
All conifers	**10,472**	**32,055**	***9***	**42,528**
Sitka spruce	4,262	9,703	*22*	**13,964**
Scots pine	614	2,017	*22*	**2,631**
Corsican pine	1,761	1,201	*34*	**2,962**
Norway spruce	310	3,119	*22*	**3,429**
Larches	1,021	3,623	*18*	**4,644**
Douglas fir	1,790	9,026	*21*	**10,816**
Lodgepole pine	171	30	*109*	**202**
Other conifers	544	3,288	*29*	**3,832**
All broadleaves	**2,925**	**177,948**	***4***	**180,873**
Oak	620	15,040	*10*	**15,660**
Beech	819	8,971	*13*	**9,790**
Sycamore	32	17,270	*15*	**17,301**
Ash	105	22,493	*9*	**22,598**
Birch	192	12,751	*13*	**12,943**
Sweet chestnut	58	2,460	*26*	**2,518**
Hazel	17	48,044	*9*	**48,061**
Hawthorn	0	12,127	*19*	**12,127**
Alder	31	4,816	*19*	**4,847**
Willow	0	11,627	*16*	**11,627**
Other broadleaves	1,052	23,494	*11*	**24,546**
All species	**13,397**	**210,310**	***4***	**223,707**

Table A3 (continued) Numbers of trees by principal species for regions in the St. Jude's storm survey area

Principal species	FC	Private sector		Total
	number of trees (thousands)	number of trees (thousands)	*SE%*	number of trees (thousands)
East England				
All conifers	**13,768**	**11,140**	***11***	**24,909**
Sitka spruce	1	704	*82*	**705**
Scots pine	1,059	3,653	*16*	**4,711**
Corsican pine	12,269	3,515	*29*	**15,784**
Norway spruce	47	1,106	*32*	**1,153**
Larches	134	992	*27*	**1,126**
Douglas fir	86	290	*34*	**376**
Lodgepole pine	18	0	*-*	**18**
Other conifers	156	880	*33*	**1,036**
All broadleaves	**2,809**	**100,979**	***6***	**103,789**
Oak	717	8,942	*14*	**9,658**
Beech	395	2,480	*22*	**2,874**
Sycamore	71	11,552	*15*	**11,624**
Ash	193	12,028	*19*	**12,221**
Birch	408	9,217	*22*	**9,624**
Sweet chestnut	74	4,453	*31*	**4,527**
Hazel	90	12,200	*24*	**12,290**
Hawthorn	0	5,912	*20*	**5,912**
Alder	29	2,886	*33*	**2,915**
Willow	2	5,419	*34*	**5,421**
Other broadleaves	831	25,891	*12*	**26,721**
All species	**16,578**	**112,120**	***5***	**128,697**
South East and London				
All conifers	**7,934**	**24,488**	***7***	**32,422**
Sitka spruce	56	625	*44*	**681**
Scots pine	1,402	6,632	*15*	**8,034**
Corsican pine	3,804	3,321	*24*	**7,125**
Norway spruce	402	4,101	*27*	**4,502**
Larches	397	2,840	*22*	**3,236**
Douglas fir	1,186	2,255	*28*	**3,441**
Lodgepole pine	20	58	*108*	**77**
Other conifers	667	4,627	*17*	**5,295**
All broadleaves	**13,016**	**262,557**	***4***	**275,573**
Oak	4,810	16,372	*7*	**21,182**
Beech	3,644	10,863	*11*	**14,507**
Sycamore	76	6,179	*17*	**6,255**
Ash	296	19,474	*13*	**19,770**
Birch	1,497	45,705	*10*	**47,201**
Sweet chestnut	237	27,817	*21*	**28,054**
Hazel	27	68,982	*8*	**69,009**
Hawthorn	0	17,059	*13*	**17,059**
Alder	185	4,568	*26*	**4,754**
Willow	0	6,220	*19*	**6,220**
Other broadleaves	2,244	38,020	*9*	**40,264**
All species	**20,950**	**287,343**	***4***	**308,293**