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Forest Condition 1998

INFORMATION NOTE

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SUMMARY

Crown density and various other features were assessed on a total of 8735 trees of five species – Sitka spruce, Norway spruce, Scots pine, oak and beech – distributed over 364 plots throughout Britain. The condition of Norway spruce was similar to that in 1997 while Scots pine had deteriorated slightly. Nevertheless, since 1991, the condition of Scots pine and Norway spruce has changed less than that of the other species. After a sharp deterioration in 1997 caused by *Elatobium abietinum*, Sitka spruce was virtually unchanged in 1998. Both oak and beech improved significantly, due largely to reduced insect damage compared with previous years but also, in the case of beech, to reduced masting. Oak was in notably poorer condition in central Scotland, south-west England, Wales and East Anglia than elsewhere.

INTRODUCTION

1. Since 1987 the Forestry Commission has monitored changes in the condition of forest trees by annually re-assessing five species in plots distributed throughout Britain. In 1998 a total of 8735 trees was assessed distributed over the following numbers of plots: 74 Sitka spruce (*Picea sitchensis* (Bong.) Carr.), 61 Norway spruce (*P. abies* (L.) Karst.), 81 Scots pine (*Pinus sylvestris* L.), 85 oak (*Quercus* spp.) and 60 beech (*Fagus sylvatica* L.). There were also three plots in mixed crops. The assessments were carried out between 22 June and 11 September 1998.

2. The feature of greatest interest in the survey is an assessment of crown density, i.e. the degree of transparency of the crown, which is used to provide an index of tree condition. Until 1993 the basis for comparison was an 'ideal' tree carrying the maximum possible amount of foliage. However, in similar surveys conducted in most other European countries comparisons are most commonly made with reference to a tree with full foliage under local conditions (the 'local tree' method). Usually, this method involves selecting, in the general vicinity of the plot, the tree with the greatest amount of foliage, to act as a reference. Selected trees may differ from year to year. In order to harmonise with results obtained in other countries, crown density estimates have been made using the local tree method since 1993. However, in order to maintain the existing time series of crown density figures, all plot trees have also been assessed using the previous idealised standard.

3. Reductions in crown density were estimated in 5% classes by reference either to a standard set of photographs of 'ideal' trees (Innes, 1990) or to 'instant' photographs of individual local reference trees.

4. In order to check the consistency of scoring by the 16 survey teams involved, 86 plots were re-assessed by one experienced supervisor. The proportion of trees for which the two scores fell within one 5% class ranged from 81% in Sitka spruce to 89% in beech. The corresponding figures for two class limits (10%) were 94% and 99%, for the same species respectively. There was evidence of consistent bias (i.e. bias affecting several species) for two survey teams: in both cases assessments were too low. There was also a general tendency to underscore Scots pine. However differences between the survey teams and the standard observer never exceeded one 5% class interval for any of the 49 team/species combinations tested. Since the teams operate on a regional basis any bias is a cause for concern but the areas affected were not sufficiently extensive to affect the geographical interpretation of results unduly.

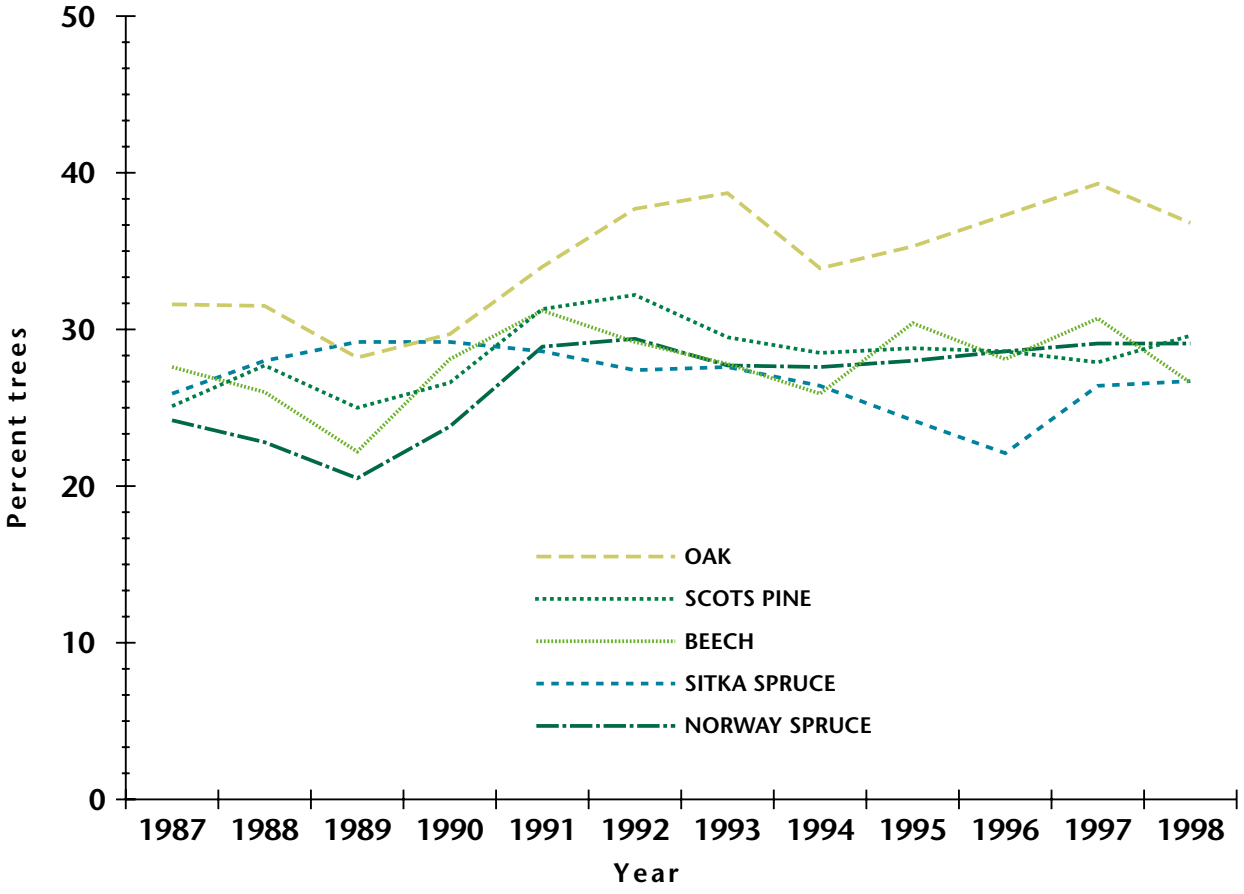
THE 1998 RESULTS

5. The crown density results, using both methods of assessment, are presented in 10% classes in Table 1. The marked effect of using a local reference rather than an ideal tree as the basis for comparison can be clearly seen for all species.

Table 1 **Percentages of trees in each crown density class for five species in 1998.**
Each 10% class represents a reduction in crown density compared either to an 'ideal tree' (I), i.e. a tree with the maximum possible amount of foliage, or to a 'local tree' (L), i.e. a tree with full foliage under local conditions.

% reduction in crown density	Sitka spruce		Norway spruce		Scots pine		Oak		Beech	
	I	L	I	L	I	L	I	L	I	L
0–10	11.8	35.7	9.2	32.9	4.8	32.9	2.0	24.9	6.7	47.0
11–20	31.6	35.0	28.8	34.6	25.7	37.7	13.2	29.8	36.5	36.2
21–30	29.8	17.0	30.1	18.6	34.7	19.2	24.4	24.7	33.1	12.0
31–40	15.5	7.3	18.4	6.9	22.6	6.5	32.4	12.0	15.5	2.2
41–50	6.4	2.2	6.2	2.8	8.0	2.0	16.5	4.3	4.9	1.0
51–60	2.2	1.1	3.4	1.9	2.1	0.9	6.3	2.5	1.5	0.9
61–70	0.9	0.8	1.3	0.5	1.1	0.5	2.5	1.0	0.9	0.3
71–80	1.2	0.7	0.3	0.3	0.6	0.1	1.5	0.4	0.4	0.1
81–90	0.2	0.1	0.5	0.0	0.1	0.0	0.6	0.4	0.1	0.0
91–100	0.4	0.3	1.6	1.6	0.3	0.3	0.5	1.0	0.4	0.3

Figure 1 Changes in crown density since 1987 for five species surveyed annually. The reduction in crown density compared to that of an 'ideal' tree is shown for each species.



6. Figure 1 shows the changes in crown condition that have taken place since 1987. An *upward* gradient in this figure indicates a *deterioration* in crown condition. In contrast to the method of presentation used previously, the figure records the **mean** percent reduction in crown density for each species compared to that of an ideal tree. The previous method expressed the results for each species as the proportion of trees in which crown density was reduced by >25%. This method was originally adopted to maintain consistency of presentation with reports issued elsewhere but, as discussed by Redfern *et al.* (1998), the use of means provides a more satisfactory way of comparing species. By removing the artificial threshold of 25% the effect of the change has been to reduce the magnitude of annual fluctuations but also, while maintaining the relative position of species, to reduce differences between them.

7. Analysis has shown that whereas most of the small annual changes in the condition of Sitka spruce were not significant, larger changes in the other species generally were significant, particularly in the case of beech. Apart from a gradual improvement in Sitka spruce, which continued almost annually from 1989 to 1996, crown density scores have fluctuated over this period revealing little evidence of a long-term trend for any species, although oak was in better condition before 1991 than it has been in more recent years. It is interesting to note that there appear to be short-term effects that are broadly common for some species, particularly oak and beech.

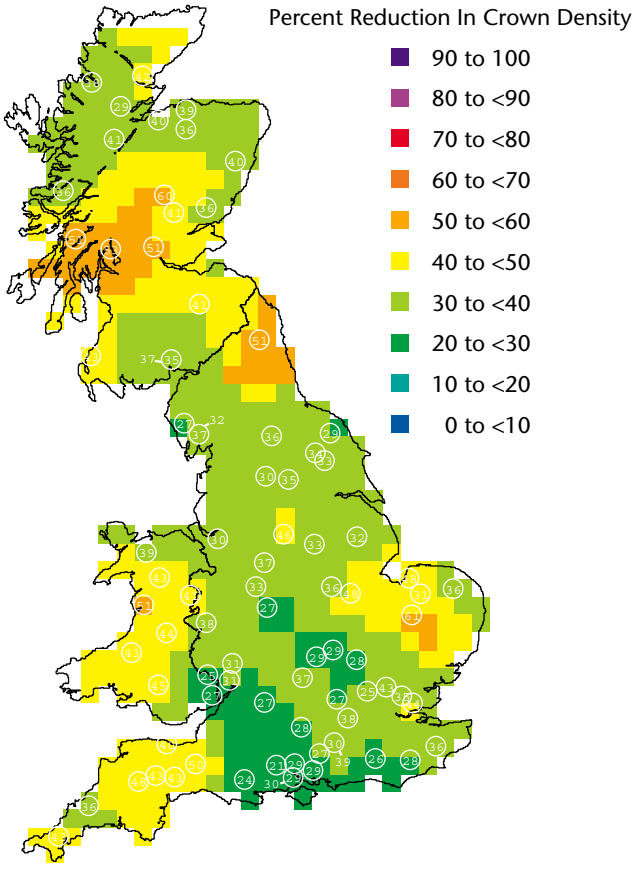
8. Since 1991 the condition of Scots pine and Norway spruce has changed less than that of any other species. In 1998 the condition of Norway spruce was the same as in 1997 but Scots pine deteriorated slightly. After a sharp decline in 1997 Sitka spruce was unchanged in 1998. Both oak and beech experienced similar declines in 1997 but improved significantly this year. For beech this continues a trend of marked, often annual, fluctuations which seem to characterise this species, but for oak it ends a 3-year period of decline, just as an improvement in 1994 ended a similar 4-year decline.

9. Figure 2 shows the geographical variation in crown density for the five species assessed. Variation was greatest in oak: which was poorest in central Scotland, south-west England, Wales and East Anglia, and best in southern England. This is broadly the same pattern that was observed in 1996 and 1997 (Redfern *et al.*, 1997; 1998). Scots pine also showed a pattern which was similar to that in the previous two years, with crown density tending to be highest south of the Humber–Mersey line. Beech showed no clear pattern. Both spruces were in slightly poorer condition in the south and east than elsewhere but this impression is created by relatively few plots and both species show considerable local variation.

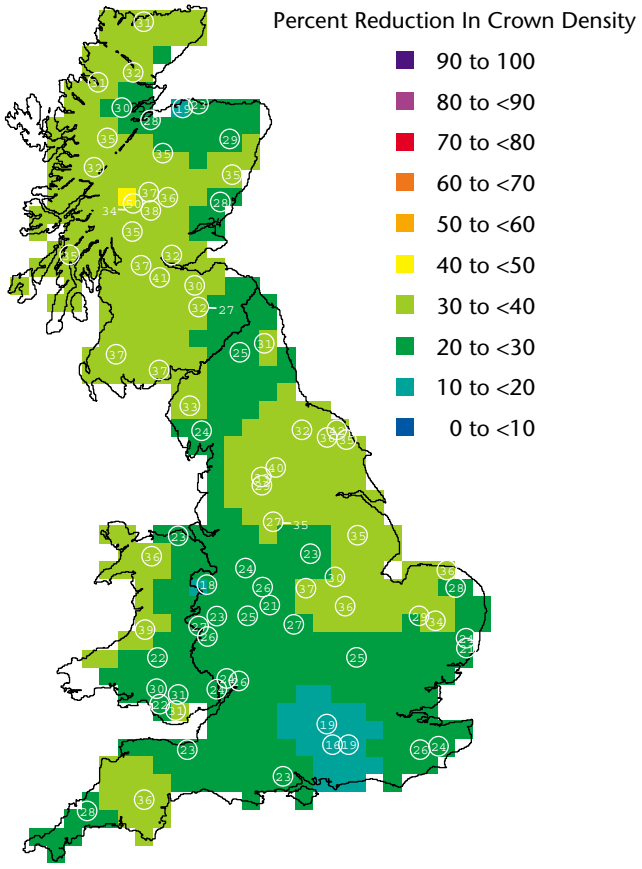
Figure 2

Geographical variation in crown density for five species in 1998. The locations of plots included in the survey are indicated by white circles, and figures within the circles are mean percent reductions in crown density. Some plots are too close to be distinguished individually. The value assigned to each 20 km square was calculated from weighted averages (weight $\propto 1/d^2$, where d = distance) for all plots within 70 km of the 20 km square centre.

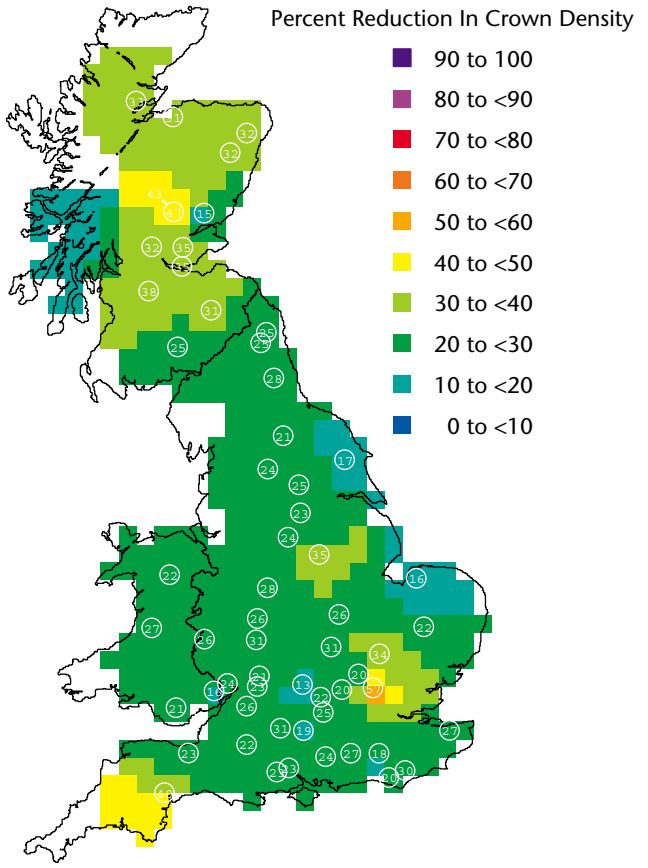
Oak 1998



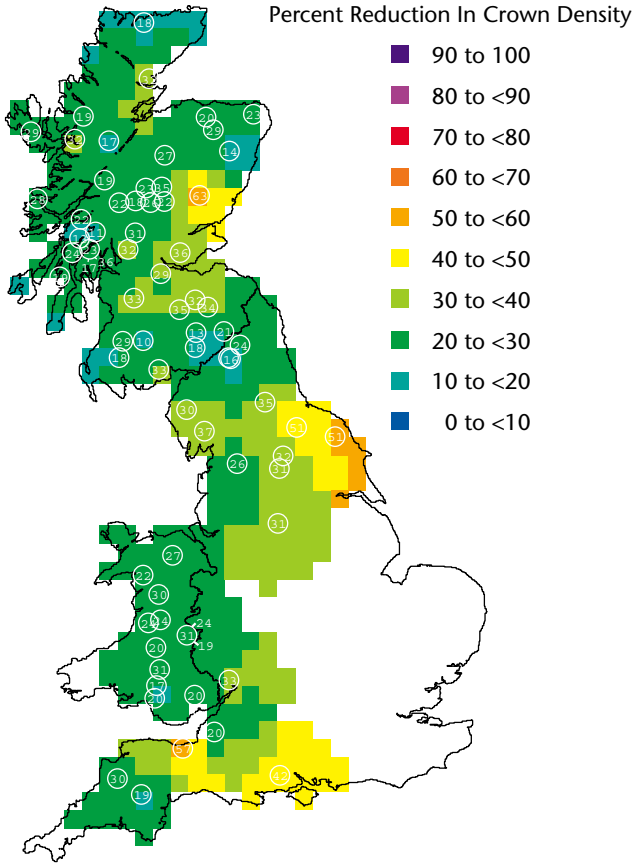
Scots pine 1998



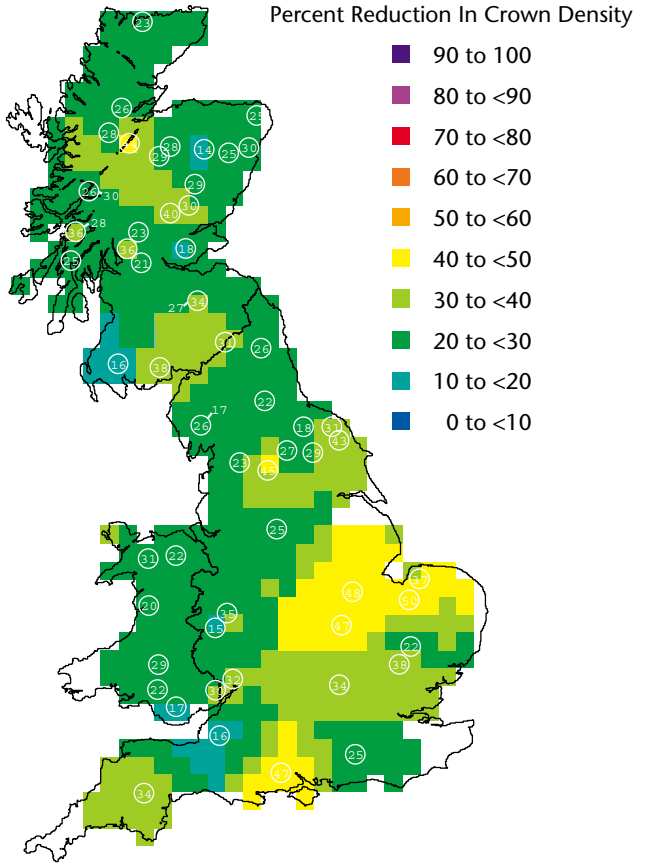
Beech 1998



Sitka spruce 1998



Norway spruce 1998



FACTORS AFFECTING CROWN CONDITION IN 1998

10. The 1998 growing season was cool and wet. Growth was generally good but these conditions favoured foliage diseases such as poplar and birch rust (Gibbs *et al.*, 1998). Several species, including young Scots pine and Sitka spruce, were damaged in east Scotland before flushing by frosts in April, but there were no damaging frosts after flushing. There was no significant damage caused by gales or snow.

11. Both oak and beech suffered much less damage by defoliating and mining insects than in previous years (Figure 3). Oak spangle galls, caused by *Neuroterus* sp., were notable on several plots in Wales and southern England but the infestation only caused slight yellowing. In beech, mast production (Table 2) was also much lower than last year when it contributed significantly to the thinness of crowns. Masting has a major influence on crown density in beech, and was associated with a previous marked decline in 1995 (Redfern *et al.*, 1996). Nevertheless, in spite of the general improvement in beech some plots have been in decline for several years, possibly as a long-term effect of drought. One of these plots is responsible for the small area of low crown density to the north of London (Figure 2). The mean crown density in this plot for the 3-year period prior to the drought year of 1995 was 36.4%, while the figure for the same period after 1995 was 46.0%.

12. Following the severe outbreak of *Elatobium abietinum* on Sitka spruce in 1997 (Redfern *et al.*, 1998) population levels remained quite high in 1998; similar levels of damage were recorded (Figure 3) and there was no improvement in mean crown density.

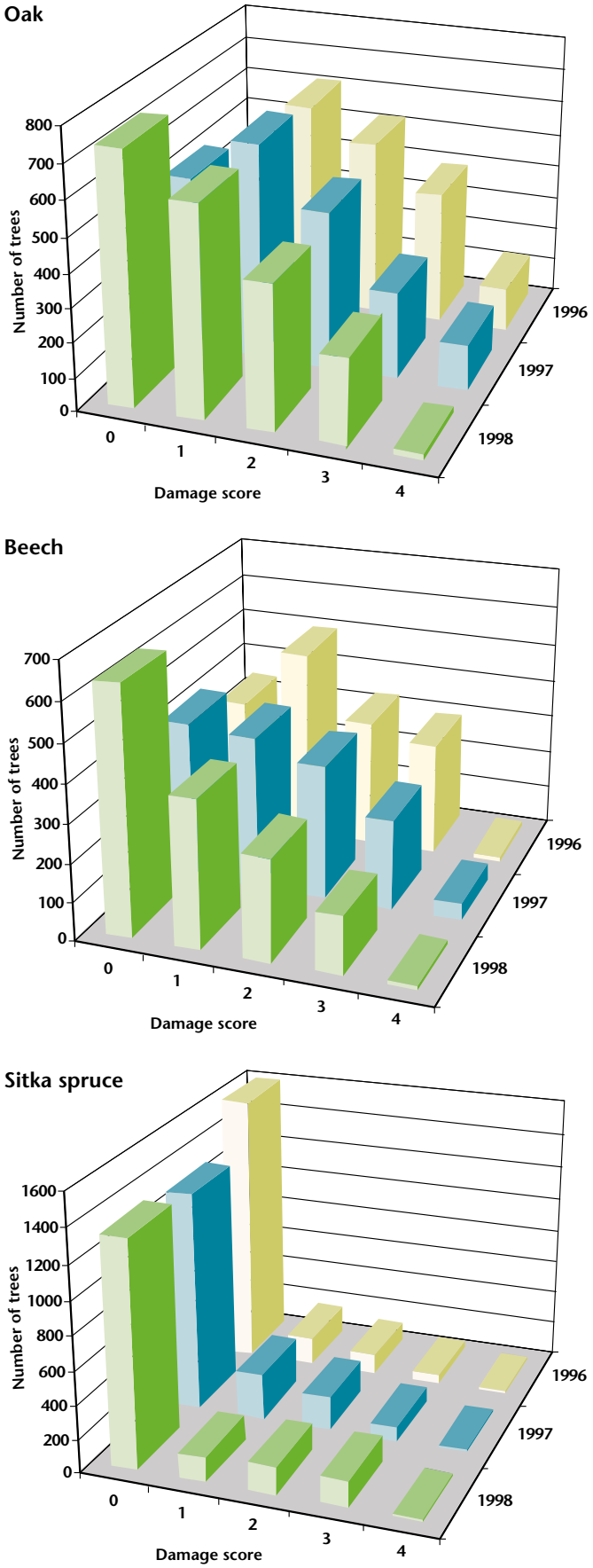
Table 2

Mast production in beech 1995–1998. The scores are 0 = none; 1 = scarce; 2 = common and 3 = abundant. Number of trees in each category.

Year	Mast score			
	0	1	2	3
1995	99	239	424	726
1996	798	349	221	94
1997	361	452	333	290
1998	789	296	247	103

Figure 3

Number of trees in five categories for damage due to defoliating or leaf-mining insects 1996–1998. The damage scores are: 0 = none; 1 = rare; 2 = infrequent; 3 = common; 4 = abundant.



Compared with the response of deciduous trees to defoliation, recovery of spruces is slow after defoliation by *Elatobium*, even after insect populations have collapsed. There was a slight deterioration in the condition of Scots pine but none of the damaging agents recorded seemed to be sufficiently common or numerous to account for the change. As in previous years, long-standing disease caused by the bud blight fungus *Cucurbitaria piceae* (*Gemmamyces piceae*) was noted in several Norway spruce plots in north England and Scotland, and in one plot it was sufficiently severe to reduce crown density.

CONCLUSIONS

13. 1998 was a wet year and generally favoured tree growth. The condition of oak and beech improved markedly, due largely to reduced insect damage compared with previous years but also, in the case of beech, to reduced masting. *Elatobium* continued to affect Sitka spruce in various parts of the country so that overall there was no improvement in crown condition compared with last year. Scots pine deteriorated slightly but no major factor appeared to be responsible for this and the change was within the range of minor fluctuations that have characterised both this species and Norway spruce since 1991.

ACKNOWLEDGEMENTS

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