Forestry Commission

Research Information Note 291

Issued by the Research Division of the Forestry Commission

FOREST CONDITION 1996, by Derek Redfern, Roger Boswell and John Proudfoot

Summary

Crown density and various other features were assessed on a total of 8952 trees of five species – Sitka spruce, Norway spruce, Scots pine, oak and beech – distributed over 373 plots. With the exception of beech, there were no major changes in crown condition this year. Oak and Norway spruce deteriorated slightly but the condition of Scots pine was virtually unchanged following a 3-year improvement which began in 1993. Sitka spruce has improved continuously since 1988. The condition of beech improved significantly but this was not sufficient to eliminate fully the severe deterioration observed in 1995.

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 1996 a total of 8952 trees was assessed distributed over the following numbers of plots: 79 Sitka spruce (*Picea sitchensis* (Bong.) Carr.), 70 Norway spruce (*P. abies* (L.) Karst.), 78 Scots pine (*Pinus sylvestris* L.), 83 oak (*Quercus* spp.) and 61 beech (*Fagus sylvatica* L.). There were also two plots in mixed crops. The assessments were carried out between 4 July and 12 September 1996.

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 harmonize 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, 87 plots were re-surveyed by one experienced supervisor. The proportion of trees for which the two scores fell within one 5% class ranged from 78% in Scots pine to 85% in Sitka spruce. The corresponding figures for two class limits (10%) were 95% and 96%, for oak and Norway spruce respectively. There was no evidence of consistent bias among survey teams (i.e. bias affecting several species) but there was a tendency for Scots pine to be underscored slightly by reference to the standard observer. Since the teams operate on a regional basis the lack of bias increases confidence in the geographical interpretation of results.

The 1996 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 in all species.

Table 1. Percentages of trees in each crown density class for five species in 1996. 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.

Percent reduction in crown density	Sitka spruce		Norway spruce		Scots pine		Oak		Beech	
	I	L	I	L	I	L	I	L	I	L
0-10	22.2	47.5	11.8	40.6	5.1	43.2	2.5	39.2	4.1	46.7
11-20	33.7	32.2	25.3	33.3	26.8	34.8	12.5	32.7	31.1	35.4
21-30	25.9	14.0	31.6	15.2	37.8	14.8	26.6	16.9	35.0	11.7
31-40	11.7	4.0	18.2	5.7	20.5	4.6	27.8	6.1	20.2	4.4
41-50	4.1	1.6	5.8	2.0	6.7	1.7	16.2	2.7	6.4	1.0
51-60	1.1	0.4	3.2	0.6	1.7	0.4	7.9	1.0	1.7	0.4
61-70	0.6	0.3	1.4	0.8	0.8	0.2	3.5	0.5	0.8	0.3
71-80	0.6	0.1	0.7	0.5	0.3	0.1	1.7	0.6	0.3	0.1
81-90	0.1	0.0	0.8	0.3	0.2	0.1	1.1	0.3	0.1	0.0
91-100	0.2	0.1	1.2	1.1	0.2	0.2	0.5	0.1	0.2	0.2

6. Figure 1 shows the changes in crown condition that have taken place since 1987 by recording the proportion of trees in which the reduction in crown density, compared with that of an ideal tree, has exceeded 25%. An upward gradient in Figure 1 would therefore indicate a deterioration in crown condition. Apart from a gradual improvement in Sitka spruce, which has continued almost annually since 1988, crown density scores have fluctuated over this period revealing little evidence of a long-term trend for any species. However, it is interesting to note that there appear to be short-term

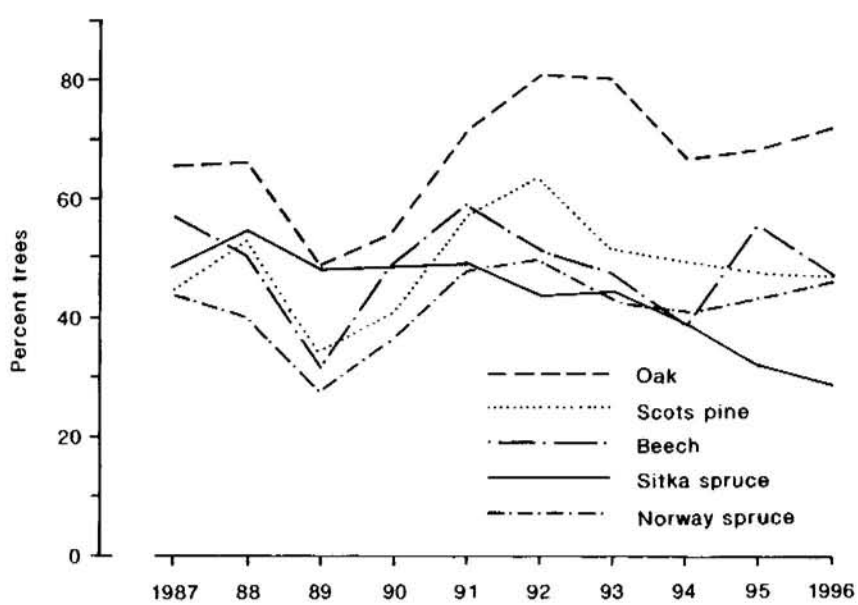

Figure 1. Changes in crown density since 1987 for five species surveyed annually. The proportion of trees in which crown density was reduced by more than 25% compared to an ideal tree is shown for each species.

effects that are common for four out of the five species. Analysis has shown that whereas most of the 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.

7. Except for beech, there have been no major changes in crown condition this year. Oak and Norway spruce again declined slightly but Scots pine was virtually unchanged. Sitka spruce maintained the slight annual improvement which has continued since 1988. The condition of beech improved significantly, but this was not sufficient to eliminate fully the severe reduction in crown density observed in 1995.

8. Geographical differences were evident for all species, in spite of the limitations imposed by the uneven distribution of plots. Differences were greatest in oak, which was notably poor in central Scotland and East Anglia compared, in particular, to central-southern England. Beech was in poorer condition in much of Scotland and south-east England than elsewhere. There was considerable local variation in Norway spruce but it was poorest in the east Midlands and Lincolnshire. Crown density in Sitka spruce tended to be greatest in Scotland, north England and Wales, whereas for Scots pine the reverse was broadly true with crown density being highest south of the Humber-Mersey line.

Factors affecting crown condition in 1996

9. The summer of 1996 was not as hot and dry as 1995, but many parts of the country were unusually dry and non-woodland beech, among other species, were widely affected in the east midlands, East Anglia and eastern Yorkshire. Much of the damage had probably been initiated in 1995 (Gregory *et al.*, 1996). Few clear signs of drought damage were evident in the woodland trees included in the survey reported here; for a variety of reasons woodland trees tend to be less vulnerable to drought than individual trees in hedgerows and on roadsides. Nevertheless, the comparatively poor condition of beech, oak and Norway spruce in the same general area suggests that the cumulative effects of drought may be a factor in the health of woodland trees here also.

10. The most important damage to oak was caused by defoliating insects such as the winter moths *Operophtera brumata* and *Erannis defoliaria*, and by the oak leaf roller moth (*Tortrix viridana*): severe damage was recorded in 25 of the 93 plots surveyed. In East Anglia a condition of oak characterised by death and dieback (Greig, 1992) contributed to the relatively high levels of defoliation. Other causes of injury, such as squirrels, were minor although previous storm damage was still evident in a few plots.

11. The major reduction in crown density recorded in beech in 1995 was largely due to heavy mast formation. Little or no mast was present this year in two-thirds of plots but it was common or abundant in the remainder. Most of these were located in Scotland and may account for the relatively low crown density recorded there. The leaf miner, *Rhynchaenus fagi*, was present in most plots, frequently on all trees, but it caused significant damage in only a few plots. Foliage yellowing was observed in 27 plots. In the majority of cases it took the form of general chlorosis but in 10 plots it was confined to the upper crown (see Redfern *et al.*, 1995). Other causes of injury included *Apiognomonia errabunda, Nectria* canker, rabbits and squirrels but damage was minor.

12. Of the three conifers, only Norway spruce was in poorer condition than in the previous year. No special factors appear to have been involved. This species is affected by a progressive climate/ physiological disorder known as 'top dying' in which pole-stage trees on unsuitable sites decline and die over a period of several years. The problem is exacerbated by drought and damage may have been accelerated in some crops by the dry summer of 1995. Crown distortion caused by the bud blight fungus *Cucurbitaria piceae* (*Gemmamyces piceae*) was observed in 13 plots of older trees in north England and south-west Scotland.

13. The condition of Scots pine was virtually unchanged compared to last year, ending a three-year improvement which began in 1993. Locally, crown density was severely affected by storm damage and defoliation by the pine shoot beetle *Tomicus piniperda*, but generally damage was insignificant though *T. piniperda* was recorded frequently. Squirrels and the needle cast fungus *Lophodermium seditiosum* caused minor damage.

14. While annual changes in the crown density of Sitka spruce have rarely been large enough to be statistically significant, the overall trend has been one of almost continuous improvement since 1988. However, it should be noted that because of the way the data are presented in Figure 1 the change represents an improvement in the mean crown density of only about 5% (data not shown). As in previous years, exposure and defoliation by *Elatobium abietinum* were the major factors affecting Sitka spruce. *Elatobium* was recorded in 32 plots but it was significant in only 8. Exposure effects were noted in 18 plots.

Conclusions

15. 1996 was generally a good year for tree growth although drought was locally important in the east, especially following the more widespread 1995 drought. This factor may have been involved in the slight deterioration of both Norway spruce and oak, which continued a similar decline in 1995. Oak was also significantly affected by insect defoliation. Following a 3-year improvement, the condition of Scots pine was virtually unchanged compared to last year. Sitka spruce maintained the general trend of improvement which began after severe defoliation by *Elatobium* in 1988. The condition of beech improved significantly but this was not sufficient to offset fully the severe deterioration observed in 1995.

Acknowledgements

16. We are grateful to staff from the Forestry Commission's Surveys Branch and Mensuration Branch who carried out this work so conscientiously and efficiently, and to Lesley Halsall and Heather Steele for help with processing and collating the results. We would also like to thank Forestry Commission staff and private woodland owners for their help in setting up and maintaining the survey plots.

References

GREGORY, S. C., ROSE, D. R., GIBBS. J. N. and WINTER, T. G. (1996). *The health of non-woodland trees in England in 1996.* Arboriculture Research and Information Note 136/PATH/96, Arboriculture Advisory and Information Service, Farnham, Surrey.

INNES, J. L. (1990). *Assessment of tree condition.* Forestry Commission Field Book 12. HMSO, London.

INNES, J. L. and BOSWELL, R. C. (1991). *Monitoring of forest condition in Great Britain – 1990.* Forestry Commission Bulletin 98. HMSO, London.

REDFERN, D. B., BOSWELL, R. and PROUDFOOT, J. (1995). *Forest condition 1994.* Research Information Note 262. Forestry Commission, Edinburgh.

Enquiries to:
Research Communications Officer
Forestry Commission Research Division
Alice Holt Lodge, Wrecclesham
Farnham, Surrey GU10 4LH

March 1997

ISSN 0267 2375

Phototypeset and published by: Forestry Commission, 231 Corstorphine Road, Edinburgh EH12 7AT