Forestry Commission **Research Information Note 282**

Issued by the Research Division of the Forestry Commission

FOREST CONDITION 1995, by Derek Redfern, Roger Boswell and John Proudfoot

Summary

Crown density and various other features were assessed on a total of 8712 trees of five species – Sitka spruce, Norway spruce, Scots pine, oak and beech – distributed over 363 plots. With the exception of beech, there have been no major changes in crown condition this year. Oak and Norway spruce deteriorated slightly but Scots pine maintained an improvement which began in 1993. Sitka spruce has improved continuously since 1988. A marked deterioration in beech was associated with heavy mast production and does not necessarily indicate ill health.

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 1995 a total of 8712 trees was assessed distributed over the following numbers of plots: 70 Sitka spruce (*Picea sitchensis* (Bong.) Carr.), 69 Norway spruce (*P. abies* (L.) Karst.), 79 Scots pine (*Pinus sylvestris* L.), 83 oak (*Quercus* spp.) and 62 beech (*Fagus sylvatica* L.). The assessments were carried out between 29 June and 1 September 1995.

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, 75 plots were re-surveyed by one experienced supervisor. The proportion of trees for which the two scores fell within one 5% class ranged from 72% in Scots pine to 83% in beech. The corresponding figures for two class limits (10%) were 89% and 98% respectively. There was also some evidence of bias among the survey teams. Half of the 20 comparisons that differed by more than 5% were accounted for by two teams. Since the teams operate on a regional basis this has significance for the geographical interpretation of the results.

The 1995 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 1995. 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	18.9	45.8	12.0	40.2	4.6	41.9	3.2	37.9	3.0	43.7
11-20	33.9	34.3	27.4	36.1	25.7	38.4	16.1	36.2	24.3	36.7
21-30	25.8	11.9	30.5	13.6	38.4	12.7	25.5	15.3	35.5	13.6
31-40	10.9	4.0	17.6	5.1	21.0	4.3	30.3	6.1	23.2	3.4
41-50	6.1	1.8	5.5	2.2	6.3	1.6	13.3	2.7	9.1	1.9
51-60	1.7	1.4	3.1	0.6	2.2	0.6	6.6	1.0	3.4	0.4
61-70	1.1	0.4	1.3	0.8	0.8	0.1	2.8	0.5	0.8	0.0
71-80	1.0	0.2	1.1	0.6	0.4	0.1	1.5	0.2	0.5	0.1
81-90	0.4	0.1	0.7	0.2	0.1	0.1	0.5	0.1	0.1	0.1
91-100	0.1	0.0	1.0	0.7	0.4	0.3	0.3	0.2	0.2	0.1

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. 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 effects that are common for all five species.

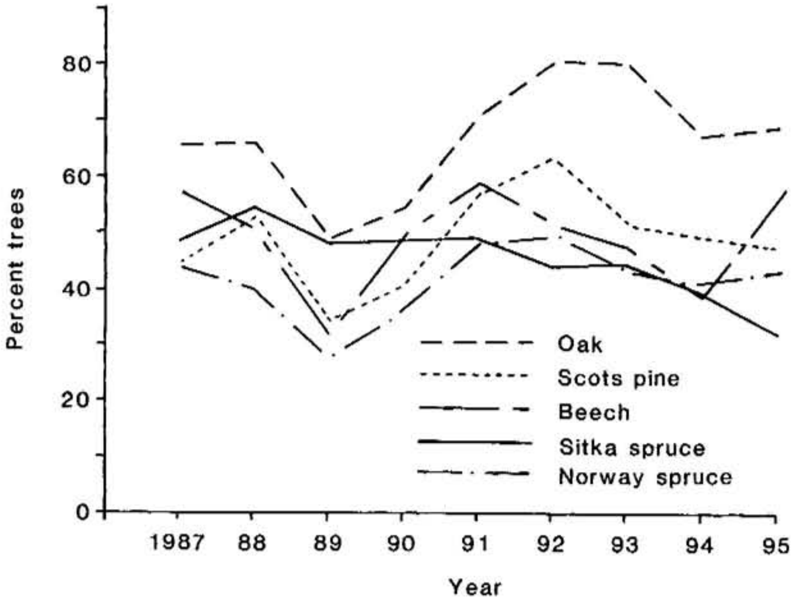

Figure 1. Changes in crown density since 1987 for five species surveyed annually. The proportion of trees in which crown density was reduced by more than 25% compared to an ideal tree is shown for each species.

7. With the exception of beech, there have been no major changes in crown condition this year. Oak and Norway spruce declined slightly but Scots pine maintained an improvement which began in 1993. Sitka spruce has improved continuously since 1988. The deterioration in beech this year was as great as in the drought year of 1990, and reversed an improvement seen over the previous 3 years. As in 1990 (Innes and Boswell, 1991) the reduction in crown density in 1995 was associated with heavy mast production (Table 2).

Table 2. Mast production in beech for selected years. 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
1989	504	250	78	27
1990	47	98	285	429
1994	908	409	140	31
1995	99	239	424	726

Factors affecting crown condition in 1995

8. Drought (Rose, 1996) and a late spring frost were the most notable climatic events but neither had more than local effects during the survey period. The drought followed a wet winter and its effects did not become evident until August and then mainly involved non-woodland trees of susceptible species such as beech, birch, ash and sycamore in open and particularly dry situations. However it may have caused the browning and yellowing of leaves recorded in some beech plots and an unusually high incidence of leaf rolling. Deep rooting species such as oak were unaffected. Frosts in April and May damaged oak and beech in large parts of Britain but when the survey began the effects were largely masked by new leaves. Again damage was most evident in non-woodland trees.

9. The most important damage to oak was caused by winter moths such as *Operophtera brumata* and *Erannis defoliaria*, and by the oak leaf roller moth (*Tortrix viridana*). Damage by these insects was recorded in 34 of the 83 oak plots in the survey. Three of these plots have been badly defoliated 3 years in succession. However records must be interpreted with care since a significant degree of recovery may take place after spring larval feeding is complete. Thus the date of assessment may have an impact on the results. One plot which has suffered regular defoliation was surveyed twice in 1995, on 12 July and 25 August. During this time six of the 24 trees in the plot improved by 10% or more and four by 5%.

10. In the early part of this decade a condition of oak, characterised by death and dieback, was recognised in parts of south and east England (Greig, 1992). It occurred in four of the plots but was severe in only one of them. There is no evidence from the surveys conducted since 1992 that the condition is becoming more common. Elsewhere trees with thin crowns due to wind damage and exposure were noted in several plots but most of the damage occurred some years ago and many trees seemed to be recovering. No significant fungal damage was recorded this year.

11. As already mentioned, the major factor affecting crown density in beech seems likely to have been the amount of mast produced. Analysis of the results for each year during the period 1989-1995 has shown a significant positive relationship in four years. There was no evidence of a relationship in 1994 or 1995 and in 1991 it was negative, but since masting is only one of a number of factors affecting crown density some inconsistency can be expected.

12. Beech leaf miner (*Rhynchaenus fagi*) and *Nectria* cankers were common but damage was only significant in two plots in each case.

13. There has been no major change in the condition of Norway spruce since 1991. However the lethal condition known as 'top-dying' continues to be the most important cause of damage. This is a progressive, climatic/physiological disorder associated with wind and drought. In north England and south and west Scotland the bud blight fungus (*Cucurbitaria piceae* (*Gemmamyces piceae*)), which causes crown distortion, has been recorded for a number of years. Exposure injury, crown breakage by wind or snow, windthrow and attacks by the green spruce aphid (*Elatobium abietinum*) are

potentially important causes of damage to both Norway spruce and Sitka spruce but none of them was significant this year.

14. The only factors appreciably reducing crown density in Scots pine were exposure and mechanical damage caused by wind or snow either recently or in the past. Heavy flowering was thought to have had a slight effect on the appearance of crowns in several plots. Minor insect damage, either to needles or shoots, was recorded in many plots. Yellowing or browning of needles on some plots in August was thought to be a response to drought.

15. Geographical differences in crown density are difficult to determine due to the uneven distribution of some species and bias among survey teams (see paragraph 4). However, in spite of this limitation, it was evident that the crown density of Sitka spruce was generally higher in the north than the south while for oak it was notably low in mid Scotland. The latter was largely due to defoliation by winter moths.

16. It should be noted that, for a variety of reasons, individual trees in hedgerows and on roadsides, particularly beech and oak, may be in much poorer condition than the woodland trees included in this survey.

Conclusions

17. 1995 was generally a good year for tree growth in spite of a severe summer drought. The above-average winter rainfall delayed the onset of drought symptoms until mid-August but casual observations showed that thereafter leaf browning and dieback became quite dramatic in vulnerable species such as beech. However, this was not fully reflected in the survey results for two reasons: the majority of plots were assessed before symptoms became apparent, and damage was most evident in non-woodland trees which are not included in the survey.

18. With the exception of beech there have been no major changes in crown condition this year. Oak and Norway spruce deteriorated slightly but Scots pine has maintained an improvement which began in 1993. Sitka spruce has improved continuously since 1988. By contrast, the condition of beech deteriorated to such an extent that an improvement which had taken place over the preceding 3 years was eliminated. As in an earlier major deterioration in beech (in 1990) the decline was associated with heavy mast production (Innes and Boswell, 1991) and does not necessarily indicate ill-health.

Acknowledgements

19. 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

GREIG, B. J. W. (1992). *Occurrence of decline and dieback of oak in Great Britain.* Research Information Note 214. Forestry Commission, Edinburgh.

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.

ROSE, D. R. (1996). Effects of weather on tree growth. *Forestry and British Timber* **25**(1), 37-38.

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

May 1996

ISSN 0267 2375

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