Research & survey in nature conservation

No. 1

The use of permanent quadrats to record changes in the structure and composition of Wytham Woods, Oxfordshire

A.S. Horsfall and K.J. Kirby

Further copies of this report can be obtained from:

Publications Branch
Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough PE1 1JY

Reprinted 1992
ISBN 0-86139-326-0

Contents

Summary

Between 1973 and 1976, 163 quadrats, each 100 m^2, were recorded in a systematic distribution through Wytham Woods in Oxfordshire. Previously unpublished results from these plots are used to describe the structure and composition of the wood. 21 quadrats were re-recorded in 1984. Changes in these plots in the intervening period are described.

Introduction

Between 1973 and 1976, 163 quadrats were laid out in Wytham Woods, Oxfordshire, to test a system for the long-term surveillance of British woodland vegetation (Dawkins & Field 1978). (Most of the recording took place in 1974 and for convenience this date only is used to refer to this work.) This paper uses unpublished results from these plots to examine the structure and composition of the wood and analyses changes in some of the plots 10 years later.

Site

Wytham Woods (National Grid Reference SP460085) are about 650 ha of predominantly broadleaved woodland owned by Oxford University which lie 8 km north-west of Oxford. Their history and general composition are described by Grayson & Jones (1955) and Elton (1966).

Methods

The plots used in this study are distributed in a systematic way through the woods at alternate intersections of a 100 m grid (Dawkins & Field 1978). The intersections of the 100 m grid are marked with wooden posts and buried metal markers. The plots are off-set from the posts by 14.14 m in a north-easterly direction (true bearing). Each plot is 10 x 10 m square with buried metal markers at the south-west and north-east corners.

All 163 plots were recorded in the 1974 survey, but in August 1984 there was time to re-survey only 21 of them (Fig. 1). These plots were relocated by finding the appropriate grid post and then following a bearing to the south-west corner of the plot. A metal detector was used to find the metal marker defining this first corner. The second corner marker was found by measuring along the bearing and then using the metal detector. The positions of the other corners were defined by triangulation, using tapes laid out along the sides and diagonals

of the plot. A few of the temporary plot markers used in 1974 still remain, although the original intention was that there should be no above-ground trace of the plots. These markers are rotting and will not be visible for much longer.

Not all the measurements made in the original survey were repeated in 1984, but the following data were collected on both occasions:

(a) estimates of percentage "canopy" cover (2.5 m or higher) along the north-east to south-west diagonal of the plot, both total cover and that for each individual tree and shrub species;

(b) diameters at breast height of the four leading (i.e. largest diameter) trees in the plot with a note of their species and location;

(c) relascope sweeps (using a tally factor of 2) from the north-east and south-west corners of the plot; (Relascope or angle gauge sampling is a technique widely used in forestry to measure the mean basal area of trees at a given point; see, for example, Loetsch and others 1973. Trees "count" in the sweep if, when viewed through the gauge, their diameter subtends an angle greater than a given set value on the gauge determined by the tally factor.)

(d) a list of all vascular plant species rooted in the plot;

(e) rooted frequency for all vascular plant species in 13 0.1 m^2 "circlets" (small circular "quadrats") evenly distributed along the two diagonals of the plot (six along each diagonal plus one in the centre).

The composition and structure of the wood were examined, using the percentage canopy cover figures, the diameters of the four leading trees in each plot and the "relascope scores" which measured the basal area of the trees present at a given point.

Species names follow Clapham, Tutin & Warburg (1962).

Results

Tree layer composition based on the 1974 survey

The relascope scores provide the best overall indication of the composition of the tree layer. All trees in the plot (not just the largest) may count in the tally, and the sweep includes the surrounding woodland as well. The wood is dominated by three species, sycamore Acer pseudoplatanus, oak Quercus robur and ash Fraxinus excelsior

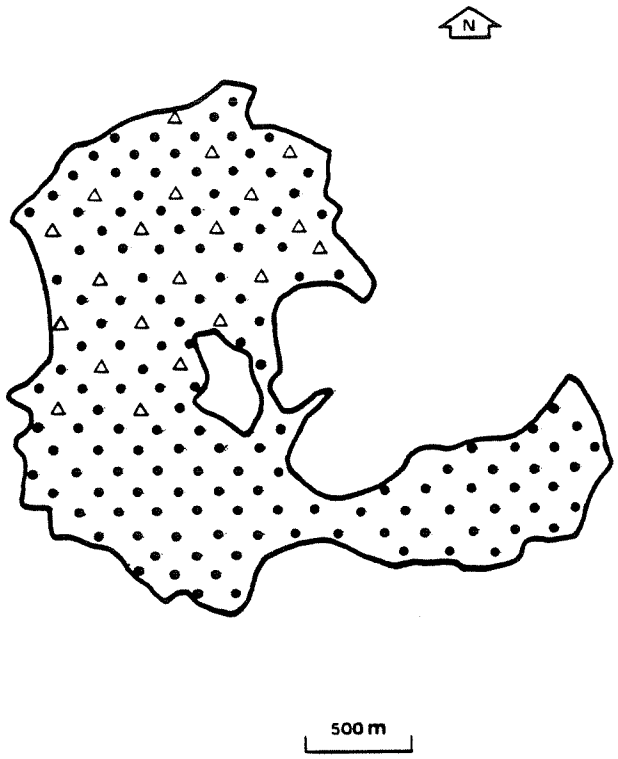


FIG. 1 Distribution of plots recorded in 1974 and 1984 (△) and recorded in 1974 only (•)

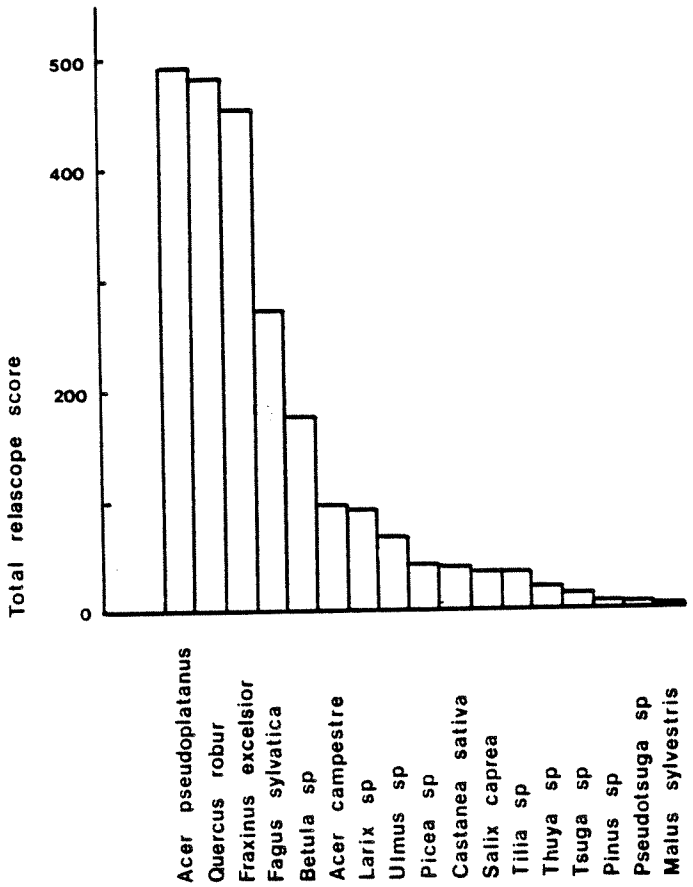


FIG.2 Relative basal area of different tree species in Wytham Woods derived from the 1974 records (163 plots)

(Fig. 2), but with a wide range of other broadleaved and coniferous species, reflecting in part the amount of new planting and replanting which has taken place in the last 40-50 years.

The distribution of trees and shrubs is far from uniform (Fig. 3). Oak is widespread, but its contribution to the canopy is very patchy. Ash is widespread but also forms a major component of the canopy in large areas. Sycamore is concentrated on the northern slopes of the hill, where it is frequently dominant in the canopy. Field maple Acer campestre and beech Fagus sylvatica provide the most marked contrast: the first is usually an understorey species, a survivor from the former coppice management which was carried out mainly in areas around the edge of the wood, whereas beech, an introduction to Wytham, was widely planted towards the top of the hill and usually forms part of the canopy.

The diameter distributions for the three main species (based on leading tree data) (Fig. 4) reflect the fact that many areas in the woods are relatively young plantations or have grown up this century from coppice. Only with oak are there many stems of more than 40 cm diameter, often old standards in the former coppices or pollards in the old wood-pasture areas (Grayson & Jones 1955).

Changes in the tree layer (1974-1984)

Because the wood is predominantly of young growth there has been a general increase in leading tree diameters for ash and sycamore from 1974 to 1984 (Fig. 4, D and E). Approximately 72% of the largest (leading) trees per plot in 1974 were still among the largest in 1984. In dense young stands rapid growth of some species has led to different individuals appearing as the leading trees without producing a significant difference in species composition. The growth of the young ash and sycamore was reflected in a rise in the relascope tallies for these species (Fig. 5). In a comparison of 1974 and 1984 relascope values plot by plot (Table 1) there were significant increases for ash ($p<0.01$) and sycamore ($p<0.05$, Wilcoxon signed rank test); but canopy cover percentages did not change significantly.

Changes in the ground flora (1974-1984)

The vascular plant lists in 1974 and 1984 for the 21 plots were very similar (Table 2) and there was no significant difference in the mean

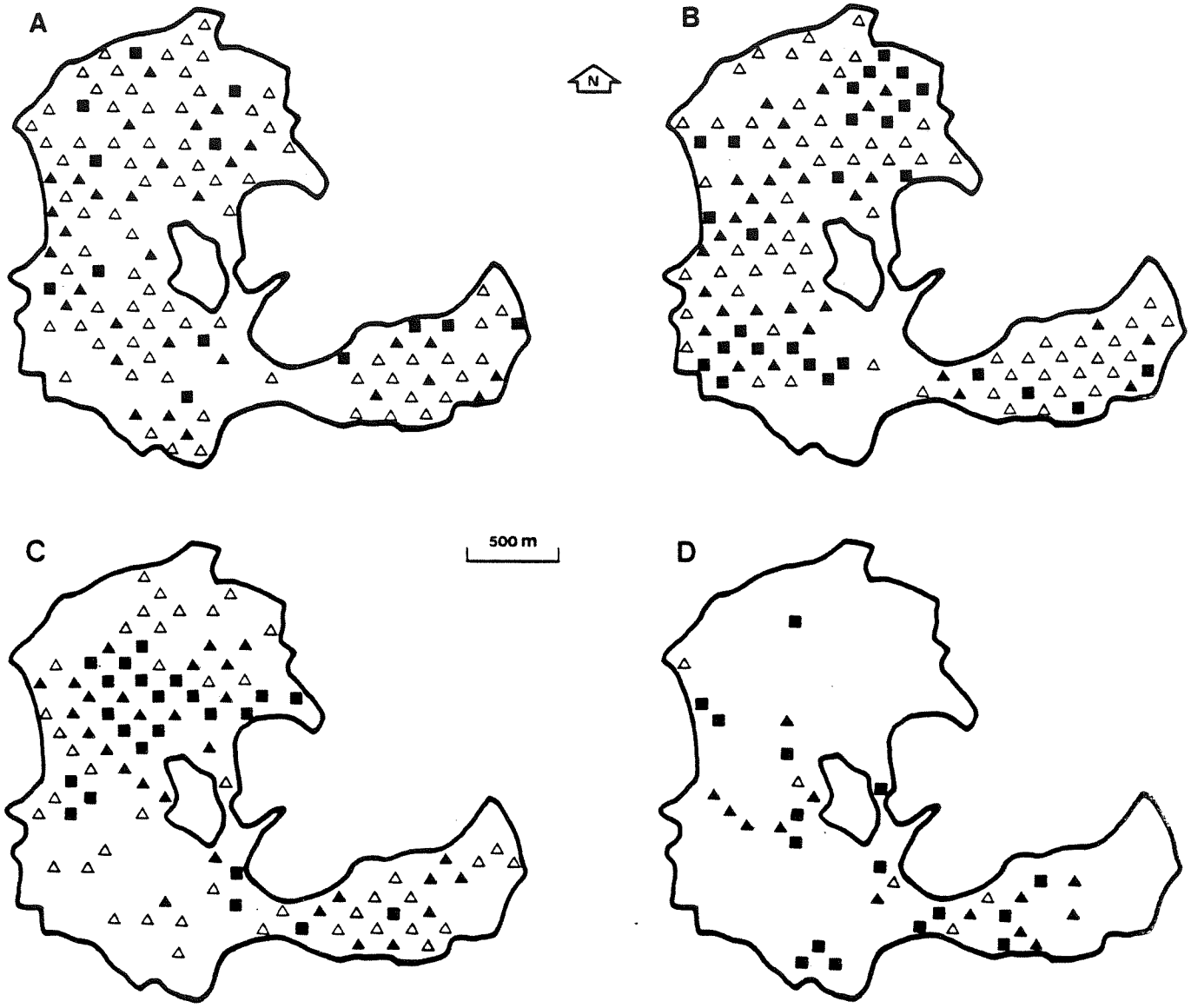
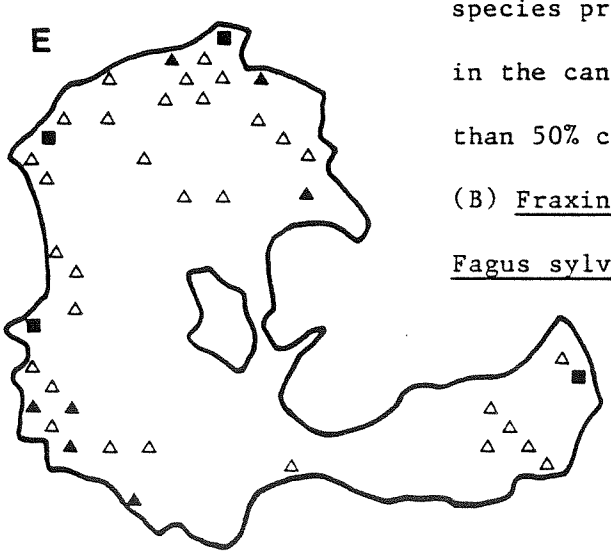


FIG. 3 Occurrence and percentage canopy cover of the main tree species derived from the 1974 records: (△) species present in the plot, (▲) species present in the canopy up to 50% cover, (■) present with more than 50% canopy cover in the plot. (A) Quercus robur, (B) Fraxinus excelsior, (C) Acer pseudoplatanus, (D) Fagus sylvatica, (E) Acer campestre.



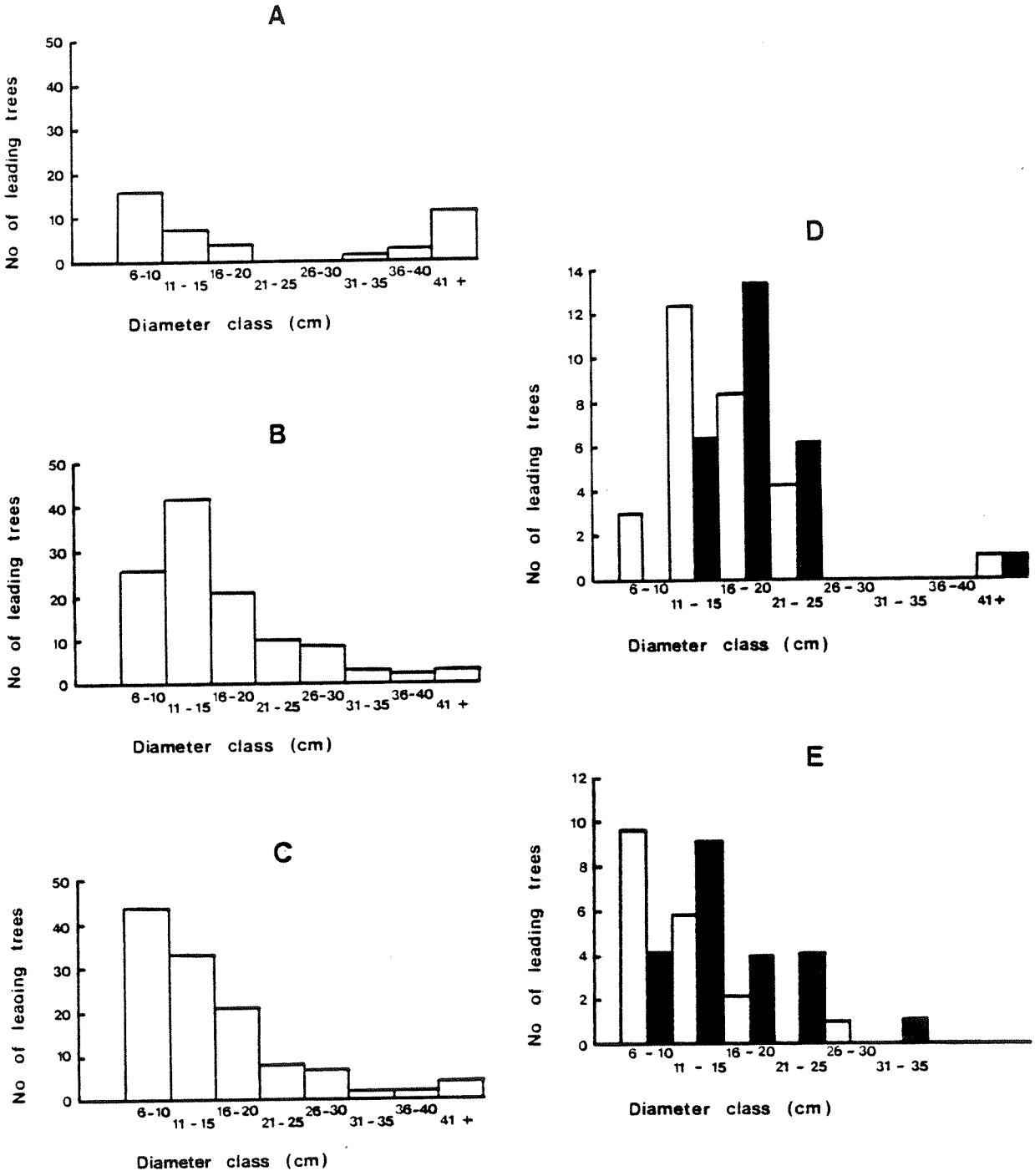


FIG. 4 Diameter distribution for the leading trees in 1974 (163 plots): (A) oak Quercus robur, (B) sycamore Acer pseudoplatanus, (C) ash Fraxinus excelsior. Changes in diameter distribution, 1974-1984 (21 plots): (D) sycamore, (E) ash (□ 1974, ■ 1984). Oak occurred too infrequently in the 1984 records to be worth plotting in this way.

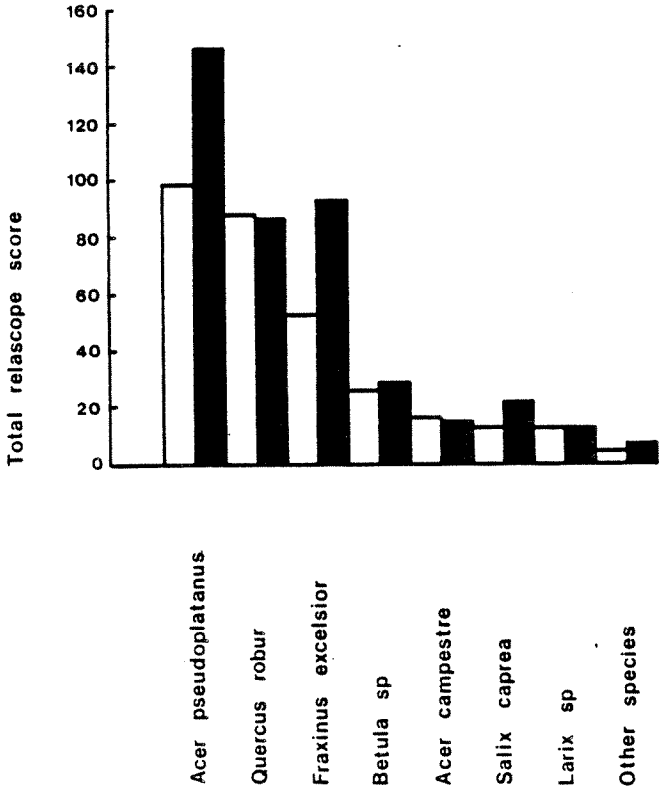


FIG.5 Changes in basal area for different tree species between 1974 (□) and 1984 (■), using data from 21 plots

number of species per plot. However, 14 of the 21 plots were recorded in May or June in 1974, whereas all the 1984 records were from August; consequently vernal species were better represented in the 1974 lists. Three plots showed reductions of 13, 16 and 17 species respectively between the 1974 and 1984 surveys. In one case several of the species not found in the plot in 1984, e.g. Symphytum officinale, were just outside it. This suggests that because of difficulties in relocating the underground markers for this particular plot (the metal detector had broken down) it was slightly offset from its true position. The other two plots which showed a large change in the ground flora were within young plantations. Decreases in the number of plant species in these plots may have been produced by increased shading and root competition from the young trees between 1974 and 1984. The percentage cover for the field/low shrub and ground layers in both plots was also reduced over the same period.

Results from the circlets (small circular "quadrats" placed along the plot diagonals) were used to compare the frequency of ash and sycamore seedlings in the two sample years. Ash seedlings were more abundant, sycamore less so in 1984 than in 1974 (Table 3) ($p<0.01$, Wilcoxon signed rank test). This probably has little long-term biological significance in a wood where both species are largely present as young trees and is more likely to represent an annual fluctuation in seedling numbers rather than part of a longer trend.

Distribution of ground flora species (1974 results)

The presence or absence data provided by the plot records were used to examine species distribution patterns in Wytham. Parts of the woods (Grayson & Jones 1955) are known to have been continuously wooded since 1600 (ancient woodland sensu Peterken 1977), whereas other areas were open grassland until recently. A gradation of species can be found between those which are more common in the ancient, rather than recent, woodland and those where the reverse is true (Fig. 6, Table 4).

Discussion

The re-recording of 21 plots was a pilot study to determine how easy it would be to relocate and re-record the plots and whether any changes could be detected over this relatively short period of time.

FIG. 6 Distribution of species between ancient (A) (sensu Peterken 1977) and recent (R) woodland: (----) the approximate boundary of the ancient woodland, (▲) Corylus avellana present in plot, (△) Sambucus nigra present, (■) both species present.

Most quadrats were relocated with little difficulty, although the system of grid posts needs renewing. Some posts had fallen over and others had become hidden by tall vegetation. Initially 22 plots were due to be sampled, but a combination of 2 m high bracken Pteridium aquilinum and dense scrub of blackthorn Prunus spinosa made it impossible to find the metal corner markers of one plot without destroying much of the vegetation in it. The metal detector proved essential for precise relocation of the plots. The prediction of the position of the corner marker, made using a tape and compass bearing from the nearest post, was frequently in error by 0.5 - 1.0 m.

The recording process did not present any major difficulties, although some measurements could be repeated with greater precision than others. The positions of the circlets, set down along the plot diagonals, were not exactly the same as in the previous survey. On the other hand, even with fairly crude estimates of the co-ordinates for the leading trees, it was easy to decide whether the same individual stem had been recorded on successive occasions. Differences in the season of year, and the observers involved, may account for some of the variations between the two sets of ground flora records and could mask real changes over time (Kirby and others in press). However the measurements appear to be precise enough for changes between 1974 and 1984 to be detected, both at the individual plot level and in the sample of 21 plots as a whole.

Independent of any subsequent recording, the records from 1974 provide a detailed picture of the woodland structure and a basis for investigating the distribution of species, for example in relation to past land-use. Differences between the ancient and recent woodland sections are apparent. Of the species in Table 4, Carex pendula does have a strong association with ancient woods in eastern England, while Sambucus nigra and Chamaenerion angustifolium are known to be fast colonists and so might be expected to be more common in the recent woodland. The differences are not as great as between separate ancient and recent sites (Peterken 1974; Peterken & Game 1984), but greater movement of species would be expected between parts of the same wood. Also the possibility that these and other species may be responding to some pattern of soil variation which overlaps with the ancient-recent woodland division rather than to land-use history directly cannot be eliminated at this stage.

Acknowledgements

We should like to thank Dr H C Dawkins for permission to use the unpublished observations from the 1974 survey, and both him and Dr C D Gibson for their enthusiastic help and advice in the 1984 survey. Permission to work in Wytham Woods was kindly given by the University of Oxford through the Wytham Management Committee.

References

CLAPHAM, A.R., TUTIN, T.G., & WARBURG, E.F. 1962. Flora of the British Isles. 2nd ed. Cambridge, Cambridge University Press.

DAWKINS, H.C., & FIELD, D.R.B. 1978. A long-term surveillance system for British woodland vegetation. Oxford Commonwealth Forestry Institute (Occasional Paper 1).

ELTON, C. 1966. The pattern of animal communities. London, Methuen.

GRAYSON, A.J., & JONES, E.W. 1955. Notes on the history of the Wytham estate with special reference to the woodlands. Oxford, Imperial Forestry Institute.

KIRBY, K.J., BINES, T., BURN, A., MACKINTOSH, J., PITKIN, P., & SMITH, I. (in press). Seasonal and observer differences in vascular plant records from woodlands. Journal of Ecology.

LOETSCH, F., ZOHRER, Z., & HALLER, K.E. 1973. Forest Inventory, Volume 2. Munchen, BLV Verlags.

PETERKEN, G.F. 1974. A method for assessing woodland flora for conservation using indicator species. Biological Conservation, 6, 239-245.

PETERKEN, G.F. 1977. Habitat conservation priorities in British and European woodlands. Biological Conservation, 11, 223-236.

PETERKEN, G.F., & GAME, M. 1984. Historical factors affecting the number and distribution of vascular plant species in the woodlands of central Lincolnshire. Journal of Ecology, 72, 155-182.

Table 1 Changes in relascope scores for oak, ash and sycamore (1974-1984)

	Number of quadrats showing:		
	Increase	Decrease	No change
Ash	14	-	7
Sycamore	10	2	9
Oak	11	7	3

Table 2 Changes in the ground flora (1974-1984) from 21 plots

(a) Number of species recorded from all 21 plots in 1974: 110
Number of species recorded from all 21 plots in 1984: 103
Number of species recorded in both years: 90
Sorensen's Similarity Index for the lists from 21 plots: 84%

(b) Total number of species occurrences in 1974: 459
Total number of species occurrences in 1984: 399
Species occurrences common to both years: 334
Sorensen's Similarity Index (quantitative form) for the lists from the 21 plots: 78%

(c) Mean number of species per plot (± S.E.) (1974): 21.8 ± 9.4 (n=21)
Mean number of species per plot (± S.E.) (1984): 18.7 ± 7.1 (n=21)
Mean Sorensen's Similarity Index for an individual plot: 71.1 ± 11.2%

(d) Number of plots (out of 21) in which the following vernal species were present:

	1974	1984
Anemone nemorosa	2	0
Arum maculatum	9	6
Endymion non-scriptus	6	2
Ranunculus ficaria	3	0

Table 3 Changes in frequency of seedling occurrence in "circlets" for ash and sycamore (1974-1984)

	Ash	Sycamore
(a) Mean number of circlets per plot (out of 13) containing seedlings in 1984 (n = 21):	2.3	0.2
Mean number of circlets per plot containing seedlings in 1974 (n = 21):	0.8	0.9

	Ash	Sycamore
(b) Number of plots (out of 21) showing an increase in the number of circlets with seedlings:	14	0
Number of plots (out of 21) showing a decrease in the number of circlets with seedlings:	2	8

Table 4 Frequency of occurrence of selected species in plots within the "ancient" woodland areas* in Wytham Woods (1974 data)

	Ancient woodland	Recent woodland	Total
Total numbers of plots	77	86	163
Plots containing:			
Carex pendula	27	11	38
Corylus avellana	40	23	63
Endymion non-scriptus	36	25	61
Festuca gigantea	25	26	51
Geum urbanum	29	41	70
Chamaenerion angustifolium	15	25	40
Sambucus nigra	19	32	51

The species are ordered according to the relative frequency with which they were recorded from the ancient woodland areas* in Wytham in 1974.

*Areas which have been continuously wooded since 1600 (Peterken 1977), identified from the maps of Grayson & Jones (1955)