

LOWLAND FORESTRY AND WILDLIFE CONSERVATION

Monks Wood Experimental Station

Symposium No. 6

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FOREWORD

The pattern of forestry in Britain is changing. Many of the assumptions on which forestry is based are being questioned and re-assessed in relation to the general needs of the population as well as in more traditional timber and economic terms. The public is concerning itself increasingly with our forests and forestry and is having a growing influence on the management and composition of woodlands. These changes in attitudes and objectives have important implications for the conservation of wildlife.

This Symposium was arranged to examine these implications and to give those concerned professionally with wildlife conservation the opportunity to hear about modern forestry and discuss it with practising foresters. The uplands and lowlands present different opportunities for the conservation of woodland wildlife which could not be adequately considered in two days so the Symposium concentrated on the lowlands where many of the most acute problems occur. The Government Paper on Forestry Policy, published in June 1972, has further increased the uncertainty over the future of lowland forests and forestry but it is hoped that the Symposium papers and summarised discussions will assist in clarifying some of the issues.

Contributors used both imperial and metric measures which have been allowed to stand. Readers who prefer one or the other will find a table of conversion factors on the following page.

The Symposium was held at Monks Wood Experimental Station on 4th and 5th May 1972. I am most grateful to Professor Mellanby and to The Nature Conservancy for providing assistance and facilities, to The Natural Environment Research Council for printing and publishing the Symposium volume, and to Mr. M.J. Woodman for the vignette on the cover.

The views and opinions expressed in the papers and discussions do not necessarily reflect the policy of The Nature Conservancy or of any other organisation.

R.C. Steele
Symposium Convenor and Editor

CONVERSION FACTORS
Metric and Imperial measures

Imperial to metric

1 inch	=	2.54 centimetres
1 foot	=	30.48 centimetres
1 yard	=	0.914 metres
1 chain	=	20.12 metres
1 mile	=	1.61 kilometres
1 square inch	=	6.45 square centimetres
1 square foot	=	0.09 square metres
1 square yard	=	0.84 square metres
1 acre	=	0.405 hectares
1 square mile	=	259.2 hectares
1 cubic foot	=	0.028 cubic metres
1 Hoppus foot	=	0.036 cubic metres
1 square foot, quarter girth per acre	=	0.292 square metres per hectare
1 cubic foot per acre	=	0.070 cubic metres per hectare
1 Hoppus foot per acre	=	0.089 cubic metres per hectare

Metric to imperial

1 centimetre	=	0.39 inches
1 metre	=	39.37 inches
1 metre	=	1.09 yards
1 kilometre	=	0.62 miles
1 square centimetre	=	0.16 square inches
1 square metre	=	10.76 square feet
1 square metre	=	1.196 square yards
1 hectare	=	2.47 acres
1 cubic metre	=	35.3 cubic feet
1 cubic metre	=	27.74 Hoppus feet
1 square metre per hectare	=	3.421 square feet, quarter girth per acre
1 cubic metre per hectare	=	14.29 cubic feet per acre
1 cubic metre per hectare	=	11.22 Hoppus feet per acre

INTRODUCTION

K. Mellanby

Director, Monks Wood Experimental Station
The Nature Conservancy

I should like to welcome you all to this sixth Monks Wood Symposium on Lowland Forestry and Wildlife Conservation. It is a great pleasure to see so many distinguished members of such a range of organisations including those concerned with commercial forestry, as well as conservationists and colleagues from other parts of the Nature Conservancy. This Symposium has been organised by the Nature Conservancy, and we are clearly concerned primarily with the wildlife - the native flora and fauna - of Britain. Many of you have other primary objectives. But we are all concerned with Conservation in some sense, and I am sure we all wish Britain to remain beautiful and interesting, and that we all wish to see a proper balance between our specific interests and those of other organisations.

In recent years there has been a considerable change in emphasis on just what forestry in Britain should comprise. We have all appreciated the way in which the Forestry Commission has wherever possible, opened its forests for recreation and for those who wish to enjoy the countryside. Their contribution to conservation has also been substantial, and is growing. However, there are those who would like to see even greater changes. I enjoyed the lecture given by Professor Richardson of University College, Bangor, at the British Association meeting in Durham in 1970, where he praised the initiative of the Danes in the developments in the State Forest near Copenhagen, which included unlikely entertainments including (organised) strip tease. He suggested that commercial forestry in Britain had a limited future, and that recreation and amenity interests might be much more important. This talk was no doubt intended to be provocative, but it does illustrate the changes in opinion which are being voiced in some quarters.

We in the Nature Conservancy are particularly concerned about woodlands in lowland Britain, because these now cover such a small fraction of our area. The models on show in the hall of this Experimental Station demonstrate how, in this immediate area, whereas in the year 200 A.D. almost the whole of the ground, other than the wet fens, was covered with deciduous trees, today the woods have shrunk to about an eighth of that amount - and this is an area chosen because it contains Monks Wood National Nature Reserve, the largest surviving remnant of forest in this part of England. The rest of lowland England has, on the whole, lost even more of its woodlands.

This change in the landscape is important to the conservationist. We must realise that most of our native flora and fauna belonged, originally, to the forests which covered almost the whole of the landscape. Some species have adapted themselves to open country and to farmland, but many of these were dependant on the hedges which are now disappearing so rapidly. We must have a reasonable cover of native trees as an essential part of our landscape. Also, we must not forget that our native trees are themselves an important part of our native flora. We must therefore preserve areas of trees, of British provenance, of the species which are now being endangered.

I have said that most of our flora and fauna is essentially a forest flora and fauna. I believe that we should be doing more research on these plants and animals in their original habitat. As you may know, I have for some time been interested in the mole, an animal usually considered a pest and a denizen of farmland. However, it too is a woodland animal, but one which can also flourish in a man-made habitat. Nevertheless, by studying the mole in woodland, it has been possible to obtain a much better picture of its normal economy, and to discover that many of the conclusions drawn from observations in farmland (an "unnatural habitat") are misleading. I am sure that studies of many other organisms originating from forests but now common elsewhere will be equally enlightening.

In the past we in England have enjoyed our wildlife on the cheap. Our picture of agricultural development up till 1945, with small fields, luxuriant hedges, and large areas of unimproved grassland, fitted into a mosaic of woods and coppices provided a wealth of habitats for both plants and animals. Modern farming is not so hospitable, and although a little compromise may allow the more adaptable birds to continue, many of our plants and insects are facing new dangers, so that we need completely to safeguard, as National Nature Reserves or through the efforts of voluntary bodies, far greater areas than in the past. The same applies to woodlands. Here, however, we need to know much more about the way mixing deciduous and coniferous trees affects the whole ecology of the area, and how far the encouragement of leisure pursuits is compatible with the continued existence of our wildlife.

This meeting is an important realisation of the urgency of these problems, and I am sure that it will lead to even greater co-operation between all interests.

THE WOODLANDS: THEIR EXTENT AND LOCATION

L.M. Simpson
Field Survey Officer, Forestry Commission

INTRODUCTION

The statistics covered by this paper relate to that land in Britain south of the Humber-Mersey line, excluding Wales, and are thus restricted to truly Lowland Britain which can be defined here, in terms of solid geology, as those areas overlying Permian and younger rocks. (The inliers of Devonian rock in Cornwall and Devon and Carboniferous rock in the north Midlands, within the main outcrop of younger rocks, are regarded as belonging to Upland Britain but it is practical to include these in the area of study.)

For convenience the area of Lowland Britain is divided into four regions and labelled NW, E, SE and SW, the major boundaries of which coincide with Forestry Commission Conservancies. The counties within each region are listed in Table 9i-iv.

CLIMATE AND TOPOGRAPHY

Considered as factors of site quality, regional climatic variations in Lowland Britain are small when compared with Upland Britain. Annual rainfall is mainly within the range 32-25" (900-650mm) and annual mean wind speed is less than 11 miles/hour (5 metres/second).

There are, however, important variations in local climatic factors e.g. exposure, frostiness and incidence of sea salt. The effect of aspect on site quality is rarely evident in Lowland Britain due to the predominantly gentle slopes and the altitude range is 0-1,000 feet (0-300 metres).

WOODLAND SURVEYS

Since the last complete woodland survey carried out by the Forestry Commission in 1947, many changes have taken place in the total area and character of British woodlands and, with the exception of the periods covered by the two world wars, these have probably been greater and more far reaching than in any comparable period in the history of this country.

A new assessment of private woodlands, concerned solely with area and physical condition i.e. classification, was carried out during 1965-67 to enable estimates to be made of potential timber production and evaluate the changes which had taken place in the area and condition of private woodlands since 1947. This general information is not only of value to such bodies as private woodland owners associations but also to those connected with the environment and planning of the countryside. An up-to-date assessment in Forestry Commission woods was unnecessary as the basic data required for forecasting and general management is under continual revision.

WOODLAND CHANGES 1947-65

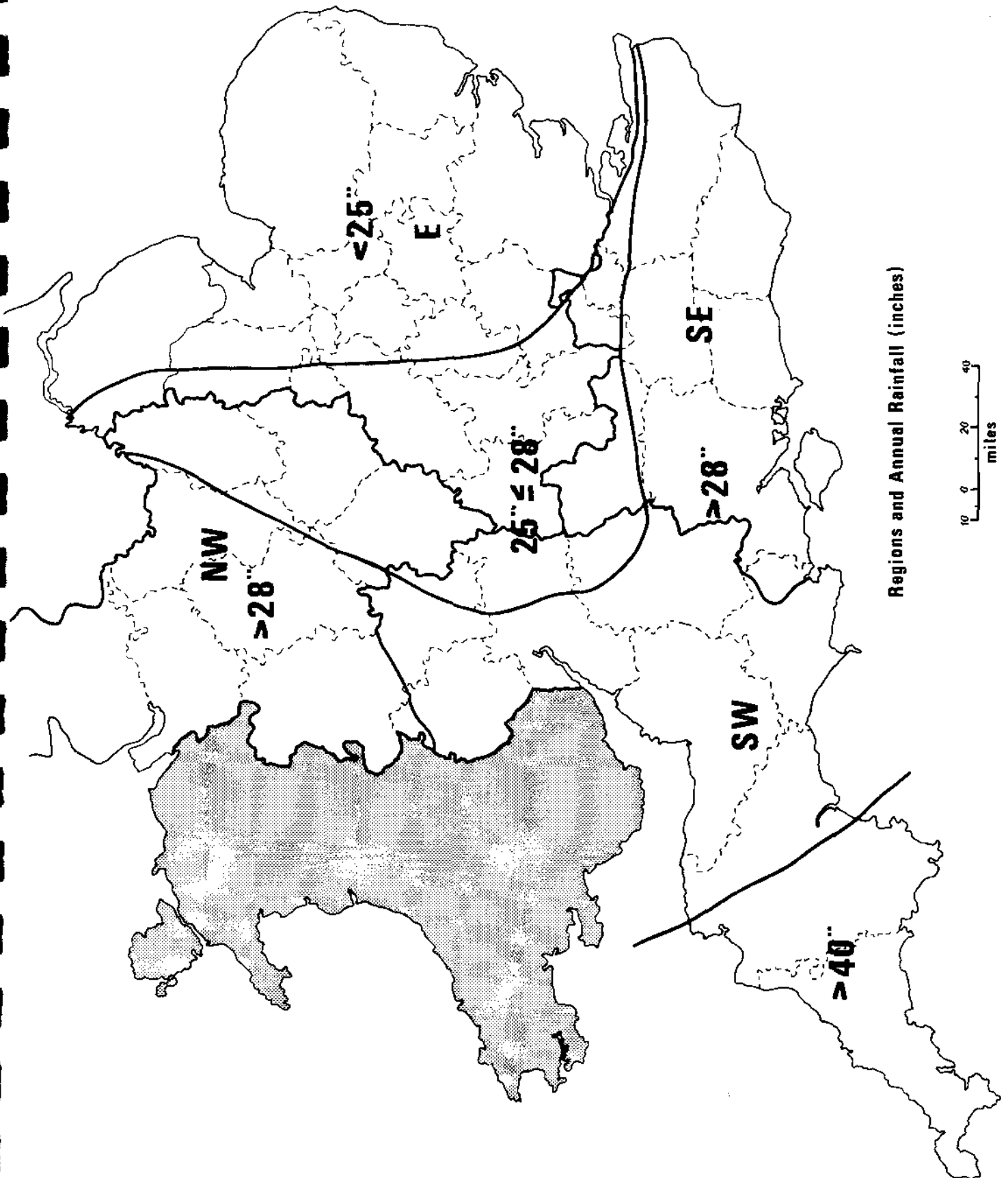
The broad changes which have taken place in Lowland Britain during the period are reflected in Table 1 and Figure 1 and by county in Table 9i-iv. When comparing these figures the following points should be borne in mind.

Table 1 Woodland area by Region and Ownership in 1947 and 1965

Region		Thousand Acres										% of Land Surface
		CHF	BHF	High Forest Total	% of Woodland	Coppice	Scrub	Felled	Total Woodland	47 (%)	65 (%)	
NW		47 65	47 65	47 65	47 65	47 65	47 65	47 65	47 65	47 65	47 65	47 65
	PW	20.3 39.1	73.0 64.1	93.3 103.2	51 61	7.7 -	45.9 60.9	35.3 5.0	182.2 (89)	169.1 (77)		
	FC	17.3 38.5	1.6 4.7	18.9 43.2	92 90	0.1	0.4 5.2	1.3 -	20.7 (11)	48.4 (23)		
E	Total	37.6 77.6	74.6 68.8	112.2 146.4	55 67	7.8 -	46.3 66.1	36.6 5.0	202.9	217.5		4 5
	PW	29.6 56.1	124.3 122.5	153.9 178.6	54 62	45.5 4.7	57.0 99.3	27.5 4.1	283.9 (80)	286.7 (72)		
	FC	47.4 79.3	13.2 22.0	60.6 101.3	87 92	0.3 -	5.0 9.3	3.2 -	69.1 (20)	110.6 (28)		
SE	Total	77.0 135.4	137.5 144.5	214.5 279.9	61 71	45.8 4.7	62.0 108.6	30.7 4.1	353.0	397.3		4 5
	PW	41.9 89.6	112.2 161.0	154.1 250.6	34 52	209.8 57.7	63.0 167.5	19.8 3.9	446.7 (88)	479.7 (82)		
	FC	24.3 52.6	25.4 38.6	49.7 91.2	80 88	5.9 -	4.2 11.4	2.5 -	62.3 (12)	102.6 (18)		
SW	Total	66.2 142.2	137.6 199.6	203.8 341.8	40 58	215.7 57.7	67.2 178.9	22.3 3.9	509.0	582.3		14 16
	PW	41.8 91.6	154.5 166.7	196.3 258.3	55 68	50.7 5.0	67.3 105.6	40.4 5.6	354.7 (85)	374.5 (78)		
	FC	35.6 64.4	17.0 27.7	52.6 92.1	85 87	1.9 -	3.0 13.5	4.4 -	61.9 (15)	105.6 (22)		
TOTAL	Total	77.4 156.0	171.5 194.4	248.9 350.4	60 71	52.6 5.0	70.3 119.1	44.8 5.6	416.6	480.1		6 7
	PW	133.6 276.4	464.0 514.3	579.6 790.7	47 60	313.7 67.4	233.3 433.3	123.0 18.6	1267.5 (85)	1310.0 (78)		
	FC	124.6 234.8	57.2 93.0	181.8 327.8	85 89	8.2 -	12.6 39.4	11.4 -	214.0 (15)	367.2 (22)		
TOTAL	Total	258.2 511.2	521.2 607.3	779.4 1118.5	53 67	321.9 67.4	245.8 472.7	134.4 18.6	1481.5	1677.2		6 7

PW = Private woodlands

FC = Forestry Commission woodlands



- i. The 1965 Census was based on a 15% sample of land area and was therefore not designed to supply accurate figures for regions as small as individual counties, although the data was worked up from a county basis.
- ii. Due to the size of the sample, the 1965 figures will be more accurate for heavily wooded counties such as Sussex or Devon than lightly wooded counties such as Lincoln or Leicester.
- iii. The rounding of figures to the nearest thousand acres may accentuate any errors of the 1965 data.
- iv. The 1965 Census figures are not directly comparable with those collected in 1947 as there has been some reclassification. Some of the poorer High Forest crops in 1947 were downgraded to scrub in 1965 and many coppice stands either upgraded to High Forest or reclassified as scrub.

The pattern of changes between the regions is fairly uniform and the major features are:-

- i. A 12% increase in total woodland area (National figure is 15%) of which 78% is still in private ownership, although the Forestry Commission has increased its estate by 72% (Figure 2). This increase between 1947-65 is probably greater than for any period for which comparable records are available.
- ii. The most important change is the increase in area by 72% of Forestry Commission woodlands. Most of this increase is accounted for by afforestation of the southern heaths but a proportion has resulted from the acquisition of standing woods or unproductive (coppice and scrub) woodland from private ownership where owners have been unwilling to undertake replanting themselves. Woodland managed by the Forestry Commission can now be found in every county except London.

Forestry Commission woodland in Lowland Britain includes such ancient Royal Forests as the New Forest in Hampshire and Forest of Dean in Gloucestershire. The rest of its estate has been built up through the steady acquisition of land.

- iii. In addition to the large area acquired by the Forestry Commission, there has also been a slight increase (3%) in the total private woodland area. This increase has occurred in all regions apart from the NW where there has been a reduction in total area of private woodland perhaps to unproductive private woodland (coppice and felled) being acquired by the Forestry Commission for afforestation.
- iv. Private woodland High Forest increased by 193.1 thousand acres (33%) and now occupies 60% of the woodland area under private ownership. Conifer High Forest (CHF) accounts for 142.8 thousand acres of this increase through afforestation or replacement of the extensive area of felled woodland. The introduction of the Dedication Scheme in 1948 encouraged planting and more intensive management of private woodlands as a whole.
- v. The area of scrub and coppice in private ownership decreased by 46.3 thousand acres. It is estimated that about 60% of such areas may be utilisable in terms of pulp or fencing material etc. A major purpose of the 1951 Act was to ensure that following felling of mature stands the areas were not permitted to lie derelict and so add to the considerable existing area of unproductive land.

Figure 1
WOODLAND AREA by REGION and FOREST TYPE

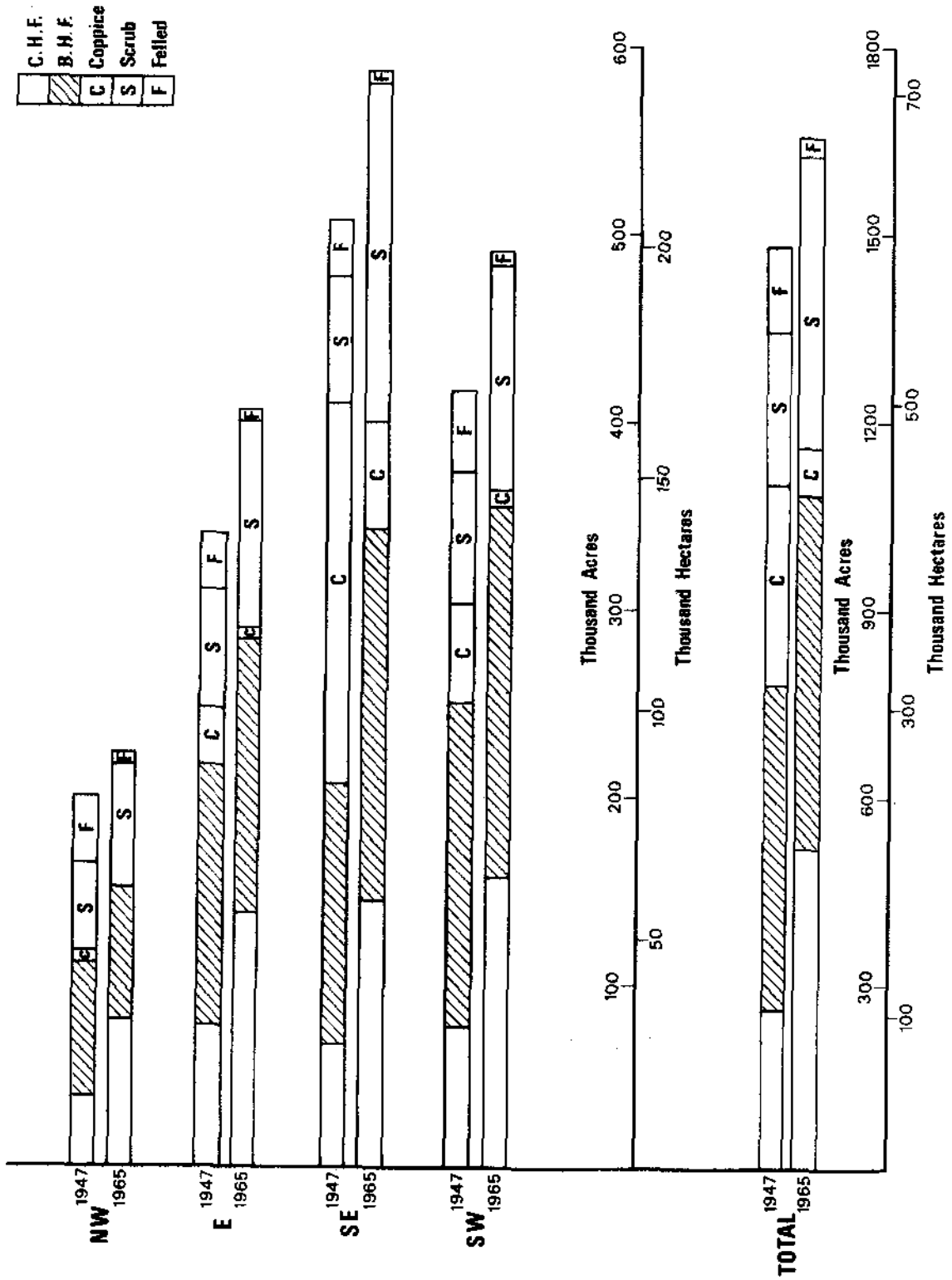
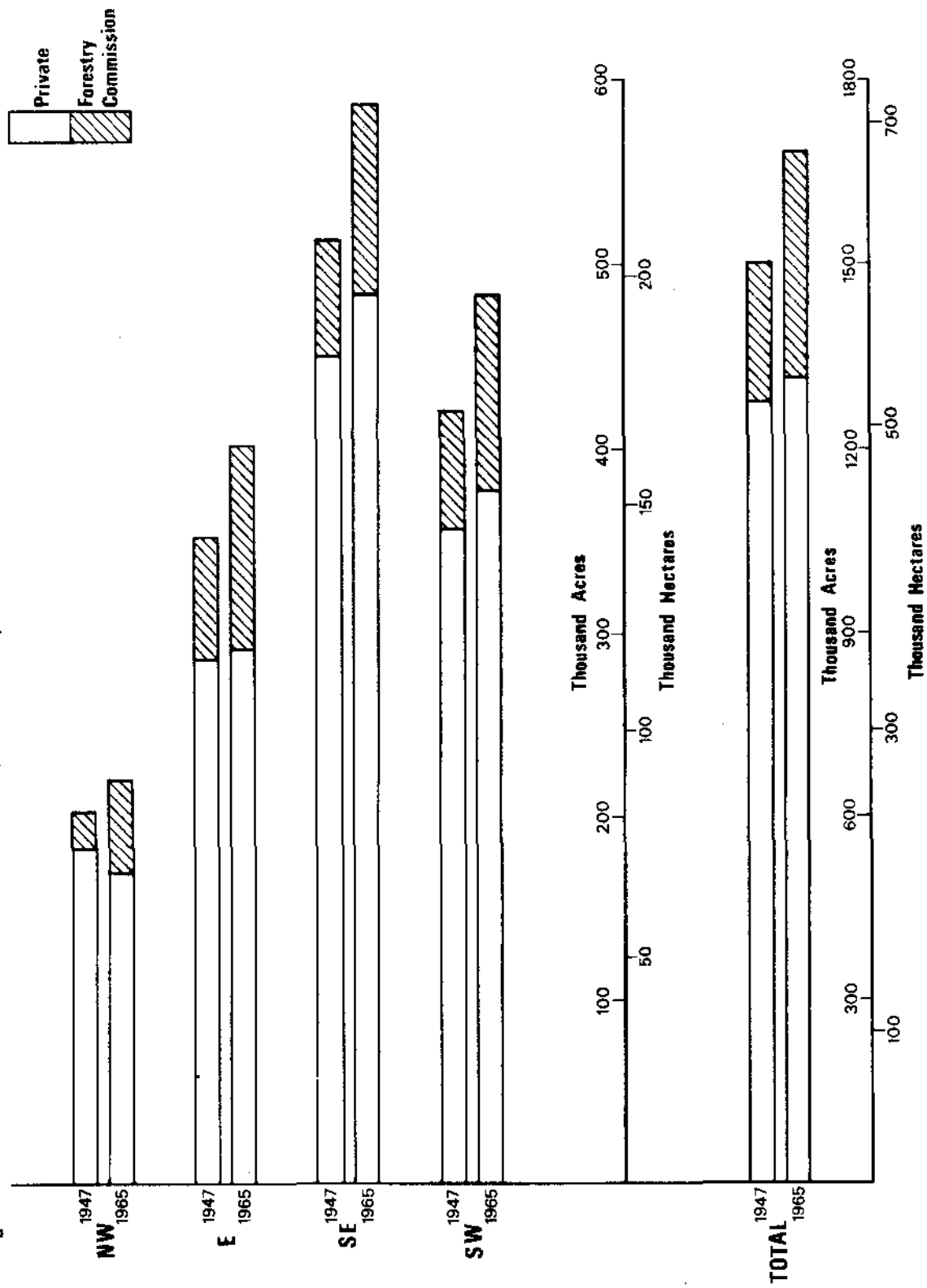


Figure 2
WOODLAND AREA by OWNERSHIP



- vi. The emphasis on the use of conifers for new planting on both private and Forestry Commission land. The area of Conifer High Forest has risen by 253.0 thousand acres (99%) while Broadleaf High Forest has risen by only 86.1 thousand (14%).

CURRENT POSITION

Ownership

The woodland area in Lowland Britain occupies 7% of the land surface, just below the national average of 8%, and, although most of the British population is concentrated in the South East region, 16% of the land area here is under woodland. Private ownership of 1310.0 thousand acres, accounts for 78% of the total area, (Table 1 and Figure 2), well distributed throughout the regions. Many of these woodlands are held by individuals but others are owned by companies, local authorities (County Councils, Water Boards, etc), or groups of people interested in woodland investment.

37% of the private woodland area is worked under approved management prescription covered by Dedicated or Approved Woodland Schemes (Table 2) with, again, an even distribution throughout the regions.

Table 2 Private Woodlands - Progress of Dedicated and Approved Woodland Schemes

Region	Scheme	1965		%	1971		%
		No. of Estates	Area Th acs		No. of Estates	Area Th acs	
NW	Dedicated Approved	224	53.2		294	59.0	
		40	5.8		37	4.3	
		264	59.0	35	331	63.3	38
E	Dedicated Approved	327	78.5		378	86.0	
		125	32.6		135	35.5	
		452	111.1	39	513	121.5	42
SE	Dedicated Approved	324	80.2		398	98.9	
		223	46.5		273	55.8	
		547	126.7	26	671	154.7	32
SW	Dedicated Approved	521	104.0		697	130.5	
		100	20.8		105	20.4	
		621	124.8	33	802	150.9	40
TOTALS		1,884	421.6	32	2,317	490.4	37

Woodland Types (1965/67)

- i. High Forest occupies 1118.5 thousand acres, 67% of the total woodland area, fairly evenly distributed throughout the regions of which 511.2 thousand acres is Conifer High Forest and 607.3 thousand acres is Broadleaf High Forest.
- ii. Coppice and Scrub. 67.4 thousand acres of coppice is recorded, all privately owned, of which 81% is in the South East region. The Forestry Commission in this region manage about 2.0 thousand acres of chestnut coppice, classified under BHF, grown pure on the most suitable soils such as clay with flints. The chestnut coppice industry, which is a relatively modern one, is peculiar to this corner of England. These areas of unworked coppice including hazel and hornbeam, for which there is little demand, and the relics of the coppice-with-standards system of management are now mainly classified under the 472.7 thousand acres of scrub of which 38% is in the SE region. In the Wealden area of the SE region scrub includes the unproductive and understocked areas of the natural hardwoods.

Age Class Distribution

The large post-war plantings on both private and Forestry Commission land are reflected in Figures 3 and 4 with 25% of High Forest in the P.41-60 class (Tables 3 and 4) evenly distributed between ownerships within regions. The distribution of BHF is unbalanced in the direction of the older age classes with 64% pre 1901 and almost all in private ownership. On the other hand, 63% of CHF is post 1940 and more evenly divided between ownership.

Species

Oak is the major component species in Lowland Britain with 316.1 thousand acres, 28% of the High Forest area, and is the principal species in the old broadleaved woodlands much of which, though greatly changed by forest management, may have descended directly from natural forest. 90% of Oak is in private ownership and it is found on the full range of sites from the light and acid 'marginal' sites in the north to the heavy Weald clays in the south. (Tables 4 and 5, Figures 4 and 5).

Scots and Corsican pine are the major conifers and cover 240.7 thousand acres which is 21% of the High Forest area, and 47% of CHF. Pines are found mainly on the infertile, normally very acid, sands and gravels of the southern heaths. Ownership is fairly evenly divided between the private and Forestry Commission sectors.

Beech accounts for 10% of the High Forest area and 68% of this is in private ownership. It has been the main species used for planting on the notoriously difficult chalk downland sites often with pine as a 'nurse' to help establishment.

Larch, long recognised as a general estate timber, forms 9% of the High Forest area and 81% is in private ownership.

Spruce occupies only 8% of the High Forest area but almost 50% of the acreage (42.0 thousand) is in the South West region. Norway is the main spruce in private ownership but 50% of the Forestry Commission Spruce plantations are Sitka and almost entirely confined to sites overlying the older acid rocks of the south-west.

Figure 3 HIGH FOREST by PLANTING YEAR CLASS and OWNERSHIP

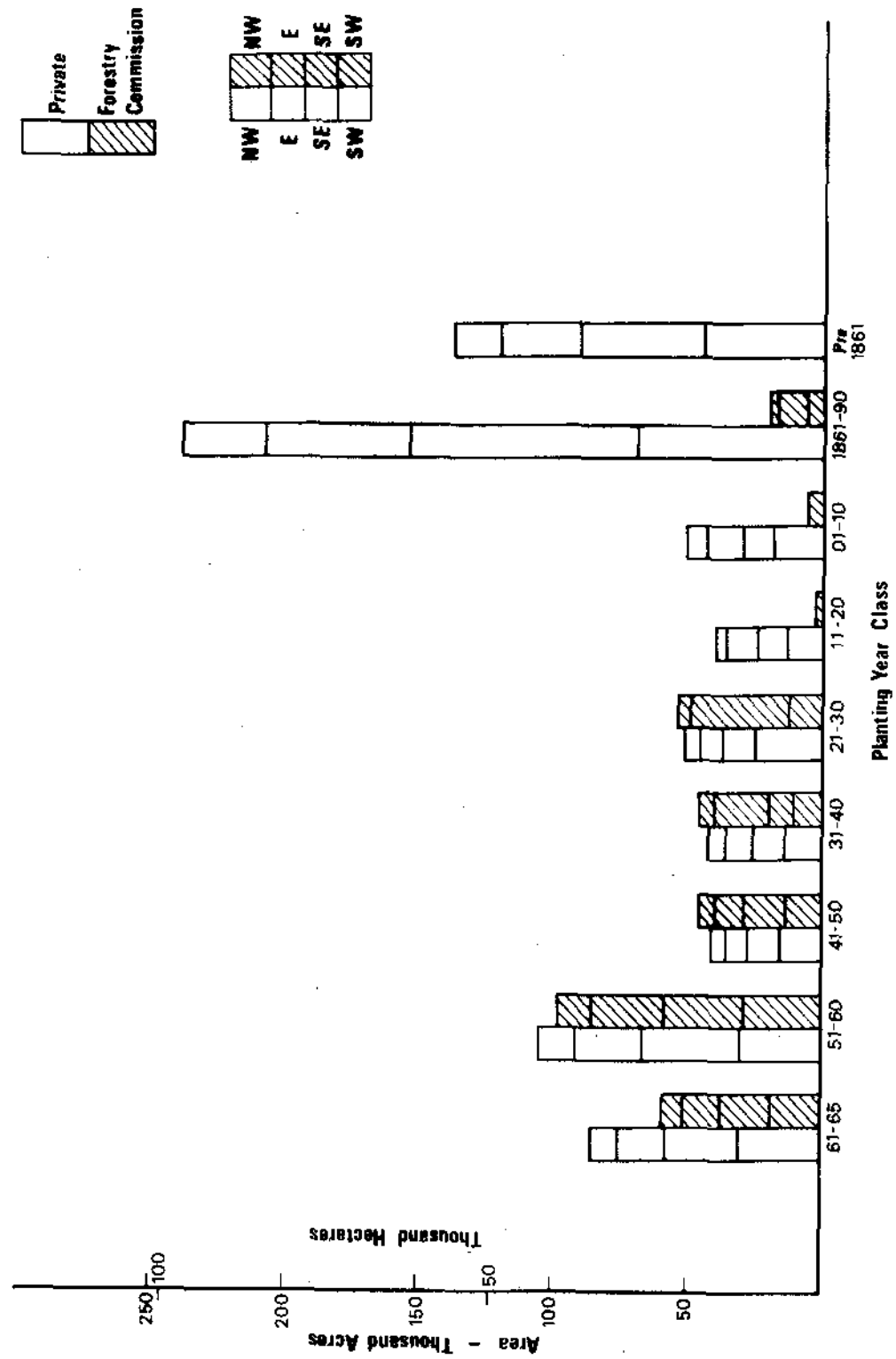
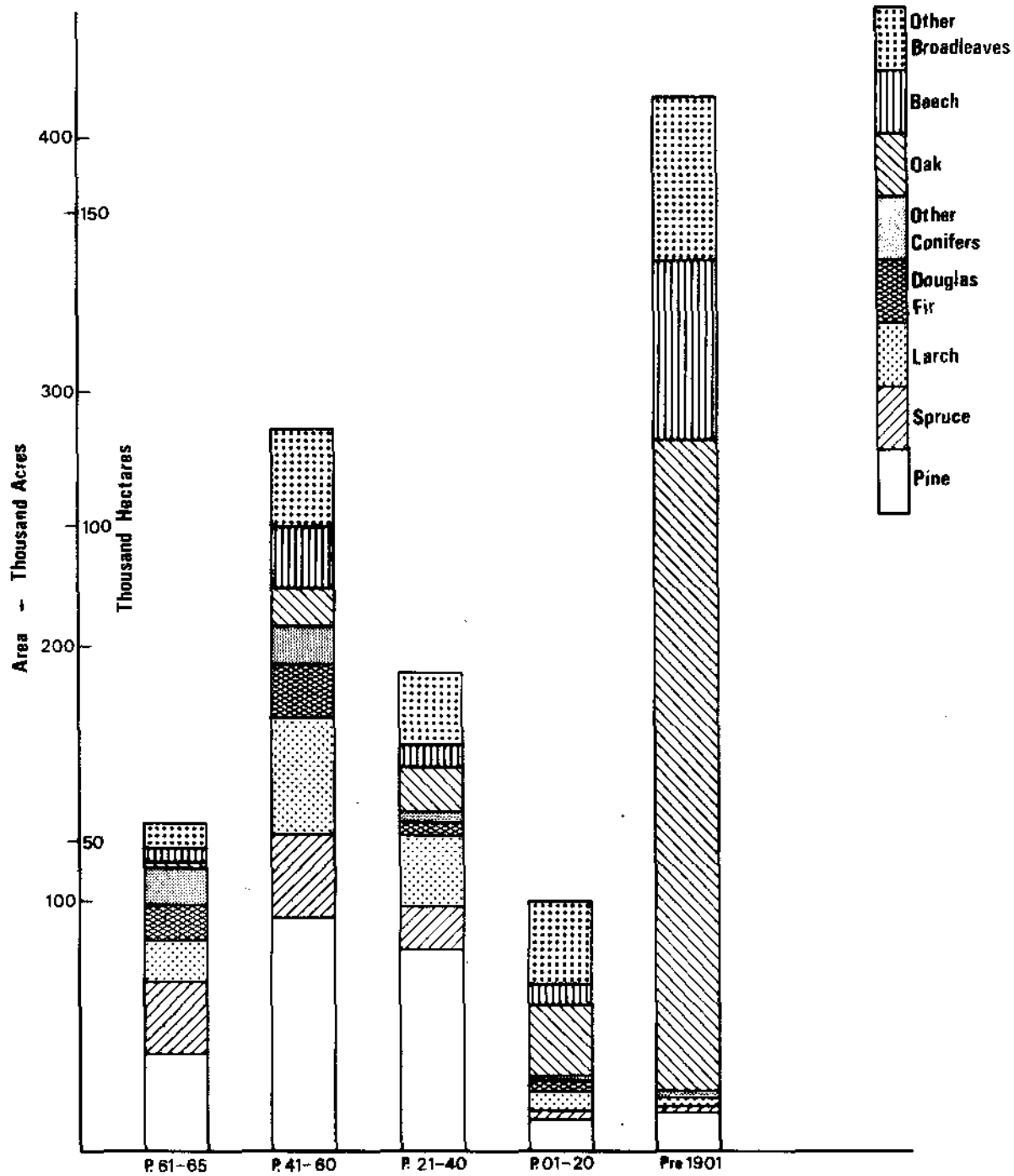


Figure 4

HIGH FOREST-SPECIES GROUPS by AGE CLASS



Thousand Acres

Planting Year Class	N.W.		E		S.E.		S.W.		Totals		Grand Total
	P.W.	F.C.	P.W.	F.C.	P.W.	F.C.	P.W.	F.C.	P.W.	F.C.	
61-65	9.4	8.6	17.3	13.0	27.7	17.2	31.8	19.8	86.2	58.6	144.8 (13%)
51-60	13.7	15.2	21.4	27.1	36.3	27.6	29.0	27.2	103.4	97.1	200.5 (17%)
41-50	5.2	7.4	8.5	11.7	12.2	14.9	15.3	14.2	41.2	48.2	89.4 (8%)
31-40	6.7	6.0	11.3	20.8	11.6	8.9	13.7	10.5	43.3	46.2	89.5 (8%)
21-30	6.7	5.6	8.1	25.6	12.2	9.7	24.4	12.2	51.4	53.1	104.5 (10%)
11-20	5.2	-	11.3	1.0	10.3	-	13.1	0.1	39.9	1.1	41.0 (4%)
01-10	7.3	0.4	12.6	0.7	12.6	2.3	17.9	2.1	50.4	5.5	55.9 (5%)
1861-1900	31.3	-	55.6	-	82.3	-	68.5	-	237.7	-	237.7 (21%)
Pre 1861	17.7	-	29.5	1.4	45.4	10.6	44.6	6.0	137.2	18.0	155.2 (14%)
TOTALS	103.2	43.2	178.6	101.3	250.6	91.2	258.3	92.1	790.7	327.8	1,118.5

Table 3 High Forest by Age Class, Ownership and Region

P.W. = Private woodlands

F.C. = Forestry Commission woodlands

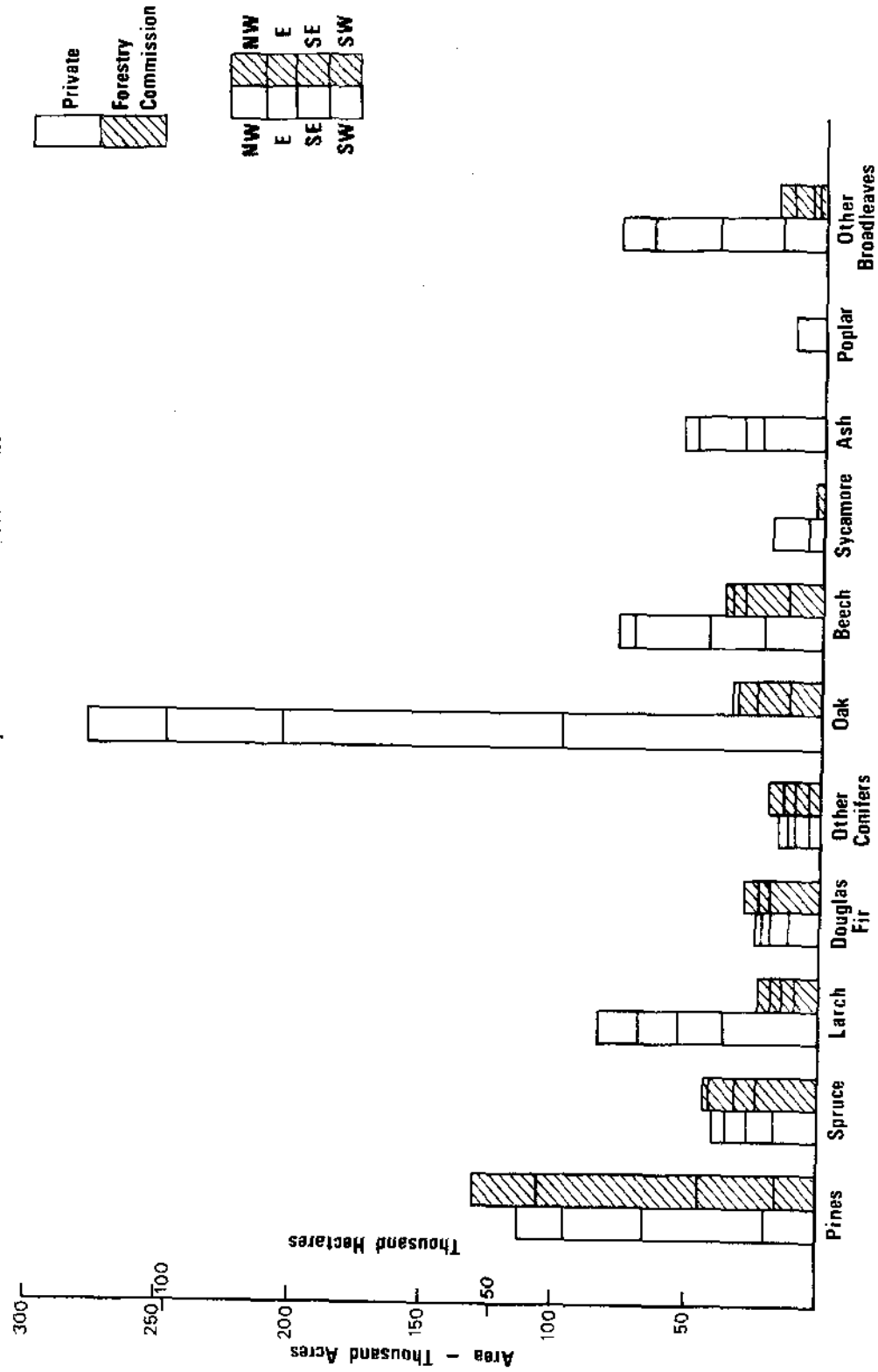
Table 4 High Forest—Species Groups by Age Class and Type of Ownership

Species Group	Thousand Acres												%						
	P.61-65			P.41-60			P.21-40			P.01-20				Pre 1901			Total		
	PW	FC	Total	PW	FC	Total	PW	FC	Total	PW	FC	Total	PW	FC	Total	PW	FC	Total	
Pines	22.7	17.8	40.5	44.5	47.9	92.4	23.2	56.4	79.6	9.0	3.4	12.4	12.2	3.6	15.8	111.6	129.1	240.7	21
Spruces	18.9	8.3	27.2	13.6	19.6	33.2	5.2	11.2	16.4	2.3	0.9	3.2	1.3	—	1.3	41.3	40.0	81.3	8
Larches	14.0	1.7	15.7	36.2	10.3	46.5	23.6	6.3	29.9	6.9	1.0	7.9	3.4	0.6	4.0	84.1	19.9	104.0	9
Douglas fir	10.0	6.1	16.1	8.2	14.0	22.2	3.7	6.7	10.4	2.2	0.4	2.6	0.6	0.3	0.9	24.7	27.5	52.2	5
Other Conifers	7.1	6.4	13.5	4.2	9.7	13.9	0.5	1.5	2.0	0.6	0.2	0.8	2.3	—	2.3	14.7	17.8	32.5	3
Total Conifers	72.7	40.3	113.0	106.7	101.5	208.2	56.2	82.1	138.3	21.0	5.9	26.9	19.8	4.5	24.3	276.4	234.3	510.7	46
Oak	0.3	0.5	0.8	4.5	10.3	14.8	11.2	6.1	17.3	26.0	2.5	28.5	236.2	18.5	254.7	278.2	37.9	316.1	28
Beech	3.7	2.4	6.1	4.4	19.5	23.9	3.6	5.7	9.3	6.7	0.5	7.2	58.0	13.2	71.2	76.4	41.3	117.7	10
Birch	0.3	—	0.3	5.9	—	5.9	2.7	—	2.7	0.7	—	0.7	1.2	—	1.2	10.8	—	10.8	1
Sycamore	0.3	—	0.3	1.6	—	1.6	2.4	—	2.4	3.2	—	3.2	10.9	—	10.9	18.4	—	18.4	2
Ash	0.5	—	0.5	6.8	—	6.8	9.6	—	9.6	17.2	—	17.2	22.3	—	22.3	56.4	—	56.4	5
Poplar	2.7	—	2.7	5.0	—	5.0	0.4	3.9	4.3	0.2	—	0.2	0.3	—	0.3	8.6	—	8.6	1
Other Broadleaves	4.2	1.4	5.6	10.6	6.2	16.8	9.0	—	9.0	13.3	1.1	14.4	28.4	1.7	30.1	65.5	14.3	79.8	7
Total Broadleaves	12.0	4.3	16.3	38.8	36.0	74.8	38.9	15.7	54.6	67.3	4.1	71.4	357.3	33.4	390.7	514.3	93.5	607.8	54
Total High Forest	84.7	44.6	129.3	145.5	137.5	283.0	95.1	97.8	192.9	88.3	10.0	98.3	377.1	37.9	415.0	790.7	327.8	1118.5	100
%	13			25			18			9			35			100			

PW = Private woodlands

FC = Forestry Commission woodlands

Figure 5
HIGH FOREST by SPECIES and OWNERSHIP



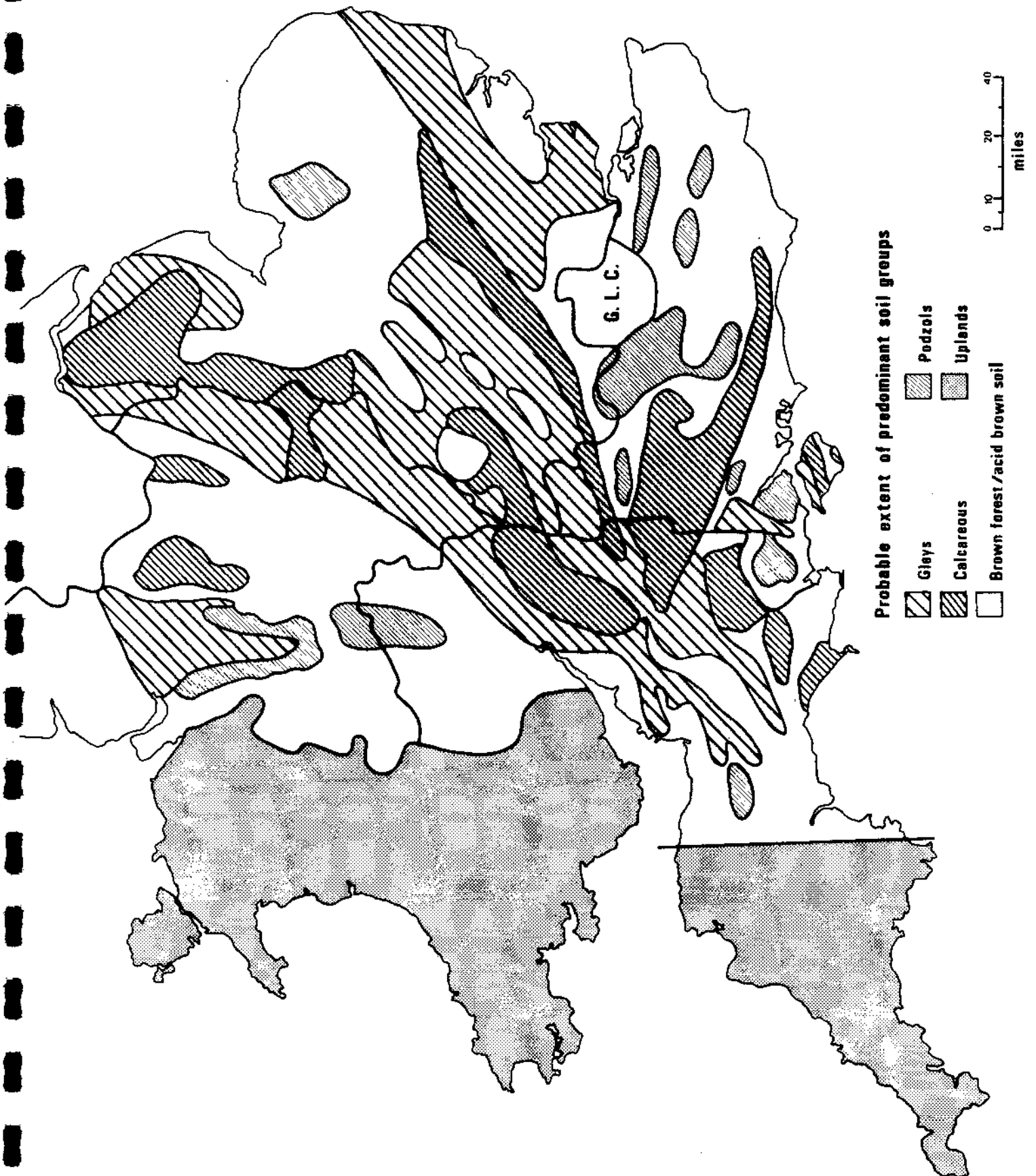
Thousand Acres

Species	N.W.		E		S.E.		S.W.		Total		Grand Totals
	P.W.	F.C.	P.W.	F.C.	P.W.	F.C.	P.W.	F.C.	P.W.	F.C.	
Pines	16.6	25.0	28.2	60.1	47.0	29.1	19.8	16.2	111.6	130.4	242.0 (21%)
Spruce	5.3	2.4	7.7	9.2	10.6	8.2	17.7	24.3	41.3	44.1	85.4 (8%)
Larch	14.5	4.7	15.5	3.0	18.9	4.8	35.2	9.4	84.1	21.9	106.0 (9%)
Douglas fir	1.2	3.4	2.7	3.5	7.1	10.7	13.7	12.3	24.7	29.9	54.6 (5%)
Other Conifers	1.5	2.5	2.0	3.2	6.0	9.0	5.2	5.3	14.7	20.0	34.7 (3%)
Oak	30.4	0.7	44.8	8.7	106.1	10.7	96.9	11.6	278.2	31.7	309.9 (28%)
Beech	5.1	1.1	26.8	6.2	20.6	16.9	23.9	10.6	76.4	34.8	111.2 (10%)
Sycamore	12.8	0.4	-	-	-	-	5.6	-	18.4	0.4	18.8 (2%)
Ash	5.9	-	18.1	-	7.9	-	24.5	-	56.4	-	56.4 (5%)
Poplar	-	-	8.6	-	-	-	-	-	8.6	-	8.6 (1%)
Other Broadleaves	9.9	3.0	24.2	7.4	26.4	1.8	15.8	2.4	76.3	14.6	90.9 (8%)
TOTALS	103.2	43.2	178.6	101.3	250.6	91.2	258.3	92.1	790.7	327.8	1,118.5

Table 5 High Forest by Species, Ownership and Region

P.W. = Private woodlands

F.C. = Forestry Commission woodlands



'Other Conifers' are mostly (84%) in the post P.41 age classes and the main species are Western red cedar and Western hemlock which have been used in the rehabilitation of scrub and coppice woodland.

Included in 'Other Broadleaves' (82% in private ownership) are chestnut, elm, ornamental trees, etc and the intimate hardwood mixtures often associated with shelter and screen woods and park stands or found in the precincts of the owner's home.

78% of both private and Forestry Commission planting programmes between P.41 and P.65 have used conifers and this proportion was maintained in private planting during P.71 but has risen to 94% on Forestry Commission land (Table 6).

Table 6 Forestry Commission - High Forest Plantings 1965 and 1971

Thousand Acres

Region	Planting year 1965					Planting year 1971				
	CHF	%	BHF	%	Total	CHF	%	BHF	%	Total
NW	1.0		0.1		1.1	0.8		0.1		0.9
E	1.8		0.2		2.0	1.7		0.2		1.9
SE	1.3		0.2		1.5	1.5		0.1		1.6
SW	1.9		0.2		2.1	2.5		0.1		2.6
TOTALS	6.0	91	0.7	9	6.7	6.5	94	0.5	6	7.0

Productivity of High Forest Crops

Using Yield Class (YC = the maximum mean annual increment attained by a given species on a given site) as an index of crop productivity, the timber volume productivity of the existing High Forest is depicted in Table 7 and shows the superior growth rates of crops in Forestry Commission ownership in all regions. Private woodlands often occupy rather better land, due perhaps to an appreciation of the indirect advantages of amenity and sport, than is available to the Forestry Commission and, given similar management they would have a comparable or higher potential site productivity for timber growth. Although private woods in Lowland Britain provide the main source of hardwood timber, particularly high value mature oak, ash, elm, beech and sycamore, there has been comparatively little broadleaved planting during the past half century (only 23% of total BHF is post P.20) and there is a big growing stock of trees which are past their prime and are often of rather poor quality for timber.

WOODLAND SITE CLASSIFICATION

Compared with the intensity of work carried out by the Forestry Commission in identifying soil groups and site classes in the upland areas, there has been no concentrated attempt to produce a detailed comprehensive site classification for Lowland Britain. A simple overall classification has been drawn up in connection with a study of the potential for the use of hardwood species and this, which may be useful for some broad managerial purposes, is given in Table 8.

Table 7 Productivity of High Forest Crops

	Av	YC	Main Species PW	YC	Main Species FC	YC
	PW	FC				
NW	6	10	Oak (30%)	4	Pines (60%)	11
E	6	10	Oak (26%)	4	Pines (60%)	10
SE	6	10	Oak (42%)	4	Pines (32%)	11
SW	7	11	Oak (37%)	4	Spruce (26%)	12
Weighted Mean	7	10				

Table 8 Site Groups

Site Group	Relative Extent	Main Areas of Occurrence	Main Characteristics
1. Shallow calcareous	15%	Chalkland scarps and valley slopes, Cotswolds, Chilterns, Downs and outcrops Harrogate to Nottingham.	Shallow to calcareous parent material. High pH, droughty and very weedy.
2. Loamy Brown Earths	35%	Chalkland plateaux, Downs, Chilterns, New Forest, Savernake, scattered areas in Cotswolds etc.	Fertile, no drainage required and weedy.
3. Gleys	30%	London Basin, Hampshire Basin, Weald, Hereford etc.	Mainly clays with impeded drainage, some sandy soils with ground-water.
4. Sands	16%	New Forest, Thetford, Bramshill, Cannock, Delamere	No drainage required. Calluna on bare sites.
5. Very silty soils	4%	Weald	Poor soil structure.

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- (Forestry Commission. 1971. Analysis of growing stock in Forestry Commission and private woodlands.)

Table 9 Woodland Area by County, Type and Ownership in 1947 and 1965
 Table 9(i) North West Region

County	Year	CHF		BHF		Total High Forest		Coppice		Scrub		Felled		Total		Total Area	% Land Area
		PW	FC	PW	FC	PW	FC	PW	FC	PW	FC	PW	FC	PW	FC		
Cheshire	47	2.3	1.5	9.0	0.1	11.3	1.6	0.1	-	4.3	-	2.6	0.3	18.3	1.9	20.2	3.1
	65	3.8	2.1	8.4	0.2	12.3	2.3	-	-	7.2	-	-	-	19.5	2.3	21.8	3.3
Derbyshire	47	4.0	0.6	9.6	0.6	13.6	1.2	0.5	-	6.1	-	4.7	-	24.9	1.2	26.1	4.1
	65	5.4	3.0	11.7	-	17.1	3.0	-	-	6.8	1.2	-	-	23.9	4.2	28.1	4.4
Leicester	47	0.8	-	5.3	-	6.1	-	0.8	-	3.1	-	2.3	-	12.3	-	12.3	2.3
	65	1.3	0.4	5.1	0.2	6.4	0.6	-	-	4.6	0.4	-	-	11.0	1.0	12.0	2.2
Nottingham	47	3.0	6.9	8.2	0.7	11.6	7.6	1.2	-	6.5	0.3	7.0	0.7	25.9	8.6	34.5	6.4
	65	5.1	12.3	7.9	1.9	13.5	14.2	-	-	9.3	2.2	-	-	22.8	16.4	39.2	7.2
Shropshire	47	5.7	3.1	20.5	0.1	26.2	3.2	2.4	0.1	10.3	0.1	9.9	0.2	48.8	3.6	52.4	6.1
	65	12.3	12.1	13.7	1.0	26.0	13.1	-	-	13.1	0.9	-	-	39.1	14.0	53.1	6.2
Stafford	47	3.5	5.2	11.3	0.1	14.8	5.3	0.3	-	11.6	-	7.1	0.1	33.8	5.4	39.2	5.3
	65	8.5	10.4	8.9	1.3	17.4	11.7	-	-	14.3	0.6	-	-	31.7	12.3	44.0	5.9
Warwick	47	1.0	-	9.1	-	10.1	-	2.4	-	4.0	-	1.7	-	18.2	-	18.2	2.9
	65	2.7	1.6	7.8	0.2	10.5	1.7	-	-	5.6	0.9	-	-	16.1	2.6	18.7	3.0

Thousand Acres

Table 9(ii). East Region

County	Year	CHF		BHF		Total High Forest		Coppice		Scrub		Felled		Total		Total Area	% Land Area
		PW	FC	PW	FC	PW	FC	PW	FC	PW	FC	PW	FC	PW	FC		
Bedford	47	2.0	0.2	4.6	0.4	6.6	0.6	2.8	-	1.7	-	1.1	-	12.2	0.6	12.8	4.1
	65	2.7	2.6	5.5	1.2	8.2	3.8	-	-	4.4	0.9	-	-	12.6	4.7	17.3	5.6
Buckingham	47	2.5	0.5	20.0	0.4	22.6	0.9	3.3	-	6.2	-	2.9	0.1	34.9	1.0	35.9	7.5
	65	4.6	5.3	18.7	3.0	23.3	8.3	0.2	-	7.6	1.7	-	-	31.1	10.0	41.1	8.6
Cambridge	47	0.5	-	2.2	-	2.7	-	1.3	-	1.3	-	0.4	-	5.7	-	5.7	1.1
	65	0.8	0.4	3.4	-	4.2	0.4	-	-	2.3	0.1	-	-	6.5	0.5	7.0	1.3
Essex	47	0.8	-	12.8	-	13.6	-	4.3	-	12.4	-	0.8	-	31.1	-	31.1	3.4
	65	2.0	1.9	10.4	0.3	12.4	2.3	1.9	-	16.3	0.8	-	-	30.6	3.1	33.7	3.6
Hertford	47	1.9	-	11.6	-	13.5	-	6.1	-	4.3	-	2.5	-	26.4	-	26.4	6.5
	65	3.9	0.8	10.5	0.3	14.7	1.1	-	-	8.5	0.5	-	-	23.2	1.6	24.8	6.1
Huntingdon	47	0.1	-	2.0	-	2.1	-	1.7	-	1.6	-	0.5	-	5.9	-	5.9	1.9
	65	0.2	0.2	2.4	0.1	0.3	-	-	-	5.9	0.6	-	-	8.5	0.9	9.4	3.0
Lincoln	47	3.8	3.3	16.5	2.3	20.3	5.6	2.3	0.3	6.5	1.8	6.4	0.2	35.5	7.9	43.4	2.6
	65	7.3	11.0	13.6	4.6	20.9	15.6	-	-	10.1	1.6	-	-	31.0	17.2	48.2	2.8
Norfolk	47	8.7	25.3	21.6	2.2	30.3	27.5	2.8	-	9.2	0.2	7.0	1.1	49.3	28.8	78.1	5.9
	65	17.2	31.7	21.7	3.7	38.9	35.4	1.1	-	15.6	1.4	-	-	55.6	36.8	92.4	7.4
Northants	47	2.0	1.8	5.8	6.3	7.8	8.1	5.9	-	5.4	0.3	1.0	0.5	20.1	8.9	29.0	5.0
	65	3.5	5.1	6.7	4.5	10.2	9.6	0.1	-	7.5	0.8	-	-	17.8	10.4	28.2	4.8
Oxford	47	1.8	-	14.7	0.3	16.5	0.3	3.2	-	4.1	-	1.5	-	25.3	0.3	25.6	5.3
	65	5.6	1.2	12.5	0.3	18.1	1.5	0.1	-	5.7	0.7	-	-	23.9	2.2	26.1	5.4
Rutland	47	0.2	-	1.9	0.2	2.1	0.2	0.1	-	0.6	-	0.3	-	3.1	0.2	3.3	3.4
	65	0.2	-	0.5	-	0.7	-	-	-	0.9	-	-	-	1.6	-	1.6	1.6
Suffolk	47	5.3	16.3	10.6	1.1	15.9	17.4	11.7	-	3.7	2.7	3.1	1.3	34.4	21.4	55.8	5.8
	65	8.1	25.3	16.4	2.2	24.5	27.5	1.4	-	14.3	0.2	-	-	40.2	27.7	67.9	7.2

Thousand Acres

Table 9(iii) South East Region

County	Year	CHF		BHF		Total High Forest		Coppice		Scrub		Felled		Total		Total Area	% Land Area
		PW	FC	PW	FC	PW	FC	PW	FC	PW	FC	PW	FC	PW	FC		
Berkshire	47	7.0	1.8	14.0	-	21.0	1.8	9.8	-	7.7	-	2.1	-	40.6	1.8	42.4	9.1
	65	8.6	5.0	14.4	1.0	23.0	6.0	1.4	-	12.3	0.8	-	-	36.7	6.8	43.5	9.4
G L C	47	-	-	0.5	-	0.5	-	-	-	0.1	-	-	-	0.6	-	0.6	0.2
	65	0.2	-	6.1	-	6.3	-	0.8	-	9.2	-	-	-	16.3	-	16.3	4.1
Hants	47	10.5	17.1	25.2	19.5	35.7	36.6	47.2	1.1	14.2	1.8	5.5	1.5	102.6	41.0	143.6	14.3
	65*	19.2	26.6	42.4	24.5	61.6	51.1	4.2	-	36.2	4.7	-	-	102.0	55.8	157.8	15.4
Isle of Wight	47	0.3	1.0	1.8	1.4	2.1	2.4	1.7	0.2	0.8	0.2	0.1	-	4.7	2.8	7.5	-
	65	-	2.9	-	1.2	-	4.1	-	-	-	0.5	-	-	-	4.6	4.6	-
Kent	47	2.9	2.7	13.9	1.0	16.8	3.7	64.4	2.8	12.2	0.8	1.5	0.3	94.9	7.6	102.5	11.1
	65	8.3	8.3	24.2	3.4	32.5	11.7	31.5	-	30.3	2.2	-	-	94.3	13.9	108.2	11.7
Surrey	47	10.3	0.5	22.9	0.6	33.2	1.1	18.3	0.3	12.7	-	3.1	-	67.3	1.4	68.7	16.5
	65	17.3	3.5	26.5	1.0	43.8	4.5	2.3	-	26.1	0.8	-	-	72.2	5.3	77.5	18.6
Sussex	47	10.9	1.2	33.9	2.9	44.8	4.1	68.4	1.5	15.3	1.4	7.5	0.7	136.0	7.7	143.7	15.4
	65	33.1	8.3	45.2	6.6	78.3	14.9	17.1	-	47.3	1.9	-	-	142.7	16.8	159.5	17.1

* includes Isle of Wight Private Woodlands

Table 9(iv) South West Region

County	Year	CHF		BHF		Total High Forest		Coppice		Scrub		Felled		Total		Total Area	% Land Area
		PW	FC	PW	FC	PW	FC	PW	FC	PW	FC	PW	FC	PW	FC		
Cornwall	47	2.5	2.5	14.5	0.1	17.0	2.6	4.2	0.3	6.9	-	3.4	-	31.5	2.9	34.4	3.9
	65	5.6	6.6	19.6	0.5	25.2	7.1	-	-	10.8	1.3	-	-	36.0	8.4	44.4	5.0
Devon	47	12.6	0.8	46.4	0.3	59.0	11.1	3.5	0.1	15.5	0.2	12.1	-	90.1	11.4	101.5	6.1
	65	25.9	20.9	52.9	1.3	78.8	22.2	-	-	30.2	3.5	-	-	109.0	25.7	134.7	8.1
Dorset	47	7.3	4.5	8.6	0.1	15.9	4.6	13.4	-	8.7	0.3	4.0	0.5	42.0	5.4	47.4	7.6
	65	10.4	11.7	9.5	2.6	19.9	14.3	0.8	-	12.6	2.5	-	-	33.3	16.8	50.1	8.0
Gloucester	47	6.0	6.2	21.8	12.2	27.8	18.4	3.6	0.6	5.6	-	4.9	2.8	41.9	21.8	63.7	7.9
	65	13.1	13.4	24.8	11.5	37.9	24.9	2.5	-	8.1	1.4	-	-	48.5	26.3	74.8	9.3
Hereford	47	2.1	4.8	17.4	0.8	19.5	5.6	8.3	-	7.1	0.1	5.0	0.4	39.9	6.1	46.0	8.5
	65	6.0	3.4	15.8	0.8	21.8	4.2	0.4	-	7.8	1.1	-	-	30.0	5.3	35.3	6.5
Somerset	47	4.5	4.7	17.8	0.1	22.3	4.8	4.4	-	11.6	0.2	5.2	-	43.5	5.0	48.5	4.7
	65	13.8	7.7	18.7	2.1	32.5	9.8	-	-	15.9	1.4	-	-	48.4	11.2	59.6	5.7
Wiltshire	47	5.4	0.8	19.3	2.9	24.7	3.7	8.7	0.5	9.0	2.1	3.6	0.6	46.0	6.9	52.9	6.1
	65	14.7	4.4	18.4	5.7	33.1	10.1	0.8	-	14.8	0.6	-	-	48.7	10.7	59.4	6.9
Worcester	47	1.4	1.3	8.7	0.5	10.1	1.8	4.6	0.4	2.9	0.1	2.2	0.1	19.8	2.4	22.2	5.0
	65	4.9	2.1	9.3	1.0	14.2	3.1	0.2	-	6.6	0.6	-	-	21.0	3.7	24.7	5.5

Thousand Acres

SESSION 1 SUMMARY OF DISCUSSION

Campbell. The trends described may have been reversed since 1965, particularly in the lowlands. In my experience planting has fallen off here during the last planting season. Rehabilitation is decreasing since the scrub clearance grants stopped and the value of agricultural land has increased to such an extent that one has now to consider whether a derelict woodland should be reclaimed for agricultural purposes.

Simpson. Some figures (Jeffers¹, 1972) indicate that there has been very little change in the pattern in Eastern England since 1965. Much of the planting after 1965 may be rehabilitation of felled coppice and scrub areas.

Jeffers. The information, based on a highly biased sample rather than total woodland area, shows that changes were much smaller than people have been suggesting. I doubt whether changes in the last year or two should be stressed and we should look at changes over a period of about 5 years.

Workman. Lumping together all pre-1900 oak, as in Figure 3, may give a distorted impression of the age-class distribution.

Simpson. I agree, but we do not have the data to complete the breakdown into twenty year age classes. It is important to note that all this pre-1900 stock exists.

Dawkins. To what extent is the study of trends over the last 30-40 years going to help in determining what will happen as a result of changes in Forestry Commission policy, because the former trends took place under the pressure and compulsion of the financial criterion?

Holmes. If you project the proportions of woodlands in the various conifer and broadleaf categories as at 1965 at the rate of planting implied, you will get a misleading picture of future trends. The high proportion of conifers in Forestry Commission areas and the large area of them relative to the total is a reflection of the strategic policy of the Commission in building up a reserve of timber for emergency purposes and also a continuation of that into the so-called commercial period when we planted high yielding softwoods for maximum return on capital. In the lowlands this is changing because of the new emphasis on social and amenity considerations and provision of employment, and also because of the availability of land in various regions of the country. The Forestry Commission's new planting programmes are concentrated in the uplands and the extension of the coniferous area, or of any Forestry Commission areas, in the lowlands of Britain is going to be very limited. Also, it is unlikely that we shall be replacing the existing hardwoods by conifers on a large scale. Both in Forestry Commission plantations and in many private plantations

¹Jeffers, J.N.R. 1972. Changes in areas of private woodlands in the counties of Essex and Suffolk. Nature Conservancy, Merlewood Research and Development Paper no. 32.

the post war period has seen the domination of the financial criterion to the extent that existing hardwoods of all categories, including what was once called derelict woodland or scrub which conservationists often regard as of very high value, were converted to economic soft-woods. The trends shown by the 1947 and 1965 figures for the lowlands are unlikely to continue.

Mellanby. It is very important to have an accurate picture of what is occurring today. What happens in the future will depend on policy and future projections will be as accurate as all of the other projections that we make such as Britain's need of physicians or of different kinds of students!

Peterken. A big change in Forestry Commission policy is taking place and we have detailed information only to 1965-67. Is there a case for the Forestry Commission to make a sample census programme which would enable trends to be recognised more quickly?

Simpson. Enough returns are coming in through the Ministry of Agriculture, scrub clearance grants, and so on and our Conservancy offices. I do not think that there is any pressing need for an immediate census of woodlands.

Mellanby. One has to be very careful on how we use samples. The annual rate of hedge removal in Britain as assessed by different organisations varies between 500 miles and 10,000 miles a year; these differences all depend on the samples which were made. The information on woodlands must exist somewhere and it should be possible to keep it up to date.

Holmes. The Forestry Commission annual reports give actual areas of land in various categories both as an annual achievement and as an addition to the national total. For the private sector we can only relate to managed woodlands and additions to that total.

Workman. Trends in forestry are only important over a longer period, such as 10 years. If assessed annually they could be very misleading.

Jeffers. After the 1947 census, there was an attempt to maintain data from regular sources, including planting grants and felling grants, for about 10 years. There was also an attempt to keep the census up-to-date by a rolling census taking 1/10th of the country at a time so that once in 10 years the whole country would be covered. Neither worked and the Commission decided that an inventory of our woodlands, even on a simple basis, was only worth attempting once every 20 years or so.

Parker-Jervis. One year's planting programme can be wiped out by the activities of wildlife and statistics of one year therefore can be completely inaccurate due to natural causes. They will not be recorded accurately in the private sector or anywhere else. Mr. Simpson indicated that dedication substantially increased productivity in the private sector. That being so, would he not agree that stability in forestry has been brought about to a very large extent by dedication. What is the Treasury attitude to the approach that says we are going to support an uneconomic crop?

Simpson. I heartily endorse continuity which is the major basis of the Approved Plan but I cannot answer for the Treasury.

Holmes. The attitude on dedication has been that one should require the production of a merchantable crop which can contribute to the economy and can be used by industry in return for the grant offered. The Government attitude, the Treasury attitude and the principle underlying the dedication scheme up to the present time is concerned with growing wood for the nation. How much money the owner makes is his business.

Parker-Jervis. The national forest body, the Forestry Commission, are not going to replace pre-1861 hardwoods with anything but the equivalent in due course, so that they are committing themselves to an uneconomic crop in the current circumstances. How do you equate the past principle, which allowed something which might show some profit, to absolute certainty on present terms of total loss?

Holmes. It has been argued in the past that if a private owner plants a low yielding species he should not get a grant because he is not growing much. That was wrong thinking. It has his decision that he should plant this species and his reasons were often very complex and may have included amenity, sporting and even wildlife conservation. For the future, the appropriate level of grant for various categories of planting, where perhaps the reasons for planting are not concerned with wood production for industry, is a political issue.

Forman. Defining productivity simply in terms of quantity of timber produced is a very dangerous way of treating the subject. The dedication scheme has greatly reduced productivity from a conservation point of view because it has got rid of all these interesting scrub areas highly productive of wildlife and converted them into conifers, which improved economic productivity but reduced wildlife productivity.

Holmes. Timber production aims are not necessarily antagonistic to wildlife conservation aims. The Dedication Scheme has produced woodlands with a diversity of species, age classes and structure because of the different objectives of owners and their different ideas about profit.

Forman. I am not criticizing the Dedication Scheme, but drawing attention to the fact that it is very dangerous to treat productivity only from the point of view of timber produced because all those other values, which we rate very highly, can never be quantified accurately in terms of money. Who is going to decide the exact objectives of forestry activities, how wide will these objectives be set, how far is conservation and amenity going to play a part and how far is government money, in the form of grants, going to be made available to assist in these wider objectives and not only the narrow economic objective?

Campbell. There is no reason why the Dedication Scheme should not have wider policy to implement.

Wright. Because of the financial emphasis of the past few years management, including rehabilitation of woods, has been concentrated on the larger woods. Small woods, which are of such great importance for conservation, are falling further and further behind, very much as in the rest of industry where the large operation is tending to prosper at the expense of the small one.

Peterken. The larger a wood the more likely it is not to be under some form of coppice structure or its derivatives. Conversely, the smaller wood the more likely it is to have something like the original coppice management system. I would say that the larger the wood the more likely it is to be economically managed.

THE FORESTRY COMMISSION

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INTRODUCTION

The Forestry Commission operates in two distinct but clearly related ways. In the first place, it is the Forest Authority and as such it is responsible among other things for implementing legislation (mainly concerning private woodlands and plant health), for undertaking or aiding research, and so on. The current activity regarding elm disease illustrates several aspects of this role. Secondly, the Commission is the manager of the National Forestry Enterprise and it is its management policies and priorities in this role which are the subject of this paper.

There are one or two definitions which, although familiar enough to foresters, it might be helpful to establish at this early stage of the Symposium. A dictionary definition of forestry is "the art and science of forest management". Forests may be managed for a variety of purposes and it is to nobody's benefit for "forestry" to be associated in the public mind exclusively with the single purpose of economic timber production, usually in the somewhat unattractive light of commercial exploitation in the case of existing woodland or uniform coniferous afforestation in the case of our denuded uplands. This has come about because of the circumstances in Britain during the last 50 years, produced by centuries of forest clearance and two shattering world wars. Even in these circumstances, or perhaps especially in these circumstances, forest management is conservation, that is, "the wise use of natural resources". It means restoring lost forest cover with benefits to soil conservation, to wildlife conservation and to landscape, and growing timber crops as a renewable resource. Indeed in most forest services in the world, including our own, it is no accident that the senior professional officers are given the title of Conservator.

The demands placed on the forest vary with time. In Britain since the Conquest they have ranged from fuelwood and grazing, through hunting and the chase, coppice for local needs, charcoal for smelting, timber for the navy and coverts for sporting, to timber for the mines and timber for pulp, with a more recent movement towards forests for wildlife and now forests for people. The forester, faced with the task of managing a particular forest, is given objects of management by the owner or his representatives and advisers. Depending on the owner's circumstances the principal object may be, for example, to build up the maximum reserve of capital with the minimum amount of expenditure or to provide the best sporting. Equally it may be to trade as profitably as possible by growing special crops for special markets. In practice it is likely to be a mixture of objects with different priorities. It is the same in the national forest estate. The nation is the owner, Members of Parliament are the owner's representatives and the government of the day provides the executive and financial advisers who frame the objects of management. These objects of management are currently under review. In December 1970, it was announced that the forestry Ministers were to re-examine various aspects of forest policy, including the return on public money invested in forestry, and the results of this review are expected this year.

OBJECTS OF MANAGEMENT

In the meantime the Commission's objects of management remain as published in 1963 when the Commission's policy was stated as follows:-

- i. To increase the production of wood as a raw material for industry by extending the area of their forests at a steady rate, in accordance with sound land use: and by making each forest as productive as possible.
- ii. Within the limits set by their other objectives to manage the forest estate as profitably as possible.
- iii. To provide employment in rural areas, especially those most affected by depopulation, and in so doing to maintain a skilled labour force.
- iv. To help in maintaining an efficient home timber trade.
- v. To give due attention to the aesthetic and protective roles of the forest and to encourage open air recreation.
- vi. To foster industrial and social development ancillary to forestry.
- vii. To encourage the orderly development of private forestry and specifically to assist in creating conditions in which produce from private as well as Commission forests can be marketed to best advantage.

Thus the primary and secondary objects of management can be identified as timber production, landscape amenity, wildlife conservation and recreation. For some purposes it is convenient to consider these as the 'timber' and the 'non-timber' benefits of forest management. Whilst any forest is better than no forest in so far as it will satisfy at least some demands, obviously there are some serious conflicts between these activities and it is important to recognise them before determining priorities in achieving the objects of management.

In forest composition (choice of species and distribution of age classes) the conflict between the timber and non-timber benefits is a conflict between uniformity and diversity. Concentration on the growth and harvesting of timber crops tends towards uniformity of species and age classes. Taken to extremes, economic timber production leads to a coniferous monoculture with large areas of even-aged plantations, which are less expensive to establish and to harvest, and are more easily marketed. On the other hand, it is a feature of this conflict that measures designed to increase diversity tend to favour all the non-timber benefits, that is, landscape and wildlife conservation and sporting and recreation. However, when all activities are considered, it becomes clear that there is usually more direct conflict between individual non-timber activities than between any one of them and timber production. Of course there are special exceptions to this generalisation, for example, high deer populations damage trees and reduce timber production.

An attempt can be made to resolve these conflicts by separating the different activities into watertight compartments. It has been suggested that there should be complete separation into either 'industrial' or 'amenity' forests, but this can be an extravagant solution which is

unrealistic and restrictive. Alternatively some form of multiple use can be attempted. This term should be treated with care, but the concept is familiar. However, any rigid solution has its dangers. If we are to try and maintain the quality of life in these crowded islands, some practical compromise is necessary. None of our forests should be all factory or all public open space or multiple use everywhere all the time.

The Forestry Commission recognises that forest management must be flexible. It is essential to avoid extremes and to keep all the options open if forest management is to evolve to meet changing demands and priorities in different places and at different periods. We know that tree growing is a long-term business and we know that demands change, not only the demands for various non-timber benefits but also the industrial demands for timber. In terms of forest composition, for example, this means that it is important to avoid those extremes of plantation layout, choice of species and age class distribution that make it difficult, if not impossible, to adapt to changing objects of management. Further, it is well understood that a degree of habitat diversification is highly desirable, although the amount will depend upon the priorities in a particular forest. Indeed by making imaginative use of fringes, wetlands, rocky outcrops and other areas relatively unproductive of timber, there can be a great gain in non-timber benefits with little loss of timber revenue.

Similarly when considering forest activities within the national forest estate it is important to avoid extreme demands. These can be accommodated elsewhere by people and bodies with different objects of management. For example, while the sporting possibilities of our forests should no doubt be exploited, sporting management involving intensive rearing, with all else subordinate to this objective, would not be possible. Again to take a wildlife conservation example, a nature reserve of national status would be better managed by the Nature Conservancy. Other examples are suggested by names like Whipsnade, Woburn and Longleat, or Battersea Park, Hampstead Heath and Southend. The Forestry Commission is more properly concerned with less specialised demands and in particular with activities compatible with the forest environment. The remaining conflicts can mostly be resolved by zoning in space and in time.

The principal objects of management are timber production, landscape amenity, wildlife conservation and recreation, and the next stage is to consider the management policies and priorities in more detail. Timber production is the subject of another session, so let it suffice to quote from a recent Financial Times:

"... There is no difficulty whatsoever in marketing the timber available since present output meets little more than 8% of Britain's total requirements of timber, pulp and paper. The rest has to be imported at a present cost of the balance-of-payments of some £750,000,000 a year, making it the fourth largest item of the import bill. Moreover, even with the sharp expansion in production which lies ahead, the home supplies will still only meet, at best, 20% of our requirements by the end of the century. And the forecast by that time is that world timber supplies will be a good deal shorter and more expensive than then are today. ..."

"... There is a growing market for all materials in the sectors in which forest owners have an interest and there is no real danger of too much afforestation taking place in Britain. If anything, severe shortages are possible, forcing up world prices. ..."

It is worth pointing out that forest management in general benefits from the discipline of growing tree crops and harvesting timber. The need for a businesslike management structure assists the achievement of the other objectives, and the satisfaction of achieving tangible aims attracts a quality of staff which is more capable of managing the non-timber activities effectively. In addition the employment of forest workers makes the all important local community more viable all the year round.

A landmark in the furtherance of the non-timber objectives was the formation in 1970 of a small Conservation and Recreation Branch in the Commission's Headquarters. Its responsibilities include all aspects of policy and planning for recreation and landscape amenity, and for the conservation and control of wildlife.

LANDSCAPE AMENITY

The landscape amenity objective was greatly assisted by the Commission's decision in 1964 to retain Miss Sylvia Crowe's services as consultant landscape architect. Every year she visits different forests and her guidance has been invaluable. This year we propose to intensify the training of our staff, especially forest officers, land agents and civil engineers, in the appreciation and solution of landscape problems. This has a high priority and the benefits will accrue to wildlife conservation as well.

In particular the Commission has recently and publicly stated that greater emphasis will be given to maintaining the woodland character of the countryside particularly in the South of England. It has been recognised that to this end in certain of the Commission's woodlands the maintenance of broadleaf species, where sylviculturally this is possible, is an essential part of the landscape. The form of management necessary may entail the lengthening of the rotation for broadleaved trees, the more gradual replacement of these other trees with broadleaved species sometimes mixed with conifers as a nurse, or the retention of some scrub areas. "The objective of the Commissioners is to perpetuate by active management the living character of the woodland landscape for future generations to enjoy". This has a great significance for wildlife conservation as well as for landscape amenity.

RECREATION

The forest recreation policy has also been restated in the last year or so. In general it is the Commission's policy "... to develop the unique recreational features and potential of its forests, particularly where they are readily accessible to large numbers of visitors from the major cities and holiday centres. This will be done in conformity with the Commission's statutory powers and obligations and within the limitations imposed by its primary objective of timber production. The Commission will ensure that such development does not damage the forest environment or conflict with its conservation."

Other features of this comprehensive recreation policy are relevant to wildlife conservation. For example, the Commission will prepare Conservancy Recreation Plans and in the process it will consult the Nature Conservancy and other bodies, such as County Naturalists' Trusts, which have an interest in the management of the forests in the different regions. To protect the forest environment, access will be subject to the Commission's byelaws and the regular use of forest roads for recreational purposes by private cars will be prohibited. In particular it is the Commission's

policy to encourage the widest use of its forests for educational purposes and the study of natural history. Such general use will be free of charge provided that no special facilities are required. In certain circumstances the written authority of Conservators may be needed, for example, to erect a hide to photograph a nesting bird, to dig soil pits or to collect butterflies or other insects. This is where recreation and wildlife conservation meet. Several Forest Information Centres and wildlife museums have been opened. Observation posts sited in strategic positions for watching and photographing wildlife have proved immensely popular. School children who have been round a Forest (Nature) Trail, of which there are now about 200, return at the weekends with their parents. In fact, school parties visit forests in increasing numbers and many School Forest Plots are maintained by rural schools.

WILDLIFE CONSERVATION

Wildlife conservation itself has always had a high priority among foresters. Forestry training has an ecological background and many individuals are drawn towards forestry as a career because of their interest in wildlife and the countryside. Wildlife management in the Commission's forests has its roots in the prevention of damage to trees, and in the last few years there have been some important changes in the organisation of this work. Many of the eleven Conservancies now have a Conservation or Wildlife Forester, that is, a trained Forester on a tour of special duties concerned not only with the protection of plantations, but also with conservation and the wildlife aspects of recreation. The work of the various trappers, warreners and stalkers has been reviewed: their duties and deployment have been revised and their training intensified. They have been regarded as Rangers and Senior Rangers and there are nearly 300 of them. In addition there are a few highly skilled and experienced Head Rangers whose duties are similar to those of the Wildlife Foresters. These arrangements permit greater flexibility of control and ensure an even more specialised approach to the changing problems of forest protection, conservation and wildlife management. They have the added advantage of further spreading understanding and practical experience throughout the Commission at a time when the significance of this aspect of forest management is increasing.

The Commission implements an enlightened wildlife policy which contains five important provisions. First, the trees must be protected, but it is realised that total prevention of damage is an impractical aim. It is worth emphasising that the approach is crop protection not population control. Secondly, when control has to be exercised to protect the trees or neighbouring crops and stock, it must be selective and carried out humanely. The Commission aims to lead the way in this field: it pioneered the selective control of deer by rifle shooting from high seats; it banned the gin trap in advance of legislation. Thirdly, harmless animals, such as the badger, must not be molested by forest staff, sporting tenants or others. Fourthly, rare animals, such as the pine marten, must be protected and encouraged. Fifthly, special measures must increasingly be taken to retain and create suitable habitats to maintain a diversity of wildlife.

Where there is some particular and important conservation interest, it is the Commission's policy to co-operate with the Nature Conservancy, either by disposing of reserves to the Conservancy or by management agreement. The Commission's forests contain several Forest Nature Reserves and Sites of Special Scientific Interest. Many reserves of local importance have been handed over under licence for management by such bodies as County Naturalists' Trusts. Some other sites are managed in conjunction with local

societies or by the Forestry Commission itself. In all some 8,000 hectares of Commission land are under special management for conservation purposes. In addition there is close co-operation with local Natural History Societies and other bodies and individuals concerned with conservation. Commission forests provide facilities for research on wildlife and conservation by many individual research workers from the universities and colleges. However it is important to stress that the ordinary woods and forests provide an invaluable sanctuary for ordinary wildlife. Forests cover a wide range of soil types and different habitats, and when every year so much of the countryside becomes increasingly inhospitable, the forests have been described as 'reservoirs of wildlife', because most species of our flora and fauna have woodland origins or affinities.

The Commission has relatively small land holdings in the lowlands, but they are none the less important for that. I believe that the Commission has forward looking policies and I think that the priorities are fairly well adjusted, although I realise that there is scope for discussion on this point. What is important is that the machinery exists inside the Commission for positive planning and consultation and that the Commission is well equipped to implement any management decisions.

THE PRIVATE OWNER

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WHY AND WHERE

85% of post-war planting in England and Wales has been the reforestation of either recently felled woodland or areas of scrub left derelict after the fellings in the wars. This continuity of forest cover can in most cases be attributed to characteristics of geography, topography and geology weighted by considerations of finance, sporting and amenity.

Continuity aids conservation which is also frequently considered both by the owner and by the forester. In the counties surrounding Huntingdonshire we have woods managed with special account taken of their beetle populations, their butterflies, their associated fishing, the ground flora and fauna and badgers and foxes in particular. Leicestershire would be a barren looking county without its fox coverts, and birds including native species such as the heron and immigrants such as the pheasant. On many local estates the keeper is closer to the owner's heart than is the forester, and also has a greater influence on the owner's pocket. A 'shoot' may ensure one's own entertainment and affords the opportunity to act as host and enjoy reciprocal hospitality, or it can be let at £3 an acre per annum on the woodland and almost £1 on the agricultural land. The latter rent is a direct result of the woodlands which give body to the 'shoot'. If these figures are compared with the average timber receipts on Estates south of the border, they represent about 80% of the outgoings. Woods apparently lose £1.80p per acre per annum (Lorrain-Smith, 1969). Where woodlands are assessed under Schedule D these outgoings may be offset against other income and the amended net return for the average owner rises to a 14% profit on outgoings. This figure is derived from the accounts for a single year and does not take compound interest on establishment costs into account. However, the Tax Inspectors do require woods to be profit orientated before they will accept assessment on Schedule D. These figures may appear remote from many of the stimuli which encourage the establishment of woodland, such as amenity, landscape, arboriculture, kudos, public and private recreation, the joy of practising silviculture and the salving of a conscience stricken by the endless removal of hedgerow trees, but the economics of woodland ownership is a fundamental consideration and colours every decision.

Between the wars Governments, or some of them, urged the private grower to plant. After the 1939-1945 war owners responded and planted six times the acreage in the decade 1957/66 compared with the period 1930/39. Grants were larger in the post-World War 2 period but still only represent some 15% of the establishment cost and even these are taxable. The Dedication Scheme and, to a lesser extent, the Approved Woodlands Scheme must be credited as being a direct encouragement to the private owner to plant. The planting and management grants and scrub clearing grants in the early days were all appreciated.

Under the Dedication Scheme assistance could be either under Basis I, 25% of the approved costs, or Basis II, where grants might yield as much as 40% of the cost. The latter also avoided some of the book-keeping involved under Basis I.

If we contemplate the land here, heavy clay and traditionally forest land because it was too difficult to work for agriculture, the two schools of forester will discuss the respective merits of planting either Corsican pine or oak. The economist will have little difficulty in recommending barley.

In lowland Britain, even excluding the less fertile sands, the thin chalk soils and rocky areas such as the worked ironstone Hill and Dale lands, only poplar on suitable soils can approach the earning rates of agriculture. The Government consider that importing 90% of our timber requirements has an adverse effect on our Balance of Payments and this and associated benefits have led the State to encourage a healthy United Kingdom forest industry, even if the earning rates of forestry do not reach those in other industries. One stimulus to private woodland ownership operates through the assessment of Estate Duty. Land, on which trees grow has a 45% allowance on its value, and the value of timber is not taken into account when assessing the rate of Estate Duty. A million pounds worth of money would attract maximum Estate Duty at 70%, 62% on the first £500,000 and 75% on the balance (£309,750 on first £500,000 + £375,000 on balance = £684,750) but £100,000 of land and £900,000 of growing timber has its rate based only upon the land value of £100,000. The rate levied on the £900,000 of timber is lower, and this latter duty need not be paid until the timber is actually felled and sold. If the beneficiary should die before all Estate Duty on the timber has been paid, the outstanding debt is waived. It is important to agree the value of timber with the tax authorities as the sum due is calculated at the time of acquisition and subsequent volume and value increment is not taxed.

The forestry finance companies have helped many of their clients to pass on a greater proportion of their wealth to their dependants rather than to the government, and at the same time have encouraged the planting of large woodland acreages. Much of this planting is in the uplands. There high rainfall favours species which mature rapidly, and poor agricultural soils, while still capable of producing forest-crops, are far cheaper to acquire than in the lowlands and the larger individual blocks of land which result give economies in fencing costs, management and harvesting. These less fertile soils give slow rates of weed growth and the decrease in competition gives cheaper establishment with a lower figure to attract compound interest during the rotation than on most lowland sites.

Protection is a broad subject encompassing the encouragement of woodland establishment, the provision of shelter for stock, privacy, improved water catchment and control of erosion, mitigation of the adverse effects of pollution, including industrial, visual and noise pollution, and general moderation of the less desirable aspects of the climate.

The final item in considering the stimuli for planting is the revenue obtainable from forest produce including saw material for the Estate Sawmill and its subsequent sale or estate use, pulpwood, chipwood, wood wool, pit wood, carcassing, sawlogs and veneer timber.

The siting of the woodland follows from the prime motives for its establishment. These may be good access to public roads and local markets, cheap establishment and favourable growing conditions, a suitable configuration and location for a shoot, a barrier between the house and some undesirable feature such as a motorway, an air base, the brick works or the east wind, around the reservoir, on sand dunes, where the Hair Streak butterfly will be at home or where nothing else will flourish.

WHAT AND WHICH

Having decided to establish a wood, the forest manager considers questions of climate, elevation, rainfall, sunshine, exposure, frost, air pollution (both salt and industrial), the aspect and whether the soil be clay, sand, chalk or peat. The range of suitable species will now be restricted and further modified by the question of timber value, growth rates, ease of establishment, whether the species are evergreen, attractive to the owner or to game, whether they will encourage the development of desirable habitat characteristics and whether they are resistant to serious insect attack, fungal attack, bacterial attack and mammal damage.

Is the plantation to be pure or mixed, what spacing is to be used, what silvicultural system followed, High Forest, Coppice or Selection (the last of which, incidentally, is discouraged by the current operation of schedule D)? Even after these deliberations the choice may be decided by personal whim or be influenced by the surplus of some species in the nursery.

The size of plant may vary from a 4 inch Corsican pine to an 8 foot Cricket Bat Willow but optimum ranges for most species are now generally accepted. Few estate nurseries can compete with the Trade Nurseries in price, but they do offer an assured freshness and a possible advantage when Value Added Tax is introduced.

WHEN AND HOW

The Plan of Operations sets out the pattern for the forest year with latitude to take advantage of appropriate markets or changes in the owner's personal circumstances. There is a general desire to achieve a 'normal' age class distribution with its associated advantages of continuity.

The sale of mature timber is often 'standing', but especially where Estate Duty applies the Estate has an incentive to process the timber as far as possible and off set these costs against immediate duty payments.

The length of the rotation may be influenced by specific markets, by amenity, by sporting interests or by pride of ownership. These considerations frequently permit the financial rotation to be extended by some 10%.

WHOM

The private woodland owner, as well as individuals, includes bodies such as the Nature Conservancy, National Coal Board, National Trust, Naturalist's Trusts, sawmillers, The Crown, The Church, Water Boards and corporations. Most of the Dedicated estates in England and Wales are members of the Timber Growers Organisation which represents their political interests vis a vis the government, the exchequer, the Forestry Commission and Local Authorities.

The silvicultural interests of many owners are fostered by the Royal Forestry Societies and management may be influenced by the regional co-operatives, by the Consultancy contracting organisations, by firms of Land Agents, by sawmillers, by nurseries, by other Private Estates or by Consultants. The Society of Foresters of Great Britain keeps a register of approved Consultants which now includes 42 names. There is a tendency for an increasing amount of forestry work to be undertaken by contractors rather than by the Estate's direct labour.

CONCLUSION

The many different types of private forest owner fall into two categories, those whose prime aim is to produce trees and incidentally make a wood, and those whose main interest is in woodland and who, in the process, grow trees. Both have a common interest in establishing and maintaining their trees as economically as possible and also in growing the most financially attractive species compatible with other interests.

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MANAGING AND INVESTMENT COMPANIES

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In order that we can consider the position of the Managing and Investment Companies I would like to outline first the types of work which commonly come the way of such companies and then develop the policies and priorities which stem from these types of work.

TYPES OF CLIENT

Broadly speaking our work falls into three main categories based on types of client

- (a) Contract
- (b) Management
- (c) Investment

Contract

The first type of work, the Contract, is almost always a fairly straightforward affair whereby the client requires a particular job to be carried out. In most cases he has a fairly precise idea of what he requires and may even have produced a form of specification and/or a Bill of Quantities. Only rarely is there the opportunity to amend specifications in such cases. The nearer such works approach "Landscape" schemes the more rigid and detailed are both the specification and the Bill of Quantities. Such contracts are priced as for a competitive market and the work carried out according to the schedule laid down. No management policies in a silvicultural sense apply except that one would resist or refuse to do work that silviculturally was not viable e.g. using the wrong species for a site. We can therefore discount this sector of work from our future discussion.

Management

By the second type, Management, I mean the property which has a resident or part-time resident owner. Usually these properties have a very personal stamp and management of such properties, very rightly, takes into account the owner's interests and wishes. In the majority of cases sport, that is shooting and fishing, takes a very high priority often conflicting with other interests. Amenity, especially round the "big house" is of critical importance. The layout of such properties, especially in the south of England, has been dominated by shooting and amenity considerations. The siting of the house, often placed on a vantage point yet surrounded at the sides and back by higher ground, was designed to give a vista which included stream or river, sometimes enlarged to pond or lake in the middle distance, and with groups of trees to emphasise the view or hide the workers cottages. The rest of the estate was planned to get the best shooting out of the available ground and designed primarily with regard to pheasants, regardless of the quality of land and length of fence lines.

The further land is from the house the more likely is its land-use to be related to its capabilities and for pheasants to take second place. Plantations are larger and are sited on the poorest ground or uncultivated slopes.

What do we learn from such estates and how are present methods of management affected by the past? Points to be considered are:-

- (a) Rental value of the sporting.
- (b) Preparation of true forest land as opposed to coverts.
- (c) Cost of re-establishment of coverts (Fence line to area ratio).
- (d) Amenity value of the woodlands, particularly in sight of the house.
- (e) Range of species silviculturally acceptable.

Investment

Lastly the Investment in which a client's approach to forests is completely different from the first two types. Often he or she will have had no previous contact in depth with what can perhaps be described as the rural economy. Farms and forests have been localities to be visited on holidays and seen but not entered. Almost exclusively the first contact is financial, approached in one of three ways.

- (a) As an estate duty saving scheme, or
- (b) as an investment proposition, or
- (c) as a deliberate and planned balance between the two.

A further point must be made here, and indeed cannot be made too strongly. Financially there is very little to commend forestry to the client himself; it is essentially a family exercise designed to ensure continuity of resources both of the crop and of income. The clients who establish the plantations rarely see them mature and certainly never benefit from estate duty. For their sons and daughters, however, it is a different story.

What then can an Investor get from his woodland?

- (a) First and foremost, an investment - the creation of an asset in growing timber.
- (b) A capital gain by improving or creating multiple land use opportunities.
- (c) Sport - fishing, shooting.
- (d) Amenity.
- (e) Perhaps a second home leading to his becoming a resident owner.

What common denominators do we find in these three approaches which enable Managing and Investment Companies to formulate their own business policies and guide lines for working or managing properties?

First, it has to be acknowledged that there is a demand for the creation and management of woodlands which can be fulfilled by any one of a wide range of companies, by the small one-man consultancy, by the co-operatives or by one of the larger management companies. All these have the same basic starting point. There is a demand for their services and silvicultural expertise to create and manage woodlands and to process and sell the produce. This demand is backed by government whose policy is that forestry should play its rightful part in the countryside. To encourage this, grants are paid when schemes of commercial forest work,

duly approved by the Forest Authority, are undertaken. Additionally, in order that investment in the private forestry sector shall be further encouraged, tax relief on the creation of commercial plantations is available, and further advantages accrue in the field of estate duty, capital gains tax and under tax schedule B. Thus, all clients can be said to be strongly motivated financially in the management requirements for the woodlands they own. An adequate return is required on their investment and certain species which may be silviculturally satisfactory, even desirable, may not necessarily provide an adequate financial return.

Secondly, all woodlands are capable of providing some form of sport within, or because of, them. This can range from the highly organised and deliberately planted pheasant shoot to the removal of rogue deer. The first is capable of fetching a good sporting rental as income to the estate but the second is a drain on resources! Whether we like it or not game, using the word in its widest sense, inhabits our woodlands and most, if not all the animals and birds classed as game or vermin, use the edges and hence also the surrounding land. Rather than regard game as an expense we should attempt to create an asset by using it.

Thirdly, there is the question of amenity. In most cases in Britain ownership of woodlands carries with it the acknowledged need to pay due regard to amenity. This may extend only to a very limited edge or corner effect, to Tree Preservation Orders, a Plan for the Chilterns or to an almost stifling blanket of bureaucracy. Amenity requirements cannot be ignored and in most cases owners require that their woodlands are acceptable to the eye but amenity species are often those with the poorest financial return and effect has to be weighted against value.

SILVICULTURAL PRIORITIES

These must be put first and foremost in woodland management. The species selected must be suitable for the site on which they are planted. In lowland Britain there is usually a very wide range of species which are capable of producing a good return and selection can be made from both hardwood and coniferous species. But, and this can not be ignored from a financial standpoint, conifers are in the majority of cases the most acceptable investment proposition. They are cheaper to establish, produce a thinning return of saleable material at an early date, complete the rotation at perhaps half the age of many hardwood crops, and produce a heavier yield per acre. Perhaps price per unit volume may not be all that a hardwood will give, but in any comparison of net discounted revenue the conifers usually end up outright winners.

Whether we like it or not, under the present system of aid to forestry there is little encouragement to go for long rotation hardwoods producing relatively low yields. Dilutions of commercial conifers by up to 5% are common on amenity or sporting grounds, but larch often plays a major part in this 5%. Occasionally an owner will request a dilution of 15% to 25% by groups or strips with the express intention of removing the conifers during thinnings to allow the hardwoods to come through. Unfortunately the hardwoods often fail to make it. Mixed woodlands of this nature take a far higher degree of management skills to produce the desired end product and not many of the country's foresters have the necessary experience. It is far easier to manage a monoculture and you do not have to know your woodlands so well - a sad commentary but true.

The one saving factor so far as the forester is concerned is what I would like to term the "edge effect". A sprinkling of hardwoods alongside the road and a few groups at the corner of rides can be seen by the public who then tend to ignore what is behind them. How far does the average tourist venture into a forest? As many animals and birds use edges there is an increased diversity of life inhabiting these fringes.

Is this then the future of the British hardwoods? I feel it is until we have a grant aid system which reflects more realistically the true costs of raising hardwood crops. An owner is primarily interested in the financial return but he will modify this to a limited extent to provide sport and amenity.

MANAGEMENT PRINCIPLE NO. 1

Select species for their financial return in accordance with good silviculture and incorporate up to 5% diversity to accommodate sporting and amenity potential, even if there is no demand for this from an owner.

As a major factor in the diversification of woodlands, sport must come second in our deliberations.

A satisfactory lay-out of access and extraction routes is required on any property and topography will dictate where these are situated. Larger areas, however, have to be broken up into manageable units and the location and orientation of these rides is usually fairly flexible. Pheasants require plenty of sun; deer have favourite routes and grazing areas; a duck pond requires flighting lines to be orientated correctly. How do we incorporate these factors? The first step on a new afforestation property or on a reafforestation area must be to carry out a full appraisal of the potential of the ground. Game either exists or can exist in almost every piece of woodland in this country, and in most cases can be made to contribute to the income or enjoyment of the owner.

Put down on a plan the key sporting areas, e.g. the areas that are too wet to drain successfully, where a pond could be created, where that river/stream fishes best, which areas attract roe deer and along which paths they move, where the best flushing points for the pheasants are and the sequence of drives, where should the release pens go, and so on. In lowland Britain many of these points are already observable on the ground or may be found out by talking to the older local people. Mark these points on the ground and on a plan. Once these points are known they can be built into the forestry plan at usually little or no extra cost purely by planning and observation. Even if the present owner has no interest in sport, if these points are incorporated into the woodland the effect is always to improve amenity and sporting potential. Inevitably this leads to higher sporting rentals and capital appreciation. Rentals of £4 per acre per annum have already been obtained on woodland blocks which are the key to the sporting on the surrounding agricultural land. £4 per acre per annum cannot be ignored especially on Schedule B. Neither can the capital value at £4 times 15 or even 10 years purchase.

MANAGEMENT PRINCIPLE NO. 2

Investigate in depth the sporting possibilities inherent in the land and lay out the area to maximise the returns available.

AMENITY AND RECREATION

How does one define amenity? There are the obvious examples of bad amenity such as straight edges to hillside plantations, and a complete blanket of one species, but in lowland Britain what is good amenity? A landscape that is easy on the eye, but on whose eye? Traditionally, lowland Britain is a land of hardwoods. If hardwoods are planted the public is happy, but how many of our existing hardwood plantations and copses are full of decaying trees and poor quality underwood and scrub? Even in the Chiltern woods where tradition and silviculture demand Beech it is simply not a practicable proposition to plant this species. Even if it escapes the depredations of youngsters or does not get taken to form a garden hedge, the squirrels, when they get tired of being hand-reared in gardens, will ruin any possibility of timber ever being taken out of these woodlands.

The sheer weight of public pressure on woodlands near population centres is increasing each year. Smaller woodlands will rapidly become almost impossible to manage but larger woods will hold out longer because of the reluctance of the public to go far into them.

Who pays for the use and abuse of the woods? Certainly not the general public. Can the owner cover his costs? One such attempt is being made by introducing the Country Club idea, membership of which, for a fee, allows access by key to a limited number of woodlands for the exclusive use of club members.

Planning is again the key to public use. Is the ground suitable and can the entrances be controlled and access charged for? Is the public going to enter in any case? Should picnic sites, viewpoints, parking spaces be provided to localise damage and keep the public where they are wanted? Is there a site suitable for a caravan park, chalet development, second home?

Locate and reserve such sites and plant suitable trees and shrubs in the forest so that these areas can be developed if the need or opportunity arises. Remember that the forest is a major recreation centre in many countries. Forests can absorb large numbers of people and opportunities for development are present if only we accept the responsibility for forward planning and planting. Hardwoods will figure to a greater degree in areas which are to be exploited for public use. They take time to come to a suitable size so planning and planting must be done early.

MANAGEMENT PRINCIPLE NO. 3

Prepare outline schemes for present or future multiple land use.

IMPLEMENTATION

In discussing Management or Investment prospects, schemes of management based on the three Management Principles must be prepared. The manager is duty bound to provide the best return on his clients investment and is expected to formulate and implement schemes which will safeguard his clients future interests. At present, grants and tax relief are available for undertaking commercial forestry investments and within the criteria of commercial forestry come many borderline facilities including the provision of fire dams-cum-duck-ponds, public access points and recreational facilities, but there is little or no encouragement or incentive for an

owner to spend appreciable amounts of money or resources on creating the traditional hardwood forest which the public seems to demand.

Do we resolve this difficulty by educating the public to accept conifers or do we press for public payment by direct or indirect methods to enable hardwood areas to be created and maintained? It is, I believe, unreasonable to expect forest owners to subsidize the public in the provision of such areas.

Management and contracting companies would be happy to undertake the planting and management of hardwood forests, at a profit, but who pays?

SESSION 2 SUMMARY OF DISCUSSION

Workman. We have suffered violent fluctuations of policy over the last half century but I think it is important to get consistent policies, otherwise the woodland suffers. I am not saying you should be stubborn and stick to something that is wrong but there is a very good case for sticking to something once you have made your mind up about it. The National Trust have had a consistent policy for 75 years which is that we maintain the landscape, open our land to the public, and manage towards hardwoods. We have modified the techniques, but not the policy.

Parker-Jervis. The Forestry Commission in the last 50 years had a very difficult time which the private woodland owners and the Nature Conservancy as a whole do not appreciate, that is, starting the national forest from scratch without any preconceived ideas at all. Learn, as Mr. Workman has said, by your lessons and develop as you wish but I would deplore them taking a line and saying that we must now change our way of thought because pressures are on us due to increase in population. We feel that they should not fall off the fence of reasonable silvicultural advice and impartiality in their dealings with private woodland owners and anybody else. We always try to develop according to the needs of the day, but we are not going to swerve to the totally selfish amenity point of view which says I want this now, I want it to remain and when I am dead I do not care what happens. You have got to look to the future, and I am sure many private woodland owners would agree with me in saying that we are very anxious that the Commission should not feel in any way under an obligation to retrace its steps.

Spencer. I wanted to talk about non-timber benefits rather than timber benefits. It is the primary aim of Forestry Commission activities, indeed the consistent aim to produce crops of timber and that is still the position. I am keen, also, and I am not being apologetic about this, to derive other benefits from forest management at the same time as we are getting the timber benefits.

Rogers. This also applies to the private owner who is going to utilise, in his development plan, those species which will be the most commercial and compatible with his other interests.

Rowe. On the question of access is there not a possible dichotomy here between the state forest policy and private woodland owners' policy?

Spencer. The Forestry Commission's land tenure varies considerably. We can only invite people on to our land where we own the freehold. We welcome people visiting our forests for enjoyment where it is in our power to let them do so.

Campbell. If one excludes leasehold properties, where access may not be possible, are there any constraints on offering access to the public?

Spencer. There are constraints because of the different activities which you may want to encourage in your woodlands. There are also constraints because people may get into difficulties or injure themselves or suffer in some way. Broadly speaking the Forestry Commission invites people into their forests where they can.

Campbell. So the Forestry Commission wish to positively encourage public access to forests areas wherever possible?

Spencer. Yes, and most of our recreation facilities are to enable people to visit our forests and our camp sites.

Cumberland. I look at this as a commercial proposition. Woodlands are an asset which people want and people are prepared to pay for exclusive use of woodlands. One of our associated companies has introduced the "country club", membership of which allows access to certain woodlands. People pay to use these woodlands from which other people are excluded. The woodland owner will have no real objection to people using his woodlands providing they do not create damage and respect the private land. Woodlands have advantages for hidden caravan sites for example. This is something the forest owner can recognise and plan for, by setting aside a certain section of his forest for this sort of specialist use. I think public access is acceptable; after all most of our woodlands are let on sporting leases and this amounts to a specialist form of public access. I do not see conflicts arising in this latter case as it is possible to combine sport with general public access. They are separated in time in many cases. Deer are shot at dusk or dawn and there are not many people in the woodland then.

Campbell. So access is acceptable as long as there is an income and it is very important that numbers should be controlled. There must be some constraints on the users.

Workman. The National Trust could not have sporting interest and total public access on the same ground as, for us, the risk to the public would be much too great.

Campbell. Are there seasonal variations in public uses. Is the demand for public access greatest in the summer?

Workman. Public use of National Trust properties continues throughout the year.

Campbell. The National Trust and Forestry Commission favour assess at any time of the year. The club system requires controlled access. If access is controlled is there a greater opportunity for integrating a sporting interest into the management of the forests, for example, the public could be specifically excluded in the pheasant shooting season?

Parker-Jervis. The general public is not automatically welcomed in all woods. Where there is substantial public access there is also the problem of the motor car, parking and getting people away from the car park. Servicing this sort of access involves very large numbers of authorities. The highways, involve the County Council, litter and sanitary arrangements involve the Borough or Rural Council and traffic involves the Police. You have also to get rid of the litter and deal with the damage which a large number of people create in a single place. If you can dispose of all those problems you have done a better job than most people have succeeded in doing so far. In areas where the population pressure is not very great, public access which is not damaging can be accepted to a reasonable extent. Where population pressure is great then all these authorities must

be brought together in the public interest to control access so that the public do not destroy the thing they most value which is the privacy and peace of the forest.

Wilson. There are commercial interests in collecting butterflies and other insects as well as people who are primarily interested in natural history and collect for study. Is collecting desirable and if not how can it be controlled?

Spencer. Permission to do anything that affects the fabric of the forest in any way should be controlled. You are going to destroy what you are trying to develop and enjoy unless you have some control. This applies to wildlife as much as anything else. We want people to come into Forestry Commission woods, particularly for the wildlife, and enjoy them. When people want to do something special, which could affect the wildlife, we would want to control it and give permission which could be charged for where there is a commercial element. Our field staff receive instructions that they should consult the Conservation Branch of the Nature Conservancy to make an assessment of whatever is being requested. Our staff also often know the natural history interest of a forest and those species which need extra protection.

Workman. Mr. Spencer helped to design a code of behaviour for this type of activity and its advantages are that you have other naturalists acting as policemen for you. A code of behaviour is much more effective than legislation.

Johnson. Would not benefits accrue to forestry and the Nature Conservancy if the first year of training was the same for both the forester grade and the warden grade, which are analogous grades, and if the training was carried out together? I am speaking as one who was trained as a forester and is now a warden.

Spencer. There has been a working party made up of various government agencies including the Countryside Commission, the Nature Conservancy and the Forestry Commission, to discuss this and it ran into difficulties because the duties vary a great deal. There are many different grades of responsibility, rates of pay and starting points, etc., which made it impracticable but there were two promising aspects. One was the common ground of meeting, guiding, controlling and informing the public. The other was that, rather than sharing basic training, there should be more joint training courses or courses run by the one body which could be open to members of others. The Forestry Commission has a training branch and staff from the Nature Conservancy have attended a number of our courses, for example Conservation and Wildlife Management. Another example is a joint course, held annually for staff from the Countryside Commission, Nature Conservancy and Forestry Commission lasting a week when people are brought together to share experiences and to describe to each other the objectives of their organisation and how they set about meeting these objectives. But joint basic training I believe to be impracticable, particularly for our foresters who have a concentration of forestry technical training bound up with their general basic botany and zoology and are trained as managers.

Johnson. Many wardens in the Conservancy have very much the same sort of work, and from my own experience, I would have thought the first year could be dove-tailed very easily.

Campbell. Is it the responsibility of the Forestry Commission to provide conservation training? Should not the private sector have the opportunity of this training?

Holmes. The Forestry Commission no longer train foresters 'in-house', and training is now done by the Department of Education and Science particularly at Newton Rigg which has a more general course than was common in the Commission. I think that the training machinery already exists in centres such as Newton Rigg, and if it is felt that more formal instruction in conservation or more basic ecology is necessary this may be achieved by representation to the Department of Education and Science.

Campbell. Training organisations exist outside the Forestry Commission and one needs to make representations to those organisations if one wishes to change the syllabus and have a greater emphasis on conservation.

Forman. The Nature Conservancy is such a small organisation in numbers and recruitment for the warden grade that it is not economical for it to set up its own training programme, other than the very modest in-house training scheme which is carried out. It has tried to overcome this by joining with the Forestry Commission and Countryside Commission and other bodies in getting its wardens included in training schemes.

Campbell. May I ask Mr. Rogers if he feels that there are adequate opportunities for wildlife conservation training for the private sector.

Rogers. Somebody from the Royal Forestry Society is taking notes and they may be encouraged to ask for more conservation in the Newton Rigg syllabus.

Wright. Mr. Cumberland has emphasised that the modern private woodland owner is to a very great extent motivated by financial considerations. Does he think that the grant structure and concessions on estate duty and so on can be modified to encourage wildlife conservation and whether they are likely to be modified to any appreciable extent.

Cumberland. I do not think any alterations in the aid to forestry, except perhaps special grant aid for hardwoods, will have very much effect. There is likely to be far more effect from the relatively high rentals for woodland sporting because this is the key to shooting on the surrounding agricultural land. In Norfolk we are getting £3-£4 per acre per annum rentals. If this is capitalised it is obviously a very attractive capital gain to the woodland owner and he is far more likely to plant his woodlands and lay them out in such a way that he can gain this rental value.

Rogers. It would be very encouraging if this income could be treated as Schedule B.

Cumberland. It would be if it were a Schedule B woodland.

Campbell. If on Schedule B it would be virtually tax free income; if on Schedule D then it is an income which reduces the establishment cost which reduces the claim for tax relief and is therefore of little benefit. Wise owners would make sure that they have an adequate proportion of their woodland holding on Schedule B which maximises the financial yield.

Dawkins. I would like to dispute whether private owners are motivated mainly by profit. I am thinking of three quite large private owners, in Buckinghamshire, Wiltshire and Berkshire who are managing their woodlands for diversity of crop and wildlife and who allow public access. If you ask, "Why are you planting oaks and hardwoods rather than the far more profitable conifers?", they say, "Because I like oak". I think these private owners are motivated by personal enjoyment and satisfaction in providing a natural history-cum-public service.

Campbell. Are these residential owners, who attach considerable value to the amenities surrounding their homes? If we reduce this to a sort of cost/benefit analysis the owner places a considerable value on his personal enjoyment.

Dawkins. My point was that they had not reckoned these values by any arithmetical juggling but simply wished their woods to be good harbours of wildlife and for local visitors to appreciate this.

Cumberland. I represent a very specialist section of private owners and most of our work is for the investment client but it is one of the aims of management in my Company to try to involve the new owner in his woodlands and to try to get him to have the same interest as a resident owner. Once that stage is reached his attitudes change. The investment client's first approach is that investment gain counts and it is only when he has been involved in the countryside that he shifts his ground and he enjoys the sporting and aesthetic values.

Dawkins. We have the old evil of the absentee landlord until you get him on the ground.

Cumberland. We recognise this as a danger and we make special efforts to get owners out on to the ground.

Rogers. I must emphasise that the bulk of lowland woodland is justified specifically on amenity, sporting and aesthetic grounds rather than pure mathematics and it is not only income from timber that can justify an investment in forestry.

Stern. In the south of England, where there is the highest proportion of private woodland, there is no doubt that the majority of woodlands are managed mainly for reasons other than timber production.

Campbell. We have listened to three expert forestry managers who collectively cover the main types of woodland owner. Mr. Spencer clearly defined the objectives of management of the Forestry Commission, which is the largest owner. Mr. Rogers covered a multitude of different types of ownership including Water Boards,

the National Coal Board, Local authorities, Church Commissioners and so on. Mr. Cumberland concentrated on a particular type of individual owner who is interested in making a return on an investment. Presumably policy is related to the type of ownership and you may feel that this information may be a useful addition in a future census.

We have had two points from the floor concerning Government Policy from which all our objectives must flow. Mr. Workman emphasised that forestry, or indeed conservation, is a long term operation which requires a stable policy. I presume he would like to see Government commit itself to a long term policy statement, say 20 years?

The other point from Mr. Parker-Jervis requested the Forest Authority not to abandon its principles in the face of opposition from minority pressure groups.

We had an interesting discussion on what motivates private ownership. Owners and managers seem to accept their moral responsibility as "trustees" to protect the woodland under their care for future generations. Many spend money with no expectation of a return. It was agreed that the Dedication Scheme had served a very useful purpose in building up confidence and implementing national policy. The increasing awareness that the grants available and the indirect taxation incentives, if brought together could produce a reasonable return on an investment and could at the same time provide considerable enjoyment and satisfaction, has obviously motivated private individuals. These incentives have resulted in a very significant contribution to the nation's forests from the private sector and must be safe-guarded. However if the nation wants diversity of species and more planting of hardwoods, which is now the stated policy of the Forestry Commission, it is only reasonable to expect the nation to bridge the economic gap. In the past the Forestry Commission have paid grants only for timber production so that if areas are excluded for wildlife conservation a reduced acreage for grants results. The Forestry Commission should reconsider this point.

We have talked about education and training. The Forestry Commission have applied themselves to this aspect and now have three hundred skilled rangers at field level. However organised training in wildlife conservation seems to be lacking elsewhere and I have grave doubts that the necessary expertise exists, outside the Forestry Commission, to implement any policy. It is sad that the Forestry Commission should be forced to retire early foresters with a lifetime experience in the countryside. Where the private sector is operating on a large scale it can employ specialists in game management and wildlife conservation. But has the general forestry consultant, particularly in the South of England, the necessary experience and skills? Perhaps we should attempt to coordinate wildlife and conservation training among the various sectors.

Management must implement policy and ensure the best use of resources. I consider some "style" of management to be essential in any organisation. In the Economic Forestry Group we would extract key result areas from the policy and agree a general objective for each. This could be "maintaining a roe-deer

population for sporting value". We would then define a specific objective such as, "maintaining a certain number of roe-deer on a certain acreage of forest". We then consider the various problems which prevent us from achieving a particular objective, e.g. "poor condition of the deer". Each problem area needs some corrective action and this must be stated, such as "culling the deer to optimise their quality and population within that forest area". You may find these suggestions useful in your own activities.

Finally, foresters cannot neglect their public image. I think the Forestry Commission have learned a great deal in the last couple of years and there is now a positive approach to public relations. As specialists we tend to sit back when there are obvious opportunities for coverage in the local press and on television. This is an important meeting. Why not issue a 'press release' tomorrow to let the public know that foresters and conservationists really mean business!

SYSTEMS OF MANAGEMENT FOR TIMBER PRODUCTION AND WILDLIFE
CONSERVATION IN LOWLAND FORESTRY

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INTRODUCTION

The title of this paper - 'Systems of management ...' - at first suggests a sort of catalogue of management methods which have been developed over the centuries and which are still in use (Brasnett, 1953). These could be examined and compared according to their potential for combining wildlife conservation with timber production. However, such an approach risks tedium and in any case things are changing rapidly in forestry as in other walks of life, and to dwell on established systems might be to miss new developments. Accordingly, in this paper, an attempt is made to assess the general trends in the management of modern timber-producing lowland forests and, against this background, to consider the possibilities and the value of integrating wildlife conservation with timber production.

THE FUNCTIONS OF MANAGEMENT

Management is the carrying out of the functions of an entrepreneur which, in a nutshell, is the organising factor in production. An entrepreneur performs two economic functions: he bears the burden of uncertainty in his enterprise and he organises his business (Hanson, 1969). In forestry we tend rather to think only of the latter part of a manager's work and, whereas we would be wrong to overlook the primary function (the bearing of uncertainty) it is the latter aspect we shall consider in this paper.

Against this background of uncertainty, a manager makes choices. The sort of economic decisions he takes are what to produce and how much of it, or the method of production and how best to combine his available resources of land, labour and capital. Expensive labour may influence his decision away from labour-intensive techniques towards mechanisation, land prices may affect his choice of location, and so on. Broadly speaking, the reason why such decisions are taken at all is because a manager is in business to make a profit. That does not necessarily mean that he ignores everything else, but in any economic enterprise profit is the primary objective.

There are a number of ways in which forestry is different from most other enterprises (Osmaston, 1968). The first of these is the long-term nature of forestry. It is common to regard forestry management as 'generally, the practical application of scientific, economic and social principles to the administration and working of a forest estate for specified objectives' (Ford-Robertson, 1971), but this definition misses something because it tends to give rather a static impression. Forestry is a long-term business and can be thought of as a sequence of operations linked to form a 'production line' of timber and related products. The process begins with establishment and subsequent operations are designed to guide the trees' growth to produce the desired timber in the shortest possible time. Production is completed when the trees are felled (Lorrain-Smith, 1969). The production line usually takes about 60 years

to complete and often the period may be twice as long. This means that some receipts are long delayed and are thus worth much less in prospect. It also means that the uncertainties surrounding marketing at that distance in time are such as to make planning a very hazardous exercise.

Secondly, there is very wide variety in forest conditions, particularly in the lowlands. Site quality is perhaps the most important variable and depends largely on soil fertility and climatic variations which may vary greatly from one locality to another according to topography and altitude. Another important factor is size. Woodlands are often small and widely scattered and this may raise costs by adding considerably both to administrative costs and to complexity, particularly in marketing.

Thirdly, a forest is capable of yielding many products simultaneously, some of which are intangible. There is need in these circumstances for extremely clear thinking for two main reasons. Firstly, management practices may have a deleterious effect on these 'non-market' benefits with a resulting net loss, even if this can only be expressed subjectively. Secondly, there is great difficulty in balancing the loss of intangibles against the value of marketable products. It would seem that wildlife is an excellent example of an intangible benefit in forestry which is extremely sensitive to changes in management practice. Thus 'profit' in forestry should not be interpreted simply in terms of money.

However, this leads us into one or two difficulties which we must pause and examine. Firstly, it should be made clear that in this paper the term 'wildlife' is taken to mean a flourishing and wide variety of both plants and animals. This is what seems to be implied by The Devon Trust (1970) and Steele (1972). Secondly, a 'non-market' benefit arising from an enterprise is one which is widely recognised as being a Good Thing but which, for one reason or another, cannot be sold by the manager of that enterprise. For example, birdsong in a forest may give pleasure to thousands of visitors, but if they do not pay to hear it, it is said to be a non-market benefit. The example is apposite because forest managers may have to decide between timber production and birdsong; more of one may mean less of the other.

If birdsong could be sold, perhaps by the hour of listening time, we could rely on the price people were willing to pay to indicate to the manager how much of it should be produced - as with most other commodities. In the absence of such a mechanism we have the risk of birdsong being under-produced by managers motivated by simple profit. One way of making sure that a sufficient amount of this or any other similar commodity is produced is to permit a manager to maximise cash profits subject to the 'constraint' that he must have adequate regard to, for instance, the requirements of wildlife in any given locality. An objective is something a manager can maximise; a constraint is a rule he must not violate. In general, a manager aims at maximisation subject to the constraints.

Constraints impinge on a manager's freedom. As they reduce his cash profit they are thus a cost and anything which interferes with the primary aim of management must be examined very critically and rejected if it does not confer benefits (of some kind) greater than its costs. A question which must be faced, therefore, is whether wildlife conservation can ever be an objective, as defined above, (in which case an order of priority would have to be decided (Gane, 1969)) or whether it must be imposed as a constraint on forestry management, perhaps by legislation. In either case, both its costs and its benefits must be very carefully considered and weighed. In

the following pages a framework will be suggested in which this might be possible but in order to do this realistically we must first look more closely at the ways in which forest management practices are tending to develop.

DEVELOPMENTS IN FOREST MANAGEMENT

The changes in invention, scientific knowledge and material and technical advance have been so rapid since 1925 that it is difficult to realise how slow the tempo of life then was. This is a point of the utmost importance to those concerned with the future of forestry management because it is only now beginning to absorb the new tools and knowledge which have become available (Osmaston, 1968). Many speak now of the sweeping changes in forestry and look forward to the time when things will settle down (Devon Trust, 1970), but it seems likely that the broom has a lot more scouring to do before that day will be reached. Moreover, the pattern which will then emerge may well look different from that which we now see.

Two of the areas where new tools and knowledge are coming into use are in harvesting where there has been very great progress in mechanisation, and in administration where improved techniques of measuring, recording and processing both physical and financial data are gradually becoming established. In place of present methods, which if flexible are often rather haphazard or even inefficient, both these developments tend to encourage a certain simplicity of approach and uniformity of working, but perhaps the most far-reaching trends are to be seen in the changing demands for forest products and in methods of production.

Demand for material forest products has never been static for long and foresters have often viewed the loss of markets with misgivings. For instance the Royal Navy's decision in 1862 to introduce metal hulls to naval warships was widely regarded as the death-knell of forestry. It has proved otherwise. Predictions have been made of a day when energy will be cheap, all materials will be synthetically produced and cellulose production will no longer be required from forests (Dawkins, 1969), but all the normal indicators show a long-term trend of rapidly rising demand for pulp wood (F.A.O., 1966). At the moment there is only a slightly increasing demand for sawtimber. Between 1913 and 1960, the proportion (by volume) of sawn wood dropped from 61 to 45 per cent of total consumption and in the future it seems likely that the trend will swing even further towards reconstituted wood (mainly coniferous) and that new management practices will evolve to fulfil the changing wood requirements. Perhaps new concepts of wood quality will emerge, based on fibre properties instead of stem form.

However, increased output of coniferous pulpwood is not the only apparent future for our forests. It seems almost inevitable that there will also be a growing demand for the services which woodlands can provide - a feature at present much under-utilized. Transport facilities and the growing standard of living will provide the means and motivation for access to woods, particularly those near large towns, which may become increasingly managed for amenity and for high-density recreation of various kinds. Some integration of these two products may be possible but it is likely that there will also be segregation according to the main aims adopted in each forest unit.

The second of the two major areas in which developments can be seen is in the efficiency of producing material forest products. It has always been the aim of foresters to increase timber production from their woods, particularly on the more fertile lowland sites, but there is perhaps now more emphasis on this than ever before. However, foresters are divided on the best way of achieving this. We can perhaps most clearly see the difference by stating the extremes and this may be useful also when considering trends in forest management, but it must be noted both that current management practices normally fall some where between these extremes, and that timber production is rarely the sole objective even in timber-producing forests.

In the first camp is a flourishing but minority group of European origin who hold as their management ideal the equilibrium concept of 'biocenosis'. A biologically balanced forest community of indigenous species is built up and maintained; foresters are ecologists; they emulate nature and do not swim against the 'biological stream'. Mixtures of every sort are desirable and a 'mechanistic' attitude of any kind is to be deplored. These foresters regard pseudo-natural conditions in forestry as the only stable and safe basis of management. Tree farming they regard as dangerous because it is a departure from this ideal (Anderson, 1956).

The opposing camp includes the great majority of foresters whose aim is to push timber production above what Nature would of herself provide. They feel that since farmers have successfully grown artificial crops in a controlled environment for centuries with very greatly increased yields, there is no reason why foresters should not do so likewise. They recognise that monocultures involve certain risks but regard the potential gains in production as more than adequate compensation. Mistakes, inevitable in any departure from tradition, would be rectified by improved technology (Peace, 1960). If one considers the probable future implications of such an extreme approach for management practice the sort of picture which emerges is one of genetically improved exotics, in even-aged stands, on improved or fertilised sites, under the protection of chemical control of weeds and pests and grown for maximum financial benefit.

The variety, structural diversity, stability and reliance on indigenous species which are inherent in the former philosophy leave little doubt about which of the two types of forest would be preferable to most wildlife conservationists but there seems to be no prospect of forestry moving in this direction as things stand at the moment. In the present technological and economic climate it is difficult to believe that forests will not inexorably become more and more 'man-made' except for the few which may specifically cater for recreation or amenity. Even in the lowland regions where variety of site seems to be greatest, intensity of working is likely to increase and operations will tend to become increasingly mechanised and large-scale.

In this brisk skim over half a century of forest management for timber production we have seen the main trends, and what the future of such forestry is likely to be. Inevitably with so short an account, only a general picture can be presented and anyone with knowledge of forestry will be able to point to gaps and exceptions. However, when one is considering exceptions it is essential to distinguish whether or not these are merely examples of individuals lagging behind the herd. In such cases the practices are really conforming to the general pattern but with a time-lag so that at any stage they look different. Alternatively, these individuals may be purposefully following a different ideal independently of the

majority, in which case their motives may well bear investigation in the hope that new knowledge and understanding may emerge. As example of the first category may be those individual private owners who plant substantially above-average proportions of hardwoods in lowland forests (Balman and Lorrain-Smith, 1970). The second category might well include the 'biocenosis' foresters, and those who manage their woods at least partly for game. In general terms, however, this account provides a background against which may be considered the prescriptions of those who wish to conserve wildlife in timber-producing forests.

THE COSTS OF CONSERVATION

The objective of this section is to look more closely at the measures which have been suggested for wildlife conservation from the forestry manager's point of view. We shall try to distinguish those measures which are a benefit to both sides and those which can only be seen as a constraint, a cost which must be borne by management if wildlife is to be conserved in the ways suggested. The question as to whether these costs may be worthwhile we shall leave until the next section. Unfortunately space does not permit any more than a very brief summary of the prescriptions which have been put forward and no attempt is made to assess their efficacy (Devon Trust, 1970: Steele, 1972).

The general recipe for wildlife seems to be simply the creation of variety and diversity of food sources and habitats. Indigenous species are preferred to exotics, and broadleaved trees rather than conifers; structural diversity is highly desirable both in the size of the trees and in the layout of the whole wood; and boundaries should be irregular (and hence long) wherever possible. In addition to the main crop of timber-producing trees other habitats should be provided (if feasible) such as large, old, dying or dead trees, fallen logs and stumps. Rides should be wide for sunshine and bent for shelter, and damp areas, ponds and water courses should be preserved.

More specifically, the timing of operations should be restricted to avoid disturbing birds during nesting; the sites of very sensitive species should be avoided completely; pesticides should be used sparingly if at all, 'natural' control is preferable; wide spacing is advocated because it delays canopy formation, and heavy thinning is desirable because it helps to break the canopy up; weeding should be delayed until late in the year and kept to a minimum, and scrub should be left alone if it is not actually in the way; harvesting should be done only in groups or small blocks, and in winter.

Merely listing these prescriptions illustrates that a sort of abyss exists in concept between progressive practices for timber production and what conservationists regard as 'wise management'. If the ends of wildlife conservation can be served adequately by leaving untidy odd corners here and there, then perhaps there is no real difficulty in integrating the two. But if, as seems the case for some of the above suggestions, a wider area or even fundamental alterations in management practice must be considered, then we must begin to look very carefully at the motives behind these prescriptions and consider to what extent wildlife is worthwhile conserving.

It must be said first of all, however, that this does not apply to all of these prescriptions. Wider spacing, heavier thinning and the retention of ponds for fire fighting are fully in accord with economic forestry practice and it is difficult to dispute the logic of judiciously varying the species so that, in view of future marketing uncertainties, all the eggs are not in one basket. Clearly also it is excellent to do no more weeding, cleaning or scrub clearing than is necessary (however that may be defined). But many of the proposals would mean extra cost of one kind or another and we must look critically at these. We can divide these proposals into three classes according to whether they increase expenditure, decrease cash revenue or delay receipts and thus make them worth less. A few examples may illustrate this.

(a) Increased expenditure

Many forestry practices which are undesirable from a wildlife point of view have been adopted by forestry managers because they reduce costs. For instance, mechanisation, particularly in ground preparation and harvesting, is much cheaper than other known methods but its full benefit can only be achieved by handling large areas and thus to prescribe small-scale working is to forfeit the economies of scale. Similarly, irregular boundaries very significantly increase the required length of fencing and hence the cost. Often work in the woods is done when labour is not required for other jobs and to alter the timing of operations not only complicates management, it may also increase total labour requirements.

(b) Decreased cash receipts

It may be true that certain areas are not worth the cost of draining - at least until cheaper methods of draining are developed. However, it is an incomplete argument to suggest that old trees should be retained if they contain little saleable timber, because this ignores the possibility that profitable crops could be grown on the (often extensive) land such trees occupy. Any loss of potentially productive land is a loss for forestry. There is a potential loss too in the restrictions which would be placed on management by the need to keep out of the woods during nesting. Managers may have to seize marketing opportunities as and when they arise, and not to do so may mean a sizeable loss in revenue.

It may be claimed that the costs involved by these sacrifices in (a) and (b) are usually small. However, it must be recognised that even if they are small, and this is by no means always true, they are additional to all the other costs a manager incurs.

(c) Delayed receipts

Some measures would not actually decrease the receipts from forestry but they could mean that they were delayed. This is perhaps the least obvious loss but it is certainly the most important. For example, prescriptions involving the choice of slower growing species (as almost all native trees are when compared with exotics), or the production of very large trees, or even phased felling with natural regeneration (as opposed to clear felling and planting), all mean the delay of final felling and hence the postponement of receipts. The delay may be fairly short or it may amount to several decades. Oak may be grown on a rotation of 120 years whereas a conifer crop could be harvested in half that time. In prospect, receipts are reduced according to the time they are delayed at the

exponential rate of compound interest or discount. For instance, in the example quoted above, the oak would have to fetch a price (per acre) in excess of the conifers by a factor of almost 6 if a discount rate of 3 per cent is used. If the rate is raised to the more realistic level of 6 per cent, the factor increases to 26; at 8 per cent one would have to expect to get one hundred times as much from the oak as from the conifers before the profit from the two schemes would be equal. Clearly, the choice of appropriate rate is of great importance in making the comparisons and it is too big a subject to go into in depth here but a good first approximation is obtained if we consider both what might be an acceptable rate if our own wealth was to be invested, and also that the Government expects a return of 8 or 10 per cent on investment in nationalised industries. Thus waiting costs money!

Whereas it might be argued (albeit unsatisfactorily) that the more obvious additions to costs (a), or reductions of cash receipts (b) were small, it is obvious that the cost incurred by increasing the rotation length (c) may be quite enormous. So large in fact that, unless there are exceedingly convincing arguments about benefits accruing from such practices, proposals of this kind are out of the question.

Thus it can be seen that from a forest manager's point of view conservation measures very often involve additional costs. Some of the ways in which these costs arise have been itemised. However, despite all this, many may feel intuitively that wildlife is of value, even if it is difficult to say just what that value is. It must be emphasised that the arguments developed in the above paragraphs are not intended to destroy the case for conservation. The point is this: I believe that we should make clear what conservation demands of forestry and, furthermore, that we should attempt to answer the question of why we want conservation at all, because the methods and extent of integrating wildlife conservation with timber production may depend very much on the underlying motive. Only on a rational basis of this kind can there be reconciliation of apparently opposing views into a mutually acceptable progressive policy of integration. In the following section we shall look more closely at some of the possible motives for conserving wildlife and some of the potential benefits that might result from conservation.

THE BENEFITS OF CONSERVATION

We now come to the most important question of all and one which, strangely, seems to have received relatively little attention in the literature: why should forest managers conserve wildlife? Often it is costly for them to do so deliberately and certain species actually wreak havoc in plantations and have to be kept out entirely or rigorously controlled (Harrison, 1971). Even if we omit these from the argument, what utility has the rest of wildlife?

It is a common assumption that wildlife species should be conserved because either they or the ecosystems to which they belong are part of our national heritage and arguments begin from that point. This seems rather a loose assumption on which to base such a far-reaching decision. 'Our national heritage' is a vague and nebulous concept which is often loosely used to justify the preservation or conservation of more or less anything. It is not a wholly reliable criterion (there would be scant enthusiasm for reintroducing the once-indigenous wolf into our plantations) and must be used with caution. In view of the trends already discernible in forest management something much more solid, clear and tangible must be used to justify the expense of conservation which, as we have seen, may be very great in certain circumstances.

The aspect of costs has not been ignored by conservationists, but whereas they have made suggestions for minimising some costs, they have apparently tried to explain others away or even to deny their existence (Harrison, 1971) - attitudes which are commendable, understandable and reprehensible respectively. However, as we saw, the conditions currently being created in timber-producing forestry are becoming steadily less suitable for wildlife conservation and these costs are likely to increase. If this trend grows, current attitudes are going to become even harder to defend, even the commendable ones. Consequently it may be more hopeful to approach the problem from another direction. Instead of, or in addition to, minimising costs, there might be more potential in maximising (and publicising) the benefits. In one major sense this is likely to be a much more successful approach because it does not fight head on against the economic pressures which are an inevitable part of our social system, as it aims to convince people that wildlife is worth conserving. It may be remembered that the 'biocenosis' foresters urged their disciples not to swim against the biological stream but to direct its latent energy. In just the same way it would seem good sense for conservationists to stop trying to paddle against the economic mill-race but to harness its power.

In this section we shall consider three possible motives why forest managers might be urged to conserve wildlife. The first suggestion is that not to do so would be catastrophic for mankind; the second is that, in a less absolute way, wildlife might be profitable; and the third reason is that man has some kind of duty to protect other forms of life.

(a) The imperative to conserve: alternative - doom!

This is perhaps the absolute value and one which could be used to justify much higher expenditure than perhaps any other motive. It arises from the belief or the fear that life on this planet will end unless some kind of 'natural balance' is kept between the various factors of the environment. It is easy to follow the doomwatch reasoning of those ecologists who point to the dangers of overpopulation, resource starvation, or chemical pollution. It can be seen that, unless current trends are changed, intolerable pressures may result. However, even if these arguments are valid, do these same dangers attend the extinction of certain wildlife populations? Is it correct, as the biocenosis foresters seem to claim (Anderson, 1956), that a serious departure from the pseudo-natural ecological equilibrium in a forest is a sure step down the slippery slope to the eventual destruction of that environment?

These are very serious questions and they demand serious investigation. For a final answer we shall have to await, no doubt, the researches of ecologists and environmentalists but it would perhaps be surprising if things turned out to be quite as black as that. There is almost certain to be considerable scope for altering the balance of nature, even to the extent of losing one or two species, without doing irrevocable damage to man's chances of survival.

(b) Conservation for profit

If conservation is not imperative, perhaps it may be made profitable (Grant, 1971). The approach suggested by this concept is that one might pursue conservation measures up to but not beyond the point where the additional benefits from the wildlife were equal to the additional costs of conserving them. In any such cost-benefit analysis the cost could probably be fairly easily calculated or estimated to a degree of accuracy

acceptable at least for a first approximation. Benefits may be much more difficult to measure, at least in some instances. At this stage, however, measurement may be regarded as secondary to identification, and the first task is to define the benefits. We shall have to regard the problems of measurement as being outside the scope of this paper.

To begin with it might be helpful to set out systematically the various ways in which wildlife either is or could be of benefit to man. For one thing, such a list may help rational thought about an abstruse subject and, for another, it may be easier to notice items missing from a framework. In the following scheme, the benefits have been arranged in order of decreasing directness. The first benefits are obvious, those at the end of the list are much less so.

- (1) Marketable produce : the sale of all marketable timber, plants and animals.
- (2) Sporting facilities : the value of hunting, shooting and fishing.
- (3) Useful ecological functions : e.g., the role of species in food chains and in biological control; also soil improvement.
- (4) Biological indicators : e.g., site indicators; also the absence of birds may be warning of unhealthy imbalance and impending epidemics.
- (5) Recreation : amateur naturalists and photographers may specifically seek the wildlife.
- (6) Amenity : ramblers and picnickers may merely enjoy the general diversity of species and structure.
- (7) Landscape effect : many may benefit from the view of the forest from outside.
- (8) Indirect research benefit : it may pay the community to finance research into conservation because of the possible beneficial spin-off effects.

The first four of these benefits accrue directly, in cash or in kind, to the forestry manager, although it is realised that (1) and (2) may present formidable marketing difficulties, while (3) and (4) may be difficult to utilise because the relevant mechanisms may not be clearly enough known. There is perhaps scope for ecological research in this area. It may perhaps be possible for managers to tap the markets presented by (5) and (6) but, whether they can or not, the point remains that these are potential benefits which could be enjoyed by some groups within the community. Similarly, (7) and (8) are social rather than private benefits. The forest manager and his staff may prefer working with the sound of birdsong and the sight and scent of flowers but if they are felling on piece-work with a power saw these aesthetic perquisites may well go unnoticed.

There must be few animals or plants or ecosystems which do not fit into one or more of these benefit-yielding groups, but just because wildlife may confer benefits it does not necessarily mean that these are net benefits. The costs of producing them must be taken into account. However, this list may help to show that benefits can arise in several different ways and these should be added together when comparing them with these costs. The total benefit may make conservation worthwhile even if the more obvious

benefits considered alone might fail to do so. Without making any claim that this classification is complete, it perhaps makes the point that wildlife may be worth conserving in forests, even if some of the benefits listed cannot be financially exploited.

One further observation which might be made is that even if the various benefits of wildlife are net, it does not follow that the whole forest should be managed to produce all of them either in the same place or at the same time. The practice of zoning areas for the different objectives and phasing the multiple uses over time may give managers much greater scope for making the best of all possible worlds (Grant, 1971), as may be indicated by the demands for the various benefits.

(c) Conscientious conservation

Quite apart from the thought of the possible benefits of conserving wildlife in forests and of the possible dangers of not doing so, there may lurk in the minds of some the feeling that man has a moral obligation to conserve wildlife. We may feel that whether or not a living thing, a species or an ecosystem, is valuable to us materially, the fact that it exists at all puts upon us some responsibility for making sure that it is enabled to go on existing (Scottish Wildlife Trust, 1972). There are probably a number of people who believe this or something like it and therefore for the sake of completeness we ought at least to note this point. That eminent authority on conscience, the Christian Bible, certainly seems to take the view that man's job on earth is to control the environment and to use the wildlife as he thinks best (Genesis 1.28-29) but it also joins man in an inseparable way to his total environment when considering his destiny at the end of time (Romans 8.18-25). Perhaps many may share these general views even if they reject the authority behind them.

It is difficult to say to what extent, if any, such general or particular beliefs should be made a basis for deciding policy about wildlife conservation even if they became common enough to be called public opinion. Perhaps wherever personal or national conscience make themselves heard they could be helpful as a guide. However, ultimate though the authority of conscience may be, it should not exclude the consideration of all other faculties, nor should it be followed without counting the cost.

CONCLUSIONS

It might be said that the first four sections of this paper were aimed at establishing the reality and the pointedness of the question of why foresters should conserve wildlife, and also of showing the need for some reasoned motive to justify the demonstrable costs of conservation. In the fifth section three possible motives were suggested, (a) that there was an imperative need, (b) that benefits outweighed costs, and (c) that there was a moral duty to protect wildlife. Whichever of these reasons is adopted as a basis for policy the costs of conservation must still be counted, but both the costs and the methods of implementation should be seen in relation to the underlying motivation. In this final section of the paper we shall try to draw together the threads of these seemingly unrelated forces.

Even with such a stark alternative as doom, the manager must still consider ways and means of increasing profit by using the 'least-cost' criterion. In these circumstances conservation would become a constraint which might well be imposed by legislation, the managers would require from ecologists a series of essential prescriptions to achieve at least the

minimum legal degree of conservation which they would then proceed to put into effect with the least possible cost. There would be need for continuing contact between both sides to ensure, firstly, that no cheaper alternative recipe could be used for the same effect and, secondly, that any technological advances in forestry were considered according to their effect on wildlife and matched by appropriately amended prescriptions if necessary. In a sense this legal enforcement of conservation may be seen as a last-ditch defense, to be used only if all else fails.

The system of market benefits would lead to very much more freedom of action for managers and under it everyone would be better off. There would be more profit and more wildlife, and thus intrinsically it is a potentially more successful system. The flaw in this delightful theory is that several of the benefits are not normally sold; one or two appear to fall outside the market mechanism and some others, which are in kind, seem only imperfectly understood. However, before concluding that this system of free exchange works properly in concept only, it should be pointed out that there are a number of possible remedies for at least some of these faults.

Firstly, benefits which are not fully known can be found out. Thus with more research one might expect to discover more about biological control and key indicating behaviour symptoms of species or ecosystems. Secondly, once the potential of a profitable market for the various benefits (or their value in kind where appropriate) had been made apparent one might expect entrepreneurial enterprise to set up shop to provide them. Thus this shortcoming might be corrected by education or publicity. Thirdly, if it proved impossible to finance the provision of certain desirable benefits, such as recreation and amenity, by means of the market (i.e. the user paying) the Government could either subsidise the private enterprise which produced them or provide such benefits directly through the medium of, for instance, the Forestry Commission using some system of shadow pricing.

In Western society the main social organiser is the market or exchange system and it operates in conjunction with the legal system which provides a form of framework. However, the promise of gain and the threat of the law do not between them explain the whole of human behaviour. There is also a third element containing such deeper human values as love, responsibility and the identification of goals outside self. This, which has been called the 'integrative' system and which forms a necessary matrix for the other two (Boulding, 1962; 1965), corresponds very closely with the last-mentioned motive for conservation, namely, that in some way man has a moral responsibility to protect wildlife. This is not so very different from saying that he should look after what he has been given or inherited or, in short, his national heritage. We saw earlier that this cannot be taken as a wholly reliable criterion on its own but it may well form an important part of the total motivation.

In such a fundamental matter as the conservation of wildlife it would not be surprising, therefore, if we should find some 'residual' motivation which is not fully explained either by fear of retribution or by prospect of material gain. We can call this rather difficult concept conscience, or responsibility for our national heritage, or whatever, but the fact that we call it anything gives it recognition along with the more easily identified threat and exchange systems which may thus together provide the motive force for integrating wildlife with forestry management.

ACKNOWLEDGEMENTS

I would like to express particular thanks to Mr. J.J. MacGregor of this Department and Mr. G.D. Holmes and Mr. D.R. Johnson of the Forestry Commission for their helpful criticisms and comments while this paper was in draft.

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SILVICULTURAL TECHNIQUES AND PROBLEMS
WITH SPECIAL REFERENCE TO TIMBER PRODUCTION

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PRINCIPLES

The principle underlying what is currently accepted as sound silvicultural practice is that the forest must be conserved, i.e. it should be continuously maintained as a productive system. Consequently, it is assumed firstly that any area felled will be restocked by one silvicultural method or another and secondly, that the classically managed forest should at any one time be composed of crops or trees of all age classes, the age at which the oldest trees are finally felled for restocking being the rotation age.

The range of products sought from a forest depend very much on the objects of management. One continuing silvicultural problem is how to adapt woods established with objectives which have become obsolete to meet the needs of the present and foreseeable future.

OBJECTIVES

Silviculture is the means whereby forests are managed for particular objectives, linking current objectives and past history for any given area. Selection of the best silvicultural solution for any forest is made more difficult where the objectives are multiple and changing, the key problem often being how to weigh different objectives, one against the other.

While different objectives have been important at different times, until very recently, forests have been managed predominantly to yield high volumes of timber and other saleable produce. Over the last hundred years objectives have included the production of timber for ship-building, fencing material, charcoal, tan bark, and the stock-piling of timber to replace degradations made during two major wars. During the last twenty-five years, the increasing public concern for the conservation of wildlife, the improvement of the human environment and more extensive facilities for recreation, exemplified first by the formation of the Nature Conservancy and the passage through Parliament of the Town and Country Planning Acts, and more recently by the Countryside Acts and formation of the Countryside Commission, have resulted in regard for landscape, provision of facilities for recreation and preservation of wildlife habitat as important factors to be taken into account in current forest management.

The validity of any objective for forest management can be tested by asking whether any particular set of silvicultural techniques would lead unambiguously to its achievement. Following this criterion, it becomes obvious, that 'conservation', 'recreation', 'amenity' (and for that matter 'timber production') are portmanteau terms which need to be subdivided before useful objectives are reached. Thus:

Wildlife Conservation can be elaborated into objectives of

1. Preservation of areas of forest which have an unbroken woodland history - 'primary' woodland sites (Peterken, 1971).
2. Conserving particular species of fauna or flora or particular habitats for a particular range of species (Best, 1962; Peal, 1971).
3. Maintaining or increasing the diversity of fauna and flora, harmless to the forest, but without any particular species in mind. Methods of achieving this particular objective have been recommended, e.g. by leaving patches of scrub uncleared, especially in wet places; planting a proportion of native species, thoughtful alignment of rides, encouragement of ground flora, etc. (Garthwaite, 1971; Williamson, 1972).

Underlying these three objectives is the assumption that special conservation measures are required for habitats or species which are rare or are in danger of becoming so, other changes in the frequency of species being of ecological interest primarily for the evidence they may provide on factors bringing about change in the communities.

Visual Amenity must be similarly differentiated, distinguishing 'Macro-landscape' i.e. woodland seen in the middle or distant countryside setting, and 'Micro-landscape', i.e. the foreground scene, where the appearance of a woodland, an edge or glade is made up by individual trees rather than by wood as a whole. A further differentiation can be made according to the number of people viewing any particular scene.

Recreation the needs of the traditional pastimes, hunting, shooting, and fishing require different management from those arising out of day visitors, campers and caravans and parties with an overt educational purpose.

Timber production must be elaborated into: pulpwood, sawn timber, fencing material, transmission poles, mining timber, woodwool, etc.

EVALUATION OF OBJECTIVES

Modern forestry depends on species that are far more productive in terms of bulk and sale value (net discounted revenue) than the native timber species. Any move towards conserving native species therefore usually implies some loss of production and consequent loss in revenue to the grower, and sometimes also, additional costs (Parkin and Dallas, 1971). Where wildlife conservationists wish to influence woodlands managed for timber production and associated revenue, it becomes vital for them, both to define as clearly as possible what are the essential elements of what is to be conserved, and also, to be able to comment constructively on the wildlife conservation worth of silvicultural alternatives in relation to their costs and returns. Helliwell (1971a, b) has made some attempt at evaluating the wildlife associated with different forms of upland land use albeit subjective and arbitrary; Moore (1969) has discussed the problems inherent in attempting to express in cash terms, the benefits of most aspects of conservation and amenity.

This problem of attempting to strike a balance for management purposes between objectives which can be evaluated in cash terms and those with no direct cash benefit is made both more difficult and more urgent because

of the other claims on forests. It is not just the alternative of wildlife or wood production; the most rapidly increasing claims on lowland forests are being made neither for timber production nor for wildlife but for recreation and landscape.

While it is clearly extremely difficult to assign cash values to additional wildlife or improved amenity, nevertheless, where these are at the expense of timber production, the costs and revenues of various alternatives can usually be stated, and these provide some basis for evaluating various non-revenue yielding alternatives.

The revenue from different species as timber producers, depends in decreasing order of importance on:-

- (i) Growth rate;
- (ii) Expected date of final harvesting;
- (iii) Interest rate chargeable on expenditure;
- (iv) Costs of planting, tending and protection;
- (v) Expected prices for different sizes of produce.

The most important of these are growth rate, the expected date of final harvesting and interest rate.

Table 1 shows the growth rate of a selection of species on four characteristic lowland soil types. Table 2 shows the expected felling revenues, expected rotation and the present worth of both thinning and felling revenues, discounting at 3 per cent and at 5 per cent.

Costs of production vary between species, mostly in relation to the early growth rate of different species and the cost of the planting stock. In this respect, native hardwoods are among the most costly, while species such as larch and Western hemlock which on many sites grow well in the first few years after planting, are comparatively cheap to establish, except on sites prone to late spring frosts.

COMMERCIAL CONSIDERATIONS IN RELATION TO SILVICULTURE

For whatever blend of objectives woods are managed, the manager is inevitably under some pressure to get the best value for money. The consequence of this pressure in relation to the timber production objective, is an increase in the size of the management unit (Elmhirst, 1971), physically large blocks providing opportunity for long spells of work for machines, a limited number of species, the timber of which is likely to be suitable for a wide range of purposes. In addition, for best returns, timber must be of large dimension (diameter and length), straight, with reasonably even annual rings, minimum taper, fluting and knots, and with the least possible spiral grain.

CURRENT SILVICULTURAL TECHNIQUES FOR TIMBER PRODUCTION

The silviculture that has evolved in order to produce timber to these specifications has as its principal means of quality control, close initial spacing. While during the last 40 years there has been a steady change in the spacing of newly established plantations, in some cases from less than 1m x 1m to the present day when 2m x 2m spacing is being prescribed for many sites, even present day practice permits selection of the best tree out of between each 4 and each 10 trees originally planted. This selection enables the straightest and most vigorous trees to be favoured

Table 2 Revenue from species grown for Timber Production

Species	Growth rate (GYC) cu m per ann. per ha	Interval between planting and expected final harvesting years (Rotation age)	Forecast Final felling revenue per hectare	Present worth of combined thinning and final felling revenues per ha Discounted at	
				3%	5%
Oak	4	140	£1500	£63	£10
	6	140	£1900	£130	£25
Beech	4	140	£1800	£56	£8
	6	140	£2500	£110	£18
Scots pine	10	60	£1250	£300	£110
	10	(80)	(£1700)	(£330)	(£98)
	10	(100)	(£1900)	(£300)	(£83)
	14	60	£1800	£570	£220
	14	(100)	(£2500)	(£510)	(£170)
Corsican pine	14	60	£1850	£560	£220
	18	60	£2350	£820	£330
Norway spruce	12	60	£1400	£480	£130
	18	60	£2350	£740	£280
Western hemlock	20	60	£2600	£820	£310
European larch	6	60	£750	£190	£67
	6	(100)	(£1000)	(£140)	(£42)
	12	60	£1500	£550	£230

Revenue forecasts based on F.C. Conifer price/size curve for C and S England as at 1.7.71 and Hardwood price/size curve. Final forecasts rounded to nearest £50: Present worth rounded to 2 significant figures. For comparison, costs of establishment are in the range £150-£300 per hectare depending on site and species.

during thinning, it ensures suppression of lower branches and hence development of cylindrical stems (as opposed to the tapered or stepped stem of heavily branched conifers or broadleaves), and it provides a reserve of trees against unforeseeable damage by storm, animals such as grey squirrels, etc.

Where no other measures to maintain quality are taken, spacings wider than this are likely to bring losses in quality due to heavy taper, large knots and rapid growth. This last applies to conifers where wide annual rings may be associated with somewhat weaker timber, rather than to hardwoods.

Nevertheless, wide spacings are possible, as with poplars and cricket bat willows, taking advantage of (i) strong apical dominance leading to growth of straight trees; (ii) uniform high quality clonal planting stock, leading to very regular early growth; (iii) very vigorous growth, 1.8m per year for several years being by no means exceptional; (iv) regular pruning to ensure a knot-free timber length of dimensions required by the planned market.

One consequence of this form of silviculture is that poplar and willow plantations are rarely devoid of ground vegetation. On the other hand, crowns are so open branched on account of fast growth there is virtually no dense (pre-thicket) habitat.

Second in importance to close spacing for production of good quality plantations are the various establishment techniques:-

- Ground preparation by clearance, cultivation and/or drainage;
- production of suitable size and quality planting stock;
- adequate planting;
- addition of fertilisers if required;
- control of weeds around the young trees until out of danger of suppression;
- protection against browsing by animals or attack by insects and fungi.

The aim, in utilising these techniques, is to establish crops at the expense of competing vegetation cover. At and immediately after planting, woody weeds and herbaceous ground vegetation are viewed as a potential threat to the survival of newly planted trees. Rarely, if ever, in lowland plantations is this ground vegetation completely eliminated by ground preparation or by weeding. Weeding by cutting tools mainly reduces the height of plants rather than killing them outright, while herbicides are selective either in the range of species controlled, or through being applied to patches or strips covering between 25 and 50 per cent of the surface area of the plantation. If ground vegetation subsequently disappears completely, this is more often the direct result of shading and competition by the trees themselves rather than by any silvicultural technique directly aimed at eliminating ground vegetation.

Once thinnings commence, the traditional aim has been to cut less than the annual volume increment in the period between successive thinnings. As a result the volume of the remaining crop slowly increases. Past thinnings have been on a three to four year cycle but more recently, the cycle has often been extended to six years, cutting more heavily but less frequently. Various methods of thinning ('low', 'crown', 'eclectic') principally affect the selection of trees within the crop. However, the proportion of the crop removed at one time has changed over the last 25

years in the direction of heavier thinnings. As a consequence, more light penetrates the canopy and there is usually a greater development of ground flora than in closely planted, lightly thinned woods. Manipulation of canopy density by thinning probably affects the structure and composition of the woodland habitat more than any other single factor.

In the past, thinnings have mostly been distributed evenly through the crop. However, current mechanical methods of harvesting require the initial removal of whole lines of trees through plantations, and in many forests the first two thinnings and occasionally the third are 'line' thinnings of this sort.

At the end of the rotation most crops are clear-felled and cleared from the ground by methods which are increasingly dependent on machines. Current methods involving power saws and extraction by tractor to rideside may be replaced by more specialised machinery for cutting trees by shears, and collection and extraction by skidder/buncher to a central processing point. Whereas currently branches are trimmed off where the tree falls when felled, with new methods branches are likely to be removed at the central processing point rather than in the forest. Where soil fertility is low, the removal of nutrients contained in foliage could be detrimental to subsequent growth unless replaced (cf. losses due to bark removal in coppice, Carlisle & Brown, 1967).

In lowland Britain, the rate of clearfelling and replanting of forests and woodlands is relatively low, compared with the total available area. Thus, the opportunity for drastic change in the timber producing species in woodlands is limited. On the other hand, in any ten year period, a very large proportion of all managed woodlands will be thinned. Thinning therefore provides the principal opportunity for adaptation of the forest to changing management objectives. In the last fifteen years, the intensity of thinning has increased, as the timber production objective has changed from that of stock-piling timber, current in the years immediately following 1945, to that of obtaining the highest financial revenue from plantations. Within limits, the intensity of thinning does not greatly affect the profitability of plantations. Thus, specification of heavier or lighter thinning to favour particular wildlife, recreation or amenity requirements are likely to be readily reconcilable with timber production.

Disposal of Dead Wood

Dead wood, predominantly branch wood, abounds in forests. However, some forms constitute a great threat to timber production by being a breeding site for harmful insects. The two pine bark beetles Tomicus (Myelophilus) piniperda and T. minor for example are best combatted by speedy removal of logs from the forest, the principle involved being similar to that currently recommended to combat Dutch elm disease, i.e. the removal and destruction of the breeding site and any insects present before they can spread further. Dead wood in conifer stumps, logs and heavy branches can also provide a breeding ground for various weevils.

At clear felling, branchwood can form a major obstruction to re-planting. A clear cut forest area left as a mass of branches and stubs at all angles can also constitute an eyesore detrimental to local amenity. Where the branchwood diameter is not too great (less than 10cm diameter) and the ground can be traversed by tractor, it is chopped to pieces by a rear-mounted series of knives on a horizontal shaft. Elsewhere, lop and

top may be piled and burned; this is both more expensive than chopping and has given rise to fungal attack by Rhizina inflata spreading from old fire sites (Murray and Young, 1961).

Conifer stumps, but not other wood, can also provide sites for colonisation by the rotting fungus Fomes annosus from which the fungus can attack newly planted trees. Pine stumps at felling are currently deliberately infected with an antagonistic fungus, Peniophora gigantea, providing one of the few examples in Britain of effective biological control of a pest; other conifer stumps are treated with Urea, sodium nitrite or creosote (Forestry Commission, 1970).

ALTERNATIVES TO CURRENT SILVICULTURAL METHODS

Choice of Species

Most of the comments on species in previous sections have given data for the two most widely discussed native hardwoods than for a few selected conifers. However, scores of different hardwood and conifer species have been planted in trials, while yet more are widely grown for amenity in parks and gardens. Forestry Commission Bulletin 30, 'Exotic Forest Trees in Great Britain' (MacDonald et al, 1957) gives details of performance of a very wide number of these under forest conditions. The question that remains is for what purpose should species other than the present favoured few be planted, on what scale and where?

Mixtures

Mixtures of species have been widely planted, sometimes because of uncertainty as to whether one or other species will grow on the site and sometimes in the expectation that the initially more vigorous species will shelter and draw up the other. In terms of production, there is no evidence that the yield of even-aged mixtures is greater than that of the higher yielding species, planted pure. Generally, a mixture results in some loss. Mixtures are most likely to continue to be planted where a final crop of native hardwoods is desired, at the same time minimising early establishment costs and providing a better return from intermediate thinnings than if the slower growing species had been planted pure. The growth rate and habit of the 'nurse' species in such mixtures must be such as not to swamp the slower species. For this reason, Norway spruce and European larch have both been widely used as nurses. Many patterns of planting have been tried, including groups and different arrangements of rows of species and mixtures in the row, all with the aim of seeking the most reliable and economic system. The most easily managed mixtures are those in which the slower species is planted in groups or in three or four-row mixture with the nurse species. Where the plantation is on a hill side visible for some distance, there may be amenity objections to the stripy appearance in winter of alternating bands of deciduous and evergreen species. Oak, especially if care has been taken to ensure seed from stands of first class vigour and form, can probably be left at a fairly wide spacing in a conifer nurse matrix. So much beech in Britain on the other hand appears intrinsically of bad form, that whereas 500 oak per hectare in a 2 metre spaced larch or spruce matrix could be expected to result in a final crop predominantly of oak of reasonable quality, for beech it would be preferable not to drop below 800 to 900 trees per hectare at planting in a similar matrix. In all such mixtures, the hardwood component will only dominate if continually favoured at thinning, at the expense of the conifers.

On light sandy soils, birch is sometimes proposed as a component of mixtures because of its role as a soil improver (Dimbleby, 1952). Unfortunately, British birch rarely reaches large dimensions and the tree can only be considered as a timber production species where there is a market for small hardwood roundwood. An experiment with Scots pine and birch has been established in the New Forest, with the intention of studying the long-term effects which pure Scots pine, pure birch and the mixture have on the soil.

Underplanting

An alternative means of establishing mixtures is by underplanting a shade-tolerant species in the shade of another crop. However, experiences with underplanting, expecting to retain both over and under crop have generally been disappointing, largely because too many stems of the overcrop have been left standing. Successful underplanting schemes have either involved removal of the overcrop within ten years of establishment of the underplanted species or the extremely heavy thinning of the overcrop to between 100 and 150 stems per hectare. Not all such heavy thinnings have been successful. The increased exposure of the trees remaining has, on hill-top and other windy sites, lead to dieback both of hardwoods and conifers.

One characteristic of the eastern part of lowland Britain is the prevalence of late spring frosts. In East Anglian forests and on the East Midland clays, late spring frosts are so severe as to eliminate tender species such as larch, spruces, Grand fir and hemlock unless shelter is available. Without shelter, choice of species in forests such as Thetford may be restricted to Corsican and Scots pine in many areas. Tender species can however be planted using an overcrop for shelter. Experiments have shown that forty-year-old Scots pine of Yield Class 10 or 12 standing at 250 or more stems per hectare give sufficient protection from late spring frosts to enable satisfactory establishment of these more vigorous but more frost susceptible species.

Enrichment

This technique has been considered in relation to the minimum expenditure that is necessary to get a final crop stocking of timber trees in valueless scrub or derelict coppice. For success rapid growing species need to be planted and given adequate headroom until clear of competing vegetation. Results of experiments on methods of enrichment are described by Wood, Miller and Nimmo (1967) who say 'unfortunately, many hardwood plots stocked at 100 stems per acre were ruined by various natural hazards, particularly grey squirrels'. Whether minimum expenditure has been incurred by enriching woodlands or more expensive techniques have been employed, there is no escaping the need for continued management to ensure adequate protection of the planted trees.

Free Growth

This technique in its original form, is applied to close-spaced oak at first thinning. Then, the crowns of trees selected for vigour and form and spaced at about 125 per hectare are freed by cutting out surrounding trees and the selected trees are high pruned. Subsequently, crowns are kept free by continued thinning at reasonably short intervals. The aim of the technique is to get maximum growth on the stems of selected trees, bringing them to a size suitable for a very high quality market

in the shortest possible time. Using this technique it appears possible to shorten the rotation by at least 40 years. Currently, it is being questioned whether oak can be widely spaced initially and grown for all its life under free growth conditions. Under such conditions, it is expected that the girth increment will be at least 50 per cent greater than that of the best trees in a conventional plantation. By foregoing the ability to select, other silvicultural methods may have to be employed if high quality is to be ensured. Specifically, stems may have to be pruned on two or three occasions in order to ensure a branch-free timber length and more prolonged weeding and cleaning may be necessary to ensure the trees are not deformed by encroaching woody weed species.

Size of Planting Stock

The larger the tree at the time of planting, the greater the risk of failure if planted conventionally by notching. Pit planting may improve survival but is more expensive. Plants over 50cm tall have only been used in experiments on enrichment of woodlands, and when establishing poplar and willow plantations and other species at very wide spacing. Trees between 1 and 1.5m tall could be ten to fifteen times more expensive than conventional stock 20 to 30cm tall. Conventional standards, i.e. plants 2 to 3m tall, could be forty to eighty times as expensive as conventional planting stock.

A recent innovation has been the growth of conifer seedlings in very small plastic or paper tubes in peat and sand. While plants in plastic tubes have only succeeded on peat soils, Coriscan pine raised in paper pots is showing promise both of better survival and more rapid early growth in forests in the East and South-East. So far, no other species likely to be used in lowland conditions have been raised in paper pots.

Regeneration Methods

Natural regeneration of woodland is only a viable proposition (i) if it is desired to perpetuate existing species rather than introduce other high yielding species or more vigorous or better quality strains of the existing species; (ii) if there is a plentiful and regular supply of seed. Table 3 gives figures for seed production from broadleaves and conifers in Britain, and shows that the three species most regularly bearing seed are birch, sycamore and Scots pine. Birch, although regenerating prolifically in many areas, is usually considered a weed. Scots pine has been naturalised for many years and regenerates freely on the Wealden Sands and similar acid, light-textured soils in South-east England, especially on areas of common land subject to periodic fire, and areas of Scots pine have been managed for natural regeneration in some enclosures in the New Forest. Scots pine is planted locally in frost hollows because of its frost tolerance but, almost everywhere else in lowland Britain, other species can be established which give higher yields. Oak natural regeneration occurs widely in neglected woodlands throughout the South, though, the stocking of naturally regenerated oak in such woods is often sparse. Where attempts have been made to regenerate oak forests naturally by small coupes (0.4 to 2 hectares) in the Forest of Dean and in the New Forest, these have only been partially successful, failure being attributed to seed and seedling losses due to rodents, squirrels, birds and browsing animals.

Table 3 Seed production of some Forest Trees in Britain

Name	Age of First Good Seed Crop	Age of Maximum Production	Average Interval Between Good Seed Crops	Remarks
Ash	25-30	40-60	3-5 years	
Beech	50-60	80-200	5-10	
Birch	15	20-30	1-2	
Ped. oak	40-50	80+	2-4	Some acorns most years.
Sess. oak	40-50	80+	3-5	
Red oak	30-40	?	2-4	Acorns take 2 years to mature.
Sycamore	20-30	40-60	2-3	Some seed most years.
Scots pine	15-20	60-100	2-3	Some seed most years.
Corsican pine	25-30	60-90	3-5	Most seed produced in SE and E England.
European larch	15-20	40-60	3-5	Flowers often damaged by frost.
Douglas fir	30-35	50-60+	4-6	
Norway spruce	30-35	50-60+	-	Rarely seeds heavily.

Data from Aldhous (1972) where a more comprehensive range of species is given.

Natural regeneration of beech is limited by the infrequency of heavy seed crops. Beech could only be regenerated naturally in Britain on a purely opportunist basis, expecting to fill in blanks in the forest with planted stock.

Uneven-aged Systems

Deliberately uneven age and selection forest systems are not common in Britain and exist primarily where owners of private woodland have chosen to practise this form of management. They require more intensive labour and supervision and are therefore somewhat more costly; the species used must be shade tolerant, so that species choice is limited; also, opportunities for full scale mechanised harvesting are restricted. On the other hand, yields are a little higher because the tree crop is utilising the site fully, virtually all the time, whereas in the first few years of a conventional plantation, tree crops make a very incomplete use of the site. There may be also some savings associated with less vigorous weed growth. Aesthetically, the effect can be pleasing; from the point of view of habitat, there is a wide size-range of trees present, though seldom any dense herbaceous ground flora.

Coppice

Coppice is an ancient system of management, largely in disuse in Britain. Hardwood pulp mills established within the last 20 years have

provided a novel outlet for hardwood coppice, but the market is not attractive. Elmhirst (1971) quotes that in Devon in the 1850's an oak coppice crop would fetch £75 per hectare (£30 per acre). Currently in South-East England, the stumpage value of coppice other than Sweet chestnut is between £100 and £125 per hectare (£40 to £50 per acre). Currently, attention is being given to the possibility of coppice with standards for the production of quality hardwoods under free growth conditions, at the same time utilising the intervening space between the big trees. This is most likely to be an attractive proposition where there is a viable coppice cover on the ground already and all that is needed is to plant trees which will become standards and to tend them until established satisfactorily.

The most extreme form of coppice working is the annual cutting of shoots from stools of the basket willows. A related recent American proposal is for shoots to be cut every 2-3 years in order to feed a pulp mill utilising the fibres produced. In Britain, there is clearly no area of suitable land large enough for such a technique to be introduced on the scale necessary to sustain a pulp mill, however, the proposition is indicative of the thinking and planning of forest enterprises overseas (Schreiner, 1970).

THE FOREST ROTATION IN PRACTICE IN LOWLAND BRITAIN

At the beginning of the paper, the silvicultural principle of management of forest on a rotation, for sustained yield, was mentioned. In practice, the age structure of individual management units of forests and woods in lowland Britain often does not conform with the concept. The divergence is greatest in relation to the smallest management units, farm woods and those of small private estates. On the other hand, aggregated over a region, the imbalance on any one estate is probably compensated for on other estates.

Large privately owned estates and large forest areas managed by the Forestry Commission can be expected to achieve the condition in which crops of all ages are represented. In any reasonably large area of woodland therefore, there should always be a full range of plantation habitat, from the grass/herb-dominated open phase shortly after planting, through an increasingly sheltered phase as trees approach thicket, then a dense thicket stage, common to conifers and broadleaved traditional plantations, when the ground flora is sparse or absent, and finally the maturing woodland stage, when understorey vegetation develops in inverse proportion to the density of the forest canopy. Table 4 shows the average proportion of time fully stocked plantations of selected species spend in each stage. It illustrates that traditional broadleaved plantations spend a higher proportion of their life in the woodland phase but that because of the longer rotation, the actual duration of the pre-thicket and thicket phases is longer.

In the context of the rotation and the changing habitat of woodlands, it should be noted that where woodlands are managed for timber production, it is assumed that access roads and the occasional gaps caused by failures occupy 15% of the surface area of any piece of ground. (Hamilton and Christie, 1971). This area is additional to the space between trees in young, pre-thicket plantation.

UNMANAGED WOODLANDS

The value for timber of unmanaged woodland depends on their previous history. Where no attempt has been made to regenerate a crop, the wood may carry virtually nothing but crooked unutilizable scrub; at the other extreme, natural regeneration may have resulted in a full stocking of species able to reach timber dimensions. Generally however woodlands which have been cut and subsequently abandoned are likely to carry trees suitable for pulpwood rather than for any more demanding market. Nevertheless, while the return from such woods is small, so is the investment.

Where a wood has been planted up and subsequently neglected, trees are likely to be overcrowded, taking longer to reach the most profitable marketable size than under conventional management. Nevertheless, with timely thinning, such woods can usually be brought into fully productive condition within five or ten years of management recommencing.

Unfortunately, there are no extensive areas of undisturbed natural forest in Britain. Recent discussions for example with reference to the New Forest, raise the question of what a present day unmanaged block of forest would become in lowland Britain, where introduced species such as Rhododendron ponticum, Gaultheria shallon, and several conifers from north-west America have become naturalised, and the larger native mammalian predators exterminated. The only certain conclusion can be that native natural British woodland would not be recreated without positive management, thus highlighting the paradox that the more intensive the conservation measures required, the less the subject of conservation is truly wild or natural.

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MARKETING DEVELOPMENTS AND TIMBER NEEDS

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INTRODUCTION

The purpose of this paper is to review markets for the wood produced from lowland forests and the various relevant aspects of marketing. The possible implications for silviculture are also mentioned. The views expressed are those of the author and do not necessarily represent those of the Forestry Commission.

There is a lower proportion of conifers in the lowlands than elsewhere in Britain and inevitably the broadleaved woodlands must be given more detailed consideration because of their increasing importance in meeting the needs of various interests in the lowlands. Marketing of softwoods is generally quite well understood whereas the same cannot perhaps be said for hardwoods. Attention will therefore be drawn in rather greater depth to the factors which are of particular significance for hardwoods rather than softwoods.

Nevertheless, it would be wrong to ignore conifers completely and Table 1 shows that substantial areas occur in England. Further analysis of the Forestry Commission Census of Woodlands figures (Locke, 1970) shows that a high proportion of the conifers is in the younger age classes, both in Forestry Commission and private woodlands; also, in the two Northern Conservancies, a high proportion of the conifers is in the upland areas. In the older age classes on private woodlands, a proportion of the conifers is in mixed woodlands with broadleaves.

Table 1 Areas of high forest by Forestry Commission Conservancies in England

Conservancy	Thousand hectares			
	Conifer		Broadleaved	
	Private Woodlands	FC	Private Woodlands	FC
NW(E)	26.8	34.3	38.8	3.6
NE(E)	32.3	64.0	21.0	3.6
E(E)	22.8	32.2	49.3	8.9
SE(E)/New Forest	36.2	22.3	65.0	15.8
SW(E)	37.2	26.1	66.5	10.9
TOTALS	155.3	178.9	240.6	42.8

MARKETS FOR SOFTWOODS

The current markets for softwoods are generally satisfactory and the indications are that they will continue so for a long time. It has been suggested that the forecast shortage of wood in the world and particularly in Western Europe may not materialise because of increased substitution and the increased supplies from plantations established in warmer climates. However, any massive substitution by plastics or mineral-based products is

unlikely in the foreseeable future; there are many uses for wood and wood products which rely on the particular properties of wood and for which substitutes are unsuitable; in addition, the cost of many substitutes is much too high to enable them to make significant inroads into the wood market. The position could change if really cheap sources of power were to be developed but this is very much on the horizon at present. What is perhaps even more important is the enormous demand there is going to be from developing countries; in many of these there is already an acute wood shortage in spite of a per capita consumption which is a fraction of that in developed countries. There are going to be great pressures for the re-distribution of timber production so that the bulk of the world's population is more adequately supplied.

The properties of home grown softwoods, the production of which is forecast in Table 2, have sometimes been questioned. For purposes of building and construction, the most important outlet for sawn softwoods, home grown spruce and pine have comparable strength properties to equivalent grades of imported whitewood and redwood, providing they are properly sawn, seasoned and graded; home grown Douglas fir and larches, possibly of more interest in the lowlands, are superior in strength to imported whitewood and redwood. Home grown softwoods are therefore suitable for most of the uses to which imported softwoods are put. For smaller sizes of roundwood, such as are produced from thinnings, there are satisfactory markets for pulpwood and chipwood on the larger industrial scale, and for fencing and rustic work for local purposes.

Table 2 Expected Conifer Production

Year	Lowland Britain			Whole of Great Britain		
	Forestry Commission	Private Woods	Total	Forestry Commission	Private Woods	Total
1970	473	177	650	1473	810	2283
1980	670	260	930	2480	1100	3580
1990	1230	380	1610	3930	1410	5340
2000	1330	490	1820	5380	1580	6960

For the most profitable conversion to sawn timber, it can be said that, in general, modern sawmills require logs which do not exceed 45-50 cm diameter although some sawmills are designed particularly to convert much smaller logs than this. There is no reason to believe, however, that larger logs will not find a market, either as veneer logs or in sawmills which are used mainly for the conversion of larger hardwoods. In these cases, the larger softwood logs are sawn for special purposes for which large sizes (and possible clear knot-free timber) are required in the same way as with the more valuable hardwoods.

MARKETS FOR HARDWOODS

The situation for hardwoods in a world context is rather different from that for softwoods. There are ample supplies of hardwoods in both tropical and temperate areas. Many of these areas, however, are remote and inaccessible, especially in the tropics, and also many of the species cannot be easily utilised because of certain of their properties

which render this difficult. In Europe, the demand for sawn hardwoods is increasing year by year but in Britain the trend has been the reverse. There is no difficulty, however, in marketing the best trees at an attractive price; poorer trees can also be sold, but at a lower price. The price range for hardwood logs is very wide, varying from £50 to £60 per cu m for top veneer quality down to less than £5 per cu m for mining timber and dunnage.

The current demand is particularly good for traditional "English" timbers such as elm, oak, ash and sycamore. To command the better prices, the logs have to be reasonably straight and knot-free (and this includes knot clusters from epicormics) with a knotty core of not more than 12 cm. They should ideally be fast grown and there is generally no limit to the rate of growth. They need not usually be very long, 6-7 metres is sufficient, nor necessarily very large, but this varies with species. The minimum diameters for ash and sycamore are 35-40 cm and for oak and elm 55-60 cm. Logs of this quality are suitable for veneers or for sawing for high grade joinery, furniture, boat building, sports goods, and other special purposes and can command prices of £25 per cu m or more.

An important market is fencing, not only for agricultural purposes and roads but also for urban use, which is a greater market than all the other uses put together. The timber from the "run-of-the-mill" oak in Britain is frequently sawn for fencing, with the better quality converted to rails, which currently command a relatively high price, and the poorer quality used for posts. Logs for this purpose can generally be sold for £8 to £10 per cu m.

Another important outlet is for pallets, and the wood for these can be sawn from the parts of logs which are unsuitable for fencing and the more valuable outlets mentioned earlier. The poorest quality is used for sawn mining timber and dunnage, where the specifications allow for virtually any defects other than decay, with a wide range of sizes and fairly wide tolerances. The price for these categories is of course considerably lower than for all other uses of sawn wood.

There is an absence of reliable statistics on the out-turn of sawn hardwoods, but an approximate breakdown by end use categories (excluding mining timber) which could be too high or too low by up to 10%, is:-

Pallets	30%
Fencing	30%
Furniture	5%
Building	15%
Miscellaneous	20%

This indicates that rather a larger proportion of home grown hardwoods is sawn for the higher value outlets than is perhaps generally realised.

Apart from sawn wood, there are of course markets for hardwood small roundwood. Table 3 shows the approximate breakdown of home grown hardwood production for 1970.

Table 3 Production of hardwoods 1970

Roundwood equivalent volumes
in million cu m overbark

Sawn hardwood mining timber	0.41
Sawn hardwood, other	0.62
Hardwood pulpwood	0.27
Other uses	0.20
TOTAL	1.50

Generally in the southern half of England, there are adequate markets for small roundwood produced from thinnings, coppice and the so-called "scrub" which is suitable for hardwood pulpwood. The majority of species are used for pulpwood although it appears that the preferred species are the lighter hardwoods such as birch, alder, sycamore and ash.

Looking ahead, it can probably be safely asserted that there will be a continuing good demand for the better grades of logs. The native British hardwoods have in many cases excellent decorative qualities and it is likely that these will be increasingly appreciated, particularly when associated with good craftsmanship and design. It is thought that the supplies of the better grades of logs will become increasingly scarce for one reason or another.

For the intermediate grades, there will almost certainly be a continuing requirement for fencing at something like the present level. The longer term future for pallets is less certain and it is possible that there will be greater use of softwoods at the expense of hardwoods and also substitution by plastics.

It is likely that the sawn mining market for the lower grades will decline. This is partly because collieries will continue to close but more important is the replacement of timber by substitute materials such as steel and concrete, resulting from the vigorous promotion of these materials. Other uses for these grades will probably be developed and some can be expected to find its way into more valuable markets through more efficient selection and processing. It is also probable that means of utilising the very rough timber as well as branchwood and tops by chipping for pulp and chipboard mills will be developed.

For small roundwood, the prospects for the pulpwood market would appear to be quite satisfactory and the two existing mills are concerned about future supplies. New chipboard mills will probably accept hardwoods, at least as a proportion of their intake. Local markets for fencing will continue to be useful. It is possible that more complete utilisation of trees, including twigs and leaves, will become feasible and there are promising developments in this direction in U.S.A. Although more doubtful because of utilisation difficulties, the concept of "forage forestry" or "silage forestry" where trees are grown on very short coppice rotations of 2-3 years, has already been considered for Britain.

MARKETING

The problems of marketing have been examined in some depth by the Economist Intelligence Unit (1970). Briefly, orderly marketing was found to be inhibited by great fragmentation and mixed motivation, both on the part of private growers and of sawmillers. The EIU identified nearly 10,000 private woodland holdings of 10 acres or more and over 600 sawmills in England and Wales. There are a much larger number of private woodland holdings of under 10 acres. On the question of motivation, the EIU found that for many private growers, commercial timber production was not a primary objective. This of course applies particularly to the lowland broadleaved woodlands, where amenity and sporting are of paramount importance. It is also clear that taxation and death duty benefits have some influence on the maintenance of the status quo. The EIU did not consider there was any likelihood of any rapid change, although they did make some suggestions as to how marketing could be improved. Discussions since publication of the report have generally confirmed the EIU's diagnosis and the prediction that change would be slow.

Forecasts of conifer production have been published (Holtam, 1966) and a completely fresh set of forecasts is very shortly to be issued in a few form. Although there are some gaps in our knowledge about conifer production and assumptions have to be made, the information, at least for the next ten years, is thought to be reasonably reliable. In the case of broadleaved production, however, there is a great dearth of knowledge. The reason for this is mainly because so much production arises from other than managed woodland (see Table 4).

Table 4 Approximate proportions of broadleaved felling

Category	Percentage
Dedicated Estates	30
Felling licences	30
Unlicensed	40

Of the total volume of 1.5 million cu m currently produced each year, a high proportion arises from haphazard felling of small woods and hedgerow trees, which in many cases do not require licences. The indication is that this volume is likely to remain more or less constant for the time being and will then decline slowly. This is because there are increasing pressures from amenity and conservation and also probably because the quantity of the better quality broadleaved trees will decline and an increasing proportion will become unattractive to sell. It is clear also that many owners value their woodlands more for other purposes and that price inducements will make little difference to this.

IMPLICATIONS FOR METHODS OF GROWING AND CONSERVATION

One of the main concerns of a number of people has been the amount of broadleaved woodland which has been felled and replanted with conifers. It has been generally assumed that conifers have been more "economic" and that broadleaves can only be grown at a loss. It could be argued that it

is impossible to lay down criteria of profitability to suit everyone and that what might be appropriate for the Commission need not be the best course of action for a private grower. It can probably be safely asserted that growing of broadleaves in the traditional way at close spacing with uneconomic thinnings and long rotations is commercially unattractive. What needs to be considered is whether other methods of cultivation are more attractive commercially and at the same time meet the needs of conservation and amenity.

It has been suggested in this paper that there is a good future for the higher grade native British hardwoods. One method of achieving this would be to grow them at wide spacing throughout their life, planting standards selected for vigour and possibly also desirable timber properties. They should be pruned from a very early age but only to a height of 6-7 metres. They would develop large crowns which would result in maximum diameter increment on clean, straight boles which would have high value. It would be important to select the most appropriate species for the site. On the best sites for the species, rotations of 50 years for sycamore and ash, 60 for elm and 80 for oak would be possible. Competing vegetation should ideally be kept down by cheap mechanical weeding and cleaning so that the crop is able to grow at maximum rate without competition. The establishment and retention of an understorey and scrub layer might be considered desirable for conservation (including sporting) purposes, and in this case it would be necessary to grow on a longer rotation. Longer rotations would also be necessary on less favourable sites.

Existing high forest crops could be thinned out to a wide spacing at the first thinning stage to encourage the development of fast grown valuable trees in a similar way. Existing crops of "scrub", mainly natural regrowth from wartime fellings, are probably best grown as pulpwood crops on rotations of 20-25 years. These areas consist of mixed coppice, often with a proportion of maidens, and with a high proportion of birch, which seeds prolifically under many conditions. This would offer a simple method of growing to many private owners and, although the gross income per hectare is relatively modest, the costs are likely to be small. This type of crop would also appear to have attractions from the point of view of conservation, although possibly less satisfactory than high forest for amenity and recreation. Another possibility would be to grow coppice with standards; this system is excellent for conservation and could also be reasonably attractive commercially if standards could be grown for high value timber and coppice for pulpwood.

It seems clear that there is a good deal of misunderstanding of the commercial possibilities for broadleaved woodlands. There is little scope for improving the value of older high forest areas and many of these will no doubt be grown for another 50 or 100 years or even longer without serious deterioration. There are, however, opportunities for making the most of younger crops and of land to be planted or replanted, not only taking into account the attractions of broadleaves for conservation and amenity, but also recognising that their commercial possibilities are greater than is perhaps generally realised.

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SESSION 3 SUMMARY OF DISCUSSION

Holmes. I suggest we give special consideration to two important themes arising from the three papers just presented on Timber Production. First, I think it is important to consider what is meant by "Wildlife Conservation values", and in what terms such values should be described, before we speak of the merits or demerits of timber management systems. Mr. Spencer said that in National Forests "... the taking of special measures to retain and create suitable habitats to favour diversity of wildlife" is a stated objective. I am sure that most of us will accept that diversity of wildlife is desirable and provides one of the most important measures of "wildlife conservation value". However, we still have to decide how much we want and how to translate this into realisable management objectives. Secondly, because deciduous broadleaved tree species can add substantially to diversity of habitat for wildlife, consideration should be given to the system of management outlined by Mr. Stern for improving the economics of growing broadleaved trees.

Beale. Mr. Aldhous' slides showed various methods of timber production, many of them now obsolete, which produce sizes and species of timber which are not now considered ideal. If we project this into the future are we sure we are planting the correct species of tree today and are we managing them correctly for requirements at the turn of the century? The requirements in 50 years will not be for timber, but will be for recreation and perhaps for wildlife.

Aldhous. I was talking on "Silviculture for timber production". This is only one objective for silviculture. To discuss silviculture appropriate for the needs of people in south-east England at the turn of the century, one has to ask what these needs are likely to be. Are the recreational, amenity and conservation needs going to be so over-riding that timber production ceases i.e. no further cutting is done, or is timber production going to continue to be the subdominant background pattern with other needs superimposed?

At the same time as analysing needs, the scope for change has to be known. The rate of turnover, i.e. felling and replanting, and the extent to which immature woodlands planted for timber production can be adapted delimit the opportunity for change. The broad woodland framework in which silviculturists can work to provide amenity and recreational facilities within the next 30 years has largely been made for us by our predecessors. The principal silvicultural tool will be the thinning regime and to a lesser extent, the system of regeneration. With these techniques, I believe it will be possible to meet most of the future demands for recreation, amenity and conservation arising in this period.

Nor must it be assumed that the conflict is between timber production on one hand and amenity, recreation and conservation on the other. Recreation demands in particular could well clash with those of conservation. For example, planting now to produce a visually attractive woodland with well-grown trees in 20 to 30 years time has to take cognizance of growth rates of different species and

choose those that will grow rapidly on the site, probably foregoing the conservation value of native species. Anyone who wishes to raise a wood composed of oak or beech must take account of their slow growth rate in planning and expect to forego the amenity value of these woods for several decades. Some objectives can complement each other. For example, light textured dry soils, carrying conifers and birch species may be far more suitable for general recreation than any other species/site combination, because of the light ground vegetation and dry ground conditions associated with such forests. They are often of low conservation value and can be used to draw people away from the more fragile sites of high conservation value on the more fertile soils.

Stern. I think that Mr. Beale, by referring to obsolete methods, meant that the traditional system of growing hardwoods is not right. I would not agree with him. It may not be the best system in the commercial sense, but it may be a very suitable system for other purposes, and if one takes all the benefits, including the wood benefits, it may be an appropriate system. I concentrated on two types of produce, but this does not mean that other types, such as perhaps wood wool, are not at the moment very attractive indeed commercially, being quite easily produced and selling at a good price.

Holmes. One important point is that a very large part of the timber which will be available before the year 2000 will come from existing forests. Whatever you plant from now on will not materially affect the issue before the year 2000. This does not mean that you do not make your mind up on what you think the demand will be in the year 2000.

Campbell. Mr. Chairman, you have drawn our attention to diversity and you have made specific reference to deciduous species which leads me to larch. I would like to ask about the future for larch as a timber tree.

Stern. I think that larch is excellent for the production of sawn timber but there has been a little difficulty in the past in marketing some of the smaller size thinnings of larch. This has been largely overcome because most of the bigger pulpmills will accept larch, and there are the existing traditional outlets like the Coal Board.

Aldhous. Is there a market for small rustic poles of larch in the towns and cities which could be important to lowland forestry?

Stern. The market in industrial areas for small conifer poles and not only larch, is extremely good.

Mellanby. Can any particular advantage be seen in diversity in relation to producing timber? There are obvious advantages if you want to produce natural conditions, aesthetic conditions and so on, but are there any for the commercial production of timber?

Aldhous. There is no clear advantage for timber growing. Species mixtures in a plantation are generally more difficult to manage than pure crops and to maintain a mixture you may have to favour the weaker members. All the evidence we have is that the more vigorous and productive species are better grown pure.

Holmes. The requirements of economic and efficient working, when taken alone, will take you to systems which give a simplified habitat as in agriculture. In forestry, as practiced in this country, there are often major differences of habitat within forest areas due to the diversity of age classes as well as breaks in the canopy caused by roads, regeneration fellings and so on. This is under the control of management and changes can often be made without sacrificing the interests of timber production entirely. My belief is that we can achieve a degree of diversity which produces an acceptable high level of wildlife conservation in various situations if we recognise certain objectives. Fundamentally the problem is to identify our objectives in each case.

Mellanby. It has been suggested that a diverse mixture would produce a greater total productivity in an area. Is this the case?

Aldhous. We lack evidence about some of the possibilities. The mixtures are generally even-aged but that is only one kind of mixture and there could be a range of diverse ages within the same area but I cannot quote figures on production levels. For even-aged stands, we have no suggestion of greater production from mixtures than from pure crops.

Steele. Can we develop a system of widely grown timber trees combined with an underwood producing pulp?

Stern. I think that is possible. Growing trees at wide spacing is not necessarily cheap because the cost of planting large plants of about 1.3m, providing protective sleeves for them and with some mechanical weeding would not necessarily be much less per hectare than with conventional planting. The idea was that with intensive care and wide spacing the roots would develop quickly, both down and laterally, so that you get a maximum crown development and girth development. If you plant something in between there is bound to be a competition effect so the growth of the standards will be reduced. We do not know enough about the interaction but I have no doubt that it would be perfectly possible to produce an attractive crop of standards with perhaps two rotations of pulp wood.

Holmes. The attractive feature is not associated with an increased volume yield but with production of a relatively early yield from the underwood crop to provide some income in advance of the later yield of the more valuable crop.

Rogers. A combination of forestry and agriculture is practiced at Bryant and Mays who have 300 acres of poplar which they inter-crop with barley for the first 6 to 8 years. Much of our crop establishment these days is assisted by chemical weeding and it would be useful if the panel would give us some idea of the comparative costs of establishment, for example on a midland clay with coppice growth, using chemicals compared with mechanical weeding.

Aldhous. This is very dependent on the weeding period. Mechanical weeding across the site would probably be 20-30% less costly than chemical weeding which in turn would be possibly 50% less than hand weeding. Wherever weeding is done it is normally partial weeding and in chemical weeding the cost of the chemicals will produce a limit to the operation.

"Spot" weeding, may affect 25-30% of the total vegetation and "strip" weeding may affect up to 50% of the area. I mentioned this in the particular concept of manipulation of habitat as some people say that if you weed chemically you are doing a lot of harm to the site.

Jeffers. I fear that we are concentrating too much, as foresters, on woodland diversity and there are different scales and other patterns which we ought to consider. We should perhaps be considering the diversity that comes from the combination of forestry and agricultural estate management. I would like to ask whether you can get a very much better yield from an area of land if you vary the pattern of management so that you are integrating agriculture and forestry in a truly diverse situation with a diverse series of ecosystems all serving quite different aims. Do we know enough about that type of diversity on that scale with that type of pattern?

Holmes. Could I ask what you mean by yield?

Jeffers. Is it more economically viable to think of a total scale of diversity than just to talk about forestry? Are we right in looking at silvicultural objectives *without looking outside the forest boundaries*?

Lorrain-Smith. We are right to separate things if we can thus study them more efficiently but we would be wrong to ignore the study of side effects. The answer to your question is no we do not have enough information but at Oxford we are trying to set up a project to study these problems on a broader scale.

Holmes. What are we trying to achieve when we say we want better wildlife conservation values in the course of timber production, and what guidelines should be given to management?

Rixon. One of the benefits is the aesthetic consideration and as far as I can see this must be a government responsibility. I should like it brought out and made much clearer that government should pay much more to the Nature Conservancy. I think one of the aims of setting up the Conservancy to advise on the conservation of the countryside flora and fauna was primarily aesthetic.

Holmes. The question of subsidising activities by any organisation to produce imponderable benefits is really a big area. I hope that the sort of discussion we are having this week will establish a few technical points and guidelines to help our politicians to say whether or not there is a case for more financial support. Someone may decide to manage his forest in the interests of wildlife conservation because he likes it but I do not know whether the public should subscribe to his cost.

Parker-Jervis. I think the timber production and wildlife conservation viewpoints are not likely to be compatible in all forests at all times and certainly not in private woodlands and there must be a process of consultation. Is it not possible for the Nature Conservancy to tell us the things which are desirable? Can they attain their objectives in small areas or relatively small areas?

Holmes. There is a plea for consultation between the various interests. I think, Mr. Parker-Jervis, that you are pleading for the same thing for which I am pleading from the chair, which is the clarification of objectives with the best advice available. I believe from everything that has been said that these two requirements of timber production and wildlife conservation are not incompatible and it is a question of how much concession to make for wildlife conservation in the course of management. This is a matter of judgement.

Workman. They may be incompatible on any single area. The conservationist does not mind the farmer growing barley but asks him to leave a hedge. It may be that foresters will go on growing spruce trees but the conservationist will ask them to leave some sort of hedge but that does not mean a thorn tree under every spruce.

Williams. The Nature Conservancy has tried to highlight, for example in the Chilterns, those areas where wildlife conservation is important and to try to grade them in some way. I would like to ask if we can look at the existing national woodland area and try to evaluate its potential for the various activities we have considered.

Lorrain-Smith. I was trying to indicate this need to add together all the benefits in any area, which should not be considered simply for timber production but for its possibilities for making use of other benefits whether these are tangible and can bring a cash revenue, or intangible. We ought to go about it by some kind of a stocktaking but some of the items are not included at the present because we do not know enough about them, e.g. biological control. Some advantages may not be quantifiable but we should write them in prose if we cannot write them in figures.

Peterken. The retention of mixed coppice of broadleaved hardwoods on a pulpwood bonus scheme is a compromise between active timber production and conservation. You get a financial return, you get active coppice management restored thus retaining an historical form of management which has been going on for well over 1000 years, you maintain the diversity of hardwood tree and shrub species, in what, in many cases, seems to be a natural distribution in relation to the soils in the wood, and you retain the natural flora and fauna under the form of management which has maintained it for a 1,000 years or more.

Holmes. My problem in summing up this discussion underlines the difficulties of defining our objectives and criteria. We spoke from this side of the table on timber production and gave an outline of present methods and systems and I hope gave you some impressions as to what the implications may be for wildlife conservation. As I see it "wildlife conservation value" implies richness and variety of both habitat and species, which very often accompanies good aesthetics and good landscape. What are the wildlife values as they occur in the ordinary course of forest management? Each time we come to the question of definition, and if possible of quantification, if we are to have positive management. We should not talk about wildlife conservation, we should talk about wildlife management and the purpose for which it is being managed. This cannot be reduced to figures but we must grope our way to certain criteria and try to emerge with some sort of simple 'input/output' model. It has to be simple to be usable.

We have to consider 'input' in terms of effort, money and time and 'output' as a mixture of benefits only some of which can be given money values.

We have heard something about Lowland forests and one thing which strikes me is their diversity. They are very much broken up and there is a wide variety of species and age-classes with a high proportion of broadleaved species. The other thing that comes out clearly is that wildlife conservation values can be increased in a variety of ways, within the context of timber production management. In most forests a high proportion of the land is not occupied by trees. As much as 1/10th of the area of forests are rides and unplatable bits and pieces which add to diversity and I am sure are of value for wildlife. We have talked about diversity including species diversity and structural diversity with age class differences. We can achieve conservation by an aggregation of small measures to enhance the variety of wildlife, and Mr. Steele's Booklet is an excellent guide for this purpose. The importance of wildlife will vary from one situation to another and we have the constructive suggestion that perhaps we need a wildlife stocktaking on a national scale. The Forestry Commission is doing this for its recreational plans and a similar thing may be possible for wildlife values.

Finally, we should keep in mind the dynamic aspect of forests. Normal forest management provides a whole succession of different habitats. Although we may have started with a uniform forest, such as Kielder which was planted within a relatively short space of time, irregular growth will create structural diversity which will be increased when felling and regenerating starts.

Subjective judgement is involved at every turn in this matter and we will only improve our understanding and the quality of our decisions by close consultation between foresters and conservationists.

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THE DEMAND FOR FOREST RECREATION

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INTRODUCTION

We are probably all aware that our forests and woodlands are being increasingly used by the public for recreation. Many of us will also be aware of the problems that this recreational use is bringing, for example conflict with commercial timber interests, interference with game, damage to wildlife, litter, traffic congestion.

Increasing recreational use of forests is inevitable and in any case desirable for social reasons. It is government policy to encourage provision for recreation in the countryside and such policy is written into the Countryside Act which gives the Countryside Commission the duty, among other functions, of "encouraging the provision and improvement for persons resorting to the countryside, of facilities for the enjoyment of the countryside and of open-air recreation in the countryside" (Countryside Act, Section 1). For the owners of private woodlands who may wish to provide recreation facilities for the general public, such as camp sites or picnic places, this can mean the provision of exchequer grant aid up to 75% towards the cost of these facilities (Countryside Act, Section 5).

The Countryside Act also confers on the Forestry Commission powers to provide tourist, recreation or sporting facilities including camping and caravan sites, picnic places, information centres, car parking and lavatories, and to make charges for these facilities (Countryside Act, Section 23); and to manage woodland primarily for amenity (Countryside Act, Section 24). The Forestry Commission's Annual Report for 1971 states that the Commission's policy towards recreation is - "to develop the unique recreational features and potential of its forests, particularly where they are readily accessible to large numbers of visitors from the major cities and holiday centres. This will be done in conformity with the Commission's statutory powers and obligations, within the financial resources available and subject to the primary objective of timber production. The Commission will ensure that its recreational development will neither injure the forest environment nor conflict with its conservation" (Forestry Commission, 1971). Money for recreational development comes from the Forestry Fund, the Commission's annual vote from Parliament. Although the Countryside Commission cannot directly aid recreation development on Forestry Commission land it may grant aid local authorities who may acquire and manage sites on lease from the Forestry Commission.

Clearly, if recreational use of forests is to be encouraged but conflicts with other interests kept to a minimum, recreation must be planned, i.e. facilities must be provided for recreation and properly managed, and recreation must be channelled into suitable areas. Effective planning requires information. On the one hand information is needed on the resources suitable for recreation. In the forests these will be areas where conflict between recreation and other interests is small, i.e. where the capacity of the forest to absorb recreation without

unacceptable damage to other interests is high. On the other hand, information is needed on the demand for recreation. Ideally the planner should know as much as possible about the present recreational use of forests, and how that use is distributed. For example, how many visitors are there? When do they come? Where do they come from? How do they come? What do they do in the forest? How long do they stay? What facilities, if any, do they require? Information will then be needed on how the pattern and level of use is likely to change in the future.

If information can be obtained on the demand for recreation, and on those parts of the forest which are suitable for recreation it should be possible to make rational decisions about the number, type and location of the recreational facilities that need to be provided, which should enable the forest environment to be safeguarded and ensure that limited financial resources are spent in the best way.

This paper attempts to quantify the present pattern of use of forests for recreation and to suggest how demands for forest recreation might change.

RECREATION DEMAND: SOME DEFINITIONS

There is dispute over the terminology of recreation demand. In this paper I am using the term demand not simply as an expression of the use of facilities but as a measure both of the use of facilities and of the desire to use facilities, either now (existing demand) or in the future (future demand).

Thus there are two components of demand, effective demand, which is the actual use made of facilities e.g. the number of visits made to a forest over any one time period; and latent demand, which represents demand which could be experienced if circumstances changed. Latent demand comprises deferred demand which is the non-participation in activities because the facilities are not available or their existence is not known, and potential demand which is demand which may become effective at some future date if the circumstances of the non-participating population change, e.g. if car ownership levels rise and the time available for leisure increases more people will be able to visit the countryside. The concept of recreational demand is illustrated in Figure 1 (see also Countryside Commission, 1970).

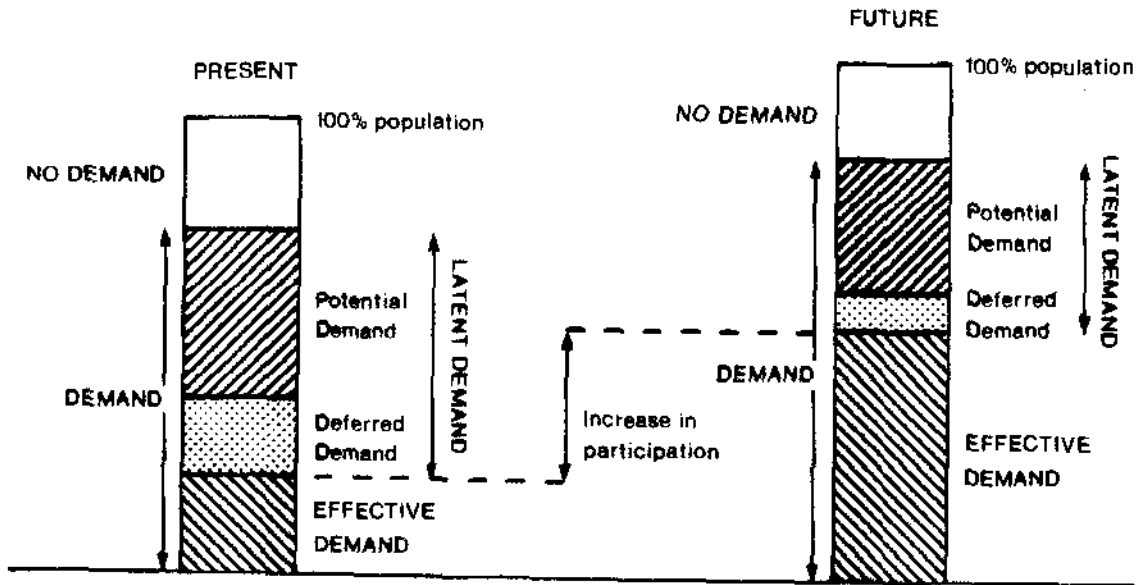
In this paper we are concerned both with effective demand and latent demand since a study of the latter will enable future patterns of participation in forest recreation activities to be predicted.

THE PRESENT DEMAND FOR FOREST RECREATION

Britain, by comparison with other European countries, is a sparsely wooded country. Only about 8% of the land surface of Britain is at present forest (most of this is in remote areas) compared with 20% in France, 30% in Germany and 40% in Austria. Britain has only 0.1 acres of woodland per head of population, almost the lowest figure in Europe (Forestry Committee of Great Britain, 1971). Clearly what woodland there is is likely to be in great demand for recreation.

Forest recreation, however, cannot be studied in isolation. It is but one facet, albeit a very important facet, of the wider field of countryside recreation. There are few, if any, activities characteristic

Fig.1 COMPONENTS OF DEMAND



of recreation in forests that are unique to a forest location, other than perhaps orienteering and some specialist forms of field studies such as fungal forays. All the activities typically associated with forest recreation, including pleasure driving, picnicking, rambling, horse-riding and wildlife study, can usually be carried out equally well, though with a different emphasis, on other areas of the countryside. What we are concerned with then is the demand for countryside recreation but particularly that part of the demand which is focussed on forests and woodland. If the forests are receiving a disproportionate amount of the total recreational use of the countryside we will want to know why. Is it because forests have a particular attraction to visitors? Is it because demand for countryside recreation is being suppressed elsewhere? Or is it a combination of both of these factors? Let us first consider to what extent the public are making use of the countryside as a whole for recreation.

It is very clear that there has been a considerable increase during the last decade in the amount of recreation taking place in the countryside, witness, for example, the increasing congestion on roads on summer Sundays in traditionally popular areas. There is however evidence to suggest that visiting the countryside is still very much a minority pursuit. For example, a survey of outdoor leisure activities in Northern England (North Regional Planning Committee, 1969) showed that only 2 per cent of the population of the area visited the countryside on an average summer Saturday and 5 per cent on an average summer Sunday or 35 per cent during a three month period. Clearly with only 5 per cent of the population visiting the countryside on the most popular day (Sunday) there exists a large untapped source of potential visitors. The problem of coping with recreation is undoubtedly only just beginning.

At what rate has the effective demand for countryside recreation been increasing? The short answer is we do not know. There are no statistics available which illustrate trends in overall recreation

participation in the countryside, nor do we have time series data for smaller areas of countryside to which the public have free access. We urgently need data, for example, on the number of visitors to the National Parks and Areas of Outstanding Natural Beauty; the lack of such data has been a great impediment to effective policy making and has for example presented problems to Lord Sandford's National Parks Policy Review Committee which is now sitting.

Almost the only information on countryside recreation trends is that on the use of facilities where the public have to pay an admission charge and where detailed records have been kept e.g. visits to historic houses and ancient monuments, and use of camp sites and hostel accommodation. Although this information may not be wholly representative of the trends taking place generally in countryside recreation, time series statistics over a decade should give some indication of the increase in total recreation activity that has taken place over the period. Table 1 shows trends for 1960 to 1970 in admissions to National Trust houses and gardens and to Department of the Environment ancient monuments; also camper nights spent on Forestry Commission sites in the New Forest, and nights spent in youth hostels. These figures clearly suggest that participation in countryside recreation has been rising rapidly; an annual growth of between 8 per cent and 10 per cent is probably as good a rough estimate of the rate of increases it is possible to make.

Table 1 Trends in Countryside Recreation

	1960	1965	1968	1970	Average Annual Increase
Number of visits to National Trust properties where charges are made.	not available	2.09m	2.83m	3.11m	9.8%
Number of visits to DOE ancient monuments where charges are made.	6.84m	8.91m	10.81m	12.50m	8.3%
Number of camper nights spent on Forestry Commission land in the New Forest.	116,000	294,000	454,000	520,000	35%
Number of overnight stops at YHA hostels in England and Wales.	not available	1.23m	1.28m	1.45m	3.6%

There is no time series data available on the recreational use of forests. The only information we have is that provided through a survey undertaken in 1968 by the Forestry Commission into day visits to Forestry Commission land (Forestry Commission, 1970) and that provided by a small number of ad hoc surveys of particular forest areas.

The 1968 survey was undertaken to provide an estimate of the total number of day visits to Forestry Commission land during the period June 1

to September 30. The survey was a pilot venture and the figures are tentative. The nearest approximation to a total estimate of day visits to Forestry Commission land over the four month period was between 10 million and 18 million. A more detailed breakdown is given in Table 2. It is to be hoped that there will now be a regular census which would enable growth in recreation to be monitored and would aid planning for recreation.

Table 2 Day Visits to Forestry Commission Land June 1 to September 30 1968

Estimated use of all sites at weekends (Forest of Dean and New Forest excluded)

	<u>Number of day visits</u> (millions)
Concentrated use sites ^a	1.86
Lesser use sites ^b	0.63
Linear use sites ^c	6.26
	<hr/> 8.75

Estimated use of the Forest of Dean and New Forest on all days

Forest of Dean	0.38
New Forest	1.80
	<hr/> 2.18

- a. Sites at which at least 15 cars are likely to be found on a typical summer Sunday afternoon.
- b. Sites at which between 5 and 15 cars are likely to be found on a typical summer Sunday afternoon.
- c. Quarter mile stretches of road bordering the forest along which single cars or groups of up to 4 cars are likely to be parked at intervals.

More detailed information is available on the New Forest. A day visitor survey undertaken in 1969 (Forestry Commission, 1969) suggested that in the year ending September 30, 1969, 3.7 million day visits were made to the forest, 2.9 million of them during the period April 1 to September 30 and 1.3 million of them during the period mid July to the end of August when on peak days a daily total of about 20,000 cars could be expected. Figures for camping and caravanning use of the New Forest have been given in Table 1. The New Forest is one of the most intensively used forest areas in Great Britain and thus the figures quoted above will not necessarily be representative of other forest areas. In many ways too the New Forest is atypical of forest areas in that a large part of the forest, perhaps 40%, is open heathland with only scattered trees so providing greater opportunities for recreation. The figures of use of the New Forest may, however, provide a foretaste of what might be expected elsewhere in future years.

THE VISITORS

To obtain a clearer understanding of the present pattern of countryside and forest recreation, and in order to predict how the pattern of demand might change, we have to look more closely at the participants. Who are they? How do they come? Where do they come from? What do they do?

The main demands for countryside recreation are at present coming from day visitors. While holiday-makers are important in some forest and woodland areas, particularly in the remoter parts of Britain, and the number of visitors from this source is rising as touring by car becomes more popular, the number of holidays⁽¹⁾ taken in Great Britain by British people (including second holidays) has been growing only slowly in recent years as shown by the following figures. ⁽²⁾

30	million	holidays	were	taken	in	1961
30	million	"	"	"	"	1967
30½	million	"	"	"	"	1969
34½	million	"	"	"	"	1970

The increase in 1970 may be exceptional and it will be necessary to wait until the statistics for 1971 are available before concluding that a rapid growth in holiday-making in Britain is again taking place. Most of the increase in countryside recreation over the last ten years can probably therefore be attributed to an increase in day visitor participation.

The majority of visitors come by car. In three recreation surveys, Slimbridge (Countryside Commission et al, 1971), Cannock Chase (University of Keele, in progress) and Box Hill (University of Sussex, in progress), 82%, 96% and 84% of the visitors respectively arrived by car. These site surveys are supported by the North Region Planning Committee survey which showed that 82% of all visits to the countryside were made by car. The close correlation between car ownership and countryside recreation has been shown in all studies.

Car ownership is largely dependent upon income and therefore there is a correlation between income and participation in countryside recreation. In the North Region Planning Committee study 25% of trips to the countryside could be attributed to persons or families in the high income group (an income of over £1,700 a year at 1967 salary levels) yet this group included only 12 per cent of the total population.

Of greater significance may be the relationship between social class and participation in countryside recreation. Table 3 (Sidaway, 1971) is a breakdown of visitors, by social class, to three contrasting countryside day-trip destinations, namely, Ragley Hall (home of the Marquess of Hertford), Slimbridge Wildfowl Trust and the Forest of Dean. In each case there is a marked over-representation of the middle classes. Where working class families have cars there is evidence to suggest that they do not use them to visit the countryside or are not able to visit the countryside, to the same extent as middle class families.

(1) Defined as trips of four nights or more away from home.

(2) Social Trends. No. 2 1971. Central Statistical Office.

Table 3 Social Class of Visitors to Recreation Areas

Social Class	Working Population	Car Owners	Visitors to:		
			Ragley Hall	Slimbridge Wildfowl Trust	Forest of Dean
	%	%	%	%	%
AB ^a	13	19	30	36	24
C1 ^b	22	28	34	29	36
C2 ^c	31	35	27	27	28
DE ^d	33	18	9	9	11

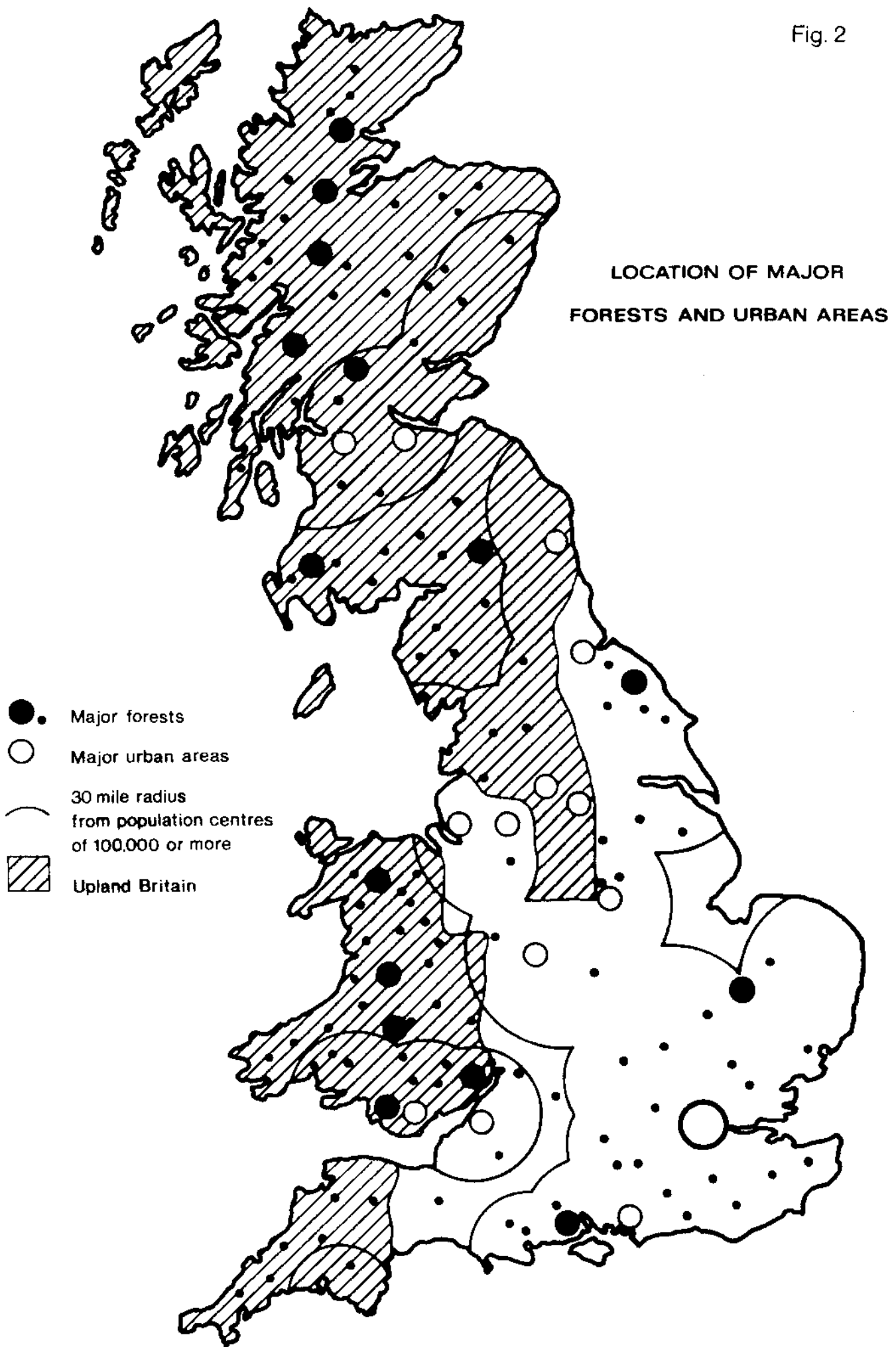
- a. Upper Middle Class: Occupation - Managerial and professional work.
- b. Lower Middle Class: Occupation - Supervisory and clerical work.
- c. Skilled Working Class: Occupation - Skilled manual work.
- d. Working Class: Occupation - Semi and unskilled manual work, casual work and pensioners.

Finally, day visitors are likely to be family parties with children. The 1969 New Forest Survey, for example, categorised 5% of day visitors as organised groups, 55% as family groups, 30% as couples and 10% as individuals; on Sundays the number of parties with children may reach 75% of the total.

Summing up, day visitor participation in countryside and forest recreation is at present largely the preoccupation of middle class families. This conclusion may have important implications in the planning of recreation in the countryside. I will return to this point.

The majority of visitors to the countryside arrive by car. How far do they come? At present most day visitors only travel up to about 30 miles from home on leisure trips to the countryside, or about an hour to 1½ hours journey time. For example, the 1969 New Forest Survey showed that between 80% and 90% of the visitors to the Forest travelled less than 30 miles and the average one-way journey was 17 miles. At Cannock Chase the average one-way journey was as little as 13 miles. With improved roads day visitors are able to travel further within the same journey time and thus will visit countryside areas more remote from their home town. As the motorway network is extended more and more "new" areas of countryside are being brought within day trip travelling time of the major centres of population. For example the M5 and the M50 have brought the Forest of Dean within an hour's travelling time of the West Midlands conurbation and with the completion of the M4 the area is now within a 2½ hour drive of central London and a 30 minute drive of Bristol. The New Forest will be within a 90 minute drive of London when the M3 is complete. Both areas are likely to see increased numbers of visitors because of improved accessibility. Though we need to know much more about the interrelationship between time, distance and cost before drawing firm conclusions about the scale of increase.

Fig. 2



Although improved communications will increase the recreation pressure on forest areas remote from the main population centres, the demand for recreation will undoubtedly continue to fall largely on forests close to these areas. It is thus possible to predict where the pressure for recreation will be most severe by describing a 30 mile radius round the main towns and cities (see Fig 2 and Sidaway, 1971). The major areas of forest lie in Wales, Northern England and Scotland and thus fall outside the zone of greatest pressure, but most of the forests in lowland Britain fall within this zone.

The forests and woodlands in lowland Britain and particularly in south-east England are largely in the ownership of the private sector; it is the private owner therefore who can make the greatest contribution to catering for recreation demand. Private sector woodland also includes a higher proportion of mature broadleaved woodland which is considered to be of greater attraction to the public.

RECREATION ACTIVITIES IN FORESTS

The majority of visitors to forest areas are day visitors, mainly families arriving by car on Sundays. Most of these visitors can be regarded as casual visitors in that they do not appear to visit the forests with any particular activity in mind except perhaps to "look at the view" or to picnic. Their main interest appears to be a drive in the car along attractive roads with somewhere to park and a place to sit and picnic and perhaps to kick a ball about. A high proportion of these visitors stay close to their cars. The 1969 New Forest Survey reported from 70% to 90% and 40% was reported in the Forest of Dean (Colenutt, 1970). Some visitors do not leave their vehicles and those that do rarely walk more than $\frac{1}{2}$ mile, although they may be persuaded to try out a nature trail or some other kind of guided walk. In the New Forest picnicking, pleasure driving, strolling and informal games in that order were the most popular activities.

To many of these visitors the forest is not essential to their enjoyment though it provides a suitable destination for an outing. Other visitors however, specially mention the forest environment - the beauty of the natural surroundings or peace and quiet - as their reason for coming. In the larger forests scenic drives along forest roads adopted for recreation traffic with associated recreation facilities could meet the needs of the casual visitor. Evidence suggests that scenic drives are becoming increasingly popular. Motorists appear to appreciate being able to drive off crowded roads on to a scenic drive, even though it may mean payment of a toll, where they can park and picnic at specially laid out picnic sites and viewpoints, and explore signposted walks and nature trails leading from the drive (Countryside Commission, 1970).

A smaller proportion of day visitors to the forests, perhaps 20%, come to participate in some particular activity such as hiking (defined as walking 5 miles or more), horse riding, wildlife study or shooting. The forest environment may often be essential to these activities.

Day visitor use occurs in all forest and woodland areas. In contrast, camping and caravanning are restricted to a small number of locations. Although the number of campers and caravanners is small when compared with the total number of visitors to the forests, only 6.5% of households contain campers or mobile caravanners (British Tourist Authority, et al, 1971),

their numbers have undoubtedly been rising as fast, if not faster, than the numbers of day visitors. In the New Forest the growth in camping and caravanning has been very rapid indeed (about 35% a year, see Table 1) though this growth is likely to be exceptional and not representative of other areas since nationally participation in camping and caravanning is only growing at about 3% a year.

PREDICTING FUTURE DEMAND FOR FOREST RECREATION

Forecasting is the most crucial and yet the most difficult aspect of demand studies. Some attempt, however, must be made to estimate future patterns of participation in countryside and forest recreation if any serious attempt is to be made to plan for this recreation.

FACTORS AFFECTING PARTICIPATION IN COUNTRYSIDE RECREATION

An analysis of the characteristics of the existing users of the countryside and forest areas gives a good indication of the factors which have probably contributed to the overall rise in participation in countryside recreation during the last two decades.

I have shown that visitors to the countryside typically earn higher than average salaries, are car owners and middle class. Income and car ownership are the key factors. Real incomes have been rising steadily during the last two decades and can be expected to continue to do so (i.e. wages are rising faster than prices). Increase in purchasing power (see Table 4) is putting car ownership within the reach of larger numbers of the population, which is reflected in the dramatic rise in car ownership levels since 1950. This rapid rate of increase is expected to continue at least until 1980, after which the rate of increase may be expected to slow down as car ownership levels begin to reach saturation point. The projected rise in car ownership from 1970 to 1980 is no less than 75%, a rise which could be matched by a corresponding rise in the number of visitors to the countryside. Undoubtedly car ownership is the most important single factor affecting participation in countryside recreation.

Table 4 Purchasing Power and Car Ownership

Consumer's expenditure at 1963 prices¹

1963 index = 100

1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
91.6	93.8	95.8	100	103.5	105.5	107.7	110.0	112.6	113.0	116.3

Private Cars in Great Britain (Millions)

1950	1960	1970	Projections	
			1980	2000
2.3	5.5	11.5	20.1	27.8

Other factors which are clearly important are rising population (a 20% increase by the end of the century on current projections, i.e. from 55.6 million to 66.5 million) and the improved accessibility to the remoter countryside areas as the motorway network is extended. Education may also be significant. Children, who might not otherwise have been able

¹Annual Abstract of Statistics, 1971. Central Statistical Office.

to experience the countryside, are now introduced to countryside pursuits such as field studies or mountaineering through schools and colleges, and may retain an interest in visiting the countryside into adult life.

These various factors together indicate a possible doubling of participation in countryside recreation in the next ten years. To what extent is this additional demand likely to be channelled into the forests and woodlands? To answer this question we have to examine what is happening elsewhere in the countryside.

The last two decades have witnessed a revolution in agricultural methods in lowland Britain and particularly in Eastern England. These methods, particularly intensive mechanisation and the extension of arable cultivation which have necessitated hedgerow removal and a loss of hedgerow trees, are tending increasingly to produce a countryside less attractive to visit and also, perhaps of more importance, a countryside where the visitor is less welcome. The increasing acreages now devoted to growing cereals, for example, are no place for the walker or picnicker. Recreation is being confined more and more to non-agricultural rural land and this process is likely to continue. In lowland Britain, forests and woodlands probably form the largest part of the non-agricultural acreage and thus are likely to have to bear the brunt of the rising demand for countryside recreation, together with the country parks and picnic sites now being set up under the Countryside Act.

SOME PREDICTIONS

Several attempts have been made to build predictive models of recreation demand in order to forecast participation in recreation at dates in the future. Such models are potentially of tremendous importance for planning purposes. Colenutt (1970) in a study of the Forest of Dean tested several different predictive techniques. All indicated that the area would be subjected to a rapid increase in visitor numbers from about 350,000 visitors in the summer of 1968 to about 1 million visitors in the summer of 1981, a three-fold increase in 13 years. Predictions of a similar rate of increase in day visits in the New Forest were made in the South Hampshire Study (South Hampshire Plan Technical Unit, 1969) where peak pressures were predicted to rise from 56,000 visitors a day in 1965, to 86,000 in 1971 and 192,000 in 1981. This increase, however, is partly accounted for by the planned population growth in the Region.

Projections are, however, notoriously prone to error and techniques for forecasting recreational use are still in their infancy. Thus, the suggested doubling of visitors to these forest areas within the next ten years could well prove to be an overestimation. There are several uncertainties.

For example, visitors to forest areas are predominantly middle class and there is evidence to suggest that when working class families acquire cars they do not use them at present to visit the countryside to the same extent as middle class families. Most of the increase in car ownership during the next decade will probably be due to an increase in car ownership in working class families in urban areas. Therefore, unless working class families show a greater interest in countryside recreation than they apparently do now, a doubling of car ownership may not lead to a doubling of participation in countryside recreation. Such an increase in interest could however occur if the suggested correlation between education and participation in countryside recreation is valid.

The other factor frequently quoted as contributing to the rising demand for countryside recreation is increasing leisure time. This may be partially true, but in manual industries at least any reduction in the official working week has been matched, almost exactly, by an increase in the amount of overtime worked, much of that at weekends. The availability of a full two day weekend break is likely to be a major factor influencing participation in countryside recreation.

It is also worth noting that tastes change. There can be no guarantee that recreation habits will remain stable even over a short time and there could well be some substitution for recreational activities over the forecast period, say from forest recreation to water sports. Finally it is important to consider to what extent country parks and similar areas may be expected to cater for countryside recreation, and thus siphon off some of the pressure from forest areas.

THE FUNCTION OF COUNTRY PARKS

The rising demand for countryside recreation and the urgent need to cater for it was recognised by the government in the Countryside Act, which empowered local authorities and private agencies to set up 'country parks' and picnic sites (Countryside Act, Sections 7 and 10). A country park has been described (Countryside Commission, 1969) as "an area of land, or land and water, normally not less than 25 acres in extent, designed to offer to the public, with or without charge, opportunities for recreation activities in the countryside". Schemes recommended by the Countryside Commission and approved by the Secretary of State for the Environment or the Secretary of State for Wales are eligible for grant aid up to 75% towards capital costs (including land acquisition) and towards the costs of recurring expenses such as wardening and litter collection. Picnic sites are smaller areas, usually with fewer facilities, but are also eligible for grant aid.

The White Paper, Leisure in the Countryside (Ministry of Land and Natural Resources, 1966), which was the forerunner of the Countryside Act saw the purpose of country parks as:

- "a. to make it easier for those seeking recreation to enjoy their leisure in the open without travelling too far and adding to congestion on the roads;
- b. to ease the pressure on the more remote and solitary places;
- c. to reduce the risk of damage to the countryside, aesthetic as well as physical, which often comes about when people simply settle down for an hour or a day when it suits them somewhere 'in the countryside' to the inconvenience and expense of those who live and work in the locality."

Clearly country parks have a very important part to play in providing for outdoor recreation. To what extent they will take the pressure off the forests depends on how many country parks are created, their location and particularly how attractive they are to visitors. It is encouraging to note that in the $3\frac{1}{2}$ years since the passing of the Countryside Act 60 country parks have been recommended by the Countryside Commission and approved by the Secretary of State for the Environment or the Secretary of State for Wales, with a total area of about 25 square miles, most of which are close to the major conurbations. An additional 36 parks have

been recommended by the Commission and await approval, and over 100 further schemes are under consideration. It is probably unrealistic, however, to imagine that country parks will ever be able to accommodate more than a small part of the demand for countryside recreation, although they may be able to absorb much of the additional demand from day visitors, particularly those visitors who are 'just looking for a destination for a day out'. Those who seek solitude and who dislike the feeling of organisation attached to a country park will continue to seek the greater informality which many forest areas can still provide. The value of forests may be that they can provide a contrasting type of recreational experience.

It is clear then that the forests will come under increasing recreation pressure though the rate of increase of recreational use may not be as great as predictions have suggested. Participation is of course partly a reflection of the supply of recreation facilities. The opening up of the forests to the public for recreation and the creation of recreation facilities in the forests, whether this be by the Forestry Commission or by private owners, is bound to accelerate the increase in effective recreation demand as deferred demand (demand that could not be satisfied because facilities were not available) is met.

ACTIVITIES

Although the overall participation in forest recreation is expected to rise, the rise may not be shared by all forest activities. While picnicking, strolling and ball games may be the most popular pursuits today, in 10 years time it could be horse riding or wildlife study. In the United States the current 'boom' activities are hiking and bicycling, and very much away from pleasure motoring; such a pattern could be repeated in Britain. Whatever changes in demands for individual activities take place these changes obviously have important implications for the planning of recreational facilities.

Attempts have been made, therefore, to establish the latent demand for particular recreation activities in order to predict more accurately which activities are likely to show rapid increases in participation, assuming that facilities are made available. The technique, which involves asking people about their recreation plans and preferences for the future, was used in the Pilot National Recreation Survey (British Travel Association/University of Keele, 1967). By comparing the existing participation in particular activities with the latent demand for that activity an indication can be obtained of those activities which have rapid growth potential. Of the activities studied in the survey which take place in forests there is an indication that horse riding and wildlife study will show the most rapid increases in participation but hiking and camping will remain the most popular activities (see Table 5).

Questions such as this have obvious limitations for they invite a degree of wishful thinking. Too much faith should not be put in conclusions drawn from this survey though they may give an indication of trends.

MEETING THE DEMANDS FOR RECREATION

I have shown that use of forests for recreation is likely to increase considerably. Can additional recreational use be accommodated without creating unacceptable conflicts with other forestry interests? The Forestry Commission thinks it can.

Table 5 Growth Activities

	A Activities reported in 1965	B Would like to take up	Total	B/A
	%	%		
Hiking	5	3	8	0.6
Camping	4	4	8	1
Wildlife Study	2	3	5	1.5
Horse riding	1	6	7	6

% = percentage of total sample

The Forestry Commission's Policy for Recreation begins with the statement "Public demand for countryside recreation is increasing rapidly. The Forestry Commission is in a unique position to help meet this demand since it is responsible for almost 3 million acres of land in Great Britain, distributed widely throughout the country. Further, forest and woodland has a greater capacity for absorbing people in the countryside without impairing the environment than other forms of land use. The Commission's staff, too, are highly trained and have long experience in land management."

That the Forestry Commission consider that woodland has a high capacity to absorb visitors into the countryside without undue environmental damage is a very significant statement. The statement is undoubtedly largely true looking at the forest resource as a whole since the visual enclosure afforded by woodland presents an environment in which a degree of seclusion is attainable which could not be achieved in more open surroundings. The screening of parked vehicles is a particularly valuable function in this respect. An example of the capacity of forests is provided by the Olympic National Park in the U.S.A. where despite millions of visitors, the environment and the animal life it succours remain attractive and varied.

The Forestry Commission proposals for recreation development go no further than the provision of picnicking and parking places, scenic drives, information centres and nature trails and this probably also represents the opinion of the majority of private forestry owners where an interesting development is the creation of the Countryside Club. Here individuals can buy access to private woodlands in the home counties. Numbers are limited to ensure that visitors can always find solitude and to ensure that commercial forestry interests will not be affected. In an address to the British Association however, Professor Richardson of the University of Wales argued that the absorptive capacity of forests should be exploited even further. He would like to see the forests cater for a predominantly urban population with urban tastes by providing pleasure parks, marinas, hotels, public houses, discotheques and even motor cycle racing tracks (Richardson, S.D., 1970), although it is very unlikely that an increasingly environment conscious public would accept that such proposals are a proper use of forest resources.

I began by outlining some of the conflicts which are occurring now between recreation and other forestry interests. Clearly if the use of forests and woodlands for recreation rises as predicted these conflicts can only become more serious unless recreation provision is planned very carefully

indeed and adequate money and other resources are made available for effective management. There are indications that this recreation challenge is beginning to be met.

The New Forest is probably under as great a recreation pressure as any other forest area in Britain and is showing signs of serious environmental damage including soil compaction and erosion caused by the surging growth of camping and day visitors. In November 1971 the final recommendations of the New Forest Joint Steering Committee were published, which proposed radical measures to control and manage the recreational use of the Forest. The recommendations included the prohibition of car access to large areas, including areas where the public have traditionally had access, and the creation of alternative parking facilities and support facilities such as toilets where motor access will cause less damage. The recommendations also included the channelling of camping from the open forest into informal camp sites, again with the aim of reducing environmental damage to the forest. It is to be hoped that these recommendations will be accepted and that work can soon begin to implement the proposals.

As the levels of recreation now found in the New Forest may well be a foretaste of what can be expected in other areas in a few years time, recreation in these areas will also need planning and managing with foresight.

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DEVELOPING THE RECREATIONAL USE OF FORESTS

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INTRODUCTION

This paper attempts to offer a system for the forest manager or owner who is considering the recreational development of his forests. Developments in Britain so far show little system and have taken place mainly in the uplands but there are a few major exceptions like the New Forest. Upland development reflects the intrinsic beauties of hilly landscape but does not reflect the needs of the majority of people since these forests are relatively inaccessible to them. Thus, this paper is concerned particularly with the development of lowland forests near to conurbations and holiday areas.

SUMMARY OF SYSTEM

Any recreational developments need to be guided by a plan. Otherwise the unanticipated advent of visitors at a forest will not only threaten the environment but may jeopardise the chance to implement the best plan at a later date. The plan can be considered as having six main stages and this paper discusses each stage mainly from a Forestry Commission standpoint though the views expressed are my own.

The stages are:-

- Statement of objectives
- Evaluation of forest location and characteristics
- Assessment of resources: cash, supervision and labour
- Consultation with other organisations operating in area
- Development plan: building, operation and recording
- The review process

STATEMENT OF OBJECTIVES

The motivation and objective of a forest owner needs to be analysed and set down before a successful recreation development can be achieved.

The Forestry Commission as a government agency recognises a social responsibility to manage its forests for other benefits as well as the production of wood. It proposes to try to meet recreational demands by developments which are compatible with the forest environment and the primary purpose of growing timber. The demands will be judged both by on the spot surveys by our own staff and by close consultation with appropriate County, Regional and National authorities. The insistence on a commercial cash return can hamper development. A low level of benefit is sufficient for much forest recreation and benefits can be measured in terms of visitor numbers as well as cash returns. Where there is a high level of investment, as in a camp site, this should be run on commercial lines to give a viable return.

A private landowner will be in a different position. He is likely to want to preserve many of the desirable forest characteristics for his own personal enjoyment. But there are other pressures too. Firstly there

will be a desire to make more income from his estate. Then there is an increasing awareness of the social pressures against the exclusion of the public from privately owned land which is under extensive rather than intensive use. Both Countryside Acts contain provision for Access Agreements with private owners but a rental element may need to be introduced, as in Holland, before wider use is made of these provisions.

In short, private owners in the future are likely to aim to develop forest recreation in such a way that it

1. brings in an extra rental from the woods,
2. is zoned by activities or areas so that their own privileges as an owner are preserved, and
3. meets the mounting social pressures.

EVALUATION

Forest location

The area of the blocks in the forest and their location in relation to resident populations, whether working or holiday, will have a very large bearing on the type of development which is possible and desirable.

As long as the production of timber is at least a companion objective to the provision of recreation, the capacity for recreation will bear a close relationship to the size of block, i.e. unless forestry is abandoned in favour of park conditions it is only the larger blocks of woodland which can absorb large numbers of visitors.

What more is known about capacity? It is certainly an amalgam of physical and sociological factors. On the physical aspects it is always a torturing question as to whether the bearing capacity of the site should be improved artificially or whether such improvement will destroy the integrity of the countryside. There are a number of useful tools for this improvement available now from so called "grass concrete" through "broplene land mesh" to "hydro seeding" and "glass fibre soil stabilisation". All these seek to retain some grasslike character to a strengthened surface and offer a more sympathetic visual appearance than tarmac or even an expanse of rolled stone. On the sociological side there is a need to cater on the one hand for the gregarious and on the other for the seeker of solitude. The latter by his nature will be prepared to make an effort, i.e. physical or extra cash, to reach his haven. Social studies can make broad generalisations as to the ratio of one class to the other and an on-the-spot survey should help to refine the ratio for that situation. It seems likely that small differences in design of say a picnic site will make a big difference to the satisfaction and therefore social capacity. For instance, it has been observed that the centre of an open space, whether it is a picnic place or a cafe, is shunned whilst there is still a choice of where to sit. The edge with a view is desired most. Hence capacity can be increased if instead of a hard-edged box-like area a sinuous outline is retained to a picnic site with plenty of cosy corners for families to make their own. There is also a class difference here. The cafe analogy is still helpful. Cafes catering for the popular market are often straightforward rooms with no privacy and customers feel one of a crowd. Cafes which are catering for a higher social class of person will sacrifice a little space and erect stalls, plants or other visual barriers which increase the capacity for that type of customer. A conflict

may arise in the development of a popular picnic site if the manager designs it with the seekers of privacy in mind and it is in a situation where it is bound to receive mainly gregarious visitors. The privacy seekers will arrive early in the day and the crowds will swamp them later.

It follows that the role of a block in relation to the surrounding population must be determined at the outset of planning. A forest can be a very valuable, and perhaps the only, open space within easy reach of the town, and the natural capacity may be no more than can absorb the local people walking their families and dog. Hence these "neighbourhood" forests within 5 miles of a town should be identified as of local appeal and kept for this purpose. The most important forests for general and car borne public recreation will lie between 5 and 35 miles from a large resident population, say 100,000 people or more. The upper limit to this mileage may be 45 miles if the road system includes much Motorway. There will be a strong case for such forests to be developed for the general day visitor. Forests further than this from large centres of population will be less important for the day visitor but may be of greater importance for active pursuits and for holiday overnight stays.

Another factor which has proved important is the general nature of the nearby population. If it is primarily a non-holiday area, e.g. the Forest of Dean, the resultant visitor pattern will be uneven with twice as many visitors on a Sunday as any other day of the week. If it is a holiday area, e.g. the Lake District, the pattern can be much more regular and peak numbers may be even be reached on a week day.

Forest characteristics

Table 1 shows many of the characteristics which a visitor might recognise or expect to be accentuated in a forest as opposed to other types of countryside. It is most important to try to identify how each forest is different from the next. Otherwise there is the danger of the 'Let's have a nature trail' answer resulting in a boring repetition and lack of new ideas. To reinforce this point it is worth looking for a moment at the content of the forest (nature) trails so far established in this country. The overwhelming majority carry a message of identification usually of trees but sometimes enlivened by wildlife as well. The opportunity for an exciting revelation of the role of the local forest in the conservation story is often not accepted. The reason for this may not be difficult to find. Foresters are so involved in their profession that they believe that the general public must also find forestry in itself interesting and they cast back to the training school and college days for inspiration. There is a challenge before us now which is greater than teaching visitors forestry. We are in a unique position to carry conservation to the general public. We have a closely knit nationwide profession and what better start could any revolutionary want than that!

At this stage readers will wonder just what programme is being advocated: is it education at the expense of recreation? The answer is that we do have a great opportunity for assisting in outdoor formal education and the Forestry Commission already conducts more than 50,000 school children on guided tours of its forests every year. But, for the general public, straight education lacks appeal. What is being advocated, therefore, is a wholehearted acceptance that interpretation is a recreation attraction and that an interpretative programme is an

early essential for any forest open to the public, necessary even before the first picnic site is opened. Interpretation leads to understanding and involvement. It offers a tool for an agreeable form of visitor control. The subject which is the basis for the interpretative message will always have a conservation basis but will ideally be related to local circumstance and have relevance to the visitors.

A check list of outstanding features for any forest should result from a study of Table 1 and this study is most effective if it is carried out by several disciplines such as historian, biologist and archaeologist with the forest manager as co-ordinator. There are always local experts who will give their time gladly for this sort of advice. One or two local story lines can be written and then the message can be apportioned to the media such as trail, information board, guide, visitor centre, etc. Too often it seems that the opposite has been the case and the media have been designed before a message was identified.

Table 1 This table identifies some of the characteristics a visitor might expect to see accentuated and some of the developments designed to do this.

Forest characteristic	Recreational developments which stem from forest characteristics a. general b. specific
1. Beauty of the landscape	a. Great care in the landscaping of forest boundaries and in forest operations generally to introduce change in a non-violent manner. b. Collections such as arboreta and pineta can be made into major attractions. Westonbirt arboretum and Bedgebury pinetum both receive over 100,000 visitors annually.
2. Lack of obvious human works	a. All artefacts are designed for the countryside and are not of an urban design. b. Urban recreation based on buildings and not the forest fabric are excluded.
3. Diversity of view, habitat, fauna and flora	a. The health of a countryside depends upon diversity of habitat. This has led in recent times to a promotion of hardwoods and mixtures, giving priority to areas of high amenity. b. Viewpoints, observation towers and over-head walkways in the trees offer opportunities for the study of wildlife both living free and, exceptionally, in collections like Whipsnade. The success of the latter must depend upon devoted care by skilled managers.

Forest characteristic	Recreational developments which stem from forest characteristics a. general b. specific
4. Relative strangeness and lack of knowledge of land use	a. General interest in forests and forestry. b. Guide services Information centres Films, slide shows, lectures Educational services
5. Slow to change, long lived appearance	a. Forest work which is sensitive to land form and the forest traditions of the area. b. The retention of mature trees preferably hardwoods about concentrated recreation zones.
6. The woodland edge. This has a special visitor appeal which is at its highest where wood meets a stream or lake	a. Special care for treatment of trees. b. Ideal situation for siting of car parks picnic sites and starts of forest walks.
7. Large space to roam and stay overnight without artificial boundaries	a. General access for the public wherever legal and other constraints permit. b. Designation of forest parks Camp sites Forest cabin developments Bothy accommodation
8. A system of paths and trackways	a. Signposting of paths to supplement public footpath system. b. Forest(nature) trails Forest walks (without interpretation) Forest drives Motor rallies
9. Sports such as shooting, fishing, orienteering and pony trekking	a. These specialist, minority sports are zoned in time and space so that they do not deny the general visitor access to the forest. b. Shooting leases and permits Fishing clubs National agreements or orienteering and car rallying Local permits for pony trekking
10. Study of nature	a. Make properties which are surplus to requirements available as field study centres. b. Encourage school and college studies by handing over research projects to them, such as bird population studies.

Forest characteristic	Recreational developments which stem from forest characteristics a. general b. specific
11. Adventure and contact with the elements in a relatively sheltered environment	a. Encourage active enjoyment of a semi-natural environment. b. Long distance walks Adventure camping Primitive holidays - re-enactment of early tribal life
12. Historical or archaeological interest, including industrial archaeology	a. The restoration and display of sites in the forest involving volunteer labour. b. Well labelled sites Reconstructions Museums
13. Production of raw materials such as wood, venison, animal skins, leaves and fruits	a. A recognition that visitors will want to buy souvenirs as a reminder of a visit to the forest. b. Production of souvenirs from a cottage industry Sale of venison
14. Peace through the visual and aural privacy which a forest provides	a. Zonation of the forest. b. First class signing and information system Zonation to limit cars and attract general public to a few chosen areas Zones of silence
15. The unexpected	Local inspiration.

ASSESSMENT OF RESOURCES

Cash

Recreation planning should include a system of priorities so that as cash is available the most urgent schemes can be implemented. In the Forestry Commission it is probable that cash will be allocated on a regional basis and be related to the population in that region.

Supervision

Recreation is a new discipline and requires careful attention to detail from a higher level of management than the level of expenditure on each item would normally warrant. Much of this supervision is concerned with design and foresters need support from people with these skills. There is a growing need to extend the forester's training to include recreation as a main subject but also to accept that other professions, especially, in the sociological and design fields, must be involved in this work.

Labour

It is always worth involving the labour force at an early stage in a recreation programme. The genuine appreciation which the public expresses for the establishment of new facilities soon overcomes the reluctance of workers to undertake new tasks and to adopt new objectives.

CONSULTATION WITH OTHER ORGANISATIONS OPERATING IN THE AREA

County planning authorities must be consulted at an early stage in recreation planning. They should be able to give guidelines on probable demands and will wish to discuss the larger projects in detail. Other bodies which should be consulted include the National and Regional Tourist Boards, particularly regarding their strategies for overnight accommodation and information centres, the Nature Conservancy, the National Trust, if they own land nearby, and local amenity societies.

DEVELOPMENT PLAN: BUILDING, OPERATING AND RECORDING

The basis for the plan will be a map of the forest which shows the physical contours, the areas of high landscape value, sites of historical interest, sites of scientific interest, public footpaths, existing recreation facilities, leases, and finally the new proposals. It is only when all is set down on one map that the strategy for visitor guidance and zonation can be fully appreciated. It is at this stage that the sign-posting, information boards and leaflet dispenser points must be pinpointed and the site for an information centre located. Whilst these matters are being decided the location of zones of least disturbance or even silence (as are now declared in the French Forest Service) should be delineated.

Next will come estimates of the capacity of each area or facility to make sure that services are being established which keep step with each increase in capacity. Car parking is the key to the overall use of the forest. Control of the car park by charging on exit, at a sliding scale, will often be the most effective method of ensuring turnround at a popular site.

Site operation should be governed by the thought that if there are visitor problems, such as litter, vandalism or overcrowding, it is the management which is largely to blame. Problems of this kind often indicate that the managers do not accept visitors wholeheartedly. Another aspect of operating is the matter of opening hours. The facilities need to be open for seven days a week particularly in the afternoon. Extra staff may be needed to achieve this and an entrance charge may become necessary to pay for them. Such employment offers an opportunity for retired staff.

A vital part of the plan is to make provision for recording. Good records are invaluable as a basis for future predictions both for the site and for other similar situations. Ideally the build up of publicity, daily use, the type and origin of visitors and their behaviour and enjoyment should be surveyed. A low level of recording will be adequate when no charges are levied and this will increase to intensive surveys when investment decisions must be made.

THE REVIEW PROCESS

Experience in the United States of America shows that the manager must be prepared to identify a capacity for his forest and to plan not to exceed this even at peak times. There is bound to be a temptation to continue to cater for extra visitors by additional facilities. It will be better to plan to direct them to new opportunities elsewhere. Data for the review process should be accumulated constantly and the feedback from visitors by question and behavioural study is the most important part of this work.

CONCLUSION

This paper scratches the surface of the new profession of recreation management. It is an attempt to show how many sides there are to it and to encourage the adoption of a flexible plan to harness the enthusiasm which abounds for the multi-use of forests.

AMENITY AND THE PRIVATE OWNER

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INTRODUCTION

It would be fair to say that woodlands which yield, at present, the greatest amenity are those which are deciduous and generally speaking in the lowlands. Members of the Timber Growers' Organisation, which is an organisation representing the interests of private woodland owners, have over 550,000 acres of woods in England and Wales in their ownership and something over half of this acreage might be considered lowland forestry. It represents an immense store of capital and yet it is the least profitable end of the forestry business. Since it is hard work to manage a crop of timber to make a reasonable return on the capital invested, it is surprising how much enthusiasm there is for ownership and how much activity there is in the world of forestry, despite the difficulties which owners face.

The great majority of deciduous woodland is in private ownership as the Forestry Commission has been unable to purchase mature timber to any noticeable extent and relies on its income to develop from plantings which have been made since 1922. This privately owned woodland has a great tradition of being "Landlord's Corn". It is an asset that can be realised when need is great and more often than not the money raised in this way has been returned to benefit the land in another form.

Imprudent and extravagant fellings have always been regarded as the prerogative of the wicked Uncle, who of course can be characterised and imagined squandering his ill-gotten capital in gambling and on those attractive ladies whose portraits, often unnamed, adorn ancestral walls. These can be studied endlessly in the search for that hint of subtlety which so obviously entranced one or other of our forbears.

AMENITY

Whether the felling of trees for cash to pursue such an object of desire would be classified as amenity fellings I would doubt, but there is no doubt that many of our woodlands have been planted and maintained from time immemorial for other sporting activities. It is only in relatively recent times that proprietors have turned their minds to the active cultivation of trees as a rotating crop which they must become if they are to yield an income. It is this interest that has created amongst owners an enthusiasm for forestry that is not easy to understand in cool financial terms. There is a romance about growing timber, the feeling that something will last after we have ourselves departed this life that encourages us to leave our mark upon the countryside but we must look more carefully than this into the reasons which cause an individual to tie up his capital in an investment which is so imponderable. I would answer that the over-riding attraction to the ownership of woodland is this all embracing word "amenity". My dictionary describes amenity as meaning "The quality of being pleasant or agreeable in situation, climate, manners, or disposition". It is a dreary wood which does not have some of

this quality and there are few forest managers who do not, in their own way, do their utmost to achieve their own idea of amenity. This ideal can vary from individual to individual. One man's meat is another man's poison, as so many foresters discover when the headkeeper appears on the scene supported by an enthusiastic sporting owner.

The Forestry Commission is much maligned by all and sundry for its dreary plantings of large areas of conifer, because even now, and only then among the earlier plantings, are they emerging into a state where their amenity cannot be denied. Delay in achievement is a penalty which cannot be avoided with large plantings all carried out over a short space of time. It is the uneven-aged mixed woodlands, which are largely in the hands of private owners, which provide the greatest amenity in the countryside and the achievement of this amenity has taken several generations of management, as well as constant care and attention to long-term planning and silviculture. Amenity does not come overnight; it is the product of careful management on a time scale which extends beyond the life of any one man and it requires a continuity of purpose rare in any industry or even in any single person in this age when life seems to move at an ever increasing pace. Looking back we can recognise that it was in the leisured period of the 18th century that our forbears had the time and money to concentrate on planting for amenity, the time to think and consider how to soften and balance the countryside with timber, how to improve their sporting interests, and how to provide the dignified privacy which they are seeking. Much of what was done in the 18th century is now in its last stage of life and we have the very difficult task of replacing a large proportion of the crop in an age when money is short and when people expect results overnight.

The present-day private woodland owner who thinks over this problem consciously recognises that he has inherited something with an ancient value which is beyond that of money alone. He knows that he can sell his mature timber and raise some cash quite quickly, but he knows too that he will not again in his lifetime see fine trees to replace those which he has removed, and indeed he may bitterly regret the enthusiasms of his wicked great Uncle! A wise owner is well aware that he has inherited a responsibility and this can be onerous but he must take action, as silviculture is a continuous business.

However, I think that it is fair to say that this responsibility is usually accepted with a good grace and it is exceptional to find an owner who wants to fell all for cash regardless of the future, even though Estate Duty may give little alternative choice.

SPORT

He will, however, turn instead to the other amenities that his woodland can provide to compensate him for the lack of direct income which he may achieve from them. The most important asset which is likely to be obtained in this way will be the sporting amenity. This can take various forms as we shall hear in the next sessions, but over large areas of the lowland countryside the shooting rights form a very important asset in the hands of a woodland owner, and many woods are maintained for this purpose alone, forestry being of secondary importance to the pheasant. I do not need to deal at length on this point in this paper as it will be adequately covered elsewhere, but the sporting amenity is a matter of great importance in the life of the countryside and one which is jealously preserved by those who possess it in order to compensate them for the loss of other more tangible financial rewards.

It is unfortunate that the sporting side is so little understood or appreciated by the public at large, and that the deadly sin of envy bites deep into many an urban mind. It is sad too that it is very difficult to mix public access and effective sporting control. Woodlands will absorb an enormous number of people seeking peace, recreation and separation from each other. On the other hand, sporting interests make it imperative that the public are not permitted to wander at will through woodlands. They must be channelled on to well-recognised footpaths and large areas of woods for sport must remain undisturbed. We are now near to the moment when land-owners and foresters must consider the balance between their own personal amenity of peace and privacy together with their sporting interests which have a value, against the value that could be obtained from access agreements with local authorities, co-ordinated with car parks, country parks and footpath circuits, and financial assistance will be required by local authorities to help in controlling the depredations which occur when visitors come in overlarge numbers.

PUBLIC REACTION TO FORESTRY

From what I have said so far it will be understood that I believe that private woodland owners greatly value the amenity, in the true sense of the word, which their woods provide, and that this amenity takes generations to achieve. Where commercial forestry is unprofitable the sporting assets are of great importance. It is necessary I think to consider one aspect of the impact which this matter of sport has upon the countryside and therefore on public opinion. Forestry and silviculture are little understood by the general public at large and in areas where no active silviculture is practised the people come to consider that trees and woods are permanent items of furniture in the countryside. They do not appreciate that timber is a crop, for ever changing and developing. Therefore where an owner is neglectful, or simply has a negative forest policy on account of his game-keeper's requirement, the public get used to seeing the same pattern of timber year after year. Any change as a result of change of policy or change of management is a shock and causes an outcry, all the more violent in heavily populated areas because it is often unexpected and seldom anticipated.

In many areas this outcry has provoked a reaction at local authority level with the consequent application of Tree Preservation Orders (T.P.O.). These are a negative woodland policy of the worst kind. The application of a T.P.O. is invariably an admission of failure, and not only this, but frequently selfish and ignorant too, since the trees preserved may only benefit people alive now without due thought for the amenity of those who follow. A T.P.O. is a failure of advance planning both by the community and sometimes by owners of the trees concerned. It is a failure to make the best use of an asset which is changing through every moment of its life however long, and it is a failure of communication between parties who should be able to forecast and recognise an inevitable course of events. In its present form a Tree Preservation Order is a continuing failure since there is no power for the parties involved to review the order as it should be done perhaps every ten years for the sake of good management. Expansion of urban development may cause isolated areas of timber to become unexpectedly important in the scenery. An owner may have to accept a T.P.O. in this cause, but the trees protected will not stand for ever, and good planning should consider their future and take steps to ensure their replacement.

Nonetheless this problem does show that the general public are becoming increasingly aware of the importance of timber in the countryside, despite the fact that they are largely uneducated as to how to deal with the matter. Age-old tradition on the one hand by owners makes them suspicious of a single stranger in their woods, and modern freedom of movement on the other by the public brings ever greater pressure on the limited areas that are available for recreation. Controversy and compromise are already with us and must be anticipated as inevitable wherever the country is heavily populated.

PUBLIC ACCESS

Public amenity in our crowded island is becoming a matter of political importance. It has been said in high places that the countryside is there for all to enjoy, not just only for those few of us who have the benefit of it because we live in it or own it. Such a philosophy may be admirable in theory but it has serious dangers in practice. Leaving aside for one moment the danger of confiscatory legislation, we have to come to know that people in the mass all too often destroy the very things they seek; privacy and peace, beauty and serenity, natural growth and continuity of management.

Our woodland areas in Southern England are largely privately owned at present, and there is the danger that on account of public demand and population pressure, legislation will cause them to be opened up more freely to the public than they are at present. Already this power of compulsory acquisition for country parks exists in the Countryside Act, and such powers, used without due thought for the future pattern of woodland and land management, could cause the traditional good husbandry to fall away into sterility. It is essential that those planners who are looking ahead to see where public benefits may be obtained in our countryside should consider this point with care. The whole concept of planning in this way is new. Public pressure demands that it should exist, and in due course the public with its usual hindsight will blame those who, on the one hand refuse to admit them to areas of high visual amenity on grounds of individual privacy, and on the other hand those who permit commercialisation in such a way that the charm and peace which is so much sought and valued is destroyed. Local authority planning can easily become culpable in this second respect and it is important that we should construct long-term plans for the future and fit the short-term and immediate requirements to these long-term plans. Local authority planning can also be malicious and positively harmful to long-term amenity where those in authority for the present can see only the current landscape as satisfactory. They fail to realise that death and decay of timber will in the end ruin what they see, and that the future must always and constantly be in the minds of those who attempt to legislate or control timber growing. There is no wood in our country which is not the better for constructive planning and active management.

I live in an area in the Chilterns where active forestry has been practised for as long as anyone can remember. Over the past 15 years we have developed and increased this activity and substantially changed the pattern of management and silviculture out of economic necessity. It has been a matter of interest and surprise to me to discover how young trees growing vigorously will overcome the depredations caused by public access. They will even survive constant contact on the side of a much used public footpath, so long as their leading shoots are not broken off. There are

fire risks from public access, and litter and vandalism are a constant problem, but in general it is surprising how the forest will develop once it is well-established even though a large number of people pass through it.

The time when exclusion, however, is essential is in the early years, perhaps the first seven, when young trees are still below eye level. At this period of their lives, especially early on, they can be trampled and damaged beyond repair. They are also substantially at risk from vermin and rabbits and the problem of cut and lifted fences and open gates is one that cannot be completely overcome. A carelessly thrown cigarette end can devastate a young plantation and years of work can be wasted in a few moments. It seems therefore that in woodlands where public access is inevitable a policy of exclusion must be practised for what is a relatively short time in the life of a tree and thereafter I would willingly accept access upon well-defined and carefully planned paths as little damage occurs and positive good can come from ever-increasing public knowledge of how a woodland develops.

Again experience has shown that sentiment plays a great part in public reaction and where a pattern of regular felling of mature timber is established, there is general acceptance of the sight of upturned butts and fallen timber. However should this take place in a woodland untouched for years, and much visited by old ladies with their dogs, outcry is inevitable. However ghastly the timber as a crop, however much one may explain that in 10 years' time it will be as beautiful if not more so than the current shambles, conservation and pigheaded ignorance is an almost universal reaction. Woodland owners faced with this problem need the help of the local authority in these matters, not the dead hand of a T.P.O. Explanation, constructive action, temporary public exclusion are necessary, and some financial help if the area must be used for access and therefore footpath fencing needed.

Many of our woodlands in semi-urban and suburban areas will be affected in this way. If they are to be effectively conserved for the benefit of people in the future, then they should not be neglected now, and positive action should be taken with the help of local authorities to put them in good order.

I must emphasise here that there is one important difference between private woodland owners and the Forestry Commission and other local and Government sponsored bodies. The vast majority of private owners have no hope of expanding their acreage which is their basic fixed asset. To meet ever increasing economic demands on their resources, timber production and the related business that goes with it must expand and develop without any additional land becoming available to enable the cropping acreage to expand. This is the cause of a tremendous difference in outlook between many lowland private owners and officers of the Forestry Commission. The latter have not only a reserve of land available but, if they are able to justify their case to the Treasury, they can expand their Estate. Few if any private owners outside the management companies who operate largely in the uplands can do this and as a result we begrudge surrendering land to other uses, and even more so we begrudge any attitude implied by the Commission which indicates that since it has a duty under the law to provide public access, everyone else must follow suit.

WILDLIFE CONSERVATION

From the point of view of wildlife conservation it is important that those who speak with authority on this subject should make themselves heard and understood at an early stage in this planning for public use, or misuse, of woodland areas. Already countryside committees exist and the private woodland owner, where he is represented, has a hard struggle to maintain the interests of silviculture as a whole against narrow-minded amenity interests. Wildlife conservationists speak with authority and good sense at such gatherings, but they are also requiring that quite large tracts of countryside should be left undisturbed. This very requirement provokes an interest from those who feel they are being excluded from participation, and causes a reaction from outsiders which may well be damaging to the interests of conservation.

Conservation societies need to have close liaison with private woodland owners. Their interests are often very similar, and much good work can be done by quiet negotiation between individuals, so that an agreed pattern can be presented to local authority planners in areas where there are conflicting interests. Public pressure in some areas in the future is going to be so great that we must decide now from where they must be excluded permanently for the long-term good of the country as a whole.

I would say that there is much more in common between private woodland owners and conservationists than there is between either party and the public access lobbyists. While all private owners are not by any means all naturalists, there is a fund of goodwill available and by mutual discussion and negotiation any existing suspicious and misunderstandings can, I am sure, be dispersed. Population pressure will defeat wildlife interests unless there is careful planning by all of us, and under no circumstances should the urban public be permitted to overrun and submerge the countryside thereby destroying the very thing which all of us, be we town or country dwellers, value most. We are all part of the general public!

SUMMARY AND CONCLUSIONS

In concluding this paper therefore I would like to leave in the mind of the reader the following points which I believe are significant to the private woodland owner relative to the amenity of the countryside, not only to himself but to the public, the conservationists and the local authorities.

Firstly, the woodland owner is himself as conscious of the benefits he obtains from the amenity of his woods as any other person. He values his woods not intrinsically in money terms but for many other things, beauty, peace, sport, privacy and tradition.

Secondly, trees are a crop, constantly changing, maturing and developing and as such they must have continuous management. Although when very young they do not provide much amenity, as the years go by this develops and long-term continuity of purpose and management is needed to develop this to perfection.

Thirdly, the general public in heavily populated areas reacts with strong emotions and sentiment to felling of trees with which they are familiar whatever kind or quality they may be. The public are largely

ignorant of the practice of silviculture and what good management entails and can produce for them. Many are only interested in the present, and ignorant public outcry can cause an equally ignorant and occasionally selfish and malicious local authority to take steps with Tree Preservation Orders that do nothing constructive for the future and may well be positively harmful to amenity over anything but the very short term.

Fourthly, public amenity is now a matter of political significance. Local authority planners must consider with care how heavy pressure in the future for public access to woodlands should be met in such a way that the public do not themselves destroy that which they seek and value.

Fifthly, owners may have to accept a restriction on their freedom to exclude the public from their forests. Access provided should be planned to co-ordination with the local authority and compensation should be paid to recompense individuals for what they are losing of their personal amenity and this is not easily assessable in financial terms and a yardstick for this will need to be devised.

Sixthly, the wildlife conservationists must be certain that they are heard at planning levels so that they can, together with private owners, stake their claim for exclusive use of woodland areas. Universal public access may be demanded but must never be permitted for reasons of essential conservation and management.

Lastly and most important, the public and therefore local authorities must accept that good management and good husbandry in woodlands, as in agriculture, depend upon the exclusion of any destructive element from young plantation areas for a period which may seem long in years but which is short in the life of a tree.

Private Forestry is a Cinderella industry, ill-rewarded and practised often for sentimental and sporting reasons only. Its significance in the countryside however is so great and so important that it needs the abundant goodwill of the public and local authorities, together with continuing support from central Government Funds if it is not to fall into derelict decay. The general public must be restrained and guided from destroying, by its own pressure, many of the rural assets which it values most and we must plan and value with great care those areas of land and forest which will have to be surrendered to meet the demands for intensive public access.

SESSION 4 SUMMARY OF DISCUSSION

Williams. I think we should look at sources as well as demand. Why not look at areas which have been damaged as a result of industrial operations over the last century and a half. We have approximately 250 thousand acres of derelict land in Britain, mainly where the urban population lives and mostly council-owned. In a small country like this, we cannot afford not to reclaim this land. I suggest that the Countryside Commission concentrate its effort in these areas rather than try to spread demand all over the countryside. There are going to be conflicts and it should be stated categorically that wildlife conservation and recreation are not automatically compatible and the greatest difficulty is caused by the motor car and the disturbance associated with people in large numbers. We must look at the recreation problem in relation to the centres of population density.

Workman. The Forestry Commission and counties like Durham have done a lot of restoration in worked out mining areas and there is scope for making country parks on some of these areas instead of spoiling places which have another function.

Lloyd. I agree. A map of the country parks so far approved shows that they are concentrated very close to major conurbations and quite a few of these are created on reclaimed derelict land. There is financial aid available now for reclaiming derelict land. The intention is to create attractive landscapes and recreational opportunities in these areas close to the conurbations.

Parker-Jervis. These things cost money. The Minister will provide 75% but reclamation can be exceedingly expensive. Finding even the 25% is often a matter of great difficulty. The money offered by the Countryside Commission is not a complete palliative and ultimately this is a burden on the public pocket which the public must accept as such.

Lloyd. In the iron and steel industry a levy is paid on every ton of iron stone mined so that money is left over for restoration. This could be extended to other industries, such as gravel workings, to pay for recreational areas.

Workman. Some of us have suggested that this should be written into the planning permission of almost all mineral exploitation schemes.

Campbell. I find a basic conflict here that I have not been able to resolve. Do we manage the nation's natural resources to meet the needs of the majority of the population? The majority of the population are urban-based and they may conflict with people who live in the countryside and usually love it and do not need to be educated towards preserving a certain level of quality. Do we want quality or do we want quantity and what is the balance between the two? I think this basic conflict is a matter for government on which we should provide some advice. As resource managers are we saying that we are going to decide what the quality of the environment is going to be?

Workman. The government must tell us what they want but our object is to devise a system to accomodate it.

Parker-Jervis. Mr. Campbell represents management companies and is clearly concerned with efficiency. There are two sides to private forestry, the efficient side and the eccentric type of woodland owners whose actions are governed by a variety of different reasons. Fortunately, in the context of existing legislation, there is a sufficiency of eccentric ownership which is not directly related to investment to preserve a broad variety. A second point is that recreation as a national problem is remarkably like delinquency. Central government, through its recent acts, has made the care of children a regional responsibility thus putting a burden on the rate-payers. They have taken a national problem and planted it as a legal obligation on county councils.

Orrom. What we should be aiming at is to preserve the difference between countryside and town. We must provide a difference of black and white, we do not want a grey mass right through the land.

Holmes. I agree that if we accept the idea of providing these benefits for the greatest number let us do it by providing rural facilities rather than urban facilities.

Wright. We have the opportunity to turn visitors into an informed public who really appreciate the countryside and its wildlife and help to conserve both.

Workman. I think the Countryside Commission could do more through television programmes to reach the public before they come into the countryside.

Aldhous. Recreation pressures do not apply evenly over the whole countryside. The public prefer the sandy areas and forests where the floor is covered in pine needles rather than dense vegetation. Many of the really rich hardwood resources which are good for wildlife are very often on heavy soils with thick ground vegetation and these are not particularly attractive for recreation. I think part of the conflict between recreation and wildlife is over-stated and with some manipulation the recreation pressures can be channelled into the less sensitive areas.

Peterken. At Sutton Park, which is embedded in the Birmingham conurbation, there are 2,000 acres being very well managed partly as a parkland landscape, partly as a woodland landscape, and partly as an open heathland landscape, where it seems to me possible to integrate public access and use of the area with wildlife conservation. From experience there I am optimistic that the countryside can sustain a considerable increase in recreational pressure with relatively little damage to its wildlife content.

Lloyd. In planning it is usually possible to find some areas on which to locate recreation.

Parker-Jervis. I think that mixed forestry is very definitely acceptable but it is difficult in certain areas because of insistence on the maintenance of the hardwood crop.

Jeffers. Perhaps we are being a little too philosophical about what people want and we should be more realistic and provide some honeypots where people will go.

Workman. Surely we are all agreed on having honeypots but what we do not know is where to put them and I think most people here do not want to put them in the forest.

Lloyd. The majority of the population never vary their choice of locality unless we publicise a new area and signpost it adequately.

Rixon. One difficulty is that the local planning office and the county council who make the plans and take the decisions may decide to develop woods for recreation which may be of the highest wildlife conservation value.

Workman. I think every county in England now has an Assistant Regional Officer available from the Conservancy who should be able to advise the Planning Authority. We must make sure that planning officers listen to his advice and have closer contacts with the Conservancy so that they will not make these wrong decisions.

Prior. I think it very important to sieve the different types of visitor. I am thinking of a pair of woods where by a chance of geology one has beautifully hard packed chalk rides and is a perpetual picnic site and dog exercise ground. Two miles away where there is clay with flints on top of the chalk and the woodland road lines are rutted and not cleared, there are only a few people who want to look at something specific. The sieve is working excellently. If the roads are improved that sieve will disappear.

Holmes. This concept of honeypot and sieve is very important. The honeypot is used to cater for the urban interests in an urban sort of situation in the countryside. Although we may not like this the honeypot principal is vital to our management and control of the situation. What we should be discussing is what sort of honeypot should we provide because it is only by getting the majority of people attracted to these areas that we are going to preserve the other values of the countryside.

Rogers. The public enjoy old woodland rather than young woodland.

Workman. The criterion is really accessibility. In the Lake District, sheep keep the ground clear and you can walk anywhere in shoes.

Williamson. At Kingley Vale the car park is at least a mile from the Nature Reserve and the pressure on that Reserve is far less than it would normally be. I think putting the car park as far as possible from those areas which are ecologically delicate to reduce public pressure is a principle we should bear in mind. Kingley Vale also has a little museum which the warden has set up there for interpreting the features of the area to school children and others.

Kerr. I cannot remember the exact figures but the Geography Department of Edinburgh University did a survey on what the public would expect in a country park. The response obtained was toilets 99%, children's playground about 75%, some fixed recreational facilities such as tennis or putting 60%, and natural history pursuits 5%.

Workman. Is the moral that the forester should not be attempting to cater for anyone except that 5%? Do all the other people want country parks and not just to be in a wood? Should we make country parks for them?

Dawkins. Things are going on all the time in forests, and there is never a word of information by the roadside as to what is being done and why. I think public ignorance is part of the trouble with forestry today and notice boards beside forestry activities explaining what is happening and why would reduce adverse comment.

Workman. I think that is a good idea and something which perhaps the Forestry Commission could experiment with.

Dawkins. Not only the Forestry Commission but private owners as well.

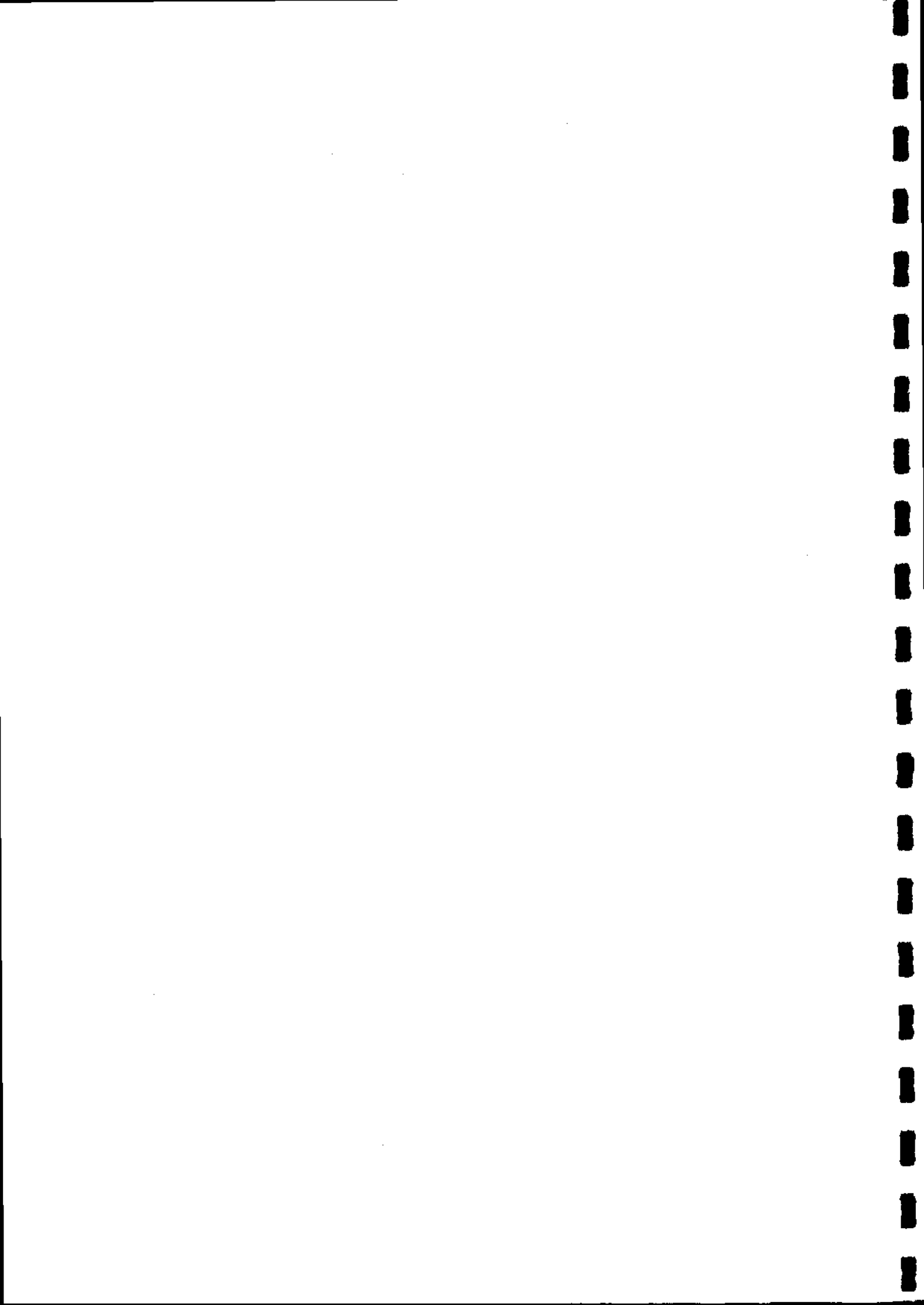
Lloyd. Many city schools are introducing urban children to the countryside and we can help to instil a sense of responsibility and interest at an early age by teaching children about the countryside.

Workman. Teachers' training colleges are even more important than schools because the teachers can pass on the information to children.

Orrom. Foresters should invite people to see what they are doing by putting up notices in appropriate places. The size of honeypots is important. They can be on extremely small areas and still be effective in attracting people away from other bits of woodland.

Parker-Jervis. Where forest activity is continuous the local population accepts it so public relations activities should be concentrated in new areas of forest.

Workman. I must now draw the discussion on the subject of amenity and recreation to a close. I think the most important thing that has come out is that we must all look at the range of values of our resources and make recreation decisions only after very careful thought and consultation, whether it is the Forestry Commission, the Nature Conservancy, private owner or local authority. Planning is necessary on a regional basis so that access to one area is related to other places in the district. We must forecast future pressure as best we can so that we can plan ahead and planning must be more systematic and not just happen as a result of the enthusiasm of an owner or a forester.



PHEASANTS AND FORESTRY

N. Gray

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INTRODUCTION

It is not so long ago that foresters and non-shooting landowners considered good forestry and pheasants to be alternatives and a combination of the two as virtually impossible.

There were several reasons for this attitude and some, unfortunately, stemmed from an antipathy which had grown up between foresters and game preservers. More sensible counsels now prevail, but there are still areas where compromise is necessary and when planning for the future it is important to decide on the correct balance between the two interests. This will vary as between the preferences of the owner, the proportional size of the forestry enterprise and the geographical position of the property. All these will influence the economics involved.

Generally speaking, land which is most productive of wild pheasants in Britain tends to be least productive for forestry and annual rainfall is a useful guide. Below a rainfall of 35 inches a year pheasant numbers are better than average. Above this figure numbers begin to decline and at about 50 inches natural breeding ceases to provide a significant shootable surplus. Nevertheless, high rainfall areas can produce good pheasant shooting if the stock is augmented with released birds.

THE VALUE OF SPORTING RIGHTS

The demand for shooting increases each year, but good game habitat is decreasing because of modern farming and forestry systems. As a result, rents and capital values of sporting rights are rising steeply. This has pointed to one of the principle problems of integrating other activities with forestry, namely the difficulty of maintaining flexibility. For instance, shooting rents in 1950 were averaging about 15p per acre and few could have foreseen that they would increase up to tenfold in twenty years. On estates where the owner was not interested in shooting, many good game coverts were ruined by unsympathetic forestry because, at this time, shooting was considered to be something that was done simply for pleasure and produced insignificant cash value as an income. With the huge increase in the value of sporting rights many of these landowners are regretting their, perhaps understandable, lack of foresight. But to alter plantations which are 15 to 20 years old is a very expensive, if not an impossible, task.

However, there is no reason why landowners and foresters should make the same mistake today because even by the mid 1950s, we, at Fordingbridge, had worked out plans for including game habitat in commercial afforestation which could be put into practice at acceptable cost. Until recently, alas, we were lone voices crying in a largely hostile forest! Today, the increased value of sporting rights, part of the so-called 'leisure explosion', is rapidly changing attitudes.

The right balance between the interests is difficult to quantify because there are so many variables but certain principles apply in all cases. I will take two widely different examples. First, a farm of 1,000 acres, including 100 acres of woodland in north-west Norfolk. With good management and without rearing, this farm could probably produce average bags of about 1 pheasant per acre, with variations from $\frac{1}{2}$ to 2. It would attract an annual sporting rent of about £1.25 per acre or £1,250 for the whole farm and the capital value of sporting rights could be as high as £75 per acre (the normal valuation of, say, 20 years purchase of the annual rent does not necessarily apply to sporting values). Modern farming methods and crop patterns can change very rapidly and nearly always unfavourably for pheasants, which makes the comparative stability of woodland areas extremely important to game conservation. Because of this, unsympathetic afforestation would affect the game production on the whole 1,000 acres and not just the 100 acres of woodland. The rentable value might well be reduced by at least half (£625). On the other hand, intelligent planning at the planting stage could avoid this loss provided that at least 5% of the woodland acreage was devoted to game habitat and this is a useful general rule. In other words, five acres is removed from the forest area in exchange for an annual income of £625 - surely a reasonable proposition?

A contrasting example would be a 5,000 acre estate in the north-west of England, including 3,000 acres of forestry, 1,500 acres of marginal land and 500 acres of productive arable farming. The sporting rent here might be 5p per acre or less. Assuming that the forestry acreage was already planted with conifers and was producing no significant crop of pheasants the problem could well concern the treatment of the marginal land. Entry into the Common Market might make the owner decide to afforest the marginal land but to plant as before would be to perpetuate the problem of inflexibility. On the other hand good planning would take into account the increasing demand for shooting and the probability that areas of marginal game production today are likely to attract much higher rents within the next decade.

Certainly, anyone in an area which is now regarded as remote, but is reasonably close to the line of a projected motorway, should bear this in mind. For instance, now that the M4 extension is open, it is possible to reach South Wales from London in a shorter time than it takes to get to Brighton!

HABITAT AND SHOOTING

To plan for pheasants in the forest one must consider two features. First, there is the right habitat for breeding and holding a good stock of birds on a wild production shoot or, in a high rainfall area holding capacity only on a reared pheasant shoot. Secondly, there is the shooting season itself with the problems of concentrating the birds in areas from which they can be easily driven and ensuring that they fly high and fast over the guns.

The floor of the forest is the most important feature of the habitat. Trees in themselves provide night roosting (although some pheasants prefer to 'jug' on the ground) and, for some hardwood species, varying quantities of seed as an addition to food supplies. But the most significant effect of the trees is that their species and density will largely dictate the quality and quantity of the ground vegetation, which will also depend on variations in soil and aspect.

Pheasants need warmth, shelter from wind, nesting cover and, with their preference for a wide choice of foods, a good variety of seeds and fruits, all at ground level. In days gone by, many of our best pheasant coverts were oak with a coppiced hazel understory. The oaks were often low in density, allowing plenty of sunlight to penetrate the canopy and producing excellent ground vegetation. The regular coppicing of the hazel for hurdle-making was an additional advantage because it resulted in a wood which was usually divided into a number of compartments, each in different stages of growth of ground cover and providing a great variety of habitats for the pheasants. This type of woodlands is disappearing today. Nevertheless we can still produce good ground conditions if sunlight is allowed to penetrate. This can be achieved in two ways, either by planting a reasonable proportion of less dense canopied hardwoods or, in the case of pure conifer plantations, leaving unplanted strips around the woodland perimeter and combining this with an adequate pattern of wide sunny rides.

The distribution and size of the woods is the key to the shooting problem. I often wish that there was a law against any wood being more than 10 acres in area and less than 200 yards distant from the next one as it would make my job a great deal easier! If I were asked to lay out a pheasant shoot on 1,000 acres of arable land, the basic design I would aim for would be two or three 10 acre coverts, each surrounded by a series of 2 to 3 acre spinneys spaced a good 'pheasant flight' (150/200 yards) from the main coverts and preferably on high ground. There are some landowners who are fortunate enough to have this kind of layout but, except in rare instances, it has usually occurred by chance. In arable areas one normally has to make the best use of existing woodlands, although there is an encouraging tendency nowadays to plant game spinneys where they are required.

Isolated woodlands larger than 10 to 15 acres can be very difficult to manage on a shooting day because they are often too big for one drive. Pheasants are usually reluctant to leave them when there is no neighbouring wood or crop for them to fly to. The best solution is to plant game crops nearby, attract the birds out by feeding, and drive them 'home' to the wood. This, however, is only possible if the farm is under the same occupation as the shoot, or the tenant farmer is willing to plant the crops, often at considerable expense. Where pheasants have to be driven to and fro within the wood to guns standing on rides, it is frequently difficult to get the birds to fly high and sometimes, if the compartments to be driven are excessively large, to get them to fly at all without an army of beaters and stops. Pheasants that rise through the tree canopy usually fly at treetop height and, except in mature stands of very tall timber, this usually means that they cross the guns too low to make sporting birds. Snap shooting at pheasants passing low across narrow rides is attractive to some but can result in comparatively large numbers of badly smashed or wounded birds. Even with rides as wide as 30 to 40 yards the pheasants rarely see the guns in time to gain any appreciable extra height before coming within range. The most satisfactory answer is to place the guns in a valley if this exists. When replanting woodland, it is important to make a careful study of the contours and leave valley floors unplanted if they can be used as gunstands. One should not be tempted to plant these areas with poplars which the guns 'can shoot between'. They don't! They shoot the leaders out every year, leaving a motley collection of mutilated trees which are an inconvenience for the guns and an unnecessary source of irritation to the forester!

The physical task of persuading birds to fly from woodland presents an additional difficulty. As the shooting season progresses, the density of birds is reduced and the problem is accentuated. This is not the case with game crops on the farm which can be reduced in size or eliminated entirely during the shooting season to maintain the game density roughly at the same level. Small coverts of $\frac{1}{4}$ to 5 acres are no great problem but large woodlands can be very difficult in this respect. Great improvements can often be made in semi-mature hardwood stands by clearing wide swathes of undergrowth on either side of the rides, leaving only the best trees to grow on. Maintenance can be by mechanical cutter or chemical spray. Wide, bare-floored clearings between pheasant drives can thus be made at reasonable cost and without affecting the timber crop. In hardwoods, the effect is to reduce the area of ground cover that has to be tapped out by the beaters, and to make it easier to prevent birds from 'leaking out' to neighbouring compartments beyond the flank of the line of beaters. This treatment can also have great aesthetic value in opening up fine vistas.

In really extensive coniferous forest it is only possible to provide worthwhile shooting by very careful planning before planting.

Let us take the hypothetical case of an area of continuous forest covering 500 acres. In this example the object should be to create pheasant coverts within the forest, deliberately using the conifers as a means of isolating one from the other. Applying the 5% rule would provide 25 acres for game. The basic plan should be to select, say, ten areas of 5 acres (preferably of marginal potential for forestry) and develop this for game in such a way that the expected timber crop would be half the value per acre of the commercial crop. This could be done by either reducing the tree density and underplanting with shrubs (laurel under larch and pine for instance) or including tree species beneficial to game but which would not be expected to be of maximum commercial value. The intervening compartments of dense-canopied conifers would be unattractive to pheasants except for roosting around the fringes and the birds would, therefore, be forced to concentrate on the selected areas.

THE DEVELOPMENT OF MARGINAL LAND

So far I have only discussed the more expensive type of shoot that would normally require the services of a full time gamekeeper. In addition, however, there is a very considerable market for so-called 'rough' shooting.

There are large areas of Great Britain that are perfectly capable of being developed to meet this demand and which are usually regarded as marginal land for sport. Pheasants are not necessarily predominant since much of the charm of this type of country is in the variety of species encountered. Duck, woodcock, snipe, grouse, capercaillie and blackgame are all possibilities where the forest is interspersed with marsh and moorland. Once again the 5% rule can be applied to preserve suitable open areas within the forest rather than plant up every available space. I must emphasize, yet again, the importance of thinking ahead when this type of planning is under discussion. Motorways not only reduce travelling distance but vastly reduce travelling time. The man who wants rough shooting is usually young, but, although he is probably less well off than the older generation, he is certainly more energetic. Four hours on a motorway plus an hour of by-roads on a Friday evening will

not deter him nor will rough country to shoot over. The landowner who considers himself to be in a remote rural area is inclined to forget this and dismiss the sporting value of his estate as insignificant. A good rough shoot with a low cost timber shooting lodge is in great demand on the continent and in North America. I see no reason why this should not be developed in this country, particularly where roe stalking is an additional attraction. In many instances the shooting lodge could be left for summer holiday occupation. And how much nicer is a log cabin compared with a caravan!

We estimate that no less than £35 million a year is spent on the sport of shooting. It would be a wise forester who gives careful consideration on how to guide some of this into his own pocket!

DEER AND FORESTRY

R. Prior
Head Ranger, Forestry Commission

HISTORICAL BACKGROUND

In the past the necessity to replenish timber stocks both in State and privately-owned woodland has been given priority and there has been antagonism to any other activity which might conflict with this prime objective. This antagonism could take the form, for example, of excluding the public from a forest area in case of an increased risk of fire, or of suppressing any form of wildlife which could possibly affect tree establishment and growth. The various species of deer present in our woodland headed the list in the latter category.

In more recent years it has not only been recognised that recreation in all its forms must become an increasing component of forest use, but also that opportunities for the recreational and other use of wildlife can be developed in parallel and without prejudice to the normal commercial operation of the forest. The control of animals purely to prevent damage can be an extremely expensive operation. On the other hand, given management techniques capable of reducing damage to tolerable proportions, wildlife can be developed to produce a reasonable return.

Red deer, Fallow deer, Japanese Sika deer, Roe, Muntjac and Chinese Water deer are all present in English woodland. The first three species are largely grazing animals and problems raised by their presence are shared by forestry and agriculture. English Red deer must be considered as something of a case apart. The only large population is in the West country, where their recognised, if contentious, position as a recreational asset affects decisions which would not apply under normal conditions. Elsewhere their numbers are comparatively small, and they are likely to be under pressure from promiscuous shooting.

The two small deer, Muntjac and Chinese Water, have not so far caused significant forest damage, although the Muntjac is spreading very widely and is likely to cause problems in the future, particularly in market gardens and similar places.

Populations of Fallow deer and Sika established themselves as a result of park escapes; at first during the 1914/18 war and again after 1939 as a result of the poor maintenance of park fences.

Roe, which rely on browse for their staple food, remain the forester's principal problem. While the main areas of colonisation are north of a line from Lancashire to Yorkshire and along the South coast from the Cornwall/Devon border to Kent, new territory is steadily being occupied where suitable habitat exists. In southern England deer were not in serious competition with forestry until just before and more particularly after the Second World War. Roe were re-introduced to southern England in 1800, but did not increase much until well into this century when, in common with the large deer species, they took advantage of the massive expansion of forestry which produced ideal habitats in the large

acreages of new planting. Established methods of controlling numbers of deer at this time, that is to say snaring and promiscuous shotgun drives, were unable to contain the increase, and numbers of roe and fallow built up very rapidly.

NEW METHODS OF CONTROL

Service men returning home from the war brought with them from Germany and elsewhere, an enthusiasm for the enlightened techniques of deer management which are accepted on the continent. Led by a small group of enthusiasts, public opinion was soon to grasp the advantages of rifle shooting as a more humane method of control. In 1963 the Deer (England and Wales) Act outlawed snaring and limited the use of a shotgun to S.S.G. or larger pellets. This was a compromise between the wounding inseparable from use of unsuitable shot, and, on the other hand, leaving farmers and others who did not possess rifles without the means of defending their crops from marauding deer. The continental system of deer management, although trophy-based, proved an excellent guide for the training of skilled riflemen and the development of deer management techniques well adapted for forest conditions. It does, however, pre-suppose that deer stalking as a sport has a very distinct value, and can be regarded as part of the forest product. Therefore, not only is the presence of deer in comparatively large numbers tolerated because of the revenue brought in by the sporting, but damage done by deer is the responsibility of the sporting tenant in most parts of the continent and he has either to take what expensive measures are necessary to protect plantations or individual trees, or to pay annually the value of the damage to the woods over which he has the right to shoot. Recently in this country, a demand has arisen for woodland stalking, and the value of venison has also more than doubled. However, these values are not yet appreciated on many estates and, elsewhere, other priorities, for example pheasant shooting, may prevent them from being developed. The forestry enterprise has therefore to stand on its own feet and take whatever practical and economic steps are possible to reduce damage by deer.

CO-OPERATION IN DEER CONTROL

A major step forward in deer management was made by the creation of local Deer Control Societies under the aegis of the British Deer Society. The object of these is to form an Association of land-owners covering the normal range of a deer community, and to apply in that area a uniform deer management policy. Stalkers accredited to the Society are available to carry out a management plan agreed annually, following as thorough a census as possible. Depending on conditions, in the area stalkers are either attached to certain woods where they have sufficient time available to carry out the complete management plan, or elsewhere they act as a police force, coping with deer control where it is found to be necessary according to the movement of the herd. Control thus remains with the owner of the land but skilled help is offered where this is not available on the estate. Above all, deer control does not vary in intensity between one part and another of the same herd's range. Uneven control usually results in influx. Free access for the stalkers prevents deer raiding crops during the night and safely lying up during the day on another estate, where he cannot follow them.

DAMAGE

Deer damage to trees can broadly be divided into fraying, browsing and bark stripping. The latter fortunately has not occurred widely in

lowland Britain, although it is a considerable problem both on the Continent and in parts of Scotland. Fraying, in the case of the larger species of deer is restricted to the time of velvet removal (a short time in the spring in the case of fallow deer) and principally during the rut. Browsing is almost entirely a winter problem except for certain very susceptible species such as maple, where buds and young leaves may be freely eaten in the spring and early summer. In the case of roe, fraying is resorted to for a number of reasons besides those already given, and principally as a threat display. The trees used for velvet removal in spring serve during the summer as territory markers.

With herding deer in woodland, rutting stands tend both to be traditional and restricted in size. Fraying damage is therefore concentrated to some extent in these areas. If the woodland is to be cleared and replanted it is likely that severe damage will occur in the neighbourhood of these rutting stands and it may be worth considering if such small areas could remain unchanged, thus avoiding the expense of repeated beating up. Deer can be controlled economically in these small openings when the rest of the new plantation is at the thicket stage. As an additional advantage, the creation of small breaks will inevitably harbour a variety of wildlife and improve this aspect of the woods.

Fraying damage by roe needs to be understood before control measures can be effective. Fraying stocks used for velvet removal and territory determination are scattered throughout the woods and are unlikely to amount to economically significant damage. Repeated buck demonstrations however result in areas of high damage. Such damage is caused primarily by competition for territory and where this is severe the antagonists are probably of fairly equal and small size. A territory buck faced by an intruder first approaches and then barks in challenge. If there is a marked disparity in size the intruder, seeing massive opposition, will probably not pursue his challenge. The same applies if a large buck wishes to displace a lesser. Barking is not effective where two bucks of equal size find themselves in competition. If, through high density, the territories are rather smaller than necessary the aggressive urge when two bucks meet is still at a high level, and this is where a confrontation often leads to demonstrations, and thus to damage. This can be repeated daily for weeks on end and a large area of serious damage develops. Animals low in the hierarchy are chased from the most desirable territories but are always pressing to return throughout the territorial phase. Damage from fraying as a result of demonstrations has been found to be materially reduced if the management plan seeks to preserve the largest of the territory-holding bucks. It has been further discovered that a large proportion of animals low in the hierarchy accumulate in the least suitable habitat which is still inhabitable by roe. The majority of animals culled can, with advantage, be taken from these low quality areas and not from the better territories. In this way the least successful animals are weeded out of the community and the prime aged territorial bucks are left in possession, with competition from their juniors much reduced. Fraying damage is minimised. It has the added advantage that there is less of an influx of animals returning to the main woods after the territorial phase, and thus the strain on the available food supply is eased at a time when browsing damage is likely to occur. The management system recommended for roe is thus based not on selection by antler growth, but on an assessment of the habitat, and bucks are culled according to age and behaviour. It is an interesting observation that the non-territorial adults observed in low preference habitats often carry poor antlers.

DAMAGE BY BROWSING

If the deer herd is in reasonable balance with its environment, the prevention of serious browsing damage depends on making susceptible plantations as unattractive to deer as possible. Either the crop must consist of tree species which are generally unacceptable to deer, or the animals must be made to feel unsafe when in the vulnerable crop or be impeded from free passage through it. At all times during the vulnerable stage of a plantation the aim should be to keep deer visible to the deer controller. It is unlikely that a planting policy can be changed materially because of the presence of deer but minor changes, perhaps of tree species, may be possible, or the size or treatment of the plantations may be altered so reducing the liability to damage. Deer habits should be considered at the planning stage of the plantation so that, for example, a highly vulnerable group of maple is not sited in an area where deer congregate.

Plantations can be made unattractive to deer in several ways. A major consideration is the amount of edge between vulnerable crops and thick cover. A long thin plantation in the middle of thicket will be immediately attractive to deer, whereas the same acreage in a square will be less so. The ultimate example of this is the under-planted group, where the whole of the new planting is within one bound of cover and security. Where silvicultural reasons permit, the maximum amount of cover should be removed before planting, making the job of the deer controller easier, and reducing the attraction to the deer. If possible it is advisable to concentrate one year's planting into reasonably-sized areas rather than into a larger number of small plots. Beyond this, a rolling system of clearing and replanting is very much preferable to scattered planting in which the vulnerable crop may be next to plantations in the thicket stage which provide plentiful cover but no food.

In lowland Britain weeding costs often form a large part of the total establishment cost. Once the trees are established it is probably not necessary to continue weeding down to a bare floor so leaving only the young trees for the deer to eat, and to which they have free access. A minimum weeding to free the leading shoot only will encourage a scrub layer which provides alternative browse for the deer, and prevents them walking freely over the area. Second growth should not however, be allowed to get high enough to hide a deer before the leading shoots of the crop trees are above browsing height. It is important in the later stages of a plantation that deer control should continue, and clearings should be left for this so that when the thicket stage is reached the deer controller can still operate. These can, for example, be frost hollows where trees are difficult to establish. Reasonably broad rides can also fulfil the same function but, unless the fire risk is high, a low scrub layer should be encouraged on either side of the access track. This not only provides food for the deer, but makes the ride less frightening to them. An important conservation benefit of this technique is that nesting cover for small birds and food plants for butterflies is also provided.

DEER AS A CROP

Measures such as these demand skilled help. The expense of this help, and of the limited damage which is inevitable if deer are present in managed woodland, can be offset at least to some extent, by regarding deer as an asset and not only as a pest. Mention has been made of the

increased prices available for venison. The return in 1970 from venison alone from an area of 6,000 acres administered by one Deer Control Society, amounted to no less than 50p per acre. This is a continuing benefit to be added to the periodic returns from a timber rotation. In addition to the venison, sporting rights can be let either on a short term basis, if trained staff are available to accompany visiting stalkers, or, with suitable safeguards, as a block letting for a term of years. This requires careful supervision on the part of the estate so that control over wild-life management is not lost. The sport provided by woodland deer is almost totally unexplored as a forest product in this country, but abroad it is a well-developed and understood industry, for which there is no lack of clients.

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WILDLIFE CONSERVATION; NEEDS AND PROBLEMS

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INTRODUCTION

The aim of wildlife conservation has been defined as the preservation of biological diversity under free-living conditions (Steele, 1972) which includes maintaining the variety of plant and animal species and the communities they form. This aim can be achieved by intensive and extensive methods or by various combinations of the two.

Intensive conservation necessitates the management of woodlands or parts of woodlands as nature reserves. Nature reserves are established and managed to preserve plants and animals and are chosen to represent the kinds of vegetation in Britain together with their associated animals. The Nature Conservancy has established 131 National Nature Reserves in Britain with a total area of about 270,000 acres in which some 70 Reserves contain about 15,000 acres of woodland. The distribution of statutory nature reserves in the lowlands is shown in Table 1 and on the map. Woodland Nature Reserves are also established by other organisations including the County Naturalists Trusts (with a total of over 600 Nature Reserves of all types), the Forestry Commission, the National Trust, the Royal Society for the Protection of Birds, Local Authorities and private owners.

Woodland Nature Reserves are an effective method of conserving the woodland flora and fauna and, properly chosen and cared for, they will help to maintain the variety of woodland species and communities. In the lowlands the pressure on land is intense, land values are high and nature conservation must compete with other types of woodland use. Thus it is difficult to envisage a very great area of woodland set aside to be managed exclusively as nature reserves and the widespread conservation of woodland wildlife is much more likely to depend on modifications to the management of forests with other primary aims, such as timber, or pulp production, or recreation. To make this concept of widespread conservation effective requires an attitude of mind which has been clearly stated by Elton (1958).

"Unless one thinks man was intended to be an all-conquering and sterilising power in the world there must be some general basis for understanding what it is best to do. This means looking for some wise principle of co-existence between man and nature, even if it has to be a modified kind of man and a modified kind of nature. This is what I understand by conservation."

I believe the most important problem in forestry today, especially in the lowlands is to achieve a co-existence between the various uses of a forest. This paper examines some of the factors which might affect the balance under five broad headings.

Policy
Public attitudes
Biological problems
Silviculture and management
Economics

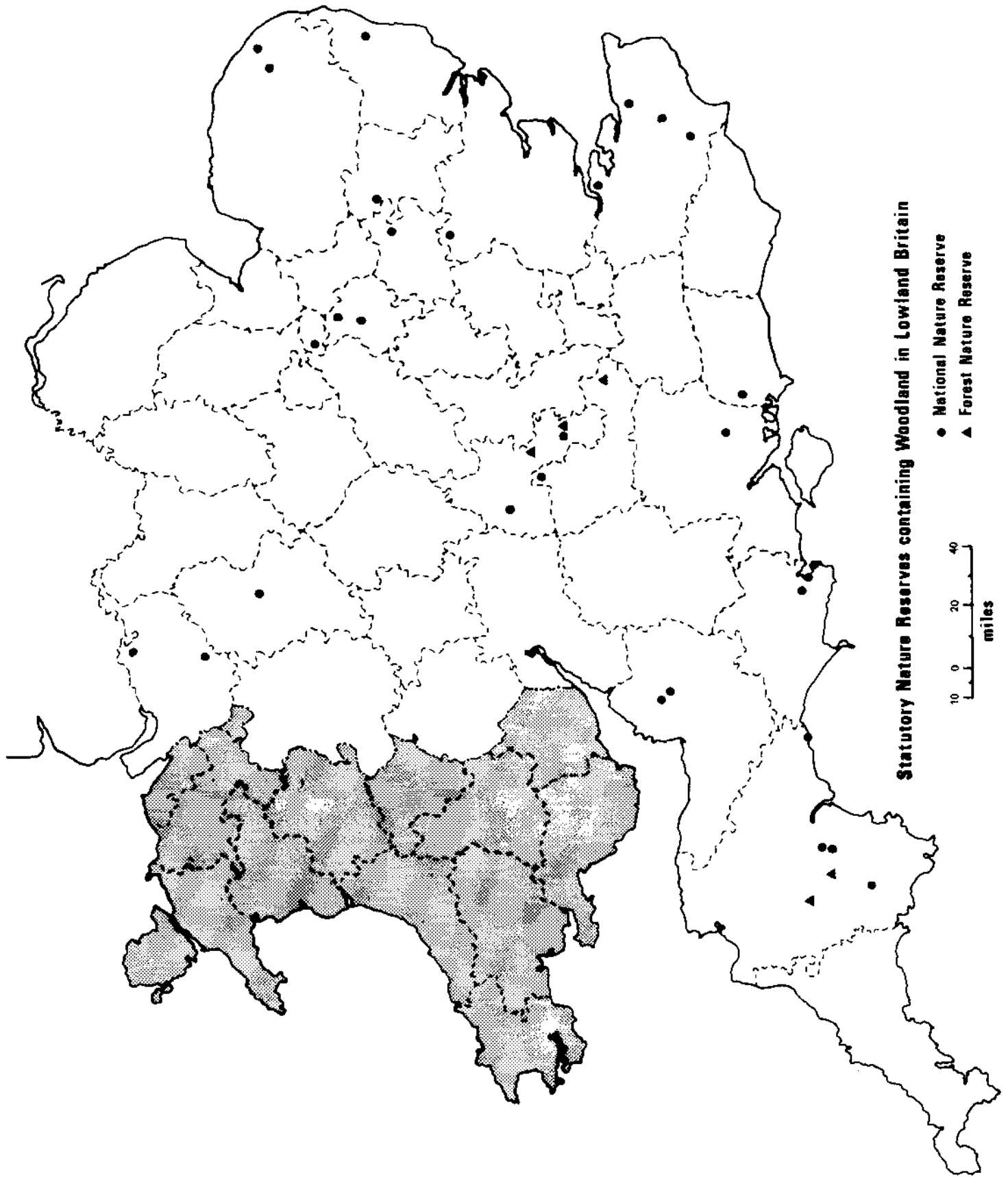


Table 1 Statutory Nature Reserves containing Woodland in Lowland Britain

The figures refer to National Nature Reserves declared under Section 19 of the National Parks and Access to the Countryside Act, 1949. Bracketed figures refer to Forest Nature Reserves established by informal agreement with owners and managed by them for research and conservation.

(County woodland areas from Simpson)

(Broadleaf woodland = Broadleaf High Forest + Coppice + Scrub)

<u>County</u>	<u>No. of reserves Containing Woodland</u>	<u>Area of Woodland In Reserves</u> acres	<u>County Woodland Area</u>	
			<u>Total</u> 000 acres	<u>Broadleaf Only</u>
Bedford	-	-	17.3	12.0
Berkshire	1(1)	3(45)	43.5	29.9
Buckingham	-	-	41.1	31.2
Cambridge	1	40	7.0	5.8
Cheshire	2	85	21.8	15.9
Cornwall	-	-	44.4	32.2
Derby	-	-	28.1	19.7
Devon	4(2)	1375(135)	134.7	87.9
Dorset	3	87	50.1	28.0
Essex	1	20	33.7	29.8
G.L.C.	-	-	16.3	16.1
Gloucester	-	-	74.8	58.3
Hampshire	1	40	157.8	112.0
Hereford	-	-	35.3	25.9
Hertford	-	-	24.8	20.1
Huntingdon	3	1123	9.4	9.0
Isle of Wight	-	-	4.6	1.7
Kent	4	566	108.2	91.6
Leicester	-	-	12.0	10.3
Lincoln	-	-	48.2	29.9
Norfolk	2	213	92.4	43.5
Northampton	-	-	28.2	19.6
Nottingham	-	-	39.2	21.8
Oxford	2(2)	715(157)	26.1	19.3
Rutland	-	-	1.6	1.4
Shropshire	-	-	53.1	28.7
Somerset	2	124	59.6	38.1
Stafford	1	35	44.0	25.1
Suffolk	2	293	67.9	34.5
Surrey	-	-	77.5	56.7
Sussex	1	110	159.5	118.1
Warwick	-	-	18.7	14.4
Wiltshire	-	-	59.4	40.3
Worcester	-	-	24.7	17.7
<u>Totals</u>	<u>30(5)</u>	<u>4829(337)</u>	<u>1677.2</u>	<u>1147.4</u>
Average area of reserve		161(67)		

Woodland in Nature Reserves as % of total Woodland area = 0.3%

Woodland in Nature Reserves as % of total Broadleaf Woodland area = 0.45%

N.B. No part of the New Forest is a Statutory Nature Reserve but most of it is subject to a Management Consultative Agreement between the Forestry Commission and the Nature Conservancy.

POLICY

There appears to be a tacit assumption that the prime purpose of forests and forestry is, and always has been, to produce timber in one form or another. Some years ago Britain's forest policy was based on the national requirements to stockpile a reserve of timber against another World War and few concessions were made to other uses. The policy now seeks to increase the production of wood as a raw material as profitably as possible, within the limits set by other objectives, and also to provide employment, to foster industrial and social development ancillary to forestry, to help maintain an efficient timber market, to encourage the development of private forestry, to give due attention to the aesthetic and protective roles of forests and to encourage open-air recreation. The production of wood is still the main objective but other uses are recognised.

In earlier days there were other ideas about what a forest was for and what it should contain. Thus (Manwood, 1665, 3rd edition):

"A forest is a certain territory of woody grounds and fruitful pastures, privileged for wild beasts and fowls of forest, Chase and Warren to rest and abide in . . ."

"And therefore a forest doth chiefly consist of these four things, that is to say of vert, venison, particular laws and privileges and certain meet officers appointed for that purpose to the end that the same may be preserved and kept for a place of recreation . . ."

If we substitute "wildlife" for "venison" and think of recreation in its widest sense we get a very useful definition of what many consider a lowland forest should consist of today. Further a forester was described as:

". . . a forester, or keeper of the Forest, must be a special preservator of the Vert and Venison of the Forest, without which it can be no forest, and therefore such an officer must always have a vigilant eye to preserve the coverts of the forest where the wild beasts may have their secret abiding . . ."

This definition recognises the interdependence of plant and animals and that it is the foresters duty to sustain both these components of the forest. It must not be thought that these definitions applied only to small areas; in the middle of the 13th century the Royal Forests covered about a third of lowland England. Following this forests passed more and more into the hands of private owners but in the last half century we have seen the main control of forests and forestry reverting again to the State. In addition to the State other corporate owners including the National Trust, Investment and Managing Companies and the Nature Conservancy now take the place of many of the large individual land-owners. It is on these organisations, as well as on the individual land-owner, that the pattern and extent of wildlife conservation in woodlands will depend.

Britain's forest policy is being re-considered by Government and publication of the revised policy is imminent so there is not much point in anticipating its directives, but I hope it will include two broad points. First, it must recognise that forests provide for many needs and

that forestry is concerned essentially with the beneficial and continuing management of forests to supply these needs. What these needs are, and they will vary from place to place and also in time, are matters for discussion and compromise but the broad benefits obtained from forests must be recognised. Second, the Forest Policy must be supervised by a Forest Authority, which is seen to be representative of a wide range of forest interests and which is not identified completely with the State Forest Enterprise.

A policy can only serve as a framework and it is the constraints and inducements that are also provided which will govern its detailed development. The forestry question is often posed as the reconciliation of the needs of the various uses of forests and how far and on what grounds constraints can be placed on wood production. I feel this is ultimately a fruitless approach as it assumes that everywhere and at all times wood production is the basic aim of forestry, it misleads in an understanding of the economics of forestry and it tackles the problem from the negative attitude of constraints rather than the positive attitude of inducements. I have already mentioned the wide range of forest uses. No single use can or should be considered as normal and all others as departures from normal. Every forest and woodland will have its own special role and we do not reduce the need to identify this role and foster its development simply by considering everything in terms of wood production. The economics of forestry also give rise to a good deal of muddled thinking. Most, if not all, forestry in this country is not profitable if judged solely on financial criteria which equate 'profit' with earning at least the going rate of interest on capital. It is only made 'profitable' in this sense directly by planting and other grants and indirectly by tax and death duty concessions and by promoting research and development. There is no reason why these subsidies should not continue, and indeed strong arguments can be advanced for increasing them, but they should not be allowed to obscure the fact that the growth of trees to provide timber or pulp is usually carried out at a loss when compared with other investments. Conifers are not more profitable than broadleaf species; they are less unprofitable. This reduction in financial return must be justified on other grounds, e.g. stockpiling timber in case of a national emergency, fostering industry, providing employment, reducing the import bill and so on. Why accept subsidised forestry for timber production but reject subsidised forestry for other purposes? If the taxpayer subsidises conifers for pulp production is there any intrinsic reason why he should not subsidise broadleaf species for other purposes? The extent and type of forestry in Britain is not a question of profit and loss in the open market as often inferred but one of social judgement, namely what expenditure of the taxpayer's money is justified in promoting general or special interests? Britain has neglected its forests for centuries and much needs to be done for them. Forestry deserves and needs every encouragement, including financial help, in both the public and private sectors. But the objectives for forests and forestry must be broad-based or we shall continue to be plagued by the extreme swings of policy and management which have been such a worrying feature of British forestry.

The present grant structure was brought out when the forest policy was aimed at building up a strategic reserve of timber. It may once have been right for this purpose but it is now quite inadequate for the present needs of forestry. How can identical grants be appropriate for example, for Kent and for Ross and Cromarty, when the soil, climate, silviculture, management, economic, marketing and social problems are so different in those areas? A suggestion that a fixed payment per acre be made on all

agricultural crops irrespective of what and where they are would not be taken seriously for one moment yet we have just such a situation in forestry. How can forestry adapt itself to meeting different conditions imposed by soil and climate on the one hand and marketing and social considerations on the other within such a strait-jacket? There is a pressing need for grant differentials and urgent consideration should be given to larger payments for broadleaf species in the lowlands. In Germany the grant for planting pure hardwoods is about $2\frac{1}{2}x$ that for pure conifers. The justification for these increased payments would be on broad amenity grounds including landscape, recreation and wildlife conservation. A step in the recognition of regional differences has already been taken by the announcement in 1971 by the Minister for Agriculture of the new mandate for the management of the New Forest. Changes of this sort are and would be of great benefit to wildlife conservation.

I would like to make a plea for small woodlands to be given special recognition in the new policy and in any revision of the grant system. In the lowlands such woodlands are major features of the landscape, of high sporting and wildlife value, and potentially very productive of timber although many of them have been neglected. (Anyone who doubts the possible timber-producing value of these small woodlands has only to study the figures of timber production from hedgerow trees.) Such woods represent a substantial part of the woodland area as the following figures indicate. (I am indebted to the Bedfordshire Naturalists Trust, who have surveyed the smaller broadleaf woodlands in Bedfordshire and from whose figures I quote. For a general account of the Woodland Survey see Steele, 1966).

Table 2 Extent of small broadleaf woodlands in Bedfordshire

Total area of broadleaf woodland		=	12,000 acres (see Simpson)	
		<u>No.</u>	<u>Area</u>	<u>% of total area</u>
Broadleaf woods $2\frac{1}{2}$ - 5 acres in area		137	514	$\frac{1}{4}\frac{1}{2}\%$
Broadleaf woods $2\frac{1}{2}$ -10 acres in area		254	1400	12%
Broadleaf woods $2\frac{1}{2}$ -20 acres in area		343	2730	23%

Woodlands less than 20 acres in area thus account for nearly a quarter of the total area of broadleaf woodland. Similar detailed figures are not available to me for other lowland counties but there is no reason to expect a very different pattern in them.

These woodlands present special difficulties in management and are likely to be uneconomic for most existing patterns of production forestry due to size, problems of scale and access and because of other values already mentioned. They need special attention and in particular more research is required on the silviculture and management systems best suited to them. From the wildlife viewpoint small woods are under a much greater threat than large woods. Large woods undergo severe ecological changes e.g. by felling broadleaf species and replanting with conifers, and they may be eroded but they usually remain as woodland, at least in part. Small woods can be destroyed almost overnight. This destruction of small woods is likely to continue unless efforts are made to provide a positive and attractive policy for their continued existence supported financially and by management advice.

The integration of wildlife conservation with other forms of land-use at the national, regional and local level depends on adequate assessments of wildlife interests at these different levels. The Nature Conservation Review, carried out by the Nature Conservancy, assessed the relative scientific importance of sites for conservation throughout Great Britain. All vegetation types were considered, including woodlands. The primary objective of this review was to define a minimal list of high quality sites which together provide an adequate National Nature Reserve series for Great Britain and the Review provides an extensive body of data about our national capital of habitat and wildlife. This work on the top quality sites is only the first step and the assessment of wildlife value must be carried on right down through the scale. The competition for land is likely to become increasingly intense and it is only by defining the desiderata for wildlife conservation at these different levels that we shall be able to ensure that wildlife conservation gets a hearing from the various planning and development authorities.

Policy takes up much of this paper but a sound policy is needed to provide the right framework. I would like to complete this Section by an observation on the double standards we adopt at present regarding rural and urban development. The urban land-owner, who is in a majority, is very strictly controlled in his use of land and there is little or no talk of compensation when he is prevented from doing what he wants. The constraints on his actions are justified in terms of the national or local interest. The rural land-owner is much freer to develop as he wishes and any suggestion that his freedom be restricted in any way is usually met with the question "But who pays?" Whatever the reasons for these different attitudes how much longer are they likely to remain unquestioned?

PUBLIC ATTITUDES TO WILDLIFE CONSERVATION

Wildlife conservation is usually justified on scientific grounds, for research, for education, to maintain a gene pool of useful or potentially useful organisms and so on but the ultimate justification for conservation, in my opinion, must be moral, a personal judgement of what is right. Very little research has been carried out on public attitudes to wildlife and wildlife conservation. What do people think, what do they expect, what attracts them, what will they not tolerate? Such questions have important practical implications as the extent to which wildlife is conserved will depend ultimately on public support. Public access to many nature reserves may have to be restricted due to the risk of damage to sensitive communities or undue disturbance of wildlife, but we shall not be able to keep people out of nature reserves indefinitely simply by decree or exhortation. We must provide alternative areas conveniently located where people can see and enjoy wild plants and animals. The management of such areas for people rather than for scientists is a field of study which would benefit from a better understanding of people's attitudes to wildlife and natural areas. Similarly we shall probably have to rely increasingly on zoning woodland use in space and time. To carry this out effectively we must know how to attract people into some areas and discourage them from entering others.

BIOLOGICAL PROBLEMS

Forest policy and the sociological aspects of conservation are matters for general consideration but in this Section I want to outline some problems which will be mainly the concern of the professional conservationist from whom other woodland users will expect authoritative advice.

Area, pattern and shape of conservation areas

A good deal has been written about the general requirements of wildlife in woodlands (see Steele, 1972) but far less information is available on more specific needs. One such problem is how much of a woodland should be managed specifically for wildlife conservation to help to retain the wildlife variety of an area, how should this area be arranged, and in what shape? The answer is likely to depend to some extent on the particular group of organisms being considered but it may be possible to formulate some general recommendations by carrying out appropriate experimental work, e.g. Williamson (1970), has provided interesting data on size and distribution of hardwood clumps in relation to the breeding of certain birds. This question of pattern and size also refers to zonation in time. For example, can we maintain the scrub habitat adequately as a successional stage rotating over a woodland in the course of normal plantation development rather than maintain it on a given site by restricting its natural development?

Small woodlands are a major feature of the lowlands and their biological characteristics need investigation:-

- (a) in terms of size
- (b) in relation to surrounding, non-forest, use
 - e.g. - in arable land
 - in grass/heath land
- (c) in relation to surrounding, forest, use
 - e.g. - broadleaf islands in conifer forest
 - conifer islands in broadleaf forest
 - broadleaf islands managed for wildlife in broadleaf woodland managed for timber/recreation.

Biological development of woodlands

These include studies in the natural and induced development of the flora and fauna of established and newly planted woodlands. Historical studies can provide us with the means of making ecological assessments of changes in the relative values of woodlands for wildlife conservation and also for scientific research and education. Such assessments and evaluations provide a strong basis for developing, as necessary, special management techniques for wildlife conservation.

Many sites, including derelict areas, available for wildlife conservation will be biologically impoverished. Some of these may be allowed to develop naturally but others will require an accelerated development and studies are needed on how this can be carried out effectively and economically. "Seeding" may be a possible method, for example using top soil from woodlands which are being destroyed perhaps to build a motorway. The 'instant' phenomenon is common in all fields of activity today and it will not be long before conservationists are asked to advise on how to obtain 'instant' nature reserves which will require the rapid biological enrichment of woodlands.

Effects of recreational use

Studies are urgently required on the biological effects of different types and intensities of recreational use. Such studies provide a guide

to planning and controlling the recreational use of woodlands where there is a high wildlife importance.

Autecological and synecological studies

Such studies are required not only for rare species and communities but also for the commoner species and the more widespread communities. The information obtained from these studies provides the basic material for effective wildlife management.

Species substitution

Much information is available on the effects of substituting conifer species for broadleaf species but little is known of the effects of more subtle forms of substitution. For example how will the fauna of a woodland be affected by replacing our native oaks by, e.g. Quercus borealis or Q. cerris?

The larvae of many lepidoptera feed on a single or a very restricted number of plant species in the wild but may have a much wider range of food plants in captivity. The problem is often not one of food selectivity by the larvae but of selection of the site for her eggs by the adult female. Is it possible to influence her behaviour so that when a food plant is scarce she can be induced to lay eggs on a more common species, which may be acceptable to the larvae as food?

Production

Production research in forestry has concentrated mainly on the management and breeding of trees for form, growth rate and timber quality. If other uses of woodlands increase what are the other forms of production which may be of concern? Examples might include breeding for prolific and regular mast production to feed birds and other animals, for vigorous and nutritious shoot production to improve browse for deer, or selection for beauty of form and autumn colour to improve the visual aspects of woodland.

Survey and monitoring

If management for wildlife, or indeed for any other purpose, is to be effective the results of management operations must be measured and assessed. In biological systems such assessments are complicated by the fact that changes take place whether or not there is deliberate management. The effects of changes due to biological development must be differentiated from those brought about by the particular management operations which concern us.

There is an urgent need to develop techniques which will provide information on the current contents or status of a woodland. This is survey. Re-survey to note changes with time or management is monitoring. Vast numbers of different types of records can be made, even in a very small and simple woodland, and the difficulty will be in determining as early as possible which of these records are likely to provide the most information on woodland development for the least expenditure of time, effort and money.

SILVICULTURE AND MANAGEMENT

A diversity of wildlife depends upon a diversity of habitats. Modern forestry has tended towards greater uniformity shown, for example, by the concentration on fewer species extending over larger areas. Research is needed on how management can be diversified to meet the needs of wildlife and some of the fields have already been described earlier in this paper.

There is, in progress, a study of past techniques of coppice management and the effects of this form of management over time together with an assessment of the present distribution and composition of coppice woodland and the present and future markets for coppice material including specialised industries such as hurdle-making. Coppice is an old and traditional form of management which is of proven value for wildlife conservation but which has been slowly declining. Any improvement in the area under coppice or the maintenance of existing coppice areas, which depends on markets, will be of value to wildlife. Similar studies are also required, and have recently started, of traditional high forest systems and their effects and value for wildlife.

Most forestry research in the past few decades has gone towards improving the silviculture and management of conifers. It is time perhaps that the interest in broadleaf species was revived otherwise even if there is the will to perpetuate our native tree species we may not know how.

ECONOMICS OF CONSERVATION

Few data are available on the costs of conservation. There are obvious difficulties in putting a price on the value of a butterfly or a flower (but see Helliwell, 1971), and one method of making estimates and comparisons is in relation to the value of alternative uses of a woodland, the best understood of which is timber production. The problem can then be stated as what is the cost of wildlife conservation in terms of loss of opportunity for timber/pulp production?

Studies might try:

- to assess costs of management for wildlife conservation
- to make comparisons of alternative uses e.g. wildlife conservation, recreation, timber production
- to show how changes in the level of one kind of use affect the other uses and how these uses change relatively to each other.

The results of such studies would provide a valuable guide to the cost of wildlife conservation, and possibly other forms of non-timber woodland use, and would indicate how money and land could most usefully be allocated.

CONCLUSION

There is no magical and single answer to the problem of reconciling the different uses of a forest. There is no single standard to which we can refer and each case must be considered on its merits. The free exchange of information and ideas is however of great importance between all those interested in forestry and forests and will help to provide the basis on which we shall be able to use a 'modified' forestry to build 'modified' forests containing perhaps a 'modified' nature, but one rich in the variety and interest of its plants and animals.

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SESSION 5 SUMMARY OF DISCUSSION

Dawkins. What is the latest view of the risk, danger or desirability of bird and mammal predators in high value pheasant rearing?

Gray. Pheasants do not need the same intensity of predator control as partridges. For example, in 1970, on our partridge study area of 14,000 acres there were high insect populations of about 900 per square yard which is almost double that required for the survival of partridge chicks. There was no shortage of chicks with excellent weather during the early part of the breeding season so the only limit to the game population was predation. With predator control there were 3.6 young for one old partridge which meant that practically every chick that hatched survived. Where there was no predator control there were 0.8 chicks to one adult bird which was not enough to maintain the population. The principle predators in that area were weasels, crows and foxes. We have a conflict over the Brown owl in pheasant areas. I think the Brown owl, like the fox, kills for the sake of killing and 150 pheasants may be killed in one night. Scaring devices particularly using flashing lights after dark may be useful. There is no evidence that the Brown owl population is declining as a result of gamekeepers' activities and indeed if gamekeepers could affect the population they would have done so a long time ago when there were many more gamekeepers than there are now.

Williamson. We need and must keep a well distributed scatter of woods about the countryside if we are to keep diversity of birdlife and of wildlife generally. It is these little woods which are the powerhouse of the hedgerow system and which provide the birds and insects and so on which go into the hedgerows. The main problem is not the loss of hedgerows but the loss of these small woods. A wood of 1 acre is not a viable habitat for a sufficient diversity of birdlife as one acre is far smaller than the territory of many woodland birds. Something of the order of ten to fifteen acres is the minimum size we need for these power house units of woodland scattered about the countryside. Ten woods each of one acre rather than one wood of ten acres is probably better for game but I think for wildlife generally it is less desirable.

Gray. I agree but if an arable farmer of say 500 acres could spare 1% that is 5 acres, I would rather distribute it than put it into one wood. Land requirements for game must first be reduced to a minimum. Later you may persuade the owner to enlarge the woodland area but if you go to an arable farmer and ask for a 10 acre field you will never get it. Ideally on a 1000 acre farm we would like a 15 acre wood in the middle like a hub of a wheel and then a distribution of spinneys around the outside like the spokes of a wheel.

Penistan. There may be an advantage in the edge effect of five small copses rather than one large woodland.

Workman. The conservation value of an isolated hardwood pole in the middle of a conifer wood is minimal, but the tiny clump is valuable. This is true is it not?

Williamson. Yes. We have been doing some work in a Forestry Commission wood near Tring on the use birds make of small stands of trees and scrub left in a matrix of European larch and pine. This can increase the diversity of the birds to a large extent provided that the little groups of trees and scrub have irregular outlines both in section and in plan with tall trees in the middle, scrub around them, and brambles, gorse and so on on the outskirts. In this wood, which has been nearly clear felled over the last 4 or 5 years, the bird density is about the same as before felling and the diversity of species has greatly increased because there is more open space and more edge. On their own, isolated trees are of very little use but if they are retained with islands of scrub here and there, perhaps one $\frac{3}{4}$ acre island for every ten or twelve acres of new plantings, they serve a very useful purpose indeed and these trees and islands can be managed to provide good hardwood timber.

Workman. This is very helpful because the retention of such areas to the order of 5%, often on land not vital to timber production, can achieve perhaps a 50% rescue operation.

Williamson. Much higher than 50%.

Workman. I think some of the botanists would not go beyond that but this is what I want the conservationists to come and tell us.

Prior. I think there is a great advantage in preserving small bits of hardwood cover on stream banks for a time when an adjoining crop is in its youth because they may act as a reservoir for all sorts of different species which can re-establish themselves after the crop has passed the thicket stage.

Campbell. I was interested to hear that the traditional method of selection of deer should be abandoned.

Prior. The argument about selection is based on the desire of people to shoot trophies and this is related to the management of game. Suggestions that this is not the best way to manage a Roe community are tentative because of the weight of continental opinion and because my recommendations may apply only to my own area of the south of England, conditions in which might not be duplicated or might not relate to other areas. Under normal conditions the largest bucks live in the best places through the summer and the surplus population, which consists largely of the young of both sexes, the over-aged animals which have ceased to bother about territory and the misfits, all of which usually have poor antlers, accumulate in the less desirable habitats. A large predator, a lynx for example, would first take prey from the easiest places which are the less desirable habitats. I think we should approximate to that type of control to keep the healthiest and most active bucks which can still defend their territories. I suggest that a reasonable way of managing a population is to decide where these young and unsuccessful animals are accumulating and to shoot them there rather than, say, shoot bucks with bad heads. A bad head may be a temporary phase and replaced by a better one in the next year. Such a buck may be a thoroughly successful territorial animal capable of clearing and keeping clear of other bucks 30 or 40 acres of wood. I think my suggestion may prove useful in keeping a healthy stock and doing it economically.

Penistan. We have shown through marking roe that a poor head may produce good antlers in the following year.

Prior. If we are thinking of carrying a population of roe in your woodlands with minimum damage, and I think this is the prime object of most of our management, then it does not matter if a buck has got an untidy head or not providing he is doing his job as a territorial buck. On the other hand if we are thinking of working up a crop of trophy heads at some stage to be shot by the paying visitor the better the head the more desirable they are to the customer.

Penistan. Would anyone like to say anything about fallow deer; there are far more fallow deer in lowland Britain than there are roe? We should note that they behave quite differently from roe and have to be managed differently.

Rogers. Mr. Gray mentions a return of £2.50 per acre on 1200 acres. Is this a net return to the estate or are the estate paying for the keepers or the introduction of chicks?

Gray. This is a rent and you get the high rent because the tenant does not have to rear any pheasants. The owner is getting the money rather than the tenant spending it on rearing pheasants, because he has kept the right habitat.

Williamson. Mr. Gray recommends that the best habitat for pheasants is a coppice-with-standards woodland. Can some of our overgrown coppice woodlands be returned to coppice-with-standards management? The edge effect provided by the 10 or 12 acres of woodland under a coppice rotation is a tremendously valuable asset to all forms of wildlife.

Workman. There are economic difficulties but it may still be a viable proposition particularly for the small woods where you can go in once in 20 years, crop it and go away again. I think it is worth promoting for those copses which may not be worth planting with conifers.

Penistan. Unfortunately hazel is economically the least attractive of the coppice crops.

Gray. The owner of 40 acres of woodland I visited recently was advised to clearfell the entire area and replant. This would have ruined the shooting for the next 20 years so the owner has decided to keep his shooting by clearing small areas of about 1/10th acre each and replanting with hardwoods, including oak and gear, and also with some conifers, including larch and spruce. The trees will be allowed to take their chance with rabbits because the areas are much too small to fence.

Penistan. I think much of the worry about game conservation is due to the afforestation situation or the restock situation. I have 40 thousand acres of plantation which has very high game rents because it is now in an irregular condition where there are natural clearings and also clearings we have made for game. We tend to be obsessed with the present rather than what we are likely to learn in a few years time when all these interests we are discussing today are applied to management.

Parker-Jervis. We heard that the dedication scheme has produced very much what the government wanted as a matter of policy over a long period. I do not think that you can make fragmented woodlands all things to all people however much the idealist may wish it to be. If you remove the hat peg of profitable forestry which I pursue and a number of others of us have done with energy for a very long time then the whole coat comes down with it. Now I really do feel most strongly about this and would not like anybody in this symposium to go away imagining that if that is the approach there is any unanimity between us.

Campbell. The balance of direct and indirect incentives to forestry in the United Kingdom is particularly important. In France they have tried several times since the end of the last war to produce legislation which would encourage investment in forestry. Confidence in forestry in France at the moment is very low and the gap between forestry as an investment and other forms of investment is increasing. At the moment the French are redrafting legislation and they are asking the Forestry Commission and ourselves how they can draft legislation to encourage a flow of money from the centres of wealth back into the countryside. There are reasons, there are motivations, why people have been prepared to spend their own money with government subsidies and these are very closely related to the balance of indirect and direct subsidies.

Steele. I am not arguing that forestry should be made less profitable. It would be difficult to do that. I do say that a flat rate grant as at present favours conifers which can be grown on a shorter rotation. We could improve the relationship between the profitability of broadleaf and conifer species by paying more for growing hardwoods than conifers. This would meet many amenity and wildlife considerations and should not affect the owner financially. Indeed he may welcome such a scheme. Similarly my arguments about the small woods were aimed at encouraging forestry in them. We heard that a small scale of operation is a direct disincentive to forestry. Are we going to abandon all our small lowland woods and let them be destroyed or are we going to try to keep them by finding methods of encouraging management? I would like to see more forestry and I would like to see some form of incentive brought in to encourage broadleaf planting and management, not necessarily by making softwoods less profitable, but perhaps by making broadleaves more profitable. Forestry, through its financial incentives, needs to achieve a better balance than in recent decades.

Lorrain-Smith. Discounting, as a technique of analysis, has been devised by economists not as a smoke screen, however successful it may be as that, but because it is an attempt to economists to take account of the very real fact that people prefer consumption now, today, rather than tomorrow or the next year. Although this concept was originated in forestry by Martin in 1848 it has been independently bought into industry as a whole and is called there discounted cash flow. It is important for forestry because of the very long time scale. It must be used with care but it has to be used whenever there is a choice between consumption now and consumption later.

Steele. Net Discounted Revenue is a valuable guide to management but it does not provide a satisfactory basis for a national forest policy.

Holmes. The Forestry Commission have carried out a considerable volume of research on broadleaf species and their silviculture dating from a time when we were interested in using broadleaf species for afforestation on a very wide variety of sites, and when we were interested in rehabilitation of derelict woodlands. Some of this research continues in the form of plots. There is an important distinction between existing forests which can show a profit both in the private sector and the national sector, and new forests which must be formed on bare ground.

Gray. When one talks about wildlife conservation what is wanted? For game we want 5% of the area, and we want some light on the forest floor if possible throughout the area of the forest but if not then at the edges. If you are going to get owners to consider what you require you must define much more precisely what you need in the forest area. It is so often valuable if you can go to a landowner and tell him exactly what you want and what you are going to do with it. Owners want much more detailed information now than they did in the early days.

Steele. The Nature Conservancy is doing this with private owners, with the Forestry Commission, with the National Trust and with other woodland owners up and down the country. The only limitation on this work is imposed by the very few men on the ground. To give specific advice you have to have specific knowledge of an area which means going to it. There are many thousands of woodlands in Britain, far more than we can get around at present.

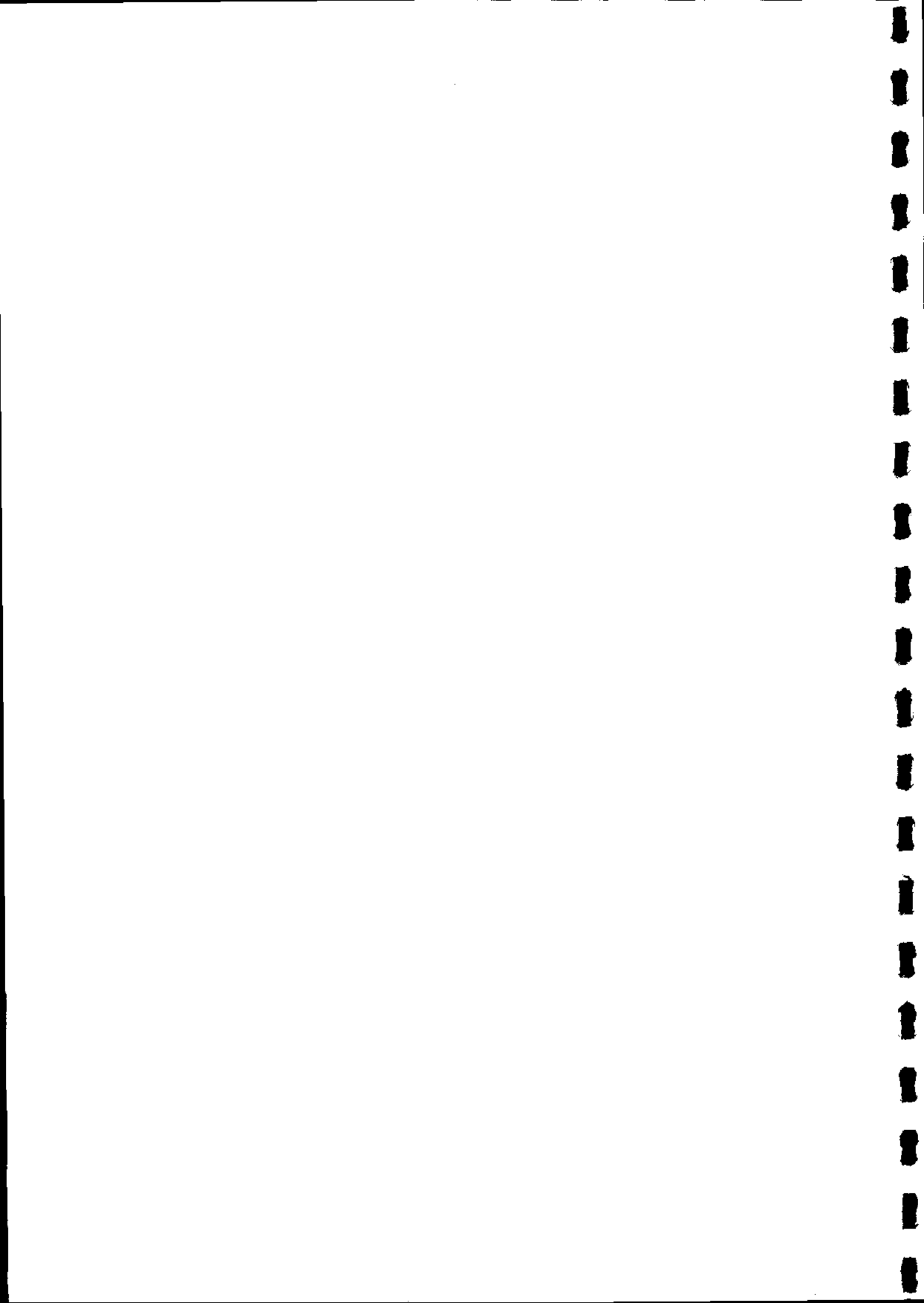
Penistan. If one can justify conservation efforts and policies in terms of acceptable opportunity loss - this difference between utterly ruthless maximisation of return and what comes from modified practice - one is usually allowed to proceed.

Workman. Ruthless pursuit of the economic maximum or the immaculate plantation has in some cases turned out to be not only pointless and a waste of money but positively damaging. By not being over zealous a forester can save money and do something for conservation at the same time.

Dawkins. Mr. Steele has defined the aim of wildlife conservation as the preservation of biological diversity etc. This is not I think a very satisfactory definition. When we had in B.B.O.N.T. to think out what we meant by wildlife conservation in woodland we went through all these sorts of definitions and discovered that there was only one way to define what you want to do and that is species by species. I cannot accept this idea that we are just wishing to conserve diversity. I think the whole conservation movement started with the threatened extinction of certain species and that became the dominant object in those particular areas. I think it is possible to arrive at definition of objects area by area rather than over the whole country and this must be done by definition of the actual species which you wish to manage, it may be hundreds or it may be one or two.

Steele. The British flora and fauna is listed in numerous publications and this is what I mean by the biological diversity of this country. This is what we must try to conserve. We cannot produce a list of all the thousands of species for every one of the thousands of woodlands in the country even if we know them all. To get ideas widely applied we must put them into general terms which I have done. For any specific site it is certainly advantageous to make specific recommendations.

Penistan. I think nevertheless there is a great advantage in the recipe to maintain a tremendous number of species in any habitat.



REVIEW OF PAPERS AND INTRODUCTION TO FINAL DISCUSSION

J.N.R. Jeffers
 Director, Merlewood Research Station
 The Nature Conservancy

Many of you will know that the emphasis at the Nature Conservancy's Merlewood Research Station is on systems analysis and systems ecology, that is, in trying to unravel and describe the basic systems which lie at the root of problems which we face in wildlife conservation. I am encouraged, therefore, to apply this type of thinking to the discussions and papers which we have had at this symposium. I want, first, to consider what I shall call "the universe of discourse", and ask the question "What is it we are actually discussing?".

Mr. Simpson's paper defined the physical area of our concern very well and he described some of the features which control the woodland in that area and which are implicit from its past. We are looking, at the present time, at the top sheet of a large pile of papers which stretches down to an almost infinite depth running back into time, and on each sheet we have the state of this particular area and its woodlands at a given point in time. We can only see the top sheet at the present time, but we know that anything on this top sheet, any part of this area, or any particular type of woodland, is very heavily dependent upon what lies immediately beneath it. Indeed, if you look at a very short period of time, the correlation between what lies immediately underneath that top sheet of paper and what lies on it is considerably greater than the correlation between any two points on the same sheet. As you penetrate deeper into past time, that correlation gets less and less, until the correlation with a point on the top sheet of paper with the same point on the sheet at the bottom of the pile, or even half way through it, may be low by comparison with the correlations between different points on the same sheet. In other words, what we now see is the end result of a whole series of past actions. Some are natural actions such as glaciation, the separation of Britain from Europe by the severing of the land bridge, and changes in climate. Other changes are brought about by man's activities, such as the industrial revolution, the wholesale felling of many of our original forests during the Napoleonic and later wars, and the introduction of new species. We sometimes make the mistake of assuming that all change has been part of a continuous trend, but we forget about the catastrophies of various kinds which may have important effects.

We have always to bear in mind that we are actually looking at the top sheet of what is, in fact, a very complicated situation - a complex series of developments from earlier times. There is, however, one property we must be careful not to ascribe automatically to this type of system, and that is the property which statisticians refer to as "stationarity". We are not entitled to assume that the rate at which changes take place and the type of changes which take place are the same at any two periods of time, and distributions in time are not necessarily the same between two spatially distributed points. I make this point because one of the assumptions which is implicit in the way people think about a natural ecosystem is that what is observed in one place is very likely to occur in another, as a fundamental principle of human observation. Similarly, what is known to have happened at a particular point

in time will happen again at some future point in time because of the continuity of the universe. Many of the mathematical, statistical, and non-mathematical arguments which people use depend very heavily on this assumption of stationarity, despite the fact that it is unlikely to be correct and, if we are to make any progress in the study of complex ecological systems, we have to overcome the difficulties involved in abandoning the assumption.

How can you make reasonable inferences about systems if you have to abandon the assumption of stationarity? I have described the complicated situation in which much of what we now observe is directly dependent upon a whole series and succession of changes which have taken place in the past. We may describe the present situation or the changes which have taken place by measuring various observable characters which I will call the "state variables". These are the variables which measure the state of our "universe of discourse" at any particular point in time and many of these have been mentioned during the papers and discussions of this symposium. They include:-

- (a) Areas under various kinds of woodland cover
 - (b) Sites and soils devoted to woodland
 - (c) The structure of forests and woodlands
 - (d) Genetics and gene pools of the trees
 - (e) Habitats provided by trees and woods for other wildlife
 - (f) Species dependent upon trees for food or habitat
 - (g) Social life dependent upon woodland as forest
 - (h) Economics of forestry and woodland ownership
- etc.

We have discussed, in particular, the areas of particular types of woodland, species, and age classes, and clearly this is one way of examining the problem of lowland woodland and of forming a conceptual image of what we have available. But it is only one way, and we also need to consider the sites upon which these woodlands stand and the soils in which the trees are growing. We frequently make the assumption, and as ecologists we are perhaps more guilty of this than anyone else, that the trees that we find on a given area are related in some tidy ecological way to the site and soil of that area. The concept of climax vegetation is so firmly embedded that we tend to oversimplify the relationship between what we find on the site and the ecological development of the ecosystem, but, for much of our ecology, the problem is vastly more complicated.

In the case of lowland woodlands, in particular, man has manipulated the woodlands to such an extent that often you can tell less about the actual site and the soils by looking at the trees than you can by looking at the ground vegetation. In addition, we have to be concerned about what has actually happened to the sites and to the soils. Are they, for example, being degraded by management practices, or have they been actually improved by these practices? Are they, in fact, in a state that you can readily move from one type of tree crop to another? Is there an irreversible trend in the development of the site? Many of us would place a great deal of importance on the structure of individual stands, and are also concerned about the genetics of the trees in our woodlands. To take a very simple example, how much native Scots pine is there left in the country? Foresters have introduced Scots pine provenances from all over Europe and elsewhere and these have interbred with the native strain so that it is now difficult to find a residual pool of genes of the native Scots

pine. The same could be said for several other species of trees and also for other organisms which live in or are associated with our woodlands. The way in which we manage our woodlands also determines the habitats for various plants and animals, and we have discussed, in this symposium, how woodlands can be manipulated to provide suitable habitats for game, deer, and other animals or plants which we regard as being specially desirable. There are many dependent species which are modified by the way in which we manipulate and manage our woodlands, and man himself may be included among these species. The changes of the economic and social life of those working in woodlands and with wood products have been mentioned in several of the papers.

All these variables measure and describe the state of our lowland woodland estate; they form the "state variables" of the total "universe of discourse" of these two days. I now want to consider the "driving variables" or forces which operate upon our "universe of discourse", and which lead to alteration in the values of the "state variables". These driving variables may be usefully allocated to four main groups, as in Figure 1.

The first of these groups is concerned essentially with forest policy, and we have talked about this from the point of view of both the forest authority and the forest enterprise. The point has been well made that the two are conceptually different. It is a historical accident that, in Britain, they are combined in the one organisation. Some deplore the combination, but others think it is valuable to combine these two aspects of our national forest organisation. The policies of private landowners also have a major impact on our woodland estate, particularly in the lowlands, and the point has also been made in our discussions that we cannot sensibly talk about a private forest policy as if it were a single entity. Private owners are diverse in their objectives, and take a responsible, if mixed, view of the opportunities and values of their forest estate. Government is currently placing a good deal of emphasis on forest policy and we may legitimately ask if it really should be accorded such importance. Do such policies have any real meaning in the sense that they actually affect what managers do when faced with practical problems in their woodlands?

The second group of driving variables may be loosely related to the impact of science on our universe. The group includes the effects of pollution, disturbance, the introduction of species, and the effects of diseases and pests. Our discussions have included the effects of management techniques and methods of extraction and transport have also been mentioned. We have not said much about utilisation, although changes in what is utilised could very well influence the state of our lowland woodlands. The developing market for hardwood pulpwood, for example, represents a major change, and one which may make former methods of management such as coppice and coppice-with-standards practicable.

We have touched only slightly on my third group of driving variables, i.e. social attitudes. The demand for access by urban populations is a striking example, and perhaps our population is a little less inclined now to be told where they must not go. There is now a vigorous demand for recreation of all kinds, including hill walking, skiing, climbing, and even some very destructive forms of recreation such as grass skiing. There is also a new attitude to travel which has grown up over the past decade. Whereas people were happy to travel by train, most would now

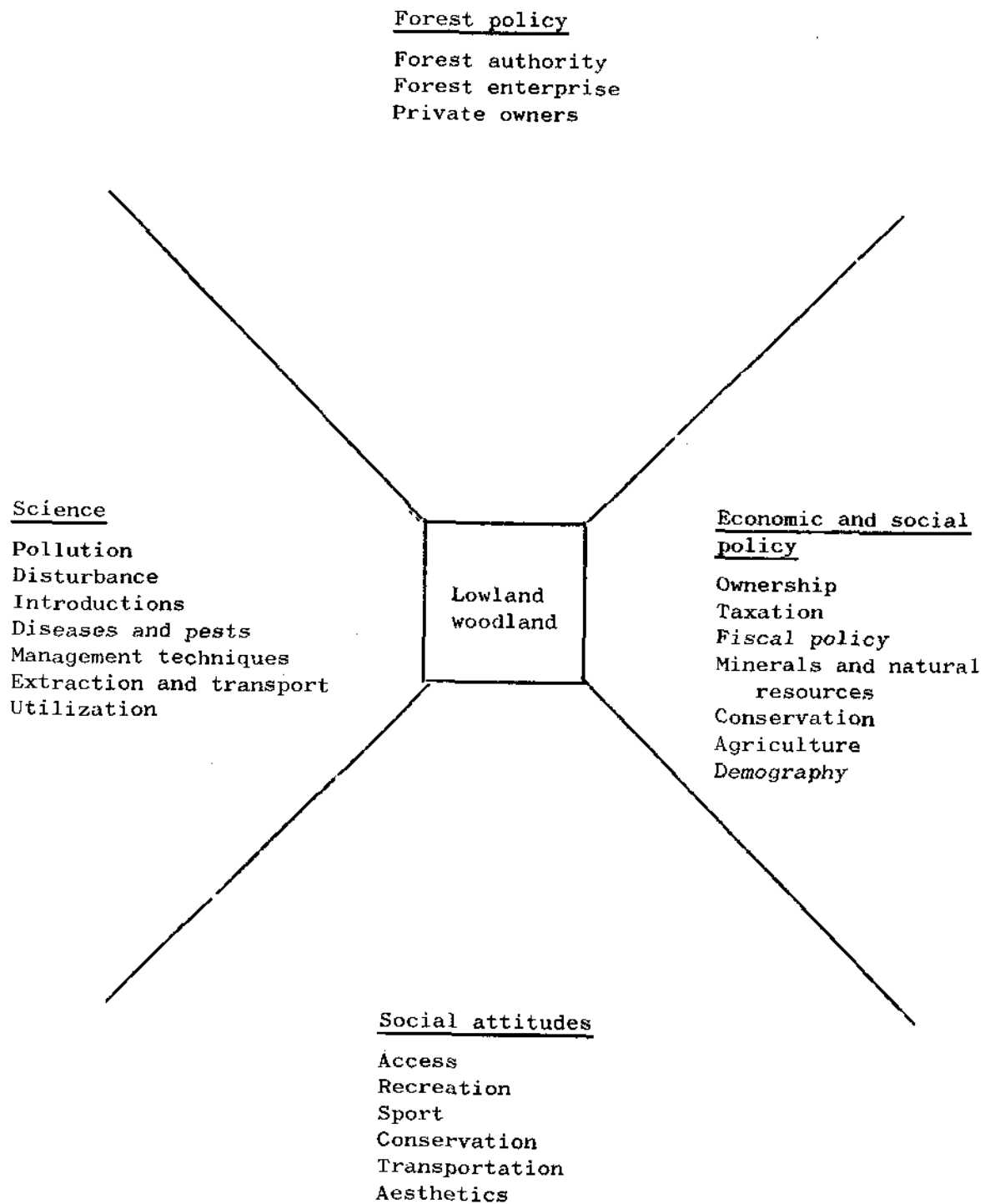
rather travel by car. Much of the current emphasis of the conservation movement is founded upon the enormous change in general aesthetics as a component part of this change in social attitudes.

Although we have discussed forest policy, the impact of science, and the impact of social attitudes in some detail in this symposium, we have not discussed adequately the way in which these three sets of variables are embedded in economic and social policy. Perhaps we felt the whole subject was too complex to be discussed or that our influence on such questions was likely to be small. Clearly, much of what we say about the other three groups of factors is deeply affected by economic and social policy. For example, at least theoretically, we live in a free society, so we cannot tell an owner what he must do. If we want him to do something, we must offer him some incentive. The whole question of ownership and the subtle variations of objectives and influences is therefore of immense importance. There is one particular group of owners which has not been adequately considered in our discussions, namely the owner who has inherited his estate and manages it for his own enjoyment, using techniques which he understands, to achieve objectives which he understands very well, but does not want to express in economic terms. Such owners form an important group who provide stability in the woodland estate, particularly in the lowlands. We also touched, by inference, upon the effects of taxation and fiscal policy. Clearly, these are important and are subject to modification; indeed, they are almost certain to be modified when we move into the European Economic Community, but we are far from certain what the effect of these alternations will be. As an illustration, consider what the effects might be of a drastic simplification of our taxation system, such as occurred in France recently.

Minerals and natural resources were not mentioned at all in our discussions, but the exploitation of these commodities from the forest estate could have a dramatic effect on the woodlands. Similarly, changes in agricultural policy and practice could release less fertile ground for more woodland, or, in contrast, could increase the demand for increased areas of arable land. Again, many problems are associated with demography and some of these problems have a direct impact on forest policy. Are we to allow social policy to influence the establishment of new plantations in areas of low employment? Such an objective would seem to me to place greater emphasis on upland rather than lowland woodland, but it might be equally possible to encourage secondary woodland industries in the lowlands.

All of the "driving variables" contained in Figure 1 are likely to have a major effect on our lowland woodlands, and I believe we must look at the problem in its entirety. I have deliberately simplified the relationships between the variables. They are, for example, almost certainly not linear relationships and may be both complicated and interactive. The problem I am describing is multidimensional, and it has feedback between many of the variables in the various groups of factors. The effects of nonlinearity and feedback have recently been demonstrated by the World Dynamic Models of Forrester and Meadows. Whatever we may think about such models, it is clear that the presence of nonlinearity and feedback in complex relationships may result in the optimum solution being counter-intuitive. When we have to make decisions in the face of such complexity, we frequently simplify the problem by making the relationships linear and by ignoring the feedback. Sometimes we are successful, at least in the short run, but I would

Figure 1 Grouping of "driving variables" on lowland woodlands



venture to suggest that the problems of lowland woodlands, especially over the long term, demonstrate very well the need for a proper understanding of the impact of the many driving variables on our universe.

For the members of the staff of the Nature Conservancy who are present at this symposium, perhaps one of the most interesting features which has emerged from the symposium is the repeated challenge for us to define what we mean by "wildlife conservation". There has been, perhaps, an understandable reluctance for us to respond to that challenge. As elsewhere, there are considerable changes taking place in the attitudes of conservationists as to what should be conserved, and how conservation can best be achieved. Much of our earlier emphasis has been on the acquisition of reserves, and the designation of the areas and sites which represent the greatest scientific importance remains as one of our most important functions. Nevertheless, the areas which we can acquire or manage as reserves, or even safeguard in other ways, will necessarily remain relatively small by comparison with the area of the country as a whole. We must, therefore, concern ourselves actively with conservation in these wider areas, and it is from this consideration that much of our keen interest in lowland woodland stems. I should like, therefore, to respond to this challenge by trying to summarise what I believe to be the three essential principles to be applied in our wildlife conservation.

First, we must think of wildlife conservation as a benefit rather than a constraint. If it is a benefit, then we must be prepared to evaluate just what the benefit is. Not all of my colleagues in the Nature Conservancy will necessarily agree with me here, because some will not want to be involved in the evaluation of comparable benefits. It is my belief, however, that unless we are prepared to think of wildlife conservation in this way we will necessarily be driven into a situation in which we are constantly providing constraints to other people's policies rather than subscribing to a policy of our own.

Second, whatever form of management for any ecosystem is adopted, it must not be allowed to convert a resource which is at present renewable into a non-renewable resource. We should not, for example, adopt a method of silviculture or a method of harvesting which will deplete the sites so that the next crop is likely to be smaller. This is a double-edged condition, because it does not necessarily imply that a particular form of ecosystem must be maintained on any one site, so long as that particular ecosystem could be recreated. It is a condition which is perhaps more flexible than many of my colleagues would wish, but the crux of the argument, I think, lies in the distinction between a renewable and a non-renewable resource.

Third, when a conflict occurs in the management of any particular ecosystem, that conflict must be resolved by a conscious evaluation of the alternatives. We should not allow ourselves to be driven into a corner by our willingness to make such a conscious evaluation and choice. In this respect, doing nothing may be a far worse treatment than some more deliberate manipulation of the ecosystem concerned. Whether we make the correct decision will depend very much on how much we know, and this leads me to the last points that I would like to make in introducing this discussion.

In listening to the discussions and the papers, several questions occur again and again, and I have listed seven which I believe should form the basis of our final discussion. None of these questions concerns the details, and particularly the scientific details, of the relationships

between the state variables and the driving variables, because I do not believe that this is the real crux of the problem. I have concentrated my questions of the relationships between what we know and the actual decision-making process. We constantly have to make decisions in the absence of complete information. And even though we may have defined objectives for our management, we frequently do not know how to achieve these objectives, because the necessary research has not been done. The input into research management and into the ecology of the whole field within which we are working has not been sufficient to enable us to achieve the objectives that we would like to formulate. I believe, therefore, that we should concentrate, in this discussion, on how we may get ourselves into a position in which we can relate our science to the actual process of decision-making which influences the impact of the variables I have outlined on our universe of discourse. So I have suggested seven questions, three of which are related to the state variables and one of which is taken from each of the main sectors of the driving variables. These questions are as follows:-

1. Are we satisfied that we devote sufficient of our resources to the recording of change, in lowland woodlands as in many other ecosystems?
2. If we are satisfied that we are spending enough on the recording of change, is there sufficient integration of these records to indicate the interactions between the effects of the different factors?
3. If we are not satisfied that we are devoting sufficient resources to recording of change, or that there is sufficient integration of these records, who has the responsibility to meet these needs?
4. What are the effective priorities in the application of policy?
5. How can we make our legislators and administrators aware of the implications of their decisions for lowland woodland?
6. Whose responsibility is it to monitor the effects of management, and to modify management to avoid undesirable consequences?
7. Do we have to accept urban attitudes as the criteria for decisions about the countryside?

SESSION 6 SUMMARY OF DISCUSSION

Steele. What measures exist to make the administrator and legislator aware of the different attitudes to forestry, and the different uses of woodlands, so that a comprehensive policy can be evolved out of these differences?

Jeffers. It is very much a function of the Forest Authority to relate policy to the attitudes to forestry and its various aspects.

Holmes. First, there is the group we refer to as the Home Grown Timber Advisory Committee, which includes the Forestry Commission, the Timber Growers' Organisation, the Timber Merchant's Associations in England, Wales and Scotland, and so on. Here, policy matters and various procedures are considered and guidance given to the Board of the Forestry Commission. Second, there are also various means for consultation with forestry interests on the timber growing side of the industry, such as the Forestry Committee of Great Britain which contains representatives of the Forestry Commission and the various private woodland interests. This Committee is consulted on matters of policy and legislation affecting forestry. Further, there are the Regional Advisory Committees in each conservancy of the Forestry Commission, usually chaired by a local person of some distinction in the countryside and land management, and with representatives from various bodies, including the Timber Growers' Organisation, Country Landowners' Association, etc. concerned particularly with the rather less tangible aspects of forest management, such as the implications to the countryside and to the society of that region. You can always say that there should be more consultation; it is like saying there should be more research or more education. No-one can deny it, but the machinery is there and it is a case of using it.

Workman. There is a group of MPs from all parties who make it their business to be interested in forestry. This Conservation Group from both Houses of Parliament meet about every two or three months and it is up to us to interest them, so that they will listen to us and, if necessary, to think in terms of putting new ideas into legislation.

Penistan. All the answers so far have referred to the top sector.

Jeffers. Yes; we have talked about how we influence forest policy, but how do we influence fiscal policy, taxation, etc? How do we show those who make decisions in this field what the results of these decisions might be?

Woodman. We need to get an overall environmental view and to get a balanced picture. It is no use every section pushing its interests up vertically. The horizontal liaison at the middle levels of management between MAFF and the Conservancy and the Forestry Commission is usually good, but when you go up higher and you look for this lateral communication it does not seem to exist.

Campbell. I think it is very difficult, in fact, to influence affairs from the grass roots level. The only solution that I can see is to win public support. By winning public support, you win political

support and you use what influence you have to do this. Recently, the Select Committee on Land Use was invited to visit some of the uplands areas in south Scotland, and, as a result of this visit, we were better able to describe our attitudes to the Committee. There is much to be said for getting people out into the field to see activities at first hand.

Holmes. I should have referred to the informal machinery for consultation as well as the more formal machinery. Informal and day-to-day contacts between, for example, the Nature Conservancy and the Forestry Commission and MAFF are vitally important as it is often in this way that new ideas are generated.

Penistan. Regional relationships are excellent, but there is no apparent resolution of the interests at the very top. All that has been said about consultation is consultation within the forestry sector. It does not refer to any of the other interests. Our problem is to build them all together in consultation.

Peterken. I want to elaborate on the Chairman's second principle, that there should be no conversion of renewable resources into non-renewable resources, and relate this particularly to the information content of woodlands. Many of our old secondary woodlands, for example the New Forest woodlands, have in their growth structure the information that tells us how this community has developed over two or three hundred years. The information contained in these stands would not be renewable if the woodlands are cut down. Many of the coppice areas in East Anglia are primary woodland, on sites which have been wooded throughout historic times. These coppices are probably directly descended from primeval woodland on the site and contain a fauna and flora which is directly descended from the natural populations. The coppice composition may vary, and the variations may be closely related to soil variation, not management boundaries. This suggests that the coppice species are semi-naturally distributed, in a manner which may be closely related to their ecology in primeval woodland. The soils themselves are direct developments from the parent material and not disturbed by cultivation; they represent perfect controls for pedological studies which try to relate the effect of long-continued cultivation on clays to the original soils. There are also wider interests, for example, woodlands may be historical monuments which show how the local economy has developed and is related to the landscape. Planting up these coppices with, say, oak or pine does destroy the information content or some of the information content of the wood, and this is one of the factors we should consider before such communities are irrevocably transformed. Not all coppices nor all ancient secondary woodlands can be preserved because they contain information. We can be selective as we are being in the Nature Conservation Review. But, I would ask you to remember that conservation is not only concerned with having a lot of plants and a lot of animals in a woodland. It also concerns the information content, which is particularly important now that ancient woodlands are such a small part of the total woodland area.

Jeffers. This is a good illustration of where conflict does come between the demand for conservation on the one hand, and the need to regard woodland as a crop on the other. If the forester is being asked to

sacrifice part of his crop, he needs to know for just how long and how much he is being asked to sacrifice. We must evaluate the alternatives and arrive at some positive prescription.

Workman. This problem is similar to that faced by conservationists in the city when they find Roman sites, ancient buildings, etc. We cannot keep it all, but we can record much of it and keep selected sites. I think that this is the right attitude.

Lorrain-Smith. I agree that wildlife conservation should be seen as a benefit but it is also a constraint. Conservation is of value, but it cannot be maximised because we cannot measure it, so we impose rules that a manager must not violate in order to maintain wildlife. When we maximise timber production or finance, something can be measured, whatever it may be, subject to certain rules which are agreed and set down as limiting forces or constraints on management. By having these built into management, we can achieve more than one objective, but it is only because they are seen as benefits that we impose these constraints. If they are not benefits we would not allow them. Therefore, I do not accept that wildlife conservation must be seen as a benefit rather than a constraint.

Jeffers. I am thinking very much in terms of optimisation models in which you have an objective function which may or may not be linear. What I think has happened in the past is that we tend to use, implicitly, this type of model and that wildlife conservation has been introduced as a constraint to the maximisation of benefit. You very quickly found that the constraint that must be relaxed to improve timber production is wildlife conservation. But wildlife can be regarded as a direct benefit contributing to the objective function, rather than as a constraint, although I accept that, if we are going to do this, it is the responsibility of the Nature Conservancy to discover how to measure and evaluate the benefit.

Parker-Jervis. What is it that the Nature Conservancy wants? What do you actually want us, the private owners of 78 per cent of lowland woodlands, to do on the ground?

Wilson. How does the forest manager, who may not be a competent biologist, set about looking at his woodlands to see what wildlife they contain, and what are the available resources for carrying out this inventory?

Steele. Many of the resources for carrying out this kind of inventory are concentrated in the Nature Conservancy. We are now discussing informally with the Forestry Commission how their field officers can help.

Penistan. The County Naturalists Trusts can also contribute a great deal.

Workman. I think twenty years ago, that is soon after the Nature Conservancy was founded, and soon after the Forestry Commission set off on its post-war policy, a symposium such as this would not have been possible. The attitudes of the two organisations were totally apart, so that in twenty years we have achieved a good deal. The Conservancy is now doing the sort of work that we have been discussing, still in a limited way, but effectively, and those people who are able to get the advice and put it into practice should be an example to others. The Chiltern Plan, for example, is an achievement which took years of hard work and consultation.

Williams. Speaking as a Nature Conservancy Regional Officer, even though our resources are very limited, we have participated in many plans at many levels, for example, the plan for the Chilterns, the New Forest, the East Hampshire area and military training land. We need more resources and we are not really able, in my opinion, to monitor changes effectively until there are more of us.

Brown. At Merlewood we are finding out what different types of semi-natural woodland there are in Britain and classifying this woodland. We will then make some measures of the wildlife resources in the different types of woodland and we are also carrying out studies in Forestry Commission commercial forests.

Jeffers. We need the private owner, the state owner, and our own management teams in the Nature Conservancy to provide the answer to three questions. Do we know what we have? (In most cases, the answer is no!) Do we know what we are going to have as a result of what we are planning to do in the future? Do we want to know what we would lost if we carry on managing as we are at the present time? If the answer to the last question is 'yes', then we may be able to tell you how to achieve what you want, but we cannot guarantee that, because there has been so little research in this particular field. If the answer to the first two questions is 'no', then I think it is our job to provide the mechanisms, or the information, for answering those particular questions, and, as far as our resources allow, to help the owner to answer those questions.

Parker-Jervis. We have exposed the fact that there is, practically speaking, no communication between the Nature Conservancy and the private woodland owner on the ground. How many of the owners of the 78 per cent of woodlands in which you are deeply interested have had any contact with the Conservancy at all? I have had none, until I served on the Chilterns Standing Conference. We all assume (we do not know) that you are doing good work, but we have no benefit from it. We have no information, and, on the ground, we remain as ignorant as ever. One constructive suggestion might be that it could be the Forestry Commission conservators' duty to try and bring together the Nature Conservancy and the woodland owner at the time of the revision of the five-year plan for Dedicated and Approved woodlands.

Penistan. This is proposed and will take place in East England.

Woodman. Unless we get more resources from the Government for more staff, more research, more advice, more management, it just will not be done.

Kerr. If there are any woodlands known to the Nature Conservancy to be of scientific interest, then it is almost certain that the Nature Conservancy have been in touch with the owners of those woodlands, and, in many cases, they will have been in touch with the Forestry Commission in relation to the Dedication plan. I think there is a fairly strong feeling that some move in relation to incentives for growing hardwoods might in fact be welcomed by all.

Jeffers. May I take this as a specific suggestion that increased resources be put into growing hardwoods?

Gray. Could I add a special plea for small woods? Since the war there has been in some areas a very startling loss of small woods.

Ranson. Figures I was able to get from map sources for a part of East Anglia from the 19th century to the present time showed a loss of woodland between 1830 and the present day of about 65%. The distribution of this loss between woodlands of various sizes did not show any particular trend, except that the larger coppice woodlands tend to be lost and the smaller woods to survive.

Butler. The Forestry Commission do not generally insist on a replanting condition on woods which are under, say, $2\frac{1}{2}$ acres. Most of the applications for restorations to agriculture fall into this class, at least in the Vale of Aylesbury.

Steele. The Forestry Commission have now provided an incentive to themselves to plant hardwoods and they are prepared to weigh other gains against a reduced financial return. Will they extend these incentives to private owners?

Workman. The Ministry of Agriculture have just terminated grant aid for planting trees in the lowlands, if that is any indication of Government policy.

Sykes. We have talked about the possibilities of obtaining information from existing woodlands, and about carrying out surveys of organisms which presently exist in woodlands; another responsibility is to make provision for monitoring the changes which occur in woodlands under different management systems.

Peterken. The historical study of a woodland is a form of monitoring which studies changes over a long period and the influences that have brought about these changes.

Holmes. This is an enormous field of study, with which the Nature Conservancy and Naturalists Trusts are most concerned, and we are prepared to co-operate in every way in such research because the outcome is going to influence our forest management. The guidelines we can offer in conservation come into three categories. First, generalised advice such as is contained in Forestry Commission Booklet 29. Second, subjective, but informed advice on particular sites by wildlife conservationists and particularly Nature Conservancy officers, to managers. Third, objective advice based on extensive research.

Jeffers. I must say something of the research the Nature Conservancy is doing in woodlands. At Monks Wood, there is a Woodland Management Section mainly concerned with general guidelines and informed advice on various aspects of woodland management. The research at Merlewood follows three main lines. The first is the survey of the woodlands we now have. The second is concerned with the dynamic changes which take place in woodlands and for which there are two aspects. We want to establish, as quickly as we can, techniques for monitoring changes which take place and to develop a system of monitoring which can be carried out by relatively unskilled staff although complex methods of evaluating the information may be necessary, involving statistical, mathematical and computing techniques. We are also investigating

the dynamics of the processes occurring in woodland ecosystems. This is complicated research which will be carried out in selected areas chosen from the results of our site classification. The third main line is research on the taxonomy and genetics of plants and animals in British woodlands.

Williamson. These, essentially, are very long-term problems and we must get down to the immediate problem of what we have on the ground. This is basic and I think there is need for co-ordination, so that we can involve members of the public, British Trust for Ornithology members for example, who are now using techniques for recording birds in different types of woodland to find out what is there. For example, we have studied semi-natural woods in Scotland. We hope to visit Killarney next year to look at the woods there. We are also working in Forestry Commission areas to find out the effects of their management. This is the kind of information which can be got together, provided there is some central organisation to co-ordinate it.

Meeham. We heard forestry described as the management of all the resources of a forest. Should we think of one discipline to cover all the aspects of a forest and the resources of the forest? When formulating training programmes, should we think in terms of the formulation of one category of professional and sub-professional field officers, backed up with specialists in places such as Monks Wood? This might break down, or do away with, a lack of lateral liaison. We would have one category of person in the field able to deal with the practical day-to-day problems of forest management.

Lorrain-Smith. I think a pool of specialists is more efficient than expecting one person to deal with all the disciplines.

Campbell. I agree. The Nature Conservancy should not try to duplicate the strength on the ground which the Forestry Commission has through its foresters. We have, in Forestry Commission personnel, a large reserve of biological training and experience which should be used for this purpose, with specialist backing. Let us not have two national structures concerned with conservation.

Meeham. I was suggesting one body representing all these interests. There must be people in the field, as you cannot manage with a pool of specialists who sit in seats of learning. I think we should be considering this for future training of field workers.

Collier. I think we are being pessimistic about how much we know about conservation of woodlands. I have been managing woodlands for eleven years, and I wonder how I have been doing this if I know nothing?

Jeffers. Are you monitoring what actually happens as a result of your management?

Collier. No, because we have not got time!

Jeffers. But, that is the crux of the problem!

Collier. No, but we have to actually manage now; we cannot wait until the Conservancy or the Trust, or whoever, comes up with an idea of principle.

Wells. I, too, think we are being pessimistic and some of the information asked for is available. The Biological Records Centre has a great deal of information about rare plants, and if rare plants are worth conserving then we are in a position to provide information on rare plants. I would like to hear whether foresters think the conservation of rare plants, such as the Ghost orchid and the Military orchid, is a worthwhile objective in a woodland?

Penistan. Certainly. We must ask ourselves what have I got at risk first and then enquire into the whole interrelation between plants and animals.

Tilney-Bassett. This is very valid from the lower levels of management. The conservation of rare species is an interesting aspect of forestry, but unless we know what these are, and where they occur, we cannot help.

Buchanan. My Naturalist Trust has in its area the Ghost orchid, the Military orchid and the Red helleborine. We have had great co-operation both from the Forestry Commission and the private owner. I wish I knew whether we were managing these sites in the right way, but I doubt very much whether the specialists would do any better than we are.

Peterken. We know mostly where the important woodlands are in the lowlands; we have a list in the Nature Conservation Review and we have schedules of Sites of Special Scientific Interest. If we do not know where they are, we know where the areas we have not explored sufficiently lie. We can go into a woodland and make an informed guess as to how important it is, relative to other woodlands, which is what we frequently do as an important part of our job at Monks Wood.

Parker-Jervis. I hope as a public relations exercise that you will publicise this particular fact. May I come back briefly to one particular point on hardwoods? I think hardwood forestry is more widely practised than most people realise. Private woodland owners have a tremendous attachment to hardwoods, but what we do feel all the time in the background is that we do not wish to be utterly committed to it. This is because of the depredations of the Grey squirrel and the considerable expense in establishing hardwoods. We may not pay lip service, or even active service, all the time to planting hardwoods in the volume in which we would like, but broadly speaking it does go on. Thirty years in the life of a hardwood tree is such a very short time, that the vigorous planting which has taken place since 1945 has not really had any particular impact on the scenery.

Penistan. I feel personally it is a pity that we do have a number of agencies impinging on the management of woodlands, particularly on the private sector, and something I regret very greatly that I cannot consider myself an officer of the Nature Conservancy, as well as an officer of the Forestry Commission. I have no doubt that Nature Conservancy officers sometimes think in the same way.

Grant. I see our function as bankers, banking wildlife. It is all we can do at this stage with many sites. We are trying surely to keep a capital reserve of diversity and as far as forestry goes, whether lowland or any other sort, we can use it to help in the banking of wildlife reserves.

Jeffers. We have described lowland forestry as a sub-set of the total forestry effort of this country, and we have had an excellent description of what we know about those woodlands, their extent and location. We have looked at management policies and priorities although in the knowledge that Government is currently reconsidering its forestry policy. We have heard many different points of view which have emphasised the many different objectives of woodland management. We considered the techniques used in timber production and there has been some emphasis, and I think many people feel quite rightly, that, if it was not for the production of timber, there would not be very many of these areas of woodland left, nor would thereby much incentive to create new woodland. We have looked at the systems of management, silvicultural techniques and problems, marketing developments and timber needs. I see the emphasis at this symposium on change - continual change. These changes are going to go on, and they are going to go on at an ever-increasing rate, so that we are not in a stable situation. We have to be accustomed to change, changing management policies, changing priorities, changing techniques. In addition we have changes in views on amenity and recreation, changes in demand for recreation, and changes in developments of recreational use of forests. We have exposed the feeling that sometimes private owners are being asked to maximise amenity for somebody else out of their own pockets and not receiving a fair return for this service. We have looked at the problems of game and wildlife and considered the real value of sporting rights for game and deer.

We have dwelt on two aspects of what we can, at present, do in terms of conservation in lowland woodlands, i.e. we can provide guidelines and informed advice from people on the basis of wide experience of looking at a large number of different places over long periods of time. We have not discussed research, except very briefly, but have noted that, given the necessary resources, we need to do very much more research in lowland woodlands.

I think we have looked at a wide spectrum of the problems which are associated with lowland woodland. We have recorded many detailed suggestions and detailed ideas which I think will have their greatest impact when we have a chance to study the papers in more detail in their printed form. I have tried to integrate some of these ideas into a wider context. The main point which has come through for me is that there is a much larger measure of agreement than I had expected from this symposium on the relative benefits of wildlife conservation in relation to timber production and other end products from woodland. We must set these benefits in relation to a whole set of decision-making processes, which are embedded in national and regional policies, in ways in which the priorities can be assessed, and which include considerations of social attitudes and economic and social policy.

What conclusions do we come to? First, there is enough common ground for us to be able to talk and to be able to arrive at some community of thought and some community of decision. Second, I think we, within the Nature Conservancy, have been made aware of some very real problems. We may feel that there is not much we can do about these problems unless we have more resources or we reallocate the resources we have in a different way. Third, there are other people we need to

talk to in different organisations, with different inclinations, in different sectors of public and private life, and we need to maintain and strengthen existing communication and initiate new contacts. You will, I hope, go away with a feeling that, although much discussion is still needed, we have made a beginning. I hope that you feel encouraged to make contact, especially at the informal level, with people you have met at the symposium to continue the dialogue.

I think it would be dangerous to pass a resolution at the end of this symposium about what we should do next. It would be preferable for us to recollect, in a little more tranquillity, what has been said, just what the differences in views are, and just what the uniformities are; and then to initiate some new moves. Finally, the main impression that this symposium has left with me is the important uniformity of view which individuals and organisations have about the importance of lowland woodlands in Britain, in economic, social, political and wildlife terms.

LIST OF PARTICIPANTS

CHAIRMEN

Campbell, Mr. J.	Economic Forestry Group
Holmes, Mr. G.D.	Forestry Commission
Jeffers, Mr. J.N.R.	Nature Conservancy
Mellanby, Prof. K.	Nature Conservancy
Penistan, Mr. M.J.	Forestry Commission
Workman, Mr. J.	National Trust

MAIN SPEAKERS

Aldhous, Mr. J.	Forestry Commission
Cumberland, Mr. J.	Economic Forestry Limited
Gray, Mr. N.	Game Conservancy
Jeffers, Mr. J.N.R.	Nature Conservancy
Lloyd, Mr. R.J.	Countryside Commission
Lorrain-Smith, Mr. R.	University of Oxford
Mellanby, Prof. K.	Nature Conservancy
Orrom, Mr. M.H.	Forestry Commission
Parker-Jervis, Mr. R.	T.G.O. and Managing Agent
Prior, Mr. R.	Forestry Commission
Rogers, Mr. M.T.	Forestry Consultant
Simpson, Mr. L.M.	Forestry Commission
Spencer, Mr. J.A.	Forestry Commission
Steele, Mr. R.C.	Nature Conservancy
Stern, Mr. R.D.	Forestry Commission

OTHERS TAKING PART

Badenoch, C.O.	Nature Conservancy
Ball, M.E.	Nature Conservancy
Beale, C.	Nature Conservancy
Bray, Dr. R.	Nature Conservancy
Brown, A.H.F.	Nature Conservancy
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Butler, M.C.F.	Buckingham County Council
Collier, R.V.	Naturalist Trust, Lincs
Crosland, J.	Forestry Commission
Dawkins, H.C.	University of Oxford
Day, J.C.	Royal Society for the Protection of Birds
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Fraser, Dr. J.F.D.	Nature Conservancy
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Hamilton, R.	Nature Conservancy
Hamilton, Mrs. R.	
Harding, P.T.	Nature Conservancy
Henchman, N.W.	Nature Conservancy
Hornby, Dr. R.	Nature Conservancy
Horrell, Dr. A.D.	Nature Conservancy

Horton, P.J.	Nature Conservancy
Horwood, M.T.	Nature Conservancy
Howells, Dr. G.	Nature Conservancy
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Johnson, C.	Nature Conservancy
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Lewis, R.S.	Forestry Commission
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Peterken, Dr. G.F.	Nature Conservancy
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Schofield, J.M.	Nature Conservancy
Selmes, K.J.	Nature Conservancy
Shaw, C.	Nature Conservancy
Simmons, S.	Forestry Commission
Sykes, J.H.	Nature Conservancy
Taylor, Mrs. J.	Nature Conservancy
Thompson, J.	Nature Conservancy
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Williamson, K.	British Trust for Ornithology
Wilson, K.W.	Forestry Commission
Wright, P.A.	Nature Conservancy
Wright, T.W.	National Trust