

FORESTRY COMMISSION

**Census of Woodlands
and
Trees
1979—1982**

PREFACE

This Census of Woodlands and Non-Woodland Trees was authorised by the Forestry Commissioners, as empowered by the Forestry Act, 1967. After preparatory work on the methods to be employed, field work for the Census started in September 1979. The reference date for the Census is 31 March 1980.

The survey work and the compiling of the Report was undertaken by the Field Surveys Branch of the Forestry Commission Research and Development Division. The Branch is grateful for the assistance of owners and occupiers of the land selected for sampling, officers of the Regional Councils, staffs of the Ordnance Survey, the Macaulay Institute for Soil Research, the Department of Agriculture and Fisheries for Scotland, the Countryside Commission for Scotland and the Nature Conservancy Council. In addition the Branch also wishes to thank the Forestry Commission Conservancy staff and staffs of the Statistics and Computing Branch and other Branches of the Research and Development Division.

Enquiries relating to this publication should be addressed to the Information Office at the address below.

**Forestry Commission
231 Corstorphine Road
Edinburgh EH12 7AT**

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CENSUS OBJECTIVES AND METHODS

OBJECTIVES

The general objectives of the Census were to take stock of the timber resources of Great Britain and to assess the environmental status of trees in the rural and urban landscape by counties or other administrative areas in England and Wales. Scotland was assessed by Forestry Commission Conservancies, using methods that varied slightly from those used in England and Wales.

The Census was divided into two main sections, the Woodland Survey and the Non-Woodland Tree Survey.

The first objective for the Woodland Survey was to provide an estimate of the total woodland area within a Conservancy. The data for Forestry Commission woodlands and for those in Dedication and Approved Woodland Schemes are on record so the survey was concerned only with "Other" woodland, but all three categories of ownership are included in this Report. The second objective was to provide estimates of woodland types, species, age classes and timber volumes.

The first objective for the Non-Woodland Tree Survey was to estimate the number of trees by their occurrence. For purposes of assessing their place in the landscape, trees were considered in terms of three categories; Isolated, Clumps and Linear Features. The last two terms are new to Census terminology so some words of explanation are required. A Clump is a small wood or group of trees in close canopy less than 0.25 hectare (ha) in extent. A Linear Feature is a line or strip of woody growth in close canopy, 20 metres (m) or less in overall width and more than 25 m long. The second objective for the Survey was to provide information on species, size classes, standing timber volumes and health of non-woodland trees.

METHODS

The Woodland Survey, which covered woodlands of 0.25 ha and over, was based on a three stage sampling system using the Ordnance Survey (O.S.) 1:50 000 maps, aerial photographs and ground surveys. The Non-Woodland Tree Survey was based on a two stage sampling system using aerial photographs and ground surveys.

Ground survey was used to collect data that could not be obtained from aerial photographs, and also to allow for changes that had occurred since the photographs were taken.

The Woodland Survey

For woodlands, the "woodland plates" (copies of the plates which print the solid green areas on O.S. 1:50 000 maps) prepared by the Ordnance Survey were marked to show Forestry Commission and Dedicated and Approved Woodlands. The boundaries of the remaining areas, "Other" woodland, were digitised to give a serial number, National Grid Reference and the area of each block. These blocks were stratified into six size classes; 0.25-1.99, 2.0-9.99, 10.0-19.99, 20.0-49.99, 50.0-99.99 and > 99.99 ha. As changes were likely to have occurred since the date of the O.S. survey, a random sample within each size class was selected from the list of digitised woods for aerial survey. The true boundaries were established for these and the areas re-calculated. The relationship between the areas so found and the digitised areas was used to establish a revised woodland area estimate for the Conservancy with a standard error no greater than ± 5 per cent. The area of extra woodland not recorded on the O.S. 1:50 000 maps was estimated in the course of the Non-Woodland Tree Survey as described below.

A sub-sample of woods was selected for ground survey. The size of this sub-sample was chosen to give an area estimate with a standard error of not more than ± 15 per cent on the most widely represented forest type. Stands were identified within this sub-sample of woods. Each of these stands was assessed for crop type, species, age, stocking, composition of the shrub layer (where present), top height and basal area (from which volumes were derived).

The Non-Woodland Tree Survey

Preparatory work indicated that stratification could make the sampling of Non-Woodland Trees more efficient. Accordingly the land area of Great Britain was classified into 24 soil groups. A pilot survey was carried out to assess the variability of the tree population using the soil groups as a basis for selection. Three samples in each group were selected at random. The size of each sample unit in England and Wales was a National Grid 500 m square (0.25 square kilometres) and in Scotland was 250 m square (0.0625 square kilometres). From the pilot data, sampling strata for the main survey were derived by combining those soil groups that produced a similar mean number of trees and a similar variance. The

sample size in each stratum was determined to obtain, at minimum cost, an estimate of the number of measurable isolated trees for a county in England and Wales or a Conservancy in Scotland, with a standard error not exceeding ± 25 per cent. A standard error limit of ± 30 per cent was also set for the number of trees of the most widely represented species of isolated tree in the county or Conservancy.

In the light of experience and also because of the need to contain costs, the size and groupings of samples for the main survey of England and Wales were changed after the survey of the first six counties (Berkshire, Devon, Humberside, Kent, Merseyside and Norfolk). Initially six sample 500 m National Grid squares were clustered together to form a strip 0.5 kilometre (km) wide by 3.0 km long (1.5 square kilometres). Subsequently the width of the strip was reduced to 0.25 km; this was done by reducing the dimensions of each sampling unit to measure 250 m by 250 m. These smaller units of 6.25 ha each were amalgamated into strips or clusters of 12 to give a total length of 3 km. This method of clustering samples was adopted in order to make it easier to obtain the required aerial photographic cover. To aid the final estimation and provide sufficient coverage, it was found necessary to have at least four sample clusters per stratum and 20 per county. The sample clusters were selected at random.

The use of 3 km long clusters was found to be impractical in Scotland where the physical geography and geology resulted in many of them crossing sample strata boundaries. It was therefore decided to make the clusters more compact and although the individual sample units remained unchanged at 250 m x 250 m they were arranged in two rows of four samples ie a block 1 km long and 500 m wide. Because the sampling frame in Scotland was the Conservancy, a very much larger area than the county which was adopted in England and Wales, the minimum number of clusters to be measured on the ground was raised from 20 to 60 and the number of clusters examined from photographs raised to 90.

All isolated trees, clumps and linear features were marked on stereo pairs of aerial photographs of each sample unit. Numbers of isolated trees were recorded and their crown diameters measured. The areas of clumps and the widths and lengths of linear features were also measured.

For the ground survey, a random sub-sample of two squares was chosen from each cluster of twelve in England and Wales or two squares from eight in Scotland. Each tree within these squares was assessed for species, health, location (roadside, waterside etc.) and also measured for diameter, total height and, for broadleaves only, timber height. Measurements of the widths and lengths of linear features and the areas of clumps were taken and each was assigned to a forest type. In addition any isolated extra woodland (not coloured green on the O.S. 1:50 000 map) was assessed for area and forest type.

A measurable tree was defined as having a diameter at breast height (dbh) of not less than 7 centimetres (cm), a persistent axis, and not pruned in such a way as to restrict its growth (an exception was made for pollarded trees). Trees less than 7 cm dbh were recorded if they were at least 1.5 m tall, had a persistent axis and were individuals rather than coppice shoots. In the case of highway and windbreak planting, any tree species, as opposed to shrub species, in clumps and linear features were included regardless of height.

An assessment of timber length was made for all measurable broadleaved trees in the ground survey. Timber length was defined as the height above the ground to 7 cm top diameter in young trees and from ground level to 15 cm top diameter in mature trees, or to the spring of the crown, whichever occurred first. To be assessed for volume, broadleaved trees were required to have a minimum of 2 m of straight timber. Trees with obvious stem rot, stem damage and twisted or deformed butts were given a timber length of zero. Forked trees with good growth in the upper stem were assigned a timber length derived from the length of the strongest fork. For conifer species, the volume was derived from the total height and the breast height diameter of the individuals.

Analysis of Results

The data collected in the Woodland Survey were used to provide population estimates for "Other" woodland. These were added to the Forestry Commission and Dedicated and Approved Woodland data. For Non-Woodland Trees the survey data were used to provide an estimate of the total population. The results are presented in the following tables and diagrams, together with explanatory notes and comments.

Data relating to trees and woodlands in National Parks (N.P.) and Areas of Outstanding Natural Beauty (A.O.N.B.) in England and Wales, although not given separately in this report, are stored in computer files. In Scotland data relating to local authority Regions are published in summarised form in the Reports for the Forestry Commission Conservancy in which they wholly or substantially fall. The results for Highland Region are contained in the North Scotland Report; Grampian, Tayside and Fife in that for East Scotland; Lothian, Borders, Dumfries and Galloway and Strathclyde in that for South Scotland and Central and Strathclyde in that for West Scotland.

GENERAL COMMENTS ON TABLE ENTRIES

In the 1947 Census, High Forest types were distinguished using a threefold classification into Coniferous, Mixed and Broadleaved. "Mixed" covered High Forest stands in which one group of species (coniferous or broadleaved) occupied 20 per cent or more of the stock. Since the 1960's, the convention adopted in describing High Forest types has been to distinguish only two: Mainly (that is more than 50 per cent) Coniferous and Mainly Broadleaved. This classification is now well established both at home and internationally.

When reading the numerical values within the Tables, it should be noted that the variances for the figures quoted can be large. For example, the aim of the Non-Woodland Tree Survey was to obtain a standard error not exceeding ± 25 per cent of the total number of isolated trees. The variance for any one species, however, may be bigger than this, and when a species is poorly represented the variance can be very large indeed. Equally, the fact that nil (—) entries appear against a particular species, size class, health class or volume does not necessarily mean that there are no trees of that species or category on the ground, but rather that these species or categories were so sparse that they were not picked up at the sampling intensity used.

Part One

Woodlands

COMMENTARY ON THE RESULTS FOR WOODLANDS
IN SCOTLAND

General

The tables and reports for Scotland contain summaries on the 1980 Survey and also some comparisons with the 1947 and 1965 Census Surveys. The Census in 1980, as in 1947 and 1965, covered both the mainland of Scotland and major islands adjacent to it, but because of the very small woodland areas involved no survey work was carried out on the Island Areas of the Western Isles, Orkneys and Shetlands.

Previous Surveys

The 1947 Census involved a complete assessment of all woods more than 2 ha in extent, and gave a detailed analysis by county and country of the position following the extensive war-time fellings. It was followed in 1951 by a sample survey of woods between 0.4 and 2.0 ha (1.5 acres) in area. In 1965, Census results were required by marketing regions, based on groups of counties, and samples of private woodlands greater than 0.4 ha (1 acre) were visited and assessed for both crop and volume estimates. Owing to both the method and intensity of sampling adopted in 1965, the precision of the estimate of total woodland area at that date is less than that for 1980.

Woodland Area

The table below shows the reported woodland area in hectares at each of the three Surveys, and also the estimated areas after adjustments have been made to bring the results to a common base. An allowance has been added for woods between 0.25 and 2.0 ha in the case of the 1947 results, and between 0.25 and 0.4 ha for the 1965 results.

Year	Area of land and inland water ha	Area of woodland ha	Minimum area of woodland ha	Estimated area of woodland 0.25 ha and over	Per cent of land area	
1947	7 320 578	512 671	2.0	530 000	7.2	6.7
1965	7 319 527	655 622	0.4	657 000	9.0	8.3
1980	7 321 263	919 925	0.25	920 000	12.6	11.7

The total areas of land and inland water were obtained from the Ordnance Survey at the time of each Census, and the changes in land area are the result of continuous resurvey and remeasurement. The figures in all instances exclude the Western Isles, Orkneys and Shetlands. For comparison, the woodland density in Wales is 11.6 per cent of the total land area and in England is 7.3 per cent.

Although the Western Isles, Orkney and Shetland were not included in the Survey, some account must be taken of their land area and of the woodland they contain. The North Scotland Conservancy of the Forestry Commission includes Skye forest, which has outlying plantations on the Western Isles and the area involved has been amalgamated with the rest of the Forestry Commission data in both this and the Conservancy report. In addition, it is estimated that there are also some 120 ha of woodland in "Other" private ownership. So far as the other two major groups of islands are concerned, the O.S. 1:50 000 maps indicate that there are some 10 ha of woodland on the Shetlands, all of which lie in blocks of less than 2 ha, and approximately 30 ha on the Orkneys. The latter total includes the Forestry Commission Research plantations on Hoy, as well as "Other" woodland, and there are no blocks greater than 10 ha in extent.

Thus it appears that in the whole of Scotland including all the islands, there are approximately 920 100 ha of woodland present on a land and inland water area of 7 877 456 ha. The density of woodland in all Scotland has risen from 6.7 per cent in 1947 to 11.7 per cent in 1980. Further reference to woodland areas in this commentary are to Scotland excluding the Island Authorities.

The area of small woods in Scotland estimated during the Survey of Hedgerow and Park Timber and Woods under Five Acres in 1951, was 15 175 ha (37 500 acres). This figure, together with an allowance for woods of 0.25-0.4 ha (some 1 840 ha) has been included in the table above. However, the area of woods in the 0.25-2.0 ha size class in 1980 is estimated to be 21 470 ha. There is a difference of some 4 500 ha between the two estimates, the major reasons for which are:-

1. The estimate of the area of small woods in 1951 was based on two independent one per cent samples of 6 inch to 1 mile O.S. maps. These were the latest maps available but in many cases were editions that pre-dated the First World War.

2. Some fragmentation of larger blocks will have occurred as a consequence of the increased pace of housebuilding, road widening, clearance for powerlines etc since 1947.
3. Woodland arising as a result of colonisation usually occurs initially as scattered small blocks, and much of it would post-date the map editions used in the earlier Survey.

Reference to the previous table shows that the total woodland area rose by 127 thousand hectares or 24 per cent, between 1947 and 1965, and increased by a further 263 thousand hectares, or 40 per cent, between 1965 and 1980. Throughout the period the increase is in the order of 390 thousand hectares, a rise of 74 per cent on the woodland area that was present in 1947.

In 1980 the details of Forestry Commission and Dedicated and Approved Woodlands were obtained from records, while the area of "Other" private ownership was based on the representation of woods on the O.S. 1:50 000 maps. Any changes to the boundaries of existing woodlands were accounted for during the course of survey. In addition, the sample units of the Non-Woodland Survey were used to locate and to estimate the area of any isolated blocks that were not depicted on the maps ("extra" woodland).

It is estimated that approximately 16 thousand hectares of woodland shown on the maps no longer existed at the time of survey, whereas there were about 24 thousand hectares of "extra" woodland. Therefore, allowing for both gains and losses it is probable that the maps have underestimated the area of "Other" woodland by some eight thousand hectares. However, because the estimate of the area of "extra" woodland is of low precision it has not been combined with the results of the main Woodland Survey.

The distribution of woodland by Forestry Commission Conservancy is shown in the following table.

Conservancy	Woodland area (thou sands of hectares)	Per cent of total	Woodland density per cent of land area
North Scotland	245	27	9.2
South Scotland	267	29	16.3
East Scotland	218	23	12.2
West Scotland	190	21	15.3
Scotland	920	100	12.6

Woodland Ownership

It can be seen that South Scotland Conservancy makes the greatest contribution to the woodland area and also has the highest woodland density. North Scotland Conservancy is second in terms of woodland but because of its extensive land area has the lowest woodland density.

The Forestry Commission owns almost 498 thousand hectares of the woodland in Scotland while private owners hold 422 thousand hectares. An analysis of woodland ownership over the years is given in percentage terms in the table below.

Year	Forestry Commission per cent	Private per cent
1947	19	81
1965	46	54
1980	54	46

While the percentages above indicate an increased Forestry Commission share of the woodland area, they mask a remarkable trend in private forestry. The results of the previous Surveys show that the private woodland area fell by 79 thousand hectares between 1947 and 1965, mainly as a result of change in land use or purchase by the Forestry Commission. Since 1965, despite a very substantial programme of private afforestation, the area has not yet climbed back to the level it was in 1947.

In West Scotland Conservancy the Forestry Commission accounts for 67 per cent of the total woodland area, followed by North and South Conservancies with 56 and 51 per cent respectively. East Scotland Conservancy has the lowest percentage held by the Forestry Commission, at 44 per cent.

Distribution by Forest Types

Forest Types by Area and Ownership

Forest Type	Forestry Commission		Private Woodland		Total		Per cent of total woodland area
	Area	Per cent of total	Area	Per cent of total	Area	Per cent of total	
Mainly Coniferous High Forest	485.0	63	281.4	37	766.4	100	83
Mainly Broadleaved High Forest	4.0	5	71.8	95	75.8	100	8
Total High Forest	489.0	58	353.2	42	842.2	100	91
Coppice with Standards	—	—	<0.1	100	<0.1	100	<1
Coppice	—	—	<0.1	100	<0.1	100	<1
Scrub	2.7	4	57.8	96	60.5	100	7
Cleared	6.1	35	11.1	65	17.2	100	2
Total	497.8	54	422.1	46	919.9	100	100

The above table shows that Mainly Coniferous High Forest forms the major part of the Scottish woodland area. Almost all the broadleaved area, including Mainly Broadleaved High Forest, most of the Scrub, and the small area under coppice management is in private ownership. Furthermore, Table 2 of the main tables shows that 80 per cent of the Mainly Broadleaved High Forest is in "Other" private ownership. The "Other" private ownership class does not necessarily imply lack of management as it includes owners who either have never joined or have withdrawn from the formal Dedication and Approved Woodland schemes, although they continue to manage their woodland on sound principles.

The classification of crops has varied from survey to survey depending upon the objectives of the assessment. In 1947 the objective was to ascertain the position after war-time fellings, and the classification included such forest types as Devastated (crops from which most of the merchantable trees had been removed), and areas felled before or after September 1939. In 1965 the need to recognise these special categories had disappeared but, as the effects of exploitation were still evident in many of the stands it was necessary to introduce new categories such as Utilisable Scrub and Worked and Unworked Coppice to accommodate woods in a transition stage. A further period of fifteen years has resulted in many crops developing either naturally or as a result of man's intervention from a less productive to a more productive category. However, it can be difficult, particularly in the case of some broadleaved crops, to place them neatly and permanently within any consistent system of classification. For example, heavy selective felling in High Forest may lead to a classification of Scrub and also, over time, Scrub stands may improve enough in quality to be considered as High Forest. Therefore, comparison of results for the distribution of forest types, particularly of broadleaved crops, is seldom straightforward and it is sometimes necessary to combine categories to show trends.

The following table illustrates the proportion of forest types found at each assessment, but does not take into account any effects associated with the various minimum areas of woodland adopted in the different surveys.

Distribution of Forest Types by Percentage of Woodland Area

Forest Type	Percentage of Woodland Area		
	1947	1965	1980
Coniferous High Forest	36	69	83
Broadleaved High Forest	9	6	8
Total High Forest	45	75	91
Coppice with Standards	<1	—	<1
Coppice	<1	—	<1
Scrub	23	17	7
Cleared	32	8	2
Total	100	100	100

NOTE:

Scrub includes Devastated in 1947 and both Utilisable and Unutilisable Scrub in 1965. Cleared includes the classification Felled in both 1947 and 1965.

The table above shows that in 1947 the area classed as Cleared accounted for no less than 32 per cent of the woodland total. The extent of this category, therefore, had a marked effect on the percentages attributable to the remaining forest types. The estimate depended not only upon the actual area of recent felling, but also on the representation of woodland on the maps in use at the time. Many of these, despite being the latest available, were editions of 1910 or before. Accordingly areas that still had visible evidence of stumps on the ground, although they may not have borne tree crops since the First World War, were included as part of the woodland resource. Some of these older map editions were still in use in 1965.

The geographical distribution of the two High Forest types is indicated in the following table which analyses the proportion of the Scottish totals of High Forest types and land area included within each Scottish Conservancy.

Percentage of Scottish totals				
Conservancy	Coniferous High Forest	Broadleaved High Forest	Total High Forest	Total Land Area
North Scotland	26	14	25	36
South Scotland	30	32	31	23
East Scotland	23	32	23	24
West Scotland	21	22	21	17
Total	100	100	100	100

It is clear from the table that South Scotland Conservancy contains the highest proportion of each of the High Forest types and consequently of High Forest area. West Scotland has a proportionally higher share of the Coniferous High Forest total than of total land area, and North Scotland rather less. South and East Conservancies hold a major and equal share of the Broadleaved High Forest total and two thirds of the area of this type is contained within these two Conservancies, where the soils and growing conditions are generally more favourable.

Mainly Coniferous High Forest

The area of Coniferous High Forest has increased its share of the woodland area from 36 per cent in 1947 to 83 per cent in 1980. Although it is not obvious from the proportions shown above, the greatest increase in area, 313 thousand hectares, came between 1965 and 1980, while over 265 thousand hectares were planted during the period 1947-1965.

Species distribution is affected by the location of new planting as well as owners' preferences. Table 4 in the main tables shows that Sitka spruce, Scots pine and Lodgepole pine are the most widely represented species. For both the Forestry Commission and owners of Dedicated and Approved woods Sitka spruce is the commonest species. For the Forestry Commission Lodgepole pine and Scots pine are the next most favoured species, while Dedicated and Approved estates have preferred the same species but in the reverse order. Among "Other" private woodlands the ordering is completely different with Scots pine followed by Sitka and Norway spruce.

The relative importance of the major coniferous species at the time of the three Surveys is shown in the table below.

Year	1st	2nd	3rd	4th
1947	Scots pine	Sitka spruce	Norway spruce	European larch
1965	Sitka spruce	Scots pine	Norway spruce	Jap./Hybrid larch
1980	Sitka spruce	Scots pine	Lodgepole pine	Norway spruce

With the massive increase in total woodland area, and in conifer woodland in particular, it is hardly surprising that the distribution of species and planting year classes in Table 5 should show that 88 per cent of the conifer stock has been planted since 1941. For crops planted before that date, the tables show that Scots pine, Sitka spruce, Norway spruce and European larch account for the greatest area, the same species ranking as was found in the 1947 Census.

The rate of change in the importance of the various species can be assessed by comparing age distributions. These show that for the species with the greatest area in 1980, four per cent of the present area of Sitka spruce was planted before 1941, 32 per cent of the Scots pine, less than one per cent of the Lodgepole pine and 22 per cent of the Norway spruce.

Mainly Broadleaved High Forest

The area of Mainly Broadleaved High Forest in 1980 accounts for eight per cent of the woodland total, whereas in 1947 it comprised nine per cent. However, the actual area of Mainly Broadleaved High Forest diminished by some 16 thousand hectares between 1947 and 1965, and has increased by 37 thousand hectares since that time. Thus there is now a greater area of woodland classified as Mainly Broadleaved High Forest than has been the case in the two previous Surveys.

Part of the drop in area between 1947 and 1965 can be attributed to the adoption of the Utilisable and Unutilisable Scrub categories in the 1965 Census which resulted in the reclassification, and consequent downgrading, of part of the Mainly Broadleaved High Forest area. Other broadleaved stands were clearfelled and replanted with conifers, or conifers and broadleaves in mixture, the latter practice causing a temporary reduction in broadleaved area. However, since 1965 there has been a significant natural development of Scrub into High Forest, as well as the normal processes of planting, restocking and the colonisation of bare land.

The age class distribution of the broadleaves in Table 5 of the main tables shows evidence of two distinct trends. Firstly, 41 per cent of all broadleaves are older than 80 years of age and are dominated by oak and beech. Secondly, there is a more modest peak of area in the 1931-1960 period, from which time 27 per cent of all broadleaves originate; here birch and sycamore are the major species with, however, a substantial area of oak in P31-40. There were 3 611 ha of elm present at the time of assessment, but some reduction of this total can be expected as more stands become infected with Dutch elm disease.

The relative importance of the major broadleaved species in High Forest at the time of each Survey is shown below.

Year	1st	2nd	3rd	4th
1947	Beech	Oak	Sycamore	Birch
1965	Oak	Beech	Birch	Sycamore
1980	Birch	Oak	Beech	Sycamore*

* The Mixed broadleaves group has a greater area than that of sycamore but it has not been recorded in the table as it represents the combined areas of several species.

The significant features of this table are the decline in the importance of beech and an increase in birch, which has risen from a six per cent share of Mainly Broadleaved High Forest area in 1947 to a 22 per cent share in 1980. The increased area of birch is a result of the reclassification of stock which was largely Scrub at the earlier dates but has since grown into the High Forest category.

Coppice and Coppice with Standards

In 1947 there were 36 ha of Coppice with Standards and 197 ha of Coppice, in 1965 no areas being worked under coppice systems were found in the samples, and in 1980 Dedicated and Approved estates report only 15 ha of Coppice with Standards and 4 ha of Coppice.

This confirms the general decline of coppice systems found elsewhere, and crops previously managed in this way have usually been reclassified as Broadleaved High Forest.

Scrub

Scrub includes crops of poor form or unmarketable species on such sites as rough grazing land, pockets of wetland and on old industrial sites. "Other" private woodlands account for 86 per cent of this total.

The area of Scrub has fallen during the last thirty years from 117 500 ha classed as Scrub and Devastated in the 1947 Report, to 111 thousand hectares in 1965 and to the present estimate of 60 512 ha. The reduction in overall area has been caused partly by clearance, partly by replanting and partly by natural development into Broadleaved High Forest.

The main components of Scrub are birch, which accounts for 68 per cent of the total, oak, and the Other broadleaves group, which includes such species as hawthorn, willow and rhododendron.

Overall Broadleaved Position

As noted above, it is difficult to make direct forest type comparisons with the past. However, it is possible to draw some general conclusions by combining the broadleaved element from all forest types, which overcomes the problem of changes in classification, and also by making allowance for differences in minimum wood size. It is then apparent that the total area of broadleaved woodland has fallen steadily over the years, and is now approximately 20 thousand hectares less than in 1947.

There has also been a change in the composition of broadleaved woodland. The area of birch has decreased by some 29 thousand hectares, oak by 11 thousand hectares and beech by 10 thousand hectares. The areas of species such as sycamore, ash and Other broadleaves have increased. However, these losses are exaggerated as a result of there being a substantial area of Mixed broadleaves in the 1980 estimate which cannot be further divided, and also because the statistics contained in the Forestry Commission and Dedicated and Approved Woodland databases do not always describe stand structure accurately in that the broadleaved element in crops that have been underplanted with conifers has sometimes been ignored.

Standing Volume

It is estimated that there are over 60 million cubic metres overbark in Scottish woodlands, with 47.7 million cubic metres of coniferous timber and 12.7 million of broadleaved timber. Analyses by forest type, ownership, planting year and size class are shown in Tables 11, 12 and 13. The distribution of volume by species is determined not only by growth rate, but also by total area and age structure. Thus, the total standing volume of Scots pine is only six per cent less than that of Sitka spruce (Table 12) although it occupies less than half the area of Sitka spruce (Table 5). Similarly, among the broadleaves, while oak and birch are almost equal in area there is twice as much oak volume (3 081.0 thousand cubic metres) than there is birch (1 455.7 thousand cubic metres). Both Scots pine and oak have a major influence on the volume in the older age classes in their respective forest types, whilst Sitka spruce and birch dominate the volume in the younger age groups.

Sitka spruce with 32 per cent and Scots pine with 31 per cent carry the most volume among conifers followed by Norway spruce and Japanese/Hybrid larch, while among broadleaves oak is closely followed by beech and then by sycamore.

The size class distribution in Table 13 shows the usual pattern of a relatively young conifer resource in that 52 per cent of the conifer volume is in trees of 7-20 cm dbh, 26 per cent is in the 21-30 cm dbh size class, 18 per cent in the 31-50 cm dbh size class and four per cent in trees greater than 50 cm dbh. Oak and beech weight the broadleaved volume towards the larger trees, with 34 per cent of the volume in the 31-50 cm dbh size class, and 35 per cent in the largest diameter class.

Volume estimates were produced for both the 1947 and 1965 Surveys, and although the standards of measurement were similar to those in 1980, the overall estimates are affected by the minimum area and classification differences.

After allowance for volume in woods of 0.25-1.99 ha, it is found that the total standing volume rose from approximately 36 million cubic metres overbark in 1947 to some 39 million cubic metres in 1965 after adjustments for the volume in small woods, and to 60 million cubic metres in 1980. These figures indicate the increases in volume which have taken place as a result of substantial areas of planting which are now producing measurable timber. The rate of volume increase, which was relatively small between 1947 and 1965 can be expected to rise rapidly as the large areas planted between 1961 and 1980 move into the measurable size category. Most of the volume increase will be in coniferous timber.

The volume distribution by ownership and by species in the productive forest types is shown below.

Volume by Ownership Classes as a Percentage of Total Standing Volume

Ownership Class	Category	1947	1965	1980
Forestry Commission	Coniferous	12	29	42
	Broadleaved	<1	<1	1
	Total	12	29	43
Private	Coniferous	60	48	37
	Broadleaved	28	23	20
	Total	88	71	57
All	Coniferous	72	77	79
	Broadleaved	28	23	21
	Total	100	100	100

The table shows that the Forestry Commission share in the total volume has risen steadily over the period from 12 per cent in 1947 to 43 per cent in 1980, and most of the increase has been in coniferous timber. The private owners' share of both coniferous and broadleaved timber has fallen partly because of the decline in private woodland area that took place mainly during the nineteen fifties, and partly because of the very substantial increase in volume of Forestry Commission plantations.

Volume by Major Species Groups in High Forest as a Percentage of Total Standing Volume

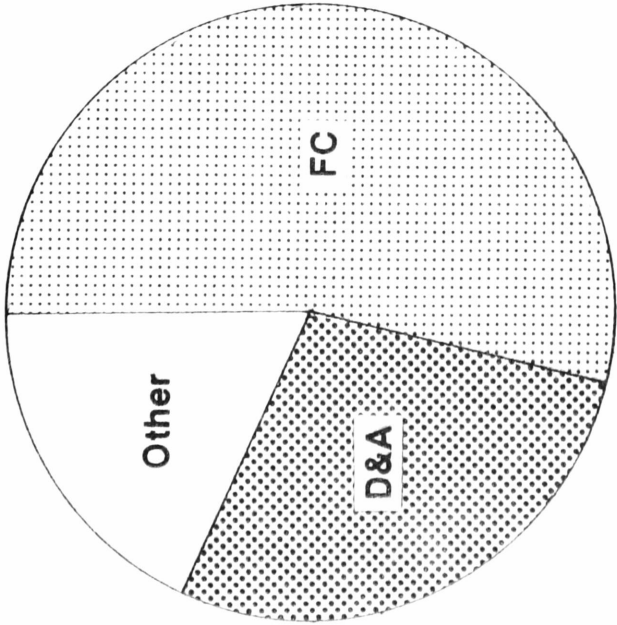
Species Group	1947	1965	1980
Pines	38	36	28
Spruces	14	23	36
Larches	11	12	11
Oak	9	6	5
Beech	10	6	5
Sycamore, ash and birch	5	3	6
Total	100	100	100

The pattern set by afforestation and by clearance and restocking in the years since the Second World War is again demonstrated in the table above. Pines, although still important, now account for substantially less than the spruce species group. The proportion of larch volume has remained the same. Although the percentage share of broadleaves in the total has declined, the broadleaved volume has actually increased. A considerable part of this increase is accounted for by species such as sycamore, ash and birch, while oak and beech, which have traditionally dominated this category, now make less of a contribution.

In estimating the standing volumes no allowance has been made for location or for any planning, conservation or amenity restrictions, so that it must not be assumed that all the volume in the tables is available for harvesting.

Diagram 1

Woodland Area by Ownership



Note: Circle not to scale

FC: Forestry Commission Woodland

D&A: Dedicated and Approved Woodland

Other: "Other" Woodland

Scotland

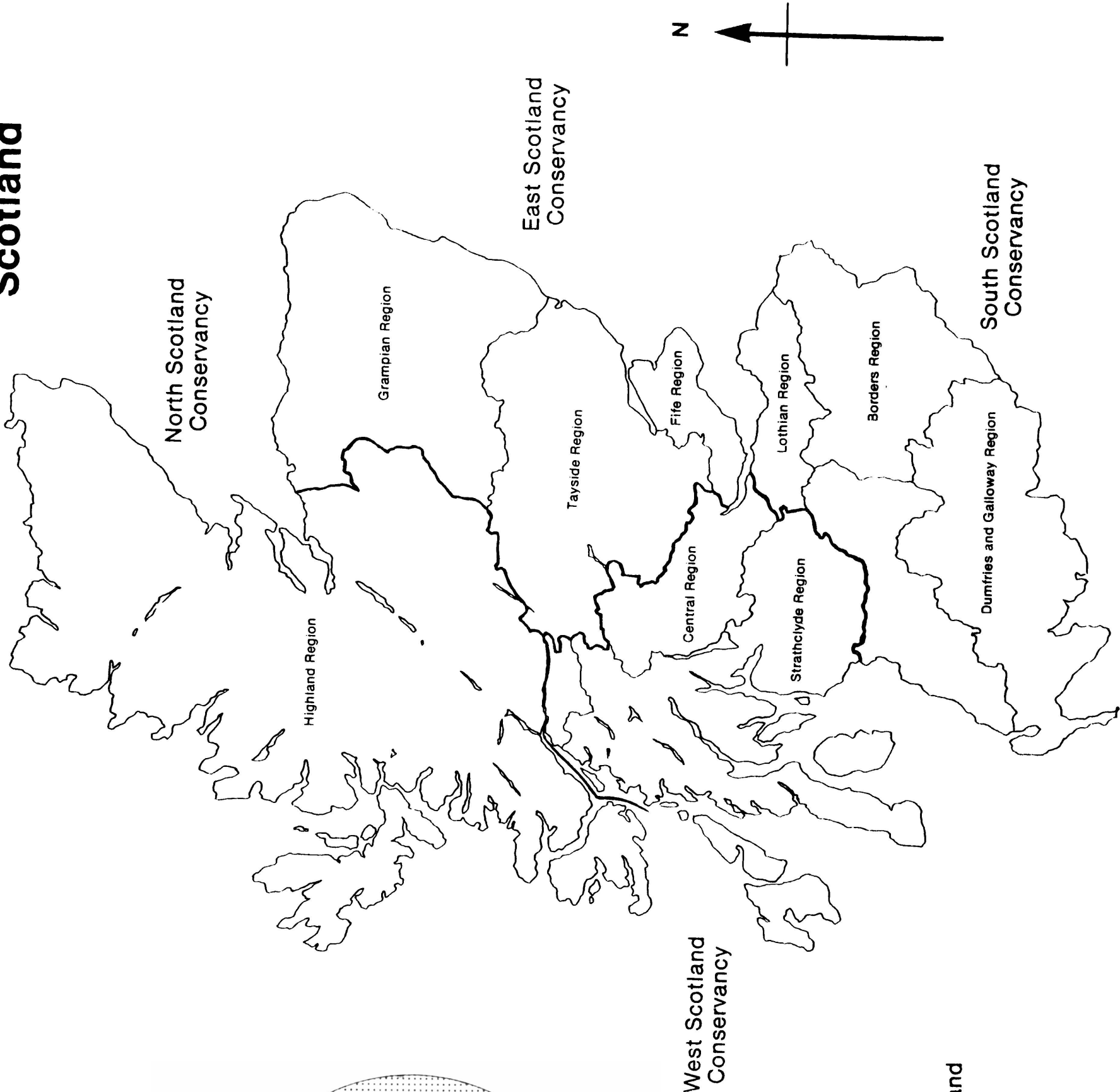


TABLE 1 **SUMMARY OF AREAS BY OWNERSHIP**

Area of Scotland (including inland water): 7 321 263 hectares.

	Hectares	% Woodland Area
Area of Forestry Commission Woodland	497 893	54
Area of Dedicated and Approved Woodland	256 495	28
Area of "Other" Woodland	165 537	18
Total Area of Woodland over 0.25 ha	919 925	100

NOTES:

The areas of Forestry Commission and Dedicated and Approved Woodlands were taken from the forest records; these are assumed to be accurate. Any uncertainty, therefore, arises in the estimate of "Other" Woodlands.

The O.S. 1:50 000 First Series maps used in the survey were compiled photographically from the O.S. Seventh Series one inch to one mile maps which were last revised for major change between 1954 and 1977. Where they were available use was made of Second Series sheets.

The estimated total woodland area is 919 925 ha (\pm 2 837 ha or 0.3 per cent). This represents 12.6 per cent of the land and inland water area of Scotland. In addition, an estimated area of 23 880 ha not represented on the maps but found during the ground sample, has not been included in the above total because of the limited information about the composition of this extra woodland and the substantial standard error attached to the estimate.

Some of the land shown on the maps as woodland has been reclassified by the Census either because the land use has changed or because it did not fall within the definition of woodland used in the survey. It is estimated that there were approximately 15 850 ha in this category.

Small Woods

Details of Forestry Commission and Dedicated and Approved Woodlands are not available as the data for these ownerships are not recorded by individual woodland blocks.

"Other" Woodlands Only

	Woods 0.25-1.99 ha	Woods 2.0-9.99ha
Total Number of Woods	21 290	14 100
Total Area of Woods	21 470 ha	53 910 ha
Mean Area of Woods	1.01 ha	3.82 ha

DIAGRAM 2

AREA OF WOODLAND BY
FOREST TYPE AND OWNERSHIP

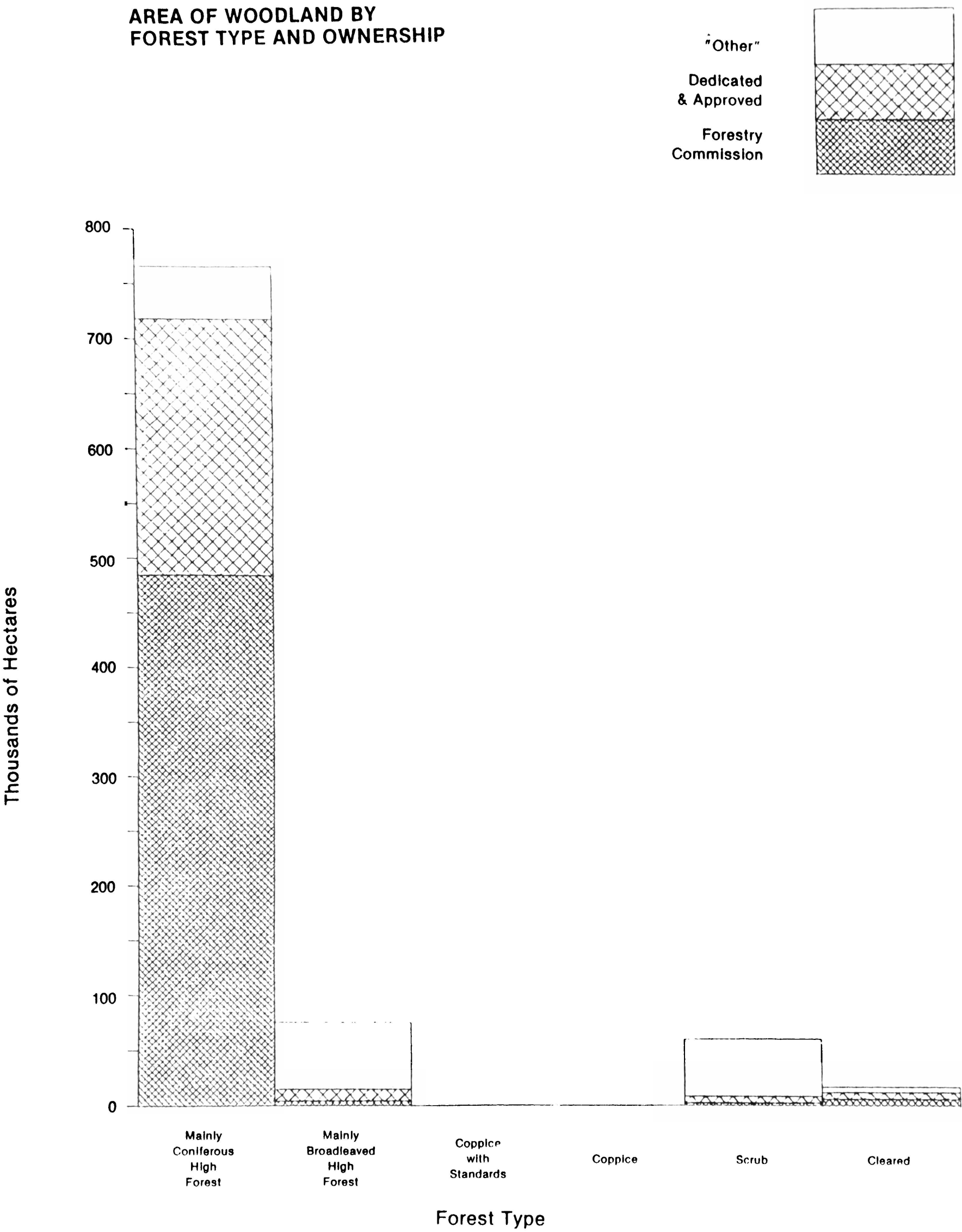


TABLE 2 AREA OF WOODLAND BY FOREST TYPE AND OWNERSHIP

Hectares								
Forest Type	Forestry Commission		Dedicated and Approved		"Other"		Total	
	area	% of total	area	% of total	area	% of total	area	% of total
Mainly Coniferous High Forest	484 994	97	233 610	92	47 747	29	766 351†	83
Mainly Broadleaved High Forest	4 033	1	10 974	4	60 842*	37	75 849†	8
Total High Forest	489 027	98	244 584	96	108 589	66	842 200†	91
Coppice with Standards	—	—	15	<1	—	—	15	<1
Coppice	—	—	4	<1	—	—	4	<1
Scrub	2 723	1	6 004	2	51 785	31	60 512†	7
Cleared	6 143	1	5 888	2	5 163	3	17 194†	2
Total	497 893	100	256 495	100	165 537	100	919 925	100

NOTES:

* This figure for Mainly Broadleaved High Forest contains 8.7 per cent of Coppice origin.

† Standard errors on the area estimates of forest types are as follows:

Mainly Coniferous High Forest	± 0.5 per cent
Mainly Broadleaved High Forest	± 4.7 per cent
Total High Forest	± 0.5 per cent
Scrub	± 5.7 per cent
Cleared	± 7.2 per cent

The percentage standard errors of area estimates of the remaining forest types are higher than these.

In this table, areas of the two categories of High Forest have been derived by allocating the area of each individual High Forest stand to either Mainly Broadleaved High Forest if 50 per cent or more of the area comprised broadleaved species, or to Mainly Coniferous High Forest if more than 50 per cent of the area comprised coniferous species.

DIAGRAM 3
AREA OF HIGH FOREST TYPES BY PLANTING YEAR CLASSES
ALL WOODLAND OWNERSHIPS
MAINLY CONIFEROUS

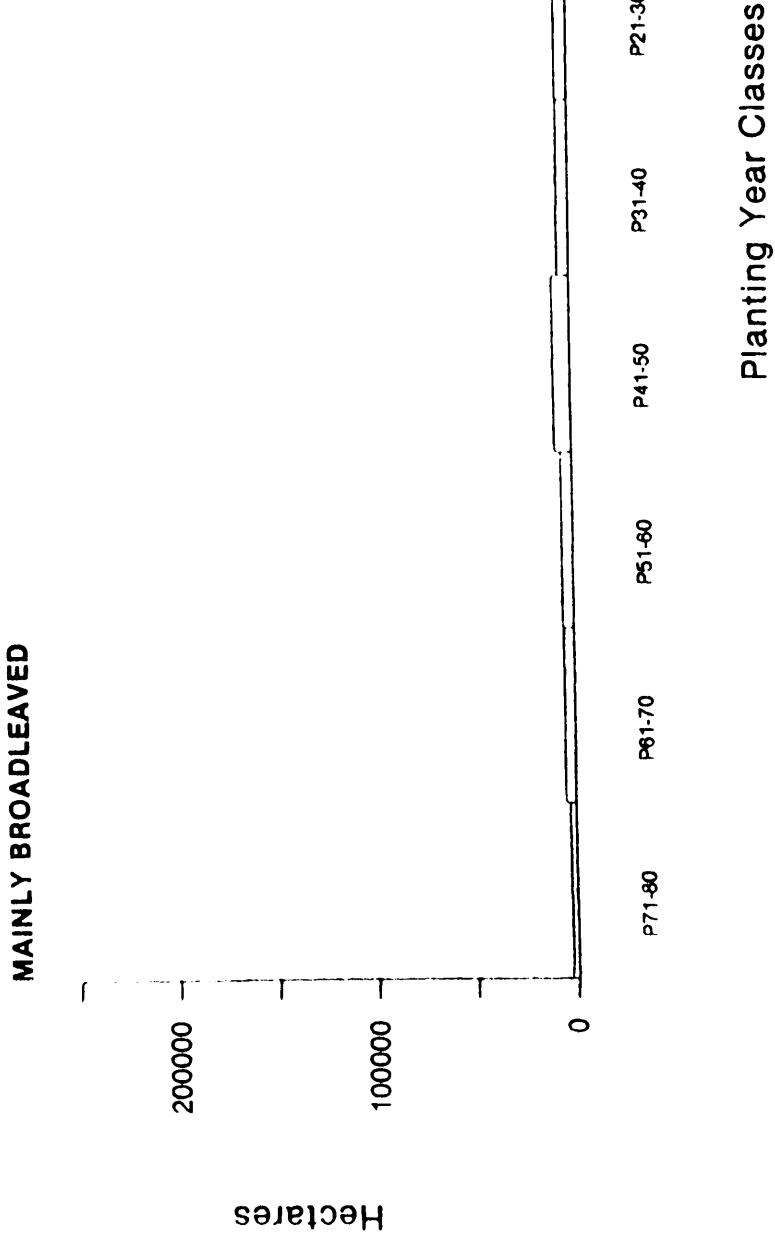
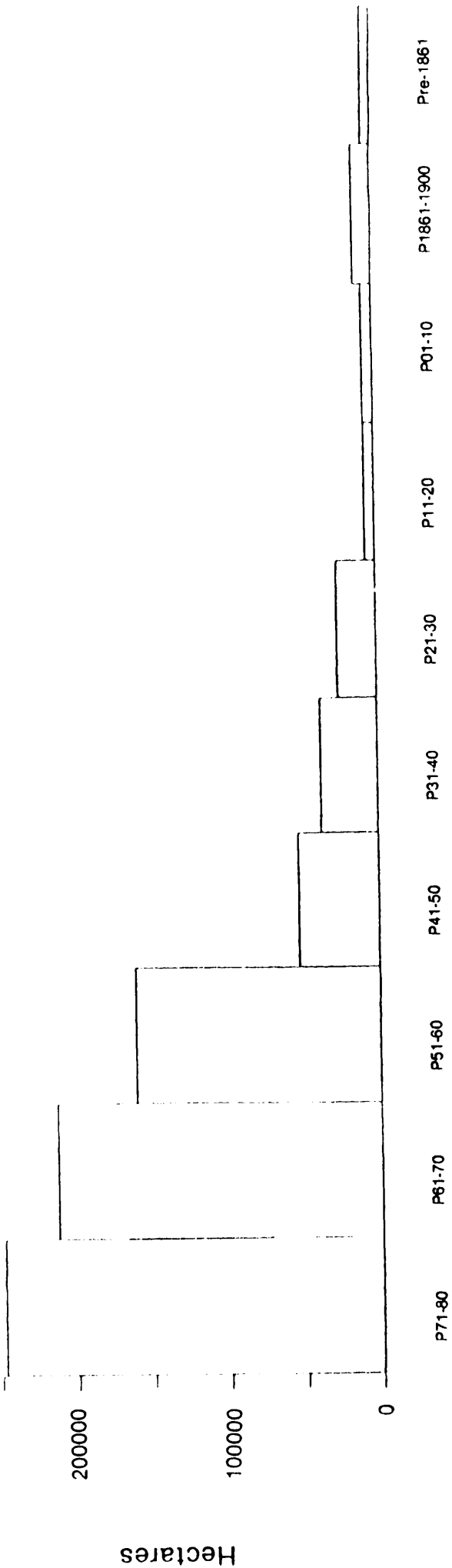


TABLE 3 AREA OF HIGH FOREST TYPES BY PLANTING YEAR CLASSES

All Woodland Ownerships Hectares

High Forest	Planting Year Classes										Total
	P71-80	P61-70	P51-60	P41-50	P31-40	P21-30	P11-20	P01-10	P1861-1900	Pre-1861	
Mainly Coniferous	247 569	212 439	160 563	52 666	37 445	25 251	6 346	6 862	11 887	5 323	766 351
Mainly Broadleaved	2 794	5 164	5 875	8 715	6 047	6 320	2 900	6 439	19 287	12 308	75 849
Total	250 363	217 603	166 438	61 381	43 492	31 571	9 246	13 301	31 174	17 631	842 200

NOTE: %

20 7 5 4 1 2 4 2

In Tables 3, 3a, 3b and 3c areas of the two categories of High Forest have been derived by allocating the total area of each individual High Forest stand to Mainly Broadleaved High Forest if 50 per cent or more of the area comprised broadleaved species, or to Mainly Coniferous High Forest if more than 50 per cent of the area comprised coniferous species.

AREA OF HIGH FOREST BY PLANTING YEAR CLASSES AND OWNERSHIPS

DIAGRAM 3a
Forestry Commission Woodland

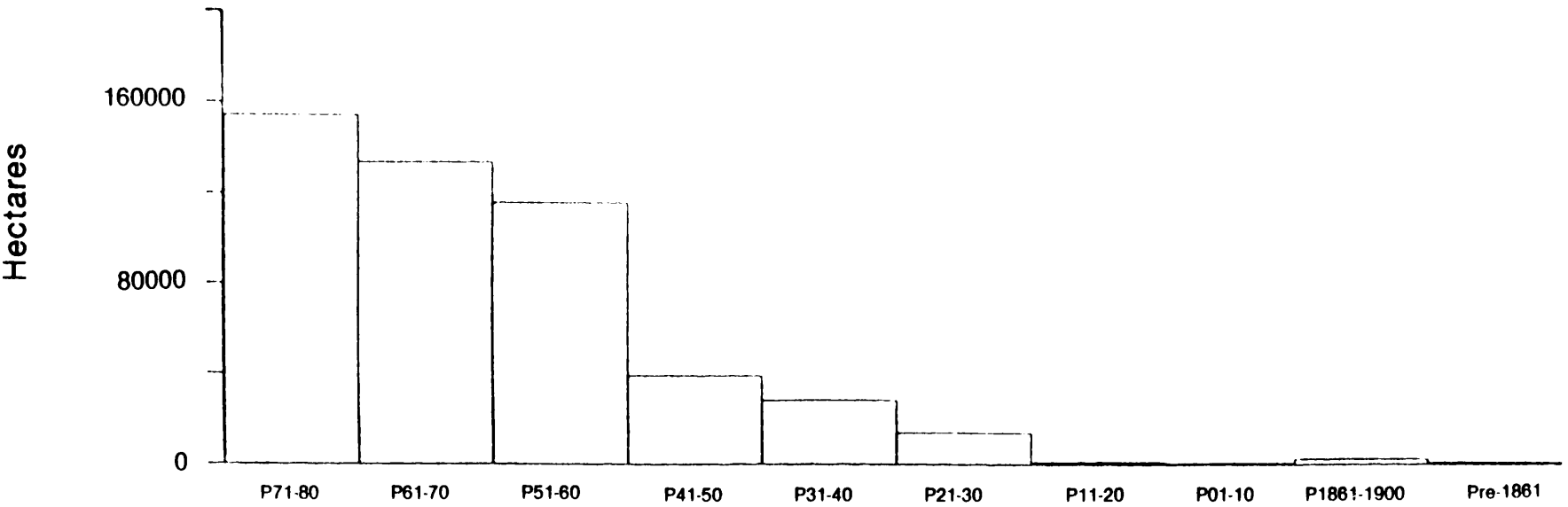


DIAGRAM 3b
Dedicated and Approved Woodland

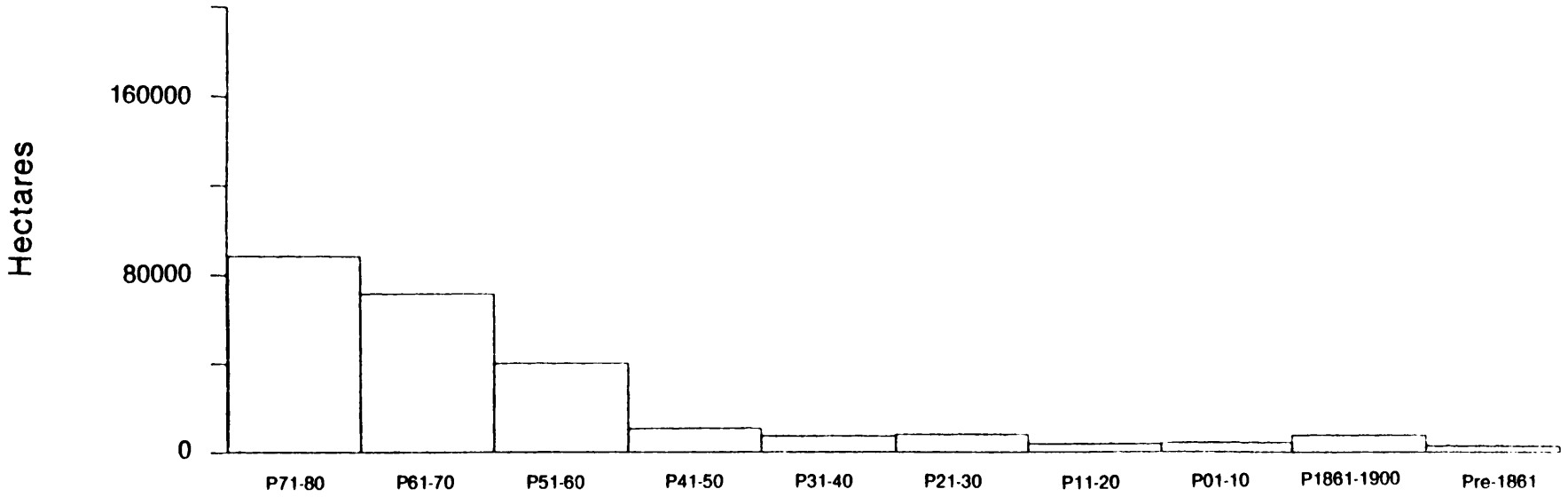
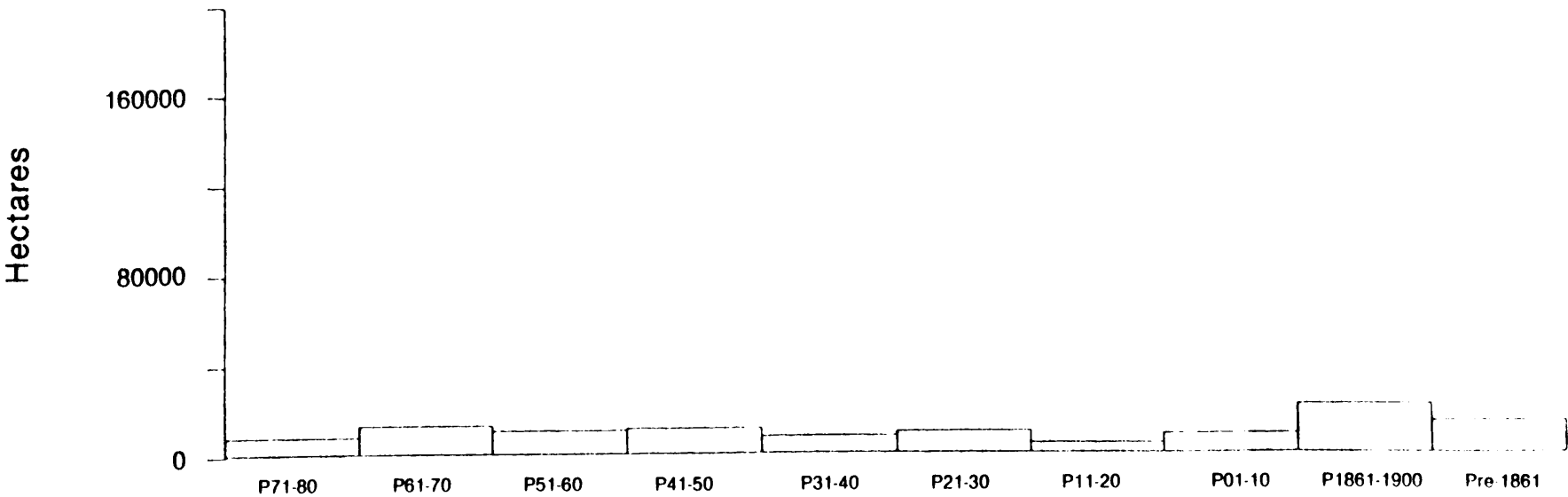


DIAGRAM 3c
"Other" Woodland



Planting Year Classes

AREA OF HIGH FOREST TYPES BY PLANTING YEAR CLASSES
AND OWNERSHIPS

TABLE 3aForestry Commission WoodlandHectares

High Forest	Planting Year Classes										Total
	P71-80	P61-70	P51-60	P41-50	P31-40	P21-30	P11-20	P01-10	P1861-1900	Pre-1861	
Mainly Coniferous	153 985	133 389	115 063	38 725	27 749	13 462	610	374	1 299	338	484 994
Mainly Broadleaved	381	192	740	466	610	250	145	49	881	319	4 033
Total	154 366	133 581	115 803	39 191	28 359	13 712	755	423	2 180	657	489 027

TABLE 3bDedicated and Approved WoodlandHectares

High Forest	Planting Year Classes										Total
	P71-80	P61-70	P51-60	P41-50	P31-40	P21-30	P11-20	P01-10	P1861-1900	Pre-1861	
Mainly Coniferous	87 366	70 295	39 231	10 395	6 914	7 754	3 331	3 335	3 853	1 136	233 610
Mainly Broadleaved	748	904	768	320	468	454	566	992	3 907	1 847	10 974
Total	88 114	71 199	39 999	10 715	7 382	8 208	3 897	4 327	7 760	2 983	244 584

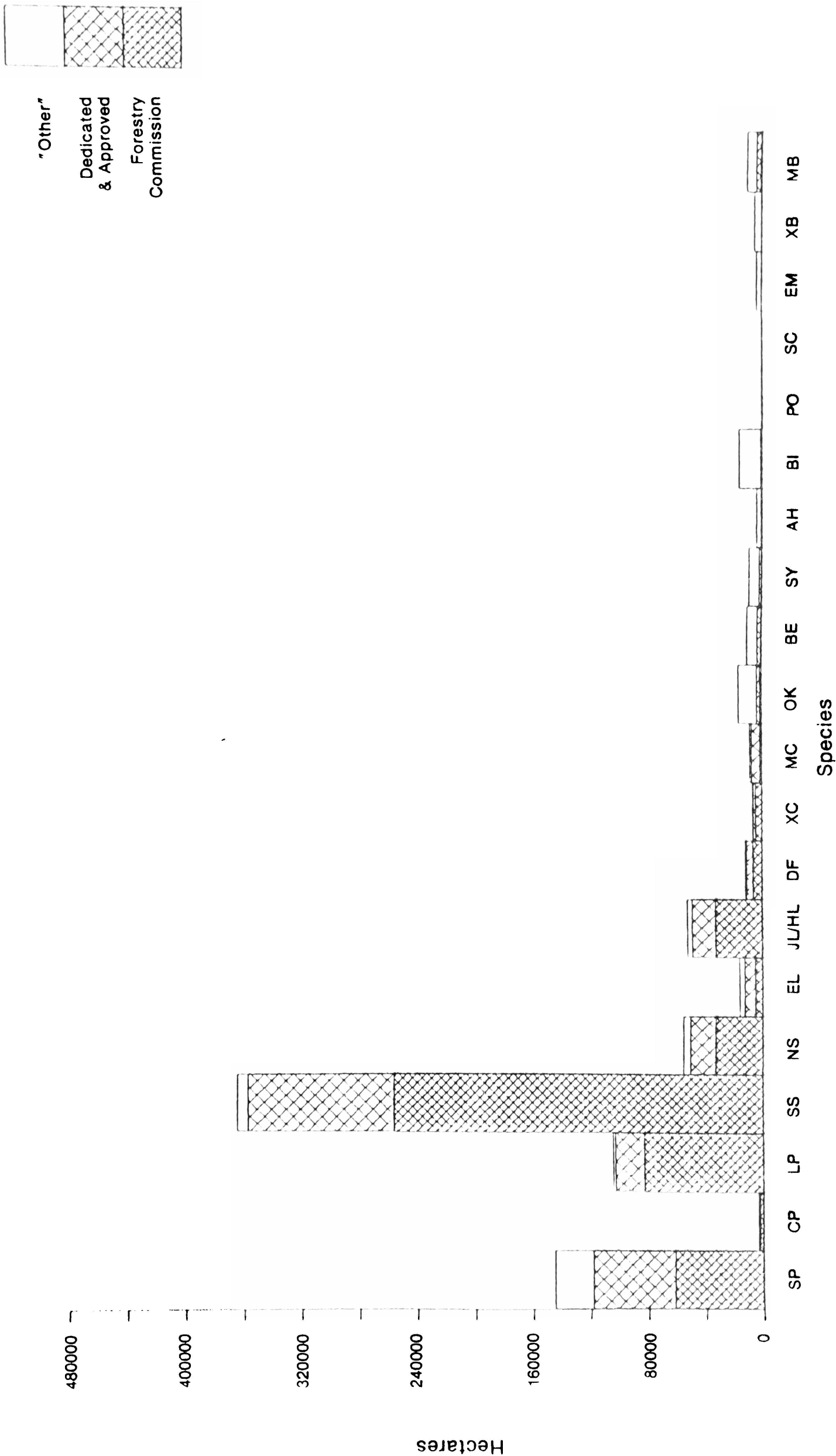
TABLE 3c"Other" WoodlandHectares

High Forest	Planting Year Classes										Total (S.E.)
	P71-80	P61-70	P51-60	P41-50	P31-40	P21-30	P11-20	P01-10	P1861-1900	Pre-1861	
Mainly Coniferous	6 218	8 755	6 269	3 546	2 782	4 035	2 405	3 153	6 735	3 849	47 747 (± 8%)
Mainly Broadleaved	1 665	4 068	4 367	7 929	4 969	5 616	2 189	5 398	14 499	10 142	60 842 (± 6%)
Total	7 883	12 823	10 636	11 475	7 751	9 651	4 594	8 551	21 234	13 991	108 589 (± 4%)

NOTE:
* This total contains 8.7 per cent of Coppice origin.

DIAGRAM 4

AREA OF HIGH FOREST BY PRINCIPAL SPECIES AND OWNERSHIP



Note: For an explanation of the abbreviations used, see Appendix 2.

TABLE 4

AREA OF HIGH FOREST BY PRINCIPAL SPECIES AND OWNERSHIP

1980

Hectares

Species	Forestry Commission			Dedicated and Approved			"Other"			Total Area of all Woodland
	Area	Percentage		Area	Percentage		Area	Percentage		
		Of Category	Of all Species		Of Category	Of all Species		Of Category	Of all Species	
Scots pine	61 299	13	12	56 953	24	23	26 119	55	24	144 371
Corsican pine	2 640	1	1	658	<1	<1	48	<1	<1	3 346
Lodgepole pine	82 497	17	17	19 925	9	8	1 502	3	1	103 924
Sitka spruce	256 066	52	52	101 346	43	41	7 189	15	7	364 601
Norway spruce	32 500	7	7	17 751	8	7	4 456	9	4	54 707
European larch	5 222	1	1	7 311	3	3	3 424	7	3	15 957
Jap./Hybrid larch	32 417	7	7	16 482	7	7	3 247	7	3	52 146
Douglas fir	6 438	1	1	4 381	2	2	809	2	1	11 628
Other conifers	4 472	1	1	1 667	1	1	173	<1	<1	6 312
Mixed conifers	1 289	<1	<1	6 189	3	3	1 163	2	1	8 641
Total conifers	484 840	100	99	232 663	100	95	48 130	100	44	765 633†
Oak	1 242	30	1	2 658	22	1	12 651	21	12	16 551
Beech	563	13	<1	2 542	21	1	7 391	12	7	10 496
Sycamore	327	8	<1	1 847	16	1	7 215	12	7	9 389
Ash	149	4	<1	562	5	<1	3 391	6	3	4 102
Birch	801	19	<1	428	4	<1	15 418	25	14	16 647
Poplar	23	1	<1	180	2	<1	126	<1	<1	329
Sweet chestnut	1	<1	<1	7	<1	<1	—	—	—	8
Elm	5	<1	<1	263	2	<1	3 343	6	3	3 611
Other broadleaves	177	4	<1	283	2	<1	4 655	8	4	5 115
Mixed broadleaves	899	21	<1	3 151	26	2	6 269	10	6	10 319
Total broadleaves	4 187	100	1	11 921	100	5	60 459*	100	56	76 567†
Total	489 027	100	100	244 584	100	100	108 589	100	100	842 200

NOTES:

* Contains 8.7 per cent of Coppice origin.

† The standard errors of the area estimates of High Forest are as follows:

Total conifers ± 0.5 per cent

Total broadleaves ± 4.5 per cent

The total area of conifer and of broadleaved species in this and subsequent High Forest tables differs from the total area classified as Mainly Conifer and Mainly Broadleaved in Tables 2 and 3. The reason for this is that here the actual percentages of species in each stand have been totalled.

% of all Woodland

17.1

0.4

12.3

43.3

6.5

1.8

6.2

1.4

0.7

1.0

9.9

2.0

1.2

1.1

0.5

2.0

—

—

0.4

0.6

1.2

9.1

100.0

TABLE 5 AREA OF HIGH FOREST BY PRINCIPAL SPECIES AND PLANTING YEAR CLASSES

All Woodland Ownerships										Hectares	
Species	P71- 80	P61- 70	P51- 60	P41- 50	P31- 40	P21- 30	P11- 20	P01- 10	P1861- 1900	Pre- 1861	Totals
Scots pine	10 269	29 011	44 705	14 335	10 665	12 201	3 894	4 462	9 914	4 915	144 371
Corsican pine	147	756	1 072	359	462	492	13	37	8	—	3 346
Lodgepole pine	45 117	39 725	17 540	614	628	284	16	—	—	—	103 924
Sitka spruce	169 265	108 695	49 758	21 248	11 275	3 929	173	93	118	47	364 601
Norway spruce	5 251	12 427	15 553	9 251	7 825	3 375	562	285	138	40	54 707
European larch	1 040	2 359	3 245	1 438	2 729	1 537	808	1 514	1 107	180	15 957
Jap./Hybrid larch	11 074	10 688	21 560	4 200	2 640	1 539	310	99	32	4	52 146
Douglas fir	1 685	3 795	3 389	573	538	1 048	192	114	166	128	11 628
Other conifers	1 487	2 367	1 378	260	441	270	27	29	42	11	6 312
Mixed conifers	1 860	2 535	2 184	256	183	432	270	207	492	222	8 641
Total conifers	247 195	212 358	160 384	52 534	37 386	25 107	6 265	6 840	12 017	5 547	765 633
Oak	140	171	550	124	1 182	361	345	2 333	6 384	4 961	16 551
Beech	412	598	462	256	256	315	105	423	3 058	4 611	10 496
Sycamore	710	1 251	555	1 110	610	864	415	906	2 379	589	9 389
Ash	155	627	359	242	206	935	67	217	1 088	206	4 102
Birch	697	1 438	2 247	5 583	2 619	1 940	1 249	650	217	7	16 647
Poplar	34	44	85	71	4	11	67	10	2	1	329
Sweet chestnut	—	—	1	1	1	3	1	—	1	—	8
Elm	5	80	18	147	106	533	53	724	1 657	288	3 611
Other broadleaves	491	509	954	649	468	998	218	180	607	41	5 115
Mixed broadleaves	530	532	823	661	652	501	461	1 019	3 764	1 376	10 319
Total broadleaves	3 174	5 250	6 054	8 844	6 104	6 461	2 981	6 462	19 157	12 080	76 567
Total	250 369	217 608	166 438	61 378	43 490	31 568	9 246	13 302	31 174	17 627	842 200

NOTE:
The standard errors of the estimates of totals in this Table are the same as those given for Table 4.

TABLE 6 PRINCIPAL SPECIES IN HIGH FOREST BY PLANTING YEAR CLASSES

All Woodland Ownerships

Planting Year Classes	Principal Species by Percentage of Area				
	First	%	Second	%	Third
P71-80	Sitka spruce	68	Lodgepole pine	18	Jap./Hybrid larch
P61-70	Sitka spruce	50	Lodgepole pine	18	Scots pine
P51-60	Sitka spruce	30	Scots pine	27	Jap./Hybrid larch
P41-50	Sitka spruce	35	Scots pine	23	Norway spruce
P31-40	Sitka spruce	26	Scots pine	25	Norway spruce
P21-30	Scots pine	39	Sitka spruce	12	Norway spruce
P11-20	Scots pine	42	Birch	14	European larch
P01-10	Scots pine	34	Oak	18	European larch
P1861-1900	Scots pine	32	Oak	20	Mixed broadleaves
Pre 1861	Oak	28	Scots pine	28	Beech

TABLE 7

AREA OF COPPICE BY PRINCIPAL SPECIES

All Woodland Ownerships

Hectares

Sub Type		Principal Species of Coppice						Total
		Sycamore	Ash	Sweet chestnut	Hornbeam	Hazel	Other species	
With Standards	ha	4	—	—	—	—	11	15
	%	27	—	—	—	—	73	100
Coppice Only	ha	—	—	—	—	4	—	4
	%	—	—	—	—	100	—	100
Total	ha	4	—	—	—	4	11	19
% of Coppice Total		21	—	—	—	21	58	100

NOTE:

"Other species" includes mixtures of the above five named species as well as other minor species of coppice.

TABLE 8

AREA OF COPPICE WITH STANDARDS BY PRINCIPAL SPECIES OF BOTH COPPICE AND STANDARDS

All Woodland Ownerships

Hectares

Principal Species of Standard	Principal Species of Coppice						Total
	Sycamore	Ash	Sweet chestnut	Hornbeam	Hazel	Other species	
Conifers	—	—	—	—	—	—	—
Oak	4	—	—	—	—	11	15
Ash	—	—	—	—	—	—	—
Sweet chestnut	—	—	—	—	—	—	—
Other broadleaves	—	—	—	—	—	—	—
Total	4	—	—	—	—	11	15
% of Total	27	—	—	—	—	73	100

TABLE 9 AREA OF SCRUB BY PRINCIPAL SPECIES

All Woodland Ownerships Hectares

Principal Species	Area	% of Total
Conifers	1 615	3
Oak	4 104	7
Beech	257	<1
Sycamore	373	1
Ash	376	1
Birch	41 742	68
Sweet chestnut	8	<1
Alder	2 252	4
Hornbeam	—	—
Hazel	2 425	4
Willow	592	1
Other broadleaves	6 768	11
Total	60 512	100

NOTE:
The main species comprising "Other broadleaves" are hawthorn, sallow and rhododendron.

TABLE 10 PRINCIPAL SPECIES OF THE SHRUB LAYER BY FOREST TYPES

"Other" Woodlands Only

Forest Type	Principal Species of Shrub Layer in Order of Total Area					
	First	Cover*	Second	Cover*	Third	Cover*
Coniferous High Forest	Other shrubs	<1	Elder	<1	Rhododendron	<1
Broadleaved High Forest	Rhododendron	2	Mixed shrubs	2	Hazel	1
Coppice with Standards	—	—	—	—	—	—
Coppice	—	—	—	—	—	—
Scrub	Hazel	2	Other shrubs	<1	Rhododendron	<1
Cleared	—	—	—	—	—	—

NOTE:
* "Cover" is the percentage of the ground area of each forest type covered by the named species. Figures relate only to "Other" Woodlands since Forestry Commission and Dedicated and Approved Woodland records do not contain data on this feature.

DIAGRAM 5

STANDING VOLUME OF TIMBER BY CATEGORY AND OWNERSHIP

All Woodlands

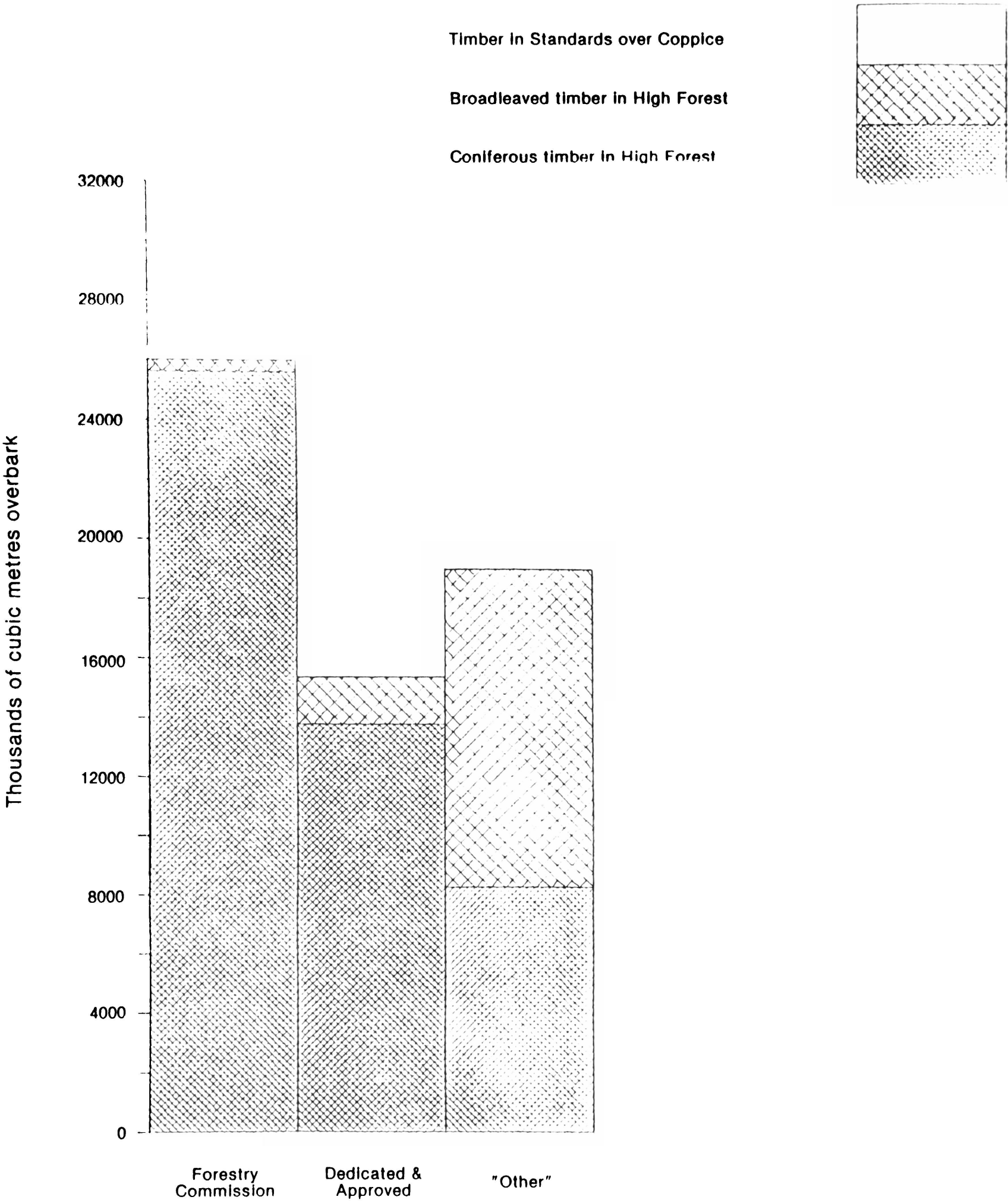


TABLE 11 STANDING VOLUME OF TIMBER BY CATEGORY AND OWNERSHIP

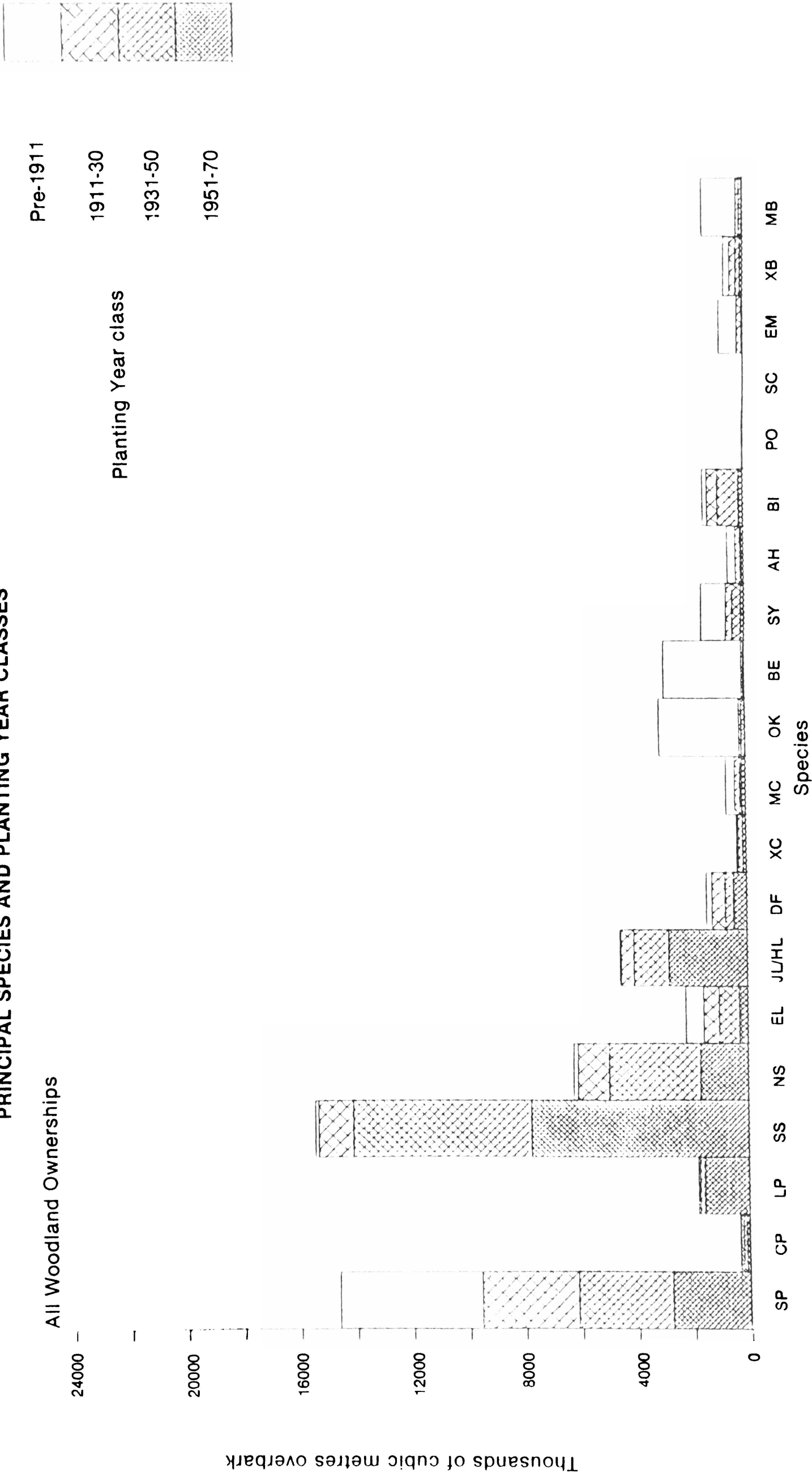
All Woodlands **Thousands of cubic metres overbark**

Volume Category	Forestry Commission	Dedicated and Approved	"Other"	Total (S.E.)
In High Forest				
Coniferous Timber	25 644.4	13 779.0	8 264.6	47 688.0 (± 2%)
Broadleaved Timber	375.7	1 575.1	10 729.4	12 680.2 (± 6%)
Total High Forest	26 020.1	15 354.1	18 994.0	60 368.2 (± 2%)
Timber in Standards over Coppice	—	1.4	—	1.4
Total*	26 020.1	15 355.5	18 994.0	60 369.6 (± 2%)

NOTE:
* No volume estimate is made for Scrub or Coppice.

DIAGRAM 6

STANDING VOLUME OF TIMBER IN HIGH FOREST AND STANDARDS OVER COPPICE BY
PRINCIPAL SPECIES AND PLANTING YEAR CLASSES



Note: For an explanation of the abbreviations used, see Appendix 2.

TABLE 12

STANDING VOLUME OF TIMBER IN HIGH FOREST AND STANDARDS OVER
COPPICE BY PRINCIPAL SPECIES AND PLANTING YEAR CLASSES

All Woodland Ownerships

Thousands of cubic metres overbark

Species	P61- 70	P51- 60	P41- 50	P31- 40	P21- 30	P11- 20	P01- 10	P1861- 1900	Pre- 1861	Total
Scots pine	368.8	2 389.8	1 478.3	1 868.4	2 520.1	916.0	1 306.1	2 410.2	1 330.6	14 588.3
Corsican pine	19.7	89.5	29.5	85.9	97.7	3.2	11.3	2.9	0.1	339.8
Lodgepole pine	522.8	1 072.0	61.1	91.2	43.6	4.4	—	—	—	1 795.1
Sitka spruce	2 508.1	5 221.2	3 648.4	2 711.4	1 175.0	70.8	37.6	57.7	16.9	15 447.1
Norway spruce	275.7	1 430.9	1 476.0	1 787.0	911.3	186.2	82.1	61.5	20.7	6 231.4
European larch	71.7	239.1	231.3	482.7	359.6	199.3	318.2	276.0	45.3	2 223.2
Jap./Hybrid larch	611.7	2 198.7	683.4	544.3	388.3	83.1	25.4	8.8	1.3	4 545.0
Douglas fir	133.0	353.9	107.0	189.8	395.1	68.1	50.7	97.8	56.0	1 451.4
Other conifers	28.5	91.1	51.3	108.8	34.8	3.8	13.2	10.5	3.1	345.1
Mixed conifers	18.2	125.4	32.1	37.7	113.5	74.1	47.4	208.5	64.9	721.8
Total conifers	4 558.2	13 211.6	7 798.4	7 907.2	6 039.0	1 609.0	1 892.0	3 133.9	1 538.9	47 688.2
Oak	2.0	12.3	6.4	118.7	43.1	47.6	378.4	1 296.8	1 175.7	3 081.0
Beech	5.3	10.2	19.4	19.8	49.3	17.6	91.9	1 055.5	1 637.7	2 906.7
Sycamore	92.4	42.5	212.9	95.5	148.3	81.8	204.7	534.7	133.6	1 546.4
Ash	62.5	13.5	34.4	22.7	155.0	9.9	26.8	222.2	50.2	597.2
Birch	21.1	134.4	534.6	227.0	248.4	131.3	125.6	32.4	0.9	1 455.7
Poplar	1.4	7.0	3.8	0.6	1.4	11.5	1.0	0.4	0.1	27.2
Sweet chestnut	—	—	—	—	0.2	0.1	—	0.1	—	0.4
Elm	2.8	0.9	21.4	14.4	180.7	13.0	182.6	395.4	63.8	875.0
Other broadleaves	22.0	91.9	58.6	86.8	187.9	54.1	36.3	162.6	8.0	708.2
Mixed broadleaves	9.5	27.5	62.5	41.9	59.5	69.8	154.8	856.8	201.3	1 483.6
Total broadleaves	219.0	340.2	954.0	627.4	1 073.8	436.7	1 202.1	4 556.9	3 271.3	12 681.4
Total	4 777.2	13 551.8	8 752.4	8 534.6	7 112.8	2 045.7	3 094.1	7 690.8	4 810.2	60 369.6

NOTE:

The standard errors of the estimates of totals in this Table are the same as those given for Table 13.

DIAGRAM 7

STANDING VOLUME OF TIMBER IN HIGH FOREST AND STANDARDS OVER COPPICE BY SPECIES GROUPS AND SIZE CLASSES

All Woodland Ownerships

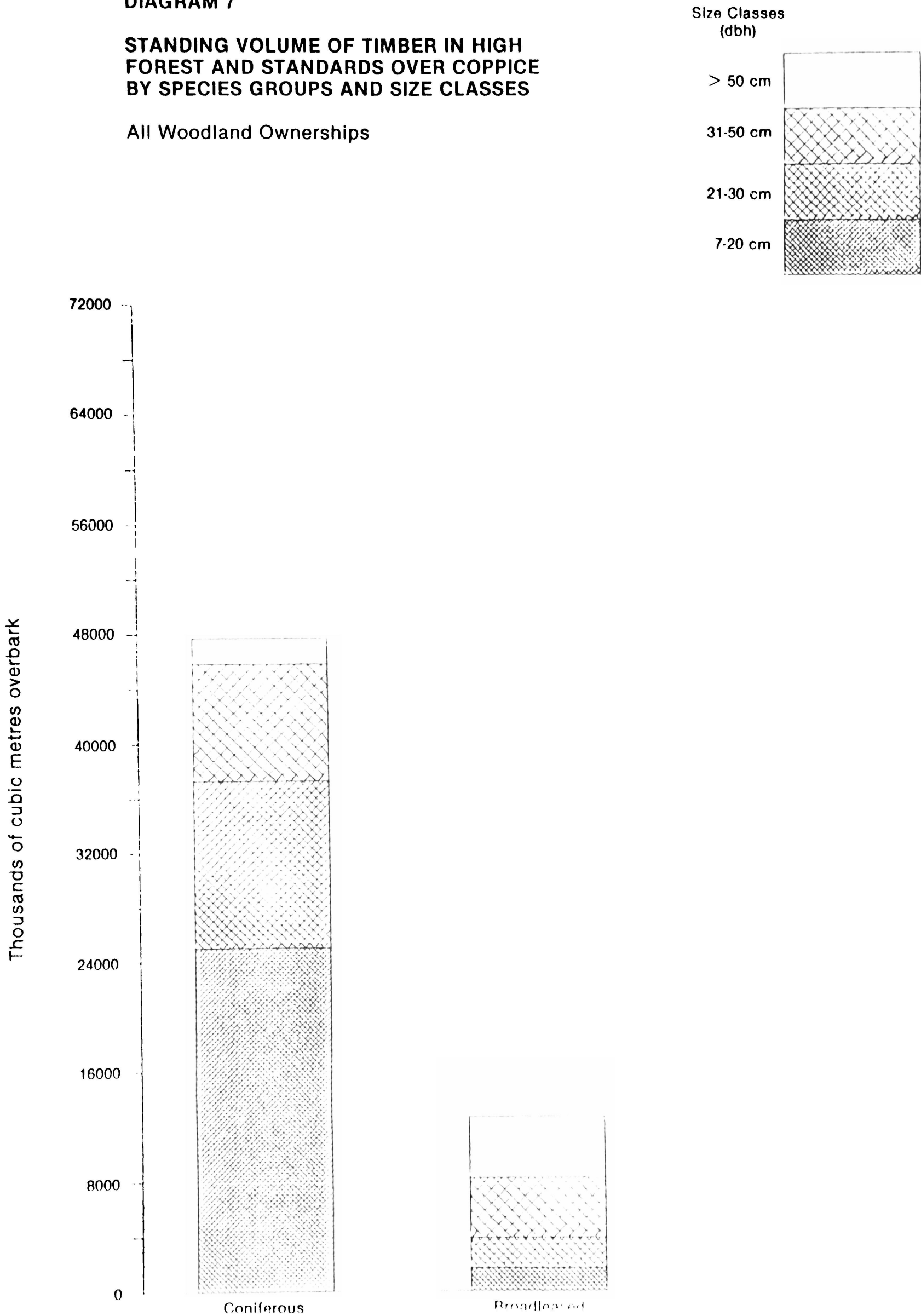


TABLE 13

STANDING VOLUME OF TIMBER IN HIGH FOREST AND STANDARDS
OVER COPPICE BY PRINCIPAL SPECIES AND SIZE CLASSES

All Woodland Ownerships

Thousands of cubic metres overbark

Species	Size Class (dbh)				Total
	7-20 cm	21-30 cm	31-50 cm	>50 cm	
Scots pine	5 624.4	3 887.5	3 919.8	1 156.6	14 588.3
Corsican pine	200.3	104.0	34.7	0.8	339.8
Lodgepole pine	1 739.1	52.6	3.4	—	1 795.1
Sitka spruce	10 063.5	3 672.1	1 597.0	114.5	15 447.1
Norway spruce	3 512.2	1 894.2	779.2	45.8	6 231.4
European larch	464.6	778.9	870.3	109.4	2 223.2
Jap./Hybrid larch	2 502.8	1 338.8	676.1	27.3	4 545.0
Douglas fir	499.4	208.1	479.4	264.5	1 451.4
Other conifers	163.3	112.9	64.3	4.6	345.1
Mixed conifers	231.1	185.7	173.6	131.4	721.8
Total conifers	25 000.7	12 234.8	8 597.8 (± 4.1%)	1 854.9 (± 14.1%)	47 688.2 (± 1.5%)
Oak	161.1	455.1	1 409.2	1 055.6	3 081.0
Beech	86.8	159.3	708.6	1 952.0	2 906.7
Sycamore	196.0	333.9	632.1	384.4	1 546.4
Ash	144.9	121.1	219.5	111.7	597.2
Birch	734.8	436.3	260.3	24.3	1 455.7
Poplar	1.0	4.7	20.7	0.8	27.2
Sweet chestnut	0.3	0.1	—	—	0.4
Elm	45.5	87.6	437.4	304.5	875.0
Other broadleaves	182.4	208.6	190.2	127.0	708.2
Mixed broadleaves	132.2	372.5	472.1	506.8	1 483.6
Total broadleaves	1 685.0	2 179.2	4 350.1 (± 7.7%)	4 467.1 (± 10.8%)	12 681.4 (± 6.2%)
Total	26 685.7	14 414.0	12 947.9 (± 3.7%)	6 322.0 (± 8.5%)	60 369.6 (± 1.7%)

NOTE:
The figures in brackets are standard errors.

Part Two

Non-Woodland Trees

COMMENTARY ON THE RESULTS FOR NON-WOODLAND TREES IN SCOTLAND

PREVIOUS FORESTRY COMMISSION SURVEYS

The 1950-51 Census of Hedgerow Trees and Small Woods provided estimates of the volume of hedgerow and park trees by country and Forestry Commission Conservancies but Scotland was totally excluded from the sampling survey of hedgerows carried out in conjunction with the 1965 Census.

Sample Strata used in the 1980 Census

Soil groups were used as a basis for the selection of sampling strata. Twenty four soil groups were recognised for England, Wales and Scotland, of which fifteen were identified in Scotland. The names and descriptions of the various soil groups are given in Appendix 3.

The sample size was chosen with the objective of estimating firstly the total number of isolated trees in a county in England and Wales and in a conservancy in Scotland with a precision of ± 25 per cent or better, and secondly the species, health, size classes and timber volumes of all non-woodland trees. As the figures in this Report are a summation of the Scottish Conservancy totals, the precision of the estimates is normally higher than those of the individual conservancies and in Scotland the precision of the estimate of isolated trees is ± 13.7 per cent.

RESULTS

General

Although non-woodland trees do occur on Forestry Commission land it can be assumed that virtually the whole of this category is privately owned.

The total number of trees in Scotland with a diameter at breast height of 7 cm or more is 12.9 million (± 11 per cent) distributed as shown below.

Millions of trees				
	Conifers	Broadleaves	Total	Per cent of total
Isolated Trees	0.4	1.2	1.6	12
Clumps	1.0	4.3	5.3	41
Linear Features	1.2	4.8	6.0	47
Total	2.6	10.3	12.9	100

Coniferous species account for 20 per cent of total number of measurable trees, a substantially higher proportion than in England or Wales where the percentages are eight and eleven respectively. Pines are the most widely represented species group with 36 per cent of the conifer total. There are also substantial numbers of spruces with 33 per cent and larches with 26 per cent. The predominant broadleaved species is birch with 26 per cent of the broadleaved total followed by alder with 15 per cent and beech with 13 per cent.

The distribution of trees by Conservancies is shown below in terms of total tree numbers and tree densities.

Conservancy	Total number of trees of 7 cm dbh or greater (millions)	Per cent of total	Tree density per square kilometre
North Scotland	1.4	11	52
East Scotland	5.0	39	286
South Scotland	3.4	26	208
West Scotland	3.1	24	247
Scotland	12.9	100	177

Note: The tree densities quoted for North and West Scotland use the areas of the mainland and inner islands and, as in other analyses in this commentary, exclude the Island Areas of the Western Isles, Orkneys and Shetlands.

From the table it will be seen that North Scotland Conservancy has a density well below the average for Scotland, whilst among the other three, East Scotland has the highest, followed by West and South Scotland Conservancies. The low number of trees in North Scotland, coupled with the fact that it is the largest conservancy in terms of land area, has reduced the overall density for Scotland. For comparison, the densities in England and Wales are 478 trees and 606 trees per square kilometre.

Isolated Trees

There are 1.6 million isolated trees with a dbh of 7 cm or greater divided into two sub-categories; 0.6 million are growing along major land use boundaries such as hedges, walls and fences and 1.0 million in open positions. Boundaries in urban areas were often difficult to assess and consequently all trees in urban situations were classed as being in open positions irrespective of actual location. It should be noted that owing to problems of access to many gardens and enclosures, it was necessary on occasions to estimate the dimensions of trees visible from a public right of way.

Conifers, with over 90 per cent of their number occurring in open positions, account for 24 per cent of the isolated tree population. Pines are the most prevalent species group accounting for well over half the total; larches are also well represented.

Among broadleaved trees 44 per cent are classed as being on boundaries and 56 per cent open grown, proportions very similar to those found in England. Birch is the most frequently occurring tree with over 20 per cent of the broadleaved total but there are substantial numbers of ash (18 per cent) and sycamore (16 per cent). Oak and beech are relatively unimportant, each accounting for less than 10 per cent of the total. Elm is also poorly represented in this category.

Clumps

There are approximately 820 thousand clumps in Scotland covering an area of about 13 600 ha and including 5.3 million trees with a dbh of 7 cm or greater. The average number of trees per clump lies between six and seven, this being a higher value than those found in England and Wales where the averages are between five and six.

Conifers account for 19 per cent of the total tree numbers with pines dominating the total with 60 per cent. Larches and spruces each have a little under 20 per cent. Birch again is clearly the most prevalent measurable broadleaved tree in this category accounting for nearly half the broadleaved total, followed by ash with 10 per cent and lesser amounts of sycamore, alder and beech. The Other broadleaved category, which comprises a wide variety of species, contains a comparable percentage to ash.

Linear Features

Linear features include trees in close canopy in well grown avenues and along boundaries as well as in shelterbelts; this category contains an estimated 6.0 million trees of 7 cm dbh or greater. Coniferous species account for 20 per cent of the total, a similar percentage to their occurrence in clumps. Spruces, occurring usually in the form of shelterbelts, account for over half the conifer total, followed by larches and pines. Alder accounts for nearly a quarter of the broadleaved total and is followed by beech with a fifth. Ash, sycamore, birch, elm and oak each occupy between eight and ten per cent.

Size Class Distribution

In addition to the trees with a minimum dbh of 7 cm there are 4.6 million live, well-grown trees recorded as being below this limit. To be included in this group in the Survey all such trees had to have single stems and show every likelihood of being able to grow on; coppice shoots were excluded. It is therefore probable that the estimate is conservative.

Table 17 shows that when the under 7 cm dbh size class is included the total number of trees in Scotland increases from 12.9 million to 17.5 million, a rise of over a third. The percentage number of trees in each of the diameter classes is as follows:

Diameter Class	Conifers	Broadleaves	Total
Under 7 cm	14%	12%	26%
7-20 cm	7%	27%	34%
21-30 cm	4%	11%	15%
31-50 cm	4%	14%	18%
Over 50 cm	<1%	7%	7%
Total	29%	71%	100%

The inclusion of the under 7 cm dbh size class results in the number of coniferous trees nearly doubling with the number of spruce increasing nearly threefold. There are also substantial numbers of young pine, some occurring naturally, others having been planted as shelter. The increase in the number of cypresses as a consequence of including the small trees is noticeable and reflects the use of this genus in parks and gardens for ornamental purposes.

The addition of trees in the smallest size category increases the broadleaved total to 12.5 million, a rise of about 20 per cent. The young trees are mostly Other broadleaves, sycamore, birch and ash. The inclusion of the small tree category does not materially alter the overall species ranking in broadleaves; birch is still clearly dominant but is followed by Other broadleaves and alder although beech, ash and sycamore are also well represented.

South and West Scotland Conservancies each account for about one third of the tree total in the smallest size class, East for a quarter and North for one tenth.

In the conifer size class distribution the less than 7 cm dbh class accounts for 48 per cent of the total numbers and the 7-20 cm dbh class for 23 per cent. Consequently over 70 per cent of the non-woodland conifers are under 21 cm dbh. Among broadleaves the pattern is slightly different in that the 7-20 cm dbh class holds the largest percentage of trees, 38 per cent, and the two smallest categories together account for over half the total. Birch, as might be expected, is best represented in the small and middle range size classes, as are alder and elm. Oak numbers are concentrated in the two largest classes, beech is well represented in all but the smallest class, and sycamore and ash reasonably well distributed throughout all the classes. The overall distribution of trees for the future looks reasonably hopeful with sufficient numbers available in the two smallest classes to provide recruitment to the larger diameters. Over one third of the present total of these two size classes are conifers, very often planted as shelterbelts and, of the broadleaves over 20 per cent are minor species, often ornamentals. The situation appears to be rather more encouraging than was apparent in 1951 when only about two per cent of the trees were classed as being between 7 and 20 cm dbh compared to the current 33 per cent; the under 7 cm dbh size class was not assessed in 1951.

Health

All live non-woodland trees were assessed for health and a count was made of dead trees. This latter cateogry covered trees of all species which were already dead and also, in the case of elm, those affected by Dutch elm disease and in a dying condition.

Table 18a shows the overall position with 66 per cent in good health, 29 per cent in moderate health, four per cent in poor health and one per cent dead or dying. The percentage of trees shown as being in good health is rather lower, and the percentage in moderate health rather higher, than was the case in both England and Wales. This is probably due in part to the somewhat harsher growing conditions which affect trees both in terms of slower growth rates and damage from exposure.

In conifers the dead trees were either pines or spruces and in broadleaves were largely alder. Relatively few dead or dying elms were found during the Survey but this may well be a measure of the efforts of landowners and local authorities in felling and removing trees as soon as evidence of Dutch elm disease was observed.

Standing Volume

It is estimated that there is a standing volume of 3.2 million cubic metres overbark (\pm 17.2 per cent) in non-woodland trees in Scotland. Of this total, 0.5 million cubic metres are coniferous and 2.7 million broadleaved. Table 19 analyses volume by species and size classes and shows that the species distribution of volume differs from that of the numbers of trees.

Forty two per cent of the coniferous volume occurs in pines, 33 per cent in larches and 20 per cent in spruces. In both pines and larches the bulk of the volume lies in the 31-50 cm dbh size class while the spruce volume is fairly equally distributed throughout the size classes. Over 70 per cent of the conifer volume occurs in East Scotland, a similar proportion to that found in 1951.

In broadleaved species oak and beech each account for nearly a quarter of the total. Four other species, namely ash, sycamore, alder and elm also have significant volumes. Sixty two per cent of the broadleaved volume is in the over 50 cm dbh size class and 91 per cent is in trees of 30 cm dbh or over. Only three species, birch, poplar and Other broadleaves have a substantial proportion of their volume in the two smaller size classes.

The relative proportions of the major broadleaved species in terms of tree numbers and volume are shown below.

Percentage	Oak	Beech	Sycamore	Ash	Birch	Poplar	Sweet chestnut	Horse chestnut	Alder	Lime	Elm	Willow	Other b/leaves
of numbers	6	13	10	11	26	1	—	<1	15	1	6	3	8
of volume	24	24	12	14	3	1	—	1	11	1	7	2	<1

This table again illustrates the weighting of the volume of oak and beech towards the larger size classes and the reverse in the case of birch and Other broadleaves, where tree numbers are high in relation to volume.

Although all trees of 7 cm dbh and greater were eligible for volume assessment it was often found that broadleaved trees contained no volume because of damage or poor form in the first two metres butt length.

Not all the volume quoted in the tables is available for harvesting as assessments were made without reference to the location of trees or to any other constraints.

Comparison with Previous Surveys

When making comparisons with estimates from each of the previous Surveys the following points must be considered.

1. In 1951 the minimum area for woodland was 0.4 ha while in 1980 it was 0.25 ha.
2. The sampling intensity used in the 1980 Survey was much higher than in the previous Survey. In 1951 the ground area sampled was approximately 1 ha in every 8 000 ha of land area whereas in 1980 the sample was 1 ha in every 2 500 ha thus producing more precise figures.
3. The minimum size of tree assessed for volume was 20 cm dbh in 1951 compared with 7 cm dbh in 1980.
4. Dutch elm disease has had an effect on the elm population in a number of Regions.

In addition, the difficulties of comparison are compounded by the effects of the sampling techniques used in each Survey. The Census of 1951 used samples placed at random over the land surface, whilst in 1980 the samples were placed at random within strata based on soil groups. The general sampling scheme adopted in the previous Survey is at its most effective where the distribution of trees is relatively uniform, whilst the approach using stratification is more suitable where tree densities are variable and likely to change over relatively short distances, as is the case in Scotland. The difference between the estimates of the two Surveys is most marked in East Scotland where apparently there has been a major increase in both the numbers of trees and volume. The most likely explanation is that the sampling fraction adopted in 1951 did not provide an adequate spread of samples over the range of conditions in the Conservancy, and resulted in an estimate which was substantially lower than that in 1980. As this Conservancy accounts for 70 per cent of the non-woodland volume the differences also affect any comparisons of the Scottish results.

Comparison of Tree Numbers

In 1951 the total number of trees of 7 cm dbh or more was estimated to be 6.7 million, but this figure must be reduced to allow for trees in woods of 0.25-0.4 ha. Once this has been effected the numbers have apparently doubled from the 1951 amended estimate of six million trees to the current estimate of 12.9 million trees. It is difficult to quantify the changes between size classes, partly because of the change from the quarter girth to the metric system, which means that size class limits are not exactly comparable, and also because there is no summarised information on the diameter distribution of "firewood" trees in 1951, ie crooked, short-boled or defective trees, nor for trees with stem lengths between six and ten feet (2-3 m), known as "short" trees which were included in the 1980 diameter distribution. It does appear likely, however, that whatever may be the changes in the other size classes since 1951, there has been a substantial increase in numbers in the 7-20 cm dbh class.

Volume Comparison

The results of the 1951 and 1980 Surveys are shown in the following table after adjustments to the 1951 figures to exclude the volume occurring in woods of 0.25-0.4 ha and to allow for the fact that the measurements in the 1951 Survey were confined to trees of 20 cm dbh and over.

Millions of cubic metres		
	1951	1980
Coniferous volume	0.1	0.5
Broadleaved volume	1.1	2.7
Total	1.2	3.2

Even allowing for the reservations discussed above these figures indicate that there has been a rise in the volume of both conifers and broadleaves in Scotland in the last 30 years. The position with regard to change in volume by species is set out in the table below. The figures quoted below for 1951 are unadjusted values and have been taken directly from the Report.

Volumes in millions of cubic metres					
1951			1980		
Species	Volume	Per cent	Species Group	Volume	Per cent
Scots pine	0.12	8	Pines	0.21	7
Norway spruce	0.01	1	Spruces	0.10	3
European larch	—	—	Larches	0.17	5
Other conifers	—	—	Other conifers	0.03	1
Total conifers	0.13	9	Total conifers	0.51	16
Oak	0.35	24	Oak	0.64	20
Beech	0.37	26	Beech	0.64	20
Sycamore	0.17	12	Sycamore	0.31	10
Ash	0.31	22	Ash	0.37	12
Birch	—	—	Birch	0.07	2
Sweet chestnut	—	—	Sweet chestnut	—	—
Elm	0.03	2	Elm	0.20	6
Other broadleaves	0.07	5	Other broadleaves	0.46	14
Total broadleaves	1.30	91	Total broadleaves	2.69	84
Total	1.43	100	Total	3.20	100

It can be seen from the volume distribution that pines, spruces and larches are more important than they were 30 years ago. There has also been a change in the balance of broadleaved volume with oak, beech, sycamore and ash proportions decreasing and birch, elm and Other broadleaves increasing.

**TABLE 14 SUMMARY OF NUMBERS OF LIVE ISOLATED
TREES AND CLUMPS AND LENGTH OF LINEAR FEATURES**
Thousands of trees and clumps

Total Number of Isolated Trees	1 656 (± 13.7%)
Total Number of Clumps	820 (± 20.1%)
Total Length of Linear Features	12 890 km (± 16.4%)

NOTES:
The figures in brackets are standard errors.
Densities per square kilometre are as follows:

Number of Isolated trees	— 23
Number of Clumps	— 11
Length of Linear Features	— 0.18 km

TABLE 15 AREA OF CLUMPS BY SPECIES GROUPS
Hectares

Species Group	Clumps
Mainly Coniferous	1 805
Mainly Broadleaved	11 822
Total	13 627

DIAGRAM 8

NUMBER OF LIVE TREES OF 7 CM DBH OR GREATER BY CATEGORY AND SPECIES GROUPS

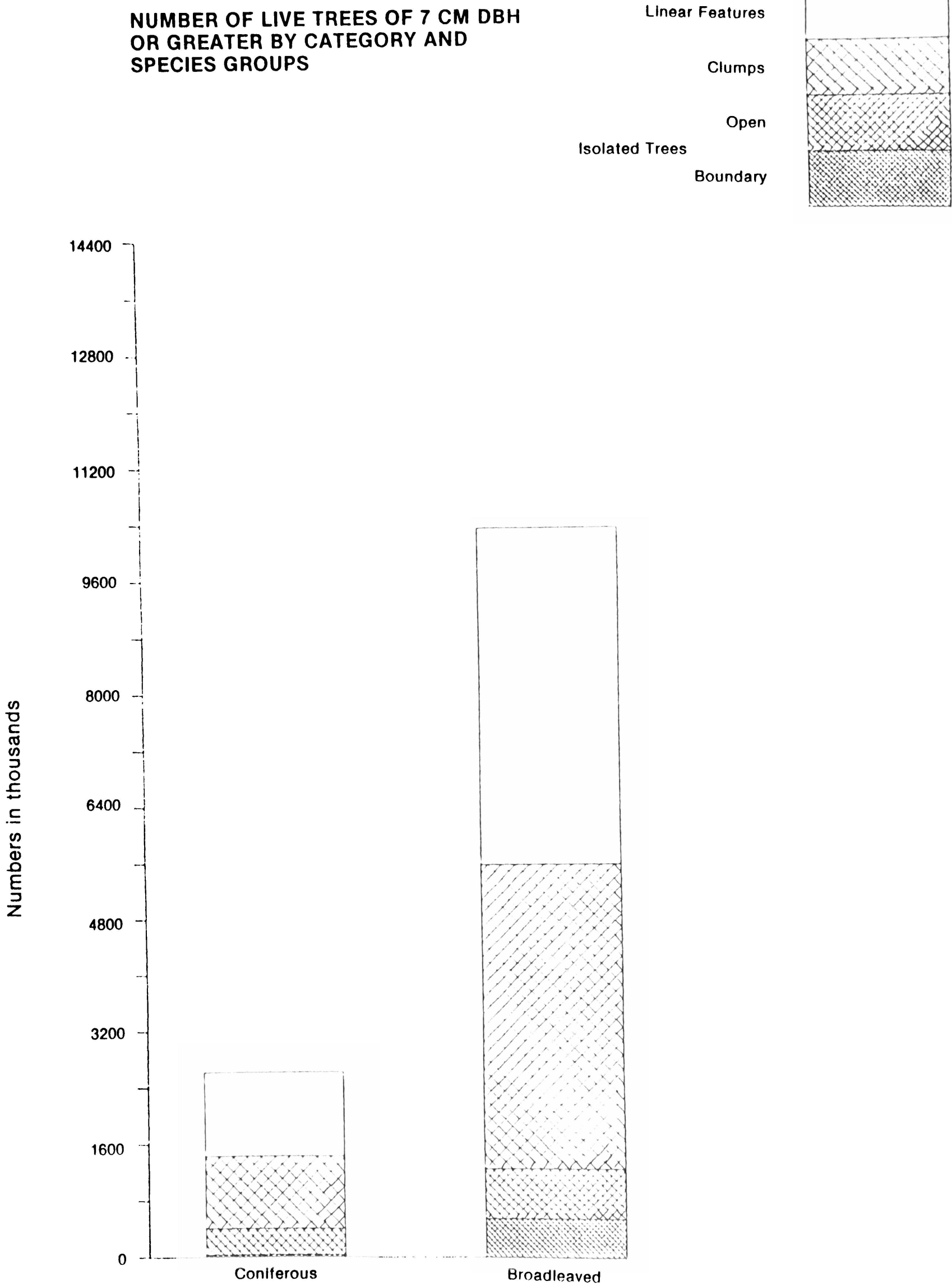


TABLE 16

NUMBER OF LIVE TREES OF 7 CM DBH OR GREATER
BY CATEGORY AND PRINCIPAL SPECIES

Thousands of trees

Species	Isolated Trees		Clumps	Linear Features	Total (S.E.)
	Boundary	Open			
Pines	34	197	616	100	947
Spruces	—	55	173	639	867
Larches	1	111	191	390	693
Cypresses	—	3	10	27	40
Other conifers	—	3	30	37	70
Total conifers	35	369	1 020	1 193	2 617 (± 31%)
Oak	57	35	116	396	604
Beech	76	37	298	961	1 372
Sycamore	103	100	383	431	1 017
Ash	167	59	431	458	1 115
Birch	21	251	2 014	417	2 703
Poplar	9	11	21	113	154
Sweet chestnut	—	—	—	—	—
Horse chestnut	6	1	29	—	36
Alder	14	37	367	1 128	1 546
Lime	8	15	46	26	95
Elm	29	21	121	411	582
Willow	3	34	42	251	330
Other broadleaves	53	105	440	180	778
Total broadleaves	546	706	4 308	4 772	10 332 (± 12%)
Total	581	1 075	5 328	5 965	12 949 (± 11%)

NOTE:

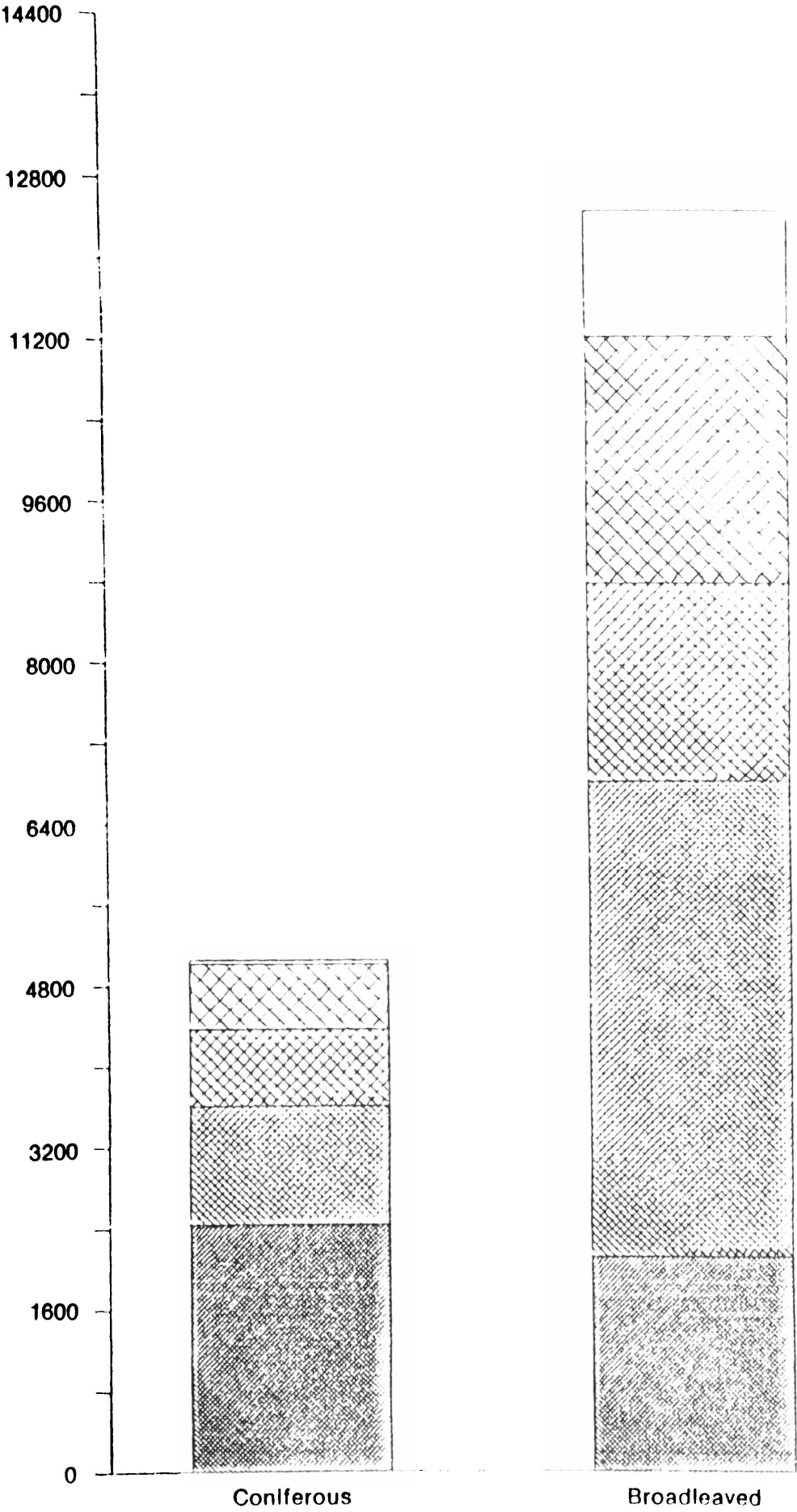
In addition, within the Country the following trees are present:

Species	Isolated Trees	Clumps	Linear Features	Total (S.E.)
Trees < 7cm dbh All species	990	1 847	1 726	4 563 (± 27%)
Dead and Dying All species	18	56	101	175 (± 36%)

DIAGRAM 9

NUMBER OF ALL LIVE TREES BY
SPECIES GROUPS AND SIZE CLASSES

Numbers in thousands



Size Classes
(dbh)

> 50 cm

31-50 cm

21-30 cm

7-20 cm

< 7 cm

TABLE 17

NUMBER OF ALL LIVE TREES BY PRINCIPAL SPECIES
AND SIZE CLASSES

Thousands of trees

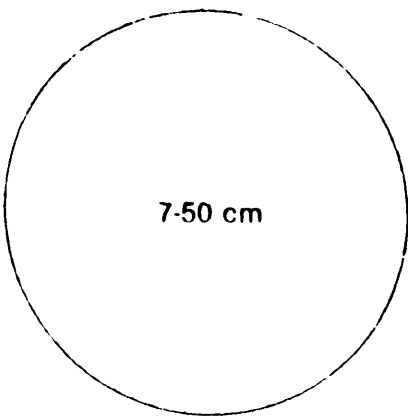
Species	Size Class (dbh)					Total
	< 7 cm	7-20 cm	21-30 cm	31-50 cm	> 50 cm	
Pines	546	315	322	299	11	1 493
Spruces	1 620	625	155	67	20	2 487
Larches	160	170	258	262	3	853
Cypresses	64	39	1	—	—	104
Other conifers	50	21	21	26	2	120
Total conifers	2 440	1 170	757	654	36	5 057
Oak	56	38	71	245	250	660
Beech	19	283	335	431	323	1 391
Sycamore	347	327	270	254	166	1 364
Ash	270	309	186	397	223	1 385
Birch	341	2 184	349	142	28	3 044
Poplar	68	100	36	18	—	222
Sweet chestnut	—	—	—	—	—	—
Horse chestnut	13	1	12	15	8	49
Alder	42	403	401	646	96	1 588
Lime	3	25	36	18	16	98
Elm	3	233	126	179	44	585
Willow	85	224	49	7	50	415
Other broadleaves	876	565	89	88	36	1 654
Total broadleaves	2 123	4 692	1 960	2 440	1 240	12 455
Total	4 563	5 862	2 717	3 094	1 276	17 512

NOTE:

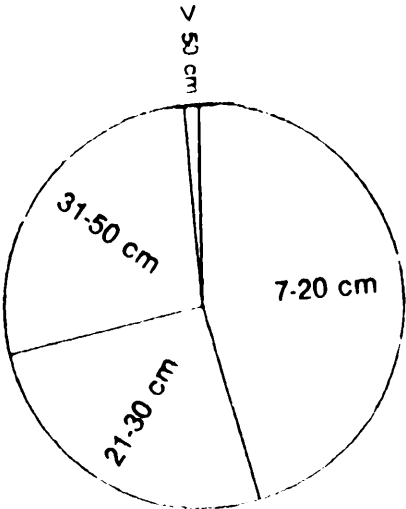
The average number of all live trees per square kilometre is 239.

DIAGRAM 10

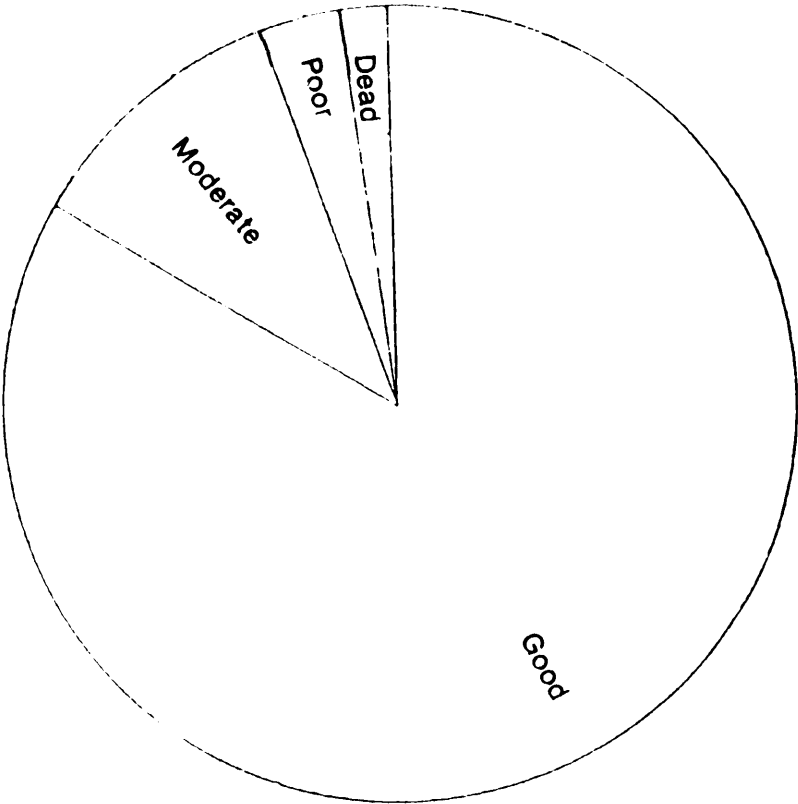
HEALTH OF ALL CONIFEROUS TREES OF 7 CM DBH OR GREATER BY SIZE CLASSES



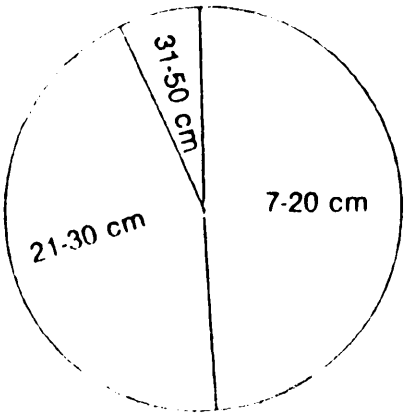
Dead



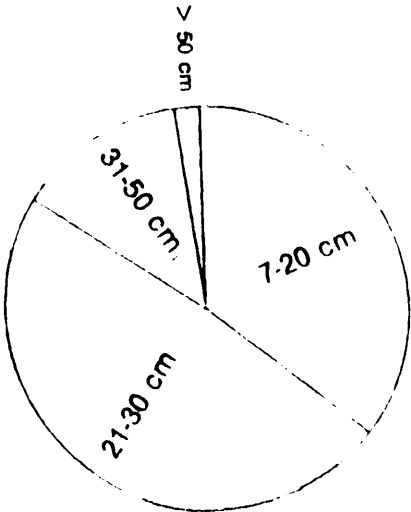
Good



Health expressed as a proportion of the total population



Poor



Moderate

Note: The sizes of the circles are not to scale

HEALTH OF ALL TREES OF 7 CM DBH OR GREATER BY PRINCIPAL SPECIES
AND SIZE CLASSES

TABLE 18aALL SPECIESThousands of trees

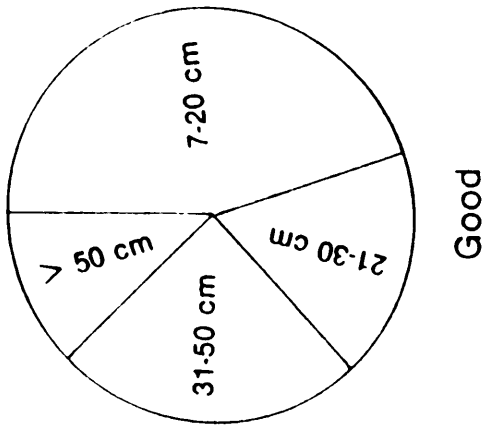
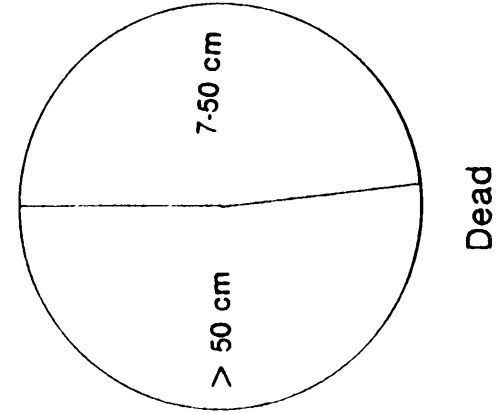
Species	dbh class cm	Health Class			Dead and Dying
		Good	Moderate	Poor	
Total conifers	7-20	1 022	106	42)
	21-30	575	144	38	) 52
	31-50	608	41	5)
	> 50	30	6	—) —
	Total	2 235	297	85	52
Total broadleaves	7-20	2 874	1 695	123)
	21-30	1 167	683	110	) 60
	31-50	1 591	727	122)
	> 50	769	387	84	) 63
	Total	6 401	3 492	439	123
Total	7-20	3 896	1 801	165)
	21-30	1 742	827	148	) 112
	31-50	2 199	768	127)
	> 50	799	393	84	) 63
	Total	8 636	3 789	524	175

TABLE 18bCONIFERSThousands of trees

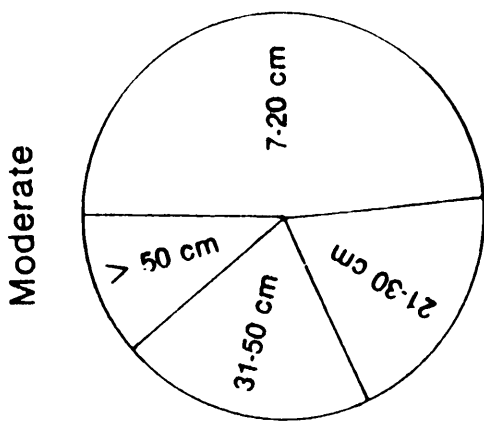
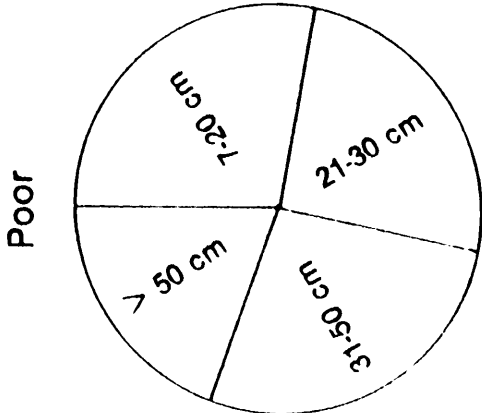
Species	dbh class cm	Health Class			Dead and Dying
		Good	Moderate	Poor	
Pines	7-20	250	53	12)
	21-30	241	71	10	) 35
	31-50	286	13	—)
	> 50	8	3	—) —
	Total	785	140	22	35
Spruces	7-20	607	5	13)
	21-30	119	21	15	) 17
	31-50	66	—	1)
	> 50	20	—	—) —
	Total	812	26	29	17
Larches	7-20	118	37	15)
	21-30	194	51	13) —
	31-50	231	27	4)
	> 50	—	3	—) —
	Total	543	118	32	—
Cypresses	7-20	39	—	—)
	21-30	1	—	—) —
	31-50	—	—	—)
	> 50	—	—	—) —
	Total	40	—	—	—
Other conifers	7-20	8	11	2)
	21-30	20	1	—) —
	31-50	25	1	—)
	> 50	2	—	—) —
	Total	55	13	2	—
Total conifers	7-20	1 022	106	42)
	21-30	575	144	38	) 52
	31-50	608	41	5)
	> 50	30	6	—) —
	Total	2 235	297	85	52

DIAGRAM 11

HEALTH OF ALL BROADLEAVED TREES OF 7 CM DBH OR GREATER BY SIZE CLASSES



Health expressed as a proportion of the total population



Note: The sizes of the circles are not to scale

HEALTH OF ALL TREES OF 7 CM DBH OR GREATER BY PRINCIPAL SPECIES AND SIZE CLASSES

TABLE 18c

BROADLEAVES

		Thousands of trees					Thousands of trees				
Species	dbh class cm	Health Class			Dead and Dying		dbh class cm	Health Class			Dead and Dying
		Good	Moderate	Poor				Good	Moderate	Poor	
Oak	7-20	30	4	4	)		7-20	1	—	—)
	21-30	52	11	8	)		21-30	12	—	—)
	31-50	164	65	16	)		31-50	2	13	—)
	> 50	183	46	21	—		> 50	2	6	—	—
	Total	429	126	49	9		Total	17	19	—	—
Beech	7-20	141	132	10	)		7-20	302	98	3)
	21-30	163	159	13	)	2	21-30	307	87	7)
	31-50	300	123	8	)		31-50	394	244	8)
	> 50	199	95	29	6		> 50	43	50	3	44
	Total	903	509	60	8		Total	1 046	479	21	77
Sycamore	7-20	304	19	4	)		7-20	23	2	—)
	21-30	226	39	5	)	—	21-30	20	15	1)
	31-50	228	20	6	)		31-50	13	5	—)
	> 50	149	17	—	—		> 50	13	3	—	—
	Total	907	95	15	—		Total	69	25	1	—
Ash	7-20	242	66	1	)		7-20	211	22	—)
	21-30	105	60	21	)	2	21-30	67	49	10)
	31-50	221	114	62	)		31-50	121	55	3)
	> 50	113	88	22	3		> 50	29	12	3	10
	Total	681	328	106	5		Total	428	138	16	14
Birch	7-20	1 016	1 100	68	)		7-20	212	6	6)
	21-30	131	187	31	)	8	21-30	4	45	—)
	31-50	61	68	13	)		31-50	5	1	1)
	> 50	16	12	—	—		> 50	5	45	—	—
	Total	1 224	1 367	112	8		Total	226	97	7	—
Poplar	7-20	64	27	9	)		7-20	328	219	18)
	21-30	35	1	—	)	2	21-30	45	30	14)
	31-50	18	—	—	)		31-50	64	19	5)
	> 50	—	—	—	—		> 50	17	13	6	—
	Total	117	28	9	2		Total	454	281	43	—
Sweet chestnut	7-20	—	—	—	)		7-20	2 874	1 695	123)
	21-30	—	—	—	)	—	21-30	1 167	683	110)
	31-50	—	—	—	)		31-50	1 591	727	122)
	> 50	—	—	—	—		> 50	769	387	84	63
	Total	—	—	—	—		Total	6 401	3 492	439	123

DIAGRAM 12
STANDING VOLUME OF TIMBER FOR LIVE
TREES OF 7 CM DBH OR GREATER BY
SPECIES GROUPS AND SIZE CLASSES

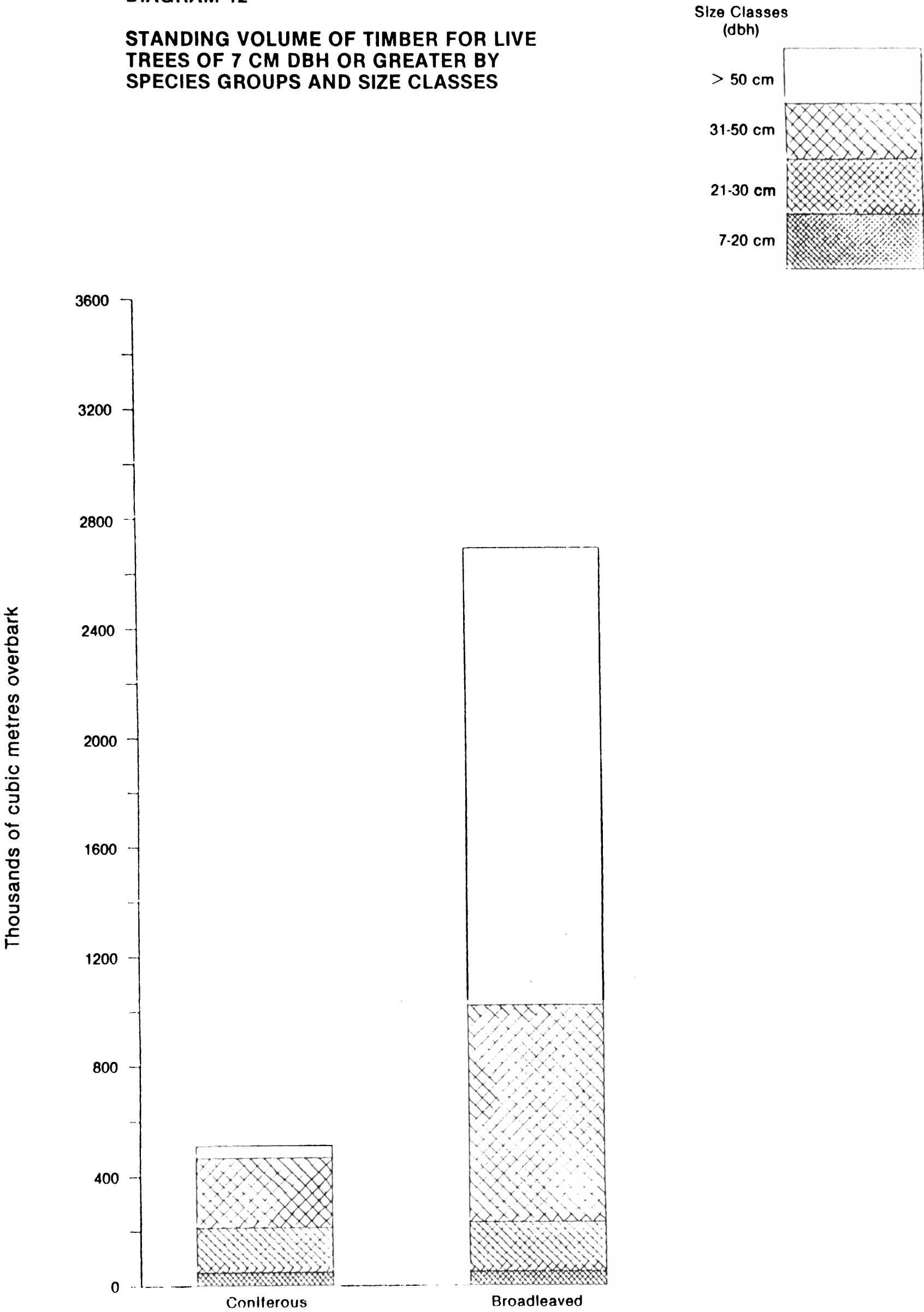


TABLE 19

STANDING VOLUME OF TIMBER FOR LIVE TREES OF 7 CM DBH OR GREATER BY PRINCIPAL SPECIES AND SIZE CLASSES

Thousands of cubic metres overbark

Species	Size Class (dbh)				Total
	7-20 cm	21-30 cm	31-50 cm	>50 cm	
Pines	14.5	62.5	123.9	12.2	213.1
Spruces	23.4	38.1	24.1	17.5	103.1
Larches	10.1	54.5	93.0	9.1	166.7
Cypresses	1.5	0.1	—	—	1.6
Other conifers	0.8	6.4	12.5	4.7	24.4
Total conifers	50.3	161.6	253.5 (± 50%)	43.5 (± 49%)	508.9 (± 39.7%)
Oak	0.9	10.6	146.2	482.6	640.3
Beech	2.5	24.6	131.4	479.7	638.2
Sycamore	6.6	25.4	78.9	202.0	312.9
Ash	8.9	25.6	145.8	191.3	371.6
Birch	10.0	8.2	30.6	24.7	73.5
Poplar	3.0	10.2	10.2	—	23.4
Sweet chestnut	—	—	—	—	—
Horse chestnut	—	2.4	5.7	14.6	22.7
Alder	14.0	51.6	160.7	85.1	311.4
Lime	0.4	3.4	6.6	27.5	37.9
Elm	4.2	15.2	69.2	113.1	201.7
Willow	0.6	0.6	1.4	48.2	50.8
Other broadleaves	0.8	2.4	3.5	2.2	8.9
Total broadleaves	51.9	180.2	790.2 (± 24%)	1 671.0 (± 20%)	2 693.3 (± 19.0%)
Total	102.2	341.8	1 043.7 (± 22%)	1 714.5 (± 20%)	3 202.2 (± 17.2%)

NOTE:

The figures in brackets are standard errors.

GLOSSARY OF TERMS AND ABBREVIATIONS

Approved Woodland

Privately owned woodland included in a Forestry Commission scheme where the owners could not, or did not wish to, enter into the long-term, legally-binding arrangement of Dedication.

Broadleaved High Forest of Coppice Origin

Crops of Coppice origin which have a mean breast height diameter of more than 15 cm and are assessed by the same criteria as Broadleaved High Forest.

Cleared

Woodland areas which are marked green on the O.S. 1:50 000 map, but at the time of the Survey were found to be cleared of trees and had not been converted to another land use.

Clump

A small woodland or group of trees of less than 0.25 ha.

Coppice

Crops of marketable broadleaved species that have at least two stems per stool and are either being worked or capable of being worked on rotation. With the exception of hazel coppice, more than half the stems should be capable of producing 3 m timber lengths of good form. Coppice crops with a mean breast height diameter greater than 15 cm are assessed as B.H.F. of Coppice origin.

Coppice with Standards (C.W.S.)

Two-storey stands where the overstorey consists of at least 25 stems per ha that are older than the understorey of worked Coppice by at least one Coppice rotation.

Dedicated Woodland

Privately owned woodland within the Forestry Commission Dedication Scheme. In return for financial assistance, an owner accepts a continuing obligation by Deed or Agreement of Covenant to manage these woodlands in accordance with a Plan of Operations which is designed to secure sound forestry practice.

Diameter Breast Height (dbh)

Diameter of a tree rounded down to the nearest centimetre at a point on the tree 1.3 m above ground level.

Disforested

Woodland areas which are marked green on the O.S. 1:50 000 map, but at the time of survey were found to be under another land use, eg agriculture, buildings.

Extra Woodland

Areas of woodland over 0.25 ha in extent found during the Survey but not marked green on the O.S. 1:50 000 map.

Forestry Commission Woodland (FC)

Woodland owned by, on lease to or managed by the Forestry Commission.

High Forest (H.F.)

Stands of trees having a canopy density of 20 per cent or more, or, in the case of young stands which have not closed canopy, occupying 20 per cent or more of the ground at normal spacing. More than half of the crop should be capable of producing 3 m timber lengths of good form and be of merchantable species.

Linear Feature

Strips of woody vegetation less than 20 m mean width, crown edge to crown edge, and more than 25 m long.

Mainly Broadleaved High Forest

High Forest (q.v.) containing 50 per cent or more by area of broadleaved species.

Mainly Coniferous High Forest

High Forest (q.v.) containing more than 50 per cent by area of coniferous species.

"Other" Woodland

Woodland which is neither in Forestry Commission ownership or management nor included in a Dedication or Approved Woodland Scheme.

Planting Year (P. Year)

The year in which the trees were planted or regenerated naturally. With older crops it was often necessary to estimate the P. Year.

Planting Year Class

A group of planting years.

Scrub

All inferior crops where more than half the trees are of poor form, poor timber potential or composed of unmarketable species, and so do not qualify as either High Forest or Coppice.

Shrub Layer

A layer of woody plants below the tree canopy.

Woodland

Area of woody growth greater than 0.25 ha in area and at least 20 m wide. Where the stocking density was less than 20 per cent or there was evidence of recent woody growth, the area was described as cleared, otherwise it was allocated to a forest type.

APPENDIX 2

LIST OF SPECIES RECORDED AND REPORTED UPON — WOODLAND

English Name	Standard Abbreviation	Botanical Name
Scots pine	SP	<i>Pinus sylvestris</i> L.
Corsican pine	CP	<i>Pinus nigra</i> var. <i>maritima</i> (Ait.) Melville
Lodgepole pine	LP	<i>Pinus contorta</i> Douglas ex Loud.
Sitka spruce	SS	<i>Picea sitchensis</i> (Bong.) Carr.
Norway spruce	NS	<i>Picea abies</i> (L.) Karst.
European larch	EL	<i>Larix decidua</i> Miller
Japanese/Hybrid larch	JL	<i>Larix kaempferi</i> (Lamb.) Carr.
	HL	<i>Larix x eurolepis</i> Henry
Douglas fir	DF	<i>Pseudotsuga menziesii</i> (Mirb.) Franco
Other conifers*	XC	
Mixed conifers	MC	
Oak	OK	<i>Quercus robur</i> L.
		<i>Quercus petraea</i> (Matt.) Lieblein.
Beech	BE	<i>Fagus sylvatica</i> L.
Sycamore	SY	<i>Acer pseudoplatanus</i> L.
Ash	AH	<i>Fraxinus excelsior</i> L.
Birch	BI	<i>Betulus</i> spp.
Poplar	PO	<i>Populus</i> spp.
Sweet chestnut	SC	<i>Castanea sativa</i> Mill.
Alder	AR	<i>Alnus</i> spp.
Elm	EM	<i>Ulmus</i> spp.
Hornbeam	HBM	<i>Carpinus betulus</i> L.
Hazel	HAZ	<i>Corylus avellana</i> L.
Willow		<i>Salix</i> spp.
Other broadleaves*	XB	
Mixed broadleaves	MB	

* Included within Other conifers and Other broadleaves are some species which were recognised in the Survey but are of such limited occurrence as to preclude their individual inclusion in the Report.

LIST OF SPECIES RECORDED BUT NOT REPORTED UPON INDIVIDUALLY — WOODLAND

English Name	Standard Abbreviation	Botanical Name
Other pine	XP	<i>Pinus</i> spp.
Other spruce	XS	<i>Picea</i> spp.
Western hemlock	WH	<i>Tsuga heterophylla</i> (Raf.) Sarg.
Western red cedar	RC	<i>Thuja plicata</i> D.Don.
Cypresses		<i>Cupressus</i> spp.
		<i>Chamaecyparis</i> spp.
		<i>x Cupressocyparis leylandii</i> (Jacks. Dallim.) Dallim.
Grand fir	GF	<i>Abies grandis</i> Lindl.
Noble fir	NF	<i>Abies procera</i> Rehd.
Other fir	XF	<i>Abies</i> spp.
Redwoods		<i>Sequoia sempervirens</i> (D.Don) End.
		<i>Sequoiadendron giganteum</i> (Lindl.) Buchholz
Yew		<i>Taxus baccata</i> L.
Other conifers	XC	
Other oak		<i>Quercus</i> spp.
Norway maple	NOM	<i>Acer platanoides</i> L.
Horse chestnut	HCH	<i>Aesculus hippocastanum</i> L.
Lime	LI	<i>Tilia</i> spp.
English elm**	EEM	<i>Ulmus procera</i> Salis.
Wych elm**	WEM	<i>Ulmus glabra</i> Huds.
Nothofagus	N	<i>Nothofagus</i> spp.
Prunus (Cherries)		<i>Prunus</i> spp.
Ornamentals		
Other broadleaves	XB	

** For the purposes of the Report, English elm and Wych elm were included as elm.

NOTE:

In certain circumstances the following were also recorded as Woodland species:

Rowan	<i>Sorbus aucuparia</i> L.
Holly	<i>Ilex aquifolium</i> L.
Field maple	<i>Acer campestre</i> L.
Whitebeam	<i>Sorbus aria</i> agg.

APPENDIX 2 (contd)

LIST OF SPECIES RECORDED AND REPORTED UPON — NON-WOODLAND TREES

English Name	Standard Abbreviation	Botanical Name
Pines		<i>Pinus</i> spp.
Spruces		<i>Picea</i> spp.
Larches		<i>Larix</i> spp.
Cypresses		<i>Cupressus</i> spp.
		<i>Chamaecyparis</i> spp.
		<i>x Cupressocyparis leylandii</i> (Jacks. Dallim.) Dallim.
Other conifers	XC	
Oak	OK	<i>Quercus robur</i> L.
		<i>Quercus petraea</i> (Matt.) Lieblein.
Beech	BE	<i>Fagus sylvatica</i> L.
Sycamore	SY	<i>Acer pseudoplatanus</i> L.
Ash	AH	<i>Fraxinus excelsior</i> L.
Birch	BI	<i>Betula</i> spp.
Poplar	PO	<i>Populus</i> spp.
Sweet chestnut	SC	<i>Castanea sativa</i> Mill.
Horse chestnut	HCH	<i>Aesculus hippocastanum</i> L.
Alder	AR	<i>Alnus</i> spp.
Lime	LI	<i>Tilia</i> spp.
Elm	EM	<i>Ulmus</i> spp.
Willow		<i>Salix</i> spp.
Other broadleaves	XB	

NOTE:
Although the above species are given in the Report the total list of species recorded was the same as for Woodland.

LIST OF SHRUB LAYER SPECIES RECORDED

English Name	Botanical Name
Rowan*	<i>Sorbus aucuparia</i> L.
Field maple*	<i>Acer campestre</i> L.
Blackthorn	<i>Prunus spinosa</i> L.
Hawthorn	<i>Crataegus monogyna</i> Jacq.
Rhododendron	<i>Rhododendron</i> spp.
Holly*	<i>Ilex aquifolium</i> L.
Elder	<i>Sambucus</i> spp.
Broom	<i>Sarothamnus scoparius</i> (L.) Wimmer ex Koch.
Gorse	<i>Ulex</i> spp.
Privet	<i>Ligustrum vulgare</i> L.
Dogwood	<i>Cornus sanguinea</i> L.
Sallow	<i>Salix caprea</i> L.
Box	<i>Buxus sempervirens</i> L.
Whitebeam*	<i>Sorbus aria</i> agg.
Spindle	<i>Euonymus europaeus</i> L.
Yew*	<i>Taxus baccata</i> L.
Hornbeam*	<i>Carpinus betulus</i> L.
Hazel	<i>Corylus avellana</i> L.
Willow*	<i>Salix</i> spp.
Other shrubs	
Mixed shrubs	

*These species have on occasion been recognised as tree species.

DESCRIPTION OF SOIL STRATA

Reassessment of Soil Survey of England and Wales 1:1 million Soil Map for Woodland Surveys

The Forestry Commission Census Section sought advice from the Soil Survey of England and Wales and the Forestry Commission's own Site Studies Branch on soils to be recognised for Census purposes. The object was to produce a map showing broad site types relevant to tree growth potential. As a result, the 71 soil units shown on the 1:1 million soil map were combined to produce 16 soil groups.

A further variable was recognised which overrode the new soil strata units: potential soil moisture deficit (PSMD). Deficits more or less than 150 millimetres (mm) were distinguished at county level; counties with >150 mm PSMD were considered dry (namely, those east of and including Nottinghamshire, Lincolnshire, Leicestershire, Northamptonshire, Oxfordshire, Berkshire and Hampshire), and counties in the 100-150 mm zone were intermediate. Wet uplands (<100 mm PSMD) were already separated (units 12 to 16 in the list below).

Soil Groups

1. Sandy; well drained.
2. Alluvial and "valley" soils; with groundwater.
3. Lowland peaty and humose soils; with groundwater.
4. Rendzinas over chalk and limestone; well drained.
5. Brown calcareous soils; well drained.
6. Lowland brown earths; mainly well drained.
7. Deeply leached brown earths; mainly over chalk.
8. Podzols; well drained.
9. Sandy soils, some podzolisation, with groundwater.
10. Surface-water gleys and other clayey soils.
11. Surface-water gleys over compacted silty or loamy beds. (High Weald.)
12. Brown earths; uplands.
13. Stagno-podzols; humose or peaty; often with iron-pan and rock.
14. Surface-water gleys in moist climates.
15. Peaty or humose surface-water gleys.
16. Hill peat.
17. Urban.

Reassessment of the Macaulay Institute for Soil Research 1:625 000 Soil Map for Woodland Surveys

Discussions with staff of the Macaulay Institute for Soil Research made it apparent that although many of the soil groups adopted for England and Wales could also be utilized for Scotland there was a need for some additional groups. After further advice from Site Studies Branch, seven additional groupings were adopted. Some of these are best described as complexes to cater for changes in soil type that take place over short distances.

18. Western seaboard complex.
19. Peaty gley complex.
20. West coast igneous peaty complex.
21. North and west coast rock and peat complex.
22. Blanket peatlands.
23. Mountain tops.
24. Coarse textured alluvium, high groundwater.

CRITERIA FOR THE ASSESSMENT OF THE HEALTH OF NON-WOODLAND TREES

For all living trees, health was estimated in three categories; good, moderate and poor.

Symptoms of poor health were:

a. Crown deterioration, indicated by:

abnormally small, sparse or unhealthily discoloured foliage;
premature discolouration of foliage or defoliation;
extensive dieback, breakage or shedding of limbs in the upper crown (disregarding 10 per cent of dieback in oak).

b. Bole deterioration, indicated by:

diseased, dead or missing areas of bark including decayed wood;
death of large limbs;
advanced and hazardous decay following lopping;
suspected internal decay of swollen boles.

c. Instability, indicated by:

wind - rock symptoms of displaced soil at the base of the bole;
exposure of root system through erosion.

From an assessment of the presence or otherwise of any of the above symptoms the condition of each tree was classified as good, moderate or poor. All assessments were external from ground level.

If none of the above symptoms were present, the health of the tree was assessed as "good".

If one symptom only was present, the health was assessed as "moderate".

If more than one symptom was present, tree health was assessed as "poor".

There were occasions, particularly in summer, when the general appearance of a tree was unsatisfactory, and then the surveyor, if in doubt, recorded tree health as "moderate".

NOTES:

1. Dead branches or areas of dead bark in beech automatically classified the tree health as "poor".

2. Elm was treated on its own, as the symptoms of Dutch elm disease can occur very quickly during the latter part of the summer. For prognosis, the general health of the tree was compared with those around it. Checks were made for dead leaves, twigs, branches and 'shepherds crooks' as well as for beetle emergence holes in the bark. Areas of dead or peeling bark indicated serious loss of health.

APPENDIX 5a

LIFE EXPECTANCY BY SPECIES GROUPS, SIZE AND HEALTH OF CONIFEROUS SPECIES
REPORTED UPON IN THE NON-WOODLAND TREE TABLES

		Pines Larches			Spruces Douglas fir Other firs			Other conifers		
Species Groups		Good	Mod.	Poor	Good	Mod.	Poor	Good	Mod.	Poor
Health										
Size Class (dbh)										
7 - 20 cm		180	90	40	150	70	30	100	60	30
21 - 50 cm		100	60	20	90	50	20	80	50	20
51 - 80 cm		80	50	10	70	40	10	60	40	10
> 80 cm		50	20	—	40	20	—	40	20	—

NOTES:

The object of this table is to give a broad assessment of life expectancy of non-woodland trees, thus allowing forecasts to be made of the likely changes in the tree population in the landscape.

The years of life expectancy are broad national figures, assuming normal conditions over the period. Allowance must be made for local climatic and soil conditions.

Redwoods and yew in good health must be considered separately from all other conifers as both species may live a very considerable time.

APPENDIX 5b

LIFE EXPECTANCY BY SPECIES GROUPS, SIZE AND HEALTH OF BROADLEAVED SPECIES
REPORTED UPON IN THE NON-WOODLAND TREE TABLES

Years

Species Groups	Oak Sweet chestnut			Sycamore Lime			Beech† Elm†			Ash			Horse chestnut Willow Alder Poplar			Birch			
	Health	Good	Mod.	Poor	Good	Mod.	Poor	Good	Mod.	Poor	Good	Mod.	Poor	Good	Mod.	Poor	Good	Mod.	Poor
Size Class (dbh)																			
7 · 20 cm		> 300	> 250	100	> 200	> 150	60	> 150	80	—	100	70	30	80	50	20	50	20	—
21 · 50 cm		> 250	> 200	90	> 200	> 100	50	> 100	60	—	80	50	20	50	30	10	30	10	—
51 · 80 cm		> 200	> 150	70	> 150	> 100	40	90	40	—	60	40	10	30	10	—	20	—	—
> 80 cm		> 150	> 100	50	> 100	> 80	20	60	30	—	40	30	—	10	—	—	10	—	—

NOTES:

The object of this table is to give a broad assessment of life expectancy of non-woodland trees thus allowing forecasts to be made of the likely changes in the tree population in the landscape.

The years of life expectancy are broad national figures, assuming normal conditions over the period. Allowance must be made for local climatic and soil conditions.

The species in this table are only those found in Table 18c. The species in the "Other broadleaves" category, namely those recognised in the Non-Woodland Tree Survey, but not reported upon individually in Table 18c, cover such a wide range of life expectancies that it is not feasible to classify them in any meaningful way.

† In the case of elms, consideration must be given to the local incidence of Dutch elm disease. The life expectancy stated above assumes that the trees will be free of this particular threat. No life expectancy is given for beech or elm in poor health because of the likelihood of Beech bark disease and Dutch elm disease; such trees may live for some time or be dead next year.