Land Resource Study

13 A Forest Inventory of Part of the Mountain Pine Ridge, Belize

Land Resources Division/Overseas Development Administration/Foreign and Commonwealth Office

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EDITORIAL NOTE

During the preparation of this report the country of British Honduras was renamed Belize. Belize is therefore used throughout the report, but as the maps accompanying the report had reached an advanced state of preparation before the announcement of this change they still bear the name British Honduras.

Foreign and Commonwealth Office
Overseas Development Administration

A Forest Inventory of Part of the Mountain Pine Ridge, Belize

By

M S Johnson and D R Chaffey
(with a contribution by C J Birchall)

Land Resource Study No. 13

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THE LAND RESOURCES DIVISION

The Land Resources Division of the Overseas Development Administration, Foreign and Commonwealth Office, assists developing countries in mapping, investigating and assessing land resources, and makes recommendations on the use of these resources for the development of agriculture, livestock husbandry and forestry, it also gives advice on related subjects to overseas governments and organisations, makes scientific personnel available for appointment abroad and provides lectures and training courses in the basic techniques of resource appraisal.

The Division works in close co-operation with government departments, research institutes, universities and international organisations concerned with land resources assessment and development planning.

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PART 1. INTRODUCTION

PREFACE

This report is the result of an inventory study made during 1969-70 of one of the principal areas of pine forest in Belize. It is published with the permission of the Belize Government. Although the main part of this study was a forest enumeration a considerable amount of other information was collected during the course of the work and is included in the report as background material. The text was written by D R Chaffey.

The project covered by this report was one of three forest inventories undertaken by the Land Resources Division between 1968 and 1971, the other two being inventories of the Chiquibul Forest Reserve and of the southern Coastal Plain.

ACKNOWLEDGEMENTS

The authors record their appreciation for the help and cooperation received from the two successive Chief Forest Officers, the late R M Waters and L S Lindo, and from the Forest Department's Counterpart Officer, O Rosado. The willing assistance given by the junior staff is acknowledged as is that given by the labourers engaged on the project. The authors also record their gratitude to Dr H C Dawkins, MBE, of the Commonwealth Forestry Institute for his generous advice on statistical matters and assistance in the computation of data.

Much valued help with the often tedious extraction and processing of data was given by Mrs M T Alford and Mrs A Y Johnson of the Land Resources Division and by two former members of LRD, M J Burke and D D French. Thanks are due to the Directorate of Overseas Surveys and to the Cartographic Unit of LRD for the preparation of maps and diagrams.

Among others whom the authors wish to mention for providing assistance or information are the following: J H Bateson, Geologist, Institute of Geological Sciences, London, K Gibson, Director of Surveys, D R Hunt, Botanist, Royal Botanic Gardens, Kew, B H Moody, formerly Divisional Forest Officer, Augustine, G R Proctor, Botanist, Institute of Jamaica.

ABSTRACT

The results of an inventory of pine in 240 km^2 (90 mi^2) of the Mountain Pine Ridge Forest Reserve are presented. The Mountain Pine Ridge is an area of naturally regenerated pine which is managed primarily for timber production but also for other secondary land uses, the most important of which is in-forest grazing of livestock. The forest inventory included the assessment of the volume of standing timber and of the replacement stocking.

By the interpretation of air photography of scale 1:10 000 and 1:20 000, nine forest/vegetation types were identified and mapped. The map accompanies this report. Four of the nine forest/vegetation types were sampled. Three of the four are pine forest types, distinguished from each other by canopy density, and these were sampled for both timber stocking and regeneration. The fourth type sampled is grassland with pine seedlings, which was sampled only for regeneration.

The project area comprises 34 management blocks. Results were computed separately for each forest/vegetation type sampled in each block.

As a background to the forest inventory, relevant aspects of the environment are described, with emphasis on soils and vegetation. The soils in the project area were the subject of a small-scale field study, the observations from which are presented. The principal type of vegetation is savanna, the distribution of which depends on the incidence of fire as well as on climate and soil.

RÉSUMÉ

Les résultats d'un inventaire des pins contenus dans une superficie de 240 km^2 de la Réserve Forestière de Mountain Pine Ridge est présentée. Mountain Pine Ridge est une région de pins

naturellement régénérée, qui est exploitée principalement pour la production de bois mais aussi pour d'autres utilisations secondaires des terres, dont la plus importante est le pâturage de bestiaux en forêt.. L'inventaire forestier comprenait l'estimation du volume de bois sur pied et du repeuplement.

Par l'interprétation de photographies aériennes à l'échelle de 1/10 000 et 1/20 000, neuf types de forêt/végétation furent identifiés et représentés sur carte. La carte est annexée à ce rapport. Quatre de ces neuf types de forêt furent échantillonnés au hasard. Trois de ces quatre types sont des forêts de pins, se distinguant l'une de l'autre par la densité de cime des pins, et dont l'échantillonnage aléatoire fut effectué afin d'en déterminer le volume d'arbres sur pied ainsi que le peuplement de régénération. Le quatrième type échantillonné est la prairie avec des sauvageons de pin, dont l'échantillonnage aléatoire fut effectué afin d'en évaluer seulement le repeuplement.

La superficie couverte par le projet comprend 34 blocs de gestion. Les résultats furent calculés séparément pour chacun des types de forêt/végétation dans chaque bloc.

Pour servir de fond à l'inventaire forestier, des aspects pertinents du milieu biophysique (l'environnement) sont décrits, en soulignant les sols et la végétation. Les sols de la superficie couverte par le projet furent le sujet d'une petite enquête sur les lieux, dont les observations sont exposées. Le type principal de végétation est la savane, dont la distribution est subordonnée à l'incidence des feux, aussi bien qu'aux sols et climats.

DESCRIPTORS FOR CO-ORDINATE INDEXING

Climate/geology/geomorphology/soil description (morphology, survey and mapping)/soil profile/ soil sampling/photogrammetric application/fauna/pedology/crown density/forest classification/ forest damage and protection/forest enumeration/forest exploitation and product/forest fire/ forest inventory/forest management/forest mapping/forest mensuration/forest sampling/forest pasture/forest stocking (potential crop)/forest working plant/forest yield/multiple use forest/ natural regeneration system/natural stand/Pinus/Pinus caribaea/silviculture/stand density/stand description/stocking density/timber producing forest/tree individual measurement/tree volume measurement/wood use/plant ecology/savanna/tropical grassland/tropical woodland/vegetation stratification/history/environment/Belize/soil physical aspect/land use (current).

SUMMARY OF RESULTS

Area

Table 1 shows the total project area and its composition in terms of (a) forest/vegetation types carrying a stocking of pine and (b) other land.

TABLE 1 Summarised area statement for the whole project area

	Area		
	ha	ac	% of total
Total project area	24 422	60 346	100
Pine forest*	18 956	48 840	78
Grassland with pine seedlings	3 191	7 884	13
Other land	2 275	5 611	9

* Includes pine savanna

Timber stocking

Stem numbers Table 2 shows the distribution of the growing stock between three size categories, taking the project area as a whole. The values shown are mean values and are not qualified by estimates of precision.

TABLE 2 Mean numbers of stems of pine per unit area in the whole project area

d.b.h.		Number of stems		
cm	in	per ha	per ac	% of total
⩾5.0	⩾2.0	497	201	100
⩾7.6	⩾3.0	281	114	57
⩾15.2	⩾6.0	61	25	12
⩾25.4	⩾10.0	10	4	2

Standing volume Minimum estimates of the standing volume of pine in three size classes are shown in Table 3. Figures quoted are at the probability level of 95%.

The standing volume per management block varies considerably. Of the 34 management blocks which comprise the project area the lowest stocked has an estimated minimum total volume of 1 370 m^3 (48 300 ft^3) and the highest stocked a volume of 10 670 m^3 (376 600 ft^3). For growing stock of d.b.h. 25.4 cm (10.0 in) and above, estimated minimum volume per block ranges from 60 m^3 (2 100 ft^3) to 3 480 m^3 (122 900 ft^3).

TABLE 3 Standing volume of pine in the whole project area

d.b.h.		Minimum estimate		
cm	in	m^3	ft^3	% of total
⩾7.6	⩾3.0	224 500	7 927 000	100
⩾15.2	⩾6.0	155 300	5 484 000	70
⩾25.4	⩾10.0	70 500	2 488 000	31

Regeneration

Regeneration is taken to include pine of d.b.h. less than 5.0 cm (2.0 in). The estimates of regeneration stocking (at 95% probability) made for the various forest/vegetation types in each management block range from nil to 1 343 stems/ha (543 stems/ac). The total areas regenerated at four different rates of stocking are given in Table 4.

TABLE 4 Regeneration of pine in the whole project area

Minimum stocking		Area		
stems/ha	stems/ac	ha	ac	% of total project area
250	101	17 532	43 322	71
500	202	12 623	31 191	51
750	304	7 232	17 870	30
1 000	405	2 869	7 089	12

In most of the 34 management blocks regeneration is largely or exclusively of *Pinus caribaea*. In five blocks a significant proportion of the regeneration is of *P. oocarpa*.

SUMMARY OF CONCLUSIONS

1. There will not be a significant increase in the present low rate of recruitment to minimum exploitable size for 10-15 years. Once the stocking of exploitable material does start to increase it will do so quickly and a preponderance of mature trees can be foreseen.

2. In the long term (ie 25 years plus) the present growing stock in all three pine forest types has the potential to produce fully stocked mature forest.

3. The reintroduction of controlled burning appears to be worth considering for most of the project area, both to inhibit encroachment by broadleaved weed species and to prevent the accumulation of fuel.

4. The paucity of sawlog material now and in the near future tends to encourage interest in the possibility of utilising some or all of the growing stock, before it reaches sawlog size, for the manufacture of industrial wood-based products. The limited supply of even small material which will be available suggests that the project area would be able to support an operation only of a type capable of economic production on a small scale.

5. The incomplete knowledge of certain subjects relevant to the management of the forest indicates a need for research. Subjects particularly deserving study may be summarised as follows:

   i. The ecology of *Pinus caribaea* and *P. oocarpa* and implications for silvicultural practice;

   ii. The rate of growth of pine, ways in which it can be increased and the response to thinning;

   iii. Artificial regeneration of both pine and merchantable broadleaved species.

PART 2. THE PROJECT

ORIGIN OF THE PROJECT

The inventory of the Mountain Pine Ridge evolved from a recommendation made in 1966 by the Forestry Adviser to the then Ministry of Overseas Development (Logan 1966). He advocated that the development of the pine resource should be given priority in the future programme for the government's forest estate and that the total standing volume of pine be increased by means of natural regeneration, the success of which was already being demonstrated in the Mountain Pine Ridge. A forest inventory of the Mountain Pine Ridge formed part of the proposals subsequently drawn up for projects to be undertaken in Belize by the Land Resources Division (Brunt, 1967). The other projects included in these proposals and subsequently carried out were a survey of the soils and agriculture of the Belize Valley and a forest inventory of the Chiquibul Forest Reserve. At a later date a third forest inventory - of the pine in the southern Coastal Plain - was requested and undertaken.

Initially it was envisaged that the pine inventory should take the form of a classification of regeneration stocking on a height basis, this to be done largely from air photographs. In 1969 the proposed scope of the study was widened at the request of the Belize Forest Department to include a full-scale ground enumeration of both standing timber and regeneration. The study was to be confined to the more accessible parts of the Mountain Pine Ridge where fire protection had been effective for some years and which were considered to be already regenerated.

The project, as it finally came to be carried out, had four broad objectives; these are described in detail in Part 4 but can be stated briefly as follows:

1. The estimation of the standing volume of pine
2. The assessment of pine regeneration
3. The construction of a volume table for pine to enable the volume of a standing tree to be estimated from simple field measurements
4. The mapping of the pine resource.

PROGRAMME OF WORK

The programme of work was as follows:

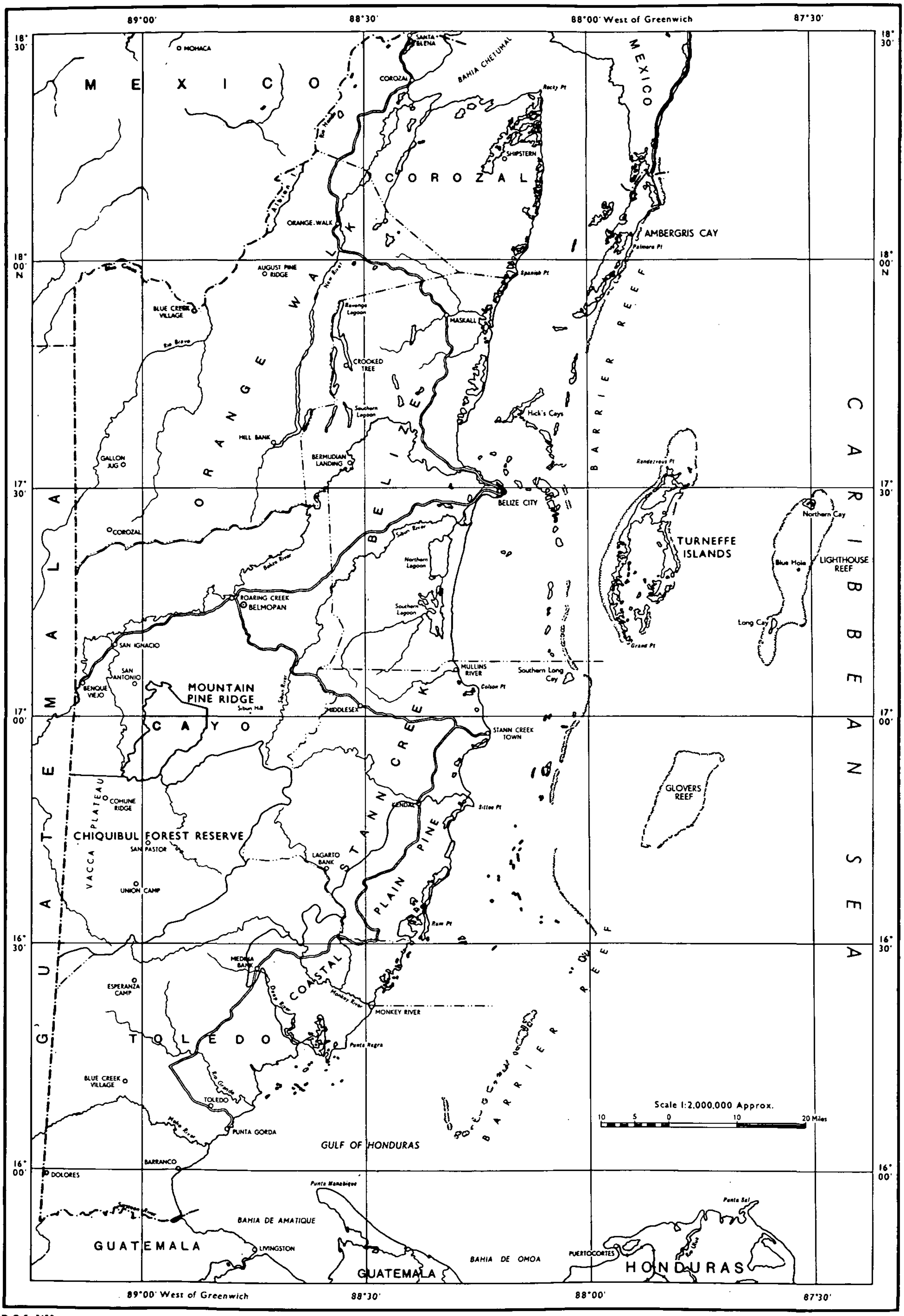
October-December 1969	Air photo interpretation, mapping of vegetation types.
January-May 1970	Design of sample layout, field enumeration, preliminary calculations.
July 1971-March 1972	Final computation of results; brief investigation of soils; preparation of report.

The project area was divided by the Forest Department into 34 management blocks. Each management block was subdivided by stereoscopic examination of the relevant air photography into nine forest/vegetation types, of which four contained pine. Each of these four types in each of the 34 management blocks was randomly sampled for timber stocking and regeneration. The methods by which this was done are described in Part 4.

TEAM COMPOSITION

The project was undertaken by a team of three forest officers assisted by three forest guards and 36 labourers. The labour was divided into six inventory gangs. Two of the officers, M S Johnson, the Senior Forest Officer, and D R Chaffey, were from the Land Resources Division and the third, O Rosado, was provided by the Belize Forest Department as Counterpart Officer. Forest guards and labour were also provided by the Forest Department. A brief investigation into the soils of the Mountain Pine Ridge was made by C J Birchall, Soil Surveyor attached to the LRD Belize Valley Project. The inventory of the Mountain Pine Ridge was, together with the other projects undertaken in Belize by the Land Resources Division, in the charge of the LRD Project Manager. R Rose-Innes acted in that capacity until December 1969 and R N Jenkin was Project Manager thereafter.

TEXT MAP - LOCATION



D.O.S. 3150

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PART 3. THE ENVIRONMENT

PHYSICAL ASPECTS

LOCATION

The Mountain Pine Ridge Forest Reserve occupies most of the area known until recently as the Great Southern Pine Ridge. It is bounded on the south and west by the Macal River and its continuation the Eastern Branch. The reserve extends north almost to the village of San Antonio and its easterly extremity lies at the divide between the headwaters of the Macal and Sibun Rivers on Sibun Hill. Augustine, the administrative centre and chief settlement, is located slightly west of the middle of the reserve and is approximately 160 km (100 mi) from Belize City, 80 km (50 mi) from Belmopan and 50 km (30 mi) from San Ignacio. The only other settlement of any size, San Luis, is 10 km (6 mi) south of Augustine.

The project area, which amounts to 250 km^2 (100 mi^2), is confined to that part of the reserve lying east of the continuous zone of broadleaved forest, which occupies the northern and western margins of the reserve, and west of the Brunton Trail which runs along the divide between the watersheds of the Macal and the Eastern Branch. The south-west corner of the project area extends south of the Brunton Trail to the Macal River and is bounded on the east by the Forest Department road called Angel's Avenue. The location and boundary of the project area are shown on the location map.

CLIMATE

The overall pattern of climate is variable from year to year but consists broadly of a dry season lasting from February to May, followed by hot stormy weather during the middle months of the year; cooler temperatures are experienced from about September onwards, the onset of which coincides with the period of heaviest rainfall, and the weather then remains cool and wet until the arrival of the next dry season. During the latter months of the year and until the following February, short spells lasting perhaps three or four days of particularly cool drizzly weather may occur sporadically; these spells are called northers as they are associated with cold northerly winds. Towards the end of the dry season and during the transition to the wettest period of the year the combination of high temperature, low relative humidity and a high incidence of electrical storms presents a situation of serious fire risk.

Meteorological data have been recorded at three stations: Augustine (since 1949), Cooma Cairn (since 1958) and Mai Fire Lookout (1960-68). For several of the years quoted, data for some climatic factors are fragmentary or missing. The climate at Mai and Augustine is probably fairly typical of that of the granite basin. Figures for Cooma Cairn are more applicable to the hilly eastern part of the reserve.

Comprehensive tables showing monthly and mean annual values for the various climatic parameters which have been measured in the Mountain Pine Ridge, based on all available data up to 1970, are given by Walker (1972).

Rainfall

Table 5 gives an impression of the amount of rainfall in the reserve and Figure 1 shows the distribution of rainfall throughout the year.

Most of the Mountain Pine Ridge lies in the rainshadow of the Mayo Mountain massif and so the rainfall which it experiences is lower than it otherwise would be. This is illustrated by the comparison shown in Figure 1 of the rainfall values for Augustine and of the more exposed Cooma Cairn.

Precipitation is probably exceeded by evaporation for up to 6 months of most years (Wright *et al.*, (1959)). Charter (1941) and others have concluded that in the moist tropics drought periods can be said to occur whenever the monthly rainfall fails to attain 100 mm (4 in) in a month (see also Beard 1953). From the histograms in Figure 1 it can be seen that the mean monthly rainfall can be less than 100 mm in any month of the year.

TABLE 5 Mean annual rainfall at 3 stations

Station	Period	Rainfall		Period	Rainy days
		mm	in		
Augustine	1949-70	1 631	64.2	1951-70	154
Mai	1960-68	1 532	60.3	1962-68	173
Cooma	1958-70	2 101	82.7	1962-70	195

Source: Belize Forest Department

Temperature

Temperature figures for Augustine and Cooma Cairn are shown in Table 6. Insufficient data are available for Mai Lookout for that station to be worth inclusion. Figures 3 and 4 compare graphically the parameters included in the table and show their monthly variation throughout the year.

TABLE 6 Temperature 1965-70 at Augustine and Cooma Cairn

Station	Mean annual				Highest maximum		Lowest minimum	
	maximum		minimum					
	°C	°F	°C	°F	°C	°F	°C	°F
Augustine	29	84	19	67	39	102	6*	42
Cooma	24	76	18	64	28*	83	6*	43

*1966-70

Source: Belize Forest Department

Relative Humidity

The mean monthly relative humidity at Augustine in the period 1965-70 varied between 70% (May) and 90% (January), with an annual mean of 82%. Corresponding figures for Cooma Cairn over the same period are 72% (May), 92% (January) and 83% (annual mean). Figure 2 compares graphically the relative humidities of Augustine and Cooma Cairn and shows their variation throughout the year. Data for Mai Lookout are too few to be worth inclusion.

Wind

Prevailing winds are onshore from the east, from which direction persistent light winds blow throughout the dry season. During the middle months of the year conditions are less predictable and the generally calm conditions are occasionally interrupted by strong depressions approaching from the east or north-east which may produce winds of high velocity and, in extreme conditions, circular storms of hurricane force. From October until the onset of the dry season, winds remain predominantly easterly to north-easterly, except for the occasional short spells already mentioned, during which cool winds blow from the north. Wind is an important factor in fire hazard and winds of hurricane force can cause severe mechanical damage to the crowns of standing pine; in extreme conditions, trees may be windthrown.

GEOLOGY

The Mountain Pine Ridge occupies the north-west corner of the Maya Mountain massif, the uplifted fault block which is the dominant geological and topographical feature of the country.

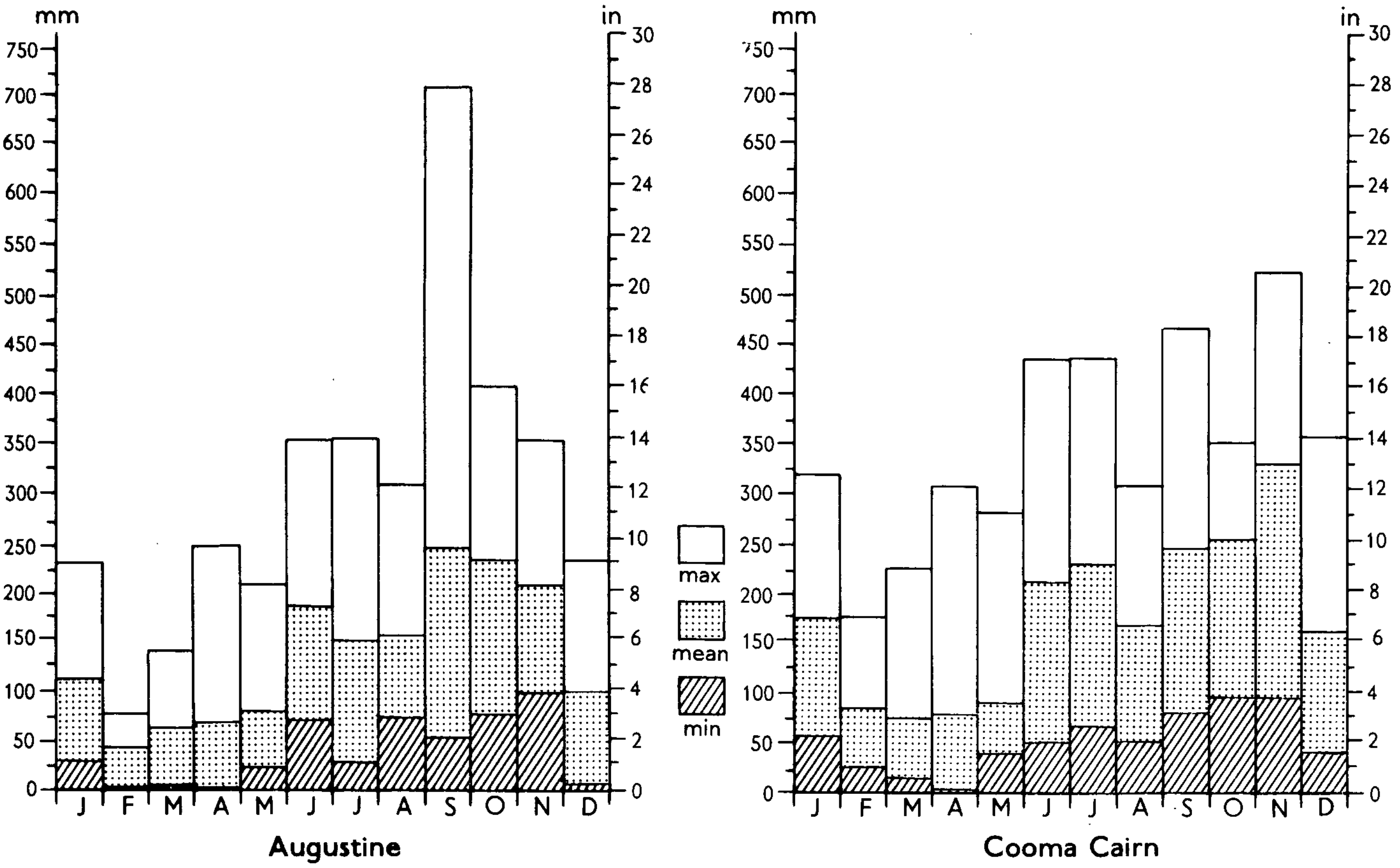

FIGURE 1 Monthly rainfall 1958-70 at Augustine and Cooma Cairn.

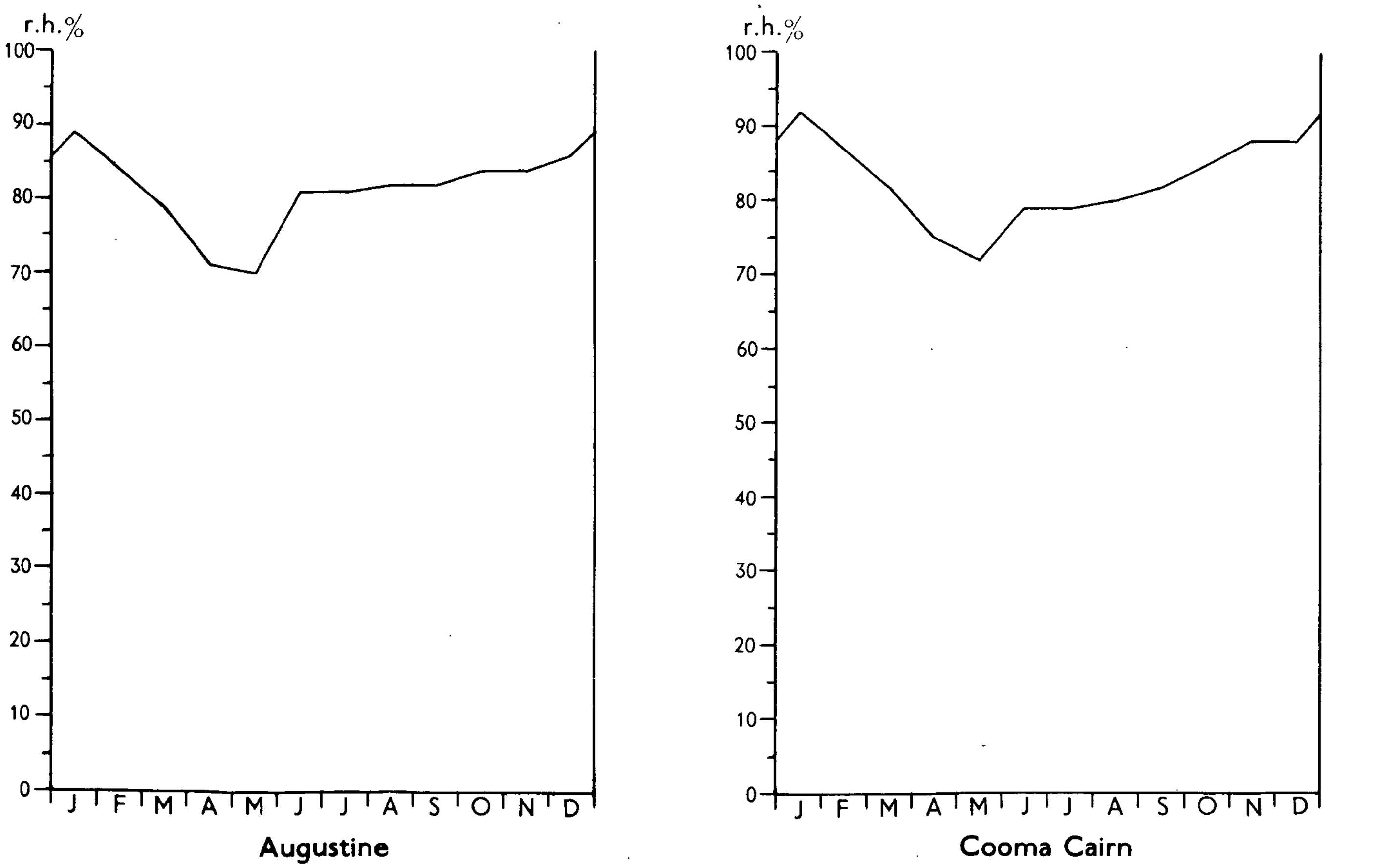

FIGURE 2 Mean monthly relative humidity 1965-70 at Augustine and Cooma Cairn.

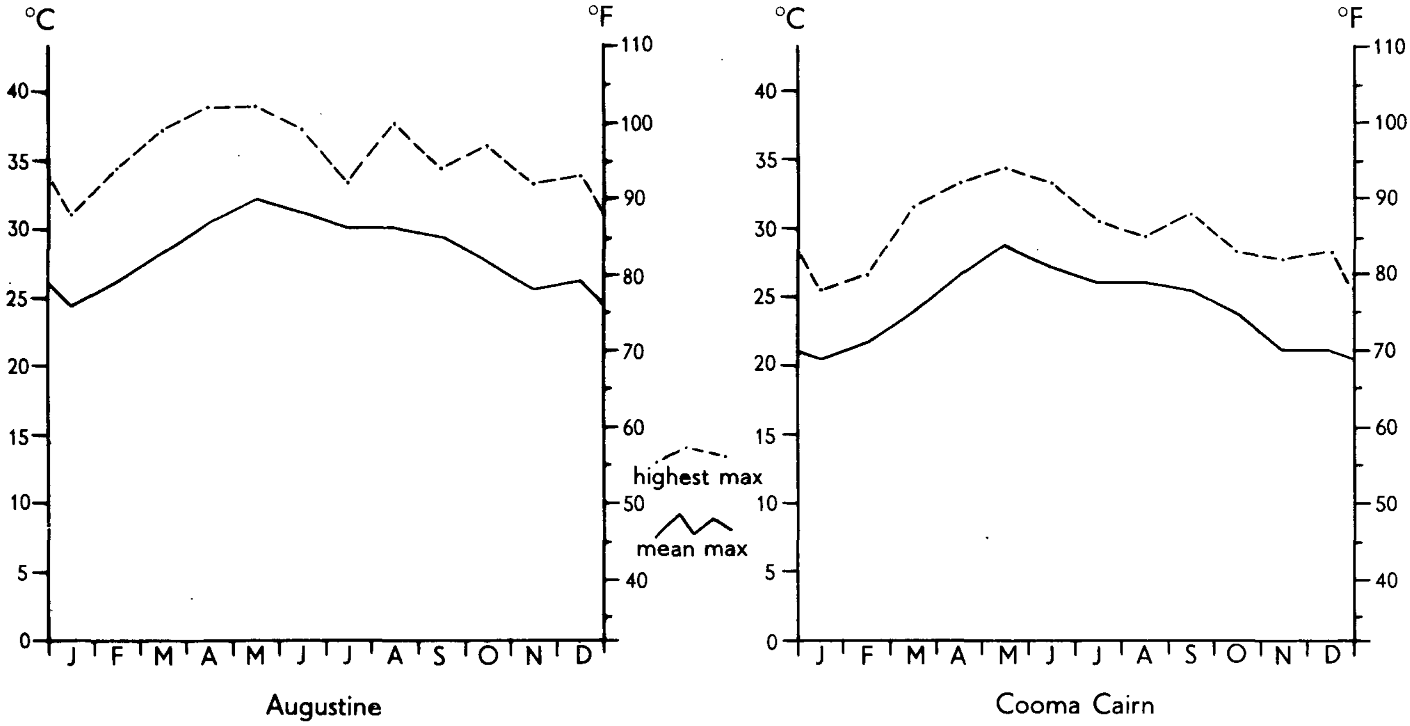

FIGURE 3 Temperature at Augustine and Cooma Cairn: mean monthly maximum 1965-70 and highest monthly maximum 1966-70.

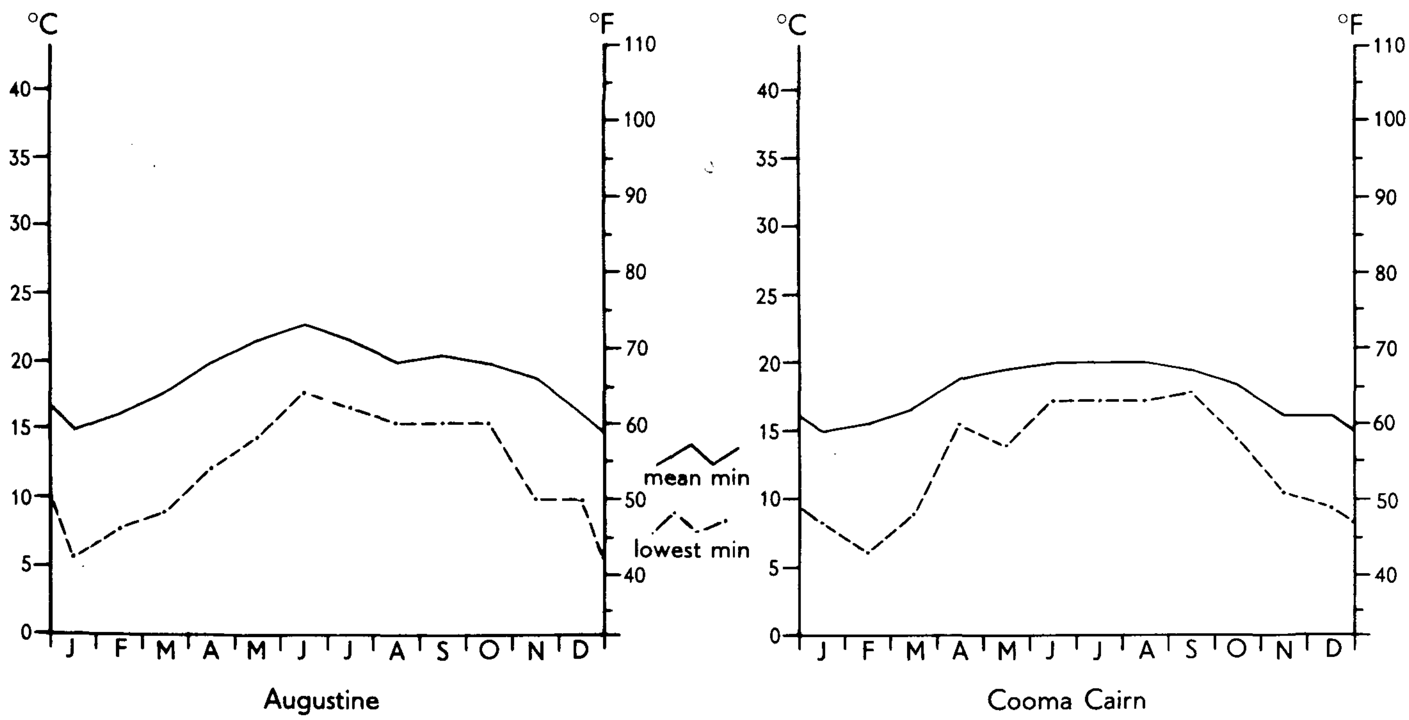

FIGURE 4 Temperature at Augustine and Cooma Cairn: mean monthly minimum 1965-70 and lowest monthly minimum 1966-70.

The central and southern part of the reserve and the greater part of the project area consists of granite intruded during early Triassic times, from which subsequently deposited Cretaceous-Eocene limestone has been eroded away. The mantle of karstic limestone remains in the north-west corner of the reserve, continuous with the massive Vacca Plateau, and there are occasional isolated limestone hills outlying. To the east the granite is rimmed by the north-west extremity of the crescent shaped lip of the Maya Mountain Plateau, a steeply folded formation of quartz-rich metamorphosed Paleozoic sediments dating from Pennsylvanian to approximately middle Permian times. Rocks of the same series of sediments circumscribe the granite to the north and south. Traversing the granite basin in a straight line running NE-SW is a prominent discontinuous vein of dolerite known locally as the quartz ridge. There are a number of other smaller post-Triassic intruded dykes.

Beds of plateau alluvium, banded sands and gravels overlying the granite to a depth of up to 5 m (16 ft) occur on the interfluves in the western part of the area at an elevation of about 540 m (1 800 ft). These deposits are attributed by Dixon (1956) to former interference with drainage from the hills by the limestone mantle. Wright *et al.* (1959) suggest that much of this part of the reserve may have become in post Cretaceous times a shallow lake which eventually broke through the surrounding limestone in the south and west to drain into the Macal River and Eastern Branch.

The Paleozoic sediments of the Mountain Pine Ridge and the soils overlying them are among the oldest in the country. The rocks comprise both arenaceous (conglomerates and sandstones) and argillaceous (shales and phyllites) sediments which, according to Dixon, belong to two series representing temporally distinct cycles of sedimentation. More recently, Bateson and Hall (1970 and in press) and Kesler *et al.* (1971) have produced evidence which appears conclusively to indicate that the sediments of the Maya Mountains belong to only one series, the Santa Rosa Group.

TOPOGRAPHY

The Mountain Pine Ridge is a dissected upland plateau comprising a gently undulating central basin bordered on the west and north by cone karst or 'cockpit' formation and rimmed on the east by a ridge of high rolling hills. The height of the ground above sea-level varies from about 300 m (1 000 ft) on the Eastern Branch to just over 900 m (3 000 ft) on the Ridge. The mean elevation of the granite basin is about 500 m (1 600 ft). The area is circumscribed on three sides - north, south and west - by the Belize River and its tributary the Macal/Eastern Branch. Drainage into the river system is by two main catchments both originating on the ridge, one south into the Macal and the other west, across the granite basin into the Eastern Branch. Only a few small watercourses escape northwards to disappear underground in the limestone lying between the Reserve and the Belize River.

The watershed of the Macal was largely excluded from the project area. Because of the steepness of its slopes and the associated difficulties of access it is not regarded as being adequately fire protected.

Drainage into the Eastern Branch is by four sizeable watercourses. The largest of these, the Rio On, drains about half the project area, in the north and north-east, by a dendritic system of tributaries. In the southern part of the project area the drainage pattern is roughly parallel with a prevailing direction of SE-NW. The gradient of the Rio On and its tributaries is generally steeper than those of the creeks in the south and has led to the development of deep valleys. These continue across the limestone fringe in the west where the watercourse has cut right through to the underlying rocks. Further south the gentler stream gradient is associated with rather flatter country and along some of the tributaries crossing the limestone, surface deposition of calcium carbonate occurs with the formation of fragile sheets. At the southern and western edges of the reserve the ground falls steeply away to the deeply incised valley of the main river.

Although the topography of the granite basin is gently undulating with generally gentle slopes, there are occasional massive exposures of bare rock, usually at hill tops or at other breaks in slope. The valleys dissecting the granite basin are evenly V-shaped and are separated by broad, fairly flat interfluves. The watercourses are strewn with large granite boulders and along the larger creek beds there are more or less continuous exposures of rock.

The hills rimming the Mountain Pine Ridge on the east are steep and are deeply fissured by numerous small watercourses. The valleys are steep sided, typically with a marked change of slope at full flood level where the valley sides become nearly vertical. The ridges between the valleys have well defined crests. Screes occur where disturbance has been caused artificially, notably by roadbuilding. In the valley bottoms there are exposures of rock in the form of ledges or vertical walls. Cuts made for roadbuilding along ridge sides reveal the steeply folded profile of the underlying rock.

A peculiar erosion feature of some of the steepest hills, most of which lie outside the inventory area, is the formation of regular concentric terraces about 1.5 m (5 ft) apart. Wright *et al.* (1959) hypothesise a sequence of solifluction to account for the formation of these terraces and suggest that as the process appears to have stopped and the slopes are now in equilibrium with prevailing conditions, erosion must at some point in the past have been subject to a sudden acceleration.

WATER

The Mountain Pine Ridge is well provided with surface streams in which water of good quality flows throughout the year.

The hills in the east act as a reservoir for the catchments of the reserve and maintain the headwaters rising in them even during the dry season. During periods of particularly heavy rain, run off is rapid and flash flooding occurs, especially on the large watershed of the Rio On.

The natural abundance of surface streams in the reserve is important from the point of view of fire protection. The water courses in the granite basin are all readily accessible to fire fighting equipment. As the headwaters in the hills lie at the bottom of very deep valleys they cannot easily be reached by vehicles and so do not constitute a source of water for fire fighting.

SOIL (by C J Birchall)

The first study to be carried out on the soil of the Mountain Pine Ridge was by Charter (1941) in a rapid reconnaissance survey of soils north of the Maya mountains. He classified them in the Croja suite as soils developed over materials with a low lime status and good external drainage. Within this suite he recognised a Blancaneau series of soils developed over certain of the weathering products of granite and the Chalillo series developed over the quartzites of the Maya Series of rocks. In January and March of 1952 F C Darcel completed a reconnaissance survey of the area for the Colonial Development Corporation and described (Darcel, 1952) over 100 auger samples from a number of localities but unfortunately the maps showing these localities are not readily available. The area was surveyed again as part of the reconnaissance survey of the whole of Belize carried out by the land use survey team comprising Wright, Romney, Arbuckle and Vial in 1952-1954. As a result of this work a report was produced (Wright *et al.* 1959) together with maps showing the distribution of the major soil types throughout the country. The soils of the Mountain Pine Ridge were classed as the Pinol set and described as mature soils in the development sequence from yellow latosolic to red-yellow podsolic, formed on lime-poor parent material. More recent work in the area has been done by Furley in 1966 with the University of Edinburgh expedition to Belize (Furley, 1968). He studied the variation of certain soil characteristics with slope along three transects in the eastern part of the area, at Baldy Beacon, Cooma Cairn and Granite Cairn.

For the purposes of the present report it was considered that more precise information on the relationships between soil-forming parent material, slope type and vegetation cover, together with relevant material extracted from the above authors mentioned, would provide a useful background to a study of the pine forests of the area. A total of 24 pits were examined in traverses located on the Cooma Cairn Road, on the Navel Road and on the Chiquibul Road near San Luis sawmill. These traverses were located to cover as many as possible of the vegetation types mapped by the forest inventory team and to incorporate a variety of slope and rock types. A brief summary follows of observations made. Descriptions of the more important soil types and locational map references are given in Appendix 1.

The most widespread soil on granite parent material was found to be the Pinol coarse sandy clay loam as classified by Wright *et al.* This soil has developed over a thick mantle of weathered granite and has a complete range of pine densities growing on it. The soil consists of a shallow loamy sand to sandy loam topsoil containing much quartz sand and fine gravel, overlying mottled gritty clay loam and mottled gritty clay which grades gradually into weathered granite. Quartz sand and concretionary ironstone pebbles are sometimes found on the surface of this soil and the moderately leached topsoil is susceptible to sheet and gully erosion. On some footslopes with broken ridge vegetation this soil has a variant with a deep dark sandy clay loam topsoil. In small depressions which are receiving drainage waters from adjacent slopes a heavier textured soil was found with a gritty clay loam topsoil and a strongly mottled sticky gritty clay subsoil.

The Pinol loamy coarse sand occurs most commonly on granite plateau sites in the western part of the Mountain Pine Ridge. It is possible that these soils are formed on old river gravels deposited by streams flowing westward into the Macal River. The profile consists of a shallow loamy sand to sandy loam topsoil overlying a deep sand or loamy sand subsoil overlying gritty clay loam at 0.9-1.2 m (3-4 ft). These soils generally support a vegetation of grass savanna with pine but there may be an increase in oak species in slightly depressed sites which are receiving ground waters from adjacent slopes.

In creek bottoms in granite areas darkly coloured deep soils rich in organic matter are found. The texture of these soils varies from sandy loam to sandy clay loam in the topsoil to silty clay loam and clay in the subsoil. The accumulation of fine material and of drainage waters in these soils due to movements downslope means that the subsoil is waterlogged for most of the year.

Soils developed on the Santa Rosa slates differ from those developed on granite in that they have redder, siltier subsoils and contain less coarse quartz sand. On steep hillsides shallow soils are developed containing many fragments of shattered purple slate and these correspond to the Pinol sandy clay hill soil mapped by Wright *et al.* as occurring fairly extensively in the northern periphery of the Mountain Pine Ridge. The textures of these soils were found to be loams and clay loams rather than clays and contain a high percentage of silt. The surface of these soils is a virtual rock pavement of fragmented angular stones derived from the weathering of strongly cleaved and folded purple and grey phyllite. On gentler slopes deeper soils are found; these have been mapped by Wright *et al.* as Pinol sandy clay loam, occurring in small areas in the north-east, south-east and south-west parts of the Mountain Pine Ridge.

Soils formed on alluvial material are of very limited extent in the Mountain Pine Ridge and are found only on the flat valley bottoms of a few streams in the south-west of the area. They tend to be free draining soils of loam texture and support a vegetation of low broadleaved forest.

Some aspects of the fertility of the soils of Mountain Pine Ridge have been studied by Darcel, Wright *et al.* and Furley. Darcel found the pH to be low on both granite and slate soils with ranges from 4.0 to 5.3 and with subsoils slightly more acid than the topsoils. All soils were found to be highly deficient in available phosphate and potash and low in soluble manganese, although high to very high in soluble aluminium. Wright *et al.*, found soils of the Pinol set to be low in natural fertility due to their senile stage of development and for the establishment of fodder pasture grasses all three major nutrients, nitrogen, phosphate and potash, had to be applied. Furley found pine ridge soils to be acid and leached of nutrients. He discovered little variation in the amounts of phosphorous according to slope but the overall reserves were low. Potash, although in short supply generally, showed a marked increase in footslope sites away from actively eroding streams. Values for loss on ignition increased in valley bottom sites to as much as 27% dry soil weight. All authors remarked on the susceptibility of the Pinol soils to erosion, and gullying is a common feature on the Forest Department roads. Sheet erosion is also thought to be very active and may account for the thin layer of coarse quartz sand often present on the surface of soils in granite areas. The availability of water in most soils of the Pinol set is low except in soils found in receiving sites for drainage waters. On the open savannas the shallow topsoil is rapidly saturated during periods of heavy rain and is equally readily dried. Because of the low water retaining capacity of the topsoil and the impermeability of the subsoil, drought is a feature which the vegetation has to endure for much of the year.

FIRE

Fire is an integral part of the environment of the Mountain Pine Ridge. Table 7 shows the incidence of fire in recent years in the Fire Control Area, which coincides approximately with the project area. The overall pattern is of a small number of fires each dry season with a major fire involving several square miles every few years. Before fire protection was undertaken the frequency and size of fires were presumably both greater and major fires probably occurred almost annually.

TABLE 7 Incidence of fire inside the Control Area 1963-70 caused by lightning and by human agency

Year	Lightning			Human agency		
	No.	Area*		No.	Area*	
		ha	ac		ha	ac
1963	3	>2	6	4	55	135
1964	6	1 283	3 170	5	735	1 816
1965	3	5	12	4	120	297
1966	2	4	10	0	0	0
1967	4	12	30	1	518	1 280
1968	8	823	2 034	0	0	0
1969	2	<1	2	1	32	80
1970	5	74	184	2	>1	3

Source: Belize Forest Department

* Area figures founded off to nearest ha and nearest ac

The grass sward of the savanna is readily flammable in dry weather and typically produces a fast moving, relatively cool ground fire which burns off the dry grass on the surface without killing the roots. A sward of new grass becomes established within a few weeks of a fire. The species of pine which occurs on the savanna (*Pinus caribaea*) is not well adapted for resistence to fire and trees under about 3 m (10 ft) in height are easily killed by cambial scorching. Moody (1964) records, from an enumeration made after a 400 ha (1 000 ac) fire in the Mountain Pine Ridge, mortality of 90% or more in regeneration up to 2 m (7 ft) in height; for trees of 3 m (10 ft) the mortality was 38%. The stems of mature trees may ignite in a very hot fire resulting from the combustion of a large accumulation of fuel. Such fires are liable to occur in areas of dense *Tripsacum* grass and fern, where the shrub layer has become particularly well developed through absence of fire over a period of years. True crown fires seldom if ever occur because of the low stocking of standing trees.

The importance of lightning as a major cause of fire appears to have been underestimated in the past possibly because, in the absence of fire records for the Mountain Pine Ridge, the greater importance of human agency in causing fires in the lowland savannas encouraged the belief that the same factors must operate in the Mountain Pine Ridge. Hummel (1926), discussing pine ridge fires in the country as a whole, does not mention lightning as a cause of fire. Wright *et al.*, (1959) stress the importance of runaway milpa fires spreading from the broadleaved forest surrounding the Mountain Pine Ridge but say that lightning fires occasionally occur as a result of dry trees igniting when struck. Hunt (1970) acknowledges the importance of lightning as a major cause of fire and quotes (1962) the rate of spread from a lightning strike as being up to 9 m (10 yd) per minute.

Wolffsohn (1967) gives the same figure for conditions of light wind (8-16 km/h, 5-10 mi/h and relative humidity 60%. At r.h. 40% he states that the rate of spread is 1.6 km/h (1 mi/h) with extensive spotting. Wolffsohn says that extensive fires in dry scrub or bracken may run twice as fast as those in grass.

VEGETATION

The principal type of vegetation in the Mountain Pine Ridge is, as the name of the reserve implies, that known locally by the generic term 'Pine Ridge'. It is this broad vegetation type with which this study is concerned. Its distribution is confined to the non-calcareous parts of the reserve. It consists typically of a generally low stocking of young naturally regenerated pine (*Pinus caribaea*) with an open understorey of small trees, shrubs and suffrutices and occasional clumps of palmetto (*Acoelorraphe wrightii* and *Schippia concolor*). Ground cover is provided by a coarse sward of bunch grasses and sedges. There remains over the area a thin scattering of 'old growth' pine, overmature trees left as seed bearers during exploitation in the decade prior to 1965. The density of the vegetation type as a whole is irregular, relatively dense stands being interspersed with wide stretches of open savanna.

Fire is a critical factor in the ecology of the Pine Ridge. In the absence of regular burning of the shrub layer the pine tends to become replaced by broadleaved species, notably oak (*Quercus* spp.), one of the principal components of the understorey. Fire, however, destroys young pine regeneration, hence the naturally low stocking of the reserve. The present stands of pine are largely the result of fire protection over the past two decades. Because of their youth the trees are still of small size.

The watercourses are fringed by strips of broadleaved forest. In the more gently sloping valleys of the granite basin the hardwood fringes take the form of broad bands extending some distance, perhaps as much as 200 m (650 ft) either side of a watercourse. In the much steeper valleys of the hills the strips of hardwood are more open and narrower, being perhaps only a few metres in width, and often contain some pine. In these steeper valleys off the granite, the woodland fringing the creeks is flanked by dense swathes of dumb cane grass (*Tripsacum latifolium* and tiger bush fern (*Dicranopteris pectinata*). These species, either in mixture or singly, cover the lower slopes of the valleys wherever the tree canopy is sufficiently open. Where the hard-wood strip is very reduced or absent the entire valley floor may be covered by a tangled mass of both these species, about 3 m (10 ft) in height. The occurence of these species is not confined to valley bottoms. There are large areas of *Dicranopteris/Tripsacum* on all slopes of the hills edging the Macal valley, where it provides a ground cover under pine.

A second species of pine (*Pinus oocarpa*) occurs at higher elevations, typically in fairly dense stands. It is more a forest-forming species than *P. caribaea*, which is typically a species of the savannas.

The limestone along the north-west edge of the Mountain Pine Ridge is covered by broadleaved forest continuous with and similar to that occurring on the limestone areas of the Chiquibul Forest Reserve.

In addition to the two species of pine, a number of other tree species of commercial importance occur in the Mountain Pine Ridge. These species occur largely in the strips of broadleaved forest along stream sides and include mahogany (*Swietenia macrophylla*), nargusta (*Terminalia obovata*), billy webb (*Sweetia panamensis*), yemeri (*Vochysia hondurensis*) and cypress (*Podocarpus guatemalensis*). Beyond the transition to the limestone, commercial species present include the two primary species, mahogany and cedar (*Cedrela mexicana*); among the secondary hardwoods occurring are nargusta and santa maria (*Calophyllum brasiliense*).

Classification of the vegetation

Bartlett (1935) adopts local terminology to describe the Mountain Pine Ridge vegetation. He calls the savanna 'pinar' or 'pinal' and distinguishes three phases, namely the pure 'pinal' and the two variants 'encinal' and 'nanzal'. 'Encinal' means oak woodland and in 'nanzal' the predominant woody species is crabboo (*Byrsonima crassifolia*). Bartlett recognises two ravine vegetation types: the relatively rich 'cypresal/barrancal', characterised by cypress (*Podocarpus guatemalensis*) and other species and a vegetation type occurring on the gentler slopes called 'cizal/helechal', characterised by *Dicranopteris*. Bartlett's scheme has the merit of simplicity and is based on readily observable characteristics of the vegetation.

Lundell (1940) treats the vegetation of the Mountain Pine Ridge under five headings: (i) vege-tation of the pine uplands, (ii) vegetation along brooks and in marshes, (iii) vegatation along creeks, (iv) marginal forest and (v) forest of the bordering limestone region.

Wright *et al.*, (1959) classify the vegetation of the Mountain Pine Ridge into three vegetation types, as follows:

18 OAK-pine-florazul forest

18a OAK-pine-*Clusia* spp. forest with abundant silver pimento

18b SAVANNA grass with scattered pine, oak, *Leucothoe* sp. *Clusia* sp. and crabboo.

Hunt (1970) rejects the classification of Wright *et al.* because of its emphasis on arborescent species which only rarely form a canopy sufficiently dense significantly to modify the ecologically dominant bunch grasses and sedges of the herb layer. The same criticism might be made of Bartlett's classification. A further shortcoming in the classification of Wright *et al.* is that it does not distinguish the broadleaved riverain vegetation which occurs along the sides of the major watercourses from the pine types, despite its individuality. Hunt also records some minor floristic inaccuracies in the classification; in particular he points out that florazul (*Tabebuia rosea*) does not appear to occur in the Mountain Pine Ridge except where introduced by planting; also, Wright *et al.* wrongly identify silver pimento (*Schippia concolor*) and confuse it with *Accelorraphe wrightii*.

Because of its drastic modification by fire, there is little to be gained in trying to fit the Mountain Pine Ridge vegetation into Holdridge's life zone classification (Holdridge 1947, 1966) which attempts to classify potential climatic climax vegetation for the different climatic zones. Data necessary for the computation of a mean annual biotemperature are not available but it is likely that it is near but a little below the critical 24°C (75°F) which Holdridge takes as the dividing line between tropical and subtropical zones. Taking into account the mean annual precipitation, the Mountain Pine Ridge would appear to fall into the subtropical moist forest category, except perhaps its highest parts which, on the basis of data from Cooma Cairn, would fall into the subtropical wet forest life zone, the rainfall being (at Cooma) just over the 2 000 mm (79 in) borderline.

Hunt (1970) describes the vegetation of the Mountain Pine Ridge under three headings: pine savanna, pine forest and marginal vegetation. He excludes from his study the broadleaved forest which occurs along the sides of creeks and in valleys although he recognises it as distinct from the types he describes in detail. Hunt's classification is followed in the presentation of the following notes.

Savanna Beard (1953) defines savanna as

> '... a plant formation of tropical America comprising a virtually continuous, ecologically dominant stratum of more or less xeromorphic herbs, of which grasses and sedges are the principal components, with scattered shrubs, trees or palms sometimes present ... the essential point is that the herb stratum is ecologically dominant'

Beard considers that the vegetation of all tropical American savannas is sufficiently homogeneous for them to be regarded as a single formation. He recognises four main phases, respectively open, orchard, palm and pine, with two fringe types, sedge savanna and high grass savanna. Beard's pine savanna phase appears to correspond to Lundell's pine uplands. Hunt, Beard and others observe that the distribution of the different phases of the savanna appear to be determined by the drainage characteristics of the site. Beard's open and palm phases and the sedge savanna are characteristic of the wet end of the spectrum and the orchard and pine phases are associated with drier conditions. This pattern may be altered by fire. Hunt places Beard's high grass savanna in his marginal vegetation category as it occurs at the edges of forest and is less readily and less frequently burned than the other savanna phases. Hunt lists the characteristic arborescent species, most of which have thick fire resistant bark, as follows:

Acoelorraphe wrightii
Byrsonima crassifolia
Clethra hondurensis
Enallagma latifolia
Leucothoe mexicana
Myrica cerifera
Pinus caribaea
Psidium anglohondurense
Quercus hondurensis
Q. oleoides
Q. peduncularis
Schippia concolor
Ternstroemia tepezapote

Describing the herb stratum, Hunt remarks on its .... 'deceptive appearance of uniformity under which lies concealed the sensitive interaction and local dominance of several species.' Only the extremes of wet and dry conditions are conspicuous. The wet end of the spectrum is characterised by *Mesosetum filifolium* and *Rynchospora globosa*, and the dry extreme by *Trachypogon angustifolius* and *Paspalum pectinatum*.

A number of species composing savanna vegetation are highly specialised in their adaptation to fire. Hunt observes that there is no seasonal flowering of the savanna flora in Belize and that flowering occurs only in response to disturbance of some kind, and particularly in response to burning. The characteristic grasses, sedges and herbs have well developed underground organs of perennation which enable them to withstand and recover quickly from a surface fire. Hunt records the appearance of inflorescences of the sedge *Bulbostylis paradoxa* within 36 hours of burning and its maturation to anthesis in nine days. The characteristic woody species of the savannas tend to have thick fire resistant bark. Burning of the aerial parts of the woody species is followed by vigorous vegetative regrowth. The vegetative and flowering response of savanna species to burning does not occur concurrently in adjacent but unburned areas of savanna.

Unlike some species of *Pinus* (notably *P. palustris*) which occur in the southern United States, as already mentioned, *P. caribaea* is not very well adapted to resist fire. It has a thick bark but lacks any adaptation to protect the terminal bud at the seedling stage. It is possible that it may to some extent exhibit the characteristic growth pattern of fire resistant species, that is the emphasis in the first few years on root development at the expense of aerial growth; provided a seedling survives this early stage it is then able to show a rapid acceleration in height growth which puts its leading shoot out of danger from ground fires. *P. oocarpa* appears not to be adapted to resist fire and this lack of adaptation is in keeping with its being a forest forming species rather than a species of the savannas; older trees, if swept by ground fire, fire, respond by producing thick bark, similar to that of *P. caribaea*, on the lower part of the stem (Lamb, 1966).

Pine forest This vegetation type is most extensive and attains its best development on the sediments forming the steep hills to the east of the granite basin.

The distribution of *P. caribaea* in Central America generally appears to be subject to an upper height limit of about 600 m (2 000 ft) above sea-level, above which there is a tendency for it to be replaced by *P. oocarpa*. Much of the higher part of the Mountain Pine Ridge is at about this elevation and the forest represents a transitional phase, with the two species occurring both in pure stands (i.e. except for broadleaved species) and in mixture with each other. McWilliam (1954) describes the pine forest in the Honduras Republic as being a mixture of the two species at elevations between 760 m (2 500 ft and 1 200 m (4 000 ft), while above the latter height *P. oocarpa* occurs pure or in mixture with oak.

In recent years the collection of cones from the Mountain Pine Ridge which exhibit characteristics intermediate between those attributed to *P. caribaea* and those of *P. oocarpa* indicates hybridisation between the two species at elevations where their respective distributions overlap. McWilliam records similar hybridisation from the Honduras Republic.

Where the pine forms a closed canopy, which *P. oocarpa* readily does, it becomes truly dominant and shades out many of the species commonly found in the savanna herb stratum. A number of woody shrubs which occur on the savannas are found also in the pine forest and Hunt lists the following:

Byrsonima crassifolia
Calliandra houstoniana
Clethra hondurensis
Leucothoe mexicana
Psidium anglohondurense
Quercus spp.
Ternstroemia tepezapote
Inga lindeniana

Ground cover is commonly provided by *Tripsacum* or *Dicranopteris* and a number of other shrubs, herbs and grasses.

Although *P. oocarpa* appears to be more typically a forest species, *P. caribaea* is also capable of forming dense stands. Such stands occur on some better drained soils just outside the reserve boundary.

Marginal vegetation This category as defined by Hunt includes the ecotone between savanna and forest, the vegetation of stream sides and wet places, of savanna margins and of roadsides and waste ground. The floristic and physiognomic characteristics of the marginal vegetation are very variable and a concise description of it is not possible. Clearly, much of the marginal vegetation is of a particularly transient nature as it constitutes a 'tension zone' continually liable to be replaced by forest or to be transformed by fire into savanna. Probably the most stable type of vegetation in this category is that equivalent to Bartlett's 'cypresal' and Lundell's 'vegetation along creeks'. Where a creek is of sufficient size a rich broadleaved forest develops along its banks which is insulated from the savanna on either side by a less stable 'tension zone'. Hunt lists the major constituent tree species as follows:

Cecropia peltata
Euterpe sp.*
Podocarpus guatemalensis
Quercus anglohondurensis
Sweetia panamensis
Swietenia macrophylla
Symphonia globulifera
Tabebuia chrysantha
Terminalia obovata
Vochysia hondurensis
Xylopia frutescens

The character and width of the 'tension zone' between savanna and forest depends on a number of factors, especially the nature of the adjacent savanna and forest, and typically is dominated by species of pine and oak. The boundary between the broadleaved forest on the limestone and pine savanna tends to be abrupt because of the sharpness of the geological boundary in the underlying rock. Periodic burning serves to emphasis the vegetational boundary as fire cannot so readily penetrate into the broadleaved forest.

Status of the savanna vegetation

The origin and maintenance of the tropical American savannas has been the subject of several theories and the most comprehensive study of them is that by Beard (1953) to which reference has already been made. Among the more important factors in the ecology of the savannas are the nature of the soil-forming rocks, the seasonal distribution of rainfall, the water relations of the soil and the occurrence of fire.

Savanna occurs on acid infertile soils derived directly or indirectly from siliceous rocks and with poor internal and external drainage. It occurs in regions which experience a distinct dry season. The incidence of fire in savanna is high and, in the Mountain Pine Ridge at least, is not dependent on, although it is enhanced by, human agency.

Charter (1941) proposes an ecological succession from broadleaved forest to mixed broadleaved/ pine forest ('Broken Ridge') to pine to savanna. He attributes this order of succession to contemporaneous soil degradation. The order of succession presented by Charter is the reverse of that which is normally associated with pine species and which is advanced in relation to pine in Belize by Ower (1926). Both Wright *et. al.* (1959) and Hunt (1970) reject Charter's thesis.

Charter's theory assumes a soil maturity sequence involving a progressive leaching of the soil to produce the characteristic sand over clay formation and infilling of depressions by clay transported by surface runoff. The developing profile characteristics of the soil and the levelling of the topography lead to progressively impeded drainage, both externally and internally, so that with the seasonal variation in rainfall conditions of alternate dessication and waterlogging obtain. From the the point of view of plant growth, drought becomes almost perpetual, alternately physical and physiological. The vegetation becomes progressively xeromorphic and the ultimate stage is in Charter's view, a sedge/palmetto community, with pine and oak persisting only on better drained mounds.

The Mountain Pine Ridge differs from the model described above in one important respect, namely in that over most of the area external drainage is sufficiently good that surface runoff is fast enough to prevent physiological drought through waterlogging. Swampy areas occur only in places and elsewhere drought is purely physical.

Charter interprets the high mortality of pine in the Mountain Pine Ridge and elsewhere in Belize in the years 1939 and 1940 (which was directly the result of attack by Scolytid beetles, the spread of which was probably favoured by unusually dry conditions) as evidence of the increasing unsuitability of the savanna sites for the growth of pine.

* This species is listed by Hunt as *E. oleracea*, an erroneous identification suggested also by Standley & Record (1936) and Wright *et al.* (1959). Proctor (1972) says the species has not been previously described and provisionally calls it *E.* aff. *macrospadix*.

The role played by fire in relation to the Central American savannas is disputable. Warming (1892), Beard (1953) and others discount fire as a cause of savanna and maintain that its origin is essentially edaphic. This view is in line with Charter's soil maturity sequence. The tendency in the past to underestimate lightning as a cause of fire has already been mentioned and Beard is no exception. He appears to consider fire only as a consequence of human occupation, and discusses fire not as an influence in itself but as an influence of man. He accepts that fire may occur naturally in savanna, once it is established, but maintains that only man-induced fire could have destroyed former broadleaved forest:

> 'It seems fairly well established that fire can arise from natural causes in savannas, but it would scarcely do so in forest. Thus the retrogression to savanna could only have started after man's arrival.'

This is to say that if they are fire-induced the savannas must date from the time of man's arrival in the Americas, which Beard quotes as being between 10 000 and 25 000 years ago. The degree of specialisation in the savanna vegetation would appear to indicate that adaptation to fire has been taking place over a much longer period than this. Beard's contention that fire cannot occur naturally in broadleaved forest is contradicted by observation in Belize. Lightning fires are facilitated by periodic hurricane damage which results in a marked increment in fuel.

The presentation of savanna as purely an edaphic climax is weakened by the fact that in the Mountain Pine Ridge broadleaved species tend to invade on areas where fire protection has been effective for some years. Charter says that such invasion occurs only on sites where there has been erosion of the savanna soil to expose underlying limestone. Lamb (1966) mentions the predominance of oak over pine on the deeper beds of grit adjacent to the limestone and Charter's explanation may be relevant here although it clearly does not apply to most of the reserve. Luckhoff (1964) suggests that in the absence of fire much of the Mountain Pine Ridge would revert to some type of broadleaved forest; he considers that only in the higher lying parts have the soils become so impoverished that broadleaved forest could no longer be supported. He regards the savanna of the Mountain Pine Ridge, in common with most other *Pinus caribaea* savannas in Central America, as a fire disclimax although, like Beard, he ignores lightning as a cause of fire. Luckhoff's view of the tropical American pine savanna as a man-induced fire disclimax is shared by a number of authors. Among these, Munro (1966) describes from Nicaragua a fire-dependent succession from broadleaved forest to pine and, in the absence of fire because of fire protection, back to broadleaved forest.

In another upland Pine Ridge in Belize, near San Pastor in the Chiquibul Forest Reserve, there is a well defined pattern of vegetation related to topography and, at least partly, to water availability and drainage. Gently undulating hills are dissected by steep valleys, at the bottom of which rich broadleaved forest occurs, as it does in the Mountain Pine Ridge. Higher up the slopes and in depressions pure oak woodland occurs and over the gently sloping plateaux there is a sparse stocking of pine over dense *Tripsacum*. While the occurrence of broadleaved forest in the valley bottoms can be attributed, as in the Mountain Pine Ridge, to a generally more fertile soil, the marked tendency for even slight depressions to be occupied by oak woodland indicates that moisture availability is an important factor in its distribution. There is ample evidence of recent fire in the San Pastor Pine Ridge and in view of its location it is unlikely that this would be caused other than by lightning.

Clearly the ecological status of the vegetation in the Mountain Pine Ridge and of Tropical American savanna in general deserves further study. The savannas which contain pine are of interest for forestry.

The upland *Pinus caribaea* savannas of Central America include not only the Mountain Pine Ridge, the San Pastor Pine Ridge and other smaller areas of Pine Ridge in Belize but also the Poptún Pine Ridge of Guatemala, extensive areas of pine in the interior of the Honduras Republic and the pine woodland on the offshore island of Guanaja. These dissected uplands differ markedly from the lowland pine savannas in their topography and in related site characteristics. Lowland pine savanna occupies the Coastal Plain of Belize and the fairly level land along the Miskito Coast of Honduras and Nicaragua.

It is possible that the relative importance of soil and fire as factors in the establishment and maintenance of savanna may not be the same for both upland and coastal sites. It is noteworthy that Charter and Beard relate savanna development to soil largely in the context of flat plains. Whether or not the physical site characteristics of the coastal savannas are such that their existence can be satisfactorily explained in terms of soil, it seems probable that in the Mountain Pine Ridge and the other upland pine savannas, the balance between savanna and broadleaved forest is determined primarily by fire, caused naturally by lightning and also, since the arrival of man, by human agency.

Pathology of Pinus caribaea*

There are two pathogenic parasites which appear to be of some importance, namely the dwarf mistletoe *Arceuthobium globosum* and the cone rust *Cronartium conigenum.*

The dwarf mistletoe attacks trees of any age, particularly seedlings and saplings. The vigour and rate of growth of the host is reduced and the seed crop is also adversely affected (Boyce 1961). The host becomes predisposed to insect and fungal attack. This species of dwarf mistletoe is known to cause extensive damage to pine in western North America. The rate of spread of the organism is slow because of the short seed flight and may amount to only about 30 m (100 ft) in a century. Spread over longer distances by animal agency is probably rare. Control can be effected by the clear cutting of infection centres with peripheral cutting to control the spread of seed. A true mistletoe (*Psittacanthus* sp.) which occurs on pine has no pathological importance.

The other important parasite *Cronartium conigenum* is particularly prevalent at the middle elevations 600-750 m (2 000-2 500 ft) a.m.s.l. in the Mountain Pine Ridge. Etheridge (1968) reports that the number of trees bearing infected cones can be as high as 15-25% and that the number of infected cones per tree may average about 8%. The alternate hosts of *Cronartium* are species of oak. Control of the rust can therefore be effected by removing oak from pine stands. The seriousness of the disease is well established in the south east United States where it habitually destroys about 20% of the cone crop of slash pine (*P. elliottii*) (Mathews 1964).

The incidence of stem and butt decay is high in mature pine. Fire scars are the commonest site of infection. Williams (1965) records primary infection through fire scars by the fungus *Lentinus pallidus*, which causes cubical brown rot. Etheridge lists nine further species of wood-destroying fungi, isolated from pine in Belize, including two brown rot fungi (*Veluticeps berkleyi* and *Polyporus meliae*) which are pathogens of living forest trees elsewhere in North America and may be of some pathological significance in the Mountain Pine Ridge.

Etheridge records the occurrence of needle tip necrosis on exposed sites but this appears to be only a physiological reaction to exposure and not due to any other organism.

Insects which are harmful to pine are principally of two kinds, termites and bark beetles.

A recent study of termites in relation to pine is that made by Williams (1965). This was preceded by a more general study on termites in Belize by Harris (1959), who identified *Coptotermes niger* Snyder as the species found infesting standing mahogany and pine. Williams concentrated on this one species and found that infestation is always secondary to heartrot (caused definitely by *Lentinus pallidus* but probably also by other rot fungi) as the termite cannot satisfactorily penetrate or feed on sound heartwood. Thus termite infestation is most commonly associated with rot-infested fire scars. *C. niger* is normally present in the bark of mature trees, whether they are sound or not, where it forages for food. The inability of *C. niger* to initiate primary attack and the fact that secondary attack appears to add little to the damage done by the heartrot renders control unnecessary.

Scolytid bark beetles are a serious pest of Caribbean pine in Belize and in the neighbouring territories. According to Etheridge the most important species is probably *Dendroctonus frontalis* Zimm., although he records *Ips calligraphus* Germar as also causing fatalities. Ordish (1966) says there are probably two species of *Dendroctonus* responsible for serious damage in the neighbouring Honduras Republic, *D. mexicanus* and *D. mexicans*; one of these species may be identical with that named by Etheridge. The injurious effect of *Dendroctonus* beetle infestation is due to the fungus *Ceratocystis* sp. which the insect transmits. Fungal infection can not only prove fatal but also degrades the timber by staining the sapwood blue.

Heavy beetle infestations appear to occur periodically at fairly long intervals and may be induced by the presence of large areas of densely stocked stands of pine of low vigour. Such stands provide favourable breeding grounds for the beetle and are in effect 'thinned' by a Scolytid beetle infestation. Vigorous trees are able to resist attack by the normal reaction of resin exudation. Ordish suggests that the occurence of sudden epidemics, rather than a more moderate persistent level of infection, may be indicative of the immaturity of the association between the beetle and the fungus, which is neither symbiotic nor commensal.

* Although this chapter refers specifically to *Pinus caribaea* it is probable that some or all of the pests and diseases described may also affect *P. oocarpa.*

A heavy infestation of bark beetles in the Mountain Pine Ridge is recorded for the year 1939 (Belize Forest Department, 1940). Subsequent aerial reconnaissance indicated a mortality of at least 75%. During the years 1963-65 pine forests in the Honduras Republic were subjected to a very damaging *Dendroctonus* attack. Haider (1967) records the rate of destruction as being as high as 40% in some regions with almost total destruction in more restricted areas.

Prevention by means of good forest hygiene and adequate thinning is probably more effective than control. Insecticidal treatment is virtually precluded by cost and impracticability, as it has to be done from the ground. Biological control measures are still at an experimental stage.

A shoot borer *Rhyaconia frustrana* Comstock is recorded as affecting *Pinus caribaea* in Belize by Loock (1950) and Browne (1968) but its importance, if any, in the Mountain Pine Ridge is not known.

FAUNA*

From the infrequency with which the larger animals other than domestic livestock are sighted in the Mountain Pine Ridge, the impression is gained that the population of wild species is low. This impression may to some extent be due to the ready availability of surface water and ground cover over the whole area, which renders unnecessary the concentration of animals in restricted locales.

The most spectacular of the mammals are the larger members of the cat family, namely jaguar (*Felis onca*) and puma (*F. concolor*). These two species are predatory upon the cattle population which grazes in the reserve as well as upon other wild mammals and so are destroyed when possible. Two smaller species of cat, the ocelot (*F. pardalis*) and the tiger cat (*F. glaucula yucatanica*) also occur. The cats are not hunted commercially in the Mountain Pine Ridge.

Species of mammal hunted for meat in the reserve are deer (*Odocoileus truei*), armadillo (*Tatusia* spp.), gibnut (*Coelogenys paca*) and the wild pigs, peccary (*Dicotyles tajacu*) and warrie (*D. labiatus*).

Other mammals worthy of note are tapir (*Tapirella bairdi*), kinkajou (*Potos flavus*), quash (*Nasua nasica*), fox (*Urocyon cinereo argentus*), bush dog (*Galictis barbara*), various anteaters (*Tamandua* spp.) and opossums of the genera *Caluromys*, *Didelphis*, *Marmosa* and *Philander*. The bat population is numerous and varied and includes blood lapping species which prey upon domestic livestock. A number of species of rat occur, some or all of which harbour the disease Dermal Leishmaniasis.

Among the reptiles the crocodile (*Crocodylus* sp.) still occurs in the less accessible reaches of some of the larger streams but, althoug a protected species, its numbers have been severely reduced by illegal hunting because of the high value of the skin. There are numerous species of snake and lizard.

The bird population exhibits a particularly rich variety of species and includes a number of winter migrants from North America. The three largest species are the ocellated turkey (*Meliagris ocellata*), which is protected, and the curassow (*Crax rubra rubra*) and guan (*Penelope purpurascens purpurascens*), both of which are hunted for meat. A smaller game bird species, the chachalaca (*Ortalis vetula intermedia*) is locally abundant. Other conspicuous bird species include various parrots, the melodious blackbird (*Dives dives dives*) and the cattle egret (*Ardoela ibis ibis*). A number of hawks occur, of which the most commonly seen is the John Crow or turkey vulture (*Cathartes aura*).

Among insects deserving mention is the leaf cutting ant (*Atta* sp.) which defoliates a wide variety of plant species. The biting fly (*Simulium sp.*) is abundant in the Mountain Pine Ridge as it is elsewhere in the country. The reserve supports a large and varied population of butterflies and moths. A number of species of termite occur and are discussed by Williams (1965). The species *Coptotermes niger* is the most important in relation to pine. Scolytid beetles of the genera *Dendroctonus* and *Ips* occur and, together with termites, are discussed elsewhere.

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* The notes on fauna given here are based largely upon the authors' own observations and impressions and are not intended to be regarded as authoritative. The principal source of specific names referred to in writing these notes is Wright *et al.* (1959).

HUMAN ASPECTS

HISTORY

Little or nothing is known of the history of the Mountain Pine Ridge before the middle of this century. There is no evidence of occupation or cultivation during the period of the Maya civilisation in the region (300-600 A.D.) although it is likely that the promimity of Maya centres on the nearby limestone may have had some effect on the area. It is probable for example that fires lit for agricultural purposes would have spread on to the pine savannas just as they have done in more recent times.

Hooper (1887) records a visit to a portion of the Great Southern Pine Ridge at about thirty miles south of the Cayo and this appears to be the earliest written reference to the area which later came to be known as the Mountain Pine Ridge. Remarkably, Hummel (1921) in a report which was regarded as the standard work on the forests of Belize, makes no specific reference to the area. Logging of the Chiquibul Forest to the south was already in progress in the 1920s and the trail through Augustine to the Guacamallo crossing of the Macal was one of the prmncipal access routes. A trail from San Antonio to Augustine, which is now in disuse, is shown on maps produced during the 1930s.

The Mountain Pine Ridge was gazetted a Forest Reserve in 1944 and given the classification of protection forest. Fire protection was introduced the following year and was by purely manual methods, except for the use of mules, until 1948 when a minimal amount of mechanical equipment was provided. Practically the whole area was burned in 1949, demonstrating the inadequacy of the organisation as it then stood. According to a brief report on the history of forestry in Belize (Belize Forest Department), most of the older pine of the new generation dates from 1949.

With the acquisition of more mechanical equipment during the 1950s an impressive programme of road building got under way and the area effectively under fire control was increased at the rate of 1 200 ha (3 000 ac) per year. In 1952 the Reserve was reclassified a production forest. In 1954 an airstrip was constructed at Augustine and in the same year improvements made to the main Augustine-Cayo road were such that the truck extraction of lumber from the two sawmills operating in the Reserve became possible throughout the year for the first time. This road was pushed right through to Guacamallo on the Macal in 1956.

Between 1948 and 1961 five fire lookout towers were constructed, of which four remain in use, and in 1956 a telephone network was installed for communication between lookout towers and Augustine. Although it was maintained and expanded in the following years, the telephone system had the disadvantage that it was easily put out of action by lightning.

It is probably true to say that the work done in the 1950s in the Mountain Pine Ridge in road construction, fire protection and the creation of Augustine Forest Station, marks the zenith of the Forest Department's achievement over the years.

While the advances made in the fire protection of the Mountain Pine Ridge have been well chronicled in the Forest Department's annual reports, the history of other aspects of the management of the Reserve is less adequately recorded. An enumeration of the granite basin was carried out in 1953 (Williamson and Wolffsohn, 1953) and in 1955 the first long-term felling licence was issued. In 1956 a Working Plan was drawn up for the whole Reserve.

During the 1950s there were a number of revisions made of the area included in the Reserve, these being the consequence of progressively more accurate mapping. In 1959 the Reserve boundary was completely redefined in accordance with recommendations made by Wright *et al.* (1959) and the area of the Reserve was given as 46 571 ha (113 588 ac).

As the management of the Mountain Pine Ridge consisted essentially of giving fire protection to the natural regeneration and because the necessary road-building had been largely completed, the Reserve suffered less than other parts of the forest estate from the implementation of Downie's recommendation in 1959 that the budget allocation of the Forest Department should be halved (Downie, 1959).

The impact of the Downie Report was overshadowed in 1961 by hurricane Hattie. Fifteen per cent of the mature pine in the central part of the Mountain Pine Ridge was estimated to be windthrown and, on the more outlying slopes, windthrow was as high as 90% (Belize Forest Department, 1962). Crown damage to pine was severe throughout the Reserve and included the destruction of potential seed crops. Broadleaved species, especially oak, suffered more than pine. Damage to young pine regeneration was negligible.

The greatly increased fire danger posed by the debris from hurricane Hattie was recognised by the Forest Department and, following recommendations made by an adviser from the Forest Research Department at Ottawa, steps were taken to improve the Department's fire control capability. The most important of the recommendations in relation to the Mountain Pine Ridge concerned the greater use of radio telephones and the acquisition of more and better fire-fighting equipment. Radios had been introduced to the Mountain Pine Ridge on a small scale (three sets) in 1961 before the hurricane and, by 1962, a complete network was established linking the Mountain Pine Ridge to the headquarters in Belize City and to other forest stations. During the next few years the radio network was progressively strengthened and the stock of mechanical equipment increased.

In 1965 a 23% enumeration of the mature growing stock was undertaken. The area enumerated was roughly the same as that covered in the present study. The detailed results of this enumeration were not produced. The Annual Report for 1966 records a change of emphasis from engineering (i.e. road construction) to silviculture and management (Belize Forest Department, 1967).

The use of the Mountain Pine Ridge for the grazing of cattle dates back at least to the 1920s. Dunlop (1921) records that cattle used for timber extraction in the adjacent hardwood forests were grazed on the Mountain Pine Ridge. He also mentions plans for grazing beef cattle in the area. The 1949 Annual Report records the fact that cattle on the pine savannas in the Mountain Pine Ridge were observed to suffer less in that year from the effects of drought than those in the Belize Valley (Belize Forest Department, 1952). Several owners were at that time sending cattle to the Reserve for grazing. In 1949 the Commonwealth Development Corporation started negotiations for the development of cattle-raising in the Mountain Pine Ridge. They in fact started a cattle/sheep operation but it soon failed and was abandoned. The present cattle operation was built up during the 1960s.

POPULATION

Population figures for the Mountain Pine Ridge are given in Table 8.

Although census figures for earlier years are not available it is certain that the population of the Mountain Pine Ridge is declining. There is a tendency for families to move their homes to San Ignacio and Santa Elena, leaving the head of the household to commute to his place of work in the Mountain Pine Ridge on a fortnightly basis. This tendency is indicated in the figures given in the table by the marked imbalance between the numbers of males and females recorded.

TABLE 8 Provisional figures from the 1970 population census for settlements in the Mountain Pine Ridge

Settlement	Total	Males	Females	Households
Augustine	223	149	74	49
San Luis	143	102	41	56
Total	366	251	115	105

Source: Belize Ministry of Finance and Economic Development

PAST FOREST MANAGEMENT: 1956 WORKING PLAN

The Mountain Pine Ridge was not subject to management according to a recognised plan prior to 1956. The only form of management in the early years of the reserve was fire protection. In 1956 a Working Plan was drawn up (Wolffsohn, 1956) for both the Mountain Pine Ridge and the Chiquibul Forest Reserves to apply during the following decade. In 1960 the Plan was amended (Wolffsohn, 1960) to take into account the reduction in expenditure following recommendations made by Downie (1959). The amended Plan was to remain current for the remainder of the original Working Plan period, i.e. until 1965.

The Plan defined a Pine Working Circle comprising three felling series. Of these the Western Felling Series was the most important and accounts for most of the present project area. Exploitation in the Pine Working Circle was to be by selection and subject to a minimum girth limit of 107 cm (42 in). This size limit was taken to represent a production period of 45 years.

Western Felling Series

Prescriptions for the management and exploitation of the Western Felling Series were based upon the results of the 1953 enumeration of the mature growing stock in the granite basin (Williamson and Wolffsohn, 1953). The 1953 enumeration area and the Western Felling Series approximately coincide.

From the enumeration, which covered an area of 14 260 ha (35 240 ac), it was estimated that the standing volume of pine of exploitable size (i.e. girth 107 cm, 42 in) was 87 800 m^3 (3 099 000 ft^3). This is equivalent to a mean stocking of 6.2 m^3/ha (88 ft^3/ac) and, in terms of stem numbers, represented a density of 6.4 trees/ha (2.6 trees/ac).

The area of the Western Felling Series was given as 13 160 ha (32 500 ac). A 15-year felling cycle was prescribed and a sustained annual yield of 1 360 000 bdft (6 200 m^3, 217 600 ft^3)* was forecast, this being the rate of cutting necessary to remove within the first felling cycle the total standing volume of exploitable timber indicated by the 1953 enumeration. The prescribed cut required the exploitation of a total area of about 1 000 ha (2 500 ac) per annum, this to be made up of coupes to be defined annually.

The long-term aim of management was stated to be the conversion, by the end of the first rotation, from a selection system to a uniform system of clear-felling with the retention of seed-bearers. The more immediate aim of management was to improve stocking by progressively increasing the area of fire-protected regeneration. Each annual coupe was to be surrounded by a road, control-burnt and then exploited. After exploitation it then became part of the floating regeneration block and was to be kept under intensive fire protection. Once the regeneration reached a stage at which it was capable of withstanding a cool fire it was to be control-burnt. Controlled burning was thereafter to be repeated at intervals of three to four years. According to the initial 1956 Plan the regeneration block was to include compartments up to the point where they were considered to be capable of withstanding an uncontrolled fire, at which point controlled burning would be discontinued. The attainment of this stage was taken to require a growing period of eight years. With an annual coupe of 1 000 ha (2 500 ac) and a regeneration period of eight years, the regeneration block was to amount to a total of 8 100 ha (20 000 ac). In the later revision of the Plan, a compartment was to be considered part of the regeneration block until it received its first thinning. Controlled burning was prescribed on a continuing basis and after the commencement of thinning it was to be carried out on a cycle coinciding with that of the thinning.

Along the outer perimeter of the Western Felling Series, a 400 m (0.25 mi) strip was to be burnt annually to prevent the spread of fire into the area from the adjoining Pine Ridge.

Northern Felling Series

The area was given as 9 200 ha (22 800 ac) and included the steep poorly stocked area to the north and east of the granite basin. According to the original version of the Working Plan exploitation was to be on an indeterminate cycle and to be subject to a girth limit of 157 cm (62 in) but in the later revision of the Plan this limit was given as 107 cm (42 in). In the revised Plan of 1960, a small part of the Northern Felling Series, known as the little granite basin, was transferred to the Western Felling Series.

A maximum of 2 000 trees was to be cut in any one year on a selection system. The 1956 Plan included mention of the amenities afforded by the area, distinct from timber production, notably those making the area suitable for recreation. Much of the Northern Felling Series is outside the project area.

Southern Felling Series

The area was given as 30 500 ha (75 370 ac) and included the steep, fairly well regenerated part of the Reserve bordering the Macal River and some areas of Pine Ridge outside the Mountain Pine Ridge Forest Reserve. This felling series was considered to be doubtfully economic because of its topography. Exploitation, if carried out, was to be by selection and subject to a girth limit of 107 cm (42 in). Provision was made for part of the Southern Felling Series to be included if necessary in the regeneration block of the Western Felling Series and to be subjected

* Conversions based on FAO roundwood conversion factor: 1 000 bdft = 4.53 m^3 (Forestry Commission, 1960).

to controlled burning. In the 1960 revision of the Plan a tentative estimate of forecast yield from the Southern Felling Series was given as 2 800 m^3 (100 000 ft^3) per annum or 2 500 trees. Exploitation was to be by systematic coupes.

Effectiveness of the 1956 Working Plan

Progress made during the early years of the Working Plan period towards the most immediate object of management - fire protection - was considerable and has already been described. Certain other prescriptions made in the Plan proved to be overoptimistic, notably those concerned with the question of forecast yield and, of comparatively less importance, those relating to the silvicultural use of fire.

The replacement stocking upon which maintenance of the forecast yield depended proved inadequate for the level of exploitation which was maintained during the years 1955-70. Depletion of the mature growing stock was accelerated by the occurrence in 1961 of hurricane Hattie. The greatly increased outturn of lumber associated with salvage cutting in the years following the hurricane can be seen from the statement of sawn lumber production given in Table 9. In 1965 the felling licence first issued in 1955 was renewed and its terms modified to restrict felling to 'old growth' trees without size limit, as it had become clear that the growing stock had been overcut. Pine sawmilling operations ceased in 1971 because the supply of commercially exploitable timber was exhausted.

The prescriptions relating to the use of controlled fire as a silvicultural measure were never seriously put into effect. Early difficulties experienced in controlling fires, once started, led to a policy of complete fire prevention. The result of this policy has been the marked development of broadleaved woodland over much of the reserve. This type of woodland could in time replace the Pine Ridge. An added complication is the role played by the oak species as secondary host to the cone rust *Cronartium conigenum*. Oak is therefore removed by hand-cutting which is time-consuming and expensive as well as being only short-term in its effect.

Exploitation: Timber Production

Exploitation of the reserve commenced on a serious scale in 1955. Since that year there has been only one major long-term licensee although substantial quantities of lumber were produced by a second licensee during the period 1959-67. Table 9 shows the amount of sawn lumber produced from the Mountain Pine Ridge since 1955. It is clear from the table that the early 1960s were the years of highest production and it was during these early years that the larger-sized material was cut. By the end of the decade, small-sized logs only were entering the mill. The small log size and the declining overall volume available rendered the operation progressively less economic until logging operations ceased in 1971.

It can be seen from Table 9 that production has been mainly from pine but that other species have been exploited in small quantities. The other species cut are principally secondary hardwoods but include also the two primary species, mahogany and cedar. Nargusta is important among the secondary hardwoods, which also include cypress, billy webb and yemeri.

Pine lumber is produced also from thinnings and Table 10 shows the volume cut during the years 1967-70, for which period records are available.

Exploitation: Seed Production

The Mountain Pine Ridge has been a major source of seed of *Pinus caribaea* for which there is a high export demand. The amount of seed collected has fluctuated widely. Production increased from about 90 kg (200 lb) per annum in the early 1950s to 700-900 kg (1 500 - 2 000 lb) per annum in the late 1950s and in 1961. The severe hurricane of 1961 destroyed the 1962 crop and appreciably damaged the 1963 crop. Production recovered to some extent in the mid 1960s and in 1965 370 kg (815 lb) was collected. Since that year seed production has been considerably reduced, with the removal of most of the larger trees, and current levels of production are low.

TABLE 9 Lumber production 1955-70*

Year	Pine: Sawnwood '000 bdft	Pine: Roundwood equivalent m^3	Pine: Roundwood equivalent ft^3	Primary hardwoods†: Sawnwood '000 bdft	Primary hardwoods†: Roundwood equivalent m^3	Primary hardwoods†: Roundwood equivalent ft^3	Secondary hardwoods†: Sawnwood '000 bdft	Secondary hardwoods†: Roundwood equivalent m^3	Secondary hardwoods†: Roundwood equivalent ft^3
1955	1 137	4 500	159 200						
1956/7	1 214	4 810	170 000						
1958	1 070	4 240	149 800						
1959	1 269	5 030	177 700						
1960	1 471	5 830	206 000						
1961	2 555	10 120	357 700				18	70	2 500
1962	4 689	18 570	656 500						
1963	4 412	17 470	617 700				80	320	11 200
1964	3 970	15 720	555 800				358	1 420	50 100
1965	2 617	10 360	366 400	16	60	2 200	848	3 360	118 700
1966	2 224	8 810	311 400	11	40	1 500	471	1 870	65 900
1967	2 152	8 520	301 300	4	20	600	166	660	23 200
1968	2 157	8 540	302 000				69	270	9 700
1969	1 756	6 950	245 800				179	710	25 100
1970	1 278	5 060	178 900	18	70	2 500	316	1 250	44 200
Total	33 971	134 530	4 756 000	49	190	6 800	2 505	9 930	350 600

* Roundwood equivalents based on FAO conversion factor: 1 000 bdft = 3.96 m^3 (Forestry Commission, 1960)

† The absence of data in some years indicates 'no recorded production'

Source: Belize Forest Department

TABLE 10 Pine lumber production from thinnings, 1967-70*

Year	Sawnwood '000 bdft	Roundwood equivalent m^3	Roundwood equivalent ft^3
1967	91	360	12 700
1968	121	480	16 900
1969	143	570	20 000
1970	128	510	17 900
Total	483	1 920	67 500

* Roundwood equivalents based on FAO conversion factor: 1 000 bdft = 3.96 m^3 (Forestry Commission, 1960)

Source: Belize Forest Department

LAND TENURE

The project area is in the Mountain Pine Ridge Forest Reserve, which is Crown land and is managed as a part of the Belize Forest Department's Western Division. Local administration of the Reserve is carried out from the Department's divisional headquarters at Augustine.

CURRENT LAND USE

The Mountain Pine Ridge is subject to and is managed for multiple land use. Five land uses can be identified, all compatible with each other at present levels of use and all spatially integrated. The two most important uses are timber production and in-forest grazing of cattle. The other uses are public recreation, armed forces training and biological field studies. Timber production is the subject of much of the rest of this report and descriptions only of the four other land uses are given here.

In-forest Grazing

One third of the Reserve, an area of about 12 000 ha (30 000 ac), is licensed as a cattle range. The present and probably final stocking of cattle is of the order of 4 000 head. The animals range freely throughout the inventory area but are discouraged from straying outside the granite basin by the poverty of the pasture and the steepness of the terrain on the surrounding hills. It was originally intended (Belize Forest Department, 1966) that the mean stocking rate should be less than 1 head per 4 ha (10 ac), but the current level of stocking exceeds that figure. Because of the tendency for cattle to congregate in certain attractive localities, the stocking level is in fact very variable but can in some parts of the Reserve be considerably higher than the figure quoted above.

The stock in the Mountain Pine Ridge are breeding stock - Brahmin bulls and various breeds of cow which produce calves for fattening on two lowland farms which are part of the overall enterprise. The cattle operation has been costly to establish but the degree of success achieved to date has been disappointing because of low calving rates which partially reflect the low plane of nutrition afforded by the Pine Ridge pastures.

The grass sward in the Reserve appears to be getting poorer as a result of cattle grazing. The frequency of palatable species, especially that of dumb cane grass (*Tripsacum latifoloim*), has declined markedly since the commencement of grazing on a large scale and there is severe trampling in some seasonally wet areas (Hunt, 1970; Lamb, 1966). The decline in the frequency of *Tripsacum* and of some other formerly dense-growing species has been a distinct advantage from the point of view of reducing fire hazard.

Public Recreation

The Mountain Pine Ridge is acknowledged to be both scenically and climatically the most attractive part of the mainland of the country. Recreational demand in the Reserve has in the past been low, at least partly because of the difficulty of getting to the area from Belize City. Day visits to the area from Belize City or from any town other than San Ignacio have been virtually out of the question because of the time and distance involved. Local demand for prolonged visits is limited for various reasons, not least because of cost. With the relative promimity of the new capital Belmopan, with its growing population, the demand for reacreation in the Mountain Pine Ridge can be expected to increase.

There is currently one small hotel operating in the Reserve, catering principally for tourists from overseas, and situated near the Privassion airstrip. Demand for the services provided by this hotel, both locally and from overseas visitors, appears to be poor. Relatively cheap accommodation is provided by the Forest Department at Augustine and the accommodation here is frequently fully occupied, especially on holiday weekends. The Forest Department have built Canadian pattern picnic shelters in the area, one near Augustine and the other just outside the Reserve boundary; no charge is made for the use of these facilities.

Despite the attractions of the Mountain Pine Ridge, its recreational use seems likely to remain largely locally based. Tourists from overseas are likely to want rather more than the Mountain Pine Ridge has to offer at present. Probably the only way of developing the use of the Mountain Pine Ridge by tourists would be to include a visit to the area as merely one part of a more varied programme, that is to make the Mountain Pine Ridge a recognised stopover point in Central American holiday tours. To do this will require a degree of organisation and cooperation between the various interests concerned not yet achieved. Any marked increase in recreational use would conflict with other uses, particularly with timber production. The greater the number of people in the Reserve, the greater the risk of fire arising through human agency. However, as Cate (1963) and others have shown, the considerable experience of forest management for multiple use in the United States has demonstrated that public recreation and the fire protection of productive forest need not be incompatible.

Biological Field Studies

The rich variety of animal and plant species in the Mountain Pine Ridge, coupled with its pleasant climate and good internal road communications, make the area particularly suitable for field studies in the biological sciences. Demand to date has tended to be on a small scale, largely from academic institutions in the United States. Substantially increased demand both from this source and locally is foreseeable. Plans for the development of Augustine into a recognised field centre, with the construction of appropriate facilities, have been put forward by interested parties, but the execution of such plans would depend largely on the attitude of other land users in the area, notably the Forest Department.

Armed Forces Training

The Mountain Pine Ridge is regularly used as a training area. Conflict with the forestry use of the Reserve arises because of fire risk. The army has come to be recognised as an important cause of fire because in the past fires have resulted from the use of explosives such as signal flares and also from the careless use of cigarettes. Firing practice is restricted to an area of pine savanna outside the Reserve and the impact area is burnt annually to prevent the accumulation of fuel as fires starting in the impact area could easily spread into the Reserve.

COMMUNICATIONS

Road communications between the Mountain Pine Ridge and the rest of the country are poor, there being only one all-weather road link between the Reserve and the Western Highway. The quality of much of this road is low and in wet weather it can become impassable to all except four-wheel drive vehicles. Road communications inside the Reserve are good, an adequate network of good-quality graded earth roads having been built up over the years for the purpose of fire protection. Within the Reserve the roads remain passable to four-wheel drive vehicles throughout the year.

Two airstrips are operational in the Reserve, one at Augustine and one at Privassion about 20 km (12 mi) north of Augustine. Both of these are usable by light aircraft. To date, the Mountain Pine Ridge has not been included in any of the scheduled flights operating in the country. There is a third disused airstrip a few miles south of San Luis.

VHF radio communication between the Forest Office at Augustine and the other Forest Department offices in Belize City and Belmopan and the divisional offices is maintained via a relay station at Cooma Cairn. Radio communication with other parts of the country is also possible via the police network, through the police relay station on Sibun Hill.

MARKETS

Markets for pine lumber are now exclusively local, although in the past considerable quantities have been exported, notably to Jamaica. Sawn pine lumber is currently (May 1971) sold at a government controlled price of 17 cents per bdft or \$72 per m^3, \$2 per ft^3 (\$BH1 = £0.25). With the closing down of the only commercial sawmill in the Mountain Pine Ridge in 1971, the only lumber sold from the Reserve now is from thinnings cut and converted by the Forest Department. This lumber is disposed of in Belize City.

Pine seed has in the past been exported to a number of territories. The demand for seed remains high and in excess of the quantity which can be supplied.

PART 4. OBJECTIVES AND METHODS

OBJECTIVES

The broad objective of the forest inventory was to quantify the growing stock of pine in the project area. The type of information to be collected and the subsequent treatment of the data were governed by the immaturity of the forest and by considerations of management and possible utilisation. The detailed objectives are defined as follows:

1. Estimation of the standing volume of pine.

   i. To estimate the standing volume of pine in each of the 34 management blocks and in the project areas as a whole. Initially it was agreed that 25.4 cm (10 in) d.b.h. be chosen as the minimum size of growing stock to be included. The precision of estimate required was ± 20% sampling error. It became apparent that very little of the 'young growth' pine was over 25.4 cm (10 in) d.b.h. and that only very imprecise estimates of volumes over that size could be achieved within the budget and time available using the relsakop sampling technique already embarked upon. For this reason and because there was the possibility of using sizes smaller than 25.4 cm (10 in) d.b.h. for pulping it was decided to quote in addition volume estimates for material over 7.5 cm (3 in) d.b.h. and over 15.2 cm (6 in) d.b.h.

   ii. To show by means of stand tables the size class distribution for each of the 34 management blocks and for the project area as a whole.

2. Assessment of pine regeneration. To assess the amount of pine regeneration by number of stems, classified by height. Regeneration was taken to comprise stems of d.b.h. < 5 cm (2 in). The precision of estimates required was ± 20%.

3. Construction of pine volume table. To construct a single variable local volume table for both *Pinus caribaea* and *P. oocarpa*. Data for this table were to be collected as far as possible only from 'young growth' trees.

4. To produce by air photo interpretation a map of the project area showing the distribution of pine forest and pine regeneration according to a canopy density classification. The map was required both for planning the field sampling and for subsequent management.

SAMPLING STRATA

The project area was divided into 34 management blocks, each of which was treated separately. Vegetation type mapping was done by stereoscopic examination of air photographs of scale 1:10 000 for the northern half and 1:20 000 for the southern half. Nine forest/vegetation types were recognised and mapped and four of these types were sampled for timber stocking and regeneration. Three of the sampling strata were pine forest types between which distinction was made on the basis of canopy density as seen on air photographs. The fourth type sampled was grassland with small pine regeneration. Table 11 shows the nine types mapped and the characteristics by which they are differentiated.

TABLE 11 Forest/vegetation types identified and mapped

Forest/vegetation type		Distinguishing features
1.	Pine forest	
	1.1*	Canopy closure % (more than 70
	1.2*	Canopy closure % (40-70
	1.3*	Canopy closure % (less than 40
2.	Broadleaved forest	
	2.1	Without pine
	2.2	Mixed pine/broadleaved forest
3.	Grassland	
	3.1	Without pine
	3.2*	With pine seedlings
4.	Swamp	
	4.1	Palmetto
	4.2	Grass

* Types sampled

RELASKOP MEASUREMENTS

Sampling of the three pine forest types and of type 3.2 was done by point sampling with the standard metric Bitterlich Spiegel Relaskop. Sample points were randomly distributed in each of the four types in each of the 34 management blocks. A total of approximately 30 sample points was used in each block for type 1.1, 50 for types 1.2 and 1.3 and 10 for types 3.2. Trees of d.b.h. 5 cm (2 in) or more, and of all species, were included in the relaskop count; their diameters were measured by caliper and recorded to the nearest mm as the mean of two measurements taken at right angles. The total height of the tallest pine trees counted was measured by relaskop to the nearest 0.5 m (1.5 ft) and recorded. Pines judged to be mature and overmature were recorded as 'old growth' on the field records. They were recognised on the basis of crown and bark characteristics.

REGENERATION COUNT

Regeneration of trees of less than 5 cm (2 in) d.b.h. was sampled by circular plots each of area 0.01 ha (0.025 ac) centred on the randomly distributed relaskop points. Stems falling within a plot were recorded and classified according to height. Three height classes were recognised: 0-1.5 m (0-5 ft), 1.5-3 m (5-10 ft) and more than 3 m (10 ft). Sampling of type 3.2, grassland with pine regeneration, was done by randomly distributed clusters of circular 0.01 ha (0.025 ac) plots. Each cluster contained 10 such plots and so had a total area of 0.10 ha. Data were collected in the same way as for the other pine vegetation types.

VOLUMETRIC MEASUREMENTS

Quantitative data for the construction of a volume table were collected from 187 randomly selected trees of both *Pinus caribaea* and *P. oocarpa*. Measurements were made of a sample of approximately 20 trees in each 5 cm (2 in) diameter class up to 55 cm (22 in) and the parameters measured were as follows: diameter at breast height, butt diameter (defined as diameter 15 cm, 6 in above ground), top diameter (defined as 10.8 cm, 4.3 in overbark), mid-point diameter, height to top diameter and total height. Diameter measurements were made to the nearest millimetre (0.04 in), each measurement being taken both under and overbark, and recorded as the mean of two measurements taken at right angles. Height measurements were taken to the nearest centimetre (0.4 in).

OTHER OBSERVATIONS

In addition to the quantitative sampling data collected at each sample point, a number of other observations were also recorded, namely stand condition, degree of canopy closure, situation, slope, aspect, drainage, underlying rock and vegetation type.

PART 5. RESULTS OF THE INVENTORY

FOREST/VEGETATION TYPES

The distribution of the forest/vegetation types is shown on the map which accompanies this report. The area of each type in each of the 34 management blocks and in the project area as a whole is shown in Table 12. The 34 management blocks are numbered from 2 to 35.

STAND TABLES

Stem numbers per unit area for a single d.b.h. class are derived from relaskop counts by the formula N = T/g

where N = number of stems per ha
T = counting factor (i.e. 1 or ¼)
g = basal area in m^2 of 1 tree

Stand tables showing mean numbers of stems per unit area (unqualified by estimates of precision) for each of the three* forest/vegetation types in each management block separately are given in Table 13. Stand tables for each of the three pine forest types over the project area as a whole are given in Table 14. The stem numbers given in Table 14 are also mean values; they are based on the figures given in Table 13 and are weighted according to the area of each type in each block. Figures 5-7 are stem number curves which illustrate graphically for each forest type the size class distribution shown in Table 14.

The d.b.h. classes shown in the stand tables each have a range of 5 cm (2 in). The smallest complete class for which figures are given is the 10 cm (3.9 in) class, which extends from 7.6 cm (3.0 in) to 12.5 cm (4.9 in). Stems of d.b.h. 5.0 - 7.5 cm (2-3 in) are shown separately and are also included in the summary columns of both tables.

The 15 cm (5.9 in) d.b.h. class is subdivided to show the number of stems of d.b.h. equal to and above 15.2 cm (6.0 in). The 25 cm (9.8 in) d.b.h. class is subdivided to show the number of stems of d.b.h. 25.4 cm (10.0 in) and above. These subdivisions are necessary in order to group the growing stock into the three size categories which are required for standing volume (described below) and are included in the summary columns of Tables 13 and 14. The two diameters which divide the three size categories are also shown in the stem number curves.

A stand table for 'old growth' pine alone is given in Appendix 5 (Table 23).

STANDING VOLUME

Volume figures are presented for three size categories of growing stock, as described in Part 4, divided according to diameter breast height as follows:

1. d.b.h. 7.6 cm (3.0 in) and above
2. d.b.h. 15.2 cm (6.0 in) and above
3. d.b.h. 25.4 cm (10.0 in) and above

Table 15 shows the mean stocking of each of three* pine forest types in each management block. These figures are derived by converting stem numbers per unit area into volume per unit area by use of the local volume table for pine (Table 19). Volume figures are added for each management block and converted to gross volumes in Table 16.

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* Although sampling by relaskop was done in four forest vegetation types as described in Part 4, stand tables and volume figures relating to total growing stock are presented for only three. Rates of stocking for material of d.b.h. 5 cm (2 in) and above in type 3.2 (grassland with pine seedlings) is negligible and and stem number distributions and standing volumes were calculated for this type only for 'old growth'.

The reliable minimum estimates quoted in Table 15 and used to derive those given in Table 16 are based on estimates of precision at the probability level of 95%. An example of the calculation involved is shown in Appendix 2.

Table 17 shows the weighted mean volume of pine per unit area in each of the three pine forest types, taking the 34 management blocks as a whole. Minimum estimates are based on estimates of precision at 95% probability. The method of calculation is illustrated in Appendix 3.

Table 18 shows the gross volume in each of the 34 management blocks and in the whole project area. The minimum estimates given in Table 18 are based on the estimates of precision used for Table 17. Estimates of precision are valid only if variances of the 34 samples are homogeneous. Use of the simple F max test of variance homogeneity described by Sokal and Rohlf (1969) indicates that the Mountain Pine Ridge sample variances do not meet the requirement of homogeneity. The minimum estimates given in Tables 17 and 18 must therefore be regarded with caution as they may be over-optimistic. Sampling errors and hence the disparity between means and minimum estimates are appreciably reduced by combining the results of all the samples, as can be seen from a comparison of Tables 15 and 17.

It follows that the summed minimum estimates for the whole project area shown in Table 18 are substantially higher than those given in Table 16. The differences between the gross volume figures of the two tables (and a small proportion of the differences in minimum estimates) is due to the inclusion in Table 18 of estimates for unsampled areas for which volume figures are excluded from Table 16. The area figures quoted in Tables 16 and 18 are not comparable. Those in Table 16 are total block areas and include all types of land. Those in Table 14 refer only to pine forest.

Despite the shortcomings mentioned it is considered that as the total number (i.e. 34) of management blocks for which results are being combined is fairly high, the minimum estimates quoted in Table 17 and 18 have some practical value, especially for the smaller-sized growing stock. The values obtained by summing reliable minimum estimates for each block, in Table 16, are almost certainly very much lower than the actual standing stocking of the project area.

It can be seen from Table 15 that in two management blocks (numbers 18 and 28), one forest type out of the three was omitted from the sampling. In Table 18 an estimate of the volume on the two unsampled areas has been included, as already stated, based on the forest type means given in Table 17.

Volume figures for 'old growth' pine alone are given in Appendix 5 (Tables 24 and 25).

VOLUME TABLE

The local volume table for *Pinus caribaea* and *P. oocarpa* given in Table 19 is produced from a linear regression of sample tree volume against overbark diameter at breast height. Confidence limits quoted are at 95% probability. The computation of the volume table data was done at the Commonwealth Forestry Institute, Oxford. The volume of each sample tree was calculated by Newton's formula:

$$V = (a + 4b + C) / 6$$

where V = stem volume
L = stem length from butt (15 cm, 5.9 in above ground) to top height
a = cross-sectional area at top height
b = cross-sectional area at middle
c = cross-sectional area at base.

Stem volume and the dimensions from which it is calculated are all underbark.

REGENERATION

Mean stocking rates for each of the four forest vegetation types sampled in each of the 34 management blocks are shown in Table 20, together with reliable minimum estimates. The latter are derived from estimates of precision at 95% probability calculated in the same way as for volumes, illustrated in Appendix 2.

The regeneration figures in Table 19 are for *Pinus caribaea* and *P. oocarpa* combined. In most of the 34 management blocks regeneration is largely or exclusively of *P. caribaea*. Results for five blocks in which there is a significant proportion of *P. oocarpa* are shown separately for the two species in Table 21 and 22.

TABLE 12 Area statement* showing composition and total areas of 34 management blocks

Block	Forest/vegetation type																		Other		Total	
	Pine forest						Broadleaved forest				Grassland				Swamp							
	1.1		1.2		1.3		2.1		2.2		3.1		3.2		4.1		4.2					
	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac
2	300	740	159	393	111	273	20	50	0	0	0	0	106	262	0	0	0	0	7	17	702	1 735
3	245	606	302	746	126	310	75	185	21	51	0	0	52	128	0	0	0	0	1	3	821	2 029
4	219	540	264	653	275	679	14	34	0	0	1	3	29	70	1	3	0	0	2	4	803	1 988
5	226	557	213	525	328	811	4	10	0	0	0	0	0	0	22	55	0	0	0	0	793	1 959
6	170	420	319	788	289	714	3	7	0	0	0	0	8	21	0	0	0	0	0	0	789	1 949
7	140	345	407	1 006	169	418	2	4	0	0	0	0	11	28	0	0	0	0	0	0	729	1 802
8	66	164	257	634	546	1 349	2	5	0	0	0	0	74	182	1	2	0	0	0	0	945	2 336
9	19	48	185	456	215	532	18	44	6	14	0	0	153	378	8	21	0	0	0	0	604	1 492
10	211	522	358	885	169	418	0	0	0	0	0	0	130	320	0	0	0	0	0	0	868	2 144
11	100	246	92	228	207	512	0	0	0	0	0	0	105	259	0	0	0	0	0	0	504	1 244
12	107	265	146	361	136	336	1	3	0	0	0	0	299	739	0	0	0	0	12	30	701	1 733
13	178	439	159	393	153	378	8	20	0	0	0	0	368	909	1	2	0	0	0	0	867	2 141
14	90	222	280	692	360	890	0	0	0	0	0	0	80	198	1	2	0	0	0	0	811	2 005
15	58	142	173	428	123	303	98	242	0	0	0	0	117	288	19	46	0	0	13	32	600	1 482
16	135	333	209	516	132	325	91	226	0	0	0	0	9	22	4	9	0	0	0	0	579	1 430
17	91	224	165	407	110	272	81	200	0	0	2	4	38	93	0	0	0	0	0	0	486	1 201
18	134	332	103	255	167	412	5	12	0	0	0	0	195	482	4	11	4	10	0	0	613	1 515
19	90	223	152	376	268	662	54	133	86	212	0	0	41	102	0	0	2	6	1	3	695	1 716
20	152	375	218	539	114	282	10	24	16	38	0	0	24	59	18	44	0	0	0	0	552	1 362

* Figures have been rounded to whole numbers after conversion from imperial to metric units. This accounts for some apparent anomalies in conversion of small areas

TABLE 12 (Continued)

Block	Forest/vegetation type																				Other		Total	
	Pine forest						Broadleaved forest				Grassland				Swamp									
	1.1		1.2		1.3		2.1		2.2		3.1		3.2		4.1		4.2							
	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac	ha	ac		
21	134	331	139	343	139	342	70	174	26	65	0	0	64	159	29	71	0	0	0	0	601	1 484		
22	65	160	227	562	135	332	106	261	0	0	0	0	0	0	2	5	6	14	0	0	540	1 335		
23	71	176	193	476	43	106	24	60	0	0	0	0	0	0	0	0	8	20	0	0	340	839		
24	201	496	180	445	196	483	54	134	0	0	12	30	14	34	50	123	1	2	0	0	707	1 746		
25	156	386	142	352	80	198	0	0	4	10	0	0	76	188	0	0	2	4	0	0	460	1 138		
26	316	781	355	877	320	790	10	24	0	0	3	8	230	568	0	0	0	0	17	41	1 250	3 089		
27	245	605	152	375	69	170	41	100	0	0	4	9	24	60	8	20	0	0	17	41	558	1 379		
28	147	364	244	604	98	241	29	71	0	0	2	4	0	0	15	36	13	32	4	9	550	1 360		
29	71	175	207	512	64	158	246	608	0	0	3	7	46	113	9	22	0	0	0	0	646	1 595		
30	299	738	280	691	157	388	216	534	3	8	10	25	8	21	5	11	0	0	0	0	978	2 416		
31	309	763	160	396	190	470	36	88	3	8	0	0	155	384	15	36	3	8	0	0	871	2 152		
32	78	192	402	994	182	450	150	370	0	0	0	0	11	26	0	0	0	0	0	0	822	2 032		
33	151	374	165	407	299	738	73	181	22	53	0	0	280	693	0	0	0	0	0	0	989	2 445		
34	74	184	63	155	72	178	0	0	111	275	0	0	237	586	0	0	0	0	0	0	558	1 378		
35	88	217	273	674	442	1 092	80	198	0	0	0	0	208	513	1	2	0	0	0	0	1 091	2 696		
Total all Blocks	5 134	12 686	7 342	18 143	6 480	16 013	1 619	4 000	297	733	36	89	3 191	7 884	211	522	39	96	73	180	24 422	60 346		

TABLE 13 Stand tables showing numbers of stems of pine per unit area* and the distribution according to size class in three pine forest types in 34 management blocks

Block	Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h. class cm (in)															d.b.h. cm (in)			
				10 (3.9)	15 (5.9)		20 (7.9)	25 (9.8)		30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
					< 15.2 (6.0)	≥ 15.2 (6.0)		< 25.4 (10.0)	≥ 25.4 (10.0)													
2	1.1	300	89.9	122.3	63.7	43.8	45.8	10.7	5.8	9.6	1.7	1.6	0.3	0.4	0.0	0.0	0.0	0.0	396	306	120	19
		(740)	36.4	49.5	25.8	17.7	18.5	4.3	2.4	3.9	0.7	0.6	0.1	0.2	0.0	0.0	0.0	0.0	160	124	48	8
2	1.2	159	124.8	179.3	41.8	35.3	21.2	4.1	1.7	2.1	0.0	0.4	0.5	0.0	0.0	0.0	0.0	0.0	411	286	65	5
		(393)	50.5	72.6	16.9	14.3	8.6	1.7	0.7	0.8	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	166	116	26	2
2	1.3	111	111.6	126.0	35.3	11.4	11.6	1.9	0.9	1.0	0.5	0.5	0.1	0.0	0.0	0.0	0.0	0.0	301	189	28	3
		(273)	45.2	51.0	14.3	4.6	4.7	0.8	0.4	0.4	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	122	77	11	1
3	1.1	245	209.8	235.2	48.5	58.6	44.1	8.5	7.0	4.9	2.4	2.2	0.0	0.4	0.2	0.1	0.0	0.0	622	412	128	17
		(606)	84.9	95.2	19.6	23.7	17.8	3.5	2.8	2.0	1.0	0.9	0.0	0.2	0.1	0.1	0.0	0.0	252	167	52	7
3	1.2	302	179.0	147.0	24.2	14.7	9.8	2.6	3.1	6.5	2.8	0.5	0.1	0.1	0.0	0.0	0.0	0.0	390	211	40	13
		(746)	72.4	59.5	9.8	5.9	4.0	1.0	1.3	2.6	1.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	158	86	16	5
3	1.3	126	117.6	90.6	17.0	7.7	10.3	1.5	4.7	1.5	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	252	134	26	7
		(310)	47.6	36.7	6.9	3.1	4.2	0.6	1.9	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	102	54	11	3
4	1.1	219	214.0	159.2	63.6	23.8	29.2	12.0	6.8	6.5	2.6	1.3	0.3	0.2	0.0	0.0	0.0	0.0	520	306	83	18
		(540)	86.6	64.4	25.7	9.6	11.8	4.9	2.8	2.6	1.1	0.5	0.1	0.1	0.0	0.0	0.0	0.0	210	124	33	7
4	1.2	264	166.8	170.7	49.1	19.1	26.7	8.0	3.6	4.0	1.5	0.8	0.3	0.1	0.1	0.0	0.0	0.0	451	284	64	10
		(653)	67.5	69.1	19.9	7.7	10.8	3.2	1.5	1.6	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0	182	115	26	4

* Figures for both stems/ha and stems/ac have been rounded to the nearest 0.1; this accounts for some apparent anomalies in conversions of low stem numbers

n.s. = not sampled

TABLE 13 (Continued)

Block	Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) < 15.2 (6.0)	15 (5.9) ≥ 15.2 (6.0)	20 (7.9)	25 (9.8) < 25.4 (10.0)	25 (9.8) ≥ 25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
4	1.3	275	174.3	137.8	20.4	6.9	10.4	3.2	2.5	1.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	358	184	26	5
		(679)	70.5	55.8	8.3	2.8	4.2	1.3	1.0	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	145	74	10	2
5	1.1	226	476.8	418.6	58.8	46.2	70.9	22.2	7.8	12.5	1.5	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1 117	640	162	23
		(557)	192.9	169.4	23.8	18.7	28.7	9.0	3.2	5.1	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	452	259	66	9
5	1.2	213	530.0	357.2	46.2	23.8	42.9	13.0	3.9	4.6	1.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0	1 024	494	90	11
		(525)	214.5	144.6	18.7	9.6	17.4	5.3	1.6	1.9	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	414	200	37	4
5	1.3	328	288.7	115.5	11.6	4.2	4.8	1.0	0.5	0.6	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	427	138	11	1
		(811)	116.9	46.7	4.7	1.7	1.9	0.4	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	173	56	4	0
6	1.1	170	320.8	150.6	30.2	0.0	14.5	7.1	0.8	9.0	0.9	0.0	0.0	0.5	0.0	0.0	0.1	0.0	535	214	33	11
		(420)	129.8	60.9	12.2	0.0	5.9	2.9	0.3	3.6	0.4	0.0	0.0	0.2	0.0	0.0	0.1	0.0	216	86	13	5
6	1.2	319	254.1	218.7	32.6	7.2	6.6	4.6	3.8	4.3	1.8	0.3	0.0	0.0	0.1	0.0	0.0	0.0	534	280	29	10
		(788)	102.8	88.5	13.2	2.9	2.7	1.9	1.5	1.7	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	216	113	12	4
6	1.3	289	198.3	79.9	8.1	3.0	6.5	2.8	1.3	2.4	1.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	303	105	17	5
		(714)	80.3	32.3	3.3	1.2	2.6	1.1	0.5	1.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	123	43	7	2
7	1.1	140	378.2	141.0	19.0	10.2	9.1	2.4	0.7	7.1	2.2	0.0	0.2	0.2	0.0	0.0	0.0	0.0	570	192	32	10
		(345)	153.1	57.1	7.7	4.1	3.7	1.0	0.3	2.9	0.9	0.0	0.1	0.1	0.0	0.0	0.0	0.0	231	78	13	4
7	1.2	407	258.6	135.7	30.0	9.2	9.2	2.2	4.7	4.1	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	455	196	31	10
		(1 006)	104.6	54.9	12.1	3.7	3.7	0.9	1.9	1.7	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	184	79	12	4

TABLE 13 (Continued)

Block	Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h. class cm (in)															d.b.h. cm (in)			
				10 (3.9)	15 (5.9)		20 (7.9)	25 (9.8)		30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
					< 15.2 (6.0)	≥ 15.2 (6.0)		< 25.4 (10.0)	≥ 25.4 (10.0)													
7	1.3	169	278.0	39.0	9.2	2.5	2.9	1.4	0.9	1.3	0.7	0.0	0.1	0.0	0.0	0.0	0.0	0.0	336	58	10	3
		(418)	112.5	15.8	3.7	1.0	1.2	0.6	0.4	0.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	136	23	4	1
8	1.1	66	330.4	293.4	68.4	31.8	39.5	11.4	3.3	3.4	1.3	0.2	0.2	0.2	0.0	0.0	0.0	0.0	783	453	91	9
		(164)	133.7	118.7	27.7	12.9	16.0	4.6	1.3	1.4	0.5	0.1	0.1	0.1	0.0	0.0	0.0	0.0	317	183	37	3
8	1.2	257	376.6	193.9	30.3	16.6	10.4	1.9	2.4	1.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	634	257	33	4
		(634)	152.4	78.5	12.3	6.7	4.2	0.8	1.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	256	104	13	2
8	1.3	546	284.2	109.2	7.6	2.4	3.6	0.6	1.0	1.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	410	126	9	3
		(1 349)	115.0	44.2	3.1	1.0	1.5	0.3	0.4	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	166	51	4	1
9	1.1	19	137.6	280.3	51.2	19.1	34.6	5.7	3.6	3.2	1.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	537	399	68	8
		(48)	55.7	113.4	20.7	7.7	14.0	2.3	1.5	1.3	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	217	161	27	3
9	1.2	185	109.1	84.1	50.4	26.7	25.5	2.2	1.1	1.4	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	302	193	58	4
		(456)	44.2	34.0	20.4	10.8	10.3	0.9	0.4	0.6	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	122	78	23	1
9	1.3	215	105.3	75.0	10.0	5.5	6.3	1.0	0.8	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	204	99	14	1
		(532)	42.6	30.3	4.1	2.2	2.6	0.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83	40	6	1
10	1.1	211	221.3	210.8	45.8	50.9	30.7	3.8	2.5	2.0	0.0	1.4	0.2	0.0	0.0	0.0	0.0	0.0	569	348	92	6
		(522)	89.6	85.3	18.5	20.6	12.4	1.5	1.0	0.8	0.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0	230	141	37	2
10	1.2	358	297.0	136.8	9.8	14.1	11.2	3.3	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	474	177	31	2
		(885)	120.2	55.4	4.0	5.7	4.5	1.3	0.4	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	192	72	12	1
10	1.3	169	240.6	94.8	7.9	2.3	3.8	0.2	0.6	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	351	110	8	1
		(418)	97.4	38.4	3.2	0.9	1.5	0.1	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	142	45	3	0
11	1.1	100	124.1	267.1	62.1	46.1	39.0	4.3	3.5	5.5	1.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	553	429	100	10
		(246)	50.2	108.1	25.1	18.7	15.8	1.7	1.4	2.2	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	224	174	40	4

TABLE 13 (Continued)

Block	Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h. class cm (in)															d.b.h. cm (in)			
				10 (3.9)	15 (5.9)		20 (7.9)	25 (9.8)		30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
					< 15.2 (6.0)	≥ 15.2 (6.0)		< 25.4 (10.0)	≥ 25.4 (10.0)													
11	1.2	92	265.3	195.9	37.0	15.6	20.8	4.7	2.8	1.4	1.0	0.6	0.0	0.1	0.0	0.0	0.0	0.0	545	280	47	6
		(228)	107.4	79.3	15.0	6.3	8.4	1.9	1.1	0.6	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	221	113	19	2
11	1.3	207	143.0	107.2	16.9	4.4	7.0	2.0	1.6	0.8	0.6	0.1	0.1	0.0	0.0	0.0	0.0	0.0	284	141	17	3
		(512)	57.9	43.4	6.8	1.8	2.8	0.8	0.6	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	115	57	7	1
12	1.1	107	299.0	278.0	87.5	56.3	63.7	16.7	7.9	7.4	0.9	0.2	0.0	0.1	0.0	0.0	0.0	0.0	818	519	153	17
		(265)	121.0	112.5	35.4	22.8	25.8	6.7	3.2	3.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	331	210	62	7
12	1.2	146	333.0	336.6	67.6	26.1	31.8	5.4	5.2	3.7	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	810	477	73	10
		(361)	134.8	136.2	27.4	10.5	12.9	2.2	2.1	1.5	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	328	193	29	4
12	1.3	136	251.6	151.1	30.3	13.5	7.3	1.6	0.6	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	458	206	24	2
		(336)	101.8	61.2	12.2	5.5	3.0	0.7	0.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	185	83	10	1
13	1.1	178	269.2	279.5	81.4	49.2	69.8	9.3	2.9	5.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	767	498	137	9
		(439)	108.9	113.1	32.9	19.9	28.3	3.8	1.2	2.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	310	202	56	4
13	1.2	159	95.6	94.9	43.8	25.3	26.4	3.3	1.2	2.4	0.9	0.7	0.1	0.1	0.0	0.0	0.0	0.0	295	199	60	5
		(393)	38.7	38.4	17.7	10.3	10.7	1.3	0.5	1.0	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	119	81	24	2
13	1.3	153	147.3	98.2	24.0	12.9	11.2	1.8	1.9	1.2	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	299	152	30	4
		(378)	59.6	39.7	9.7	5.2	4.5	0.7	0.8	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	121	61	12	1
14	1.1	90	412.6	211.1	79.6	19.1	37.3	7.0	3.6	4.4	1.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	777	364	73	10
		(222)	167.0	85.4	32.2	7.7	15.1	2.8	1.5	1.8	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	314	147	30	4
14	1.2	280	211.7	151.5	26.3	7.2	9.6	2.9	2.1	3.5	0.4	0.5	0.1	0.0	0.2	0.0	0.0	0.0	416	204	26	7
		(692)	85.7	61.3	10.6	2.9	3.9	1.2	0.8	1.4	0.2	0.2	0.0	0.0	0.1	0.0	0.0	0.0	168	83	11	3

TABLE 13 (Continued)

Block	Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) < 15.2 (6.0)	15 (5.9) ≥ 15.2 (6.0)	20 (7.9)	25 (9.8) < 25.4 (10.0)	25 (9.8) ≥ 25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
14	1.3	360	110.1	78.1	19.2	7.9	7.0	2.6	1.5	1.5	0.7	0.0	0.2	0.0	0.0	0.0	0.0	0.0	229	119	21	4
		(890)	44.6	31.6	7.8	3.2	2.8	1.1	0.6	0.6	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	93	48	9	2
15	1.1	58	194.4	320.4	100.6	60.6	82.9	20.2	6.1	6.9	0.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	793	599	178	14
		(142)	78.7	129.7	40.7	24.5	33.6	8.2	2.5	2.8	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	321	342	72	6
15	1.2	173	198.9	287.9	94.2	43.8	35.0	5.8	2.2	2.5	1.2	0.2	0.3	0.0	0.0	0.0	0.0	0.0	672	473	91	6
		(428)	80.5	116.5	38.1	17.7	14.2	2.3	0.9	1.0	0.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	272	191	37	3
15	1.3	123	171.7	137.0	29.5	10.2	8.1	1.8	0.5	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	360	188	21	1
		(303)	69.5	55.4	12.0	4.1	3.3	0.7	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	146	76	9	1
16	1.1	135	115.1	212.3	100.4	45.2	76.7	20.5	11.2	10.5	1.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	590	479	166	24
		(333)	46.6	85.9	40.6	18.3	31.0	8.3	4.5	4.3	0.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	240	194	67	10
16	1.2	209	83.2	143.9	46.7	28.2	43.0	11.1	6.7	5.2	1.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	369	286	96	13
		(516)	33.7	58.2	18.9	11.4	17.4	4.5	2.7	2.1	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	149	116	39	5
16	1.3	132	106.0	149.6	40.9	16.0	26.6	7.2	1.8	2.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	350	244	54	4
		(325)	42.9	60.5	16.5	6.5	10.8	2.9	0.7	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	142	99	22	2
17	1.1	91	113.8	143.8	40.7	33.8	19.5	5.0	5.9	5.9	1.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	372	258	73	15
		(224)	46.1	58.2	16.5	13.7	7.9	2.0	2.4	2.4	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.0	150	104	30	6
17	1.2	165	123.9	104.2	30.2	18.4	16.6	11.1	5.4	7.1	2.6	1.4	0.1	0.1	0.0	0.0	0.0	0.0	321	197	63	17
		(407)	50.2	42.2	12.2	7.4	6.7	4.5	2.2	2.9	1.1	0.6	0.1	0.0	0.0	0.0	0.0	0.0	130	80	26	7
17	1.3	110	83.3	103.5	18.2	12.1	15.5	4.9	2.9	3.1	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	244	161	40	7
		(272)	33.7	41.9	7.4	4.9	6.3	2.0	1.2	1.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	99	65	16	3
18	1.1	134	78.4	104.7	39.8	8.5	14.9	4.9	4.0	1.9	1.2	0.9	0.4	0.3	0.1	0.0	0.0	0.0	260	182	37	9
		(332)	31.7	42.4	16.1	3.4	6.0	2.0	1.6	0.8	0.5	0.4	0.2	0.1	0.0	0.0	0.0	0.0	150	74	15	4

TABLE 13 (Continued)

Block	Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) < 15.2 (6.0)	15 (5.9) ≥ 15.2 (6.0)	20 (7.9)	25 (9.8) < 25.4 (10.0)	25 (9.8) ≥ 25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
18	1.2	103	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
		(255)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
18	1.3	167	119.5	66.8	19.5	11.4	13.6	3.3	1.8	1.7	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0	239	119	33	5
		(412)	48.4	27.0	7.9	4.6	5.5	1.3	0.7	0.7	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	97	48	13	2
19	1.1	90	205.7	176.4	45.9	15.9	20.4	4.0	2.8	6.9	2.7	0.4	0.2	0.0	0.0	0.0	0.0	0.0	482	276	53	13
		(223)	83.2	71.4	18.6	6.4	8.3	1.6	1.1	2.8	1.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	195	112	22	5
19	1.2	152	227.2	175.2	62.2	31.8	55.0	23.1	10.6	12.7	3.7	0.5	0.0	0.2	0.1	0.0	0.0	0.0	602	375	138	28
		(376)	92.0	70.9	25.2	12.9	22.3	9.4	4.3	5.1	1.5	0.2	0.0	0.1	0.0	0.0	0.0	0.0	244	152	56	11
19	1.3	268	115.2	81.7	17.5	5.8	9.0	4.8	1.8	4.0	1.1	0.3	0.1	0.0	0.0	0.0	0.0	0.0	241	126	27	7
		(662)	46.6	33.0	7.1	2.4	3.6	2.0	0.7	1.6	0.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	98	51	11	3
20	1.1	152	473.2	465.0	106.2	38.1	34.2	6.7	4.6	4.2	1.3	0.8	0.0	0.1	0.0	0.0	0.0	0.0	1 134	661	90	11
		(375)	191.5	188.2	43.0	15.4	13.8	2.7	1.8	1.7	0.5	0.3	0.0	0.1	0.0	0.0	0.0	0.0	459	268	36	5
20	1.2	218	206.6	155.5	29.2	12.1	23.2	4.9	2.8	5.8	3.7	0.1	1.7	0.2	0.1	0.1	0.0	0.0	446	239	55	15
		(539)	83.6	62.9	11.8	4.9	9.4	2.0	1.1	2.3	1.5	0.4	0.3	0.1	0.0	0.0	0.0	0.0	180	97	22	6
20	1.3	114	122.4	96.1	16.3	7.1	11.3	3.1	2.1	4.1	2.4	0.8	0.4	0.1	0.0	0.0	0.0	0.0	266	144	31	10
		(282)	49.5	38.9	6.6	2.9	4.6	1.3	0.8	1.7	1.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	108	58	13	4
21	1.1	134	155.3	180.8	45.0	32.3	42.1	9.3	7.6	6.4	3.4	1.8	0.4	0.2	0.1	0.1	0.0	0.0	485	330	104	20
		(331)	62.8	73.2	18.2	13.1	17.0	3.8	3.1	2.6	1.4	0.7	0.2	0.1	0.1	0.0	0.0	0.0	196	133	42	8
21	1.2	139	233.9	199.0	48.4	25.8	29.2	5.6	2.3	5.9	3.2	1.7	0.7	0.3	0.0	0.0	0.0	0.0	556	322	75	14
		(343)	94.7	80.6	19.6	10.4	11.8	2.2	0.9	2.4	1.3	0.7	0.3	0.1	0.0	0.0	0.0	0.0	225	130	30	6
21	1.3	139	124.8	158.1	39.0	17.6	18.7	3.7	1.7	2.2	1.5	0.3	0.0	0.0	0.0	0.0	0.0	0.0	368	243	46	6
		(342)	50.5	64.0	15.8	7.1	7.6	1.5	0.7	0.9	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	149	98	19	2

TABLE 13 (Continued)

Block	Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) < 15.2 (6.0)	15 (5.9) ≥ 15.2 (6.0)	20 (7.9)	25 (9.8) < 25.4 (10.0)	25 (9.8) ≥ 25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
22	1.1	65	181.8	280.3	110.6	61.9	56.2	12.6	5.5	3.3	2.1	0.5	0.4	0.0	0.0	0.0	0.0	0.0	715	533	143	12
		(160)	73.6	113.4	44.8	25.1	22.8	5.1	2.2	1.3	0.8	0.2	0.2	0.0	0.0	0.0	0.0	0.0	289	216	58	5
22	1.2	227	202.2	326.8	82.2	36.2	43.6	9.2	3.2	5.5	2.3	0.2	0.3	0.1	0.0	0.0	0.0	0.0	712	510	101	12
		(562)	81.8	132.2	33.3	14.7	17.6	3.7	1.3	2.2	0.9	0.1	0.1	0.0	0.0	0.0	0.0	0.0	288	206	41	5
22	1.3	135	177.6	140.3	19.0	13.9	16.1	3.6	2.0	1.9	0.6	0.1	0.1	0.0	0.0	0.0	0.0	0.0	376	198	38	5
		(332)	71.9	56.8	7.7	5.6	6.5	1.4	0.8	0.8	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	152	80	16	2
23	1.1	71	68.7	200.2	85.3	54.4	70.5	11.9	3.3	6.1	2.2	0.9	0.2	0.0	0.0	0.0	0.0	0.0	504	435	150	13
		(176)	27.8	81.0	34.5	22.0	28.5	4.8	1.3	2.5	0.9	0.3	0.1	0.0	0.0	0.0	0.0	0.0	204	176	61	5
23	1.2	193	163.1	149.0	51.7	42.8	86.9	20.3	6.5	7.2	2.5	0.9	0.1	0.0	0.0	0.0	0.0	0.0	531	368	167	17
		(476)	66.0	60.3	20.9	17.3	35.2	8.2	2.6	2.9	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	215	149	68	7
23	1.3	43	128.0	124.0	28.9	18.5	15.1	1.7	0.9	0.8	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	318	190	37	2
		(106)	51.8	50.2	11.7	7.5	6.1	0.7	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	129	77	15	1
24	1.1	201	111.3	187.2	62.3	37.9	53.3	6.8	5.9	4.6	1.7	1.3	0.0	0.1	0.0	0.0	0.0	0.0	472	361	112	14
		(496)	45.0	75.8	25.2	15.3	21.6	2.8	2.4	1.9	0.7	0.5	0.0	0.0	0.0	0.0	0.0	0.0	191	146	45	6
24	1.2	180	150.6	340.6	73.1	33.0	33.8	6.8	3.3	3.8	1.3	0.3	0.1	0.0	0.1	0.0	0.0	0.0	647	496	83	9
		(445)	60.9	137.8	29.6	13.4	13.7	2.8	1.4	1.5	0.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	262	201	33	4
24	1.3	196	55.6	118.3	29.1	15.6	21.4	3.4	2.0	0.9	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	247	191	44	4
		(483)	22.5	47.9	11.8	6.3	8.7	1.4	0.8	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	77	18	1
25	1.1	156	297.4	363.5	66.4	32.5	49.7	19.0	5.3	5.2	2.3	1.0	0.3	0.1	0.0	0.0	0.0	0.0	842	545	115	14
		(386)	120.3	147.1	26.9	13.2	20.1	7.7	2.2	2.1	0.9	0.4	0.1	0.1	0.0	0.0	0.0	0.0	341	221	47	6
25	1.2	142	287.0	291.7	87.3	38.9	50.3	9.9	5.7	10.4	0.8	0.4	0.3	0.0	0.0	0.0	0.0	0.0	783	496	117	18
		(352)	116.2	118.0	35.3	15.7	20.3	4.0	2.3	4.2	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	317	201	47	7

TABLE 13 (Continued)

Block	Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h. class cm (in)															d.b.h. cm (in)			
				10 (3.9)	15 (5.9)		20 (7.9)	25 (9.8)		30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
					< 15.2 (6.0)	≥ 15.2 (6.0)		< 25.4 (10.0)	≥ 25.4 (10.0)													
25	1.3	80	225.6	142.0	28.7	12.7	14.9	3.2	1.7	2.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	432	206	35	4
		(198)	91.3	57.5	11.6	5.1	6.0	1.3	0.7	0.8	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	175	83	14	2
26	1.1	316	221.3	377.8	96.1	41.1	52.7	6.1	6.9	3.9	2.9	0.5	0.0	0.0	0.0	0.0	0.0	0.0	809	588	114	14
		(781)	89.5	152.9	38.9	16.6	21.3	2.5	2.8	1.6	1.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	328	238	46	6
26	1.2	355	432.1	301.6	63.7	27.2	16.2	8.2	3.0	4.9	2.5	1.1	0.1	0.0	0.0	0.0	0.0	0.0	861	429	63	12
		(877)	174.9	122.0	25.8	11.0	6.6	3.3	1.2	2.0	1.0	0.5	0.1	0.0	0.0	0.0	0.0	0.0	348	173	26	5
26	1.3	320	275.5	153.0	13.7	11.1	13.5	5.1	2.1	1.6	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	477	201	34	5
		(790)	111.5	61.9	5.5	4.5	5.5	2.1	0.8	0.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	193	81	14	2
27	1.1	245	371.9	364.8	144.8	67.1	58.6	7.1	1.7	2.9	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1 019	647	138	5
		(605)	150.5	147.6	58.6	27.2	23.7	2.9	0.7	1.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	412	262	56	2
27	1.2	152	441.9	264.4	33.8	13.5	15.0	2.9	1.7	3.5	0.8	0.6	0.0	0.0	0.0	0.0	0.0	0.0	778	336	38	7
		(375)	178.8	107.0	13.7	5.5	6.1	1.2	0.7	1.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	315	136	15	3
27	1.3	69	139.5	132.9	31.7	12.4	11.6	2.3	2.2	1.8	0.8	0.2	0.1	0.1	0.0	0.0	0.0	0.0	336	196	32	5
		(170)	56.4	53.8	12.8	5.0	4.7	0.9	0.9	0.7	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	136	79	13	2
28	1.1	147	204.8	235.8	65.0	36.5	42.0	7.1	1.9	4.5	2.4	0.3	0.1	0.2	0.1	0.0	0.0	0.0	601	396	95	10
		(364)	82.9	95.4	26.3	14.8	17.0	2.9	0.8	1.8	1.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	243	160	39	4
28	1.2	244	216.9	175.8	29.0	13.4	24.7	5.3	2.6	3.4	1.8	0.6	0.1	0.1	0.0	0.0	0.0	0.0	474	257	52	9
		(604)	87.8	71.2	11.7	5.4	10.0	2.2	1.0	1.4	0.7	0.2	0.0	0.1	0.0	0.0	0.0	0.0	192	104	21	3
28	1.3	98	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
		(241)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
29	1.1	71	205.0	176.9	29.5	21.2	13.3	3.1	2.5	5.1	1.7	0.7	0.2	0.1	0.0	0.0	0.0	0.0	459	254	48	10
		(175)	83.0	71.6	11.9	8.6	5.4	1.2	1.0	2.1	0.7	0.3	0.1	0.1	0.0	0.0	0.0	0.0	186	103	19	4

TABLE 13 (Continued)

Block	Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) < 15.2 (6.0)	15 (5.9) ≥ 15.2 (6.0)	20 (7.9)	25 (9.8) < 25.4 (10.0)	25 (9.8) ≥ 25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
29	1.2	207	195.3	293.6	66.4	17.6	25.6	8.2	1.2	2.2	0.7	0.7	0.1	0.0	0.0	0.0	0.0	0.0	611	416	56	5
		(512)	79.0	118.8	26.9	7.1	10.4	3.3	0.5	0.9	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	247	168	23	2
29	1.3	64	50.1	65.7	17.1	7.8	8.5	4.0	1.1	2.1	0.7	0.1	0.1	0.0	0.0	0.0	0.0	0.0	157	107	24	4
		(158)	20.3	26.6	6.9	3.2	3.4	1.6	0.5	0.9	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	64	43	10	2
30	1.1	299	641.6	347.0	96.1	36.1	62.6	13.8	5.0	5.4	1.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	1 210	568	125	13
		(738)	259.7	140.4	38.9	14.6	25.3	5.6	2.0	2.2	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	490	230	51	5
30	1.2	280	196.4	226.2	74.5	47.6	43.5	7.7	4.1	5.5	0.8	0.8	0.4	0.0	0.1	0.0	0.0	0.0	607	411	111	12
		(691)	79.5	91.5	30.1	19.3	17.6	3.1	1.7	2.2	0.3	0.3	0.2	0.0	0.0	0.0	0.0	0.0	246	166	45	5
30	1.3	157	257.3	153.9	31.1	13.9	15.1	4.5	3.5	2.9	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	483	226	41	7
		(388)	104.1	62.3	12.6	5.6	6.1	1.8	1.4	1.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	196	91	16	3
31	1.1	309	311.2	254.8	77.1	27.7	37.0	7.2	5.3	6.8	1.7	1.5	0.8	1.0	0.1	0.1	0.0	0.0	732	421	89	17
		(763)	134.0	103.1	31.2	11.2	15.0	2.9	2.1	2.8	0.7	0.6	0.3	0.4	0.1	0.0	0.0	0.0	296	170	36	7
31	1.2	160	191.3	254.8	61.3	16.5	19.6	6.4	3.9	6.0	2.2	1.8	1.0	0.1	0.1	0.0	0.0	0.0	565	374	58	15
		(396)	77.4	103.1	24.8	6.7	7.9	2.6	1.6	2.4	0.9	0.7	0.4	0.0	0.0	0.0	0.0	0.0	229	151	23	6
31	1.3	190	133.1	86.0	20.2	7.9	14.0	3.0	2.3	3.0	0.6	0.5	0.2	0.0	0.0	0.0	0.0	0.0	271	138	32	7
		(470)	53.9	34.8	8.2	3.2	5.7	1.2	0.9	1.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	110	56	13	3
32	1.1	78	178.2	151.0	34.4	10.6	38.9	12.3	6.1	18.3	4.2	1.2	0.5	0.0	0.0	0.0	0.0	0.0	456	278	92	30
		(192)	72.1	61.1	13.9	4.3	15.7	5.0	2.5	7.4	1.7	0.5	0.2	0.0	0.0	0.0	0.0	0.0	185	112	37	12
32	1.2	402	190.1	167.5	29.5	15.0	33.0	13.6	8.4	8.4	2.7	1.5	0.5	0.2	0.1	0.0	0.0	0.0	470	280	83	22
		(994)	76.9	67.8	11.9	6.1	13.4	5.5	3.4	3.4	1.1	0.6	0.2	0.1	0.0	0.0	0.0	0.0	190	113	34	9

TABLE 13 (Continued)

Block	Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h class cm (in)															d.b.h. cm (in)			
				10 (3.9)	15 (5.9)		20 (7.9)	25 (9.8)		30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
					< 15.2 (6.0)	≥ 15.2 (6.0)		< 25.4 (10.0)	≥ 25.4 (10.0)													
32	1.3	182	144.7	96.9	14.4	4.7	12.3	3.0	1.8	1.4	1.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	281	136	25	5
		(450)	58.6	39.2	5.8	1.9	5.0	1.2	0.7	0.6	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	114	55	10	2
33	1.1	151	213.9	177.8	36.0	18.9	19.9	2.3	2.3	5.0	3.9	2.2	1.3	0.8	0.1	0.2	0.1	0.1	485	271	57	16
		(374)	86.5	72.0	14.5	7.6	8.1	0.9	0.9	2.0	1.6	0.9	0.5	0.3	0.0	0.1	0.0	0.0	196	110	23	6
33	1.2	165	14.0	52.6	24.5	2.1	11.8	5.8	2.4	5.2	3.4	1.7	0.7	0.9	0.2	0.0	0.0	0.0	125	111	34	15
		(407)	5.6	21.3	9.9	0.8	4.8	2.3	1.0	2.1	1.4	0.7	0.3	0.4	0.1	0.0	0.0	0.0	51	45	14	6
33	1.3	299	114.6	90.0	15.8	6.1	14.2	3.6	3.2	4.7	1.6	0.9	0.4	0.1	0.1	0.0	0.0	0.0	256	141	35	11
		(738)	46.4	36.4	6.4	2.4	5.7	1.5	1.3	1.9	0.7	0.3	0.2	0.0	0.0	0.0	0.0	0.0	103	57	14	4
34	1.1	74	160.4	153.3	27.0	12.3	6.5	6.2	2.7	7.9	4.4	0.3	1.2	0.8	0.2	0.1	0.1	0.0	383	223	43	18
		(184)	64.9	62.1	10.9	5.0	2.6	2.5	1.1	3.2	1.8	0.1	0.5	0.3	0.1	0.0	0.0	0.0	155	90	17	7
34	1.2	63	172.2	146.0	8.1	4.6	17.1	5.4	4.4	10.4	4.6	2.9	2.8	1.0	0.2	0.0	0.1	0.1	380	208	54	27
		(155)	69.7	59.1	3.3	1.9	6.9	2.2	1.8	4.2	1.8	1.2	1.1	0.4	0.1	0.0	0.0	0.0	154	84	22	11
34	1.3	72	181.3	81.5	13.5	7.5	9.4	2.2	0.8	3.1	2.2	0.9	0.4	0.2	0.1	0.0	0.0	0.0	303	122	27	8
		(178)	73.4	33.0	5.5	3.0	3.8	0.9	0.3	1.3	0.9	0.4	0.2	0.1	0.0	0.0	0.0	0.0	123	49	11	3
35	1.1	88	70.2	79.6	20.7	10.4	9.0	3.5	4.0	1.8	0.6	1.0	0.4	0.0	0.1	0.0	0.1	0.0	201	131	31	8
		(217)	28.4	32.2	8.4	4.2	3.6	1.4	1.6	0.7	0.3	0.4	0.2	0.0	0.1	0.0	0.0	0.0	81	53	13	3
35	1.2	273	195.0	109.9	19.5	8.4	11.2	6.1	3.9	6.4	3.5	1.7	0.9	0.0	0.4	0.0	0.0	0.0	367	172	43	17
		(674)	78.9	44.5	7.9	3.4	4.5	2.5	1.6	2.6	1.4	0.7	0.3	0.0	0.2	0.0	0.0	0.0	149	70	17	7
35	1.3	442	54.5	57.7	8.5	2.0	6.5	3.1	1.6	2.3	0.5	0.2	0.1	0.1	0.0	0.0	0.0	0.0	138	83	16	5
		(1 092)	22.0	23.3	3.4	0.8	2.6	1.3	0.7	0.9	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	56	34	7	2

TABLE 14 Stand tables for three pine forest types showing mean numbers of stems of pine per unit area* and the distribution according to size class for the whole project area

Type	Area ha (ac)	d.b.h. 5.0-7.5 cm (2.0-3.0 in)	d.b.h. class cm (in)															d.b.h. cm (in)			
			10 (3.9)	15 (5.9)		20 (7.9)	25 (9.8)		30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	≥ 5.0 (2.0)	≥ 7.6 (3.0)	≥ 15.2 (6.0)	≥ 25.4 (10.0)
				< 15.2 (6.0)	≥ 15.2 (6.0)		< 25.4 (10.0)	≥ 25.4 (10.0)													
1.1	5 134	262.3	247.4	68.4	36.2	43.1	9.3	4.8	6.0	1.8	0.9	0.2	0.2	0.0	0.0	0.0	0.0	680	418	103	14
	(12 686)	106.1	100.1	27.7	14.7	17.4	3.8	2.0	2.4	0.7	0.4	0.1	0.1	0.1	0.0	0.0	0.0	275	169	42	6
1.2	7 342	228.9	196.1	43.7	20.8	25.2	7.0	3.7	4.7	1.8	0.7	0.3	0.1	0.1	0.0	0.0	0.0	533	304	64	11
	(18 143)	92.5	79.3	17.7	8.4	10.2	2.8	1.5	1.9	0.7	0.3	0.1	0.0	0.0	0.0	0.0	0.0	216	123	26	5
1.3	6 480	166.4	103.3	17.5	7.5	10.0	2.7	1.7	1.9	0.7	0.2	0.1	0.0	0.0	0.0	0.0	0.0	312	146	25	5
	(16 013)	67.2	41.8	7.1	3.0	4.0	1.1	0.7	0.8	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	126	59	10	2

* Figures for both stems/ha and stems/ac have been rounded to nearest 0.1. This accounts for some apparent anomalies in conversions of low stem numbers.

FIGURE 5

Stem number curve for pine forest type 1·1

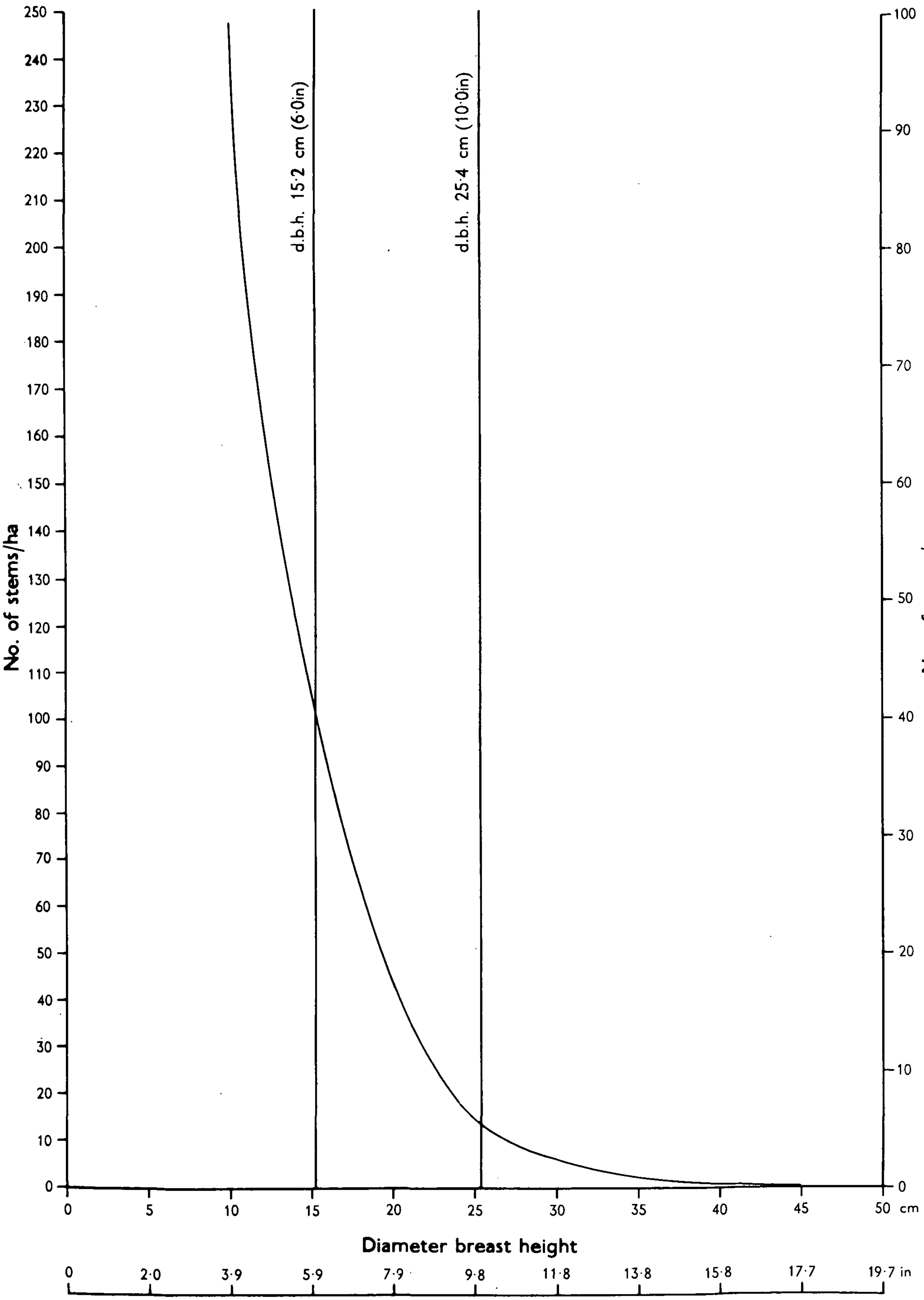

FIGURE 6

Stem number curve for pine forest type 1·2

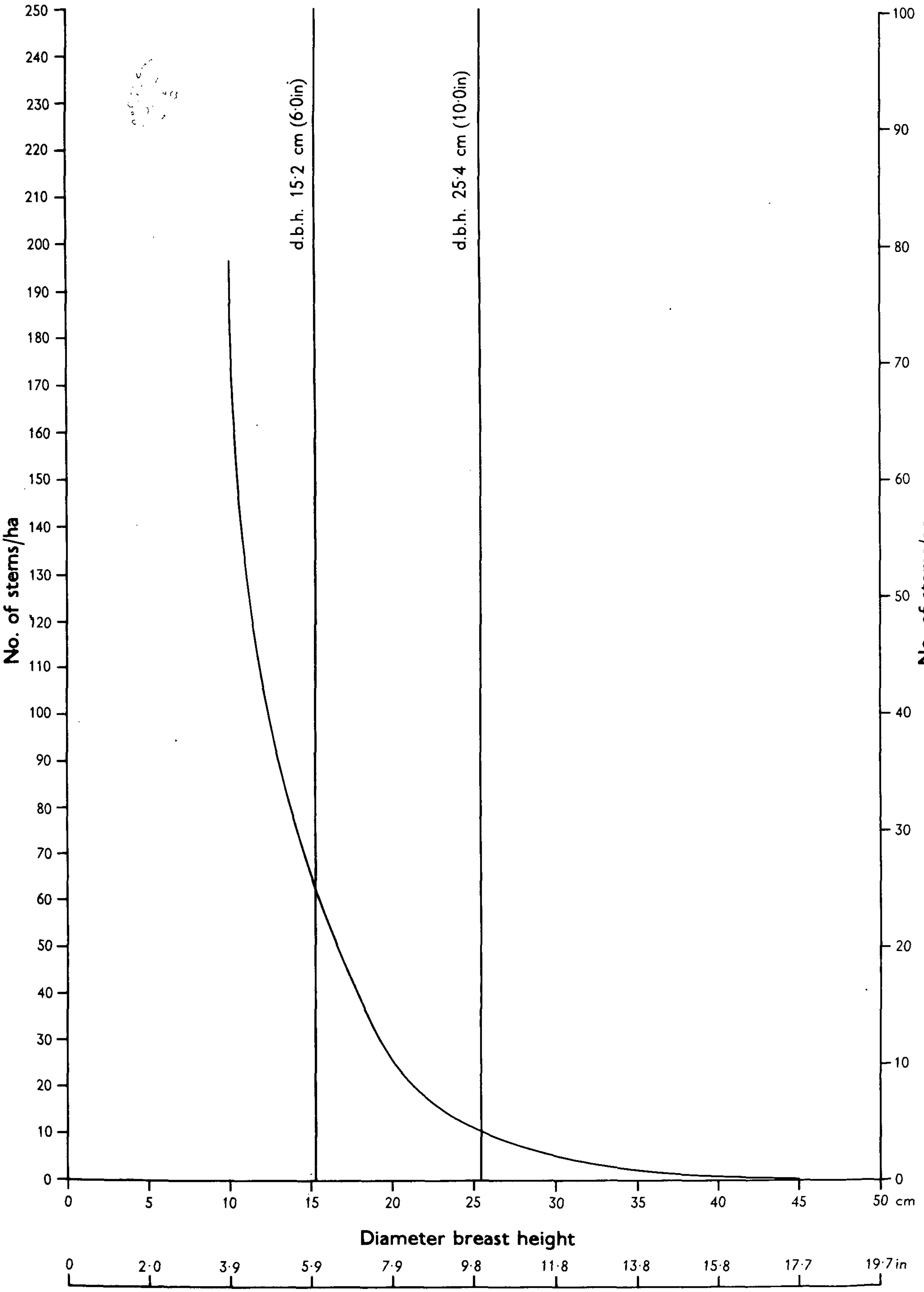

FIGURE 7

Stem number curve for pine forest type 1·3

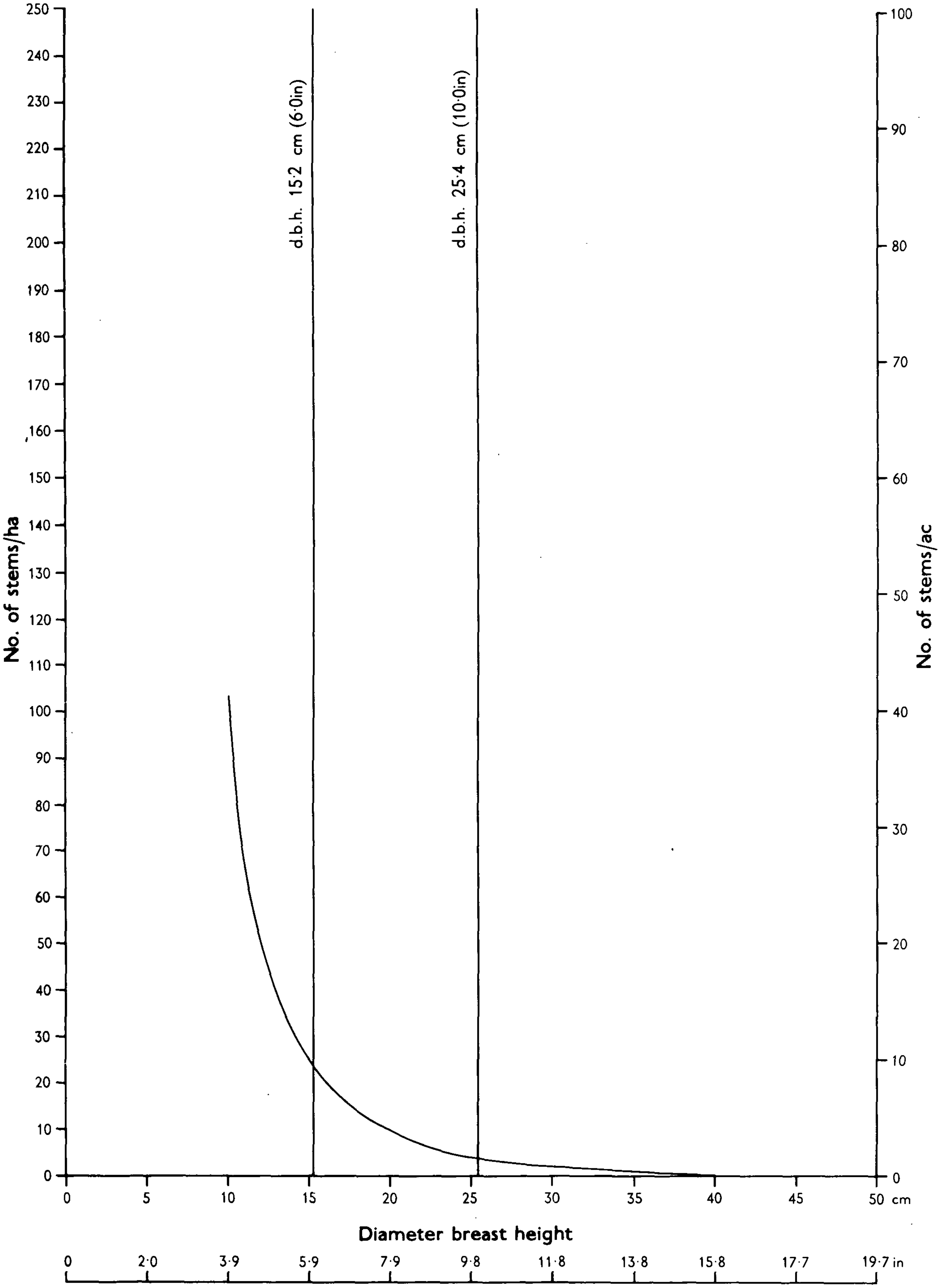

TABLE 15 Standing volume of pine per unit area* in three pine forest types in 34 management blocks

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
2	1.1	300	740	a b c	21.0 17.1 9.0	300 244 129	14.0 10.0 3.5	200 143 50
2	1.2	159	393	a b c	10.7 7.0 2.1	153 100 30	8.4 5.0 1.0	120 71 14
2	1.3	111	273	a b c	6.4 3.6 1.4	91 51 20	4.8 2.3 0.4	69 33 6
3	1.1	245	606	a b c	22.7 17.8 8.5	324 254 121	13.5 9.5 2.7	193 136 39
3	1.2	302	746	a b c	10.2 7.6 5.3	146 109 76	7.5 5.0 3.0	107 71 43
3	1.3	126	310	a b c	5.0 3.3 1.4	71 47 20	3.5 2.0 0.6	50 29 9
4	1.1	219	540	a b c	17.2 13.3 6.9	246 190 99	10.3 7.4 3.2	147 106 46
4	1.2	264	653	a b c	14.3 10.0 4.4	204 143 63	10.2 6.9 2.7	146 99 39
4	1.3	275	679	a b c	6.3 3.9 1.9	90 56 27	4.7 2.6 1.2	67 37 17
5	1.1	226	557	a b c	29.2 21.2 8.2	417 303 117	23.0 14.8 4.0	329 211 57
5	1.2	213	525	a b c	18.2 11.7 4.0	260 167 57	12.7 7.1 1.7	181 101 24
5	1.3	328	811	a b c	3.6 1.1 0.4	51 16 6	2.0 0.6 0.1	29 9 1

* Figures for m^3/ha have been rouned to nearest 0.1, those for ft^3/ac to nearest whole number This accounts for apparent anomalies in the conversions of small volumes.

** a ≥ 7.6 cm (3.0 in)

b ≥ 15.2 cm (6.0 in)

c ≥ 25.4 cm (10.0 in)

+ Where sampling errors of 100% or higher were obtained, the reliable minimum estimate is zero.

n.s. = not sampled

TABLE 15 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
6	1.1	170	420	a b c	10.8 7.9 5.2	154 113 74	6.2 2.7 0.5	89 39 7
6	1.2	319	788	a b c	9.6 5.7 3.8	137 81 54	7.4 3.5 1.8	106 50 26
6	1.3	289	714	a b c	4.2 3.1 1.9	60 44 27	2.9 1.9 1.0	41 27 14
7	1.1	140	345	a b c	8.9 6.4 4.9	127 91 70	5.1 2.8 1.7	73 40 24
7	1.2	407	1 006	a b c	8.0 5.2 3.4	114 74 49	5.8 3.1 1.6	83 44 23
7	1.3	169	418	a b c	2.7 1.8 1.1	39 26 16	1.5 0.9 0.4	21 13 6
8	1.1	66	164	a b c	17.4 11.3 3.4	249 161 49	12.7 6.7 1.2	181 96 17
8	1.2	257	634	a b c	6.9 3.7 1.1	99 53 16	4.7 2.0 0.4	67 29 6
8	1.3	546	1 349	a b c	3.3 1.6 1.0	47 23 14	2.3 0.8 0.4	33 11 6
9	1.1	19	48	a b c	14.0 8.6 2.9	200 123 41	10.1 5.4 0.9	144 77 13
9	1.2	185	456	a b c	8.8 5.8 1.5	126 83 21	4.5 2.6 0.0	64 37 0
9	1.3	215	532	a b c	3.0 1.6 0.5	43 23 7	1.6 0.8 0.2	23 11 3
10	1.1	211	522	a b c	13.5 9.4 2.7	193 134 39	5.8 3.7 0.5	83 53 7
10	1.2	358	885	a b c	5.5 3.4 0.8	79 49 11	3.1 1.3 0.3	44 19 4
10	1.3	169	418	a b c	5.5 3.1 1.2	79 44 17	1.3 0.0 0.0	19 0 0

TABLE 15 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
11	1.1	**100**	246	a	**16.8**	240	**13.0**	186
				b	**11.3**	161	**8.3**	119
				c	**3.8**	54	**1.4**	20
11	1.2	**92**	228	a	**10.2**	146	**7.5**	107
				b	**6.7**	96	**4.7**	67
				c	**2.3**	33	**1.0**	14
11	1.3	**207**	512	a	**4.5**	64	**3.6**	51
				b	**2.5**	36	**1.8**	26
				c	**1.2**	17	**0.7**	10
12	1.1	**107**	265	a	**24.6**	351	**17.7**	253
				b	**18.3**	261	**12.5**	179
				c	**5.6**	80	**2.4**	34
12	1.2	**146**	361	a	**16.1**	230	**13.3**	190
				b	**10.0**	143	**8.0**	114
				c	**3.1**	44	**1.8**	26
12	1.3	**136**	336	a	**4.3**	61	**3.0**	43
				b	**1.8**	26	**1.0**	14
				c	**0.5**	7	**0.1**	1
13	1.1	**178**	439	a	**20.2**	289	**12.8**	183
				b	**13.8**	197	**8.3**	119
				c	**3.0**	43	**1.3**	19
13	1.2	**159**	393	a	**10.0**	143	**6.1**	87
				b	**7.3**	104	**4.1**	59
				c	**2.5**	36	**0.4**	6
13	1.3	**153**	378	a	**5.6**	80	**4.3**	61
				b	**3.5**	50	**2.5**	36
				c	**1.3**	19	**0.7**	10
14	1.1	**90**	222	a	**15.0**	214	**10.9**	156
				b	**9.5**	136	**5.8**	83
				c	**3.4**	49	**1.3**	19
14	1.2	**280**	692	a	**7.8**	111	**5.7**	81
				b	**4.9**	70	**3.1**	44
				c	**3.0**	43	**1.6**	23
14	1.3	**360**	890	a	**4.8**	69	**3.9**	56
				b	**3.2**	46	**2.3**	33
				c	**1.5**	21	**0.9**	13
15	1.1	**58**	142	a	**27.6**	394	**21.0**	300
				b	**20.0**	286	**14.4**	206
				c	**4.6**	66	**2.5**	36
15	1.2	**173**	428	a	**17.4**	249	**13.0**	186
				b	**9.8**	140	**7.1**	101
				c	**2.7**	39	**1.3**	19
15	1.3	**123**	303	a	**4.9**	70	**3.9**	56
				b	**2.2**	31	**1.5**	21
					0.4	6	**0.1**	1

TABLE 15 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
16	1.1	135	333	a b c	28.5 22.2 8.1	408 318 115	22.9 16.8 4.8	327 240 69
16	1.2	209	516	a b c	16.1 12.1 4.5	230 173 64	12.4 8.7 2.8	177 124 40
16	1.3	132	325	a b c	8.8 5.7 1.4	126 81 20	6.8 3.9 0.7	97 56 10
17	1.1	91	224	a b c	13.7 10.4 5.4	196 149 77	9.6 6.5 2.9	137 93 41
17	1.2	165	407	a b c	13.9 11.6 6.8	199 166 97	9.8 7.7 3.5	140 110 50
17	1.3	110	272	a b c	7.5 5.4 2.4	107 77 34	5.4 3.4 1.2	77 49 17
18	1.1	134	332	a b c	10.4 8.0 4.5	149 114 64	7.0 4.8 2.2	100 69 31
18	1.2	103	255	a b c	n.s. n.s. n.s.	n.s. n.s. n.s.	n.s. n.s. n.s.	n.s. n.s. n.s.
18	1.3	167	412	a b c	5.3 4.1 1.9	76 59 27	3.6 2.5 0.8	51 36 11
19	1.1	90	223	a b c	12.8 9.0 5.3	183 129 76	7.8 4.2 1.2	111 60 17
19	1.2	152	376	a b c	26.8 22.2 10.5	383 317 150	20.3 15.6 6.2	290 223 89
19	1.3	268	662	a b c	6.6 4.8 2.9	94 69 41	5.0 3.4 1.9	71 49 27
20	1.1	152	375	a b c	20.7 11.1 4.2	296 159 60	15.2 7.7 2.2	217 110 31
20	1.2	218	539	a b c	14.3 12.3 7.3	204 176 104	10.2 8.2 4.6	146 117 66
20	1.3	114	282	a b c	8.6 6.7 4.7	123 96 67	6.9 5.1 3.3	99 73 47

TABLE 15 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
21	1.1	**134**	331	a b c	**21.6** **17.3** **9.2**	309 247 131	**15.2** **11.3** **5.0**	217 161 71
21	1.2	**139**	343	a b c	**16.8** **12.6** **7.1**	240 180 101	**13.1** **9.1** **4.3**	187 130 61
21	1.3	**139**	342	a b c	**8.7** **5.9** **2.3**	124 84 33	**6.6** **4.1** **1.4**	94 59 20
22	1.1	**65**	160	a b c	**24.3** **16.7** **4.8**	347 239 69	**18.8** **11.0** **1.5**	269 157 21
22	1.2	**228**	562	a b c	**20.1** **12.7** **4.6**	287 181 66	**16.3** **9.1** **2.1**	233 130 30
22	1.3	**135**	332	a b c	**7.3** **4.8** **1.7**	104 69 24	**5.5** **3.3** **0.9**	79 47 13
23	1.1	**71**	176	a b c	**23.9** **17.8** **5.2**	341 254 74	**17.0** **11.5** **2.5**	243 164 36
23	1.2	**193**	476	a b c	**24.6** **21.3** **6.6**	351 304 94	**20.1** **16.6** **4.0**	287 237 57
23	1.3	**43**	106	a b c	**6.2** **3.6** **0.7**	89 51 10	**4.6** **2.4** **0.1**	66 34 1
24	1.1	**201**	496	a b c	**19.0** **14.4** **5.1**	271 206 73	**14.6** **10.4** **2.6**	209 149 37
24	1.2	**180**	445	a b c	**16.9** **9.9** **3.5**	241 141 50	**12.3** **6.1** **1.0**	176 87 14
24	1.3	**196**	483	a b c	**7.9** **5.4** **1.3**	113 77 19	**6.0** **3.7** **0.6**	86 53 9
25	1.1	**156**	386	a b c	**22.5** **16.1** **7.5**	321 230 107	**17.4** **11.3** **3.8**	249 161 54
25	1.2	**142**	352	a b c	**21.3** **14.9** **7.5**	304 213 107	**17.1** **11.1** **4.8**	244 159 69
25	1.3	**80**	198	a b c	**7.2** **4.8** **1.5**	103 69 21	**5.5** **3.8** **0.9**	79 54 13

TABLE 15 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
26	1.1	316	781	a b c	21.8 13.7 5.1	311 196 73	15.8 8.9 2.1	226 127 30
26	1.2	355	877	a b c	15.4 9.3 4.8	220 133 69	11.2 6.4 2.5	160 91 36
26	1.3	320	790	a b c	7.0 4.5 1.6	100 64 23	5.3 3.0 1.1	76 43 16
27	1.1	245	605	a b c	22.4 12.5 1.7	320 179 24	16.7 8.3 0.6	239 119 9
27	1.2	152	375	a b c	9.8 5.5 2.6	140 79 37	7.4 3.6 1.4	106 51 20
27	1.3	69	170	a b c	7.3 4.4 2.1	104 63 30	5.5 3.2 1.4	79 46 20
28	1.1	147	364	a b c	17.1 12.1 4.4	244 173 63	12.6 8.1 2.5	180 116 36
28	1.2	244	604	a b c	11.6 8.0 4.0	166 114 57	9.0 5.6 2.6	129 80 37
28	1.3	98	241	a b c	n.s. n.s. n.s.	n.s. n.s. n.s.	n.s n.s. n.s.	n.s. n.s. n.s.
29	1.1	71	175	a b c	10.8 7.5 4.4	154 107 63	6.2 3.6 1.5	89 51 21
29	1.2	207	512	a b c	13.2 7.3 2.7	189 104 39	9.4 4.5 1.1	134 64 16
29	1.3	64	158	a b c	5.2 3.7 1.7	74 53 24	2.9 2.2 0.7	41 31 10
30	1.1	299	738	a b c	23.2 13.2 4.3	331 189 61	15.2 7.7 1.6	217 110 23
30	1.2	280	691	a b c	18.7 13.3 4.7	267 190 67	14.2 9.6 3.2	203 137 46
30	1.3	157	388	a b c	8.4 5.5 2.4	120 79 34	6.4 3.9 1.8	91 56 26

TABLE 15 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
31	1.1	309	763	a b c	21.7 15.8 9.2	310 226 131	15.0 9.8 4.9	214 140 70
31	1.2	160	396	a b c	16.7 14.0 12.2	239 200 174	12.8 10.0 7.9	183 143 113
31	1.3	190	470	a b c	6.7 5.1 3.3	96 73 47	5.3 3.6 1.6	76 51 23
32	1.1	78	192	a b c	21.8 18.7 11.9	311 267 170	17.8 14.5 7.8	254 207 111
32	1.2	402	994	a b c	18.6 15.4 8.8	266 220 126	15.0 11.8 6.6	214 169 94
32	1.3	182	450	a b c	5.9 4.1 2.1	84 59 30	4.7 3.1 1.2	67 44 17
33	1.1	151	374	a b c	17.6 14.1 10.6	251 201 151	13.1 9.9 6.7	187 141 96
33	1.2	165	407	a b c	12.4 10.8 8.5	177 154 121	8.7 7.2 5.2	124 103 74
33	1.3	299	738	a b c	9.3 7.4 5.0	133 106 71	7.7 5.9 3.8	110 84 54
34	1.1	74	184	a b c	17.3 14.4 11.8	247 206 169	12.2 9.3 7.2	174 133 103
34	1.2	63	155	a b c	20.2 18.2 15.0	289 260 214	14.9 12.9 10.5	213 184 150
34	1.3	72	178	a b c	7.8 6.2 4.4	111 89 63	6.0 4.7 3.1	86 67 44
35	1.1	88	217	a b c	7.9 6.2 3.9	113 89 56	4.6 3.1 1.6	66 44 23
35	1.2	273	674	a b c	11.5 10.0 7.9	164 143 113	7.2 5.8 3.7	103 83 53
35	1.3	442	1 092	a b c	4.6 3.5 2.2	66 50 31	3.0 2.0 1.1	43 29 16

TABLE 16 Summary statement of the standing gross volume of pine in 34 management blocks

Block	Area		Gross volume						Reliable minimum estimate					
			d.b.h. cm (in)						d.b.h. cm (in)					
			⩾ 7.6 (3.0)		⩾ 15.2 (6.0)		⩾ 25.4 (10.0)		⩾ 7.6 (3.0)		⩾ 15.2 (6.0)		⩾ 25.4 (10.0)	
	ha	ac	'o m^3	'oo ft^3	'o m^3	'oo ft^3	'o m^3	'oo ft^3	'o m^3	'oo ft^3	'o m^3	'oo ft^3	'o m^3	'oo ft^3
2	702	1 735	871	3 076	664	2 346	319	1 126	607	2 143	405	1 430	125	442
3	821	2 029	927	3 274	707	2 497	386	1 363	601	2 124	409	1 444	164	581
4	803	1 984	928	3 275	663	2 340	320	1 129	624	2 204	416	1 468	174	616
5	793	1 959	1 166	4 117	764	2 699	284	1 002	856	3 023	505	1 785	130	459
6	789	1 949	611	2 158	406	1 433	265	934	425	1 502	213	750	95	335
7	729	1 802	496	1 751	332	1 171	226	797	333	1 176	181	638	96	338
8	945	2 336	472	1 668	257	908	105	372	330	1 166	139	493	40	141
9	604	1 492	254	897	158	558	44	156	137	483	76	267	6	21
10	868	2 144	575	2 030	372	1 315	106	374	255	902	125	440	21	75
11	504	1 244	355	1 254	226	800	84	297	274	966	164	584	38	133
12	701	1 733	557	1 966	366	1 294	112	396	424	1 499	264	933	53	189
13	867	2 141	604	2 134	415	1 467	113	399	391	1 379	251	887	40	142
14	811	2 005	526	1 858	338	1 193	169	595	399	1 406	222	783	89	314
15	600	1 482	521	1 841	313	1 104	78	277	395	1 394	225	794	38	135
16	579	1 430	838	2 958	628	2 217	222	784	658	2 324	460	1 625	133	468
17	486	1 201	437	1 542	345	1 220	188	663	309	1 089	224	790	97	344
18*	613	1 515	228	805	176	620	92	325	154	543	106	375	43	152
19	695	1 716	700	2 470	547	1 932	285	1 006	513	1 811	366	1 293	156	551

* Volume on 103 ha (255 ac) of forest type 1.3 excluded

TABLE 16 (Continued)

Block	Area		Gross volume						Reliable minimum estimate					
			d.b.h. cm (in)						d.b.h. cm (in)					
			⩾ 7.6 (3.0)		⩾ 15.2 (6.0)		⩾ 25.4 (10.0)		⩾ 7.6 (3.0)		⩾ 15.2 (6.0)		⩾ 25.4 (10.0)	
	ha	ac	'o m^3	'oo ft^3	'o m^3	'oo ft^3	'o m^3	'oo ft^3	'o m^3	'oo ft^3	'o m^3	'oo ft^3	'o m^3	'oo ft^3
20	**551**	1 362	**724**	2 558	**513**	1 812	**277**	976	**532**	1 879	**354**	1 250	**171**	605
21	**601**	1 484	**644**	2 274	**489**	1 727	**254**	897	**478**	1 686	**335**	1 183	**146**	517
22	**540**	1 335	**713**	2 518	**462**	1 630	**159**	560	**567**	2 001	**323**	1 140	**70**	246
23	**340**	839	**671**	2 370	**553**	1 953	**167**	591	**528**	1 866	**412**	1 456	**95**	337
24	**707**	1 746	**841**	2 970	**573**	2 025	**191**	675	**633**	2 234	**391**	1 382	**82**	290
25	**460**	1 138	**711**	2 511	**501**	1 770	**236**	832	**558**	1 971	**364**	1 287	**135**	476
26	**1 250**	3 089	**1 460**	5 155	**898**	3 172	**383**	1 352	**1 067**	3 766	**604**	2 134	**190**	672
27	**558**	1 379	**748**	2 642	**420**	1 484	**96**	338	**560**	1 977	**280**	990	**46**	161
28*	**550**	1 360	**534**	1 887	**373**	1 318	**162**	573	**405**	1 430	**256**	903	**100**	354
29	**646**	1 595	**383**	1 353	**228**	806	**98**	346	**257**	908	**133**	469	**38**	134
30	**978**	2 416	**1 349**	4 765	**854**	3 014	**298**	1 052	**953**	3 364	**560**	1 978	**166**	585
31	**871**	2 152	**1 065**	3 761	**809**	2 857	**542**	1 915	**769**	2 716	**531**	1 876	**308**	1 088
32	**822**	2 032	**1 025**	3 620	**840**	2 965	**485**	1 712	**827**	2 922	**644**	2 274	**348**	1 229
33	**989**	2 445	**749**	2 643	**612**	2 163	**450**	1 589	**572**	2 019	**445**	1 570	**301**	1 062
34	**556**	1 378	**312**	1 100	**266**	939	**214**	754	**227**	803	**184**	649	**142**	501
35	**1 091**	2 696	**587**	2 072	**482**	1 703	**347**	1 226	**370**	1 306	**274**	968	**164**	578
All blocks summed	**24 420**	60 343	**23 582**	83 279	**16 550**	58 446	**7 757**	27 394	**16 988**	59 993	**10 841**	38 285	**4 040**	14 267

* Volume on 98 ha (241 ac) of forest type 1.3 excluded

TABLE 17 Overall mean standing volume per unit area in three pine forest types

Type	Area		Mean						Minimum estimate					
			d.b.h. cm (in)						d.b.h. cm (in)					
			⩾ 7.6 (3.0)		⩾ 15.2 (6.0)		⩾ 25.4 (10.0)		⩾ 7.6 (3.0)		⩾ 15.2 (6.0)		⩾ 25.4 (10.0)	
	ha	ac	m^3/ha	ft^3/ac	m^3/ha	ft^3/ac	m^3/ha	ft^3/ac	m^3/ha	ft^3/ha	m^3/ha	ft^3/ha	m^3/ha	ft^3/ac
1.1	**5 134**	12 686	**19.5**	279	**13.9**	198	**6.0**	86	**18.3**	261	**12.8**	183	**5.3**	76
1.2	**7 342**	18 143	**13.7**	196	**9.7**	139	**4.8**	69	**13.0**	186	**9.2**	131	**4.4**	63
1.3	**6 480**	16 013	**5.7**	81	**3.7**	53	**1.8**	26	**5.4**	77	**3.5**	49	**1.7**	24

TABLE 18 Summary statement of the standing gross volume of pine in three pine forest types in the whole project area

Type	Area		Gross volume						Minimum estimate					
			d.b.h. cm (in)						d.b.h. cm (in)					
			⩾ 7.6 (3.0)		⩾ 15.2 (6.0)		⩾ 25.4 (10.0)		⩾ 7.6 (3.0)		⩾ 15.2 (6.0)		⩾ 25.4 (10.0)	
	ha	ac	'oo m^3	'ooo ft^3	'oo m^3	'ooo ft^3	'oo m^3	'ooo ft^3	'oo m^3	'ooo ft^3	'oo m^3	'ooo ft^3	'oo m^3	'ooo ft^3
1.1	**5 134**	12 686	**1 004**	3 544	**712**	2 515	**309**	1 092	**940**	3 318	**657**	2 320	**273**	964
1.2	**7 342**	18 143	**1 005**	3 549	**716**	2 527	**354**	1 252	**956**	3 375	**672**	2 373	**324**	1 145
1.3	**6 480**	16 013	**369**	1 302	**242**	854	**118**	417	**350**	1 230	**224**	791	**107**	379
3 types summed	**18 956**	48 840	**2 377**	8 393	**1 670**	5 894	**782**	2 761	**2 245**	7 927	**1 553**	5 484	**705**	2 488

TABLE 19 Local volume table for *Pinus caribaea* and *P. oocarpa*

$\log_e$ volume m^3 underbark = 3.028($\log_e$ d.b.h. cm overbark) - 11.34					
d.b.h. overbark		Volume under bark		Confidence limits	
cm	in	m^3	ft^3	$\pm m^3$	$\pm ft^3$
10	3.9	**0.013**	0.46	**0.002**	0.07
15	5.9	**0.043**	1.52		
20	7.9	**0.103**	3.64	**0.006**	0.21
25	9.8	**0.203**	7.17		
30	11.8	**0.353**	12.46	**0.017**	0.60
35	13.8	**0.563**	19.88		
40	15.8	**0.844**	29.80	**0.049**	1.73
45	17.7	**1.205**	42.55		
50	19.7	**1.658**	58.54	**0.122**	4.31
55	21.7	**2.213**	78.14		
60	23.6	**2.880**	101.69	0.254	8.97

TABLE 20 Regeneration of pine *(Pinus caribaea* and *P. oocarpa)* in four forest/vegetation types in 34 management blocks*

Block	Type	Area		Height class**	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
2	1.1	300	740	a b c d	100 184 0 284	40 74 0 115	13 10 0 68	5 4 0 28
2	1.2	159	393	a b c d	238 158 19 414	96 64 8 168	150 104 5 294	61 42 2 119
2	1.3	111	273	a b c d	127 52 0 180	51 21 0 73	45 20 0 96	18 8 0 39
2	3.2	106	262	a b c d	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
3	1.1	245	606	a b c d	356 500 200 1 056	144 202 81 427	77 88 0 241	31 36 0 98
3	1.2	302	746	a b c d	475 329 64 867	192 133 26 351	171 173 17 455	69 70 7 184
3	1.3	126	310	a b c d	1 005 412 95 1 512	407 167 38 612	297 181 23 734	120 73 9 297
3	3.2	52	128	a b c d	270 309 71 650	109 125 29 263	0 0 0 0	0 0 0 0

* All figures rounded to nearest whole number

n.s. = not sampled

\+ Where sampling errors of 100% or higher were obtained, the reliable minimum estimate is zero

** a < 1.5 m (5 ft) b 1.5 - 3.0 m (5 - 10 ft)

c > 3.0 m (10 ft) c total

TABLE 20 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
4	1.1	219	540	a	289	117	136	55
				b	141	57	48	19
				c	78	32	25	10
				d	507	205	295	119
4	1.2	264	653	a	302	122	91	37
				b	216	87	120	49
				c	88	36	42	17
				d	606	245	413	167
4	1.3	275	679	a	464	188	341	138
				b	206	83	121	49
				c	100	40	59	24
				d	769	311	582	236
4	3.2	29	70	a	n.s.	n.s.	n.s.	n.s.
				b	n.s.	n.s.	n.s.	n.s.
				c	n.s.	n.s.	n.s.	n.s.
				d	n.s.	n.s.	n.s.	n.s.
5	1.1	226	557	a	814	329	297	120
				b	1 800	728	451	183
				c	343	139	333	135
				d	2 257	1 197	1 112	450
5	1.2	213	525	a	693	280	417	169
				b	723	293	393	159
				c	140	57	71	29
				d	1 557	630	902	365
5	1.3	328	811	a	900	364	558	226
				b	695	281	356	144
				c	0	0	0	0
				d	1 595	645	1 073	434
5	3.2	0	0	a				
				b				
				c				
				d				
6	1.1	170	420	a	490	198	287	116
				b	231	93	110	45
				c	86	35	39	16
				d	807	327	522	211
6	1.2	319	788	a	482	195	338	137
				b	207	84	121	49
				c	40	16	15	6
				d	729	295	527	213
6	1.3	289	714	a	695	281	512	207
				b	270	109	191	77
				c	29	12	12	5
				d	993	402	785	318
6	3.2	8	21	a	1 083	438	0	0
				b	293	119	0	0
				c	8	3	0	0
				d	1 383	560	185	75

TABLE 20 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
7	1.1	140	345	a	531	215	334	135
				b	352	142	211	85
				c	124	50	64	26
				d	1 007	408	687	278
7	1.2	407	1 006	a	797	323	541	219
				b	342	138	252	102
				c	90	36	10	4
				d	1 229	497	922	373
7	1.3	169	418	a	985	399	599	242
				b	364	147	263	106
				c	100	40	59	24
				d	1 449	586	0	0
7	3.2	11	28	a	1 287	521	490	198
				b	537	217	233	94
				c	92	37	23	9
				d	1 914	775	839	340
8	1.1	66	164	a	259	105	150	61
				b	122	49	65	26
				c	75	30	35	14
				d	456	185	276	112
8	1.2	257	634	a	552	223	385	156
				b	291	118	219	89
				c	70	28	39	16
				d	913	369	709	287
8	1.3	546	1 349	a	703	284	477	193
				b	291	118	207	84
				c	80	32	41	17
				d	1 063	430	774	313
8	3.2	74	182	a	835	338	332	134
				b	125	51	18	7
				c	34	14	0	0
				d	995	403	441	178
9	1.1	19	48	a	63	25	22	9
				b	31	13	4	2
				c	26	11	0	0
				d	120	49	57	23
9	1.2	185	456	a	333	135	141	57
				b	88	36	8	3
				c	12	5	0	0
				d	433	175	189	76
9	1.3	215	532	a	482	195	160	65
				b	114	46	49	20
				c	27	11	0	0
				d	622	252	293	119
9	3.2	153	378	a	355	144	105	42
				b	25	10	11	4
				c	5	2	0	0
				d	385	156	137	55

TABLE 20 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
10	1.1	211	522	a b c d	359 310 69 738	145 125 28 299	88 145 21 330	36 59 8 134
10	1.2	358	885	a b c d	483 611 120 1 252	195 247 49 507	313 351 57 815	127 142 23 330
10	1.3	169	418	a b c d	652 716 122 1 490	264 290 49 603	464 468 55 1 108	188 189 22 448
10	3.2	130	320	a b c d	721 530 124 1 375	292 214 50 556	462 119 42 797	187 48 17 323
11	1.1	100	246	a b c d	587 381 197 1 165	238 154 80 471	385 183 41 697	156 74 17 282
11	1.2	92	228	a b c d	681 290 75 1 048	276 117 30 424	468 207 38 786	189 84 15 318
11	1.3	207	512	a b c d	1 148 495 67 1 709	465 200 27 692	597 232 26 941	242 94 11 381
11	3.2	105	259	a b c d	1 247 206 8 1 449	505 83 3 586	826 145 0 1 034	334 59 0 418
12	1.1	107	265	a b c d	371 436 176 982	150 176 71 397	113 110 77 441	46 45 31 178
12	1.2	146	361	a b c d	369 512 100 977	149 207 40 395	205 189 47 512	83 76 19 207
12	1.3	136	336	a b c d	610 669 80 1 351	247 271 32 547	424 375 5 882	172 152 2 357
12	3.2	299	739	a b c d	840 154 3 987	340 62 1 399	541 32 0 654	219 13 0 265

TABLE 20 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
13	1.1	178	439	a	410	166	167	68
				b	460	186	201	81
				c	187	76	106	43
				d	1 010	409	519	210
13	1.2	159	393	a	288	117	194	79
				b	127	51	69	28
				c	59	24	7	3
				d	474	192	450	182
13	1.3	153	378	a	667	270	438	177
				b	451	183	244	99
				c	69	28	22	9
				d	1 186	480	792	321
13	3.2	368	909	a	847	343	590	239
				b	361	146	204	83
				c	32	13	0	0
				d	1 243	503	840	340
14	1.1	90	222	a	1 024	414	576	233
				b	584	236	364	147
				c	197	80	74	30
				d	1 782	721	1 098	444
14	1.2	280	692	a	1 042	422	734	297
				b	744	301	503	204
				c	114	46	29	12
				d	1 846	747	1 180	478
14	1.3	360	890	a	1 273	515	834	338
				b	408	165	296	120
				c	198	80	0	0
				d	1 710	692	1 235	500
14	3.2	80	198	a	1 518	614	1 065	431
				b	341	138	227	92
				c	16	6	1	0
				d	1 874	758	1 343	543
15	1.1	58	142	a	136	55	71	29
				b	88	36	31	13
				c	33	13	3	1
				d	258	104	146	59
15	1.2	173	428	a	184	74	117	47
				b	228	92	84	34
				c	186	75	22	9
				d	526	213	197	80
15	1.3	123	303	a	412	167	249	101
				b	370	150	220	89
				c	80	32	2	1
				d	862	349	537	217
15	3.2	117	288	a	851	344	578	234
				b	507	205	267	108
				c	23	9	0	0
				d	1 381	559	929	376

TABLE 20 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
16	1.1	135	333	a b c d	195 102 48 345	79 41 19 140	4 0 36 136	2 0 15 55
16	1.2	209	516	a b c d	259 134 4 390	105 54 2 158	92 46 0 167	37 19 0 68
16	1.3	132	325	a b c d	370 182 20 567	150 74 8 229	216 80 0 345	87 32 0 140
16	3.2	9	22	a b c d	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.
17	1.1	91	224	a b c d	161 145 81 387	65 59 33 157	79 65 31 230	32 26 13 93
17	1.2	165	407	a b c d	382 402 191 968	155 163 77 392	167 19 0 265	68 8 0 107
17	1.3	110	272	a b c d	337 190 54 598	136 77 22 242	157 93 8 316	64 38 3 128
17	3.2	38	93	a b c d	919 267 9 1 195	372 108 4 484	510 108 0 754	206 44 0 305
18	1.1	134	332	a b c d	102 151 67 311	41 61 27 126	26 74 22 154	11 30 9 62
18	1.2	103	255	a b c d	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.
18	1.3	167	412	a b c d	900 557 59 1 516	364 225 24 614	588 310 8 1 037	238 125 3 420
18	3.2	195	482	a b c d	1 120 421 7 1 548	453 170 3 626	626 155 1 890	253 63 0 360

TABLE 20 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
19	1.1	90	223	a b c d	229 249 124 610	93 101 50 247	135 125 57 396	55 51 23 160
19	1.2	152	376	a b c d	315 309 147 770	127 125 59 312	212 174 17 501	86 70 7 203
19	1.3	268	662	a b c d	267 344 67 678	108 139 27 274	115 177 7 373	47 72 3 151
19	3.2	41	102	a b c d	1 089 811 109 1 993	441 328 44 807	0 0 8 0	0 0 3 0
20	1.1	152	375	a b c d	115 210 854 1 180	47 85 346 478	39 95 282 571	16 38 114 231
20	1.2	218	539	a b c d	188 300 407 895	76 121 165 362	65 87 45 332	26 35 18 134
20	1.3	114	282	a b c d	356 393 283 1 032	144 159 115 418	189 218 122 634	76 88 49 257
20	3.2	24	59	a b c d	850 556 66 1 471	344 225 27 595	354 188 0 593	143 76 0 240
21	1.1	134	331	a b c d	129 113 58 300	52 46 23 121	21 17 7 96	8 7 3 39
21	1.2	139	343	a b c d	408 333 16 757	165 135 6 306	251 191 3 480	102 77 1 194
21	1.3	139	342	a b c d	469 213 26 707	190 86 11 286	272 136 10 454	110 55 4 184
21	3.2	64	159	a b c d	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.

TABLE (20 Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
22	1.1	65	160	a	469	190	233	94
				b	242	98	22	9
				c	231	93	5	2
				d	941	381	719	291
22	1.2	227	562	a	302	122	100	40
				b	187	76	154	62
				c	130	53	49	20
				d	614	248	450	182
22	1.3	135	332	a	605	245	380	154
				b	312	126	223	90
				c	191	77	41	17
				d	1 041	421	739	299
22	3.2	0	0	a				
				b				
				c				
				d				
23	1.1	71	176	a	168	68	78	32
				b	193	78	150	61
				c	82	33	22	9
				d	443	179	255	103
23	1.2	193	476	a	588	238	290	117
				b	192	78	114	46
				c	47	19	25	10
				d	827	335	465	188
23	1.3	43	106	a	713	289	452	183
				b	387	157	228	92
				c	57	23	28	11
				d	1 162	470	738	299
23	3.2	0	0	a				
				b				
				c				
				d				
24	1.1	201	496	a	206	83	61	25
				b	150	61	69	28
				c	46	19	14	6
				d	402	163	185	75
24	1.2	180	445	a	450	182	303	123
				b	336	136	232	94
				c	146	59	89	36
				d	948	384	702	284
24	1.3	196	483	a	261	106	108	44
				b	176	71	63	25
				c	37	15	0	0
				d	474	192	186	75
24	3.2	14	34	a	404	163	119	48
				b	281	114	142	57
				c	53	21	15	6
				d	739	299	348	141

TABLE (20 Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
25	1.1	156	386	a	707	286	435	176
				b	393	159	268	108
				c	181	73	100	40
				d	1 324	536	926	375
25	1.2	142	352	a	976	395	522	211
				b	421	170	178	72
				c	132	53	52	21
				d	1 503	608	822	333
25	1.3	80	198	a	1 273	515	583	236
				b	579	234	336	136
				c	154	62	16	6
				d	2 006	812	1 086	439
25	3.2	76	188	a	770	312	0	0
				b	555	225	84	34
				c	147	59	0	0
				d	1 472	596	129	52
26	1.1	316	781	a	457	185	181	73
				b	537	217	159	64
				c	293	119	81	33
				d	1 287	521	507	205
26	1.2	355	877	a	390	158	259	105
				b	327	132	199	81
				c	90	36	31	13
				d	831	336	576	233
26	1.3	320	790	a	709	287	436	176
				b	700	283	353	143
				c	514	208	117	47
				d	1 836	743	1 031	417
26	3.2	230	568	a	325	132	109	44
				b	233	94	68	28
				c	51	21	2	1
				d	607	246	202	82
27	1.1	245	605	a	346	140	138	56
				b	661	267	197	80
				a	314	127	51	21
				d	1 346	545	526	213
27	1.2	152	375	a	300	121	148	60
				b	351	142	193	78
				c	104	42	418	169
				d	755	306	412	167
27	1.3	69	170	a	383	155	220	89
				b	259	105	151	61
				c	41	17	8	3
				d	683	276	429	174
27	3.2	24	60	a	742	300	186	75
				b	251	102	41	17
				c	4	2	0	0
				d	997	403	235	95

TABLE 20 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
28	1.1	147	364	a b c d	358 571 169 1 098	145 231 68 444	135 285 61 575	55 115 25 233
28	1.2	244	604	a b c d	249 404 81 726	101 163 33 294	149 217 28 423	60 88 11 171
28	1.3	98	241	a b c d	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.
28	3.2	0	0	a b c d				
29	1.1	71	175	a b c d	54 132 214 351	22 53 87 142	0 34 21 38	0 14 8 15
29	1.2	207	512	a b c d	283 272 162 721	115 110 66 292	0 0 18 75	0 0 7 30
29	1.3	64	158	a b c d	284 84 44 406	115 34 18 164	0 25 0 6	0 10 0 2
29	3.2	46	113	a b c d	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.
30	1.1	299	738	a b c d	767 673 380 1 887	310 272 154 764	281 366 184 1 018	114 148 74 412
30	1.2	280	691	a b c d	278 265 269 808	113 107 109 327	0 92 96 277	0 37 39 112
30	1.3	157	388	a b c d	731 533 198 1 463	296 216 80 592	465 367 82 1 012	188 149 33 410
30	3.2	8	21	a b c d	269 44 4 291	109 18 2 118	83 13 0 108	34 5 0 44

TABLE 20 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
31	1.1	309	763	a	325	132	92	37
				b	253	102	114	46
				c	138	56	57	23
				d	719	291	330	134
31	1.2	160	396	a	646	261	444	180
				b	389	157	267	108
				c	227	92	121	49
				d	1 262	511	933	378
31	1.3	190	470	a	702	284	463	187
				b	564	228	336	136
				c	140	57	35	14
				d	1 406	569	947	383
31	3.2	155	384	a	148	60	42	17
				b	54	22	16	6
				c	5	2	0	0
				d	206	83	59	24
32	1.1	78	192	a	100	40	0	0
				b	52	21	0	0
				c	72	29	8	3
				d	224	91	0	0
32	1.2	402	994	a	135	55	59	24
				b	113	46	46	19
				c	93	38	43	17
				d	346	140	179	72
32	1.3	182	450	a	891	361	559	226
				b	380	154	245	99
				c	52	21	18	7
				d	1 320	534	957	387
32	3.2	11	26	a	n.s.	n.s.	n.s.	n.s.
				b	n.s.	n.s.	n.s.	n.s.
				c	n.s.	n.s.	n.s.	n.s.
				d	n.s.	n.s.	n.s.	n.s.
33	1.1	151	374	a	386	156	145	59
				b	104	42	37	15
				c	237	96	70	28
				d	728	295	442	179
33	1.2	165	407	a	368	149	173	70
				b	34	14	0	0
				c	9	4	0	0
				d	411	166	214	87
33	1.3	299	738	a	705	285	390	158
				b	175	71	93	38
				c	48	19	20	8
				d	927	375	600	243
33	3.2	280	693	a	1 006	407	482	195
				b	104	42	0	0
				c	11	4	2	1
				d	1 121	454	608	246

TABLE 20 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
34	1.1	74	184	a b c d	170 202 146 518	69 82 59 210	79 115 57 307	32 47 23 124
34	1.2	63	155	a b c d	128 235 168 550	52 95 68 223	50 93 470 237	20 38 190 96
34	1.3	72	178	a b c d	283 338 162 783	115 137 66 317	199 180 118 505	81 73 48 204
34	3.2	237	586	a b c d	755 404 13 1 172	306 163 5 474	309 230 0 589	125 93 0 238
35	1.1	88	217	a b c d	691 184 25 900	280 74 10 364	165 97 5 304	67 39 2 123
35	1.2	273	674	a b c d	823 277 40 1 140	333 112 16 461	557 202 15 820	225 82 6 332
35	1.3	442	1 092	a b c d	896 164 16 1 076	363 66 6 435	538 108 4 687	218 44 2 278
35	3.2	208	513	a b c d	1 757 318 4 2 079	711 129 2 841	1 079 162 0 1 324	437 66 0 536

TABLE 21 Regeneration of *Pinus caribaea* in four forest/vegetation types in five management blocks*

Block	Type	Area		Height class**	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
20	1.1	152	375	a	69	28	7	3
				b	41	17	16	6
				c	128	52	0	0
				d	239	97	74	30
20	1.2	218	539	a	86	35	17	7
				b	136	55	12	5
				c	275	111	0	0
				d	496	201	121	49
20	1.3	114	282	a	341	138	179	72
				b	370	150	209	85
				c	233	94	86	35
				d	944	382	571	231
20	3.2	24	59	a	850	344	354	143
				b	556	225	188	76
				c	66	27	0	0
				d	1 471	595	593	240
21	1.1	134	331	a	74	30	0	0
				b	81	33	0	0
				c	42	17	0	0
				d	197	80	8	3
21	1.2	139	343	a	400	162	246	100
				b	316	128	180	73
				c	16	6	3	1
				d	733	297	473	191
21	1.3	139	342	a	457	185	264	107
				b	174	70	99	40
				c	17	7	4	2
				d	648	262	405	164
21	3.2	64	159	a	n.s.	n.s.	n.s.	n.s.
				b	n.s.	n.s.	n.s.	n.s.
				c	n.s.	n.s.	n.s.	n.s.
				d	n.s.	n.s.	n.s.	n.s.

* All figures rounded to nearest whole number

+ Where sampling errors of 100% or higher were obtained, the reliable minimum estimate is zero

n.s. = not sampled

** a < 1.5 m (5 ft) b 1.5 - 3.0 m (5 -10 ft)

c > 3.0 m (10 ft) d total

TABLE 21 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate +	
		ac	ha		stems/ha	stems/ac	stems/ha	stems/ac
33	1.1	151	374	a	229	93	11	4
				b	82	33	22	9
				c	212	86	44	18
				d	524	212	114	46
33	1.2	165	407	a	293	119	107	43
				b	34	14	0	0
				c	9	4	0	0
				d	336	136	147	59
33	1.3	299	738	a	694	281	378	153
				b	164	66	83	34
				c	33	13	10	4
				d	891	361	559	226
33	3.2	280	693	a	1 006	407	482	195
				b	104	42	0	0
				c	11	4	2	1
				d	1 121	454	608	246
34	1.1	74	184	a	120	49	37	15
				b	130	53	65	26
				c	98	40	14	6
				d	348	141	171	69
34	1.2	63	155	a	120	49	43	17
				b	213	86	70	28
				c	160	65	25	10
				d	513	208	196	79
34	1.3	72	178	a	207	84	91	37
				b	205	83	63	25
				c	79	32	15	6
				d	491	199	255	103
34	3.2	237	586	a	747	302	313	127
				b	386	156	201	81
				c	8	3	0	0
				d	1 141	462	540	219
35	1.1	88	217	a	650	263	120	49
				b	163	66	73	30
				c	13	5	0	0
				d	825	334	222	90
35	1.2	273	674	a	804	325	535	217
				b	252	102	168	68
				c	39	16	13	5
				d	1 094	443	767	310
35	1.3	442	1 092	a	872	353	518	210
				b	150	61	96	39
				c	14	6	3	1
				d	1 036	419	645	261
35	3.2	208	513	a	1 755	710	1 075	435
				b	316	128	153	62
				c	4	2	0	0
				d	2 075	840	1 320	534

TABLE 22 Regeneration of *Pinus oocarpa* in four forest/vegetation types in five management blocks*

Block	Type	Area		Height class**	Mean		Reliable min. estimate +	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
20	1.1	152	375	a b c d	46 169 726 941	19 68 294 381	6 50 277 316	2 20 112 128
20	1.2	218	539	a b c d	102 164 132 398	41 66 53 161	0 0 0 0	0 0 0 0
20	1.3	114	282	a b c d	15 22 50 87	6 9 20 35	0 0 0 0	0 0 0 0
20	3.2	24	59	a b c d	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0
21	1.1	134	331	a b c d	55 32 16 103	22 13 6 42	0 0 0 16	0 0 0 6
21	1.2	139	343	a b c d	8 16 0 25	3 6 0 10	0 0 0 6	0 0 0 2
21	1.3	139	342	a b c d	11 39 9 59	4 16 4 24	1 20 1 31	0 3 0 12
21	3.2	64	159	a b c d	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.	n.s. n.s. n.s. n.s.

* All figures rounded to nearest whole number

\+ Where sampling errors of 100% or higher were obtained, the reliable minimum estimate is zero

n.s. = not sampled

** a < 1.5 m (5 ft)   b 1.5 - 3.0 m (5 - 10 ft)

c > 3.0 m (10 ft)   d total

TABLE 22 (Continued)

Block	Type	Area		Height class	Mean		Reliable min. estimate	
		ha	ac		stems/ha	stems/ac	stems/ha	stems/ac
33	1. 1	151	374	a	157	64	29	12
				b	22	9	0	0
				c	26	11	0	0
				d	204	83	68	28
33	1. 2	165	407	a	75	30	0	0
				b	0	0	0	0
				c	0	0	0	0
				d	75	30	0	0
33	1. 3	299	738	a	11	4	0	0
				b	11	4	0	0
				c	14	6	0	0
				d	37	15	0	0
33	3. 2	280	693	a	0	0	0	0
				b	0	0	0	0
				c	0	0	0	0
				d	0	0	0	0
34	1. 1	74	184	a	50	20	3	1
				b	71	29	3	1
				c	48	19	8	3
				d	170	69	24	10
34	1. 2	63	155	a	8	3	0	0
				b	23	9	0	0
				c	8	3	0	0
				d	38	15	0	0
34	1. 3	72	178	a	76	31	0	0
				b	133	54	32	13
				c	83	34	5	2
				d	293	119	67	27
34	3. 2	237	586	a	8	3	0	0
				b	18	7	0	0
				c	5	2	0	0
				d	31	13	0	0
35	1. 1	88	217	a	41	17	0	0
				b	22	9	7	3
				c	13	5	0	0
				d	75	30	19	8
35	1. 2	273	674	a	19	8	0	0
				b	25	10	0	0
				c	2	1	0	0
				d	46	19	0	0
35	1. 3	442	1 092	a	24	10	0	0
				b	14	6	0	0
				c	2	1	0	0
				d	40	16	0	0
35	3. 2	208	513	a	3	1	0	0
				b	2	1	0	0
				c	0	0	0	0
				d	5	2	0	0

PART 6. CONCLUSIONS

EXPLOITABLE GROWING STOCK

Taking the project area as a whole, it is clear that with the present low standing volume of pine and the negligible proportion of the growing stock which has reached or is near the minimum exploitable size(i.e. 107 cm, 42 in girth or 34 cm, 13 in d.b.h.) that the resumption of exploitation for saw-timber must await recruitment from material which is at present only small.

Sample plot data recorded by the Forest Department from the Mountain Pine Ridge indiciate a mean annual increment in d.b.h. of about 1 cm (0.4 in). Thus it takes five years for a tree to pass through a single 5 cm d.b.h. class. On the basis of this rate of growth it can be seen from the stem number curves (Figures 5-7) that there will not be a significant increase (shown by the change in slope) in the present low rate of recruitment to minimum exploitable size for 10-15 years. To achieve the modest stocking of 50 exploitable trees per ha (20 stems/ac) would take, even in the absence of exploitation, 15-20 years.

The steep gradient of the curves signifies that once recruitment to exploitable size does start to increase, it will proceed quickly: a preponderance of mature trees can be foreseen, following from the predominance of small material now. Such a pattern is to be expected, bearing in mind the recent history of exploitation and the tendency for pine to form even-aged stands.

The stem number curves suggest that there will be for a considerable time appreciable differences between the three pine forest types in terms of the stocking of exploitable trees and the yield which can be obtained from them. If it is assumed that trees are harvested as they reach exploitable size (ie yield = recruitment), but ignoring loss by thinning, the annual yield after, say, 20 years for type 1.1 is likely to be of the order of 25 exploitable trees per ha (10 stems/ac), which represents approximately 12 m^3/ha (172 ft^3/ac). Comparable figures for type 1.2 are 15 stems/ha (6 stems/ac) or 8 m^3/ha (114 ft^3/ac), while the yield after 20 years for type 1.3 is likely to be only about 6 stems/ha (2.4 stems/ac) or 3 m^3/ha (43 ft^3/ac).

In the longer term (ie 25 years plus), as the growing stock matures and as thinning and exploitation have a greater effect on the dense than on the less dense stands, the difference in stocking between the forest types should diminish and the yield throughout the project area become more uniform. The summarised stand tables (Table 14) show that if material presently below the 10 cm (3.9 in) diameter class is taken into account, all three forest types have the potential to produce eventually a mean stocking of exploitable trees equivalent to that to be expected from plantations*.

SEEDLING REGENERATION

In the long term the present stocking of regeneration (i.e. stems of d.b.h. less than 5 cm, 2 in d.b.h.) is relevant. The regeneration figures show (Table 4) that 71% of the total project area carries a minimum stocking of pine seedlings of 250 stems/ha (101 stems/ac), a level of stocking which may be taken as an arbitrary but lenient criterion of success. From the area breakdown given in Table 12, it follows that only 10% of the project area (i.e. broadleaved forest, swamp and 'other') can be regarded as incapable of carrying naturally regenerated pine forest. The total potential area of pine - that is pine forest types 1.1, 1.2 and 1.3 and grassland types 3.1 and 3.2 - is 222 km^2 (86 mi^2), of which one fifth or 4 700 ha (12 100 ac) has a minimum stocking of less than 250 stems/ha (101 stems/ac).

Very much meaning cannot be attached to regeneration figures except in the context of a particular management block and forest/vegetation type, because regeneration is significant only in relation to the stocking of larger material. A low regeneration count, for example, can be obtained from both (a) an area with few trees of any size and (b) a well stocked stand which has passed through the regeneration stage.

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* Luckhoff (1964) quotes a final stocking rate of 321 stems/ha (130 stems/ac) for *Pinus caribaea* in plantations in South Africa.

SILVICULTURE

Thinning

The low stocking of the principal species, *Pinus caribaea*, indicates that only a low yield can be expected from thinnings. Although average figures conceal the considerable variation in stand density, it seems clear that only light thinning will be justified in the two denser pine forest types (1.1 and 1.2), with virtually none in type 1.3. Heavier thinning may be appropriate in the denser stands of *P. occarpa*.

Broadleaved weed species

The encroachment on to the Pine Ridge by broadleaved species, especially oak, apparently as a result of fire protection, suggests that there may be reason to consider the reintroduction of controlled burning. The advantage of burning over both cutting and chemical control is that, as well as reducing competition to pine from broadleaved species, it prevents the accumulation of combustible materials on the forest floor. Burning is also comparatively cheap. There is no reason why the silvicultural use of fire should not be perfected as a routine technique in the Mountain Pine Ridge as it has been in pine forest in the southern United States. An important point in relation to controlled burning is that fire-scarring of standing trees by too hot a fire should be avoided because of the known tendency for decay organisms to enter through fire scars.

Repeated burning should perhaps not be practiced in stands of *P. oocarpa*. This species' fire tenderness, its tendency to form a closed canopy, so inhibiting the spread of weed species, and its association with a lush ground cover of *Tripsacum/Dicranopteris* which is not readily flammable but which, once ignited, produces an intense fire, all suggest that repeated burning may be inappropriate in *P. oocarpa* forest. This is not to say that fire may not have a role at certain stages in the production period, probably, for example, before final felling and regeneration. The five management blocks which contain a significant proportion of *P. oocarpa* regeneration are in those parts of the project area where controlled burning would be most difficult because of the steep terrain.

UTILISATION

In view of the number of years which must elapse before sawmilling can start again, the possibility of utilising material below sawlog size for industrial wood-based products is of interest. Investigations are currently being made by the Tropical Products Institute into the suitability for industrial use of *Pinus caribaea* from the Mountain Pine Ridge and elsewhere in Belize. Possibilities being studied are pulp, particle board and cement bonded building board. The only conclusion which can be drawn from the inventory results is that as the supply of even small material will be very limited, any industrial operation dependent for its raw material largely or entirely upon the Mountain Pine Ridge would have to be of a kind capable of economic small-scale production.

To put into perspective the present standing volume of material of d.b.h. 7.6 cm. (3 in) and above (see Table 18), it represents about a year's supply for a pulp mill (using 295t/day, 300 ton/day) or 10 years' supply for a particle board plant (using 30t/day, 30 ton/day).

Prospects for the establishment of a wood-based industry depend of course on a number of factors in addition to the quantity and quality of available raw material. In the context both of Belize and Central America generally, markets are likely to present a serious problem irrespective of technical considerations.

Other outlets which may exist for small material, for example construction and fencing, are of interest in relation to thinnings. Ways in which the utility of early thinnings can be increased, such as preservative treatment, may be worth investigating.

RESEARCH

The lack of adequate information on and the incomplete understanding of certain aspects of the pine resource and its environment which are relevant to forest management indicate a need for research. Directions which research should take have been suggested by two successive Forestry Advisers - Logan (1966) and Wyatt-Smith (1970). Subjects which one or both have recommended as deserving research are as follows:

1. The conditions favouring the natural regeneration of pine, including the role (if any) of fire

2. The control of invading broadleaves species, including the use of controlled burning

3. The rate of increment of pine and the response to thinning

4. The success of both pine and broadleaved timber species, grown under plantation conditions

These recommendations remain valid and warrant consideration. The first two listed, which embrace the fire ecology of the savanna, are particularly relevant at the present stage of development of the pine resource.

To the recommendations above may be added the suggestion that methods should be investigated of increasing the low rate of growth of the naturally regenerated pine. In particular, aerial application of fertiliser, especially phosphate, might be considered.

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APPENDICES 1 - 5

APPENDIX 1.
SOIL PROFILE DESCRIPTIONS*

In the soil descriptions given below, map references quoted apply to 1:50 000 scale maps, DOS 4499 (series E 755). The locations of the three traverses along which sampling was done are as follows:

i. Cooma Cairn road: Sheet 24, grid reference 941,853 to 935,842

ii. Navel road: Sheet 29, grid reference 970,770 to 970,778

iii. Chiquibul road: Sheet 28, grid reference 863,717 to 865,729

PINOL COARSE SANDY CLAY LOAM

Location:	Map sheet 24, grid reference 937.5,847
Situation:	Mid slope
Slope:	10%
Aspect:	NW
Forest/vegetation type:	1.3

Horizon	Depth cm (in)	Description
1	0-8 (0-3.2)	Very dark greyish brown (2.5Y 3/2), moist; unmottled; sandy loam; moderate medium subangular blocky structure; friable consistence, moist; few small interstitial, small and medium tubular, and small vesicular pores; few medium and large subangular quartz grains; few small ants; many small fibrous and small and medium woody roots; clear, smooth boundary to:
2	8-20 (3.2-7.9)	Brownish yellow (10YR 6/6), moist; unmottled; gritty sandy clay loam; weak medium subangular blocky structure; friable consistence, moist; common small interstitial and tubular, and few medium tubular pores; common to many small medium and large subangular quartz grains, few large subangular feldspar grains, few small subangular quartz stones; common small fibrous and few small woody roots; clear, smooth boundary to:
3	20-35 (7.9-13.8)	Yellow (10YR 7/8), moist; common small and medium distinct and prominent red mottles; gritty sandy clay; moderate fine to medium subangular blocky structure; firm consistence, moist; few small interstitial and tubular pores; common medium and large subangular quartz grains, few large subangular feldspar grains, few small subangular quartz stones; few small fibrous roots; wavy, gradual boundary to:
4	35-120 (13.8-47.2)	Yellow (10YR 8/8), moist; many medium and large prominent red and few medium distinct brownish yellow mottles; gritty sandy clay; weak fine to medium subangular blocky structure; firm consistence, moist; few small interstitial and tubular pores; common large subangular quartz grains, few medium and large rotting feldspar grains, few small rotting feldspar stones; few small fibrous roots; boundary not observed to:

* Descriptions are made from soil pits to a depth of 60 cm (24 in); horizons below that depth are described from auger samples and structure and pores could not be observed.

Horizon	Depth cm (in)	Description
5	120-140 (47.2-55.1)	Brownish yellow (10YR 6/8), moist, many medium and large prominent red mottles; gritty sandy clay; firm consistence, slightly moist; common to medium and large subangular to angular quartz grains, few medium and large rotting feldspar grains, few small rotting feldspar stones; few small fibrous roots; boundary not observed to:
6	140-200+ (55.1-78.7+)	Red (2.5YR 5/8), moist; common medium distinct brownish yellow mottles; gritty sandy clay; firm consistence, slightly moist; common medium and large quartz and rotting feldspar grains, few small quartz and rotting feldspar stones.

PINOL LOAMY COARSE SAND

Location:	Map sheet 28, grid reference 866,722.5
Situation:	Upper slope
Slope:	6%, slightly concave
Aspect:	NW
Forest/vegetation type:	1.1

Horizon	Depth cm (in)	Description
1	0-6 (0-2.4)	Brown (10YR 4/3), moist; unmottled; loamy sand; very weak fine subangular blocky structure; loose consistence, moist; many small interstitial and tubular and few medium tubular pores; many small, medium and large quartz grains; many small fibrous and few small woody roots; clear, smooth boundary to:
2	6-35 (2.4-13.8)	Reddish yellow (7.5YR 6/6), moist; unmottled; sand; weak medium subangular blocky structure; loose consistence, moist; many small interstitial and tubular and few medium tubular pores; many small medium and large quartz grains; many small fibrous and few small woody roots; wavy, gradual boundary to:
3	35-80 (13.8-31.5)	Brownish yellow (10YP 6/8), moist; unmottled; sand; very weak coarse subangular blocky structure; loose consistence, moist; many small interstitial, few small and medium tubular and vesicular pores; many small medium and large quartz grains, few small subangular quartz stones; common small fibrous roots; boundary not observed to:
4	80-140 (31.5-55.1)	Reddish yellow (7.5YR 6/8), moist; common medium and large prominent red mottles; gritty sandy clay loam; firm consistence, moist; common large quartz grains, few small subangular quartz stones; few small fibrous roots; boundary not observed to:
5	140-180+ (55.1-70.9+)	Many prominent mottles of light grey, yellow, reddish yellow and red, moist; gritty clay; firm consistence, slightly moist; common large quartz grains; common large grains and small stones of rotting feldspar.

PINOL CREEK SOIL*

Location: Map sheet 29, grid reference 970,774

Situation: Valley bottom

Forest/vegetation type: 2.2

Horizon	Depth cm (in)	Description
1	0-12 (0-4.7)	Very dark greyish brown (2.5Y 3/2), moist; unmottled; sandy loam; very weak subangular blocky structure; very friable consistence, moist; common small interstitial and small and medium tubular pores; common small and few medium quartz grains; many small fibrous, common small and medium woody roots; smooth gradual boundary to:
2	12-25 (4.7-9.8)	Very dark greyish brown (2.5Y 3/2), moist; unmottled; silty sandy loam; very weak medium subangular blocky structure; friable consistence, moist; common small interstitial and small and medium tubular pores; common small and few medium quartz grains; common small fibrous and woody roots; wavy, gradual boundary to:
3	25-50 (9.8-19.7)	Very dark greyish brown (2.5Y 3/2), moist; unmottled; silty sandy loam; weak medium subangular blocky structure; friable consistence, moist; common small interstitial and small and medium tubular pores; common small and few medium quartz grains; common small fibrous and small medium woody roots; smooth gradual boundary to:
4	50-80 (19.7-31.5)	Very dark grey to dark grey (5Y 3-4/1), moist; common small and medium faint brown mottles; silty clay loam; weak coarse angular blocky structure; firm consistence, moist to very moist; common small tubular and interstitial pores; common small and few medium quartz grains; common small fibrous and woody roots; boundary not observed to:
5	80-140 (31.5-55.1)	Black (10YR 2/1), moist; unmottled; silty clay loam; structureless; sticky consistence, wet; few small and medium interstitial pores; no coarse material present; common small fibrous and woody roots; boundary not observed to:
6	140-170+ (55.1-66.9+)	White coarse sand. Few small and medium and many large subangular to subrounded quartz grains. Few medium and large subrounded feldspar grains. Few small subangular to subrounded quartz stones.

PINOL SANDY CLAY LOAM HILL SOIL**

Location: Map sheet 29, grid reference 970,771

Situation: Planar hill top

Forest/vegetation type: 3.2

Horizon	Depth cm (in)	Description
1	0-12 (0-4.7)	Yellowish brown (10YR 5/4), moist; unmottled; stony sandy loam; weak, fine subangular blocky structure dominated by stones; friable consistence, moist; common small interstitial and small and medium vesicular pores; common small quartz grains, many small, medium and large angular and weathered purple subangular phyllite stones; many small fibrous roots; wavy, clear boundary to:

* Not recognised by Wright *et al.* (1959)
** Equivalent to the Pinol sandy clay hill soil described by Wright *et al.* (1959)

Horizon	Depth cm (in)	Description
2	12-35 (4.7-13.8)	Brownish yellow (10YR 6/8), moist; few small and medium prominent red mottles especially around weathered stones; stony silty loam; weak to moderate subangular blocky structure dominated by stones; slightly firm consistence, moist; common small and medium interstitial and tubular and few medium vesicular pores; few large phyllite grains, common small quartz grains, common small, medium and few large angular to subangular purple to red weathering phyllite stones; few millepedes; common small fibrous roots; irregular clear boundary to:
3	30-70 (13.8-27.8)	Yellow (10YR 7/8), moist; common to many medium and large prominent red mottles formed from soft weathered phyllite stones; silty loam; weak coarse angular blocky structure; friable consistence, slightly moist; common small tubular and few small interstitial pores; few large phyllite grains, common small, medium and large soft weathered phyllite stones, common small quartz grains; few to common small fibrous roots; abrupt broken boundary to:
4	70+ (27.8+)	Grey phyllite, weathering purple at edges, dip 170°, strike 30°, strong cleavage at 60°.

PINOL SANDY CLAY LOAM

Location: Map sheet 24, grid reference 940,851

Situation: Mid slope

Slope: 12%

Aspect: S

Forest/vegetation type: 1.2

Horizon	Depth cm (in)	Description
1	0-10 (0-3.9)	Brown (10YR 4/3), moist; unmottled; sandy clay loam; moderate, medium subangular blocky structure; slightly firm consistence, moist; common small interstitial and tubular and few medium and large tubular pores; few small, medium and large quartz grains; many small fibrous and few small and medium woody roots; smooth clear boundary to:
2	10-25 (3.9-9.8)	Reddish yellow with common brown stains on ped faces (7.5YR 6/6), moist; few small distinct red mottles; sandy clay loam; weak medium subangular blocky structure; slightly firm consistence, moist; common small interstitial and tubular and few medium and large tubular pores; few small, medium and large quartz grains, few small and medium, angular to subangular slate stones; common small fibrous and few small medium and large woody roots; smooth gradual boundary to:
3	25-40 (9.8-15.8)	Reddish yellow (7.5YR 6/8), moist; common small and medium faint to distinct red mottles; gritty sandy clay; weak coarse angular blocky structure; firm consistence, moist; common small tubular, few small interstitial and medium tubular pores; few small and medium and common large quartz grains, few small subangular quartz stones; few small and medium subangular phyllite stones; few small ants; common small fibrous roots; irregular gradual boundary to:

Horizon	Depth cm (in)	Description
4	40-120 (15.8-47.2)	Reddish yellow (7.5YR 7/8), moist; many medium and large prominent red mottles; gritty sandy clay; moderate coarse angular blocky structure; firm consistence, moist; few small interstitial and common small tubular pores; few small and medium and common large quartz grains; few small fibrous roots; boundary not observed to:
5	120-160 (47.2-63.0)	Many mottles of red, dark red, yellow and reddish yellow; gritty sandy clay; firm consistence, moist; few small and medium and common large quartz grains; common rotted slate stones in the form of dark red mottles.

ALLUVIAL SOIL*

Location;	Map sheet 28, grid reference 865,720
Situation:	Valley bottom
Forest/vegetation type	2.2

Horizon	Depth cm (in)	Description
1	0-10 (0-3.9)	Very dark greyish brown (10YR 3/2), moist; unmottled; loam; strong fine subangular blocky structure; friable consistence, slightly moist; common small and medium interstitial and tubular, few medium tubular, few medium and large vesicular (with worm casts) pores; common small and few medium quartz grains; many small fibrous, common small woody and few medium woody roots; clear smooth boundary to:
2	10-22 (3.9-8.7)	Very dark greyish brown (10YR 3/2), moist; unmottled; loam; strong fine to medium subangular blocky structure; friable consistence, slightly moist; common small interstitial and tubular, few medium tubular and medium and large interstitial, few medium and large (with worm casts) pores; common small and few medium quartz grains; few large earthworms, common small fibrous, few small woody roots; clear smooth boundary to:
3	22-45 (8.7-17.7)	Very dark greyish brown (10YR 3/2), moist; unmottled; sandy loam; moderate fine to medium subangular blocky structure; very friable consistence, moist; common small interstitial and tubular, few medium tubular, few medium and large (with worm casts) vesicular pores; common to many small, medium and few large quartz grains; common small fibrous, few small woody roots; gradual smooth boundary to:
4	45-55 (17.7-21.7)	Dark brown (10YR 3/3), moist; unmottled; sandy loam; weak medium subangular blocky structure; very friable consistence, moist; common small interstitial, few small medium and large tubular pores; common to many small medium and few large quartz grains; common small fibrous, few small woody roots; clear smooth boundary to:
5	55-110 (21.7-43.3)	Brown (10YR 4/3), moist; unmottled; loamy sand; weak coarse angular blocky structure; loose consistence, moist; common small interstitial and few small and medium tubular pores; many small and medium and few large quartz grains; few small fibrous roots; boundary not observed to:

* Not recognised by Wright *et al.* (1959).

Horizon	Depth cm (in)	Description
6	110-125 (43.3-49.2)	Brown (10YR 4/3), moist; common small and medium faint and distinct grey, yellowish brown and brownish yellow mottles; loamy sand; loose consistence, moist; many small and medium quartz grains; boundary not observed to:
7	125-205+(49.2-80.7+)	Greyish brown (10YR 5/2), moist; few small faint brownish yellow mottles; sand; loose consistence, moist; many small and medium quartz grains.

APPENDIX 2.
CALCULATION OF STANDING VOLUME IN m^3/ha

Example: Block 32, pine forest type 1.1, d.b.h. ≥ 7.6 cm

Observed values y of mean volume per ha obtained from relaskop counts as follows:

21.118	21.893	13.901
32.547	37.638	23.795
13.355	19.248	24.939
28.216	38.937	17.779
19.371	7.947	17.653
12.759	35.325	22.074
28.610	19.811	23.089
33.402	14.836	0.000
31.688	29.085	0.000

Sum of observed values		Σy	=	589.016
No. of observations		n	=	27
Mean	$\Sigma y/n$	= $\bar{y}$	=	21.815
Squared sum		$(\Sigma y)^2$	=	346 939.8
Sum of squared observations		Σy^2	=	15 537.7
Correction factor	$(\Sigma y)^2/n$	= Cf	=	12 849.6
Sum of squares	Σy^2-Cf	= SSy	=	2 688.0
No. of degrees of freedom	n-1	= Dfy	=	26
Sample variance	SSy/Dfy	= Vy	=	103.386
Standard deviation	$\sqrt{Vy}$	= SDy	=	10.168
Coefficient of variation	100 SDy/$\bar{y}$	= CV%	=	46.615
Sampling fraction		f	=	0 (point sampling)
Variance of mean	(Vy/n)(1-f)	= $V\bar{y}$	=	3.829
Standard error	$\sqrt{V\bar{y}}$	= $SE\bar{y}$	=	1.957
Student's t at p = 0.05, Dfy = 26				2.056
Reliable minimum estimate	$\bar{y}$-(t x $SE\bar{y}$)	RME	=	17.791
Sampling error	100t x $SE\bar{y}/\bar{y}$	E%	=	18
Approximate no. of sampling units required for E% = 20	$(CV\% \times t/e\%)^2$			23

APPENDIX 3.
CALCULATION OF GROSS VOLUME IN THREE PINE FOREST TYPES IN WHOLE PROJECT AREA

Example: Forest type 1.3, d.b.h. $\geq$ 25.4 cm

Block	Mean volume $\bar{y}$	Area w	Gross volume $w\bar{y}$	Number of samples	Sample variance	Variance of mean	
	m^3/ha	ha	m^3	n	Vy	$V\bar{y}$	$w^2V\bar{y}$
2	1.4	111	155	46	11.7	0.25	3 080
3	1.4	126	176	45	7.4	0.16	2 540
4	1.9	275	523	52	6.4	0.12	9 075
5	0.4	328	131	40	0.6	0.02	2 152
6	1.9	289	549	55	10.2	0.19	15 869
7	1.1	169	186	58	8.6	0.15	4 284
8	1.0	546	546	35	3.0	0.09	26 830
9	0.5	215	108	48	1.0	0.02	925
10	1.2	169	203	46	23.1	0.50	14 281
11	1.2	207	248	60	3.7	0.06	2 571
12	0.5	136	68	51	2.0	0.04	740
13	1.3	153	199	49	4.9	0.10	2 341
14	1.5	360	540	51	5.8	0.11	14 256
15	0.4	123	49	50	1.1	0.02	303
16	1.4	132	185	56	6.6	0.12	2 091
17	2.4	110	264	53	17.1	0.32	3 872
18	1.9	167	317	51	13.6	0.27	7 530
19	2.9	268	777	55	12.8	0.23	16 520
20	4.7	114	536	57	25.8	0.45	5 848
21	2.3	139	320	54	10.3	0.19	3 671
22	1.7	135	230	42	7.6	0.18	3 281
23	0.7	43	30	47	4.3	0.91	1 683
24	1.3	196	255	48	4.7	0.10	3 842
25	1.5	80	120	48	5.1	0.11	704
26	1.6	320	512	46	2.9	0.06	6 144
27	2.1	69	145	46	6.1	0.13	619
28	n.s.*						
29	1.7	64	109	32	8.7	0.14	573
30	2.4	157	377	48	4.2	0.09	2 218
31	3.3	190	627	51	38.1	0.75	27 075
32	2.1	182	382	46	7.5	0.16	5 300
33	5.0	299	1 495	63	22.6	0.36	32 184
34	4.4	72	317	43	20.1	0.47	2 347
35	2.2	442	972	53	15.4	0.29	56 656

* n.s. = not sampled

Σw = 6 383

$\Sigma w\bar{y}$ = 11 651

$\Sigma w^2V\bar{y}$ = 281 492

Type mean	$\Sigma w\bar{y}/\Sigma w$	= $\bar{Y}$		1.825
Type variance of mean	$\Sigma w^2V\bar{y}/(\Sigma w)^2$	= $V\bar{Y}$	=	0.007
Student's t at p =0.05, Dfy = 32				2.037
Sampling error	$100t\sqrt{V\bar{Y}}/\bar{Y}$	= E%		9.3
Gross volume	$(\Sigma w)\bar{Y}$	= $\Sigma w\bar{y}$	=	11 651
Reliable minimum estimate	$(100\text{-E\%})(\Sigma w)\bar{Y}$	= RME	=	10 570

APPENDIX 4.
LIST OF COMMON AND BOTANICAL NAMES OF PLANTS MENTIONED IN THE TEXT

COMMON NAMES*

Billy webb; *Sweetia panamensis* Benth.
Cabbage palm (= mountain cabbage palm); *Euterpe* sp. (= *E.* aff. *macrospadix* Oersted)
Caoba; *Swietenia macrophylla* King
Caribbean pine; *Pinus caribaea* Morelet var. *hondurensis* Barr & Golf.
Cedar, cedro; *Cedrela mexicana* Roem.
Cortez; *Tabebuia chrysantha* (Jacq.) Nich.
Crabboo; *Byrsonima crassifolia* (L.) DC.
Cypress; *Podocarpus guatemalensis* Standl.
Dumb cane grass; *Tripsacum latifolium* Hitchcock
Dwarf mistletoe; *Arceuthobium globosum* Hawkins & Wiens
Florazul; *Tabebuia rosea* (Bertol.) DC. (syn. *T. pentaphylla* (L.) Hemsl.)
Mahogany; *Swietenia macrophylla* King
Mistletoe; *Psittacanthus* sp.
Nargusta; *Terminalia obovata* (R. & P.) Steud.
Oak; *Quercus anglohondurensis* (Lundell) McVaugh
Q. hondurensis Trel.
Q. oleoides Schlecht & Cham.
Q. peduncularis Neé var. *sublanosa* (Trel.) C.H. Muller
Palmetto; *Acoelorraphe wrightii* (Griseb.) Wendl.
Schippia concolor Burret
Pine, pino; *Pinus caribaea* Morelet var. *hondurensis* Barr & Golf.
P. oocarpa Schiede var. *ochoterenai* Mart.
Polewood; *Xylopia frutescens* Aubl.
Santa maria; *Calophyllum brasiliense* Camb. var. *rekoi* Standl.
Silver pimento; *Schippia concolor* Burret
Slash pine (USA); *Pinus elliottii* Engleman
Tiger bush (fern); *Dicranopteris pectinata* (Willd.) Underw.
Trumpet; *Cecropia peltata* L.
Waika chewstick; *Symphonia globulifera* L.f.
Yemeri; *Vochysia hondurensis* Sprague

BOTANICAL NAMES

Acoelorraphe wrightii (Griseb.) Wendl.; palmetto
Arceuthobium globosum Hawkins & Wiens; dwarf mistletoe
Bulbostylis paradoxa (Spring.) Lindm.
Byrsonima crassifolia (L.) DC.; crabboo
Calliandra houstoniana Benth.
Calophyllum brasiliense Camb. var. *rekoi* Standl.; santa maria
Cecropia peltata L.; trumpet
Cedrela mexicana Roem.; cedar, cedro
Ceratocystis sp.
Clethra hondurensis Britton
Clusia spp.
Cronartium conigenum (Pat.) Hedge & Hunt
Dicranopteris pectinata (Willd.) Underw.; tiger bush (fern)
Enallagma latifolia (Mill.) Small
Euterpe oleracea Mart.
Euterpe sp. (= *E.* aff. *macrospadix* Oersted); (mountain) cabbage palm
Inga lindeniana Benth.

* The common names given are those found by the authors to have wide local usage and/or mentioned in the text. More complete lists of the common names of plants in the Mountain Pine Ridge (and elsewhere in Belize) are given by Standley and Record (1936) and by Wright *et al.* (1959).

Lentinus pallidus Berk & Curt.
Leucothoe mexicana (Hemsl.) Small
Leucothoe sp.
Mesosetum filifolium Hubbard
Myrica cerifera L.
Paspalum pectinatum Nees
Pinus caribaea Morelet var. *hondurensis* Barr & Golf.; Caribbean pine, pine, pino
P. elliottii Engleman: slash pine (USA)
P. oocarpa Schiede var. *ochoterenai* Mart.; pine, pino
P. palustris Miller
Podocarpus guatemalensis Standl.; cypress
Polyporus meliae Underw.
Psidium anglohondurense (Lundell) McVaugh
Psittacanthus sp.; mistletoe
Quercus anglohondurensis (Lundell) McVaugh; oak
Q. hondurensis Trel.: oak
Q. oleoides Schlecht & Cham.; oak
Q. peduncularis Neé var. *sublanosa* (Trel.) C.H. Muller; oak
Rhynchospora globosa Roem. & Schult.
Schippia concolor Burret; palmetto, silver pimento
Sweetia panamensis Benth.; billy webb
Swietenia macrophylla King: caoba, mahogany
Symphonia globulifera L.f.; Waika chewstick
Tabebuia chrysantha (Jacq.) Nich; cortez
T. rosea (Bertol.) DC. (syn. *T. pentaphylla*) (L.) Hemsl.); florazul
Terminalia obovata (R. & P.) Steud.; nargusta
Ternstroemia tepazapote Schlecht. & Cham.
Trachypogon angustifolius (Kunth) Nees
Tripsacum latifolium Hitchcock; dumb cane grass
Veluticeps berkleyi Cke
Vochysia hondurensis Sprague; yemeri
Xylopia frutescens Aubl.; polewood

APPENDIX 5

'OLD GROWTH PINE': STAND TABLES AND VOLUMES

TABLE 23 Stand tables showing numbers of stems of 'old growth pine' per unit area* and the distribution according to size class in 34 management blocks

Block	Type +	Area ha (ac)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) <15.2 (6.0)	15 (5.9) >15.2 (6.0)	20 (7.9)	25 (9.8) <25.4 (10.0)	25 (9.8) >25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥7.6 (3.0)	≥15.2 (6.0)	≥25.4 (10.0)
2	1.1	300 (740)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.1 0.5	0.8 0.3	1.0 0.4	0.0 0.0	0.4 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	3.3 1.3	3.3 1.3	3.3 1.3
2	1.2	159 (393)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.8 0.3	0.3 0.1	0.3 0.1	0.2 0.1	0.1 0.1	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.1 0.9	2.1 0.9	1.3 0.5
2	1.3	111 (273)	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.1 0.0	0.0 0.0	0.1 0.0	0.4 0.2	0.3 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.2 0.5	1.2 0.5	0.9 0.4
3	1.1	245 (606)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.8 0.3	0.3 0.1	0.2 0.1	0.2 0.1	0.2 0.1	0.1 0.1	0.0 0.0	0.0 0.0	1.8 0.7	1.8 0.7	1.8 0.7
3	1.2	302 (746)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.4 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.4 0.2	0.4 0.2	0.4 0.2
3	1.3	126 (310)	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.1 0.1	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.4 0.2	0.4 0.2	0.1 0.1
3	3.2	52 (128)	0.0 0.0	0.0 0.0	1.7 0.7	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.4 0.2	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.9 1.2	2.9 1.2	1.2 0.5
4	1.1	219 (540)	0.0 0.0	0.0 0.0	0.0 0.0	1.3 0.5	0.0 0.0	0.0 0.0	1.2 0.5	0.9 0.4	0.7 0.3	0.3 0.1	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.5 1.8	4.5 1.8	3.2 1.3
4	1.2	264 (653)	2.5 1.0	0.0 0.0	0.0 0.0	1.9 0.8	0.0 0.0	0.4 0.1	0.6 0.2	0.6 0.3	0.6 0.3	0.3 0.1	0.1 0.0	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	7.1 2.9	4.6 1.9	2.7 1.1

* Figures for both stems/ha and stems/ac have been rounded to the nearest 0.1; this accounts for some apparent anomalies in conversion of low stem numbers

n.s. = not sampled

+ For each block, figures are given only for types in which mean stocking ≳ 0.1 stems/ha (0.04 stems/ac)

> For this symbol read ≳ throughout this table

TABLE 23 (continued)

Block	Type	Area ha (ac)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) <15.2 (6.0)	15 (5.9) >15.2 (6.0)	20 (7.9)	25 (9.8) <25.4 (10.0)	25 (9.8) >25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥7.6 (3.0)	≥15.2 (6.0)	≥25.4 (10.0)
4	1.3	275 (679)	1.2 0.5	0.3 0.1	0.9 0.4	3.7 1.5	0.7 0.3	1.1 0.4	0.5 0.2	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	8.7 3.5	7.1 2.9	1.8 0.7
5	1.1	226 (557)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.5 0.2	0.5 0.2
5	1.3	328 (811)	0.0 0.0	0.0 0.0	0.0 0.0	0.8 0.3	0.1 0.1	0.0 0.0	0.2 0.1	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.2 0.5	1.2 0.5	0.2 0.1
6	1.1	170 (420)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.0 0.0	0.0 0.0	0.2 0.1	0.0 0.0	0.0 0.0	0.1 0.1	0.0 0.0	0.8 0.3	0.8 0.3	0.8 0.3
6	1.2	319 (788)	0.0 0.0	0.0 0.0	0.0 0.0	0.6 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.0 0.0	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.8 0.3	0.8 0.3	0.2 0.1
6	1.3	289 (714)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.0 0.0	0.3 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.7 0.3	0.5 0.2
7	1.1	140 (345)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.4 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.9 0.4	0.9 0.4	0.9 0.4
7	1.2	407 (1 006)	0.0 0.0	0.0 0.0	0.0 0.0	1.0 0.4	0.0 0.0	2.9 1.2	1.4 0.6	0.7 0.3	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	6.0 2.4	6.0 2.4	5.0 2.0
7	1.3	169 (418)	0.0 0.0	0.0 0.0	0.2 0.1	0.0 0.0	0.1 0.0	0.0 0.0	0.4 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.7 0.3	0.4 0.2
8	1.1	66 (164)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.3 0.1	0.7 0.3	0.8 0.3	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.0 0.8	2.0 0.8	2.0 0.8
8	1.2	257 (634)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.2 0.1	0.2 0.1
8	1.3	546 (1 349)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.1 0.1	0.2 0.1	0.3 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.7 0.3	0.7 0.3
8	3.2	74 (182)	0.0 0.0	0.0 0.0	2.0 0.8	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.0 0.8	2.0 0.8	0.0 0.0
9	1.2	185 (456)	0.0 0.0	1.3 0.5	1.9 0.8	1.9 0.8	2.2 0.9	0.4 0.1	0.3 0.1	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	8.2 3.3	6.9 2.8	0.9 0.3
9	1.3	215 (532)	0.7 0.3	0.3 0.1	0.7 0.3	1.9 0.4	0.1 0.0	0.2 0.1	0.2 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	3.4 1.4	2.4 1.0	0.6 0.2

TABLE 23 (continued)

Block	Type	Area ha (ac)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) <15.2 (6.0)	15 (5.9) >15.2 (6.0)	20 (7.9)	25 (9.8) <25.4 (10.0)	25 (9.8) >25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥7.6 (3.0)	≥15.2 (6.0)	≥25.4 (10.0)
10	1.1	211 (522)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.5 0.6	0.6 0.3	0.5 0.2	0.0 0.0	0.5 0.2	0.0 0.0	0.0 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	3.2 1.3	3.2 1.3	1.7 0.7
10	1.2	358 (885)	2.3 0.9	1.2 0.5	0.0 0.0	0.0 0.0	0.4 0.2	0.0 0.0	0.0 0.0	0.6 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.6 1.8	1.0 0.4	0.6 0.2
10	1.3	169 (418)	0.0 0.0	0.0 0.0	0.3 0.1	0.0 0.0	0.0 0.0	0.1 0.0	0.3 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.7 0.3	0.5 0.2
10	3.2	130 (320)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.3 0.1	0.3 0.1	0.3 0.1
11	1.1	100 (246)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.5 0.2	0.5 0.2
11	1.2	92 (228)	0.0 0.0	0.0 0.0	0.0 0.0	0.6 0.2	0.0 0.0	0.0 0.0	0.5 0.2	0.2 0.1	0.5 0.2	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.9 0.8	1.9 0.8	1.3 0.5
11	1.3	207 (512)	0.0 0.0	0.0 0.0	0.2 0.1	0.5 0.2	0.4 0.2	0.2 0.1	0.5 0.2	0.3 0.1	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.2 0.9	2.2 0.9	1.1 0.5
11	3.2	105 (259)	0.0 0.0	3.7 1.5	0.0 0.0	0.9 0.4	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.6 1.9	0.9 0.4	0.0 0.0
12	1.1	107 (265)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.6 0.3	0.0 0.0	0.0 0.0	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.8 0.3	0.8 0.3	0.8 0.3
12	1.2	146 (361)	0.0 0.0	0.0 0.0	0.0 0.0	0.6 0.2	0.0 0.0	0.3 0.1	1.1 0.4	0.0 0.0	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.1 0.9	2.1 0.9	1.5 0.6
12	1.3	136 (336)	0.6 0.3	0.7 0.3	0.9 0.4	0.3 0.1	0.8 0.3	0.4 0.2	0.6 0.2	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.5 1.8	3.3 1.3	1.3 0.5
12	3.2	299 (739)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.0 0.0	0.3 0.1	0.5 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.3 0.5	1.3 0.5	0.8 0.3
13	1.1	178 (439)	0.0 0.0	0.0 0.0	0.0 0.0	2.1 0.8	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.7 1.1	2.7 1.1	0.7 0.3
13	1.2	159 (393)	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.0 0.0	0.0 0.0	0.3 0.1	0.4 0.2	0.3 0.1	0.0 0.0	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.0 0.8	2.0 0.8	1.3 0.5
13	1.3	153 (378)	0.0 0.0	2.0 0.8	2.2 0.9	3.7 1.5	0.8 0.3	0.9 0.4	0.7 0.3	0.4 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	10.8 4.4	8.8 3.6	2.1 0.8

TABLE 23 (continued)

Block	Type	Area ha (ac)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) <15.2 (6.0)	15 (5.9) >15.2 (6.0)	20 (7.9)	25 (9.8) <25.4 (10.0)	25 (9.8) >25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥7.6 (3.0)	≥15.2 (6.0)	≥25.4 (10.0)
13	3.2	368 (909)	0.0 0.0	0.0 0.0	0.9 0.3	5.1 2.1	0.4 0.2	0.0 0.0	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	6.6 2.7	6.6 2.7	0.3 0.1
14	1.1	90 (222)	0.0 0.0	1.9 0.8	1.4 0.6	1.8 0.7	0.0 0.0	0.5 0.2	0.0 0.0	0.6 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	6.2 2.5	4.3 1.7	1.1 0.5
14	1.2	280 (692)	0.0 0.0	0.0 0.0	0.0 0.0	2.4 1.0	0.4 0.2	0.7 0.3	1.1 0.4	0.2 0.1	0.5 0.2	0.1 0.0	0.0 0.0	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	5.6 2.3	5.6 2.3	2.8 1.1
14	1.3	360 (890)	0.0 0.0	0.0 0.0	0.2 0.1	0.0 0.0	0.1 0.0	0.2 0.1	0.1 0.1	0.2 0.1	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.1 0.4	1.1 0.4	0.7 0.3
14	3.2	80 (198)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.2 0.5	0.5 0.2	1.2 0.5	0.0 0.0	0.0 0.0	0.0 0.0	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	3.1 1.2	3.1 1.2	1.8 0.7
15	1.1	58 (142)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.2 0.1	0.2 0.1
15	1.2	173 (428)	0.0 0.0	0.0 0.0	0.0 0.0	0.6 0.3	1.3 0.5	0.4 0.1	0.3 0.1	0.8 0.3	0.0 0.0	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	3.6 1.4	3.6 1.4	1.6 0.6
15	1.3	123 (303)	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.2 0.1	0.0 0.0	0.1 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.9 0.4	0.9 0.4	0.2 0.1
15	3.2	117 (288)	0.0 0.0	0.0 0.0	1.2 0.5	1.6 0.6	0.1 0.2	0.0 0.0	0.4 0.1	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.0 1.6	4.0 1.6	0.6 0.2
16	1.1	135 (333)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.6 0.2	0.0 0.0	0.4 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.9 0.4	0.9 0.4	0.4 0.1
16	1.2	209 (516)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.2 0.1	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.9 0.4	0.9 0.4	0.9 0.4
16	1.3	132 (325)	0.0 0.0	0.0 0.0	0.2 0.1	0.4 0.2	0.4 0.2	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.2 0.5	1.2 0.5	0.1 0.1
17	1.1	91 (224)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.3 0.5	0.3 0.1	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.9 0.8	1.9 0.8	1.9 0.8
17	1.2	165 (407)	0.0 0.0	0.0 0.0	1.1 0.4	2.2 0.9	1.5 0.6	0.4 0.2	1.6 0.7	0.0 0.0	0.4 0.1	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	7.3 3.0	7.3 3.0	2.5 1.0
17	1.3	110 (272)	0.0 0.0	0.0 0.0	0.2 0.1	1.4 0.5	1.5 0.6	0.8 0.3	0.9 0.4	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.8 2.0	4.8 2.0	1.8 0.7

TABLE 23 (continued)

Block	Type	Area ha (ac)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) <15.2 (6.0)	15 (5.9) >15.2 (6.0)	20 (7.9)	25 (9.8) <25.4 (10.0)	25 (9.8) >25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥7.6 (3.0)	≥15.2 (6.0)	≥25.4 (10.0)
17	3.2	38 (93)	0.0 0.0	0.0 0.0	1.2 0.5	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.5 0.6	1.5 0.6	0.3 0.1
18	1.1	134 (332)	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.0 0.0	0.8 0.3	0.3 0.1	1.2 0.5	0.7 0.3	0.3 0.1	0.2 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.5 1.8	4.5 1.8	3.8 1.5
18	1.2	103 (255)	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.
18	1.3	167 (412)	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.2 0.1	0.1 0.0	0.1 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.0 0.4	1.0 0.4	0.6 0.2
18	3.2	195 (482)	3.2 1.3	0.0 0.0	0.0 0.0	0.0 0.0	1.1 0.4	0.5 0.2	0.4 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	5.1 2.1	1.9 0.8	0.8 0.3
19	1.1	90 (223)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	1.5 0.6	1.9 0.8	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	3.8 1.5	3.8 1.5	3.8 1.5
19	1.2	152 (376)	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.9 0.4	0.4 0.2	0.3 0.1	0.4 0.2	0.3 0.1	0.0 0.0	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	3.3 1.3	3.3 1.3	1.7 0.7
19	1.3	268 (662)	0.0 0.0	0.0 0.0	0.0 0.0	0.3 0.1	0.4 0.2	0.1 0.0	0.6 0.2	0.3 0.1	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.8 0.7	1.8 0.7	1.1 0.5
20	1.1	152 (375)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.8 0.3	1.1 0.5	0.9 0.3	0.0 0.0	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.9 1.2	2.9 1.2	2.9 1.2
20	1.2	218 (539)	0.0 0.0	0.0 0.0	0.8 0.3	0.0 0.0	1.5 0.6	0.6 0.3	2.9 1.2	1.9 0.8	1.1 0.4	0.6 0.3	0.3 0.1	0.1 0.1	0.1 0.0	0.0 0.0	0.0 0.0	10.0 4.0	10.0 4.0	7.7 3.1
20	1.3	114 (282)	0.0 0.0	0.3 0.1	0.0 0.0	1.4 0.6	0.4 0.2	0.9 0.4	1.7 0.7	1.0 0.4	0.6 0.2	0.3 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	6.7 2.7	6.4 2.6	4.6 1.9
20	3.2	24 (59)	4.6 1.8	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.7 0.3	0.9 0.3	0.0 0.0	0.0 0.0	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	6.8 2.8	2.3 0.9	2.3 0.9
21	1.1	134 (331)	0.0 0.0	0.0 0.0	1.6 0.6	0.0 0.0	0.7 0.3	1.2 0.5	0.5 0.2	2.8 1.1	1.3 0.5	0.2 0.1	0.2 0.1	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	8.6 3.5	8.6 3.5	6.3 2.6
21	1.2	139 (343)	0.0 0.0	1.4 0.6	1.0 0.4	1.3 0.5	0.9 0.4	1.5 0.6	1.8 0.7	1.9 0.8	1.2 0.5	0.3 0.1	0.5 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	11.8 4.8	10.4 4.2	7.2 2.9
21	1.3	139 (342)	0.0 0.0	0.3 0.1	0.0 0.0	0.7 0.3	0.2 0.1	0.2 0.1	1.2 0.5	0.8 0.3	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	3.7 1.5	3.4 1.4	2.4 1.0

TABLE 23 (continued)

Block	Type	Area ha (ac)	d.b.h. class cm (in)															d.b.h. cm (in)		
			10 (3.9)	15 (5.9)		20 (7.9)	25 (9.8)		30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	≥7.6 (3.0)	≥15.2 (6.0)	≥25.4 (10.0)
				<15.2 (6.0)	>15.2 (6.0)		<25.4 (10.0)	>25.4 (10.0)												
22	1.1	65 (160)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.3 0.1	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.5 0.2	0.5 0.2
22	1.2	227 (562)	0.0 0.0	0.0 0.0	0.0 0.0	2.1 0.9	0.0 0.0	0.0 0.0	0.9 0.4	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	3.3 1.3	3.3 1.3	1.2 0.5
22	1.3	135 (332)	0.0 0.0	0.4 0.2	0.0 0.0	0.0 0.0	0.1 0.1	0.0 0.0	0.3 0.1	0.3 0.1	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.3 0.5	1.0 0.4	0.8 0.3
23	1.1	71 (176)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.3 0.1	0.3 0.1	0.3 0.1
23	1.2	193 (476)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.4 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.4 0.2	0.4 0.2	0.0 0.0
23	1.3	43 (106)	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.1 0.0	0.1 0.0	0.2 0.1	0.2 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.1 0.5	1.1 0.5	0.5 0.2
24	1.1	201 (496)	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.0 0.0	0.0 0.0	0.6 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.3 0.5	1.3 0.5	0.6 0.2
24	1.2	180 (445)	0.0 0.0	0.0 0.0	0.0 0.0	1.3 0.5	0.0 0.0	0.0 0.0	0.3 0.1	0.2 0.1	0.0 0.0	0.1 0.1	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.1 0.8	2.1 0.8	0.7 0.3
24	1.3	196 (483)	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.0 0.0	0.2 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.5 0.2	0.3 0.1
24	3.2	14 (34)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	0.4 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.9 0.4	0.9 0.4	0.9 0.4
25	1.1	156 (386)	0.0 0.0	0.0 0.0	0.0 0.0	1.6 0.6	2.2 0.9	0.9 0.4	1.4 0.6	0.8 0.3	0.8 0.3	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	7.8 3.2	7.8 3.2	4.1 1.7
25	1.2	142 (352)	0.0 0.0	0.0 0.0	0.0 0.0	0.8 0.3	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.8 0.3	0.8 0.3	0.0 0.0
25	1.3	80 (198)	0.0 0.0	0.0 0.0	0.0 0.0	0.3 0.1	0.3 0.1	0.3 0.1	0.7 0.3	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.8 0.7	1.8 0.7	1.2 0.5
26	1.1	316 (781)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.0 0.4	0.4 0.1	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.6 0.7	1.6 0.7	1.6 0.7
26	1.2	355 (877)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.4 0.2	0.0 0.0	0.8 0.3	0.0 0.0	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.5 0.6	1.5 0.6	1.0 0.4

TABLE 23 (continued)

Block	Type	Area ha (ac)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) <15.2 (6.0)	15 (5.9) >15.2 (6.0)	20 (7.9)	25 (9.8) <25.4 (10.0)	25 (9.8) >25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥7.6 (3.0)	≥15.2 (6.0)	≥25.4 (10.0)
26	1.3	320 (790)	0.0 0.0	0.0 0.0	0.3 0.1	0.0 0.0	0.1 0.0	0.2 0.1	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.8 0.3	0.8 0.3	0.4 0.2
26	3.2	230 (568)	0.0 0.0	0.0 0.0	0.0 0.0	1.6 0.6	0.8 0.3	0.7 0.3	0.7 0.3	0.3 0.1	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.3 1.7	4.3 1.7	1.8 0.7
27	1.1	245 (605)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.4 0.2	1.0 0.4	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.4 0.6	1.4 0.6	1.4 0.6
27	1.2	152 (375)	0.0 0.0	0.0 0.0	0.0 0.0	1.2 0.5	0.9 0.3	0.7 0.3	2.4 1.0	1.0 0.4	0.5 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	6.7 2.7	6.7 2.7	4.6 1.9
27	1.3	69 (170)	0.0 0.0	0.0 0.0	0.3 0.1	1.2 0.5	1.2 0.5	1.8 0.7	1.4 0.6	0.8 0.3	0.3 0.1	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	7.1 2.9	7.1 2.9	4.4 1.8
27	3.2	24 (60)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.5 0.2	1.1 0.4	0.5 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.0 0.8	2.0 0.8	2.0 0.8
28	1.1	147 (364)	0.0 0.0	0.0 0.0	0.0 0.0	2.0 0.8	0.5 0.2	0.8 0.3	1.5 0.6	0.7 0.3	0.2 0.1	0.0 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	5.7 2.3	5.7 2.3	3.2 1.3
28	1.2	244 (604)	0.0 0.0	0.9 0.4	1.4 0.6	3.2 1.3	1.9 0.8	0.8 0.3	2.0 0.8	0.9 0.4	0.5 0.2	0.1 0.0	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	11.8 4.8	10.8 4.4	4.4 1.8
28	1.3	98 (241)	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.	n.s. n.s.
29	1.1	71 (175)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.8 0.3	0.3 0.1	0.2 0.1	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.5 0.6	1.5 0.6	1.5 0.6
29	1.2	207 (512)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.4 0.2	0.0 0.0	0.0 0.0	0.2 0.1	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.7 0.3	0.7 0.3
29	1.3	64 (158)	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.5 0.2	0.1 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.1 0.4	1.1 0.4	0.3 0.1
30	1.1	299 (738)	0.0 0.0	0.0 0.0	0.0 0.0	1.1 0.4	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.8 0.7	1.8 0.7	0.7 0.3
30	1.2	280 (691)	0.0 0.0	0.0 0.0	0.0 0.0	1.3 0.5	0.0 0.0	0.4 0.2	1.2 0.5	0.4 0.2	0.2 0.1	0.4 0.2	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	3.8 1.5	3.8 1.5	2.5 1.0
30	1.3	157 (388)	0.0 0.0	0.0 0.0	0.0 0.0	0.3 0.1	0.3 0.1	1.0 0.4	0.1 0.1	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.1 0.8	2.1 0.8	1.4 0.6

TABLE 23 (continued)

Block	Type	Area ha (ac)	d.b.h. class cm (in) 10 (3.9)	15 (5.9) <15.2 (6.0)	15 (5.9) >15.2 (6.0)	20 (7.9)	25 (9.8) <25.4 (10.0)	25 (9.8) >25.4 (10.0)	30 (11.8)	35 (13.8)	40 (15.8)	45 (17.7)	50 (19.7)	55 (21.7)	60 (23.6)	65 (25.6)	70 (27.6)	d.b.h. cm (in) ≥7.6 (3.0)	≥15.2 (6.0)	≥25.4 (10.0)
31	1.1	309 (763)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	0.0 0.0	0.5 0.2	0.0 0.0	0.0 0.0	0.2 0.1	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	1.7 0.7	1.7 0.7	1.0 0.4
31	1.2	160 (396)	0.0 0.0	0.0 0.0	0.0 0.0	0.6 0.2	0.4 0.2	0.0 0.0	1.4 0.6	0.4 0.2	0.8 0.3	0.4 0.1	0.2 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.2 1.7	4.2 1.7	3.2 1.3
31	1.3	190 (470)	0.6 0.3	0.7 0.3	0.9 0.4	0.2 0.1	0.4 0.2	0.6 0.3	0.6 0.3	0.3 0.1	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	4.5 1.8	3.2 1.3	1.7 0.7
32	1.1	78 (192)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.7 0.3	1.0 0.4	0.4 0.2	0.0 0.0	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.3 0.9	2.3 0.9	2.3 0.9
32	1.2	402 (994)	0.0 0.0	0.0 0.0	0.0 0.0	0.6 0.2	0.8 0.3	0.7 0.3	0.8 0.3	1.0 0.4	0.9 0.4	0.3 0.1	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	5.2 2.1	5.2 2.1	3.8 1.5
32	1.3	182 (450)	0.0 0.0	0.4 0.1	0.8 0.3	1.9 0.8	1.5 0.6	0.7 0.3	0.9 0.4	0.6 0.2	0.1 0.1	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	7.0 2.8	6.6 2.7	2.5 1.0
33	1.1	151 (374)	2.6 1.1	2.8 1.1	1.0 0.4	2.0 0.8	0.5 0.2	1.9 0.8	4.4 1.8	3.7 1.5	2.0 0.8	1.2 0.5	0.7 0.3	0.1 0.0	0.2 0.1	0.1 0.0	0.1 0.0	23.2 9.4	17.8 7.2	14.3 5.8
33	1.2	165 (407)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	2.9 1.2	2.0 0.8	4.0 1.6	1.8 0.7	2.1 0.8	0.8 0.3	0.7 0.3	0.2 0.1	0.0 0.0	0.0 0.0	0.0 0.0	14.4 5.8	14.4 5.8	11.5 4.7
33	1.3	299 (738)	0.0 0.0	0.3 0.1	0.9 0.4	2.4 1.0	1.1 0.4	1.5 0.6	2.0 0.8	0.9 0.4	0.4 0.2	0.2 0.1	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	9.8 4.0	9.5 3.9	5.1 2.1
33	3.2	280 (693)	0.0 0.0	0.0 0.0	1.3 0.5	7.1 2.9	3.7 1.5	2.0 0.8	2.8 1.1	1.7 0.7	0.0 0.0	0.0 0.0	0.1 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	18.7 7.6	18.7 7.6	6.6 2.7
34	1.1	74 (184)	4.9 2.0	1.3 0.5	0.0 0.0	1.2 0.5	3.8 1.6	1.4 0.6	5.7 2.3	2.8 1.1	2.9 1.2	1.2 0.5	0.8 0.3	0.2 0.1	0.1 0.0	0.1 0.0	0.0 0.0	26.4 10.7	20.2 8.2	15.2 6.1
34	1.2	63 (155)	0.0 0.0	0.0 0.0	0.0 0.0	4.8 1.9	1.1 0.4	2.7 1.1	8.1 3.3	3.6 1.5	2.4 1.0	2.7 1.1	1.0 0.4	0.2 0.1	0.0 0.0	0.1 0.0	0.1 0.0	26.8 10.9	26.8 10.9	20.9 8.5
34	1.3	72 (178)	0.7 0.3	0.0 0.0	0.3 0.1	0.7 0.3	0.8 0.3	0.4 0.2	2.2 0.9	1.8 0.7	0.7 0.3	0.3 0.1	0.3 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	8.4 3.4	7.7 3.1	5.9 2.4
34	3.2	237 (586)	0.0 0.0	1.3 0.5	0.9 0.4	0.6 0.2	1.7 0.7	1.4 0.6	1.6 0.7	1.2 0.5	0.8 0.3	0.1 0.0	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	9.7 3.9	8.5 3.4	5.2 2.1
35	1.1	88 (217)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.6 0.2	0.0 0.0	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.9 0.4	0.9 0.4	0.9 0.4
35	1.2	273 (674)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.2 0.1	0.6 0.3	0.0 0.0	0.3 0.1	0.0 0.0	0.0 0.0	0.0 0.0	1.1 0.5	1.1 0.5	1.1 0.5
35	1.3	442 (1 092)	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.1 0.0	0.2 0.1	0.1 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.4 0.2	0.4 0.2	0.4 0.2

TABLE 24 Standing Volume of 'Old Growth' Pine Per Unit Area* in 34 Management Blocks

Block	Type ++	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
2	1.1	300	740	a b c	2.3 2.3 2.3	34 34 34	0.2 0.2 0.2	3 3 3
2	1.2	159	393	a b c	1.0 1.0 0.8	14 14 12	0.3 0.3 0.2	5 5 3
2	1.3	111	273	a b c	0.7 0.7 0.7	10 10 10	0.1 0.1 0.1	2 2 2
3	1.1	245	606	a b c	2.1 2.1 2.1	30 30 30	0.0 0.0 0.0	0 0 0
3	1.2	302	746	a b c	0.3 0.3 0.3	4 4 4	0.0 0.0 0.0	0 0 0
3	1.3	126	310	a b c	0.1 0.1 0.1	2 2 1	0.0 0.0 0.0	0 0 0
3	3.2	52	128	a b c	0.7 0.7 0.6	10 10 9	0.0 0.0 0.0	0 0 0
4	1.1	219	540	a b c	2.3 2.3 2.1	32 32 30	0.0 0.0 0.0	0 0 0
4	1.2	264	653	a b c	2.3 2.2 2.0	32 32 29	0.6 0.6 0.4	9 9 6
4	1.3	275	679	a b c	1.2 1.2 0.6	17 17 9	0.6 0.6 0.3	9 9 4

* Figures for m^3/ha have been rounded to nearest 0.1, those for ft^3/ac to nearest whole number. This accounts for apparent anomalies in the conversions of small volumes.

** a ⩾ 7.6 cm (3.0 in)

b ⩾ 15.2 cm (6.0 in)

c ⩾ 25.4 cm (10.0 in)

\+ Where sampling errors of 100% or higher were obtained, the reliable minimum estimate is zero.

n.s. = not sampled

++ Types as given in Table 23.

TABLE 24 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
4	1.2	264	653	a	2.3	32	0.6	9
				b	2.2	32	0.6	9
				c	2.0	29	0.4	6
4	1.3	275	679	a	1.2	17	0.6	9
				b	1.2	17	0.6	9
				c	0.6	9	0.3	4
5	1.1	226	557	a	0.4	5	0.0	0
				b	0.4	5	0.0	0
				c	0.4	5	0.0	0
5	1.3	328	811	a	0.2	3	0.0	0
				b	0.2	3	0.0	0
				c	0.1	1	0.0	0
6	1.1	170	420	a	1.2	16	0.0	0
				b	1.2	16	0.0	0
				c	1.2	16	0.0	0
6	1.2	319	788	a	0.4	5	0.0	0
				b	0.4	5	0.0	0
				c	0.3	4	0.0	0
6	1.3	289	714	a	0.3	5	0.1	1
				b	0.3	5	0.1	1
				c	0.3	4	0.0	0
7	1.1	140	345	a	0.4	6	0.0	0
				b	0.4	6	0.0	0
				c	0.4	6	0.0	0
7	1.2	407	1 006	a	1.7	24	0.4	6
				b	1.7	24	0.4	6
				c	1.6	22	0.4	6
7	1.3	169	418	a	0.2	3	0.0	0
				b	0.2	3	0.0	0
				c	0.2	2	0.0	0
8	1.1	66	164	a	2.0	28	0.0	0
				b	2.0	28	0.0	0
				c	2.0	28	0.0	0
8	1.2	257	634	a	0.1	2	0.0	0
				b	0.1	2	0.0	0
				c	0.1	2	0.0	0
8	1.3	546	1 349	a	0.3	5	0.0	0
				b	0.3	5	0.0	0
				c	0.3	5	0.0	0
8	3.2	74	182	a	0.1	2	0.0	0
				b	0.1	2	0.0	0
				c	0.0	0	0.0	0
9	1.2	185	456	a	1.1	15	0.0	0
				b	1.0	14	0.0	0
				c	0.3	4	0.0	0

TABLE 24 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
9	1.3	215	532	a b c	0.4 0.4 0.2	6 5 3	0.1 0.1 0.0	2 2 0
10	1.1	211	522	a b c	1.1 1.1 0.8	15 15 11	0.0 0.0 0.0	0 0 0
10	1.2	358	885	a b c	0.5 0.4 0.3	7 6 5	0.1 0.0 0.0	1 0 0
10	1.3	169	418	a b c	0.2 0.2 0.2	3 3 2	0.0 0.0 0.0	0 0 0
10	3.2	130	320	a b c	0.1 0.1 0.1	1 1 1	0.0 0.0 0.0	0 0 0
11	1.1	100	246	a b c	0.2 0.2 0.2	2 2 2	0.0 0.0 0.0	0 0 0
11	1.2	92	228	a b c	0.9 0.9 0.8	13 13 12	0.0 0.0 0.0	0 0 0
11	1.3	207	512	a b c	0.7 0.7 0.6	10 10 8	0.3 0.3 0.2	5 5 3
11	3.2	105	259	a b c	0.2 0.1 0.0	3 1 0	0.0 0.0 0.0	0 0 0
12	1.1	107	265	a b c	0.4 0.4 0.4	6 6 6	0.0 0.0 0.0	0 0 0
12	1.2	146	361	a b c	0.7 0.7 0.6	9 9 9	0.1 0.1 0.1	2 2 1
12	1.3	136	336	a b c	0.7 0.7 0.4	10 10 6	0.2 0.2 0.1	2 2 1
12	3.2	299	739	a b c	0.5 0.5 0.4	7 7 5	0.0 0.0 0.0	0 0 0
13	1.1	178	439	a b c	0.6 0.6 0.4	8 8 5	0.0 0.0 0.0	0 0 0
13	1.2	159	393	a b c	1.1 1.1 1.0	15 15 14	0.0 0.0 0.0	0 0 0

TABLE 24 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
13	1.3	**153**	378	a b c	**1.4** **1.4** **0.7**	21 20 10	**0.6** **0.5** **0.2**	8 8 2
13	3.2	**368**	909	a b c	**0.7** **0.7** **0.1**	11 11 1	**0.0** **0.0** **0.0**	0 0 0
14	1.1	**90**	222	a b c	**0.8** **0.7** **0.5**	11 10 7	**0.0** **0.0** **0.0**	0 0 0
14	1.2	**280**	962	a b c	**2.0** **2.0** **1.7**	29 29 24	**0.6** **0.6** **0.4**	8 8 6
14	1.3	**360**	890	a b c	**0.5** **0.5** **0.4**	7 7 6	**0.1** **0.1** **0.1**	2 2 1
14	3.2	**80**	198	a b c	**1.0** **1.0** **0.8**	14 14 11	**0.0** **0.0** **0.0**	0 0 0
15	1.1	**58**	142	a b c	**0.2** **0.2** **0.2**	3 3 3	**0.0** **0.0** **0.0**	0 0 0
15	1.2	**173**	428	a b c	**1.1** **1.1** **0.8**	16 16 12	**0.3** **0.3** **0.2**	5 5 3
15	1.3	**123**	303	a b c	**0.2** **0.2** **0.1**	2 2 1	**0.0** **0.0** **0.0**	0 0 0
15	3.2	**117**	288	a b c	**0.6** **0.6** **0.3**	9 9 4	**0.0** **0.0** **0.0**	0 0 0
16	1.1	**135**	333	a b c	**0.2** **0.2** **0.1**	3 3 2	**0.0** **0.0** **0.0**	0 0 0
16	1.2	**209**	516	a b c	**0.4** **0.4** **0.4**	6 6 6	**0.0** **0.0** **0.0**	0 0 0
16	1.3	**132**	325	a b c	**0.2** **0.2** **0.1**	3 3 1	**0.1** **0.1** **0.0**	1 1 0
17	1.1	**91**	224	a b c	**0.9** **0.9** **0.9**	12 12 12	**0.0** **0.0** **0.0**	0 0 0
17	1.2	**165**	407	a b c	**1.7** **1.7** **1.1**	24 24 16	**0.2** **0.2** **0.0**	3 3 0

TABLE 24 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
17	1.3	110	272	a	1.0	14	0.0	0
				b	1.0	14	0.0	0
				c	0.6	7	0.0	0
17	3.2	38	93	a	0.2	3	0.0	0
				b	0.2	3	0.0	0
				c	0.1	2	0.0	0
18	1.1	134	332	a	2.7	38	0.6	9
				b	2.7	38	0.6	9
				c	2.6	37	0.6	8
18	1.2	103	255	a	n.s.	n.s.	n.s.	n.s.
				b	n.s.	n.s.	n.s.	n.s.
				c	n.s.	n.s.	n.s.	n.s.
18	1.3	167	412	a	0.6	8	0.2	2
				b	0.6	8	0.2	2
				c	0.5	8	0.1	2
18	3.2	195	482	a	0.5	7	0.0	0
				b	0.4	6	0.0	0
				c	0.2	3	0.0	0
19	1.1	90	223	a	1.7	24	0.0	0
				b	1.7	24	0.0	0
				c	1.7	24	0.0	0
19	1.2	152	376	a	1.4	19	0.2	3
				b	1.4	19	0.2	3
				c	1.1	16	0.1	2
19	1.3	268	662	a	0.7	10	0.3	5
				b	0.7	10	0.3	5
				c	0.6	8	0.3	4
20	1.1	152	375	a	1.9	27	0.6	8
				b	1.9	27	0.6	8
				c	1.9	27	0.6	8
20	1.2	218	539	a	5.4	77	3.1	44
				b	5.4	77	3.1	44
				c	5.1	72	2.8	41
20	1.3	114	282	a	2.8	40	1.7	24
				b	2.8	40	1.7	24
				c	2.6	37	1.5	22
20	3.2	24	59	a	1.7	24	0.0	0
				c	1.6	24	0.0	0
				c	1.6	24	0.0	0
21	1.1	134	331	a	4.2	60	1.0	14
				b	4.2	60	1.0	14
				c	4.0	57	0.8	12
21	1.2	139	343	a	4.7	67	2.3	33
				b	4.6	66	2.2	32
				c	4.3	61	2.0	29

TABLE 24 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
21	1.3	**139**	342	a b c	**1.3** **1.3** **1.2**	19 19 17	**0.4** **0.4** **0.4**	6 6 5
22	1.1	**65**	160	a b c	**0.5** **0.5** **0.5**	7 7 7	**0.0** **0.0** **0.0**	0 0 0
22	1.2	**227**	562	a b c	**0.7** **0.7** **0.5**	10 10 7	**0.0** **0.0** **0.0**	0 0 0
22	1.3	**135**	332	a b c	**0.6** **0.6** **0.5**	8 8 8	**0.0** **0.0** **0.0**	0 0 0
23	1.1	**71**	176	a b c	**0.2** **0.2** **0.2**	3 3 3	**0.0** **0.0** **0.0**	0 0 0
23	1.2	**193**	476	a b c	**0.1** **0.1** **0.0**	1 1 0	**0.0** **0.0** **0.0**	0 0 0
23	1.3	**43**	106	a b c	**0.3** **0.3** **0.2**	5 5 3	**0.0** **0.0** **0.0**	0 0 0
24	1.1	**201**	496	a b c	**0.3** **0.3** **0.2**	4 4 3	**0.0** **0.0** **0.0**	0 0 0
24	1.2	**180**	445	a b c	**0.7** **0.7** **0.6**	10 10 8	**0.0** **0.0** **0.0**	0 0 0
24	1.3	**196**	483	a b c	**0.1** **0.1** **0.1**	2 2 2	**0.0** **0.0** **0.0**	0 0 0
24	3.2	**14**	34	a b c	**0.3** **0.3** **0.3**	4 4 4	**0.0** **0.0** **0.0**	0 0 0
25	1.1	**156**	386	a b c	**2.7** **2.7** **2.2**	39 39 31	**0.0** **0.0** **0.0**	0 0 0
25	1.2	**142**	352	a b c	**0.1** **0.1** **0.0**	1 1 0	**0.0** **0.0** **0.0**	0 0 0
25	1.3	**80**	198	a b c	**0.6** **0.6** **0.5**	9 9 7	**0.2** **0.2** **0.1**	2 2 1
26	1.1	**316**	781	a b c	**0.8** **0.8** **0.8**	11 11 11	**0.0** **0.0** **0.0**	0 0 0

TABLE 24 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
26	1.2	355	877	a b c	0.5 0.5 0.4	7 7 6	0.0 0.0 0.0	0 0 0
26	1.3	320	790	a b c	0.2 0.2 0.2	3 3 3	0.0 0.0 0.0	0 0 0
26	3.2	230	568	a b c	1.1 1.1 0.7	15 15 11	0.0 0.0 0.0	0 0 0
27	1.1	245	605	a b c	0.5 0.5 0.5	6 6 6	0.0 0.0 0.0	0 0 0
27	1.2	152	375	a b c	2.3 2.3 2.0	32 32 28	1.2 1.2 0.9	17 17 14
27	1.3	69	170	a b c	2.3 2.3 1.9	32 32 27	1.4 1.4 1.2	20 20 17
27	3.2	24	60	a b c	0.8 0.8 0.8	11 11 11	0.0 0.0 0.0	0 0 0
28	1.1	147	364	a b c	1.7 1.7 1.4	24 24 20	0.6 0.6 0.4	8 8 6
28	1.2	244	604	a b c	2.9 2.9 2.1	42 41 31	1.5 1.5 1.1	22 22 16
28	1.3	98	241	a b c	n.s. n.s. n.s.	n.s. n.s. n.s.	n.s. n.s. n.s.	n.s. n.s. n.s.
29	1.1	71	175	a b c	0.8 0.8 0.8	12 12 12	0.0 0.0 0.0	0 0 0
29	1.2	207	512	a b c	0.4 0.4 0.4	6 6 6	0.0 0.0 0.0	0 0 0
29	1.3	64	158	a b c	0.3 0.3 0.1	4 4 2	0.0 0.0 0.0	0 0 0
30	1.1	299	738	a b c	0.5 0.5 0.4	7 7 6	0.0 0.0 0.0	0 0 0
30	1.2	280	691	a b c	1.5 1.5 1.3	21 21 19	0.3 0.3 0.2	5 5 3

TABLE 24 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
30	1.3	157	388	a	0.5	8	0.2	3
				b	0.5	8	0.2	3
				c	0.4	6	0.2	3
31	1.1	309	763	a	1.1	15	0.1	2
				b	1.1	15	0.1	2
				c	1.0	14	0.0	0
31	1.2	160	396	a	2.4	35	0.3	5
				b	2.4	35	0.3	5
				c	2.3	33	0.3	5
31	1.3	190	470	a	1.0	14	0.3	4
				b	0.9	13	0.2	4
				c	0.8	11	0.2	2
32	1.1	78	192	a	1.0	15	0.0	0
				b	1.0	15	0.0	0
				c	1.0	15	0.0	0
32	1.2	402	994	a	2.7	38	1.3	18
				b	2.7	38	1.3	18
				c	2.5	35	1.1	16
32	1.3	182	450	a	1.7	24	1.1	15
				b	1.7	24	1.1	15
				c	1.2	17	0.7	9
33	1.1	151	374	a	10.1	145	5.9	85
				b	10.0	143	5.9	84
				c	9.6	138	5.6	81
33	1.2	165	407	a	7.7	110	4.6	65
				b	7.7	110	4.6	65
				c	7.2	102	4.3	62
33	1.3	299	738	a	3.0	43	2.0	28
				b	3.0	43	2.0	28
				c	2.5	36	1.6	23
33	3.2	280	693	a	4.1	59	0.0	0
				b	4.1	59	0.0	0
				c	2.7	38	0.0	0
34	1.1	74	184	a	11.1	159	6.4	91
				b	11.0	158	6.3	90
				c	10.2	146	5.8	83
34	1.2	63	155	a	14.3	204	8.8	126
				b	14.3	204	8.8	126
				c	13.6	194	8.2	117
34	1.3	72	178	a	3.8	55	2.5	36
				b	3.8	55	2.5	36
				c	3.6	51	2.3	33
34	3.2	237	586	a	3.0	43	0.8	12
				b	3.0	42	0.8	12
				c	2.5	36	0.4	6

TABLE 24 (Continued)

Block	Type	Area		d.b.h.**	Mean		Reliable minimum estimate+	
		ha	ac		m^3/ha	ft^3/ac	m^3/ha	ft^3/ac
35	1.1	88	217	a b c	0.5 0.5 0.5	7 7 7	0.0 0.0 0.0	0 0 0
35	1.2	273	674	a b c	1.6 1.6 1.6	23 23 23	0.1 0.1 0.1	2 2 2
35	1.3	442	1 092	a b c	0.6 0.6 0.6	8 8 8	0.0 0.0 0.0	0 0 0

TABLE 25 Summary Statement of the Standing Gross Volume of 'Old Growth' Pine in Three Pine Forest Types in the Whole Project Area

Type	Area		Gross volume						Minimum estimate					
			d.b.h. cm (in)						d.b.h. cm (in)					
			≥7.6 (3.0)		≥15.2 (6.0)		≥25.4 (6.0)		≥7.6 (3.0)		≥15.2 (6.0)		≥25.4 (10.0)	
	ha	ac	'00 m^3	'000 ft^3	'00 m^3	'000 ft^3	'00 m^3	'000 ft^3	'00 m^3	'000 ft^3	'00 m^3	'000 ft^3	'00 m^3	'000 ft^3
1.1	**5 117**	12 644	**83**	294	**83**	292	**78**	274	**66**	232	**65**	231	**61**	215
1.2	**7 027**	17 364	**117**	415	**116**	411	**102**	362	**101**	357	**100**	353	**90**	319
1.3	**6 386**	15 780	**49**	173	**49**	172	**39**	139	**42**	148	**42**	147	**33**	118
3 types summed	**18 530**	45 788	**249**	882	**248**	875	**219**	775	**209**	737	**207**	731	**184**	652

PUBLICATIONS OF THE LAND RESOURCES DIVISION

These publications have a restricted distribution and are not available to booksellers. The Division makes a report on each completed project. The report is published as a *Land Resource Study* or *Technical Bulletin* only with the consent of the government concerned. The abbreviated titles of the reports in the style of the 'World List of Scientific Periodicals' are *Land Resour. Stud.* and *Tech. Bull. Land Resour. Div. overseas Dev. Admin.*

RAWDEN M G and LANGDALE-BROWN I	1961	An aerial photographic reconnaissance of the present and possible land use in the Bamenda Area, Southern Cameroons.*
BAWDEN M G and STOBBS A R	1963	The land resources of Eastern Bechuanaland.
LANGDALE-BROWN I and SPOONER R J	1963	The land use prospects of Northern Bechuanaland*
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* Out of print.

** Land Resource Study No. 7 has not yet been published.

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