SILVICULTURE IN THE PRIVATE AND CORPORATELY OWNED FORESTS OF CANTERBURY

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SYNOPSIS

Although most of Canterbury is not a good forest site, exotic forests, particularly of Pinus radiata, *have been established with considerable success for many years. Their silviculture and management must always take into account the difficult climatic and site conditions under which they grow.*

Detailed aims of management and management prescriptions, as carried out at present, are described and discussed. A mean annual increment of 310 cu. ft for Pinus radiata *is possible provided thinning can be undertaken and disasters are not encountered.*

Adequate stumpages are essential for a full management programme. The independent forest owner cannot continue without making a profit and the type of stumpages necessary and possible are shown.

INTRODUCTION

It has often been said that Canterbury has a non-forest climate; but tree planting has formed an important part of the Province's development since it was first encouraged by legislation in 1858. Canterbury was largely a treeless area, but is now quite well endowed with plantations, which were established for shelter, fuel, timber, wind-erosion and sand-dune control. Exotic species were used almost exclusively, with *Pinus radiata* predominant in later years.

The plains soils are generally shallow, overlying compacted gravels, while the foothills have heavier soils more suited to tree growing. High temperatures in summer, associated with strong drying northwest winds, bring about low humidities, rapid evaporation and long periods of high fire hazard. Average annual rainfalls vary from 24 to 45 in., and heavy snowfalls do occur. From time to time gale force winds, usually from the northwest, have occurred, the worst in 1945 causing extensive wind-damage to forests.

In past years rabbits have caused serious losses during the establishment period but, thanks to the Rabbit Boards, their numbers have been greatly reduced. Hares still cause some loss throughout Canterbury. The presence of such vigorous weeds as gorse and broom have also made establishment difficult and costly, although the advent of herbicides has made their control easier.

Against this historical background silviculture in Canterbury has evolved, influenced by the many adverse site factors mentioned above as well as by the ever present limitations of available finance.

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Every time a gradation of age classes looks possible, something upsets it and so prevents an adequate regular income being available for a full silvicultural programme. In spite of a certain amount of present day prejudice, *P. radiata* will continue to be the main species on the plains; it is the chief concern of this paper. However, well managed plains forests can be an economically competitive form of land use, notwithstanding the hazards (Ward, 1963).

ESTABLISHMENT

Plains site qualities are generally not high so the aim is to create, artificially, a "forest climate" as soon as possible, *i.e.*, in 8 to 9 years. To achieve this with *P. radiata*, 800 to 900 trees per acre are needed, and on the better sites with higher rainfall 1,000 to 1,100 *Pseudotsuga taxifolia* or *Pinus nigra* are required. Some pre-planting cultivation gives the best results and, provided the ground can be consolidated before planting, strip-ploughing is successful. If blanking can be eliminated by good initial planting, so much the better.

Re-establishment of cut-over areas is not easy. Natural regeneration of *P. radiata* has been very patchy — varying from overstocking to none at all. Once the risk of *Hylastes ater* has gone, blank areas must be replanted before weeds take over. In earlier years, logging slash was piled and burnt by the contractor but, after several unhappy experiences, this has been abandoned in most places. By insisting on full utilization, it is hoped to leave an insignificant amount of slash or to burn only when absolutely necessary.

Converting wattle and eucalypt stands is not easy, particularly as wattle becomes an aggressive weed species and most of the eucalypts coppice. To clean up the stands sufficiently for replanting, firewood of both species is cut, but it has to be left in the plantation to dry for one or two years. During that time weed species become established and have a distinct advantage over subsequently planted *P. radiata* stock. One hopes for a severe frost to check the wattle and eucalypt regrowth. Admittedly, hormones can be used and are successful against wattle. One also hopes for two or three good summers after replanting to enable the pines to become well established.

In recent years, flank firebreaks running into the northwest have been put in as the major lines of defence. Even a half chain flank firebreak provides width enough from which to attack and control a fire. One or two recent large fires in Canterbury have demonstrated that the cross-wind firebreak is useless, no matter how wide.

At the same time, it has become customary to orientate planting lines into the northwest, in the hope of increasing stability during gales. Subsequent thinning of outrows should let the wind through a stand to some extent. It has also been suggested that an elongated diamond shaped group-system with long axes into the northwest could be used to reduce wind resistance. The difficulty with this idea is that the large area of unproductive land between groups would be difficult to keep clear of weeds. Salvage and restocking after the 1945 gales has produced an irregular grouping of age classes within the one stand with consequent irregularity of height

classes. It is hoped that this breaking up of the stands will make them more wind firm even though their management will be more difficult.

Release-cutting is not widely practised because of costs and shortage of labour. Good preparation before planting, an adequate survival, and using *P. radiata* where the weed growth is worst, almost eliminate the need for release cutting. If necessary in future, the N.Z. Forest Service example of using weedkillers by aerial spraying will be followed as a releasing technique.

PRUNING

1. *Low Pruning*

With *P. radiata* this is done at approximately 9 to 10 years of age when stand height is 25 to 30 ft. All trees are pruned except those badly malformed, which are chopped out, and the marginal trees. Having all trees pruned improves access, helps management, and reduces felling costs; but most important of all it reduces the fire danger and the likelihood of a crown fire.

The outside of marginal trees is not pruned, in order to leave a green mantle right to the ground. The green mantle keeps the wind out to some extent and so prevents rapid drying of slash and ground. It is not so inflammable to sparks which might blow in from a neighbouring fire. Also the mantle helps to prevent the growth of weeds along the margin where they cannot be ploughed out during firebreak cultivation because of surface tree-roots. A marginal strip of gorse or broom along the base of trees would be a severe fire hazard almost certain to promote a crown fire.

2. *High Pruning*

Extensive high pruning has not been done because of the cost and the ever present risk of losing a stand from fire or gale. High pruning does not improve stand stability and while the risk is so great the returns from a costly investment become doubtful. If high pruning is to be done it should be done after thinning, despite the accumulation of slash. How often stands have been high pruned, but not thinned to allow the favoured trees room to grow and benefit from the pruning. In a year or two the better formed high pruned trees are suppressed beyond point of recovery. This is a very critical operation economically and experience to date does not indicate that sawmillers will pay a premium for selected logs with improved grade from high pruning. It is hoped that this attitude will change.

THINNING

This is a most important operation to the forester because it gives him an opportunity to obtain a credit with which to reduce the burden of costs that his final crop must carry. By gradually reducing stem numbers per acre it increases stand stability, which is particularly important in Canterbury. While trees will blow over at all ages, they are most susceptible after reaching 50 ft in height.

The aim is to thin first at about age 16 years so that the stand has time to recover and become stabilized before it is 50 to 55 ft high. As most of the stands being thinned are on flat ground, every seventh row (known as the outrow) is removed completely, while the six rows in between are marked for thinning in the normal

way. The stocking per acre aimed at after thinning must include that area occupied by the outrow. This has many advantages: it provides an attractive volume for both contractor and seller, allows access for motor vehicles right into the stand and, being early enough to produce only small material, completely eliminates early logging. It lends itself equally well to the production of firewood, pulpwood, or fencing material. Yield is 16 cords per acre. There is only a limited demand for firewood so the area covered per annum is smaller than desirable. Treated pine fencing material still faces a buyer resistance in Canterbury, especially on the plains. *P. radiata* from first thinnings does not produce an attractive post or strainer by Canterbury standards, so is not yet keenly sought after. The answer seems to lie in cordwood for chipboard or pulp production. Because of the fire danger, it is essential that thinning operations leave a minimum of slash. Where there is a constant danger from windthrow, thinning is like the traditional American prelogging salvage in that it makes easier and more economic any wind-salvage that might be necessary later. In many cases, because of lack of market, thinning is delayed until trees are large enough to produce small sawlogs. Therefore the first thinning might not be done until 25 to 30 years of age and outrows would be further apart. Yield is about 2,300 cu. ft per acre in sawlogs, firewood and round produce. If a cordwood thinning is carried out at age 16 to 18 years, two sawlog thinnings will be possible before clear-felling, the first at age 25 to 28 years and the second at 34 to 35 years. The stand can then be retained for a rotation of 45 years or longer. Many of the stands planted 60 years ago at 10 ft spacing are still healthy and vigorous. Final stocking has not been completely determined but it will probably be about 100 to 120 stems per acre following the ideal treatment. The above prescriptions and yields assume that there is a full stocking.

As much as anything, periodic thinnings aim at keeping the green crown level as low as possible for three reasons:

(a) to increase the stability of the stand,
(b) to improve timber grades by maintaining live knots, and
(c) to decrease the crown fire hazard by retaining green branches.

A deep light crown must subject the trunk and roots to much less strain and so reduce the likelihood of windthrow. A well thinned stand with spaces between crowns will allow the wind to filter through and break up turbulence, resulting in less massed windthrow and "drives". Green crowns mean live knots and improved grade recovery. It appears that after a certain age in Canterbury, branch size in the upper crown does not increase appreciably with age. Therefore grades are not reduced by knots becoming too large. If improved grade recovery can be obtained this way by thinning, the need for a lot of high pruning, especially beyond 16 ft, is eliminated. Stands with all green crowns are much less liable to crown fire except under explosive fire hazard conditions. A stand well thinned on the outrow principle has better access so that fire fighting is much easier. Trees will be vigorous and healthy and, if utilization is full, pathological dangers are less likely. Of course a little slash is unavoidable and some fire risk remains for a while after any operation.

Anticipated yields in merchantable volume per acre, are:

Age (years)	*Treatment*	*Volume (cu. ft)*	*Trees remaining*
16 to 18	Firewood or pulpwood thinning	1,280	300 to 350
25 to 28	First sawlog and pulpwood thinning	1,800	170 to 200
34 to 35	Second sawlog and pulpwood thinning	2,000	100 to 120
45	Clearfelling	9,000	—
Total yield, *i.e.*, m.a.i. of approximately 310 cu. ft		14,080	

CLEARFELLING

Clearfelling, too, is a most important part of the silvicultural programme, both physically and economically. It must be done well and in such a way to lead on to the re-establishment programme. Full utilization is essential to obtain value for the stand and to minimize the cost of slash clearing before replanting (Smith, 1961). A good net return will ensure that sufficient finance is available to start the second crop off on the right footing.

STUMPAGES

The private forest owner is limited by the amount of money available as to how much silviculture he can do, no matter how desirable that operation might be. He must obtain the highest return possible for the produce he sells, his operation must be efficient, and he must feel that what he is about to do will be rewarding in the long run. Therefore, to obtain a good stumpage is a matter of good business and of understanding the various markets available.

Stumpages will be related to the type of product sold, the costs of production all along the line, and the selling prices of the end product. For example, firewood is worth 3d per cu. ft stumpage, sawlogs from first thinnings 8d, sawlogs from clearfelling 1s 0d, posts and small poles 1s 6d and larger poles 2s 0d. Everyone, including the forest owner, is entitled to make a profit, even though traditionally, due largely to our indigenous heritage, he has had to live on the crumbs that were left. It will be a long time before the forest owner can expect to recoup all his silvicultural costs, plus interest rates, plus a profit on all his business costs and risks, as a stumpage; but figures somewhere near the above should go a long way towards it. And what other business would continue to operate without making a profit? Buyers of stumpage always say that an increase will price timber out of the market in favour of substitute materials. But 1d per cu. ft is equivalent to approximately 1s 6d per 100 bd. ft sawn measure, £7 10s 0d per average house and 10s 0d per ton of newsprint; all fairly insignificant to the end purchaser, but 1d per cu. ft increase in stumpage means a lot to the forest owner. An increase of 1d per cu. ft on the 1960 New Zealand exotic log cut of 95 million cu. ft would have meant £400,000 more to encourage afforestation and better silviculture. Political reasons have kept timber prices in New Zealand down so that building costs would not rise. But New Zealand's timber prices are well below world parity and could stand better stumpage charges without greatly affecting the end user's price, as shown above.

A merchant's minimum mark-up for handling radiata pine is 12s 0d per 100 bd. ft sawn, an equivalent of 8d per cu. ft. His business risks for the fairly short time he carries that stock and debt are not comparable with the 35 to 45 years' risks which the forest owner must face before getting his return, and he therefore deserves something better than 3d. These types of figures can pinpoint the argument (Cooney, 1961).

Stumpages are the all important part of the forest owner's business enterprise. He cannot start or carry on without decent stumpages as his incentive, no matter how keen he might be. He must have them now to ensure an adequate forest crop for the future.

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