MANAGEMENT OF SOUTH WESTLAND TERRACE PODOCARP FOREST UNDER A SELECTION LOGGING SYSTEM

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SYNOPSIS

Selection management began on the morainic podocarp forests of State tenure in south Westland in 1963 in an effort to conserve forest structure and to provide a timber source in perpetuity. The area of these forests is 14,500 hectares. During the first seven years of the initial cutting cycle (prescribed as 30 years) some 710 ha have been worked and the system appears to be fulfilling its aims. Past clearfelling practices on these terraces caused severe soil degradation. The soils are naturally characterized by waterlogged mineral horizons, hardpan formations, lack of structure, severe leaching, acidity and extreme nutrient deficiency. Under the selection system, however, this degradation is kept to a minimum by retention of forest structure.

Machines used, and extraction methods employed, are governed by stand conditions. Mechanical damage to residual trees is kept to a minimum, rarely exceeding 5%, and machine scarification of the ground improves seedbed conditions. The effect heavy machinery is having on increment, through compaction of shallow feeding roots of rimu (Dacrydium cupressinum), *is not certain at this stage. Ponding in localized areas also causes root damage to rimu, and subsequent mortality is rapid. It is hoped that selection logging may eventually be extended to replace clearfelling practice in hill country forests.*

INTRODUCTION

Utilization of the podocarp forests of Westland has been continuous since early settler days in the 1850s. Initially there was no restriction on felling, but with tramway cartage most felling was confined to the flat lands. An increase in awareness of the need for conservation and sustained yield production led to a decision in 1956 to restrict clearfelling in State forest to hill country, and to begin strip felling on the flat and rolling country. Felled strips were 80 m in width and up to 800 m long. This gave way to selection logging in 1965, and 710 ha have been worked by this method in the first cutting cycle, prescribed as 30 years.

RESOURCES

South Westland contains 83% of the Westland Conservancy total merchantable podocarp resource. Of this, 45% (32,000 ha) is suitable for long-term management under a selection system. Long-term sale agreements have been made with industry to

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supply 25,000 m³ per annum. This represents an annual working area of approximately 280 ha.

FOREST TYPES AND SOILS

The soils of the terraces are described as hydrous and hygrous lowland podzolized yellow-brown earths and podzols formed on a greywacke, granite or schist alluvium base (N.Z. Soil Bureau, 1968).

Forest types on these terraces are described in National Forest Survey reports for the Westland Unit as predominantly P1*, carrying an average merchantable volume of 350 m³/ha; mean stocking is about 190 s.p.ha. with average dbh of 50 cm and mean merchantable length of 15 m.

The wide distribution of these terraces, their easy contour, accessibility, and their high volume and stable forest cover, would seem to indicate that they could be readily managed by traditional methods of clearfelling and re-establishment. However, this is not so. Kennedy (1954) described the terrace conditions as "something of a nightmare" because of the nature of the soils. The chief characteristics of these terrace soils are waterlogged mineral horizons, lack of structure, severe leaching, hardpan formations, impermeability, acidity and extreme nutrient deficiency. Clearfelling, through increasing the waterlogging, has in the past accentuated these soil conditions, and when coupled with periodic burning of the cutover, has caused accelerated soil degradation. In particular the humus, which is the principal rooting medium, was thereby removed.

SELECTION LOGGING PRINCIPLES

On the basis of work by Chavasse and Travers (1966) a "conversion to normality" period was set at 120 years with four cutting cycles. For the first cutting cycle, one quarter of the merchantable volume was to be removed, up to a maximum of 84 m³/ha. This provided for the emphasis to be on the removal of overmature and malformed trees. In areas with low volume, up to 50% of the merchantable stand volume could be extracted. The patchy nature of the forest must be taken into account; over-mature patches or groups are removed and younger, more vigorous groups are left untouched. An effort is made during extraction to strike a balance between loss of forest structure if gaps become too large, and inadequate regeneration if gaps are too small.

For volume control purposes, an average increment of 1.40 m³/ha per annum is assumed, but it appears likely that the increment could be higher than this. Recent studies by Franklin (1971) have indicated that the natural forest is 85% fully stocked (in comparison with the assumed ideal) with

*P1—heavy podocarp stands, mainly of rimu, occurring usually on the seaward morainic slopes. The type includes relatively denser stands of smaller trees in areas too small to be typed out.

TABLE 1: CANOPY DESCRIPTION IN RELATION TO REGENERATION AND TREATMENT

Canopy Description	*Regeneration*	*Treatment*
Dense. High number of stems per ha; small mean diameter of merchantable stems. Vigorous and healthy.	Scattered or absent; stunted and unhealthy.	Removal of larger trees in patches, but not necessarily a complete group felling.
Moderately dense. Small number of stems per ha; large mean diameter. Distinct group structure of merchantable stems, pole and sapling stands, either pure or associated with hardwoods. Windthrow and broken tops present.	Present but often localized or scattered. In the more open patches is healthy and vigorous.	Removal by patches, which often leads to a more complete group felling. Trees left for seeding purposes only if it is considered that windthrow will not be a problem. Extra scarification necessary in patches where seedlings are absent.
Large scattered trees with dense hardwood understorey. Large mean diameter of merchantable stems. Generally in poor health.	Distinct advance growth patches and areas with nil regeneration.	No removal of timber. Treatment by scarification of patches where no advance growth or regeneration is present.

an increment, before logging, of 1.50 ± 0.07 m^3/ha. Franklin states: "Unless selective logging greatly modifies the site potential it would be unwise to assume that this forest has a potential increment of more than 1.75 m^3/ha per annum". On the basis of this estimate, the time required to replace an economic logging volume of 70 m^3/ha is forty to fifty years.

REGENERATION AND SCARIFICATION

The podocarp terrace forests are generally considered to be understocked with regeneration. This is accentuated by the patchy distribution of regeneration. The problem is to promote regeneration in those areas where it is absent, even where there may be no merchantable timber, or where it has been reduced by logging. Factors for successful regeneration are a suitable seedbed, adequate drainage and adequate light.

Franklin (1971) has shown that it is economically possible to secure regeneration by scarifying the forest floor before logging, using a D4-type crawler tractor. Net cost to the forest amounted to *14 cents per m^3 after savings in logging costs* were taken into account, when the cost of scarifying was $30 per hectare.

Where merchantable timber is concentrated in groups, rubber-tyred skidder extraction ensures adequate scarification by virtue of a high volume being extracted from a small area. Consequently, in this case regeneration is being induced in the areas where it is most needed—where trees have been removed. Effective scarification, however, still requires a conscious effort during logging or, as in the case of hauler extraction, a separate operation. This is not undertaken at present. Extra scarification may also prove necessary in forest gaps where seedlings are few or absent.

Regeneration will occur throughout a wide variety of light regimes, up to full sunlight. However, there seems to be a critical lower limit below which subsequent development of seedlings will not occur. This critical limit seems to be about 30% of full sunlight. Table 1 summarizes treatments for various canopy types to ensure regeneration.

MECHANICAL DAMAGE TO THE RESIDUAL STAND

Damage to Residual Merchantable Forest

The best way of ensuring minimum damage during logging is to employ an experienced logging gang. Under present working methods, visible mechanical damage rarely exceeds 5% of residual merchantable trees. Most damage is done during extraction rather than felling. Some of the most common causes are: pivoting logs between residual trees during break-out; rope burns; rubbing by skidder tyres; bark loss, and limb shatter, during felling; and general root damage. Figures are not yet available to show the effect such damage has on subsequent increment, or loss following decay and insect attack. Research into loss of increment due to logging damage is in progress.

More serious is the effect of root damage. The feeding roots of rimu are very shallow, penetrating to depths of 15 to 45 cm. When these roots are compacted, mortality occurs rapidly. What unseen effect heavy machinery is having on increment through root damage is not certain at present.

Waterlogging of the root system also causes mortality. Induced ponding by roading, and localized ponding within the forest, are causing concern. Trees are currently being removed where ponding is likely to have an adverse effect.

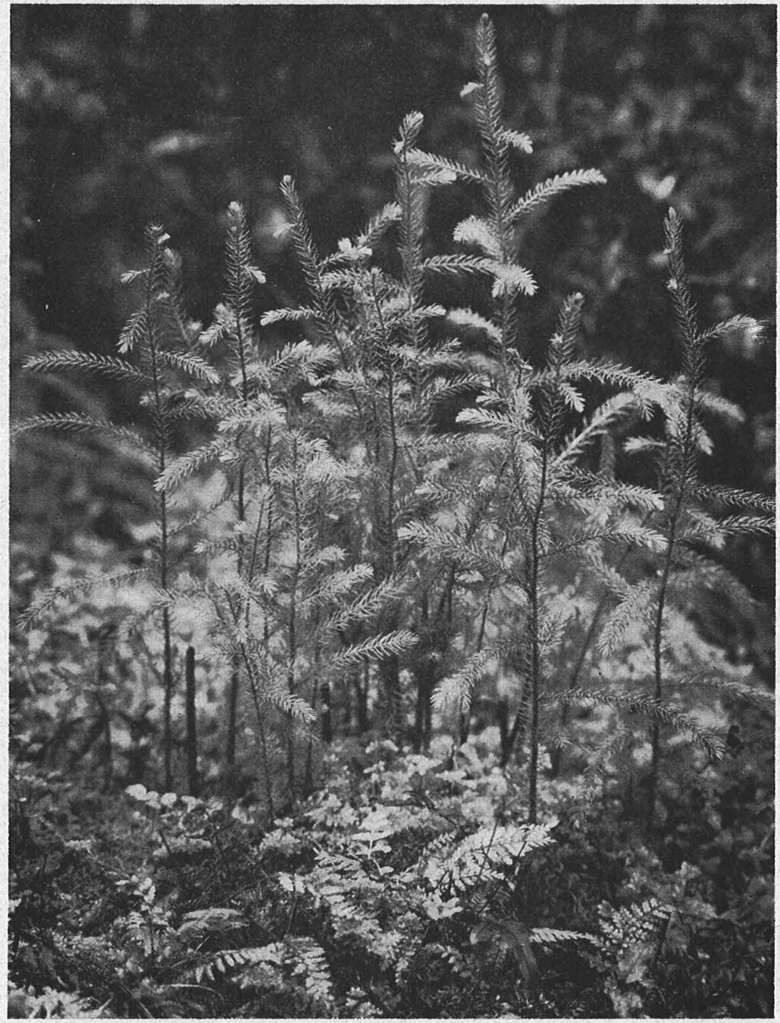

FIG. 1: *Rimu regeneration on scarified ground following selection logging 6 years earlier.*

N.Z. Forest Service photo by J. H. G. Johns, A.R.P.S.

FIG. 2: *Rubber-tyred skidder extraction in high volume terrace forest. (National Forest Survey, Westland Unit, Type P1.)*
N.Z. Forest Service photo by J. H. G. Johns, A.R.P.S.

Under selection logging specifications, merchantable trees damaged beyond a minimum acceptable level are felled and extracted before moving to a new landing.

Damage to Residual Poles, Saplings and Seedlings

Franklin (1971) gave the following diameter class percentages destroyed by logging in an eight hectare block in Ianthe State Forest. Extraction was by rubber-tyred skidder.

	dbh classes			
	0-2.5	*2.6-7.5*	*7.6-12.5*	*12.5-23.0*
Percentage destroyed by logging	40	38	29	9

Of these, a certain number would be malformed stems that the loggers made no effort to avoid.

In hauler operations the lines of extraction are straight. There is a certain amount of flexibility in the location of main tracks, and by using a bull-block the secondary tracks can be located through a 60° arc. However, destruction of a certain amount of regeneration cannot be avoided. In practice, hauler extraction causes less damage in dense stands, and rubber-tyred skidder extraction less in open stands, not taking into account any unseen damage caused through soil disturbance. With the desire for larger and more powerful tractors or skidders, an extensive study of site modification will need to be undertaken.

SEEDFALL AND PATCH SIZE

Dispersion of rimu seed is subject to conjecture at present. It is known to occur by direct fall from seed trees, and birds also distribute seed (Beveridge, 1964). It has been assumed in the past that, of the two, direct fall from trees has been the more important in Westland. Studies begun in 1954 have shown that the majority of seed falls within 30 m of its source. There is, however, much evidence through the terrace and hill country forests of abundant and healthy seedlings at distances far removed from seed sources. Until more is known about seed dispersion mechanisms, it is assumed that any area to be regenerated should be no more than 30 m from a seed tree, or preferably from a bank of seed trees.

EFFECT OF WINDTHROW

Although few quantitative data are available, it seems that windthrow of residual merchantable stems will not prove a problem. Where excessive windthrow may occur (the evidence being broken tops, old windthrown trees lying on the ground, tree size, and extensive canopy openings) more emphasis should be placed on wind-firmness during marking for extraction.

TIMBER TRENDS AND THEIR EFFECT ON MANAGEMENT

The original selection logging specifications called for the selection of trees to be extracted as follows: badly leaning trees not expected to stand for 30 years; unhealthy dying trees —*e.g.*, hollow butt, side decay, dead leader, spike-top decay; and dead and dying foliage, generally in excess of 50% of the crown. It is becoming increasingly difficult to quit the poorer logs of cull trees to sawmillers. With the trend of increasing freight rates and lowering of demand for rimu building grades, logs that sawmillers regard as acceptable will continue to rise in quality. The effect of this trend will be retention of more decadent and poorly-formed trees in the bush. The flexibility which is inherent in a selection system of management will, however, ensure that future variations in rimu timber usage can be accommodated without detriment to the perpetual forest crop.

SELECTION LOGGING ON HILL COUNTRY

Trials have been initiated to establish the feasibility of providing a timber source in perpetuity on rolling hill country forests from which, at present, all merchantable stems are being extracted. Initial trials will involve strip-felling systems and minimum diameter cutting limits in which all stems less than 40 cm dbh will be retained.

CONCLUSION

The terrace podocarp forests of south Westland have now been under full selection management for seven years. During this time, timber sale commitments have been met, net economic returns have been positive, and forest structure has been maintained. Further research and refinement of logging methods will ensure the continuing success of management.

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