FOREST MANAGEMENT AND RESEARCH IN INDIGENOUS PRODUCTION FORESTS

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Abstract

Indigenous production forests are a fast-dwindling resource but sufficient research has been done to allow a considerable expansion of current, small-scale management operations and ensure permanent production of some indigenous timbers. While the beech, beech/podocarp and dense rimu forests on the western side of the South Island offer the best prospects for management, carefully-controlled selective logging of podocarp forests elsewhere, particularly in central North Island, would perpetuate these forests and preserve forest values additional to timber production.

INTRODUCTION

Nearly twenty years have passed since the results of the National Forest Survey were compiled. In the account of the indigenous forest resources of New Zealand (Masters *et al.*, 1957) prospects for management of logged and unlogged forest were discussed but, with the exception of the beech species and kauri, the situation was not considered promising. In the following pages, research findings since that time and their application by management are reviewed, and the need for further research and scope for future management are outlined.

KAURI

Since the mid-1950s surveys have indicated the extent of the major areas of Kauri regeneration, and some areas not previously within State forest have been acquired, but there is still scope for further acquisition. Several studies of natural regeneration (*e.g.*, Lloyd, 1960) have shown that most occurs beneath seral shrub hardwoods such as manuka, kanuka (*Leptospermum* spp.) and towai (*Weinmannia silvicola*), which have arisen after substantial clearing and/or fire. This is a

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lengthy and uncertain process dependent upon the preservation of adequate seed trees and the presence of a suitable nurse species. The possibilities of inducing natural regeneration by selectively logging mature forest are also uncertain, but selective logging has been carried out, particularly in Northland, with the aim of utilizing the mature trees while protecting the immature trees for future use. If this is to be continued, it will be necessary to improve means of recruiting regeneration, perhaps by group felling and inducing a suitable nurse species.

The prospect of producing nursery-raised seedlings suitable for planting out has been examined (Morrison and Lloyd, 1972). Planting out of kauri seedlings wth the aim of forming plantations has been carried out on a small scale in Northland but problems of siting and establishment have to be resolved before it could be applied on a wide scale. There is possibly scope for enriching natural regeneration where this is patchy, and for enriching selectively-logged forest; further investigations along these lines could be profitably undertaken.

Quite large areas (5 000 ha) of kauri regeneration on Great Barrier Island and in Northland have been released from overhead competition but the actual benefits of such releasing have yet to be demonstrated by research findings. Studies of this nature are required, incorporated with trials to test early thinning of regeneration where appropriate. Thinning of pole stands has been carried out on a small scale and this could be expanded into a routine operation in future if there is a market for the produce and/or if the benefits of increased growth outweigh the costs incurred.

PODOCARPS
(excluding beech forest)

Logged Forests

These forests are extremely variable, depending upon their original composition, whether there was advance growth present at the time of logging, whether seed sources of merchantable species were left, the intensity of the logging, the time since logging, the occurrence of fires and the impact of browsing animals. Suitable techniques have been developed for assessing the stocking of cutover forest; such assessments will be necessary for determining management priorities if and when intensive management of existing cutover forest is contemplated.

Provided that there is a solid base of natural regeneration, trials have shown that full stocking can be achieved by enriching with nursery-raised podocarp seedlings, but the technique is probably too expensive to be used on a wide scale or used where the natural regeneration is sparse. Enrichment

with exotics such as eucalypts or Japanese cedar (*Cryptomeria japonica*) has also been demonstrated as feasible.

Management of cutover indigenous forest has to date consisted almost solely of fire-protection, and this of course should continue. Where natural regeneration of merchantable species exists, there is scope for more intensive management, particularly where there is a residue of merchantable trees. Elsewhere the options are to retain the forest as a reserve, with the potential to produce cellulose in the future, or to convert it to a more productive form of land use.

Forests with Scattered Podocarps

In these forests there are usually fewer than 10 merchantable podocarps (70 m^3 per hectare) and the smaller size classes are generally poorly represented, so there is little scope for selectively logging the podocarps alone. The alternatives appear to be: reservation, either for amenity purposes or as a contingency timber reserve; logging and leaving to form a future amenity reserve or potential source of cellulose; or logging and converting to a more productive form of land use. Where the hardwood associates are valuable species such as tawa (*Beilschmiedia tawa*), kohekohe (*Dysokylum spectabile*), or mangeao (*Litsea calicaris*) and these are numerous enough, selective logging may be possible. Other than some assessments of regeneration and monitoring of growth rates, there has been no research work done in this type of forest. Recent surveys have revealed areas of forest in the West Taupo region where scattered podocarps are present in association with a substantial amount of well-developed podocarp regeneration. A trial has been initiated to remove the bulk of the mature trees while retaining most of the regeneration and keeping forest disturbance to a minimum.

Forests with Moderately Dense Podocarps

These are forests where there are sufficient podocarp trees (between 10 and 50/ha or 70 to 250 m^3/ha) for selective logging to be feasible. Selective logging trials have been established in such forest at Pureora and Minginui in central North Island and in north and south Westland. These trials have proved that selective logging can be economically feasible and can be carried out without destroying the essential structure of the forest or causing undue damage to residual stems. Because the smaller size classes are usually poorly represented, except where there is an admixture of hardwoods such as tawa and hinau (*Elaeocarpus dentatus*), and because of the long rotations required for podocarps (200 to 300 years), it is probably not possible to manage these forests for a sustained yield in perpetuity, but at least they can be logged without being

destroyed and they can be relogged in the foreseeable future if that should be desired. It is naturally desirable to promote regeneration of merchantable species, but obtaining such regeneration is not an essential prerequisite for indigenous forest management. The problems of regenerating podocarps in podocarp/tawa forests of central North Island have received some attention (Beveridge, 1973). Another important objective in selective logging of these forests is to leave the forest in a stable and healthy condition. In the Pureora trial an assessment of all merchantable trees was made 12 years after removing one-third of the crop in small groups. As a high proportion of leaning and thin-crowned podocarps were removed in logging, it was found that the incidence of windfall and death of large trees was lower in the selectively-logged blocks than in the unlogged control block. Careful tree marking and control of logging is required to achieve this result. In the past, logging of much of the indigenous forest has been relatively uncontrolled and has resulted in much more devastation than necessary.

Despite the fact that the trials have been established for 6 to 13 years, the Forest Service has only recently attempted to manage these forests as indigenous production forests, and then only in south Westland.

There is considerable scope for further trials in this type of forest, mainly to test the physical limitations to selective logging and the economics of selectively logging the lower volume areas. The economics of logging depend to a large extent on the value of the extracted logs, and this could change drastically with changes in supply and demand.

Dense Podocarp Forests

There are three distinct types of dense podocarp forest: the all-aged rimu forests found mainly on terraces in south Westland; even-aged pole stands, which occur locally throughout the country; and dense stands of mostly mature trees, which occur mainly in the central North Island.

Research into and the management of the terrace rimu forests of south Westland have been well documented (*e.g.*, Franklin, 1968, 1971, 1972a; Gover, 1972). These forests can be logged economically without destroying their structure or causing undue damage to residual stems provided that roads are carefully sited and adequately culverted to avoid ponding of water. Recruitment of rimu regeneration has been found to be greatly favoured by the presence of disturbed ground and the presence of seed trees within 30 to 40 m. Current logging favours regeneration by logging out small groups of overmature and/or unhealthy trees by using skidders working from pre-formed tracks wherever possible. Forming the extraction tracks ahead of logging ensures that damage to re-

sidual stems, particularly regeneration, is kept to a minimum, while group logging ensures minimum felling damage to residual stems and maximum ground disturbance where regeneration is most needed — around the stumps of felled trees. The groups are kept small to ensure that there is always a seed source nearby.

Increment studies have shown that increments of between 1.5 and 2.0 m^3/ha/yr are common in virgin forest and that these are not lkely to be depressed by selection logging extracting between 20 and 35% of the standing merchantable volume. Further investigations into the increment of unlogged forest and forest logged to differing degrees are continuing, together with studies of the factors which favour the recruitment and growth of rimu seedlings.

The thinning of pole stands of podocarps has not been well tested, mainly because of the limited extent of such stands and the lack of markets for the produce. Management has consisted of either bypassing them as in Westland, or clearfelling them for conversion to exotics as at West Taupo. Where pole stands are adjacent to areas being selectively logged, they should come under selection management when their produce is utilizable; thinning to waste certainly cannot be economically justified at the present time. The existing pole stands in south Westland could eventually constitute between 25 and 50% of the area which is selectively logged for a sustained yield.

The thinning of dense stands of mature podocarps has also not been well tested, mainly on the assumption that thinned stands would be unstable and subject to widespread windthrow. Management has favoured converting such forest to exotics after logging, mainly because of the size and location of the areas involved and the relative ease of land preparation. If they are to be retained as indigenous forest there is an urgent need to test selective logging, first to see whether damage and windthrow can be kept below acceptable levels and, secondly, to see whether podocarp regeneration can be induced. A selective logging trial is planned in Tihoi Forest, and results from this trial could be used to determine future management of the remaining dense podocarp stands in West Taupo forests.

BEECH AND PODOCARP/BEECH FORESTS

The presence of ghost moth (*Aenetus virescens*) casts doubt on the feasibility of managing beech forest in the North Island for the production of quality timbers and veneers. Red beech has been widely utilized for fencing material and has been satisfactorily regenerated at Kaimanawa and Rangataua forests, but elsewhere in the North Island regeneration has been fortuitous and patchy. In the South Island, only in

western Southland have beech forests been managed on any scale but there is considerable scope for beech management, and mixed podocarp/beech management, on the West Coast.

Recruitment of Regeneration

In western Southland trials have shown that regeneration is best achieved by having advance growth present at the time of logging; this in turn is best achieved by removing the ground vegetation (chiefly *Blechnum discolor*) to expose mineral soil up to three years before logging so that at least one good seedfall is received before logging. This has been carried out wherever possible as a routine measure since 1963. The greatest barriers to obtaining full stocking are steep areas, where pre-logging scarification by tractor is not possible, and dense piles of slash, particularly those created by felling cull trees. Where the ground cannot be scarified before logging, planting is the only alternative to having patchy regeneration and unproductive areas. Eucalypts (*E. regnans* and *E. delegatensis*) have been tested and found to grow well without adversely affecting adjacent beech regeneration. The planting of artificially-raised silver beech seedlings in such situations has not yet been tested but experiments have been initiated.

The slash created by cull felling could be avoided by poisoning or ringbarking culls but this is slightly more expensive and has not been favoured because of the ugly appearance of large numbers of dead standing trees. If logging for chipwood eventuates, this will remove the problem caused by cull felling, but because it will destroy much more of the advance growth, successful regeneration will be much more dependent upon obtaining recruitment after logging. This aspect is under investigation in two recently established chipwood logging trials, but at least one further trial needs to be established to test whether pre-logging scarification serves any useful purpose where the forest is logged for chipwood.

Trials in the Maruia Valley of south-west Nelson have shown that red beech forest in this locality, and probably in inland valleys further west, reacts in much the same way to scarification and logging as silver beech forest in western Southland. Regeneration is precluded by the presence of dense ground vegetation or dense slash. A chipwood logging trial has shown that this forest can be successfully regenerated, and further trials to test more fully the effects of chipwod logging, particularly in relation to time of major seedfall, will be established in 1975. On the assumption that advance growth could still contribute significantly to regeneration after chipwood logging, trials are also being established to ensure that advance growth is present at the time of logging; these will test the effects of ground scarification and/or canopy opening by log-

ging for small chipwood material, several years in advance of the main logging.

On the flat to rolling poorly-drained soils of the West Coast, the beech forests classified as PB3 and PB4 by National Forest Survey are in the main dominated by mountain beech, silver beech or hard beech. Because these forests usually contain a high volume of podocarps, the great bulk of them have already been cut over. An assessment of a representative sample in 1973 showed that, where the canopy is intact, there is usually a good stocking of advance growth, and where the canopy has been opened up there is often abundant regeneration. Trials have been established to see whether the remaining chipwood can be removed without destroying too much of the regeneration, and to see whether there is any benefit in leaving seed trees or planting a nurse crop of eucalypts along the extraction tracks. In these logged forests, residual podocarp poles and podocarp regeneration could contribute significantly to any future crop, and therefore these areas should probably be regarded as mixed podocarp/beech management areas. In the few remaining unlogged areas, mainly in Hochstetter and Charleston State Forests, selection management could favour podocarps ahead of beech; a trial to demonstrate this will be established as soon as a suitable area becomes available.

On the West Coast hill country where slopes are steep, the podocarp beech forests often have a dense ground vegetation and beech advance growth is scarce. Podocarp stockings are generally low, and selective logging for podocarps leaves the forest canopy largely intact except around landings. Because of this heavy residue of beech, the dense ground vegetation, the lack of advance growth, and the steepness of slopes precluding scarification, these forests would be very difficult to manage for beech. A considerable body of experience has been built up on the use of eucalypts for enriching these forests after logging for sawlogs (Franklin, 1972b) and this is now standard practice in the Westport district. Elsewhere on the West Coast, the prospect of more intensive beech utilization in the near future, together with the fact that eucalypts have yet to be grown to utilizable sizes in beech forests, have been the reasons given for not using eucalypts more widely for enrichment plantings. There is a need to test whether chipwood logging will enhance the prospects for beech management on this hill country, or whether more extensive supplementary planting of eucalypts will be required to keep the land fully productive. Planning of suitable trials is under way.

Treatment of Regeneration

Where adequate beech regeneration has been obtained, it then has to be managed to produce an acceptable product at a reasonable cost. Experience from many trials has shown that

if thinning is delayed, extensive windthrow may occur, attack by pinhole borers may degrade the timber and lead to mortality in times of drought, and epicormic shoots may diminish the chances of growing clear timber. The alternatives appear to be either to leave the regeneration untended or to thin early and heavily (see Franklin, 1974; Johnston, 1972; Milligan, 1972, 1974). Untended regeneration will not produce high quality produce in less than 100 years and will still be prone to attack and damage from pinhole borers. Thus, in recent years emphasis has been placed on testing heavy early thinnings, with pruning where necessary to obtain clear timber in the butt logs. Early thinning does not lead to loss of form of crop trees and can result in average diameter increments of 1 cm/year on individual trees, thus presenting the possibility of producing beech sawlogs and veneers on a rotation of 60 to 80 years.

Early thinning of beech regeneration to 2 000 to 3 000 stems/ha is now standard practice in western Southland and is also being introduced as a routine operation to suitable areas of beech regeneration on the West Coast. Intensive management can be justified where the regeneration is dominated by red beech or silver beech because of the potential value of the timber produced, but where the regeneration is dominated by mountain beech or hard beech, such intensive management may not be warranted.

IMPLICATIONS FOR MANAGEMENT

The Forest Service has made substantial efforts to manage silver beech in western Southland and rimu in the terrace forests of south Westland, and results are promising. Progress has been made on kauri management and on understanding the problems of collecting seed, raising seedlings in the nursery and planting out most of the major native timber species. Elsewhere, however, management of indigenous forests for sustained or prolonged yield of indigenous timbers has been neglected.

Over the years, the area of virgin indigenous forest has been steadily and substantially reduced, often by a single logging operation in which all podocarps and some of the hardwods have been removed. Currently, the major North Island hardwood, tawa, is being rapidly exploited for pulpwood. It has not usually been practicable to produce further podocarp timber crops from forests logged in this manner because advance growth has often been scarce or absent at the time of logging, no adequate seed source has been left, and the forest structure has often been destroyed. In some cases, this result was inevitable once the decision to log had been taken. In others, however, where selective logging would have been possible, the extraction of the maximum amount of timber at

least cost, together with conversion of the land to exotics, has taken precedence over managing the forest for a sustained or prolonged yield of indigenous timbers.

Too often in the past, logging operations have called the tune for management instead of being made the main silvicultural tool for leaving the forest in a condition where positive management for further crops of indigenous timber can be practised. Sound forestry dictates that optimum management should control the method, intensity and timing of logging. It is often difficult to justify managing indigenous forests for timber production alone, but perpetuation of indigenous forest may be the optimum form of management if other considerations, such as soil and water conservation, recreation and amenity are taken into account.

This review has shown that sufficient is known for indigenous forest management to be practised more widely. Thus, despite the fact that indigenous forests are a diminishing resource in this country, there is still scope for greatly increasing the area which is positively managed as a permanent indigenous resource.

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