

THE ENRICHMENT OF LOGGED WEST COAST BEECH FOREST WITH EUCALYPTS

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SYNOPSIS

At present, the West Coast podocarp/beech forests are being logged mainly for podocarp sawlogs, leaving a large beech resource standing. Although some beech regeneration is usually forthcoming after logging, in most areas it is insufficient for beech management. Enrichment of the logged forest with eucalypts aims at keeping the land productive and providing sufficient volume in the future for another sawlog operation. As such, it is a stop-gap measure which should be used only until fuller utilization allows better management. If the West Coast beech forests are logged for chipwood, it is proposed to enrich large areas with eucalypts as a safeguard against obtaining inadequate beech regeneration, but again it should be regarded as a stop-gap measure until more information on regeneration is obtained.

The use of eucalypts (particularly *E. delegatensis*, *E. nitens* and *E. regnans*) for enriching logged podocarp/beech forest on the West Coast over the last eight years has shown promise, but, because of the risk of windthrow and damage by pathogens in older stands, the technique cannot be claimed to be a success until the eucalypts can be harvested.

INTRODUCTION

At FRI Symposium No. 5 on beech forestry in 1964, it was concluded that the most feasible form of management at that time for the West Coast podocarp/beech hill forests was enrichment planting soon after logging. The forests were, and still are, being logged mainly for podocarp sawlogs. Only a few of the best red and silver beech (*Nothofagus fusca* and *N. menziesii*) are logged, and then only to meet specific orders. Compared with rimu, beech timber is difficult to saw and season and requires an expertise that most West Coast sawmillers do not have. Therefore, although the market for beech timber has picked up recently because of Japanese buying, sawmillers still remove only virtually defect-free logs. Hard beech (*Nothofagus truncata*) is often a major component of these forests, and it remains unsalable.

Thus, after logging, these forests often contain a large (mostly chipwood) resource of beech, and it would be wasteful and expensive to fell this for conversion to exotic conifers, particularly at present when the performance of exotics on these sites is not known with certainty. Small areas of logged beech forest have been converted to exotics, but these have been on red beech sites which are generally believed to be more fertile than hard beech sites. Finally, in the absence of any policy to create a large pulpwood resource of conifers in

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Westland, there is sufficient area of non-beech country of equal or better site quality to sustain Westland's planting programme for many years.

After the forest has been logged for podocarps, where red beech is present in the canopy, regeneration of this species often appears on disturbed ground, particularly along the sides of major extraction tracks, around landings and along roadsides. Hard beech also regenerates occasionally on these sites, but seedfall appears to be a limiting factor with this species; only two good seed years (1960 and 1971) have occurred in the last 12 years, whereas in the same time there have been at least four good seedfalls of red beech. Without pre-logging scarification, it is doubtful whether enough regeneration could be obtained in most areas to manage the forest as beech forest, and large areas are too steep to scarify. Although occasional rimu (*Dacrydium cupressinum*) poles and some beech poles survive logging, and some beech regeneration can be expected after logging, it is doubtful whether there would be sufficient volume of sawlogs for logging to be economic even when the regeneration reaches millable sizes.

THE RATIONALE FOR ENRICHMENT

The rationale for enrichment in these circumstances is to create sufficient extra volume to provide a resource that will be economic to log in future. Enrichment should not be regarded as an inferior form of conversion providing the whole of the future resource, but as supplementary to an existing resource which is insufficient by itself. As such it is a stop-gap measure, keeping the land as productive as possible until fuller utilization allows better management. Because enrichment is essentially an extensive form of management, it must be simple and cheap to be an economic proposition. It must be carried out at the time of logging or soon after, when access and cleared planting sites are available, and the minimum should be spent on establishment and tending.

The species used for enrichment need to be resistant to browsing by deer and opossums, and to be fast growing, at least in their early years, if releasing from competing weed growth is to be avoided. Some of the ash-type eucalypts, particularly *E. delegatensis*, meet these requirements best; in addition, when planted at wide spacings they will produce clean timber without requiring pruning or thinning if there is some overwood present. They are also suited to the climate, they do not adversely affect existing or future regeneration of beech, and they produce timber and pulpwood which is similar to, but better than, that of the beech species.

WEST COAST EXPERIENCE

On the West Coast the winter climate is mild but the rainfall is heavy (2,000 to 2,500 mm/yr), and the soils available for enrichment planting generally consist of a thick, fibrous duff overlying a gleyed or waterlogged mineral horizon derived from loess. In many areas the parent materials are old, infertile, fluvioglacial deposits and in others the soils are

shallow and overlies infertile bedrock. Weed growth is not usually a problem for two or three years after logging, but thereafter regrowth of kamahi (*Weinmannia racemosa*) and quintinia (*Quintinia acutifolia*) is usually vigorous, and histiopteris (*Histiopteris incisa*) becomes well established on any disturbed humus. Under these conditions, direct seeding of eucalypts has not been successful because of slow early growth, even where fertilizers have been used, and large robust planting stock is needed.

Eucalypts were first used for the enrichment of beech forest on the West Coast in 1959, when the gaps in patchy red beech regeneration at Granite Creek (Ahaura District), were planted with *E. delegatensis* at spacings as close as 1.2 m. At that stage the regeneration was only a few years old and there was very little overwood. However, the site was very wet and there has been widespread failure except where plantings were on roadside spoil or areas drained by the road formation. More recently, gaps in thicket red beech regeneration at Fletchers Creek and Staircase Creek (Reefton District), and at Flagstaff (Ahaura District) have been planted with *E. delegatensis*. These have mostly shown poor survival and have not grown well because gaps are usually waterlogged, contain compacted soils (extraction tracks) or are occupied by dense histiopteris or bracken which provides serious root competition. However, where the eucalypts have survived and grown well (around the margins of gaps and beneath ring-barked overwood) they have not had any adverse effect on the survival and growth of beech regeneration.

In 1965 a small area of freshly logged podocarp/hard beech forest at Allanwater (Ahaura District) was planted with 1/0 *E. delegatensis* from Rotorua. Since then eucalypts have been raised at Rangiora and over 10,000 have been used for enrichment plantings on the West Coast each year. In the early years 1/0 stock was used, but this was insufficiently hardened in the nursery by wrenching and was puddled in a clay mix, both of which led to poor survivals (50-60%) and slow early height growth. In more recent years well-wrenched 1½/0 stock which is 40-60 cm tall and puddled with vermiculite powder has given much better results (Franklin, 1971).

In 1966 a small fertilizer trial was established at Allanwater and this seemed to indicate that *E. delegatensis* responded to both nitrogen and phosphorus. Of the slow acting fertilizers tested, blood and bone at 30 g per tree was the cheapest, the most readily available, and produced the greatest height growth up to 5 years later. None of the fertilizers increased the survival rate. More recently, trials have been established to test the effects of rate of application and time of application of blood and bone on the growth of eucalypts, but all other enrichment plantings of eucalypts receive a small handful of blood and bone in late October following planting, as a routine operation.

Species and provenance trials were established in 1968 at Granite Creek using stock grown in plastic pots, and in 1969 at Lake Ahaura (Ahaura District) using 1½/0 bare-rooted stock. The species tested included *E. delegatensis* (4 provenances),

E. nitens, *E. regnans* (2 provenances), *E. fastigata* (2 provenances), *E. obliqua*, *E. muellerana*, *E. laevopinea*, *E. saligna* and *E. botryoides*. Results from the two sites differed considerably, particularly with respect to provenances, but *E. delegatensis*, *E. nitens* and *E. regnans* show the most promise. Of the four provenances of *E. delegatensis* (one from Southland, two from Tasmania and one from Victoria), none was clearly superior or inferior to the others. Of the two provenances of *E. regnans* from Tasmania, the lowest altitude seed source produced the fastest growing seedlings. In these experiments, the sites used had variable soil and canopy conditions. Further work needs to be done to compare the merits of the species using uniform sites, but this is largely dependent upon obtaining seed of each species from a range of seed sources.

In 1969 an experiment was established to test the effects of soil conditions on the survival and growth of *E. delegatensis*. This showed that poor soil drainage markedly lowers the survival of this species, and also depresses the height growth of survivors. To date, the height growth of seedlings planted on disturbed duff (minor extraction tracks) has been much greater than that of seedlings planted on mineral soil (major extraction tracks) or undisturbed duff. From general observations it appears that trees planted on burnt areas grow even faster. Further trials have been established to determine more thoroughly the effects of soil conditions on the survival and growth of both *E. delegatensis* and *E. nitens*.

Canopy conditions also have a marked effect on height growth. At Lake Ahaura, under full light conditions, seedlings of all species of eucalypt have grown twice as fast as they have when planted beneath small canopy gaps. Because it is not worth planting trees beneath a canopy or where the soil has not been disturbed, in a normal sawlog operation there are only about 200 planting sites per hectare when the minimum spacing is 2½ m. When heads and slash are burnt, it may be possible to increase the stocking to 250 to 300 per hectare.

In 1970, 100 *E. delegatensis* and 50 *E. nitens* were planted out at Stony Creek (Reefton District) at 4- to 6-weekly intervals from the beginning of January to the beginning of September. The *E. delegatensis* were still actively growing when lifting commenced in January, and this adversely affected survivals. In June 1971, the January planting of *E. delegatensis* showed only 50% survival, the February planting showed 70% survival and all other plantings showed between 75% and 90% survival. The survival rate of the April planting was the highest. The survival of all the *E. nitens* plantings was 94% or better even though the 1969-70 summer was much drier than average for this district. Seedlings of both species planted before April showed significantly greater height growth the following summer than trees planted later in the season. Thus, provided reasonable care is taken in handling and well-conditioned stock is used, autumn planting is not only feasible but more desirable for height growth the following season. Since 1970, most enrichment planting on the West Coast has been carried out in March or April.

ANIMAL AND INSECT DAMAGE

Opossums are the only animals which have caused significant damage to eucalypts planted in cutover podocarp/beechn forests on the West Coast. Nursery-raised *E. delegatensis* have not been browsed, but in one instance small potted stock planted out in November suffered 84% mortality from opossum browsing. Sometimes nursery-raised *E. nitens*, *E. regnans*, *E. obliqua* and *E. fastigata* have been killed when soft stock has been used or when seedlings have been planted in heavily logged areas, but the pattern of damage is not clear. To date, most damage has occurred soon after planting before blood and bone has been applied, but further damage may occur as the trees become large enough to climb, particularly if they are growing in areas where there are high opossum populations.

Pinhole borer (*Platypus* spp.) has occasionally caused serious damage to *E. delegatensis*, as yet the only species used in enrichment plantings that has reached a size (15 cm d.b.h.) where attack is likely. Attack is dependent on a nearby source of breeding material (usually beech) because the insects cannot breed in live eucalypts; before they have penetrated very far into the wood their tunnels are flooded by gum. Although the injury they cause is very small, the trees react by producing kino veins which extend several centimetres around the circumference of the tree and up to 30 cm in a longitudinal direction from a single hole. Multiple attack results in much more extensive damage. This can seriously weaken the timber for construction purposes and ruin it for use as boards. Unfortunately, it appears that eucalypts, especially fast-grown individuals with thick fibrous bark, are particularly attractive to the insects and the only remedy at present is to ensure that nearby breeding material is kept to a minimum.

IMPLICATIONS OF THE PROPOSED WEST COAST
CHIPWOOD SCHEME

In the proposed West Coast chipwood scheme, up to 117,000 ha of beech forest are scheduled for chipwood logging without conversion to exotic conifers. Beech seed trees will be left, but only 34,000 ha are confidently expected to regenerate successfully to beech; on the rest of the area it is proposed to plant eucalypts as an insurance against insufficient beech regeneration. On steep country, particularly where there is much small material, chipwood logging will only be an extension of the present sawlog operations—i.e., after logging, a forest will still remain, although it will have many gaps. Planting of eucalypts in this situation will be similar to the present enrichment of areas logged for sawlogs, except that stockings per hectare will be higher and the resource being enriched will consist only of future regeneration with perhaps some advance growth. On areas of easier topography, particularly where there is little small material, chipwood logging will be more akin to clearfelling than to current sawlog operations. Where there is little overwood other than seed trees, eucalypts

will have to be planted fairly intensively to obtain reasonable form. The result will be stands of eucalypts, possibly containing beech regeneration, rather than beech forest enriched with eucalypts.

In both cases, if beech regeneration is not forthcoming, the result will be a eucalypt forest inferior to stands produced by complete conversion. If beech regeneration is forthcoming, it is most likely to appear where the eucalypts have been planted—i.e., in the cleared gaps—and the future of the eucalypts must then be decided. If the forest is to be managed for future timber production, should they be grown on until the beech reach loggable sizes and both be harvested together, or should the eucalypts be harvested at an earlier date? Will the latter be possible without destroying much of the beech? These are questions which cannot be answered confidently at present and lead to the conclusion that supplementary planting of eucalypts in areas logged for chipwood should be regarded as a stop-gap measure until more knowledge is available on the recruitment of beech regeneration. If not, it may be better to convert completely to eucalypts or some other species.

CONCLUSIONS

The use of eucalypts for enriching logged podocarp/beech forest has so far shown considerable promise, but the technique cannot be claimed to be a success on the West Coast until the eucalypts can be harvested. The effects of windthrow, pathogens and opossums on older trees are not known and may be serious. In particular, the magnitude of the effects of pinhole borer on the quality of the sawn timber or pulpwood are not known. Of the species tested, most promise is shown by *E. delegatensis*, *E. nitens* and *E. regnans*, all of which produce timber with similar properties.

E. delegatensis has been used more widely than the other species because it is hardy, easy to handle, will survive and grow on a variety of sites, and is unpalatable to opossums. *E. nitens* is often faster growing than *E. delegatensis*, it will tolerate more mishandling, and is probably more tolerant of wet sites, but it is susceptible to browsing by opossums soon after planting and it may also be susceptible to opossum damage in later life. On good sites *E. regnans* is much faster growing than *E. delegatensis* but it is less hardy, more sensitive to poor handling and poor sites, and it is also susceptible to opossum browsing in some circumstances. With all species, successful establishment is dependent upon using good stock.

REFERENCE

- Franklin, D. A., 1971: The enrichment with eucalypts of logged podocarp beech forest on the West Coast. *FRI Indigenous Silviculture Rep. No. 9* (unpubl.).