Growth response to silvicultural tending of red and silver beech regeneration

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Abstract

Some long-term silvicultural trials in naturally regenerated beech in Westland (red beech, *Nothofagus fusca*) and Southland (silver beech, *N. menziesii*) have shown considerable promise of enhanced diameter growth in response to periodic thinning. Three decades after commencing thinning of beech forest regeneration the mean tree diameter of plots thinned heavily to 150 stems per hectare was twice the diameter of unthinned controls for both red and silver beech. The positive implications of such a response for timber production prospects from natural beech forest, when under intensive management by continuous-cover systems that maintain near-natural stand structure and composition, are tentatively discussed.

Figure 1 : Vigorous regrowth of mixed beech forest in a small (0.05 ha) harvested coupe at Glenhope Forest, Nelson. Selective thinning of this regeneration has potential to significantly improve sustainable timber production.

Introduction

Indigenous forests in private ownership that have approved sustainable management plans or permits amount to 63 000 ha in area (MAF publicity, June 2001) and of this total it is estimated that 48% is predominantly red beech (*Nothofagus fusca*) and silver beech (*N. menziesii*) forest. The area of beech forest under approved plans and permits continues to increase and the potential area available has been estimated at 450 000 ha (cf. O'Loughlin and May 1999).

Tree growth increment in New Zealand's natural beech forests has most probably been viewed too pessimistically in terms of economic performance for sustainable timber harvest. Also, current management practices have a strong focus on harvesting systems, the size of felled areas and the management of regeneration within these felled areas, whereas tending of tall natural stands has received little attention.

Previous studies (Evans and Jackson 1972; Franklin 1974; Gleason 1982) of beech regeneration growth rates have shown that there are large growth gains and significant potential for reduction in rotation length by early heavy thinning. However, there is now a need for more site-specific forest growth information, as well as an increased understanding of the dynamics of forest structure and composition. Whyte & Zhao (1999) have recently been developing tree diameter growth equations for beech forests, and models incorporating competition and site variables are being developed by Landcare Research (Wiser pers. comm.). We primarily wish to draw attention to some measured growth responses of beech to silvicultural treatment, and their implication for sustainable management of indigenous beech forests, especially when aiming for ecological sustainability of near-natural structure and composition in managed stands.

Silvicultural trials at Staircase Creek (Westland) and Alton Valley (Southland) are providing important growth information because forest regeneration of known age has been intensively thinned to a range of stocking rates on relatively uniform sites. These trials were established and measured by Dudley Franklin as part of the Forest Research Institute's former beech management programme, and he summarised the growth information and the effects of heavy early thinning and pruning ('What's New In Forest Research' No. 98,1981). Reassessment of these trials 18 years later in 1999 forms part of a current study in Landcare Research's (PGSF funded) programme to address ecosystem management regimes that permit harvesting of timber from indigenous forests on privately owned land in New Zealand.

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Table 1: Silvicultural tending of regenerated red beech at Staircase Creek (Westland) and silver beech at Alton Valley (Southland)

Site	Species	Regenerated naturally	Thinned	Final Stocking(sph)	Pruned
Staircase Creek	Red beech	1952	1965 1975 1982	150 250 500 unthinned	1976-1980
Alton Valley	Silver beech	1951	1971 1980	150 250 500 unthinned	1975-1979

Trial sites

The Staircase Creek trial at 200 m a.s.l. in the upper Grey Valley is predominantly in red beech forest with a few scattered hard beech (*N. truncata*) trees. Soils are lowland yellow-brown earths (Blackball) and mean annual rainfall is ca 1900 mm. Following a regeneration felling leaving 10 seed trees per ha in 1952, the area regenerated naturally and got its first thinning in 1965 when 19 plots, each of 0.16 ha in size, were established in the 13 year-old regeneration. At the time of this first thinning the trees were 4-8 metres tall with stem diameters of 3–6 cm. These plots were further thinned in 1975 and 1982 to final crop stockings of 150, 250, 500 and 1500 (unthinned control) stems per hectare. Final crop trees were progressively pruned to 6 metres from 1976 to1980 (Table 1).

The Alton Valley trial at 60 m a.s.l. in Western Southland is predominantly in silver beech forest with some mountain beech (*N.solandri var. cliffortioides*) trees. Soils are lowland yellow-brown earths (Lillburn) and mean annual rainfall is ca 1250 mm. The trial area regenerated naturally after a regeneration felling leaving 30 seed trees per ha in 1951. It was first thinned in 1971 when 15 plots each of 0.2 ha were established in the 20-year-old regeneration. Trees were 5 – 8 metres high and 6 –10 cm diameter at the time of first thinning. Treatments included unthinned controls of 3000 stems per hectare (sph), thinned plots with 1500 and 750 sph and there followed a second thinning of these plots to final crop trees of 500, 250, and 150 sph in 1980. Final crop trees were progressively pruned from 1975 to 1979 to a height of 5.5 metres (Table 1).

At both sites final crop trees were given individual tag numbers. Diameter and height growth was measured at approximately 5-yearly intervals from 1965 to 1999.

Tree growth

In 1999 tagged trees, including a few hard beech at the Staircase Creek site, but excluding mountain beech at the Alton Valley site, were remeasured for diameter and height and the number of dead trees recorded. Some plots at Staircase Creek had received a fertiliser application in 1975, but measurable effects were so small (Whyte and Zhao 1999) that we ignored this treatment. The effect of pruning on growth has not been assessed.

Figures 2 and 3 illustrate the strong relationship between stocking and mean diameter as a result of thinning. Diameter increased over unthinned controls by a maximum of 20.7 cm (18.4-39.1 cm) in the red beech and 19.0 cm (15.8-

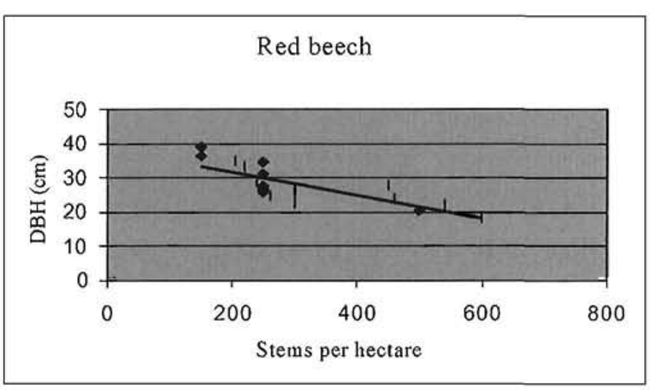

Figure 2: Mean tree diameter 34 years after commencing thinning of red beech at age 47 years relative to stocking. Staircase Creek, Westland.

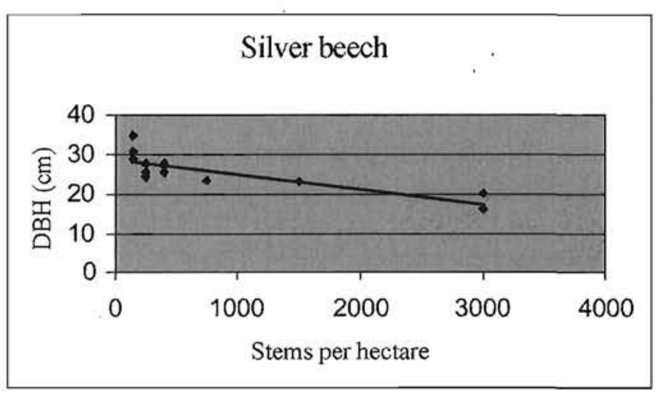

Figure 3: Mean tree diameter 28 years after commencing thinning of silver beech at age 48 years relative to stocking. Alton Valley, Southland.

34.8 cm) in silver beech plots where they were heavily thinned to 150 sph. Tree heights in 1999 ranged from 15.3 m (500 sph) to 22.3 m (205 sph) for red beech and 12.9 m (150 sph) to 16.3 m (1500 sph) for silver beech, but there was no clear relationship between height growth and stocking. Tree mortality was light in all plots at both sites. Tagged trees that have died since a 1982 assessment were 0.8% (838 measured trees) in red beech and 1.8% (1117 measured trees) in silver beech. Pinhole borer (*Platypus spp.*) attack after thinning possibly contributed to tree mortality but this was not assessed.

Discussion

For beech stands managed under an age-class (i.e. plantation style) silvicultural regime, Whyte and Zhoa's (1999) tree diameter equations point the way for management to be able to use stand projection tables for tree diameter predictions. There are extensive areas of uniform beech regrowth in old cutover forest and some landowners are showing interest in planting beech stands. However, judging from overseas experience (Monserud and Sterba 1996) tree growth prediction for uneven-aged, mixed forests will pose additional complications and results from thinning trials in 'uniformly' regenerated stands at Staircase Creek and Alton Valley may initially need to be extrapolated with some caution.

The individual tree diameter response by beech to thinning in the post-clearfell age-class trials does have important implications for management of natural beech forests. Tending by selective thinning to favour 'future' canopy dominants with an eventual harvest potential for quality timber is a key silvicultural tool in the practice of continuous-cover, near-natural forestry. Likewise, this applies to the tending of regenerating cohorts in small coupes of group selection or irregular shelterwood systems.

Active forest management, by selective tree tending (i.e. tending to enhance the standing volume), should increase the quantity and quality of timber that can be harvested sustainably. This would be carried out in accordance with classical uneven-aged/mixed-species silviculture flexibly tailored to local forest types and sites (e.g. soils). Traditional predictions of a sustainable cut based on growth data from unmanaged natural forests have inevitably been so modest as to substantially jeopardise the economic viability of any prospective management. This unfortunately may encourage some managers to risk 'low-impact' selective harvest over extensive forest areas in the expectation that the potential for unsustainability of such harvest will not become apparent for a long time to come.

The future for sustainable timber harvest from much natural and near-natural indigenous beech forest, including regenerating cutover, particularly on private land will lie in intensive (not extensive) forest management at a local level of site type and species composition. So, what is the exciting significance of the results from beech thinning trials reported here for the manager committed to forest sustainability (both ecologically and productively)? It is the implied potential for much greater harvestable increment from wisely tended natural stands than previous growth data and harvest methods of natural beech forest have indicated.

Selective felling can be used to increase the diameter growth of desired 'quality' trees that are retained for future harvest. Therefore, forest owners should be encouraged to realise that, under management, New Zealand beeches are capable of good growth rates by international standards for hardwoods. Thus, beech forests can provide high quality decorative and furniture timbers on an ecologically sustainable basis.

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