CHAPTER 7 -PRUNING and THINNING

Mark Dean (Ernslaw One), Mark Kimberley (Scion), Paul Silcock (Scion) and Rob Webster (NZ Forestry)

Figure 13: 29 year old untended redwood, East Coast

Introduction

Redwood has proved to grow well in New Zealand when correct siting and establishment practices are attended to. With mean annual increments in excess of 30 m^3/ha/year on good quality sites (warm, sheltered and with regular rainfall e.g Taranaki or Bay of Plenty), growth rates can equal or better those of radiata pine. Redwood is more shade tolerant than most conifer species so will survive in very low light situations. However it does require full sunlight to grow rapidly. Perhaps because of these attributes redwood readily grows from coppice and stump or root sprouts. These physiological attributes potentially allow some innovative regimes not commonly practiced with more light demanding conifer species.

Redwood enjoys a strong market demand in USA (Chapter 2), where restricted access to natural stands enhances the potential for an export market to develop for New Zealand-grown redwood. However, the Redwood lumber market differs from the radiata pine model we are used to. In California, clear heart grades attract a large premium over those with sapwood content and unpruned 'tight knot' grades, which in turn are more valued than timber with bark-encased knots. This grade and price differential, based on branch condition as well as size, provide an important distinction from the radiata pine lumber market, which most New Zealand forest growers are used to, and will provide some challenges in managing redwood silviculture.

Current Issues

While New Zealand growth rates allow for rotation lengths of around 35 years, careful attention will need to be paid to designing regimes that will capture most of the potential value with such rotations. The target will be to achieve large pruned butt logs with upper unpruned logs with green or moribund branches less than 50 mm diameter. Although there have been several hundred hectares of redwood grown and harvested in New Zealand, most have not been intensively managed so the effect of various pruning, thinning and initial/final crop stocking combinations has not yet been quantified.

However, over the past few years Scion, with assistance from NZ Forestry Ltd, The NZ Redwood Company and the Plantation Management Cooperative, has initiated a number of silviculture trials to study some of these interactions. A series of final crop stocking trials have been installed in existing stands located in the Central North Island, East Coast, Hawkes Bay and Otago. Within four or five years there will be sufficient data to formulate a thinning-response function to augment the basic growth functions implemented in the NZ Forestry/NZ Redwood Company growth model. This will allow managers to predict the outcome of various thinning and final crop stocking regimes in terms of tree growth.

Given the high value of clearwood and the premium for heartwood over sapwood combined with the uniform wood properties from pith to bark, pruning to achieve these classes of end-product is certainly a favoured option. It may be worth pruning redwoods to a small DOS as has been done with cypresses in some instances.

Figure 14: Epicormic shoots sprouting from the branch collar and cambium of a young pruned tree.

Operationally speaking, pruning redwood is not difficult. The wood is relatively soft and branches in plantation grown trees are generally small and well-spaced. Although redwood bark is thick and fibrous on mature trees, young trees have bark that is easily damaged so care must be taken to not damage the bark and cambium around branch collars when pruning.

Two pruning trials, at Tutira and Gisborne, have been installed by the Plantation Management Cooperative in partnership with The New Zealand Redwood Company. Although still in progress, interim results indicate that both stocking and pruning severity affect tree growth.

Of much greater interest is the impact of pruning severity on the incidence of epicormic shoots. These originate from buds in the cambium and are stimulated by the combination of stress induced by removing the green crown (live branches) and light on the stem. When early severe pruning treatments are applied the stems can be clothed with epicormic shoots which negates the pruning effort. However, by delaying pruning until the bark is thicker, pruning in autumn and leaving more green crown, much of this problem may be avoided.

Another silvicultural challenge is to maintain live or only recentl dead branches in the lower unpruned logs, typically from 6-15 metres height on mature stems. Currently our understanding of crown height recession with increasing stocking and age is fairly basic. There is a need to better quantify this and also to understand the time delay between branches dying and the formation of bark-encased 'loose knots'. As for managing redwood stands to minimise the incidence of bark-encased knots in sawlogs, there are a number of possible strategies which, to the authors' knowledge, have yet to be tried. For example, regimes involving multiple thinnings or possibly ultra high pruning may serve the desired goal.

There have recently been sales of small logs (down to 20 cm SED) which can be sawn for utility uses. This may make it possible to carry out production thinning on some sites. Alternatively, pruning dead branches to facilitate higher recovery of more valuable 'tight knot' grades of lumber may be warranted.

As stated earlier, log quality is of paramount importance in order to maximise the returns from redwood. To date very little is understood about the timber grade and hence value recovery from various log types arising from regime options. The sawing study currently being carried out by Scion and Interpine with funding through FIDA and the redwood theme within Future Forests Research Ltd should significantly improve baseline knowledge and provide for realistic economic analyses to attract investors and set fair market values for logs.

Figure 15: Left unmanaged epicormic shoots can quickly undo the pruning investment. The epicormic growth on the lower portion of these trees is just 12 months old.

Figure 16: Insect attack, possibly pin hole borer on an 8 year old pruned redwood. This attack may have been aborted once through the bark.

Silvicultural research

In recent years Scion, with industry support, has established more than 60 permanent sample plots in stands throughout New Zealand. In response to interest from clients (The New Zealand Redwood Company, NZ Forestry Ltd), Scion has collected retrospective growth data and developed a preliminary New Zealand Redwood Growth Model to predict yield. It is intended that as more data become available the model will be improved and mortality, pruning and thinning response functions will be added.

With funding from the Plantation Management Cooperative a series of trials designed to quantify growth response to final crop stocking and to investigate the effects of pruning severity and timing on growth and log quality has been installed (Table 4).

Table 4: Replicated silviculture response trials.

Location	Plant year	Trial type	Date Installed
Waiotapu (CNI)	1982	Final crop stocking	July 2004
Otago Coast (Otago)	1986	Final crop stocking	August 2004
Mangatu (East Coast)	1978	Final crop stocking	April 2004
Tutira (Hawkes Bay)	1998	Pruning, final crop stocking	Dec 2003

Case Study: Waiotapu Redwood Final Crop Stocking Trial

Coppice growth two years after thinning

Redwood is among the few conifers capable of producing true epicormic shoots ('sprouts'). Sprouts arise from dormant buds found along stems and, branches, and among burl tissues at the base of the tree/root collar, and can therefore coppice from stumps. Buds can be released from dormancy when sources of inhibiting hormones are eliminated and environmental conditions are favourable. Two opposing processes affect the vigour of a sprout clump: the decline in carbohydrate and mineral-nutrient reserves in the stump, and the accumulation of reserves by the sprout clump. The sprout-clump vigour is therefore a function of both the reserves at the time of cutting and the light environment following cutting.

The initial 2-year measurement of coppice growth in this trial provided data on the frequency, recruitment and vigour of sprout growth on thinned redwood stumps under three final-crop stockings. Over time this data will be useful in evaluating silvicultural regimes where coppicing may be desired (continuous-cover forestry) or not (when thinning to a final crop). The stand was planted in 1982 with an initial stocking of 1200 stems/ha. It was thinned in 2004 to four stockings: 350, 500, 650 and 1000 stems/ha.

A simple survey carried out in spring of 2005 and 2006 measuring number and height of coppice at each thinning stump shows the effect of light on coppice incidence and vigour. Figure 17 shows a higher incidence of stumps coppicing in the lower final crop stocking whereas Figure 18 shows a much higher number of shoots per stump occurring in the 500 stems/ha treatment.

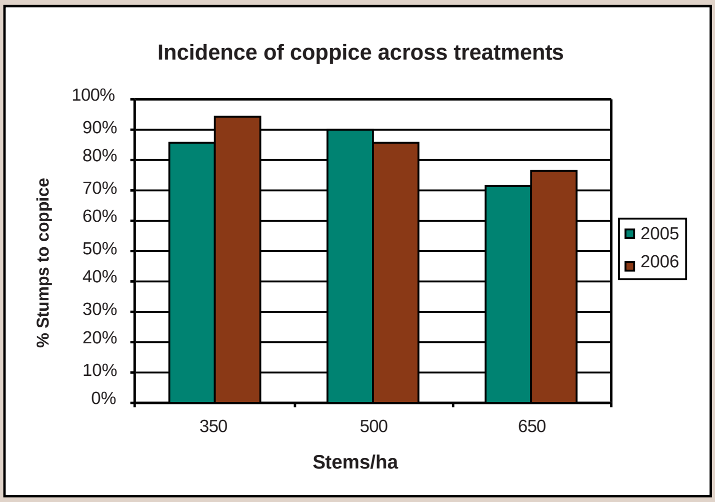

Figure 17: Incidence of coppicing stumps across three different final crop stocking thinning treatments in Waiotapu forest in 2005 and 2006

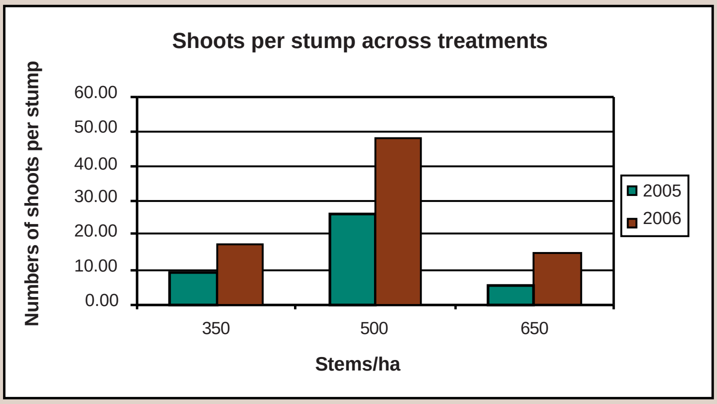

Figure 18: Vigour of stump coppice as shown by number of shoots per stump across three different final crop stocking thinning treatments in Waiotapu forest in 2005 and 2006

Case Study: Epicormic Shoots

Although there is considerable interest in growing and intensively managing redwood in New Zealand, little is understood about how it responds to the intensive silviculture commonly practiced with radiata pine in this country.

One such response is that of epicormic shoots developing up the length of the trunk after pruning. The shoots arise from buds that otherwise remain suppressed by the concentrations of auxin and carbohydrates in the phloem. Rapid changes in the light levels, temperature, nutrients or moisture can also induce a similar response.

Epicormic shoots are not true branches and do not have a knot that goes right back to the pith like a normal branch. If removed within the first season they may not cause any serious loss in clearwood recovery. However if left growing, they could cause serious downgrade to the target pruned clearwood.

In 2004 a replicated randomised block design pruning trial for redwood was installed at Tutira in Hawkes Bay. Silviculture treatments covered a range of three pruning intensities and three stocking levels. In the Wairengaokuri step- out trial, two replicates of one treatment have been established, with half the trees in each plot being pruned in spring and the other half pruned in autumn to test if season of pruning has any impact on development of epicormic shoots.

An assessment of epicormic response across the different treatments was carried out in November 2005 and December 2006, 22 and 35 months after pruning.

At the two trial sites intensive pruning resulted in sufficient numbers of epicormic shoots of significant size as to severely compromise clearwood yield. The incidence and size of epicormic shoots proved to be dependent on the severity and season of the pruning treatment. Most (and the largest) epicormic shoots appear on those stems pruned in spring, with the most severe treatment (5.5cm calliper), on the portion of the stem exposed to the most sunlight (1.2 m).

The effect of season on shoot numbers reduces over time, with no difference between spring and autumn two years after pruning. However those shoots that remain are significantly larger on the stems pruned in spring. Therefore it may be advantageous to delay pruning until the trees have thicker bark and a greater degree of canopy closure and retain a number of follower stems to provide shade to the stem. Scheduling more lifts of less severity during the autumn months should reduce epicormic incidence and size.

Key Points

- Redwood requires pruning to produce clearwood
- Overpruning can result in epicormic shoots
- Pruning in autumn reduces epicormic shoot development

Suggested reading:

Dean, 2007