WILL ECOLOGICAL THINNING INCREASE JARRAH'S SUSCEPTIBILITY TO *Phytophthora cinnamomi*

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SUMMARY

In summer and autumn 2008, 240 ha (two-thirds) of the Cobiac research catchment was thinned as part of the Wungong catchment trial (Reed et al 2012), mostly by notching of small, currently unsaleable stems. Monitoring showed that thinning reduced the leaf area by 37 percent, the crown cover by 46 percent, the basal area by 47 percent, cambial area 55 by percent and the number of stems by 66 percent. Such a large reduction in interception and evapo-transpiration was expected to improve forest health and resilience to drought.

Crown health classes were assessed in November 2011, following a severe drought in 2010 and a dry summer in 2011. Comparisons were made between an un-thinned stand (104 tree crowns) and thinned stands that were classified as either dieback-free (98 trees) or as dieback-affected (162 trees). The dominant trees were jarrah (76 percent) and marri (15 percent). Thinning substantially increased the crown health on the retained trees, irrespective of the dieback status of the site. In contrast, within the un-thinned control there were several recently dead trees and many had very poor crowns.

The health of tree crowns within areas mapped as dieback affected was re-assessed in June 2020, 12 years after thinning. The ratio of very healthy to very poor crowns has continued to improve. No deaths of jarrah attributed to P cinnamomi were observed.

It is essential that research and monitoring be done at a landscape-scale. This is the first report of a large-scale thinning trial that did this and showed no difference, despite claims that thinning in dieback-affected forest will result in the death of most of the retained trees. The level of mortality and ill-health in the control area show that drought is a greater threat to forest health.

INTRODUCTION

The trial area of about 360 ha is located within Cobiac forest Block at the south-eastern end of the Wungong catchment. The Mattiske-Havel vegetation complexes are mapped as: Dwellingup 2 (on slopes and ridges), Yarragil 2 (in broad valleys) and Swamp (Water Corporation 2005). The site-vegetation types are variations of the widespread site-types S and P (Havel 1975a), with type D on valley floors. Jarrah (*Eucalyptus marginata*) is the dominant tree species, admixed with marri (*Corymbia calophylla*), banksia (*Bankisa grandis*) and sheoak (*Allocasuarina fraseriana*). Two-thirds of the catchment has been mapped as affected by *Phytophthora* by trained interpreters. Site-types P and D are often poorly drained and known to be susceptible to *Phytophthora* disease.

SILVICULTURAL OPEATIONS

In summer 2008, a 240 ha area (2/3 of the catchment) was tree-marked for felling by Forest Product Commission (FPC) staff to either a thinning or a shelterwood

prescription, in accordance with tree-marking guidelines approved in the Forest Management Plan 2004-2013. Trees were retained as either "habitat trees" or as "growing stock".

Following the commercial operation, all other trees that were not marked for retention were then notched in autumn by contractors supervised by staff from the Department of Environment and Conservation (DEC).Non-commercial notching was required, as the smaller-sized logs could not be sold.

The designated stream reserve was left un-thinned, as was a "control" strip 200 m in width from stream zone to ridge top for experimental purposes, and 15 ha that had been mined for bauxite and then rehabilitated. The areas not treated totalled 120 ha.

Data were collected on basal area density, stems per hectare, diameter class distribution, crown cover and an index of leaf area, both before and after these operations. The basal area in treated sites was reduced from 34 to 18 m2/ha, a reduction of 47%. The number of stems per hectare (sph) was reduced by two thirds, from about 410 to 140. As notching targeted the smaller size classes (87% of notched stems were less than 30 cm dbhob), the average size of the retained trees increased after silvicultural treatment.

MONOTORING TREE HEALTH

The very low 2010 rainfall was followed by a long, dry, hot summer. By March 2011, major scorching of tree crowns was obvious, particularly in the higher-rainfall, western jarrah forest, and deaths then continued until June/July. Deaths occurred on all tenures – State forest, National Park and Conservation Park.

Deaths were observed in all major upland species – jarrah, marri, allocasuarina and banksia. Most sites were associated with shallow soils, but deaths were also observed on water-gaining sites where some bullich and blackbutt had died. The understorey species were healthy. The low winter rainfall followed by a dry summer, the pattern of deaths and subsequent partial recovery in the overstorey, the healthy understorey and the timing of the collapse all point to drought stress as the primary driver.

Within the Cobiac trial area, loss of crown and tree deaths were observed in the bauxite rehabilitated areas, the stream reserve and the un-thinned "control" strip, where about half the crowns were thin and unhealthy (Fig1). Unsurprisingly, the tree crowns in the thinned areas were denser and healthier, with no recent drought deaths.

Field surveys were conducted in November 2011 to assess the effects of thinning on forest structure and crown health. Transects were 10m wide and crown health was classified as very healthy, healthy, average, poor, very poor and recently dead. Tree health was assessed in 10 cm diameter classes from 10-20 cm to >60 cm.

There were 660 m of transect in a thinned, dieback-free site (98 trees assessed, estimated stocking 140 sph); 1080 m in the thinned, dieback-affected site(162 trees, 150 sph) and 210 m in the un-thinned control strip (104 trees, 467 sph).Crown health was assessed as the ratio of healthy and very healthy crowns to poor and very poor

crowns. Within all thinned sites, this ratio was 3:1 whereas in the un-thinned the ratio was 0.8:1. There were 33 recently dead trees per hectare in the un-thinned control and only 0.6 within thinned stands.

Crown health improved in trees that were retained in areas mapped as dieback-affected , despite the statements from opponents to thinning and in some research papers that claim thinning in dieback-affected forest will lead to increased susceptibility to infection and result in the death of most of the retained trees.

Trees were retained within all size classes, from 10 to >60 cm. Thinning targeted the smaller stems, 90 percent were < 30 cm in diameter. Pre treatment there were 9 small (<30 cm) stems for every large tree (>50 cm). Post thinning this was reduced to 3.5:1.

The crown health in younger trees (<30 cm diameter) calculated as 3.3:1, but older trees (>50 cm diameter) were still healthy, with a ratio of 2:1. This is as expected, as tree crowns usually deteriorate a little with increasing age.

Jarrah was the dominant tree (76 %) with marri (15 %), banksia (8 %) and allocasuarina (1%) the other species recorded on thinned sites. The low number of individuals other than jarrah meant that any comparison between species would not be valid.

The health of tree crowns within the area mapped as dieback affected was re-assessed in June 2020, 12 years after thinning, on 150 crowns along a stripline 1000m x 10m (one hectare). 12 years is sufficient time to observe any detrimental effects of *P.cinnamomi* on tree health, particularly in view of the improved soil-moisture regime within thinned .The improvement in crown health increased from 3:1 in 2011 to 3.9:1 in 2020 (Fig2).No deaths of jarrah attributed to P cinnamomi were observed.

DISCUSSION

After thinning, the deep groundwater stabilised, the shallow water tables rose, soil moisture storage improved and stream-flows increased, indicating a substantial improvement in soil moisture within the thinned areas.

Data on crown health collected 3.5 years and then 12 years after thinning has been sufficient time to observe any detrimental effects of *P.cinnamomi* on tree health, particularly in view of the improved soil-moisture regime within thinned areas. The improvement in crown health recorded in 2011 has now been re-confirmed in 2020.

These results are quite contrary to statements that claim any thinning in dieback-affected forest will result in the death of most of the retained trees (Bunny et al 1995). The rate of mortality on these dieback sites is low, with a loss of < 1 percent of trees over 12 years. The level of mortality and ill-health in the control area (7 percent dead and 38 percent with poor crowns) show that drought is a greater threat to forest health.

The lesson to be learnt from the results of this trial is that it is unwise to extend research results obtained on a few trees or on differences in lesion length in wounded

stems and roots, into broad-scale management prescriptions. It is far better to test silvicultural theories in landscape-scale, adaptive management trials that cover tens if not hundreds of hectares. It is these larger trials that will better reflect reality.

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Figure1- Dead and dying jarrah trees within a re-habilitated bauxite pit (left), and on the un-thinned control strip (right), Cobiac research catchment, March 2012 (F Batini).

Figure 2– Crowns in 2020, on trees thinned in 2008, in a dieback affected area (F Batini)