THE COBIAC RESEARCH CATCHMENT TRIAL

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Summary

Two-thirds of the catchment was thinned, from a basal area of 34 to 18 square metres/hectare, and a reduction in crown cover of 46 percent.

The overall reduction in evapo-transpiration (30 percent) raised the shallow groundwater tables and increased stream- flow : by about 75mm over the four years of measurement, which included the 2010 severe drought year.

The cost of treatment was $ 168000 and 27000 cubic metres of additional streamflow was generated. To desalinate an equivalent volume would cost about $800000. In addition to the extra water in soils and streams, areas that had been thinned were healthier.

Silvicultural Operations

The trial area of about 360 ha is located within Cobiac forest Block at the south-eastern end of the Wungong catchment. The rainfall is about 1100mmpa and the Mattiske-Havel vegetation complexes are mapped as : Dwellingup 2 (on slopes and ridges), Yarragil 2 (in broad valleys) and Swamp (Water Corporation 2005).

In early 2008, a 240 ha area was tree-marked for felling by Forest Products 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 from Western Forest Management 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 due to current Policies relating to use of native timber for bio-energy.

The designated stream reserve was left un-thinned, as was a “control” strip 200m in width from stream zone to ridge top for experimental purposes, as well as three small areas totalling 15 ha that had been mined for bauxite by Alcoa World Alumina and then rehabilitated. The areas not treated totalled 120 ha or one-third the area of the catchment. Data were then 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.

Results

About one-third of the catchment on lower slopes is protected as stream reserves or has been affected by Phytophthora disease. These more open areas were left untreated and have an average basal area of 11 m2.

The data show that the basal area in treated sites was reduced from 34 to 18 m2/ha, a reduction of 47 percent. Of this 16 m2, only 6 m2 were removed commercially with the balance being notched. Of the retained basal area, 7 m2 were classified as “habitat trees”, 6.5 m2 as “future growing stock” and 4.5 m2 as “culls/notching misses”. The number of stems/ha were reduced by two-thirds, from about 410 to 140 sph. As notching targeted the smaller size classes (87 percent of notched stems were less than 30 cm dbhob), the average size of the retained trees increased after silvicultural treatment.

Larger trees have less sapwood area for a given basal area and therefore transpire less than an equivalent basal area of smaller trees. Estimates of sapwood area were made using the diameter class distributions before and after thinning using a spreadsheet and sapwood data provided by Dr C Macfarlane of CSIRO. The calculated estimate of sapwood area before thinning was 2.9 m2/ha and after thinning as 1.3, a difference of 55 percent.

Crown cover estimates were obtained from remotely sensed imagery collected by Spec Terra Services at a resolution of 0.5m, that is four pixels per square metre. These data were collected for 13 separate “blocks”, nine for native forest, three for rehabilitated areas and the stream zone. These show that the average canopy cover for native forest before treatment was 50 percent (range 48-52), the cover for rehabilitated areas was 44 percent and that the streamzone was more open at 33 percent. Following treatment, native forest cover in November 2008 averaged 27 percent (range 21 to 40), a reduction of about 46 percent (Figure 1).

Data for canopy area and percentage cover are also available for November 2009 (following an average winter rainfall) and for November 2010 (which followed the driest winter ever recorded). The pattern of growth varied markedly between the untreated and treated areas. In both the stream zone and the bauxite rehabilitation the crown cover increased substantially from 2005 to 2009, by nine and fourteen percent respectively; but then fell after the poor 2010 winter, both by seven percent. Tree deaths and loss of crown were visible on both sites by late summer 2011.

In contrast, the thinned areas took some time to recover, with the 2008 and 2009 data being similar at 27 percent. Crowns then expanded by nine percent between November 2009 and 2010. This is in response to the 2009 winter rainfall, since jarrah crown growth usually occurs in late spring-early summer, between November 2009 and January 2010. Tree crowns were still healthy and no deaths were observed by late summer 2011.

The estimated reduction in basal area (47%), sapwood area(55%), stems per hectare(66%) and crown cover (46%)make sense. As the smaller trees were targeted for thinning, it is expected that tree numbers and sapwood area would decrease more than basal area or crown cover. However, these reductions apply to only 220 ha of this 340 ha catchment. Thus the overall reduction in potential transpiration for the whole catchment, as estimated from sapwood area or crown cover, lies between 30 and 37 percent, not 46 to 55 percent.

Estimates of Leaf Area Index (LAI) were obtained by the Water Corporation from data supplied by consultant G Mauger (Geographic Information Analysis). These data show that LAI values in adjacent untreated areas can range from 2 to 2.5 whereas in treated areas the range was from 0.4 to 1.4 with an average of 0.8 (Figure 3). Mauger has also supplied average LAI values for January data in the

Cobiac catchment for the period 2004-2011. These LAI values average 1.50 (four years, pre treatment) and 0.95 (four years, post treatment), a reduction of 37 percent.

Tree Health

The 2010 winter rainfall was the lowest ever recorded in Perth and the forest areas. This was followed by a long, dry, hot summer. By March 2011, major crown scorch of vegetation was obvious, particularly in the higher-rainfall, western jarrah forest, and some deaths and recovery then continued until June/July.

Deaths were observed in all major upland species- jarrah, marri, allocasuarina and banksia. A number of the dead trees were large, exceeding 90 cm dbhob and therefore probably over 200 years old. Most sites were associated with shallow soils, as well as 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 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 strip, where about half the crowns were thin and unhealthy (Figure 4). These were confirmed by field survey. Unsurprisingly, the tree crowns in the thinned areas were denser and healthier, with no recent drought deaths observed.

Monitoring of groundwater tables show that these have improved since the thinning. In the four years of monitoring post thinning stream-flows increased by about 75mm or 270000 Kl. The cost of treatment was $168000 and it would cost $800000 to desalinate an equivalent volume, a Benefit/Cost ratio of 4.75.

In addition to the extra water in soils and streams, areas that had been thinned were healthier. Improved crown health continued until 2020, twelve years after thinning.

REFERENCES

Reed A, K L Barrett and J T Croton (2012) Future streamflows from the northern jarrah forest. Learnings from the Wungong catchment trial. Water Corporation 1 74043 797 7

Water Corporation (2005) The Wungong catchment environment and water management project.

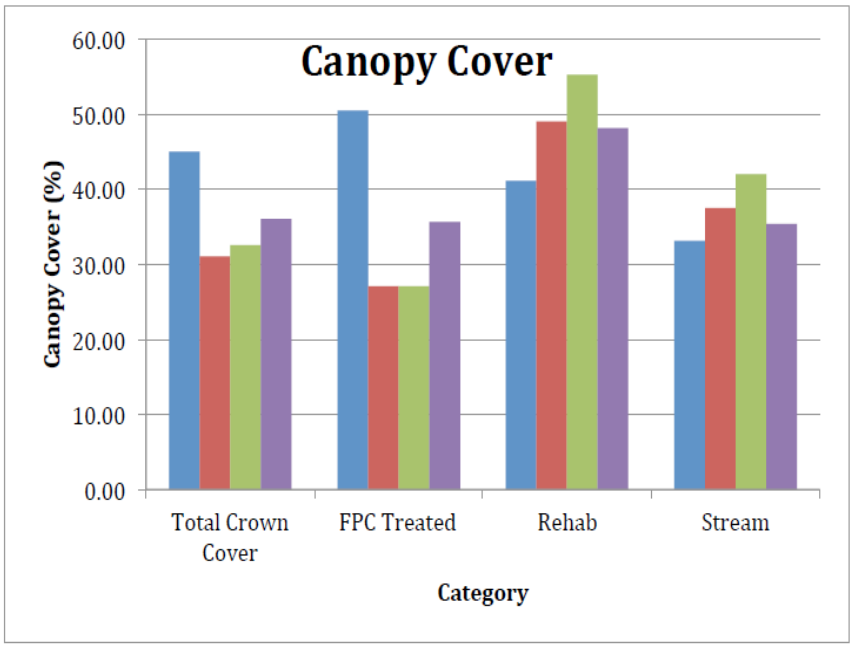


Figure A3
Canopy cover estimates for Cobiac catchment taken in November, for the years 2005, 2008, 2009 and 2010 (Spec Terra Services Pty Ltd).

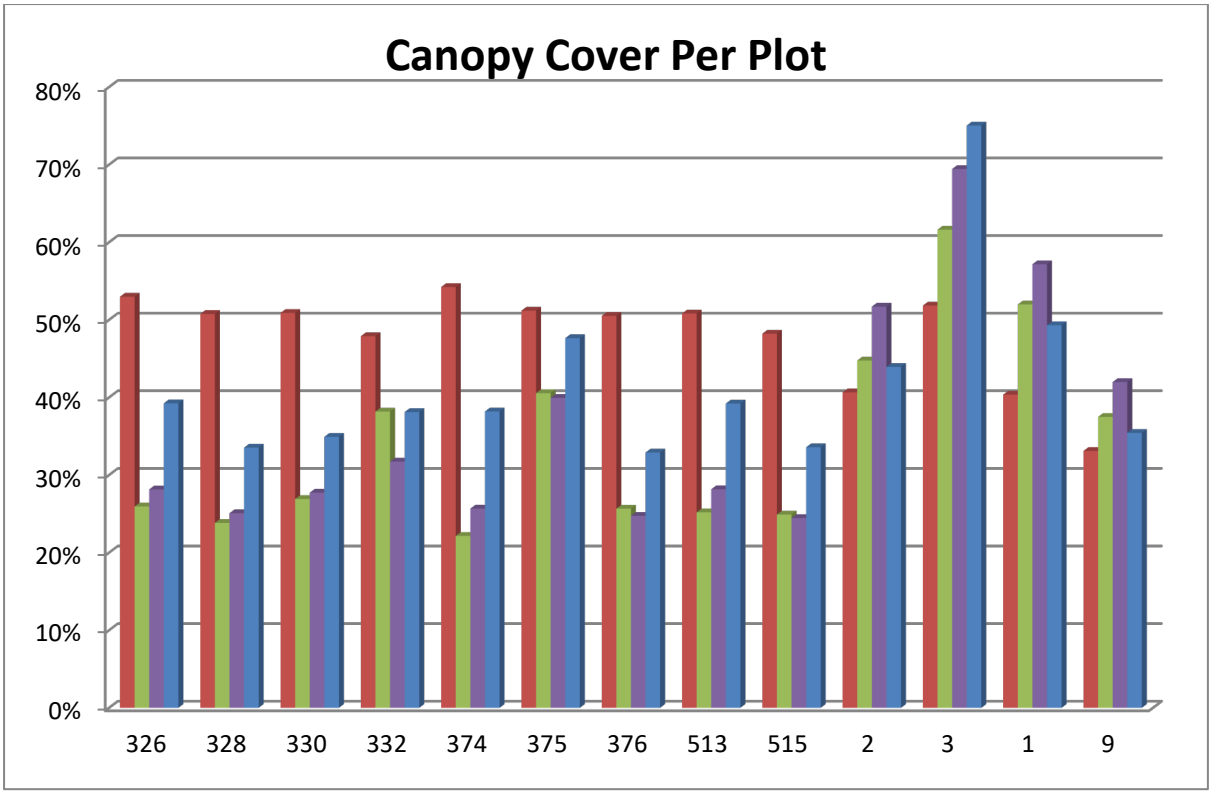


Figure 2

Canopy cover estimates (percent) taken in November, for years 2005, 2008, 2009 and 2010 (Spec Terra Services Pty Ltd)

Identifiers are as follows;	9	Stream reserve
	1, 2 and 3	Rehabilitated bauxite pits
	All others	Areas treated by thinning

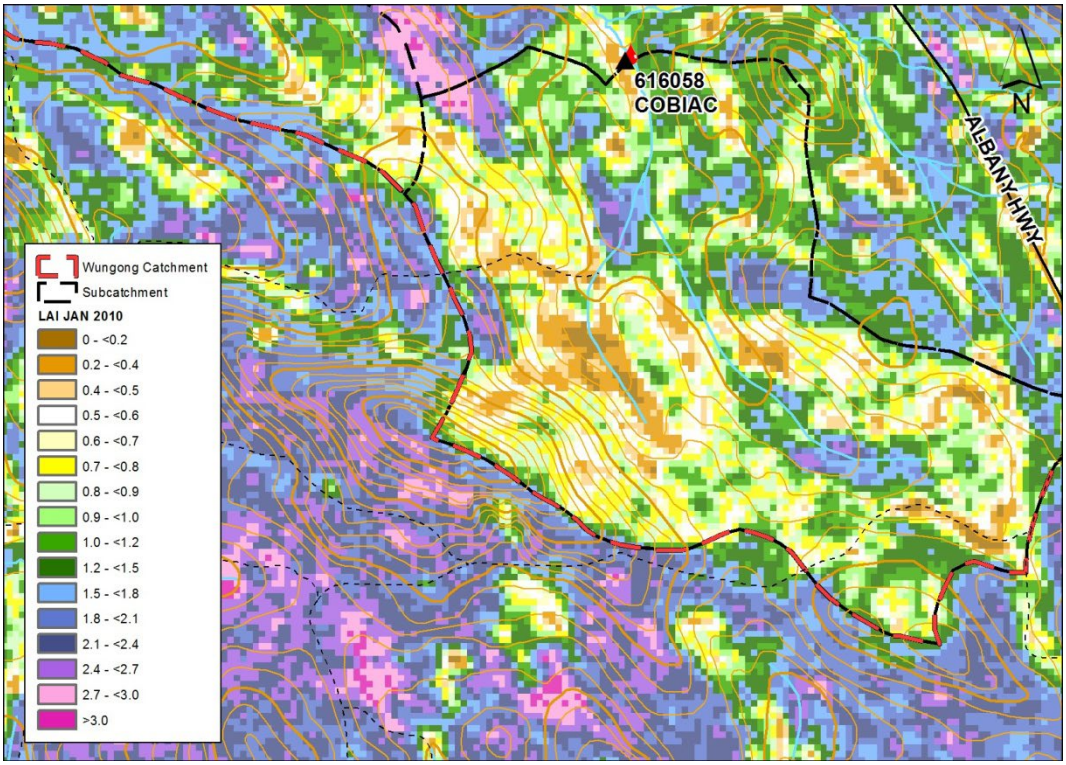
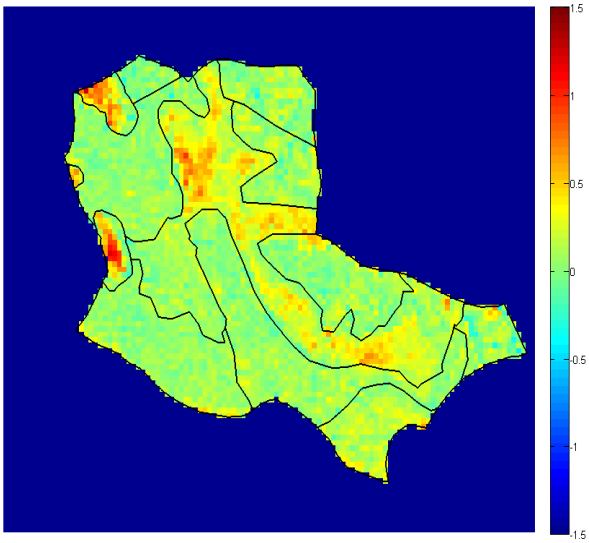


Figure 3

Estimates of leaf Area Index (LAI) in January 2010.

Thinned areas have low LAI, mostly <1.0, whereas un-thinned areas have LAI that exceed 2.0



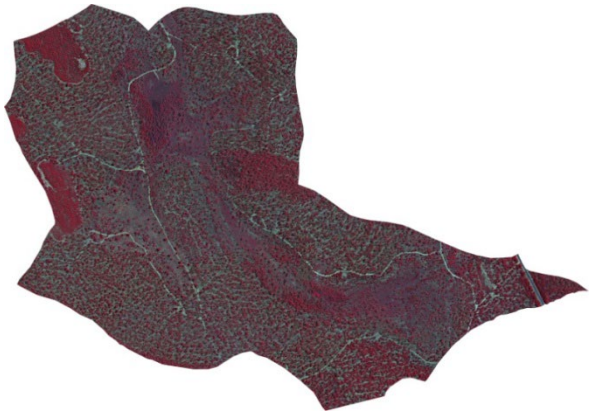


Figure 4

Above: Estimates of changes in Leaf Area Index(LAI), January 2010 to March 2011 (red and yellow = decline; green and blue = improvement) provided by Dr C Macfarlane, CSIRO

Below: canopy density post thinning, false colour image, provided by Spec Terra remote sensing services.

Note: the denser areas were not thinned and show a greater decline in LAI.