Review of Pruning Eucalypts for Clearwood in Western Australia

(Presented to A National Appraisal of Pruning for Clearwood Workshop – Launceston 21st March, 2000. J.V.A.P. Grant Taskforce)

Bob Hingston
Farm Forestry Unit, CALM

Introduction

The following outlines the Western Australian situation as presented to the National Review of "Pruning Eucalypts for Clearwood" Workshop held in Launceston on 21st March, 2000. The review is a major recommendation of the RWG for Agroforestry and RPCC for the evaluation of a nationally coordinated approach to clearwood regimes.
The following review presents the current status of plantations in Western Australia. (Table 1) An inventory of privately owned eucalypt sawlog plantations is also presented (See Table 3).
Current pruning practices are discussed in Section 2 where species, regimes and some limitations are proposed.
Section 3 covers existing Research projects in Western Australia and the current status of trials. This focuses on wide-spaced pruned agroforestry trials, milling studies and eucalypt tree breeding trials.
The future direction for research is discussed in Section 4.

Section 1

Planted areas

Presently, there is approximately 243,364 ha of commercial species planted in W.A. The planting rate of plantations during 1999 was 38,200 ha. It is anticipated that a further 47,600 ha will be planted in 2,000 (Table 1). Private plantations of eucalypt sawlog regimes are shown in Table 3.

Table 1. The 5 main species, areas planted, current planting rates & the projected planting rates in Western Australia.

Species	Areas planted (ha)	Current planting rate (1999) (ha)	Projected planting rate for 2000 (ha)
E.globulus	130,600 [1]	27,000	~ 30,000
Oil mallees	30,000	7,500	12,500
P.radiata	44,000	~1,200 [2]	~100
P.pinaster	32,000	2,500	5,000 [3]
Other eucalypts [4]	6,764	?	?
Total	**243,364**	**38,200**	**47,600**

Source: [1] Sewell (1999) [2] replanting of clearfelled sites [3] sharefarm agreements
[4] CALM owned - includes *E.muelleriana* and *E.astringens*
Note: this Table does not include privately owned eucalypt sawlog regimes. See Table 3.

Table 2. The percentage of plantations grown specifically for sawn products in W.A.

Species	**Areas planted** (ha)
E.globulus	~ 1%
P.radiata	100%
P.pinaster	99%
Other eucalypts *	unknown

As approximately 99% of bluegums are grown for pulpwood, under joint sharefarming or leasing agreements, it is difficult to estimate what percentage of these plantations may be converted to other end uses; eg sawn products, MDF and veneers. Some private companies have not yet committed their plantations for particular markets, such as pulpwood only.

Privately owned eucalypt sawlog regimes.

An inventory of privately owned eucalypt sawlog plantations, is shown in Table 3. Information specific to these plantations has been sourced mainly from the network within CALM's Farm Forestry Unit at Busselton. The areas planted under this regime may therefore be a conservative estimate of the W.A. resource. I would estimate that there is about 1067 ha of eucalypt sawlog regimes of which 60% of this is *E.globulus*, or 642 ha (Table 3).

Although it is difficult to predict the future resource under sawlog regimes, it is clear that there is currently a strong interest among growers and investment groups based on inquiries to the Farm Forestry Unit from potential growers. I would anticipate that these areas will increase in the next 5-10 years. A public prospectus is currently being proposed for the solid timber market with eucalypts (B.Mattinson, *pers.comm.*).

The main areas planted in W.A. for eucalypt sawlogs are the South West and the South Coast Region ie, the high rainfall zone (>600mm). It appears that there is also an interest in extending these boundaries into the medium rainfall zone (450-600mm), where land prices are lower and farmers are keen to diversify their tree growing options.

Table 3. Inventory of privately owned eucalypt plantations in W.A being grown for sawlogs [1]

REGION	Total area planted (ha)	Area of Species planted (ha)									
		E.glob.	*E.salig.*	*E.grand.*	*E.mac.*	*E.botry.*	*E.camal*	*E.divers.*	*E.paten.*	*E.muell.*	others [2]
Bsn/Marg.R./Aug. [3]	**259**	159	15	7	27	18		7		6	7
Swan Coast Plain	**33**	7	4	2	5	6					9
Btn/BoyupBk./Koj. [4]	**150**	69	46		24					5	6
South Coast (inc.Esp)	**469**	308	22	20	29	30	10	13	11		25
Dbk/Collie/Capel [5]	**97**	83	6		5						2
Others(Metro etc)	**75**	16	5	10	16	14	3				10
Total	**1067**	**642**	**98**	**39**	**106**	**68**	**13**	**20**	**11**	**11**	**59**
% of total area		60%	9%	3.5%	10%	6%	1%	2%	1%	1%	5.50%

[1] Estimated by CALM's Farm Forestry Unit
[2] Other species include: *E.viminalis, E.pilularis, E.oreades, E.accedens, E.cladocalyx, E.sideroxylon, E.muelleriana*
[3] Busselton, Margaret River, Augusta. [4] Bridgetown, Boyup Brook, Kojonup. [5] Donnybrook, Collie, Capel

Section 2.

Outline of current W.A. eucalypt management practice

Except for CALM research trials, there are no government owned eucalypt sawlog plantations in W.A. The "resource" is owned by the private sector, mostly farmers.

In W.A. there is a strong interest within the farming community for the growing of eucalypts for sawlogs. Some of the reasons for this appear to be; uncertainty surrounding future returns from pulpwood markets; an interest in grazing stock under eucalypts (diversification); a feeling of "confidence" in future sawlog markets; speculation of better returns from sawlogs than just pulpwood (although W.A. has no firm market at present) and community pressure to value add for solid wood products, rather than chipping.

Currently, the two methods of growing eucalypt sawlogs are 1.) wide-spaced, high pruned regime and 2.) traditional close-spaced regime until age 8-10 years, with no pruning.

Background

The objective of wide-spaced regimes is to produce high-grade sawlogs in the shortest possible time ie, 18-25 years. Therefore the regime involves heavy and early culling or thinning. To prevent large knots from developing on the wide-spaced trees, branches are pruned from an early age. Numerous milling studies have shown that knots are the main defect in downgrading eucalypt timber (White and Siemon, 1992, Brennan *et al,* 1992, Moore *et al,* 1996, Brennan *et al,* 1999, Siemon, G.R., 2000, Washusen, R, and Waugh, G, 2000).

Results of trials and practical experience over the past 20 years have been packaged by CALM's Farm Forestry Unit into extension material for private growers. Delivery methods include Treenotes, Field Days, Master Tree Growers Courses, Introduction to Farm Forestry Courses and one-on-one training with landowners.

Pruning

The aim of pruning is to maintain a small knotty core of at least 12-15 cm. Pruning generally commences at year 3 where all branches are removed to a 10 cm stem diameter limit, at about 2-3 metres and while green. Subsequent pruning is carried out to a height of 6-8 metres. No more than 50% of crown is removed in any lift.

Pruning is carried out in late autumn and winter to minimise the possibility of fungal attack and to maintain growth rates. Based on local mill studies, there has been no evidence of fungal attack on appearance grade boards.

Species such as *E.botryoides, E.maculata, E.saligna, E.camaldulensis, Acacia melanoxylon* are generally form pruned from age two. Form pruning aims to remove forks, large branches and generally increases the crop tree selection ratio. This practice is also required where 28 parrots have damaged the main leader.

Species such as *E.saligna, E.botryoides* and *E.grandis* have been observed to produce large branches within 12 months of pruning eg, to a height of 3-6 metres. There appears to be a branch growth response, whereby excessively large knotty cores will result if the branches are not pruned within 12 months. This also results in higher pruning costs as the branches take longer to remove. This has been confirmed in a recent milling study

with *E.saligna.* Branches (25-25mm) were pruned 18 months after the first lift, and this caused significant downgrade in the mid-log sections. Timing of pruning operations is therefore a key factor in clearwood regimes.

Thinning

If growers are aiming for sawlog production in as short as time as possible then either a culling or a thinning should be carried out by age 5-6 years. A commercial harvest is encouraged (if market is available) as this will offset establishment costs and increase cash flow. If contractors are unavailable or pulpwood volumes are too low (<80m^3/ha), culling to waste is recommended. Deferring harvesting is an option, however the risk of windthrow is a possibility where top height exceeds 20 metres.
Thinnings have been utilised as fence posts or firewood. Current stumpage for *E.globulus* thinnings is between \$18-\$21/m^3 and other species eg, *E.saligna* ~\$9/m^3.

Trials have shown that a stocking rate of between 150-200 trees/ha is desirable for optimum tree growth in the high rainfall zone and aiming for an average of 2-2.5 m^3 per tree on appropriate soils. In the medium rainfall zone stocking rates of 100-150 trees/ha aim to produce 1-1.5 m^3 per tree.

Coppice control

Coppice is controlled by foliar spraying with a 20 part water to 1 part Roundup (glyphosate) solution when the height reaches 30-40 cm.

1. Wide-spaced high pruned regimes

A typical sawlog pruning and thinning regime recommended by CALM's Farm Forestry Unit for a *Eucalyptus globulus* plantation on an average site quality in the South West of W.A. is shown in Table 4.

Table 4. Typical management practice for a *E.globulus* sawlog regime in the South West of W.A.

Age (years)	Operation
0	Plant 1250 trees/ha
3	Prune 300 trees/ha to a 10cm stem diameter limit (2-3 metres)
5	Prune 150-200 trees/ha to half tree height (5-6 metres)
5	Commercially thin to 150-200 trees/ha
5	Treat coppice
6	Prune to 6-8 metres (optional)
18-25	Harvest sawlogs

This regime is capable of producing 2-2.5 m^3/tree, or 300-375 m^3/ha in twenty years at 150 trees/ha on a high quality site and rainfall exceeding 800mm per year. Fertiliser is applied at least 3-4 times during the rotation.

2. Traditional close-spaced regime

Some landowners use this approach in growing eucalypt sawlogs because they have decided late in the rotation that sawlogs are a better management option or they are unable to carry out the pruning due to a number of reasons eg, time, cost or other reasons as discussed above.
Under this regime pruning is not carried out prior to harvesting at age 8 to 10 years. By this time self-pruning has occurred. A typical regime is shown in Table 5.
It is interesting to note that presently, 80% of *E.globulus* plantations harvested by Western Timber Cooperative for small growers are for sawlog regimes (C.Leishman, *pers.comm.*). These plantations have not been pruned and I would expect downgrade from knots following milling.

Table 5. A typical traditional *E.globulus* unmanaged sawlog regime.

Age (years)	Operation
0	Plant 1250 trees/ha
8-10	Thin to 300 trees/ha for pulpwood
18-25	Harvest for sawlogs

Limitations for growth
The main limitations for adequate growth of eucalypts are:

1. Soil types. Soil and salinity surveys are carried out in the planning phase of the project so that growth rates are maintained at an economic level and the correct species are matched to soil type. Soil profile descriptions are recommended to determine impeding layers or hardpans etc.
2. 28 parrots. If damage occurs at a young age, the log length is minimised. Parrot control is required in susceptible areas to minimise damage.
3. Rainfall. Most of the high rainfall eucalypt species such as, *E.globulus, E.saligna, E.grandis, E.botryoides* etc will produce economic rotations of sawlog regimes in 18-25 years. Evidence from trials indicates that on suitable soils, the rainfall cut-off limit for these species is about 600mm per annum. In the rainfall zone of 450-600mm, a range of species suitable for sawlog regimes on suitable soil types include; *E.cladocalyx, C.maculata, E.camaldulensis, E.occidentalis, E. , Cas.cunninghamiana* (Hingston, R.A., 1999)

An economic spreadsheet is used by the Farm Forestry Unit to indicate long term viability of eucalypt sawlog regimes for landowners. Growing and management costs, expected timber volumes, milling costs etc are input into the spreadsheet and cash flow graphs or expected returns are calculated over the nominated timeframe of the project.

A large private company within 50 km of Albany, is pruning areas of their *E.globulus* plantations for veneer, LVL and sawn timber products. The aim is to produce a 45 cm log and small end diameter of 30 cm. Plantations are culled to 300 trees/ha at age 4 years.

Extension methods

1. The publication of the TreeNote Information Sheet series is seen as a key extension tool by CALM and Agriculture W.A. The TreeNotes were produced to supply

common information to interested landowners or prospective growers. At present, 28 Treenote Information Sheets have been produced in a joint exercise, with a further 10 or so to be published soon. They include topics on growing eucalypts for salogs.

2. Field Days on growing and managing eucalypts for sawlogs are held on a regular basis to interested landowners across the state. They are organised by CALM Farm Forestry Unit or AgWA staff, Land Conservation District Committees and RPCs.
3. Master Tree Growers Courses. Exposure to good silvicultural practice is a key focus for these courses. It is interesting to note that following these courses, the pruning of eucalypts are adopted by some participants. Perhaps the message is getting out to these key farmers.
4. Introduction to Farm Forestry Courses. These courses are run to expose CALM and AgWA staff, Landcare Coordinators and Agribusiness consultants to "commercial" Farm Forestry options and design. This allows further tree cropping options to be explored in revegetation projects rather than the "uncommercial" landcare alternatives. Again, participants are exposed to the eucalypt sawlog options during these courses. To date, there have been 3 courses run across the agricultural geographic regions.
5. Farm Forestry Unit. This Group, managed by Richard Moore, is currently in a position to provide a one-on-one service to farmers, landowners and investors for the promotion of eucalypt sawlog regimes. This Group has used past research experience to develop extension material on farm forestry.

Section 3

Research currently in progress (CALM)

1. Agroforestry species trials

These trials aim to provide information on species, growth rates and management costs or returns.

Agroforestry trials in W.A have been primarily aimed at producing high quality sawlogs ie, as quickly as possible, at low tree stocking rates (Table 6). These trials were initiated with grazing of stock as a secondary objective and hence, were wide-spaced from age 3 years with pruning and culling a key management practise. Key eucalypt trials are discussed.

In 1978, a trial at Mundaring (40 km east of Perth) was planted primarily for water catchment control with *P.radiata, P.pinaster* and *E.camaldulensis.* In 1981, an agroforestry demonstration trial was planted with 6 eucalypt species near Busselton. Species were *E.globulus, E.paniculata, E.maculata, E.diversicolor, E.muelleriana and E.oreades.*

The same year in the Wellington Catchment, east of Collie, an unreplicated trial was planted for salinity control testing *E.saligna* and *E.accedens* at low-stocking and were high pruned for sawlogs

A further series of wide-spaced eucalypt provenance trials commenced in 1987 and 1989.

Table 6. Current eucalypt species trials in W.A. testing wide-spaced sawlog regimes

Trial location & planting year	Project description	Species tested	Variables tested	Status of project
Mundaring P.78	An evaluation of total production of some combinations of trees & pasture	*P.radiata, P.pinaster, E.camaldulensis*	Variable row spacing, time & severity of pruning, methods of treating slash, hydrology	Growth monitoring
Vasse plantation P.81	Comparison of eucalypt species at variable tree stocking rates	*E.globulus, E.paniculata, E.maculata, E.diversicolor, E.muelleriana, E.oreades*	Species, tree density,	Growth monitoring
Wellington Catchment P.81	Establishment of trees to control salinity with timber, grazing & aesthetics as secondary benefits	*P.radiata, P.pinaster, E.saligna, E.accedens*	Various planting layouts, mixture of species, grazing,	Growth monitoring
Vasse P.87	An agroforestry system combining grazing & cropping with growing wide-spaced eucalypts	*E.saligna, E.maculata, E.microcorys*	Species provenance at low density (125 trees/ha)	Growth monitoring
Boyup Brook P.87	An agroforestry system combining grazing & cropping with growing wide-spaced eucalypts	*E.saligna, E.maculata, E.microcorys*	Species provenance at low density (125 trees/ha)	Growth monitoring
Manjimup P.89	An agroforestry system combining grazing & cropping with growing wide-spaced eucalypts	*E.globulus, E.viminalis, E.saligna*	Species provenance at low density (125 trees/ha)	Growth monitoring

3. Milling studies

a.) A mill study of wide-spaced high pruned (to 10 metres) *E.globulus* showed that marketable sawlogs could be produced in 13 years when grown at 135 trees/ha and a high proportion of timber produced from sawlogs was of appearance grade (Moore *et al*, 1996). This study also recommended that logs be grown to 700 to 800 mm diameter or to 20 to 25 years.
b.) Wood quality milling pilot studies have recently been carried out on 16 year old high pruned *E.muellerana, E.oreades* and *E.maculata* from the Vasse plantation. Pruning caused minimal downgrade from knots. Logs were cut to 2.5 metre lengths and milled the same day with a Wood Mizer horizontal bandsaw using the backsawn method of cutting. Boards were resawn at the Harvey Timber Technology centre.
c.) Another pilot study was carried out recently on 18 year old pruned *E.globulus* and *E.saligna.* Preliminary results indicate that green off-sawn recovery was 48.8% for *E.globulus* and 40.3% for *E.saligna.* Prime and standard grade material was 30.1% for *E.globulus* and 15.6% for *E.saligna.* Again, downgrade from knots was minimal for *E.globulus*. However this was not the case with the mid-log section of *E.saligna* where late high pruning caused boards to be rejected because of large knots ie, >2.5 cm.

3. Tree breeding research

The following CALM tree breeding species trials are currently in progress (Table 7) (R.Mazanic, *pers. comm.*). These species have been recognised as having some commercial potential. Most of these trials will be grown as traditional dense-planted regimes, where tree form, branching qualities and growth rates are assessed.

Table 7. CALM eucalypt species tree breeding trials and rainfall zones of W.A..

Species	No of trials	Rainfall zone (mm)
E.pilularis	1	>1100
E.resinifera	2	>1100
E.botryoides	3	~ 900
E.saligna	1	>1100
E.sideroxylon/tricarpa	2	700
E.viminalis	2	700 & 900
E.camaldulensis	4	>1100
E.marginata	3	>1100
E.muelleriana	2	1100
E.wandoo		700 & 1100
E.microcarpa	2	700
E.occidentalis	1	<600
E.globulus	numerous	>600
Oil mallee spp	numerous	<600

A large private company is also researching *E.camaldulensis/E.grandis* for pulpwood purposes on low rainfall sites.

Section 4

Future directions (practise and research)

The following milling studies are proposed, but subject to funding (in conjunction with Timber Technology Centre, Harvey):

- determine drying schedules for fast grown eucalypt species.
- wood quality mill studies will be carried out using a range of wide-spaced pruned agroforestry eucalypts especially at age 20 years.
- evaluating potential of on-farm milling and seasoning techniques

Tree Crops research (J.McGrath, CALMScience *pers.comm.*)

- In low/medium rainfall zones we may need to investigate the management of high quality products where cartage distance to pulpwood markets is prohibitive. This is particularly pertinent to sites that are managed for water use. Planted tree crops may use more available water than some remnant vegetation types.
- May need to investigate other products in relation to over supply of woodchips especially in the 600-700 mm rainfall zone. Where water use is limiting is *E.globulus* the right species? Companies are pushing the limits of this species where land prices are lower.
- Low rainfall zone growth rates for a range of potential eucalypt sawlog regime species need to be obtained. This will provide economic evaluation of suitable species for landowners and give advisory staff more confidence.

Market research and development

- Further work is required to investigate alternative markets for high quality eucalypt sawlog material.
- Boards from milling trials need to be evaluated by industry for gluing, nailing, machining etc

Future research priorities will be set following the split of CALM. The Timber Technology Centre and CALMScience will become part of the newly formed Forest Production Council.

References

Brennan, G.B., Hanks, W.R. and Ward, S.L. (1992). Processing plantation-grown Tasmanian blue gum. Department of Conservation and Land Management, Wood Utilisation Research Centre. W.U.R.C. Technical Report No 41.

Brennan, G.B., Smith, E.L., Sratico, S.C. and Pitcher, J.A. (1999). Assessing wood quality of 30-year-old regrowth karri from Nairn Block, Pemberton. Department of Conservation and Land Management. CALMScience Vol. 3, No 1 (1999).

Moore, R.W., Siemon, G.R., Eckersley, P. and Hingston, R.A. (1996). Sawlogs from 13-year old *Eucalyptus globulus* – Management, recovery and economics. 1996 Australian Forest Growers Conference. *Farm Forestry & Plantations. Investing in the Future Wood Supply.* Mt. Gambier, South Australia. 9-12 September 1996

Sewell, H. (1999). Opportunities for securing long term fibre supply, paper presented at Asia Pacific Pulp & Paper Summit, Singapore, November 1999. Great Southern Plantations Limited, West Perth, Western Australia.

Siemon, G.R. (2000). Utilisation of Sawn and Round Timber of Tasmanian Blue Gum (*Eucalyptus globulus* subsp. *globulus*). Department of Conservation and Land Management. February 2000. Unpublished report.

Washusen, R., and Waugh, G. (2000). Opportunities for solid wood products from low-rainfall plantation-grown eucalypts. Paper presented for IUFRO Conference *'The Future of Eucalypts for Wood Products'*. Launceston, Tasmania. March 2000.

White, K.J., and Siemon, G.R. (1992). Sawn recoveries from jarrah and karri graded logs. Department of Conservation and Land Management, W.U.R.C. Technical Report No 39.