Leatherwood Silviculture - Implications for Apiculture

Mark Neyland[1] and John Hickey[2]
[1]Department of Parks, Wildlife and Heritage, Tasmania
[2]Forestry Commission, Tasmania

Abstract

Nectar from Eucryphia *species is important for honey production. The silviculture of* Eucryphia lucida *is reviewed and trials to re-establish* E.lucida *after logging of mixed forest and rainforest are reported. Some* E.lucida *regenerates after clearfelling and burning of mixed forest but is insufficient to replace the nectar resource in the short to medium term.* E.lucida *regenerates abundantly after logging of rainforest if there is an adjacent seed source and no subsequent burn. Planted* E.lucida *seedlings can be successfully established in the absence of browsing but the cost is prohibitive. Artificial sowing of* E.lucida *seed has not been successful. Although the nectar resource from eucalypt regeneration areas is small there are good potential supplies from mixed forest and rainforest areas not subject to logging.*

Introduction

Leatherwood honey is prized for its distinctive flavour and has a national and international reputation. It is obtained from the nectar of two species, leatherwood (*Eucryphia lucida* (Labill.) Baill.) and dwarf leatherwood (*Eucryphia milliganii* Hook f.), which occur in mixed forest and rainforest in western and southern Tasmania. In 1987-88 the total Tasmanian honey production was 801 tonnes with a return to the apiarists of $1.3 million (Australian Bureau of Statistics). Sixty one percent of that production was leatherwood honey.

Mixed forest areas, particularly those in north-western and southern Tasmania, are also important for wood production and apiarists have indicated their concern (e.g. Cunningham 1973, Tasmanian Woodchip Export Study Group 1985, Hoskinson and Graeme-Evans 1988) that there will be a reduction in the leatherwood nectar resource available to apiarists due to clearfelling of leatherwood-rich mixed forest without subsequent regeneration of the leatherwood component. Such a reduction in total leatherwood honey production has not yet been evident as roads built for forest harvesting have allowed apiarists into previously untapped forest. However the total potential nectar supply is reduced as mixed forest is felled, sown with eucalypts and grown on planned rotations of 80 - 100 years. Over the last 15 years research has been carried out, particularly in north-western Tasmania in the early 1980s, to assess the potential for leatherwood re-establishment in mixed forest and rainforest following logging. This paper summarises those results. All the work reported here was done on *Eucryphia lucida* but some of the results may also be applicable to *E.milliganii*. In this paper the term 'leatherwood' refers specifically to *E.lucida*. Forests containing *E.milliganii* are not subject to logging.

Distribution and Ecology

Two species of leatherwood occur in Tasmania: *Eucryphia lucida*, a small tree reaching about 15 - 25m, and *E.milliganii*, a shrub, rarely exceeding 3m in height. *E.milliganii* closely resembles *E.lucida* but is smaller in all its parts. Hybrids have been recorded between the two species (Curtis & Morris 1975). *E.lucida* is more common and widespread than *E.milliganii* - both are important nectar sources for apiculture.

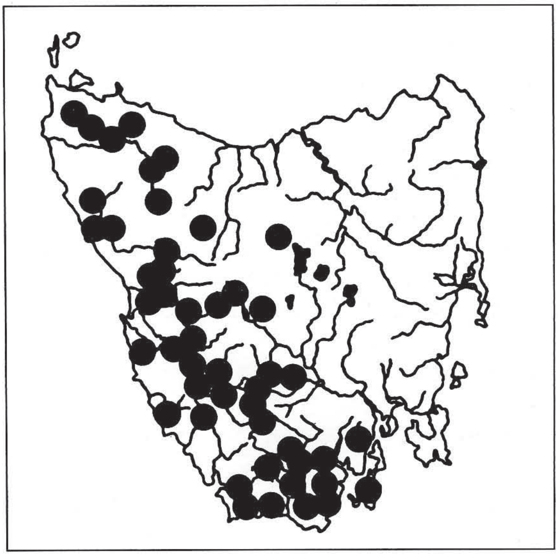

Fig. 1. Distribution of Eucryphia lucida (from Kirkpatrick and Backhouse 1985)

Eucryphia lucida occurs throughout western Tasmania in areas of high rainfall and low fire frequency (Kirkpatrick and Backhouse 1985, Fig. 1). *E.milliganii* has a more restricted range and is generally found at higher altitudes.

Both species occur in a range of communities from mixed forest to rainforest. *E.lucida* is characteristic of thamnic rainforest, where it is a prominent tree but it is also present in implicate rainforest (Jarman *et al.* 1984). Mixed forest communities containing *E.lucida* may be dominated by *Eucalyptus obliqua*, *E.delegatensis*, *E.brookeriana*, *E.regnans*, *E.nitida*, *E.johnstonii* or *E.subcrenulata* (Kirkpatrick *et al.*, 1988).

Eucryphia milliganii is present in some thamnic and implicate rainforests (Jarman *et al.*, 1984). It is also found in subalpine mixed forests dominated by *Eucalyptus subcrenulata* and *E.coccifera* and less commonly in mixed forests dominated by *E.delegatensis* and *E.nitida*.

Flowering, Seed Production and Dispersal

Leatherwood flowering occurs mainly from December to March each year, but flowers may be seen as early as November or as late as June. Unlike some Tasmanian rainforest trees (e.g. *Nothofagus* (Hickey *et al.* 1983), *Athrotaxis*, (Cullen 1987), *Lagarostrobos* (A. Shapcott, pers. comm.), and *Phyllocladus*) flowering and subsequent seed set is relatively consistent from year to year (Hickey *et al.* 1983, Read 1989). Saplings first flower at ages less than ten years when grown under open conditions. Basal sprouts arising from stumps have been observed to flower after four years. Flowering is generally more abundant on dominant trees in full light (e.g. on gully sides, or under broken canopies).

The fruit develops in the spring following flowering. The light, winged seed is borne in leathery capsules of five or six carpels, each of which contain several seeds around 4mm long. Seed is shed over summer and autumn. Hickey *et al.*, (1983) recorded peak seedfall for lowland sites in northwestern Tasmania in February-March. Read (1989) found the period of seedfall from trees at 700m at Mount Field to extend from May to June. This suggests that the flowering period of trees at higher altitudes is later than that for lowland trees. *E.milliganii* is reported to flower slightly later than *E.lucida* even when growing at the same elevation (C. Parker pers. comm.).

Hickey *et al.*, (1983) recorded annual seedfalls in the range of two to eight million seeds per hectare. They also found that viable seed is commonly wind dispersed over 40m from parent trees, with occasional viable seeds being dispersed as far as 150m.

***E.lucida* seed viability**

Two studies, Read (1989) and Hickey *et al.*, (1983) have looked at seed viability. The results obtained were very variable, but the range of conditions and incubation regimes used were such that the results are not directly comparable.

Both studies found good germinative capacity for seed stored at 3 - 5°C. Read found acceptable (50-80 per cent) germination rates for seed stored for 32 months at room temperature, whereas Hickey *et al.* report rates of 4 per cent and 0 per cent for seed stored under similar conditions for 28 and 40 months respectively. Unfortunately Read does not report the exact conditions of her trial, as some of her other results point to the possibility of induced dormancy, for which Hickey *et al.* did not test.

For example, Read found that germination rate and onset were both increased for seed stored at 4°C for four weeks and then incubated at 25°C, over seed incubated at 12, 17 or 25°C without a cold pre-treatment. This suggests that some form of dormancy is being broken by the cold treatment. It has also been found that germination rates were increased by giving seed a moist pre-chilling treatment of 3°C for seven days (B. Turner pers. comm. in Felton 1977).

Hickey *et al.* (1983) report a peak germinative capacity of around 40 per cent for seed incubated under a regime of 20°C for 16 hours and 30°C for 8 hours. Read reports overall germination rates in excess of 90 per cent for seed incubated under a range of conditions.

Read (1989) reports that some *E.lucida* seed germinates in the field one to two months after seed fall. Germination can also occur in the following spring. There is no evidence to indicate the seed is stored in the soil.

Regeneration

(a) Natural regeneration

In undisturbed rainforest and mixed forest, leatherwood regenerates more or less continuously in canopy gaps created by the death and/or windthrow of canopy trees. Mesibov (1978) and Read and Hill (1985) observed that a dense ground cover of ferns or dry litter inhibits regeneration on the forest floor but that regeneration can still occur on fallen logs, amongst moss, or on exposed

Table 1. Rainforest regeneration on CFI plots established in eucalypt regeneration areas in Smithton District up to 1984.

Plot No.	Year regenerated		Rainforest Species Stems Present (Stems/0.1ha) Leatherwood	Myrtle	Blackwood	Sassafras	Celery Top Pine
3234	1966	W*	9	150 +	-	5	-
3235	66	W	-	43	4	88	-
3236	67	A	-	110	2	7	-
3237	66	W	-	8	12	-	-
3238	66	W	-	8	-	-	-
3239	66	W	-	3	3	-	-
3240	66	W	-	2	5	-	-
4194	69	A	40	60	2	-	-
4195	62	A	13	200 +	1	10	-
4196	66	W	-	1000 +	-	1	-
4197	69	A	-	6	-	-	-
4198	66	A	100 +	200 +	14	39	2
4199	66	W	-	8	15	-	-
4200	66	W		2	37	-	-

*W = Wildfire
A = Artificial (i.e. sown to eucalypt following logging)

mineral soil. Regeneration can also result from the release of basal sprouts following the death of the main stem. (Hickey 1982, Read and Hill 1988).

(b) Regeneration following logging

Mixed forests

The effects on vegetation of clearfelling mixed forest followed by regeneration to eucalypts have been summarised by Duncan (1985). Logging of mixed forests on a rotation shorter than the period required for its full re-establishment, about 200 years, will lead to a shift towards a wet sclerophyll understorey. Surprisingly, from the few data that are available, this shift after a single clearfelling cycle may not be very great. Felton and Lockett (1983) reported the regeneration of rainforest species from regeneration surveys from 15 former mixed forest coupes in Smithton District. Twelve of the areas had been logged while three had resulted from wildfires. They found the most poorly stocked coupe had at least 600 stems of rainforest regeneration per hectare. However the results for leatherwood alone (Blakesley 1978) were less encouraging with 11 of the 15 areas having less than 15 per cent mil-acre stocking (less than 375 stems of leatherwood regeneration per hectare).

Regeneration surveys have often shown that clearfelled and unburnt areas, and clearfelled and burnt areas close to unburnt areas, carry excellent leatherwood regeneration (Blakesley 1978, 1980; Hickey 1981, 1982, 1983; Neyland 1983).

A pilot study of rainforest regeneration in regenerated eucalypt forest was carried out in

Table 2. Leatherwood regeneration following a range of logging treatments (from the Sumac rainforest trial)

Measurement	Age since Treatment (years)	Treatments[1] (all in 1977) Selectively logged for sawlog only	Logged with retained seed trees	Clearfelled, culls retained Cool burn	Clearfelled, culls felled Hot burn	Source
$4m^2$ stocking (%)	5	10	50 - 80	22 - 50	0	2
Stems/ha	5	1100	4000 - 60,000	700 - 4700	0	
Mn height of tallest stems (cm)	5	4*	34	n.a.	0	
$4m^2$ stocking (%)	9	15	50	20	0	3
stems/ha	9	860	6250	670	0	
stems/ha	11	n.a.	39500	1300	0	4
Mn height of tallest stem (cm)	11	n.a.	160	93	0	

Sources; 1. Blakesley 1980
2. Hickey 1983
3. Jennings 1987
4. Kelly 1989

* Heavily browsed

1984 using Continuous Forest Inventory (CFI) plots established up to that time in Smithton District. The results are shown in Table 1. The limited data indicate that myrtle (*Nothofagus cunninghamii*) regeneration is present and sometimes abundant in the regeneration areas. The regeneration of the other rainforest tree species is less common. Leatherwood regeneration was recorded on four of the 14 plots.

Rainforests

A moratorium on rainforest logging has been in place since 1982. However, some small areas of rainforest have been logged in northwest Tasmania in order to study a range of silvicultural systems for regeneration of rainforest tree species. The major trial area is known as the Sumac rainforest trial. Table 2 indicates the amount of leatherwood regeneration obtained following a variety of site treatments at that locality.

Table 2 indicates that following a clearfell, cull-fell and hot burn treatment, little or no leatherwood regeneration occurred. Some regeneration occurred where leatherwood 'cull' trees were retained and the burn was 'cool'.

Leatherwood regeneration after selective logging was mainly confined to disturbed sites where there were gaps in the canopy e.g. snig tracks and log landings. The best leatherwood regeneration resulted after logging where seed trees were retained and there was a mineral soil seedbed.

Planting Trials

A number of planting trials have been established (Table 3), encompassing a range of sites and conditions. In the eucalypt regeneration areas both growth and survival rates of seedlings unprotected from browsing were poor. Growth was reduced by the intense early competition from the eucalypt and other sclerophyllous regeneration. Seedlings in individual cages (see Fig. 2), planted on the more fertile sites have the highest chance of survival but the costs of establishing such trees, at greater than $4 per stem, are prohibitive. The browsing pressures in the eucalypt regeneration areas appear to be greater than in the rainforest regeneration areas. Browsing is particularly noticeable on recently clearfelled and burnt sites where little herbage is available. Leatherwood is only a moderately palatable species (Hickey 1982) and browsing pressures should decrease as other preferred food sources become available a few years after planting.

Sowing Trials

A variety of sowing trials have been conducted (See Table 4). These trials have been variously designed to test rates of seedling establishment using different sowing rates, seed sources and seedbeds, plastic shelters and cultivation to encourage germination, and pelleted vs. unpelleted seed.

A number of areas within the Sumac rainforest trial were also sown, but at very low rates (Blakesley 1980, Hickey 1983) and the sown areas were indistinguishable from adjacent areas which had natural leatherwood regeneration.

The sowing trials have been conclusive in that very few leatherwood seedlings have successfully established, even where very high sowing rates have been used (compared with 0.5kg ha^{-1} of eucalypt seed for aerial sowing). The lack of established seedlings is attributed to:

- heavy browsing of young seedlings in recently burnt areas;
- the low sowing rates (in most trials);
- the low field germination rate of stored leatherwood seed;
- competition from other species; and
- droughts on compacted areas.

Discussion and Conclusion

Some leatherwood regenerates after clearfelling, burning and regeneration of

Table 3. Summary of leatherwood planting trials

	Locality	Number planted	Survival	Mean annual increment cm y^{-1}	Notes	Source
Eucalypt regeneration areas	Holder rainforest species trial	100	44% after 8 years	7		Blakesley 1976 Neyland 1984b
	Dempster 19	110	18% after 2 1/2 years	7	Heavily browsed, compacted soil.	McCormick 1981 Neyland 1984
	Sumac 15	50	70% after 4 years	12		McCormick 1981 Mesibov 1985
	Sumac 11	136	92% after 2 years	23	Protected from browsing (individual cages)	McCormick 1983 Mesibov 1985
	Sumac 11	197	<50% after 2 years	<9	Heavily browsed	McCormick 1983 Mesibov 1985
Rainforest regeneration areas	Sumac rainforest species trial	354	53% after 5 years	20	Unfenced	) Blakesley 1980) Hickey 1983)
		345	81% after 5 years	23	Fenced	)
	Part only, Sumac rainforest species trial	108	55% after 9 years	30	Unfenced	) Jennings 1987, Kelly 1989)
		40	75% after 9 years	30	Fenced	)

Table 4. Summary of leatherwood sowing trials

Locality	Rate of Sowing	Seed Germination Test	Conditions Tested	Results	Sources
Milkshakes Spur 4 Holder Spur 5	17 - 22g/ha	not tested	Local & other seed. Pelleted and unpelleted seed. Fenced and unfenced plots	Scattered seedlings after 3 years. No established seedlings after 10 years.	Aalders 1974 Blakesley 1977 Neyland 1984a
Milkshakes Spur 11 Holder Spur 7	16 kg/ha	26%	Bare and pelleted seed. Compacted, disturbed & bare ground.	Milkshakes: Some seedlings recorded after 1 year, later overrun by competing vegetation e.g. *Gahnia grandis*. Holder: Very few seedlings recorded. Later burnt by wildfire.	Castley 1976 Blakesley 1977 Neyland 1984a
Arve Valley	Large plots 750g/ha Small plots 50kg/ha	not tested	Plots on top of bank, midslope & on river flats.	Very few seedlings after 2 years. No established seedlings after 3 years.	Clark 1975 Orme 1977 Clark 1978
Picton 30 + 33 Warra	5, 10, 20 & 40kg/ha	not tested	Sites burnt 3, 2, & <1 years ago.	No seedlings after 2 months. Not followed up.	
Dip 4 & Sumac 15	100 seeds/spot	25%	Mineral soil & peat soil. Cultivated & uncultivated ground. Unsheltered, sheltered with plastic buckets or cones.	No established seedlings. after 2 years.	McCormick 1982 Neyland 1984a

Fig. 2. Protected leatherwood plantings in a eucalypt regeneration area in Smithton District. Photo N. McCormick

mixed forest especially on snig tracks and other disturbed areas where the burn is least intense. Leatherwood establishment can be improved by retaining leatherwood culls and reducing burn intensity but this is likely to result in reduced regeneration of eucalypts. The value of leatherwood regeneration for apiculture in eucalypt coupes may be small as there is likely to be little flowering due to shading by the faster growing eucalypt regrowth.

Leatherwood regenerates abundantly after logging of rainforest if there is a suitable seed source, seed bed and no subsequent burn.

Planting is possible and height increments up to 30cm per year can be achieved in the absence of browsing and competing vegetation. However the cost of planting is prohibitively high.

Artificial sowing of leatherwood seed has never been successful even at very high application rates.

Although the nectar resource from leatherwood in eucalypt regeneration areas is low there are good potential sources from:

- mixed forest reserved by management prescriptions e.g. streamside reserves, visual management zones, steep country.
- rainforest outside reserves but not subject to logging.
- mixed forest and rainforest in formal reserves.

Efforts to assess the size and availability of these nectar resources are likely to be much more rewarding for apiculture than those directed at increasing the supply from eucalypt regeneration areas.

References

Aalders, J.G. (1974) Leatherwood Sowing Trials - South Arthur Forests. Unpublished report, Forestry Commission, Tasmania

Blakesley, A. (1976) Holder Rainforest Species Trial Establishment Report. Unpublished report, Forestry Commission, Tasmania

Blakesley, A. (1977) Progress Report on Leatherwood Sowing Trials in Smithton District. Unpublished report, Forestry Commission, Tasmania

Blakesley, A. (1978) Rainforest Regeneration Surveys in Eucalypt Treatment Areas of Smithton District. Unpublished report, Forestry Commission, Tasmania

Blakesley, A. (1980) Sumac Rainforest Logging and Regeneration Trial Establishment Report. Unpublished report, Forestry Commission, Tasmania

Castley, M.C. (1976) Leatherwood Sowing Trial. Unpublished report, Forestry Commission, Tasmania

Clarke, G.M. (1975) Leatherwood Trial Sowing, Geeveston. Unpublished report, Forestry Commission, Tasmania

Clarke, G.M. (1978) Leatherwood Trial Sowing, Arve Valley. Unpublished report, Forestry Commission, Tasmania

Cullen, P.J. (1987) Regeneration patterns in populations of Athrotaxis selaginoides D. Don from Tasmania. *J. Biogeog.* 14: 39 - 51.

Cunningham, D. (1973) Tasmanian Beekeepers Association Conference 1973. Leatherwood Report.

Curtis, W.M. and Morris, D.I. (1975) *The Students' Flora of Tasmania, Part 1.* (Second Edition). Govt. Printer, Hobart.

Duncan, F. (1985) Tasmania's vegetation and its response to logging operations. *Working Paper No. 6, EIS on Tasmania Woodchip Exports beyond 1988.*

Felton, K. (1977) Progress Report of Studies of Leatherwood Ecology and Regeneration. Unpublished report, Forestry Commission, Tasmania

Felton, K. and Lockett, E.J. (1983) Silvicultural practice in Tasmanian eucalypt forests. Proc. 10th. I.F.A. Conference 'Facing Forestry's Future'. Institute of Foresters of Australia pp. 111-114.

Hickey, J. (1981) Julius Dolomite Rainforest Logging and Regeneration Trial Establishment Report. Unpublished report, Forestry Commission, Tasmania

Hickey, J. (1982) Natural and artificial regeneration of some Tasmanian rainforest trees. In: Tasmanian Rainforest, Recent Research Results. Forest Ecology Research Fund, pp. 47 - 54.

Hickey, J. (1983) Sumac Rainforest Trial-Progress Report. Unpublished report, Forestry Commission Tasmania

Hickey, J., Blakesley, A.J. and Turner, B. (1983) Seedfall and germination of *Nothofagus cunninghamii*, (Hook) Oerst, *Eucryphia lucida* (Labill.) Baill. and *Atherosperma moschatum* Labill. Implications for regeneration practice. *Aust. For. Res.* 13:21-28.

Hoskinson, H., and Graeme-Evans, A. (1988) The importance of rainforest to the Tasmanian beekeeping industry. *Tasmania's Rainforest. What future?* pp. 35 - 40. Wilderness Society, Hobart.

Jarman, S.J., Brown, M.J. and Kantvilas, G. (1984) *Rainforest in Tasmania.* N.P.W.S. Hobart.

Jennings, S. (1987) 1987 Planting plot measurement summary. Unpublished report, Forestry Commission, Tasmania

Kelly, J. (1989) The Sumac Rainforest Logging and Regeneration Trial - 1989 Progress Report. Unpublished report, Forestry Commission, Tasmania

Kirkpatrick, J.B. and Backhouse, S. (1985) *Native Trees of Tasmania.* Sue Backhouse, Hobart.

Kirkpatrick, J.B., Peacock, R.J., Cullen, P.J. and Neyland, M.G. (1988) *The Wet Eucalypt Forests of Tasmania.* Tas. Cons. Trust. Hobart.

McCormick, N.D. (1981) Leatherwood Planting - Establishment Report. Unpublished report, Forestry Commission, Tasmania

McCormick, N.D. (1982) Sheltered Leatherwood Sowings - Establishment and Progress Report. Unpublished report, Forestry Commission, Tasmania

McCormick, N.D. (1983) Open Rooted Leatherwood Plantings - Establishment Report. Unpublished report, Forestry Commission, Tasmania

Mesibov, R. (1978) Some observations on seedlings of rainforest trees. Unpublished report, Forestry Commission, Tasmania

Mesibov, R. (1985) Leatherwood Plantings - August 1985 Remeasurement. Unpublished report, Forestry Commission, Tasmania

Neyland, M.G. (1983) Regeneration survey results on Mixed Forest Regeneration Trial, Holder 9. Unpublished report, Forestry Commission, Tasmania

Neyland, M.G. (1984a) Leatherwood Sowing Trials, Progress Report. Unpublished report, Forestry Commission, Tasmania

Neyland, M.G. (1984b) Smithton Leatherwood Plantings, Progress Report. Unpublished report, Forestry Commission, Tasmania

Orme, R.K. (1977) Leatherwood Sowings: Scotts Divide Road. Unpublished report, Forestry Commission, Tasmania

Read, J. (1989) Phenology and germination in some rainforest canopy species at Mount Field National Park, Tasmania. *Pap.Proc.Roy.Soc.Tas.* 123: 211-221.

Read, J. and Hill, R.S. (1985) Dynamics of *Nothofagus* dominated rainforest on mainland Australia and lowland Tasmania. *Vegetatio* 63: 67 - 78.

Read, J. and Hill, R.S. (1988) The dynamics of some rainforest associations in Tasmania. *J.Ecol.* 76: 558 - 584.

Tasmanian Woodchip Export Study Group (1985) Supplement to the draft Environmental Impact Statement on Tasmanian Woodchip Exports beyond 1988. Hobart, Tasmania.

Tasforests