CRITICALLY ENDANGERED WA PLANTS - TRANSLOCATION AND RE-ESTABLISHMENT TRIALS

Project Number: ESU 00006033

By

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FINAL REPORT SUBMITTED TO THE COMMONWEALTH THREATENED SPECIES AND COMMUNITIES SECRTION, BIODIVERSITY GROUP, ENVIRONMENT AUSTRALIA

WESTERN AUSTRALIAN DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

MAY 2000

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This study (Project No. 564) was funded by the Commonwealth Threatened Species and Communities Section, Environment Australia.

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BACKGROUND

This project aimed to undertake translocation and re-establishment trials for ten critically endangered flora species. The ultimate objective is to develop protocols for the establishment of a range of critically endangered flora with various life histories. Funding for this project was received in 1997, and a research scientist was appointed in February 1998 to coordinate and implement these translocations. Translocation proposals, necessary under the Department of Conservation and Land Management Policy 29 (see Appendix 1), were developed for all taxa targeted for translocation. These translocation proposals are attached at Appendix 2- 9. Seed of seven taxa were removed from long term storage and germinated. Seedlings of these seven taxa were translocated in 1998 and have been monitored over the subsequent months. Seed of the same seven taxa plus seed from one additional taxon was germinated in November 1998 and seedlings planted in winter 199[illegible] Population details for all species targeted for translocation are shown below.

Table 1. Population details for taxa selected for translocation.

Species	Nearest town to popns	CALM District	No. of popns	No. of individuals
Acacia aprica	Coorow	Moora	5	115 + 2 seedlings
Acacia cochlocarpa **subsp. *cochlocarpa***	Watheroo	Moora	2	164
Cyphanthera odgersii subsp. occidentalis	Wyalkatchem	Merredin	1	228
Daviesia bursarioides	Three Springs	Moora	5	119
Dryandra ionthocarpa	Kamballup	Albany	1	1157
Grevillea calliantha	Cataby	Moora	6	143
Grevillea maccutcheonii	Busselton	South West Capes	1	14 adults + 4 seedlings
Lambertia echinata **subsp. *echinata***	Esperance	Esperance	1	3 adults + 4 seedlings
Lambertia echinata **subsp. *occidentalis***	Busselton	South West Capes	1	7 adults + 10 seedlings
Lambertia orbifolia **(Narrikup form)**	Narrikup	Albany	2	89 adults + 80 seedlings

WORK COMPLETED

1.0 SCOPE ITEM 1.

ACTION: Development of propagation, field establishment and monitoring techniques for critically endangered flora

1.1 Development of propagation techniques for critically endangered flora.

Seed from seven species were withdrawn from long term storage at -18°C, and germinated in 1997. Germination data and seedlings survival prior to being planted into the wild are listed below in Table 2. The resulting germinants were raised at the accredited nursery at the Botanic Gardens and parks Authority (BGPA). Germinants of *Acacia aprica*, and *A. cochlocarpa* subsp. *cochlocarpa* were too small to be planted out in 1998 and so direct seeding was used for the translocation in that year.

Table 2. Germination data for seven species of critically endangered flora translocated in 1998.

Species	Days to germ. First and last	No. of viable seeds	% germ.	No. seedlings at BGPA 10/2/98	No. seedlings at BGPA 6/5/98	No. seedlings at BGPA prior to planting	No. of seedlings planted
Acacia aprica	46 - 167	395	82.4	31	11	11	1500 (seed)
Acacia cochlocarpa* subsp. *cochlocarpa	20 - 206	322	42.4	4	4	4	1500 (seed)
Daviesia bursarioides	45 - 168	241	55.2	205	216	195	196
Grevillea calliantha	12 - 103	75	76.5	95	110	110	106
Lambertia echinata* subsp. *echinata	32 - 89	209	77.1	165	109	90	90
Lambertia echinata* subsp. *occidentalis	28 - 102	98	89	66	34	12	11
Lambertia orbifolia	28 - 46	301	93.1	270	238	216	216

* BGPA Botanic Gardens and Parks Authority

In the case of the three Lambertia species there was high seed viability and germination was rapid, however, the number of seedlings dying in the nursery was also high. Various propagation mixes were trialed, the seedlings were treated regularly with fungicide and plants moved into different cultivation areas to alter the shading and watering regimes. These changes in propagation techniques were not undertaken as experiments, however death rates appeared to decline and consequently these techniques were used in the propagation of seedlings for the 1999 planting's.

Table 2. Germination data for seven species of critically endangered flora translocated in 1998.

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Grevillea calliantha	12 - 103	75	76.5	95	110	110	106
Lambertia echinata* subsp. *echinata	32 - 89	209	77.1	165	109	90	90
Lambertia echinata* subsp. *occidentalis	28 - 102	98	89	66	34	12	11
Lambertia orbifolia	28 - 46	301	93.1	270	238	216	216

* BGPA = Botanic Gardens and Parks Authority

Seed for the nine species (Table 3) were either collected from the wild populations in 1998, or withdrawn from long term storage in 1998. These were either germinated at the Department of Conservation and Land Management Threatened Flora Seed Centre (TFSC) in 1998 (98) or 1999 (99) under laboratory conditions or Kings Park and Botanic Gardens in 1999 (BGPA 99) where seed was sown directly into the soil (Table 3). These experimental treatments focused on assessing which was the best method of germination, so that these methods could be used for future translocations.

Table 3. Germination data for nine species of critically endangered flora targeted for translocation in 1999.

Species	Treatment	% germination	No. seedlings at BGPA 7/12/98	No. seedlings at BGPA 11/1/99	No. seedlings at BGPA 4/2/99	No. seedlings at BGPA 4/3/99
Acacia aprica	TFSC 98	83	171	171	171	170
Acacia cochlocarpa **subsp. *cochlocarpa***	TFSC 98	39	106	106	106	106
	TFSC 99	21	-	-	-	6
	BGPA *	45	112	{230	{237	{237
	BGPA **	40	101			
Cyphanthera odgersii **subsp. *occidentalis*[1]**	TFSC 99	52	-	20	18	1
	Cuttings	-	-	-	not yet taken root	not yet taken root
Daviesia bursarioides	TFSC 99	81	-	124	119	105
	BGPA 99	0.5	0	1	0	0
Dryandra ionthocarpa	TFSC 99	85	-	120	154	150
	BGPA 99	0	0	0	0	0
Grevillea calliantha	TFSC 99	94	0	106	109	112
	BGPA 99	4	0	1	5	5
Lambertia echinata **subsp. *echinata***	TFSC 98	76	-	-	13	13
	TFSC 99	82	-	-	0	94
Lambertia echinata **subsp. *occidentalis***	TFSC 99	96	-	56	53	40
	Cuttings	-	-	-	-	165
Lambertia orbifolia	TFSC	96	-	275	269	271
	Cuttings	-	-	89	87	87

[1] Due to the poor germination of seed and low survival of cutting material translocation of this species has been postponed until sufficient propagules are available.

1.2 Development of field establishment techniques for critically endangered flora

Several standard horticultural methods were tested to see whether these techniques might enhance establishment of the translocated seedlings (Table 4).

Table 4. A description if experimental treatments to be tested to establish planting protocols.

Treatment	Description of Experimental Treatments
Control	Plants not given any treatment.
Mulched	A layer of mulch is placed around the plant to see whether it enhances survival by increasing water retention. Two levels of mulch (light or heavy) may be used.
Watered	Plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether watering over the first summer enhances survival.
Watered and mulched	A layer of mulch is placed around the plant and in addition plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether it is a combination of both watering and mulching that enhances survival.
Shaded	A circle of wire netting, approximately 1m in diameter covered in shade cloth is placed around the plant after planting to see whether survival is enhanced by the creation of a shaded environment around the plant.
Gro-cone	A Gro-cone is placed around the plant after planting to see whether it enhances survival by creating a sheltered environment around the plant.
Caged	A circle of wire netting, approximately 1m in diameter is placed around the plant after planting to see whether survival is enhanced by the elimination of herbivo·
Uncaged	No wire is placed around the plant, to test whether herbivory significantly reduces survival or growth rates.
One Year Old Plants	Seedlings up to a year old are planted to see whether younger seedlings establish better than older seedlings
Two Year Old Plants	Seedlings up to two years old are planted to see whether older seedlings establish better than younger seedlings
Early Planting	Seedlings are planted early in winter to see whether this enhances survival
Late Planting	Seedlings are planted late in winter to see whether this enhances survival

Translocation proposals have been written in 1998 for seven species and submitted for review by CALM and external referees. These were approved by the CALM Director of Nature Conservation. These translocations commenced in winter 1998, and results of the experimental treatments are shown at Table 5. Translocation proposals for six of the seven species translocated in 1998 plus one new species, *Dryandra ionthocarpa*, were approved in 1999. These taxa were planted out in winter 1999 and results of the application of experimental treatments are shown at Table 6. Cuttings of *Lambertia echinata* subsp. *occidentalis* were considered too small to be planted in 1999, and so were held in the nursery for the following years planting. Propagation of the final species, *Grevillea maccutcheonii,* commenced in 1997, these are ready to be planted in winter 2000. Propagation difficulties have meant that the translocation of the final species (*Cyphanthera odgersii* subsp. *occidentalis*), scheduled for 1999, has been delayed. However, the translocation site has been selected and a translocation proposal written, so that if sufficient propagules can be raised the translocation can go ahead.

1.3 Development of monitoring techniques for critically endangered flora

Regular and reliable monitoring is a critical component of the translocation program. It allows for the assessment of translocation success in terms of the establishment of species, the suitability of the translocation sites, and whether the establishment techniques have assisted in enhancing survival and growth of the translocated plants. It is also important to monitor the natural populations in the same way as the translocated populations to determine whether the demographics of the translocated populations is similar to the natural population.

A monitoring program has been designed and a sample data sheet is attached at Appendix 10. Preliminary results from the monitoring program show that whilst establishment is patchy for some species (*Daviesia bursarioides*, *Lambertia echinata* subsp. *echinata*, *Lambertia echinata* subsp. *occidentalis*) all surviving individuals are growing (Tables 5-8). Some species are already flowering and fruiting (*Grevillea calliantha*, *Acacia cochlocarpa* subsp. *cochlocarpa*, *Acacia aprica*, *Lambertia orbifolia*) which also suggests that these species have successfully established. Unfortunately due to lack of funding for the third year of this project it was not possible to fully assess the value of the monitoring techniques or the success of the translocations.

Table 5. Monitoring data for seven taxa translocated in 1998. Mean height and width are shown for each establishment technique for November 1998 and November 1999.

Species	Experimental Treatment	Mean height (m) 1998	Mean width (m) 1998	Mean height (m) 1999	Mean width (m) 1999
Acacia aprica	Control	Did not germinate	-	-	-
	Mulched				
	Watered				
	Watered + mulched				
Acacia cochlocarpa **subsp.** *cochlocarpa*	Control	-	-	0.16	0.22
	Mulched			0.20	0.50
	Watered			0.30	0.37
	Watered + mulched			0.23	0.60
Daviesia bursarioides	Control	0.10	0.10	0.4	0.29
	Mulched	0.10	0.09	0.47	0.29
	Watered	0.12	0.08	0.44	0.27
	Watered + mulched	0.12	0.10	0.45	0.28
Grevillea calliantha	Control	0.23	0.42	0.30	0.47
	Mulched	0.23	0.50	0.29	0.51
	Watered	0.25	0.43	0.31	0.54
Lambertia echinata **subsp.** *echinata*	Control	0.32	0.14	0.42	0.36
	Shaded	0.34	0.17	0.49	0.32
	Watered	0.30	0.15	0.41	0.33
Lambertia echinata **subsp.** *occidentalis*	No treatments	0.19	0.15	-	-
Lambertia orbifolia	Control	0.54	0.24	1.05	0.46
	Light Mulch	0.59	0.27	1.08	0.45
	Thick Mulch	0.58	0.26	0.98	0.42
	Gro-cone	0.60	0.20	1.19	0.49

Table 6. Monitoring data for seven taxa translocated in 1999. Mean height and width are shown for each establishment technique for November 1999.

Species	Experimental Treatment	Mean height (m) 1999	Mean width (m) 1999
Acacia aprica	Control	0.91	-
	Mulched	0.87	
Acacia cochlocarpa **subsp.** *cochlocarpa*	1 year old plants	0.22	0.32
	2 year old plants	0.28	0.92
Daviesia bursarioides	Control	0.09	0.06
	Mulched	0.10	0.07
	Watered	0.13	0.07
	Watered + mulched	0.97	0.05
Dryandra ionthocarpa	Control	0.11	0.09
	Shaded	0.10	0.10
	Watered	0.11	0.09
Grevillea calliantha	Early Planting	0.25	0.26
	Late Planting	0.24	0.23
Lambertia echinata **subsp.** *echinata*	Control	0.11	0.07
	Shaded	0.14	0.07
	Watered	0.14	0.07
Lambertia orbifolia	Cuttings + Caged	0.84	0.35
	Cuttings + Uncaged	0.68	0.35
	Seedlings + Caged	0.38	0.26
	Seedlings + Uncaged	0.45	0.26

2.0 SCOPE ITEM 2.

ACTION: Determine factors critical for population establishment and long term survival.

Long term factors for survival cannot be determined at this stage, as translocation sites have only been established for up to 18 months and we estimate that at least three years will be required to provide any reasonable assessment of those factors. However,

preliminary observations can be made from the monitoring program (see Tables 5–8). Of those seedlings planted in 1998 there were a variety of responses to the establishment techniques. Interestingly watering *A. cochlocarpa* subsp. *cochlocarpa* seedlings had no positive effect on survival, although it did encourage plants to grow taller. Only when watering was combined with mulching was there a higher survival rate than the control plants. Mulching by itself had higher survival than all other treatments, and also encouraged plants to grow wider. In contrast watering of *D. bursarioides*, *G. calliantha* and *L. echinata* subsp. *echinata* resulted in a higher survival than all other treatments. There was very little difference in survival between treatments for *Lambertia orbifolia*. However, those seedlings which had gro-cones placed around them grew taller and wider than other seedlings, and seedlings with the thick layer of mulch around them were smaller on average than seedlings given other treatments. At this stage it appears that although establishment techniques have no major effect on survival of *Lambertia orbifolia* they do influence the rate of growth.

Of the seedlings planted in 1999 there is no clear trend for any treatment enhancing survival six months after planting (Table 8). The high number of dead *Daviesia bursarioides* seedlings can be attributed to the seedlings not being fenced (because it was believed that the prickly foliage would repel herbivores) and being heavily grazed (probably by Kangaroos). The high death rate was not associated with any treatment effect. Subsequently the remaining seedlings have been fenced to prevent any further loss of seedlings due to grazing. As watering had not commenced at the November monitoring it cannot be considered a factor in any differences between this treatment and other treatments.

Table 7. Percentage survival over one and a half years of translocated seedlings of seven species given different establishment treatments (translocations planted in 1998).

Species	Experimental Treatment	Number of seed or seedlings planted	% survival Nov 1998	% survival Mar 1999	% survival Nov 1999
Acacia aprica	Control	75	-	-	-
	Mulched	75	-	-	-
	Watered	75	-	-	-
	Watered + mulched	75	-	-	-
Acacia cochlocarpa **subsp. *cochlocarpa***	Control	75	16	13.3	13.3
	Mulched	75	36	30.6	26.6
	Watered	75	25.3	13.3	9.3
	Watered + mulched	75	25.3	21.3	21.3
Daviesia bursarioides	Control	48	91.6	18.8	14.6
	Mulched	48	95.8	14.6	14.6
	Watered	48	91.6	37.5	31.2
	Watered + mulched	48	95.8	41.7	35.4
Grevillea calliantha	Control	36	100	83.3	66.6
	Mulched	35	100	65.7	60
	Watered	35	100	88.6	80
Lambertia echinata **subsp. *echinata***	Control	30	100	66.6	26.7
	Shaded	30	90	40	23.3
	Watered	30	100	56.6	43.3
Lambertia echinata **subsp. *occidentalis***	No treatments	11	36.4	36.4	0
Lambertia orbifolia	Control	54	100	100	100
	Light Mulch	54	100	100	100
	Thick Mulch	54	98.1	94.4	94.4
	Gro-cone	54	100	98.1	98.1

Table 8. Percentage survival over six months of translocated seedlings of seven species given different establishment treatments (translocations planted in 1999).

Species	Experimental Treatment	Number of seed or seedlings planted	% survival Nov 1999
Acacia aprica	Control	90	100
	Mulched	90	99
Acacia cochlocarpa **subsp.** *cochlocarpa*	Control/ One Year Old	114	98
	Control/ Two Year Old	59	98
	Watered/ One Year Old	120	99
	Watered/ Two Year Old	51	100
Daviesia bursarioides	Control	36	50
	Mulched	36	30.5
	Watered	36	33.3
	Watered + mulched	36	16.6
Dryandra ionthocarpa	Control	46	93.3
	Shaded	46	89.4
	Watered	46	100
Grevillea calliantha	Early planting	58	98.3
	Late Planting	57	100
Lambertia echinata **subsp.** *echinata*	Control	33	33.3
	Shaded	33	23.3
	Watered	33	43.3
Lambertia orbifolia	Cutting/ caged	42	100
	Cutting/ not caged	40	100
	Seedling/ caged	125	97.6
	Seedling/ not caged	123	91

CONCLUSIONS

Preliminary observations from the monitoring program indicates that the eight translocations are showing mixed success. Some factors, such herbivory of the *Daviesia bursarioides* seedlings, can be addressed easily. However, other factors, such as the lack of

any seed germination of *Acacia aprica* in the first year and the propagation difficulties for *Lambertia echinata* subsp. *occidentalis* cannot be addressed easily and have resulted in these translocations taking several years. The propagation difficulties for *Cyphanthera odgersii* subsp. *occidentalis* and the difficulty in collecting sufficient seed of *Grevillea maccutcheonii* have resulted in the delay of these translocations, which were subsequently planned for year three of this project. Because funding was not available for the third year of this project the translocations of these two species, *Cyphanthera odgersii* subsp. *occidentalis* and *Grevillea maccutcheonii,* could not proceed. Similarly a follow-up translocation of *Lambertia echinata* subsp. *occidentalis,* considered critical to the translocation program for this species, was not possible. Of the seven translocations that were completed it is critical that ongoing monitoring be maintained to enable accurate assessment of their success.

WORK SCHEDULES

(As of January 2000)

Listed below are the work schedules for the species translocated in 1998 and 1999.

Acacia aprica

Proposed work schedule	Action	Date Completed
November 1997	Seeds put down for germination.	13 Nov 1997
February 1998	Translocation site selection	1 Apr 1998
April 1998	Translocation proposal submitted for review.	20 May 1998
June 1998	Translocation proposal approved.	23 Jul 1998
June - July 1998	Translocation of seeds into the Carnamah Shire Recreation Reserve.	19 Aug 1998
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 19 Aug 1998 and continuing
November 1998	Setting up of irrigation system.	See 1.2 point 8.
April 1999	Final report.	Apr 1999
July – August 1999	Further translocation of seedlings into the Carnamah Shire Recreation Reserve.	4 Aug 1999
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 19 Aug 1998 and continuing
January 2000	Final report.	January 2000

Acacia cochlocarpa **subsp.** ***cochlocarpa*****.**

Proposed work schedule	Action	Date completed
November 1997	Seeds put down for germination.	7 Nov 1997
February 1998	Translocation site selection.	23 Feb 1998
April 1998	Translocation proposal submitted for review.	20 May 1998
June 1998	Translocation proposal approved.	23 Jul 1998
June - July 1998	Translocation of seeds into the Gunyidi Nature Reserve.	11 Aug 1998
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 11 Aug 1998 and continuing
November 1998	Setting up of irrigation system.	11 Dec 1998
April 1999	Final report.	Apr 1999
July – August 1999	Further translocation of seedlings into the Gunyidi Nature Reserve.	27 Jul 1999
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 11 Aug 1998 and continuing
January 2000	Final report.	January 2000

Daviesia bursarioides

Proposed work schedule	Action	Date completed
October 1997	Seeds put down for germination.	7 Nov 1997
March 1998	Translocation site selection.	24 Feb 1998
April 1998	Translocation proposal submitted for review.	20 May 1998
June 1998	Translocation proposal approved.	9 Sept 1998
May - June 1998	Translocation of seedlings into the Sweetman Nature Reserve, where population 6 occurs.	9 Sept 1998
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 9 Sept 1998 and continuing
April 1999	Final report.	Apr 1999
July – August 1999	Further translocation of seedlings into the Sweetman Nature Reserve.	2 Aug 1999
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 9 Sept 1998 an continuing
January 2000	Final report.	January 2000

Dryandra ionthocarpa

Proposed work schedule	Action	Date completed
November 1998	Seeds put down for germination.	Nov 1998 + Apr 2000
November 1998	Translocation site selection.	Nov 1998
April 1999	Translocation proposal submitted for review.	Apr 1999
July 1998	Translocation proposal approved.	Jul 1999
June - July 1999	Translocation of seedlings into the Kalgan Plains Nature Reserve.	15 Jul 1999
August 1999 - May 2000	Monitoring and maintenance of translocation site.	Commenced 15 Jul 1999 and continuing
January 2000	Final report.	Jan 2000

Grevillea calliantha

Proposed work schedule	Action	Date completed
November 1997	Seeds put down for germination.	5 Nov 1997
February 1998	Translocation site selection	24 Feb 1998
April 1998	Translocation proposal submitted for review.	14 Apr 1998
June 1998	Translocation proposal approved.	23 Jul 1998
May - June 1998	Translocation of seedlings into the C Class Water Reserve.	28 Jul 1998
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 28 July 1998 and continuing
November 1998	Setting up of irrigation system.	Watering by hand commenced 25 Nov 1998
April 1999	Final report.	Apr 1999
July – August 1999	Further translocation of seedlings into the C Class Water Reserve.	11 June 1999 30 July 1999
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 28 July 1998 and continuing
January 2000	Final report.	January 2000

Lambertia echinata **subsp.** ***echinata***

Proposed work schedule	Action	Date completed
October 1997	Seeds put down for germination.	31 Oct 97
March 1998	Translocation site selection.	18 Mar 98
April 1998	Translocation proposal submitted for review.	20 May 98
June 1998	Translocation proposal approved.	21 Aug 98
May - June 1998	Translocation of seedlings into the gravel pit where population 1a occurs.	23 Sept 98
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 23 Sept 98 and continuing
April 1999	Final report.	Apr 99
July – August 1999	Further translocation of seedlings into the gravel pit where population 1a occurs.	23 June 1999
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 23 Sept 1998 and continuing
January 2000	Final report.	January 2000

Lambertia echinata **subsp.** ***occidentalis***

Proposed work schedule	Action	Date completed
October 1997	Seeds put down for germination.	31 Oct 97
February 1998	Translocation site selection.	11 Mar 98
April 1998	Translocation proposal submitted for review.	14 Apr 98
June 1998	Translocation proposal approved.	23 Jul 98
May - June 1998	Translocation of seedlings into the Smith Road site.	23 Jul 98
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 23 Jul 98 and continuing
April 1999	Final report.	Apr 1999

Lambertia orbifolia

Proposed work schedule	Action	Date completed
October 1997	Germination of seed started.	31 Oct 97
March 1998	Translocation site selection.	10 Mar 98
April 1998	Translocation proposal submitted for review.	14 Apr 98
June 1998	Translocation proposal approved.	21 Aug 98
June - July 1998	Translocation of seedlings into the Chorkerup Nature Reserve.	26 Aug 98
September 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 26 Aug and continuing
April 1999	Final report.	Apr 99
July – August 1999	Further translocation of seedlings into the Chorkerup Nature Reserve	3 June 1999
August 1998 - May 1999	Monitoring and maintenance of translocation site.	Commenced 26 Aug 1998 and continuing
January 2000	Final report.	January 2000

APPENDIX 1

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

POLICY STATEMENT NO. 29

TRANSLOCATION OF THREATENED FLORA AND FAUNA

Revised July 1995

This Policy should be read in conjunction with Policy Statements 9 (Conservation of threatened flora in the wild), 33 (Conservation of endangered and specially protected fauna in the wild), 44 (Wildlife Management Programs) and 50 (Setting priorities for the conservation of Western Australia's threatened flora and fauna). This Policy applies to all translocations of threatened taxa undertaken by any person anywhere in Western Australia and to translocations of threatened Western Australian flora and fauna to places outside the State.

1. OPERATIONAL OBJECTIVE

To conserve threatened animals and plants in the wild by carrying OUT translocations if such measures are warranted.

2. DEFINITIONS

In This Policy:

"Fauna Reconstruction Site" means an area where The Department Of Conservation and Land Management (CALM) is proposing to reconstruct, or is reconstructing, the vertebrate fauna as far as is possible through predator control, habitat management and translocations,

"Interim Wildlife Management Guidelines (IWMGs)" means guidelines approved by the Director of Nature Conservation for The management and protection of threatened or harvested taxa where no full Wildlife Management Program has been prepared.

"Introduction" means releasing or establishing an organism outside its historically known native range.

"Re-introduction" means the movement of an organism into part of its native range from which it has disappeared or become extirpated in historic times as a result of human activities or natural catastrophe.

"Re-stocking" means the movement of numbers of plants or animals with the intention of building up the number of individuals of that species in an original habitat or of introducing greater genetic diversity.

"Species Recovery Site" means an area where management priority is given to the recovery and conservation of one or more nominated threatened species.

'Successful translocation" means, as far as this Policy is concerned, one that provides a self-perpetuating population with at least 90% of the genetic diversity of the source population, without expensive, non-routine management.

"Taxon" (plural taxa) is a term for any classificatory group of organisms such as families, genera, species subspecies or varieties, whether formally described or not.

"Threatened taxon" means any animal taxon declared under Section 14(2)(ba) or any plant taxon declared under Section 23F(21 of the *Wildlife Conservation Act* as 'likely to become extinct or is rare".

"Translocation' means the movement of living organisms from one area with free release in another. Translocation includes introductions, re-introductions and restocking.

'Translocation Proposal' means a written statement of intent to carry out a translocation in Western Australia covering all matters provided in Appendix 2.

'Western Australian Wildlife Management Program" means a publication produced by CALM providing detailed information and guidance for the management and protection of threatened or harvested species or groups of those species. Programs for threatened taxa are usually referred to as "Recovery Plans".

3. BACKGROUND

The Department of Conservation and Land Management (CALM) has the statutory responsibility for the conservation and protection of flora and fauna in Western Australia. An essential part of this responsibility is to prevent the extinction of any species.[1] of native flora or fauna.

Many Australian animals, particularly mammals, have suffered enormous range reductions over the past century, and some remain only as small, remnant populations sometimes only on islands. Many plants have suffered enormous contractions in range, mostly because of clearing for agriculture and urban development, and some are now reduced to a few individuals in unprotected habitat. Even within protected areas (national parks, conservation parks, nature reserves, and other conservation reserves), some animals are threatened by introduced predators and many plants are threatened by dieback disease caused by *Phytophthora* species. With techniques now being available for the control of the European Red Fox, feral cats, rabbits and Other exotic animals, reconstruction of the original fauna is becoming possible in some areas, Reconstruction of the original flora of areas affected by *Phytophthora* dieback is not yet possible.

Translocation to protected, managed and, in the case of dieback-susceptible species, dieback-free areas, is an effective and popular method of research into and conservation of threatened species of both plants and animals. In Western Australia, translocations have already been carried out, or are being contemplated, for mammals, birds, reptiles, frogs and plants. For some species, translocations are likely to be the best or the only way of preventing extinction. In much of the State, translocation is the only method for reconstructing the former fauna of an area. Translocation can also be used for preserving genetic diversity within species and at infra-specific levels.

In general, translocations for conservation purposes should not be attempted unless The causes of the original extinction have been removed or ameliorated or unless The causes are not present at the site chosen for translocation. As well, any other threats posed to the translocated species by, for example, feral animals and plant diseases, need to be controlled. Experimental translocations may be necessary to establish the cause of a local extinction if this can not be established in any other way. No translocations, including experimental ones, should take place unless the fate of the animals or plants is monitored adequately.

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[1] 1 In this Policy Statement, unless otherwise indicated, species is used in its wide context and includes intra-specific taxa

Planning for translocation and other actions to conserve threatened species will be aided by the adoption of consistent terminology for areas where threatened species are being managed. This policy adopts such terminology for threatened species Coordination and planning in relation to Fauna Reconstruction Sites will be particularly important. For example, it could be unwise to add too many species to an area in a short period of time, since the species may interact or compete for food or shelter, and it may be difficult to determine reasons for one species not establishing while another did. Adding a predator, such as the chuditch, to a reconstruction site before possible prey species, e.g., the numbat, is well established, could also be unwise.

When considering the translocation of critical weight range mammals (adult body weight 35 g to *ca* 8 kg [2]) and some ground nesting birds, where the major reason for local extinction's has been introduced predators, control of the introduced predators) will be a prerequisite for translocation. Total removal of introduced predators is not, in most cases, possible. Scientific research in the south-west of Western Australia has shown that significantly decreasing the density of foxes is sufficient for remnant populations of mammals to increase rapidly in numbers and for translocations of animals such as numbats and woylies to be successful. In arid parts of the State, the control of feral cats has been more difficult than the control of foxes or dingoes; however recent research by CALM has resulted in the development of a new method of controlling cats. At present the levels of cat reduction necessary for the successful translocation of various threatened species in arid areas are unknown and will have to be established.

Introduced herbivores, such as the rabbit and goats, can have a significant effect on native plants and on the habitat of threatened animals. These and other possible causes of the local extinction of a species need to be addressed when considering translocations.

In general, it is desirable that plants and animals for translocation come from wild stocks. In some instances, however, especially where the wild population has been reduced to a few individuals, the prevention of extinction may require the captive breeding or cultivation of Threatened species followed by re-introduction or introduction. This type of management is likely to involve collaborative programs between CALM and Kings Park and Botanic Garden, Perth Zoo, other institutions, private wildlife parks and nurseries or private individuals.

Kings Park has both the expertise and facilities for the propagation of threatened plant material (including tissue culture techniques). In conjunction with CALM nurseries, sufficient numbers of plants could be cultivated for most translocation programs. Kings Park has also established a threatened plant garden and hopes to be able to display much of the State's Declared Threatened Flora.

Although they have excellent propagating facilities and have a seed collection of their own, Kings Park will often rely on CALM for much of the material (seed, cuttings, tissue culture material) necessary for the cultivation of a species prior to its translocation in the wild. Most seed material will be available from CALM's Threatened Flora Seed Centre; for some species seed and cutting material will also be available at Kings Park or from horticulturists. The CALM Threatened Flora Seed Centre has a program for the systematic collection and long term storage of adequate genetic resources of rare or

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[2] 2 modified from Burbidge, A.A. and McKenzie, N.L. (1989). Patterns in the modern decline Of Western Australia's vertebrate fauna. causes and conservation implications, *Biological Conservation 50,* 143-198.

threatened species particularly those susceptible to *Phytophthora*. Material from a number of species is now available for propagation and translocation projects if required.

Other botanic gardens and privately-owned nurseries often have excellent facilities for the propagation of threatened plants. Where appropriate, agreements with such organisations may promote the conservation of threatened plant taxa.

Perth Zoo has been involved in captive breeding projects for threatened species (both Australian and non-Australian) for many years. Perth Zoo has a strong commitment to conservation through the Australasian Species Management Program, which coordinates zoo captive breeding projects.

Some other zoos and wildlife parks have suitable captive breeding facilities for Western Australian threatened species. Where appropriate, agreements with such organisations and private individuals may promote the conservation of threatened animal taxa.

Re-introductions from one mainland site to another a relatively short distance away should present few difficulties, providing The habitat is suitable and the cause of the original local extinction has bee removed or can be sufficiently reduced to allow the species to re-establish. Re-introductions over long distances may be more difficult because of possible genetic and physiological differences between subpopulations. If there is a choice among populations, the source population should be the one that has the closest ecological characteristics (e.g., morphology, physiology, behaviour, phenology, habitat preferences) to the original sub-population.

Re-introductions from an island to the mainland need careful consideration because of possible differences between mainland and island populations, which have usually been separated for many thousands of years. Unless there are over-riding reasons (e.g., significant differences in physiology and habitat of remaining mainland sub-populations and the original sub-population), translocations from islands to the mainland should not be considered unless the species is extinct on the mainland.

INTRODUCTIONS

Because of the possible negative impact Of introductions on the balance of natural systems, introductions should be considered only where there are exceptionally strong conservation reasons fc so doing and where it has been demonstrated that the impact of the introduced species is unlikely to be significant. As a general principle, introductions will not be approved if opportunities for re-introductions exist.

Introductions to mainland sites will be necessary to conserve species whose habitat has been largely destroyed. For example, some threatened plants which have become threatened because of extensive clearing in the Whealbelt now occur only on road verges or in small remnants of native vegetation on private property. To conserve such species in the wild it may be necessary to introduce them to conservation reserves, even though they do not occur naturally there. Proposals to introduce species must always include a thorough assessment of potential impact, including an evaluation of competition or predator/prey interactions between other threatened species and the species under consideration.

Introductions to islands need very careful consideration. Islands are frequently of very high intrinsic value for nature conservation as intact or near-intact ecosystems and because of endemism in their biota.

Australian offshore islands are crucial for vertebrate conservation. Nine species of mammals that formerly occurred on the mainland now occur only on islands, five of them occurring only in Western Australia. Moreover, there are many mammal, bird and reptile taxa that are endemic to islands. Data on plants on Western Australian islands have not been collated, but few species are thought to be restricted to islands, one example being *Leucopogon interruptus,* which occurs only on islands in the Archipelago of the Recherche.

Island faunas and floras are particularly vulnerable to introductions of alien species. Possible impacts on the fauna (including invertebrates) and flora of islands must, therefore, be considered. In the past, some mammal introductions have had a major detrimental impact on vegetation (eg, the Tammar Wallaby *Macropus eugenii* to Granite Island, South Australia) and it is possible that translocations could affect other fauna (eg, introducing a predator to an island with important seabird or lizard populations, or an important turtle rookery).

There have been numerous translocations of indigenous animals to islands. Australia wide, at least 29 mammal species have been translocated to at least 52 islands; very few of these have been well planned or documented. Many were not appropriate and some have failed. In Western Australia, CALM records show that only five approved indigenous animal translocations to islands have occurred: Rothschild's Rock-wallaby from Enderby Island to West Lewis Island; Banded Hare-wallaby from Dorre Island to Dirk Hartog Island (this translocation was unsuccessful); Greater Stick-nest Rat from a captive-bred colony sourced from Franklin Island, South Australia, to Salutation Island; Shark Say Mouse from Bernier Island to Doole Island; and Noisy Scrub-bird from Two Peoples Bay to Bald Island. Unapproved translocations have included Western Grey Kangaroos from the mainland to Woody Island and Tammar Wallabies from one of the Wallabi Islands to North Island, Houtman Abrolhos. Many weeds have become established through unplanned introductions.

Introductions of threatened species to islands can provide important security for that species against imminent extinction when control of the threatening process on the mainland is not possible or very costly. However, there are relatively few islands suitable for species' translocations and often the establishment of a species on an island will close options for future translocations of other, perhaps more threatened species (e.g., when the second species has similar niche requirements). Therefore, it is very important that introductions to islands are well thought through and are only conducted after a full assessment, including an evaluation of other possible translocations of perhaps more threatened species. Proposals to introduce species to islands must therefore include a thorough assessment of potential impact on the island ecosystem in question, and must include an evaluation of other threatened species that might compete with the species under consideration, and for which the island has suitable habitat.

RESTOCKING

Restocking may be necessary where populations of threatened species have limited genetic diversity (either naturally or following a translocation) or where augmentation of numbers is necessary for the population to be able to recover quickly.

Restocking proposals should present few difficulties where interbreeding of the original and translocated individuals can take place without manipulation. In some cases, however, manipulation may be necessary. For example, some mammals that defend territories may not allow a newly translocated

animal to enter an existing population and successful restocking may not be possible unless some animals are removed from the established population.

4. POLICY

The Department will:

4.1 Designate areas as Fauna Reconstruction Sites and Species Recovery Sites, and publish a list of such sites annually.

4.2 Ensure that all translocations in Western Australia and from Western Australia to outside the State, except as provided herein, follow the principles laid down by IUCN (1987)[3] (see Appendix 1 for a summary),

4.3 During the preparation of Recovery Plans or Interim Wildlife Management Guidelines, identify those threatened plant and animal species in need of translocation in the wild and decide whethe the Translocation will be from wild populations or from captive-bred or cultivated populations.

4.4 Ensure That translocations of threatened species within Western Australia or from Western Australia to elsewhere are conducted only under approved Wildlife Management Programs or Interim Wildlife Management Guidelines, or, in exceptional circumstances or emergency situations, for example salvage of plants or animals under immediate threat of destruction, by approval of the Director of Nature Conservation: this will be a holding action only and will be reviewed by the development of Interim Wildlife Management Guidelines or a Recovery Plan. Ensure that all translocations of threatened animals are approved by a properly constituted Animal Experimentation and Ethics Commit-tee.

4.5 Except as provided in 4.4, ensure that The Director of Nature Conservation approves translocations only after review of a written Translocation Proposal.

4.6 Undertake and foster research into the ecology, population biology, genetics, captive-breeding or cultivation of threatened flora and fauna, and translocation and subsequent management c" threatened flora and fauna in the wild.

4.7 Collaborate and liaise with other organisations to coordinate research into conservation genetics of threatened species, especially as it relates to maintaining genetic variability in captive-bred or propagated populations of threatened species and conserving genetic resources in translocated populations of threatened plants and animals.

5. STRATEGIES

To accomplish the above objective and policies CALM will:

5.1 Designate areas as Fauna Reconstruction Sites and Species Recovery Sites as required for the conservation of threatened species or for educational purposes. Such designation will require the

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[3] IUCN (1987). The IUCN position statement on translocation of living organisms. Introductions re-introductions and re-stocking IUCN, Gland, Switzerland. See Appendix 2.

approval of The Corporate Executive and the National Parks and Nature Conservation Authority, and if on land controlled by another body or private person, the approval of that body or person. Publish the list annually.

5.2 Administer the Wildlife Conservation Act and Regulations, in so far as translocations are concerned, according to this Policy Statement.

5.3 Except in the case of emergency salvage operations, decide whether to approve proposed translocations only after review of a written "Translocation Proposal" (TP, see Appendix 2) prepared by the proponent which will cover all relevant matters. TPs will be referred to at least two experienced scientists for refereeing. Public advertisement of the-TP and a period of public review will be considered by the Director of Nature Conservation if the project has probability of significant environmental or social impact. The TP will aim to fulfil a strategy defined in a Wildlife Management Program or Interim Guideline and will present specific proposals for translocation in detail.

5.4 Provide guidance and assistance to persons wishing to develop TPs, especially in the development of Interim Wildlife Management Guidelines or Recovery Plans.

5.5 Except in the case of emergency salvage operations, approve Translocations only where the TP has demonstrated that there will be no detrimental effect on the viability of the source population.

5.6 Approve the introduction of species to habitats or locations from which they have not been recorded in historical times only where available distributional data (including sub-fossil records) or bioclimatic modelling suggest that the species probably occurred in the area or where:

(a) opportunities for re-introductions do not exist; and
(b) the TP has demonstrated that the impact of the introduced species is unlikely to be significant; and
(c) the TIP demonstrates that the translocation has a high probability of success or that translocation is The only method available to establish the reasons for a species' local extinction or
(d) there are exceptionally strong conservation reasons for so doing.

5.7 Approve introductions to islands only if the TP has demonstrated, in addition to the requirements of strategy 5.6, that the proposed translocation is more important than. or will have no effect on, possible translocations of other threatened taxa to that island.

5.8 Approve translocations from islands to the mainland only if the TP has provided strong evidence that the taxon, or one with which it might hybridise, does not now exist on the mainland, or provided there are over-riding conservation reasons for the introduction of an island population.

5.9 Where there is more than one possible source for the plants or animals to be translocated, approve translocations only if the TP has provided strong reasons why the particular population

was chosen above others. Where there is more than one potential translocation site, the TP must evaluate the alternatives and provide reasons for choosing the recommended site.

5.10 Undertake research into the ecology, population biology, genetics, captive breeding and cultivation, maintenance of habitat quality, habitat restoration and re-establishment and subsequent management of threatened flora and fauna in the wild.

5.11 Collect from wild plant populations, under programs approved by the Director of Nature Conservation, seed and other propagating materials from threatened taxa for storage in the Threatened Flora Seed Centre arid use by Kings Park and Botanic Garden, other relevant institutions and individuals in cultivation programs.

5.12 Foster research and collaborate with Kings Park and Botanic Garden and other organisations and individuals on the propagation and cultivation of threatened flora.

5.13 Foster research and collaborate with the Perth Zoo and other approved organisations and individuals on captive breeding of threatened native fauna.

5.14 Maintain in the Department's Threatened Flora Seed Centre suitable stocks of properly documented collections of seed from threatened plant species and ensure that replicates (when available) are exchanged with Kings Park and Botanic Garden, and other relevant collections (subject To proper controls on commercial and other uses).

5.15 Where appropriate and necessary, foster the distribution of captive-bred threatened fauna and the proper maintenance of captive populations (including the use of stud books to maximise genetic diversity) in zoos and other institutions throughout Australia and overseas.

5.16 Undertake training 'in the management practices necessary for the re- establishment and monitoring of populations of threatened species.

5.17 Monitor numbers of both the translocated population and the source population.

5.18 Establish and maintain seed orchards of selected threatened species under approved Wildlife Management Programs or Interim Wildlife Management Guidelines.

5.19 Propagate and build up cultivated stocks of threatened flora in Departmental nurseries, in collaboration with Kings Park and Botanic Garden and other organisations, for translocation to the wild under approved Wildlife Management Programs or Interim Wildlife Management Guidelines.

5.20 Publicise efforts to avert extinction of threatened flora and fauna using translocation techniques, encourage community involvement and seek sponsorship and donations for conservation of these threatened species.

Syd Shea
EXECUTIVE DIRECTOR

10 July 1995

Distribution:

Lists A, B, D, E & L

APPENDIX 1

Summary of IUCN (1987) Position Statement on Translocation of Living Organisms.

Definitions of translocation, introduction, re-introduction and restocking are the same as in this Policy Statement.

PART I INTRODUCTIONS

Background. The Position Statement reviews the background of introductions of exotic species for reasons such as economic development. It states that the damage done by harmful introductions to natural systems far outweighs the benefit derived from them and that this has been a world-wide problem. It points out that islands are especially vulnerable to introductions.

Intentional introductions. Two principles are given:

1. Introduction of an alien species should only be considered if clear and well defined benefits to man or natural communities can be foreseen

2. Introduction of an alien species should only be considered if no native species is considered suitable for the purpose for which the introduction is being made.

Much of this section concerns introductions into modified habitats for economic reasons. In the section dealing with introductions to natural habitats the Position Statement states "No alien species should be deliberately introduced into any natural habitat, island, lake, sea, ocean or centre of endemism whether within or beyond the limits of national jurisdiction. A natural habitat is defined as a habitat not perceptibly altered by man."

Planning a beneficial introduction. The Position Statement states that essential features of investigation and planning consist of:

- ·an assessment phase culminating in a decision on the desirability of the introduction;
- an experimental, controlled trial;
- the extensive introduction phase with monitoring and follow-up.

These phases are described in detail.

Accidental introductions. The Position Statement discusses ways of minimising accidental introductions.

Where alien species are already present. The Position Statement encourages the removal or eradication of alien species of no apparent benefit to humans, It states that special efforts should be made to eradicate introductions on islands, in areas which are centres of endemism, in areas of high

species diversity or ecological diversity and in areas where a threatened endemic is jeopardised by the presence of the alien.

Biological control. The Position Statement states that biological control has shown itself to be an effective way of controlling introduced plants and more rarely, animals. As 'biological control involves introductions of alien species, the same care and procedures should be used as with other intentional introductions.

Micro-organisms. The Position Statement encourages the same care and procedures be used for the introduction of micro-organisms as with other introductions.

PART II THE RE-INTRODUCTION OF SPECIES.

Re-introductions are particularly useful for restoring a species to an original habitat where it has become extinct due to human persecution, over-collecting, over-harvesting .6e habitat deterioration, but where these factors can now be controlled. Re-introductions should only take place where the original causes of extinction have been removed. Re-introductions should only take place where the natural habitat requirements of -the species are satisfied.

The basic program for re-introduction should consist of'

. a feasibility study;

. a preparation phase;

release or introduction phase;

follow-up phase.

Details of each of these phases are provided.

PART III RESTOCKING.

The Position Statement discusses where restocking may be useful. It states that attention should be paid to the genetic constitution of stocks used for restocking-

PART IV NATIONAL INTERNATIONAL AND SCIENTIFIC IMPLICATIONS OF TRANSLOCATIONS

The Position Statement recommends that there be permit systems for introductions and prohibitions on the introductions of potentially harmful organisms. There should be appropriate penalties for illegal introductions and a person responsible for an illegal introduction should bear the costs of eradication and habitat restoration.

It discusses the scientific work needed for better management of translocations.

APPENDIX 2

Matters to be covered by a Translocation Proposal (TP).

Before preparing a Translocation Proposal, the proponent should be conversant with this Policy. The TP must provide sufficient information about the species and the proposed translocation for an informed decision to be made whether to approve or reject the proposal. It should review relevant knowledge about the species' biology and ecology, its past and present distribution and conservation status, and the urgency of conservation action. Information presented should be supported by references or data. Opinions expressed about aspects of the species' conservation biology, should be clearly identified as such. The TP should be forwarded to the Director, Western Australian Threatened Species and Communities Unit, Department of Conservation and Land Management, PO Box 51, Wanneroo, WA 6065, at least three months before the planned date of the translocation.

The Translocation Proposal must take account of all provisions of this Policy Statement and should be prepared according to the following headings and contain the following information.

1. **Summary** (maximum of one page).

2. **Name and affiliation of proponent.**

3. **Background.** To contain information on the species' former and present distribution, its conservation status, its biology and ecology.

4. **The Translocation.** To discuss why the translocation is being proposed and provide a detailed description of the proposal, including post-release monitoring.

   (a) Provide details of the status of the land at the translocation site and, for lands other than those managed by CALM, provide evidence of the agreement of the controlling body or owner.

   (b) Where there is more than one possible source for the organisms to be translocated, TPs will provide reasons why a particular population was chosen above others. Where there is more than one potential target site, the TP must evaluate the alternatives and provide reasons for choosing the recommended site.

   (c) TPs proposing introductions must demonstrate that opportunities for re- introductions of the species do not exist, that the impact of the introduced species on the natural environment is unlikely to be significant, that there are exceptionally strong conservation reasons for the introduction, and/or that available distributional data (including sub-fossil records) or bioclimatic modelling suggest that the species probably occurred in the area. TPs proposing introductions to islands must also demonstrate that the proposed introduction is more important than, or will have no effect on, possible translocations of other threatened taxa to that island.

(d) TPs for translocations from islands to the mainland must provide strong evidence that the taxon, or one with which it might hybridise, does not now exist on the mainland, or provide over-riding conservation reasons for the introduction of an island population.

(e) TPs will consider t e principles of conservation genetics when proposing translocations. In particular, TPs will discuss the number of individuals to be translocated in relation to maintaining genetic variability. TPs will state whether it is proposed to mix individuals from more than one population and, if so, provide evidence that this will benefit conservation of biodiversity.

(f) When re-introductions are being proposed, TPs will review the causes, of the original local extinction of the taxon at the target site and provide evidence that the cause(s) has been removed or ameliorated.

(g) TPs covering threatened species that are considered to have became locally extinct because of introduced animals such as the fox or feral cat must discuss the extent To which introduced predators will be controlled and the extent to which such control will be effective in allowing the establishment of a population of the threatened species. TPs covering species that have become locally extinct due TO grazing by introduced herbivores must discuss the extent to which this threatening process will be controlled.

(h) Details of post-release monitoring must include a commitment to monitor the resulting population in the medium to long term, including a commitment to closely monitor the fate of a proportion of the translocated organisms in the short term where experience with translocating the taxon is limited or where the translocation is to an environment into which the taxon has not been translocated previously.

5. **Funding.** To identify the source of funds for the translocation and demonstrate that long term management resources for the translocated population are available and committed.

6. **Animal Experimentation Ethics Committee approval.** For threatened animals, provide evidence that the proposal has been submitted to and approved by an Animal Experimental Ethics Committee operating according to the "Code of practice for the care and use of animals in research in Australia' (National Health and Medical Research Council and Commonwealth Scientific and Industrial Research Organisation).

7. **Endorsement by proponent's organisation**

8. **References.**

9. **Attachments.** To include the IWMG or Recovery Plan, Science Project Plan or equivalent, copies of supporting documents, funding approvals, etc.

APPENDIX 2

TRANSLOCATION PROPOSAL
Blunt Wattle, *Acacia aprica* ms (Mimosaceae)

1. SUMMARY

Acacia aprica ms is a spreading, open multi-stemmed shrub to 2 m tall. The branches are slightly flexuose (zig zagging). The phyllodes are terete, sessile with a sharp point at the end. They are a dull medium-green, between 6 and 14 cm long and 1-1.4 mm wide, with 8 closely parallel nerves. The inflorescences are golden, globular to oblong and occur from June to August (Chapman and Maslin, in prep). The seed pods are linear and seed viability ranges from 43 - 84% (A. Cochrane pers. comm).

The first known collection of *A. aprica* ms, was made in 1957 by JW Green "15 miles south of Carnamah". Despite extensive further surveys in this area only five populations of this species have been discovered. At this stage the species has not been formally named, however it has been assigned the manuscript name of *aprica*.

A. aprica ms is endemic to the Coorow area of Western Australia having a range of around 45 km. It is known from five populations, with 120 individuals. It is found in gravelly brown sand or loam within a heath vegetation type. Due to the small population sizes, restricted distribution and threats associated with growing in narrow road verges that are exposed to weed invasion, accidental damage from road maintenance activities and chemical drift from adjacent farms, *A. aprica* ms was declared as Rare Flora in November 1997, and ranked as Critically Endangered at the same time. An Interim Recovery Plan is being written for this species (Stack and Brown in prep).

The aim of this translocation proposal is to conserve the wild genetic stock of the species by establishing another viable population of *A. aprica* ms. This will be achieved by translocating (introducing) this species to a secure reserve. This translocation proposal outlines the need for translocation of the critically endangered *A. aprica* ms, the site selection process, the design of the translocation site and the provisions for monitoring. In addition it outlines the criteria for success or failure of this proposed translocation.

2. PROPONENTS

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3. BACKGROUND

3.1 History, Taxonomy and Status

Acacia is a large Australia genus belonging to the family Mimosaceae. Commonly known as wattles, the genus is comprised of some 700 named species.

Acacia aprica ms is a spreading, open multi-stemmed shrub to 2 m tall. The branches are slightly flexuose (zig zagging). The phyllodes are terete or sometimes quadrangular, sessile with a sharp point at the end. They are a dull medium-green, between 6 and 14 cm long and 1-1.4 mm wide, with 8 nerves, which are parallel and more or less equally wide. The inflorescences are golden, globular to oblong, hang 2 per axil and occur from June to August. The seed pods are linear, up to 60 mm long and around 2 mm wide (Chapman and Maslin, in prep). Seed viability ranges from 43 - 84% (A. Cochrane pers. comm).

The first known collection of *A. aprica* ms, was made in 1957 by JW Green "15 miles south of Carnamah". Despite extensive further surveys in this area by botanist Charles Chapman, *Acacia* expert Bruce Maslin and consultant Diana Papenfus only five populations of this species have been discovered. At this stage the species has not been formally named, however it has been assigned the manuscript name of *aprica*, meaning sun-loving or open to the sun.

Due to the small population sizes, restricted distribution and threats associated with growing in narrow road verges that are exposed to weed invasion, accidental damage from road maintenance activities and chemical drift from adjacent farms, *Acacia aprica* ms was simultaneously declared as Rare Flora, and ranked as Critically Endangered in November 1997. An Interim Recovery Plan is in the process of being written for this species (Stack and Brown, in prep).

3.2 Distribution and Habitat

A. aprica ms is endemic to the Coorow area of Western Australia having a known range of around 45 km. It is known from five populations, with 120 individuals. It is found in gravelly brown sand or loam within a heath vegetation type. Associated species include *Acacia acuminata, Allocasuarina campestris, Grevillea paniculata, Hakea scoperia* and *Melaleuca fulgens.*

4. THE TRANSLOCATION

4.1 The Need to Translocate

A. aprica ms is known from just five populations with only 120 individuals (see table 1). Four of these populations consist of seven plants or fewer. All five of the populations occur within a range of approximately 45 km on narrow road reserves vested with the Shire of Coorow or Main Roads, WA.

Population no.	Number of individuals	Land tenure
1	107	MRD road verge
2	2	MRD road verge
3	7	Shire road verge
4	1	Shire road verge
5	3	Shire road verge

Road maintenance activities could have an impact on the populations of *A. aprica* ms. On April 1st 1998 it was noted that activities associated with fenceline maintenance had caused damage to the largest population, narrowly missing at least one plant. Weed invasion is evident in all populations, and chemical drift from fertilisers and pesticides from adjacent farms are considered to be a problem. Translocation of this critically endangered species is considered to be of high priority due to the tenuous nature of these road verges. The draft Interim Recovery Plan for *A. aprica* ms also recommends the translocation of this species to a secure site (Stack and Brown, in prep).

4.2 Translocation Site Selection

A search was made of areas around the known populations at Coorow on 23rd February 1998 to locate a suitable translocation site. An area on the southern boundary of the Carnamah Shire Recreation Reserve (#19728) was chosen as the translocation site. Permission was sought and granted from the Shire of Carnamah to locate the translocation site on the reserve (see Appendix three). Endorsement was also received from the CALM Midwest Region (Appendix five). Despite the reserve being vested in the Shire of Carnamah as a Recreation Reserve, and not as a Conservation Reserve, this site is considered secure. This is because the shire has no plans to develop the site, and has granted permission for the old tip and gravel pit within the reserve to be rehabilitated as part of this translocation project (see Appendix three).

As this species has not previously been recorded from this reserve this translocation can be considered an introduction under the definitions provided by Policy Statement 29 and the Guidelines for Translocation of Threatened Plants in Australia. A map of the proposed translocation site in relation to the known populations is shown in Appendix one.

The known populations of *A. aprica* ms occur on a soil type of gravelly light brown sand or loam and have an underlying geology of lateritic gravel with sand and minor amounts of clay, laterite or deeply weathered schist (Baxter and Lipple 1985). The proposed translocation site occurs on a soil type of lateritic gravel grading to light brown loam and has an underlying geology of lateritic gravel with sand and minor amounts of clay (Baxter and Lipple 1985) which is identical to the known populations.

The existing populations have a highly modified vegetation structure of Low Scrub A (using Muir's classification). The proposed translocation site is also located within a highly modified environment, but is surrounded by vegetation which fits the criteria of Heath A (using Muir's classification). The proposed translocation site has many associated species in common with the know populations, these are shown below in Table 2. No individuals of *A. aprica* ms were found during surveys of this reserve for translocation sites, despite the similarity of the vegetation. It is considered highly unlikely that *A.aprica* ms will hybridise with any species within the reserve (B. Maslin pers. comm).

Table 2. A comparison of the main associated vegetation at the proposed translocation site within the Carnamah Shire Recreation Reserve with the known populations of *A. aprica* ms.

Main associated species of the original populations of *A. aprica* ms.	Main associated species of the proposed translocation site within the Carnamah Shire Recreation Reserve
Acacia acuminata	*Acacia acuminata*
Allocasuarina campestris	*Allocasurina campestris*
Borya spaerocephala	
Dianella sp.	
Eremophila duttonii	
Eucalyptus loxophleba	
Grevillea paniculata	*Grevillea paniculata*
Hakea scoperia	*Hakea scoperia*
Melaleuca fulgens	*Melaleuca fulgens*
Olearia axillaris	
Scaevola spinescens	
Verticordia sp.	

The proposed translocation site is considered to have almost identical environmental attributes of climate, soil type, vegetation structure and associated vegetation to the known populations of this species. The proposed translocation site is only 12.7 km from the furthermost and 8.45 km from the nearest occurrences of this species. It is therefore, the closest site on a secure shire reserve, with almost identical attributes, and so is considered to be the best site available for the translocation of such a critically endangered species.

4.3 Translocation Design

A total of five replicates of 16m x 5m each will be measured. Each replicate will be divided into a grid of 15 x 4 rows.

In the absence of any data as to what is the best pretreatment method a fairly standard pretreatment technique will be used. That is, if there are wet soil conditions, seeds will be soaked overnight in just boiled water prior to planting out. If there are dry soil conditions seed will only be soaked in near boiling water for 15 seconds before being dried and then planted. This species is known to have a germination of between 43 - 84% (A. Cochrane pers. comm), so each hole in the grid will be planted with five seeds to increase the chances of each hole eventually containing a germinant.

A total of four treatments will be tested: control, watering, mulching or watering and mulching (see Table 3). Treatments will be randomly assigned to a row in the grid (see Appendix one for site diagram).

An irrigation system will be set up in November 1998 to water once a week those plants assigned to the watering or watering and mulching categories. A soil wetting agent will be added to the soil around all plants in November 1998.

Each plant will be permanently tagged so that each individual will always be identifiable. A cage of rabbit netting will be placed around each plot to prevent the consumption of the seedlings by large herbivores.

All equipment used during translocation planting will be maintained under strict disease hygiene.

Table 3. Description of experimental treatments.

Treatment	Description of Treatment
Control	Plants not given any treatment.
Mulched	A layer of mulch is placed around the plant to see whether it enhances survival by increasing water retention.
Watered	Plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether watering over the first summer enhances survival
Watered and mulched	A layer of mulch is placed around the plant and in addition plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether it is a combination of both watering and mulching that enhances survival.

Monitoring of the translocated population will be undertaken every second month commencing one month after the planting out of the seeds. Monitoring will include counting the number of surviving germinants, height of the surviving germinants, width of the crown of the surviving germinants in two directions (so that crown volume can be calculated), reproductive state, number of inflorescences and pods, whether second generation plants are present and general health of the plants. A set photo point will be allocated for each plot and a photo will be taken each time monitoring takes place.

Monitoring of the original populations will also occur every second month in conjunction with monitoring of the translocated population. This will provide essential baseline data for assessing the performance of the translocated population. Monitoring will include counting the number of individuals, height and crown width of the individuals, reproductive state, number of inflorescences and pods and general health of the plants.

4.4 Source of Plants

Seed was collected under guidelines outlined in Appendix four. Seed has been sourced from population one from a bulked collection from 60 plants for planting at the translocation site in 1998. Population 1 was by far the largest population and therefore considered to have the greatest genetic variability. In addition, seed was only available from population 1.

4.5 Criteria for Success or Failure

Criteria for Success

- Short Term: germination and establishment of translocated seed
  production of flowers and seed
  after one generation the number of individuals is sustained by natural recruitment
- Long Term: after two or more generations the number of individuals is sustained by natural recruitment, and a soil stored seed bank has been established.
- The production of guidelines for the establishment of future translocations of related species.

Criteria for Failure

- Short Term: failure of translocated seed to germinate and establish
  failure of plants to produce flowers and seed
- Long Term: there is a significant decline in the size of the translocated population due to lack of natural recruitment

5. TIMETABLE

Time	Action
November 1997	Seed collection
February 1998	Translocation site selected.
April 1998	Translocation proposal submitted for review.
June - July 1998	Translocation of seeds into the Carnamah Shire Recreation Nature reserve.
July - August 1998	Follow up monitoring and maintenance of translocation site.
August 1998 - May 1999	Monitoring and maintenance of translocation site.
October 1998	Translocation proposal for 1999 translocation submitted for review.
November 1998	Seed collection
November 1998	Setting up of irrigation system.
November 1998	A batch of seeds put down for germination. Resulting seedlings raised at Kings Park and Botanic Gardens.
April 1999	Progress report.
May - June 1999	Translocation of seedlings into the Carnamah Shire Recreation Reserve.
June - July 1999	Follow up monitoring and maintenance of translocation site.
August 1999 - May 2001	Monitoring and maintenance of translocation site.
May 2001	Final Report

6. FUNDING

This project is fully funded for three years under National Heritage Trust ESP project number 566.

7. ACKNOWLEDGMENTS

Rob Brazell (CALM Mornington District), Bob Fitzgerald (CALM Central Forest Region), Les Robson (CALM Swan Region), Greg Durell (CALM Narrogin District), Andrew Batty (Kings Park and Botanic Gardens), and Kingsley Dixon (Kings Park and Botanic Gardens) are thanked for the opportunity to view their translocation projects or proposals, and for advice given.

8. REFERENCES

Baxter J.L. and Lipple S.L. (1985) Perenjori Western Australia 1:250 000 Geological Series - Explanatory Notes. Geological Survey of Western Australia. Perth Western Australia.

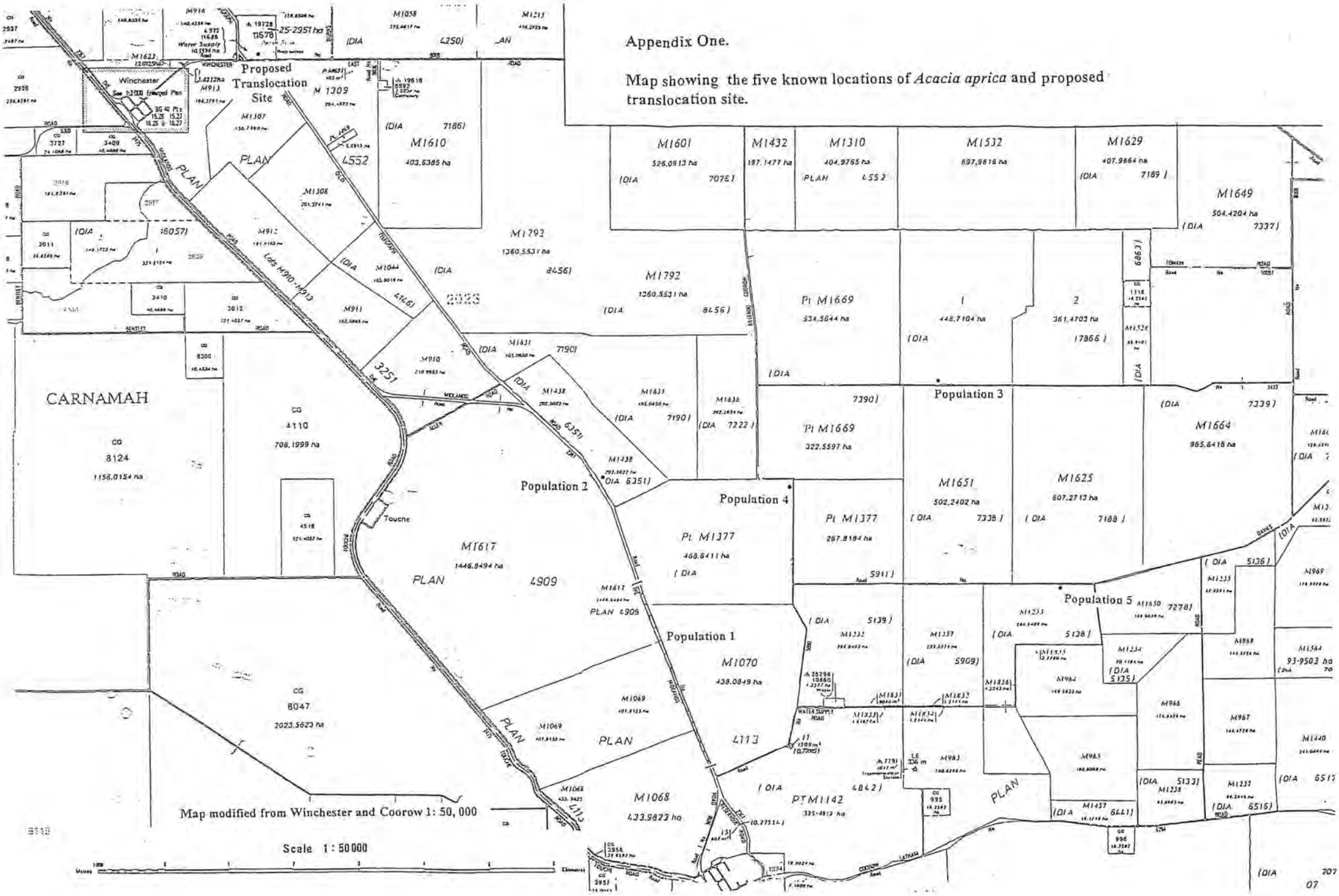
Chapman A.R. and Maslin B.R. (in prep). Flora of Australia treatment.

Guidelines for the Translocation of Threatened Australian Plants. (1997) Produced by The Australian Network for Plant Conservation Translocation Working Group. Canberra, Australia.

Stack G. and Brown A. (in prep). Blunt Wattle (*Acacia aprica* ms) Interim Recovery Plan. Department of Conservation and Land Management, Perth W.A.

Appendix One.

Map showing the five known locations of *Acacia aprica* and proposed translocation site.

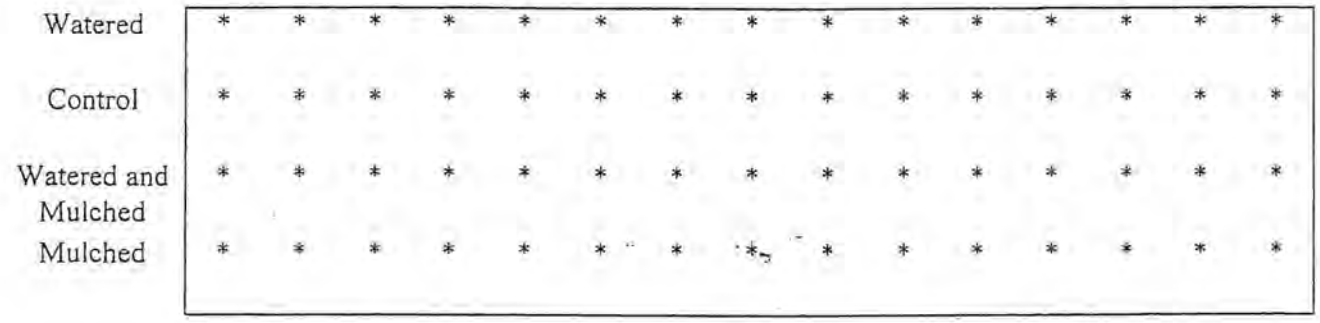


Appendix Two.

Site Diagram for Proposed Translocation of *Acacia aprica* ms.

1500 seeds will be planted with 5 seed planted per hole to ensure at least one seedling per hole will eventuate. These will be planted as shown in the diagram below, with five seeds planted at each point marked with an asterix (*).
The four treatments of control, watered and mulched, watered and mulched will be assigned as per the diagram below.

Replicate 1



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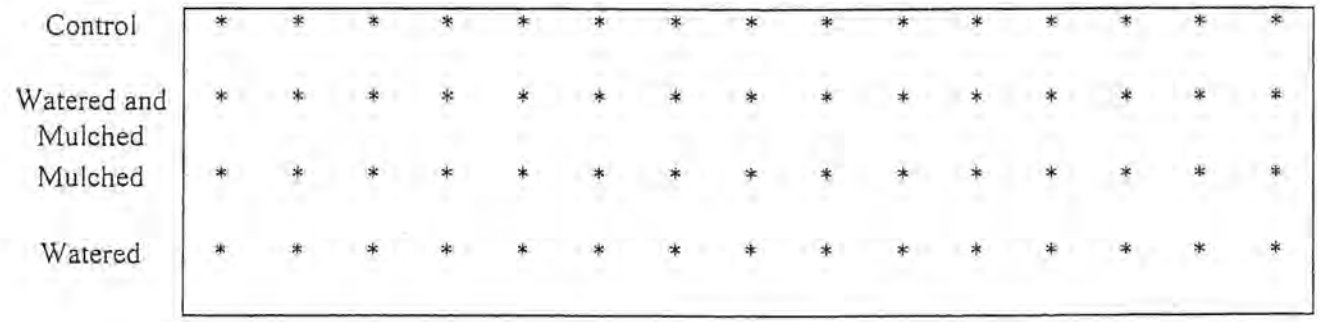

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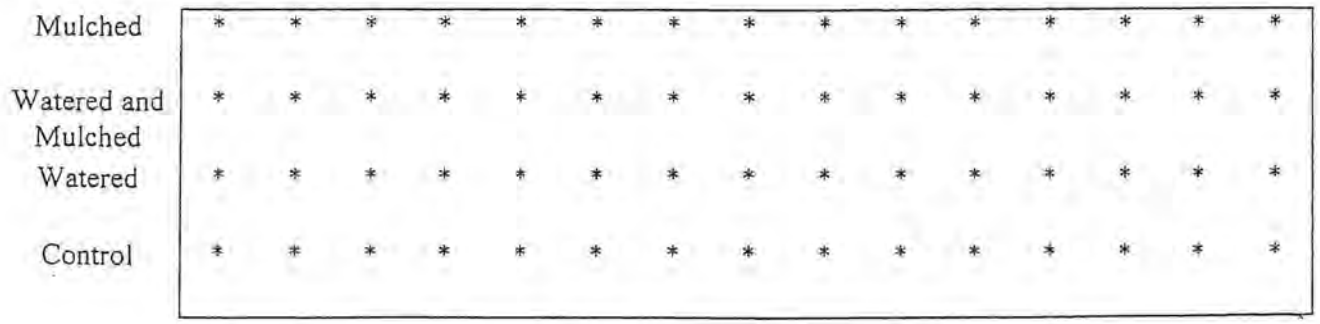

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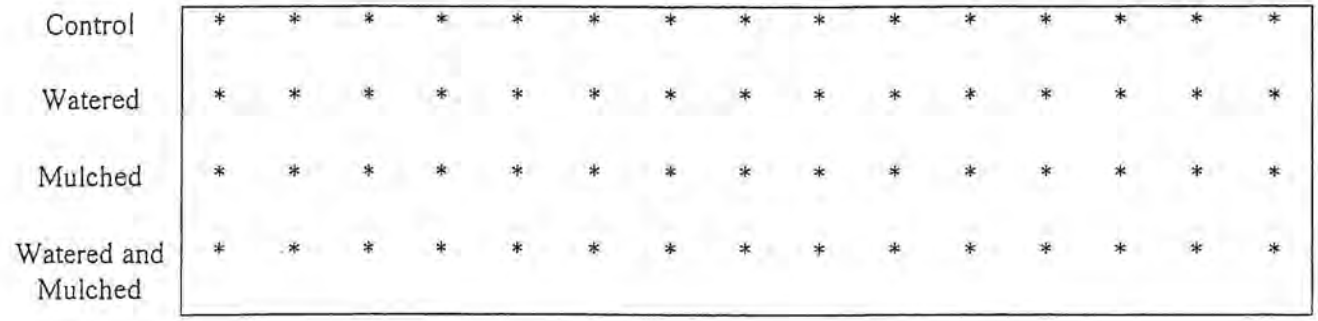
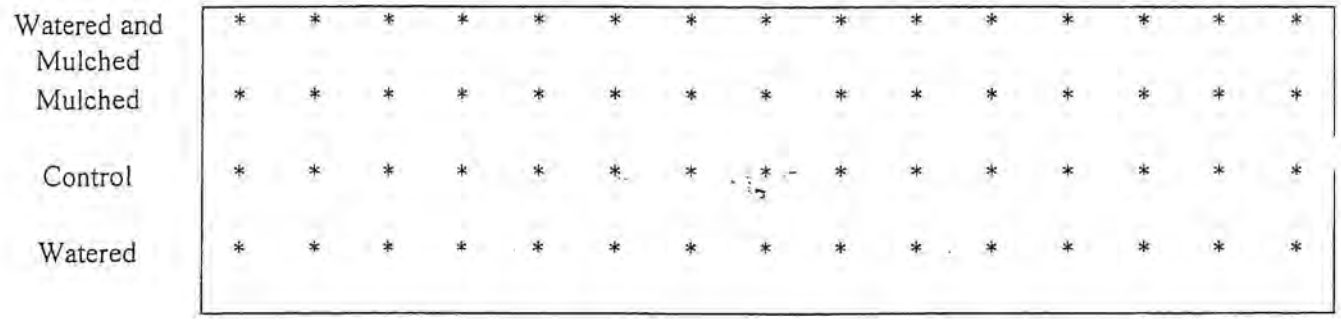


Replicate 5



Scale: 1 m

Appendix Three.
A copy of the letter from the Shire of Carnamah granting permission for the translocation site to be located within the Shire's recreation reserve.

SHIRE OF CARNAMAH

MACPHERSON STREET, CARNAMAH
P.O. Box 80, Carnamah 6517
Telephone (08) 9951 1055
Fax (08) 9951 1377

Ref: MLC:CC F10/1, R11/2.15, R10/3
Enquiries: Lance Croft

22nd April 1998

Ms Leonie Monks
Research Scientist
W A Herbarium
Department of Conservation and Land Management
Locked Bag 104
BENTLEY DELIVERY CENTRE WA 6983

Dear Leonie,

RECREATION RESERVE 19728: CRITICALLY ENDANGERED SPECIES ACACIA APRICA

Thank you for your letter of April 6th proposing to translocate the critically endangered species Acacia aprica to reserve 19728. I am pleased to advise that Council has approved of your request.

Further, regarding your proposition that it may be possible to coordinate this translocation with the full rehabilitation of the tip site, my Council has expressed interest subject to more detail. Will you please advise further on this matter.

Yours faithfully,

M L CROFT
Chief Executive Officer

SHIRE OF CARNAMAH

MACPHERSON STREET, CARNAMAH
P.O. Box 80, Carnamah 6517
Telephone (08) 9951 1055
Fax (08) 9951 1377

Ref: MLC:CC F10/1, R11/2.15, R10/3
Enquiries: Lance Croft

5th June 1998

Ms Leonie Monks
Research Scientist
Department of Conservation and Land Management
W A Herbarium
Locked Bag 104
BENTLEY DELIVERY CENTRE WA 6983

Dear Ms Monks,

ENDANGERED FLORA (ACACIA APRICA) TO RESERVE 19728

I refer to your letter of May 26th outlining possible rehabilitation actions for some pits on reserve 19728, rubbish disposal, and weed control, prior to translocating the above endangered species. It is noted that stage 1 – pushing all topsoil back onto the two western pits and then deep ripping the area prior to plantings – will be undertaken as soon as possible. The second stage involving burying the rubbish onsite in the eastern pit area would be done in the autumn of 1999. It is further noted that the project would be fully funded by CALM.

I have discussed these proposals with Mr Anthony Desmond of CALM, Geraldton, who has indicated he would provide onsite supervision and would endeavour to minimise damage to existing flora as far as possible. Regarding stage 2, I would like onsite discussions to clarify and refine the proposed activities.

Stage 1 may proceed, bearing in mind the foregoing.

Yours faithfully,

M L CROFT
Chief Executive Officer

IMPORTANT CONSIDERATIONS

Make sure that seed is mature. If fruits are green the seed is probably still immature. If brown or black the seed is probably mature. If in doubt, sacrifice 1or 2 seed to check maturity. The inside of the seed (endosperm) should be white and solid, not soft and translucent. Also check to see that the fruits have seed inside. Seed may have dehisced so don't waste your time with collecting empty fruits.

Use secateurs rather than breaking seed or stems. This will cause less damage to the plant and there is less likelihood that insect predators or disease will enter a clean cut.

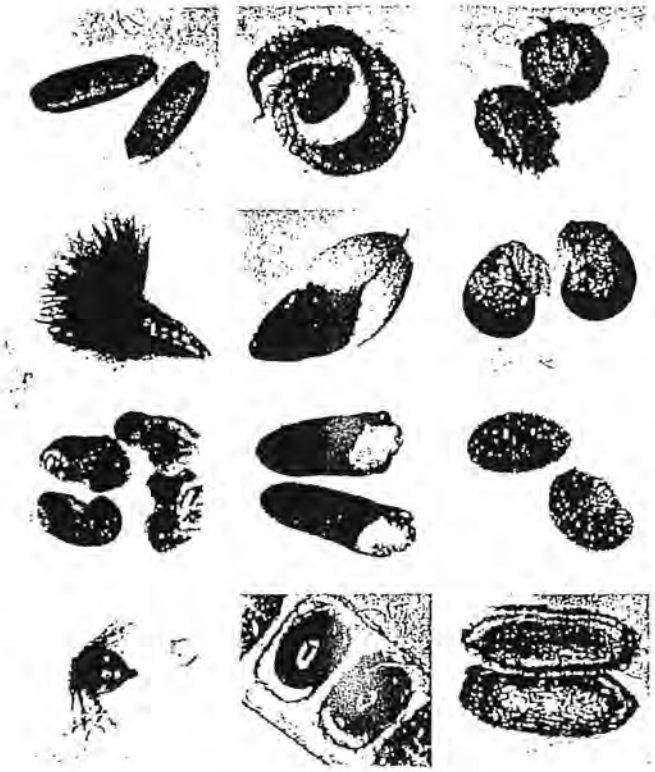
Store seed or fruits in paper or calico, never in plastic. Plastic can sweat and seeds can easily go mouldy. Mould can kill seed and high moisture contents can reduce viability.

Send seed as soon as possible for processing and storage as viability can decrease considerably over time. Also insect pests can be a problem and seed may require fumigation.

Adequate information about the collection is required, such as species, location, date of collection and number of plants collected from.

Appendix Four.

Guidelines under which seed was collected for the translocation.



Threatened Flora Seed Centre
Western Australian Herbarium
Department of Conservation and Land Management
Locked Bag 104, Bentley Delivery Centre
Western Australia 6983

phone (08) 93340502
fax (08) 93340515

BASIC GUIDELINES FOR CONDUCTING SEED COLLECTIONS FOR CONSERVATION PURPOSES

Compiled by the
Threatened Flora Seed Centre

Appendix Five.
Regional Endorsement of the Translocation Proposal.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
Midwest Regional Headquarters, Geraldton - Telephone 099 21 5955 Facsimile 099 21 5713

To : Leonie Monks. Research Scientist, Woodvale.

Your ref :
Our ref : 20L32
Enquiries : Ron Shepherd

Subject : Translocation Proposals for Critically Endangered Flora – Moora District

I refer to your letter of 20 May 1998, seeking Midwest Region approval for four translocation proposals for critically endangered flora in the Moora District.

I provide the following comments on the four translocation proposals:

- *Acacia aprica*. Proposal endorsed.
- *Acacia cochlocarpa* subsp. *cochlocarpa*. Proposal endorsed subject to "Necessary Operations" approval being obtained for the activities that are planned to occur on Gunyidi Nature Reserve (No. 23602).
- *Davesia bursarioides*. Proposal endorsed subject to written confirmation of permission to utilise the proposed translocation site is obtained from the land owner.
- *Grevillea calliantha*. Proposal endorsed subject to written confirmation of permission to utilise the proposed translocation site is obtained from the Shire of Dandaragan.

The endorsement forms are attached as requested.

Kelly Gillen
Regional Manager – Midwest Region
MIDWEST REGION

Wednesday, June 10, 1998

C:\MY DOCUMENTS\DRFTRANS.DOC

APPENDIX 3

TRANSLOCATION PROPOSAL
Spiral-fruited Wattle,
Acacia cochlocarpa Meisn. subsp. *cochlocarpa* ms.

1. SUMMARY

Acacia cochlocarpa Meisn subsp. *cochlocarpa* ms (Spiral-fruited Wattle) is known from two small populations, of just 38 and 13 individuals respectively. The populations are only 500 m apart, occurring on a narrow road verge and in a small area of remnant vegetation north of Watheroo in the Moora CALM District.

A. cochlocarpa subsp. *cochlocarpa* is a sprawling, glabrous shrub to 0.7 m tall and up to 3 m wide. The branchlets are slightly flexuose. The phyllodes are linear to slightly elliptic, 3-7.5 cm long, 3-6 mm wide, incurved and erect, with 7 nerves per face. The flower heads are golden, sessile and cylindrical, 7-10 mm long. Flowering occurs from June to July.

This species was first collected from the "Swan Colony" by James Drummond and subsequently named by Meissner in 1855. Since then only 12 further collections have been made. An intensive survey for this species was undertaken by Diana Papenfus in 1996, however, no new populations were located. It is believed that the rarity of this species is caused by the extensive clearing for agriculture that has occurred in the area. The species was declared as Rare Flora in November 1997 and subsequently ranked as Critically Endangered in 1997. An Interim Recovery Plan is being written for this subspecies (Stack and Brown in prep).

The aim of this translocation proposal is to conserve the wild genetic stock of the subspecies by establishing another viable population of *A. cochlocarpa* subsp. *cochlocarpa*. This will be achieved by translocating (introducing) this species to a secure CALM managed reserve. This translocation proposal outlines the need for translocation of the critically endangered *A. cochlocarpa* subsp. *cochlocarpa*, the site selection process, the design of the translocation site and the provisions for monitoring. In addition it outlines the criteria for success or failure of this proposed translocation.

2. PROPONENTS

Dr David Coates
Principal Research Scientist
Dept. Conservation and
Land Management
KENSINGTON WA 6151
(08) 9334 0490

Leonie Monks
Research Scientist
Dept. Conservation and
Land Management
KENSINGTON WA 6151
(08) 9334 0495

TABLE OF CONTENTS

3. BACKGROUND

3.1 History, Taxonomy and Status

Acacia is a large Australia genus, commonly known as wattles, comprising some 700 named species.

Acacia cochlocarpa subsp. *cochlocarpa* is a sprawling, glabrous shrub to 0.7 m tall wide. The branchlets are slightly flexuose. The phyllodes are glabrous, linear to slightly elliptic, 2.5-4 cm long, 3-6 mm wide, leathery to touch, incurved and erect, with 5-7 strongly raised nerves per face and olive green in colour. Inflorescence are simple, 2 per axil, golden, sessile and short-cylindrical, 7-10 mm long. The legumes are tightly coiled into pendulous cylinders 3-4 mm wide. (Chapman and Maslin, in prep.). Very little is known about the biology and ecology of this subspecies. Germination is known to be low, ranging from 36 - 71% (A. Cochrane pers comm).

The first known collection of *A. cochlocarpa* was made by J. Drummond and subsequently named by Meissner in 1855. Maslin and Cowan (1994), after assessing much of Meissners' work suggested that there are two subspecies within the species - *A. cochlocarpa* subsp. *cochlocarpa* and *A. cochlocarpa* subsp. *velutinosa*. They differ in that *A. cochlocarpa* subsp. *velutinosa* has shorter phyllodes, smaller oblongoid flower heads and branchlets, phyllodes and seed pods covered in velvety hairs. *A. cochlocarpa* subsp. *velutinosa* is restricted to an area near Manmanning and is listed as Priority One under the W. A. Wildlife Conservation Act.

Due to the small population sizes and restricted distribution *Acacia cochlocarpa* subsp. *cochlocarpa* was declared as Rare Flora in November 1997, and ranked as Critically Endangered in 1997. An Interim Recovery Plan is being written for this subspecies (Stack and Brown in prep).

3.2 Distribution and Habitat

Only two populations of *A. cochlocarpa* subsp. *cochlocarpa* are known at present, despite the fact that this subspecies has been recorded in the past over a range of ca. 20 km north of Watheroo. Numerous searches in the Watheroo area have found no new populations of this subspecies and most of the areas where it was collected from in the past appear to have been cleared for agriculture.

The two known populations grow only 500 metres apart, occurring in red-brown clayey-gravel, within open low and dwarf scrubland over very open low grass and open herbs.

4. THE TRANSLOCATION

4.1 The Need to Translocate

The rarity of *A. cochlocarpa* subsp. *cochlocarpa* is probably due to the amount of clearing that has occurred for agricultural purposes in the Watheroo area. The largest population occurs on a small piece of remnant vegetation adjacent to the Midlands Highway and the access track to Glenroy Farm, the other exists on the road side reserve along the Midland Highway. Due to the unsecured nature of the land in which the populations occur and small number of individuals the need for translocation is considered to be high. A draft Interim Recovery Plan (Stack and Brown, in prep) also recommends the translocation of this species to a secure site.

4.2 Translocation Site Selection.

A search was made of areas around the known populations at Watheroo on 23rd February 1998 to locate a suitable translocation site. An area on the north eastern corner of the Gunyidi Nature Reserve (#23602) was chosen as the translocation site. Endorsement for the use of this site was received from the CALM Midwest Region (Appendix three). This site was chosen because it is only 4.3 km from population 2 and 4.8 km from population 3 (by road), as well as having several attributes in common with the existing populations. The site selected was within a disused gravel pit which has subsequently been deep ripped by CALM Midwest Region in preparation for this translocation and to allow natural rehabilitation to occur. The gravel pit site was chosen so that there will be no further disturbance of the nature reserve.

As this species has not previously been recorded from this reserve this translocation can be considered an introduction under the definitions provided by Policy Statement 29 and the Guidelines for Translocation of Threatened Plants in Australia. A map of the proposed translocation site in relation to the known populations is shown in Appendix one.

The two known populations of *A. cochlocarpa* subsp. *cochlocarpa* both occur on a soil type of red-brown clay gravel. They have underlying geology of Noodine Chert (chert is defined as a form of fine grained silica) (Carter and Lipple 1982). This form of Chert contains different sizes of grains of quartz sand cemented together by silica (Carter and Lipple 1982). The proposed translocation site occurs on an identical soil type and geological formation as the two known populations.

Both the translocation site and the existing populations have a similar vegetation structure of open low scrub A and dwarf scrub D and over very open low grass and open herbs (using Muir's classification) in an area that has been disturbed in the past (D. Papenfus pers. comm). The proposed translocation site has many associated species in common with the know populations. These are shown below in Table 1. No individuals of *A. cochlocarpa subsp. cochlocarpa* were found in the proposed site during surveys for translocation sites, despite the similarity of the vegetation. It is considered highly unlikely that *A. cochlocarpa subsp. cochlocarpa* will hybridise with any species within the reserve (B. Lepschi pers. comm).

Table 1. A comparison of the main associated vegetation at the proposed translocation site within the Gunyidi Nature Reserve with the known populations of *A. cochlocarpa* subsp. *cochlocarpa*.

Main associated species of the original populations of *A. cochlocarpa* subsp. *cochlocarpa*.	Main associated species of the proposed translocation site within the
Acacia bidentata	
Acacia jacksonioides	
Acacia neurophylla	
Allocasuarina campestris	*Allocasuarina campestris*
	Allocasuarina drummondiana
Astroloma sp.	
Cryptandra leucopogon	
Eucalyptus sp. - mallee	
Gastrolobium appressum	
Glischrocaryon aureum	
	Grevillea ?levis
Grevillea thyrsoides	*Grevillea thyrsoides* subsp. *pusulata*
Hakea scoperia	*Hakea scoperia*
Hypocalymma sp.	
	Leucopogon sp.
Melaleuca sclerophylla	
	Petrophile shuttleworthiana

The proposed translocation site is in a previously disturbed area which has recently been deep ripped to allow natural rehabilitation to occur. The proposed site is considered to have almost identical environmental attributes of climate, soil type, vegetation structure and associated vegetation to the known populations of this species. The proposed translocation site is 4.3 and 4.8 km from the two known occurrences of this taxon, secure in a conservation reserve and therefore is considered to be the best site available for the translocation.

4.3 Translocation Design

A total of five replicates of 16m x 5m each will be measured. Each replicate will be divided into a grid of 15 x 4 rows.

In the absence of any data as to what is the best pretreatment method a fairly standard pretreatment technique will be used. That is, if there are wet soil conditions, seeds will be soaked overnight in just boiled water prior to planting out. If there are dry soil conditions seed will only be soaked in near boiling water for 15 seconds before being dried and then planted. This species is known to have a germination of between 36 and 71% (A. Cochrane pers. comm). Each hole in the grid will be planted with five seeds to increase the chance of a hole eventually containing a germinant.

A total of four treatments will be tested: control, watering, mulching or watering and mulching (see Table 2). Treatments will be randomly assigned to a row in the grid (see Appendix two for site diagram).

An irrigation system will be set up in November 1998 to water once a week those plants assigned to the watering or watering and mulching categories. A soil wetting agent will be added to the soil around all plants in November 1998.

Each plant will be permanently tagged so that each individual will always be identifiable. A cage of rabbit netting will be placed around each plot to prevent grazing of the seedlings by large herbivores.

All equipment used during translocation planting will be maintained under strict disease hygiene.

Table 2. Description of experimental treatments.

Treatment	Description of Treatment
Control	Plants not given any treatment.
Mulched	A layer of mulch is placed around the plant to see whether it enhances survival by increasing water retention.
Watered	Plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether watering over the first summer enhances survival
Watered and mulched	A layer of mulch is placed around the plant and in addition plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether it is a combination of both watering and mulching that enhances survival.

Monitoring of the translocated population will be undertaken every second month commencing one month after the planting out of the seeds. Monitoring will include counting the number of surviving germinants, height of the surviving germinants, width of the crown of the surviving germinants in two directions (so that crown volume can be calculated), reproductive state, number of inflorescences and pods, whether second generation plants are present and general health of the plants. A set photo point will be allocated for each plot and a photo will be taken each time monitoring takes place.

Monitoring of the original populations will also occur every second month in conjunction with monitoring of the translocated populations. This will provide essential baseline data for assessing the performance of the translocated population. Monitoring will include counting the number of individuals, height and crown width of the individuals, reproductive state, number of inflorescences and pods and general health of the plants.

4.4 Source of Plants

Seed was collected under guidelines outlined in Appendix four. Seed has been sourced from both populations from a bulk collection from 30 plants for planting at the translocation site in 1998.

4.5 Criteria for Success or Failure

Criteria for Success

- Short Term: germination and establishment of translocated seed
  production of flowers and seed
  after one generation the number of individuals is sustained by natural recruitment
- Long Term: after two or more generations the number of individuals is sustained by natural recruitment, and a soil stored seed bank has been established.
- The production of guidelines for the establishment of future translocations of related species.

Criteria for Failure

- Short Term: failure of translocated seed to germinate and establish
  failure of plants to produce flowers and seed
- Long Term: there is a significant decline in the size of the translocated population due to lack of natural recruitment

5. TIMETABLE

Time	Action
November 1997	Seed collection.
February 1998	Translocation site selected.
April 1998	Translocation proposal submitted for review.
June - July 1998	Translocation of seeds into the Gunyidi Nature reserve.
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May 2001	Final Report

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7. ACKNOWLEDGMENTS

I would like to thank Rob Brazell (CALM Mornington District), Bob Fitzgerald (CALM Central Forest Region), Les Robson (CALM Swan Region), Greg Durell (CALM Narrogin District), Andrew Batty (Kings Park and Botanic Gardens), and Kingsley Dixon (Kings Park and Botanic Gardens) for the opportunity to view their translocation projects or proposals, and for advice given.

8. REFERENCES

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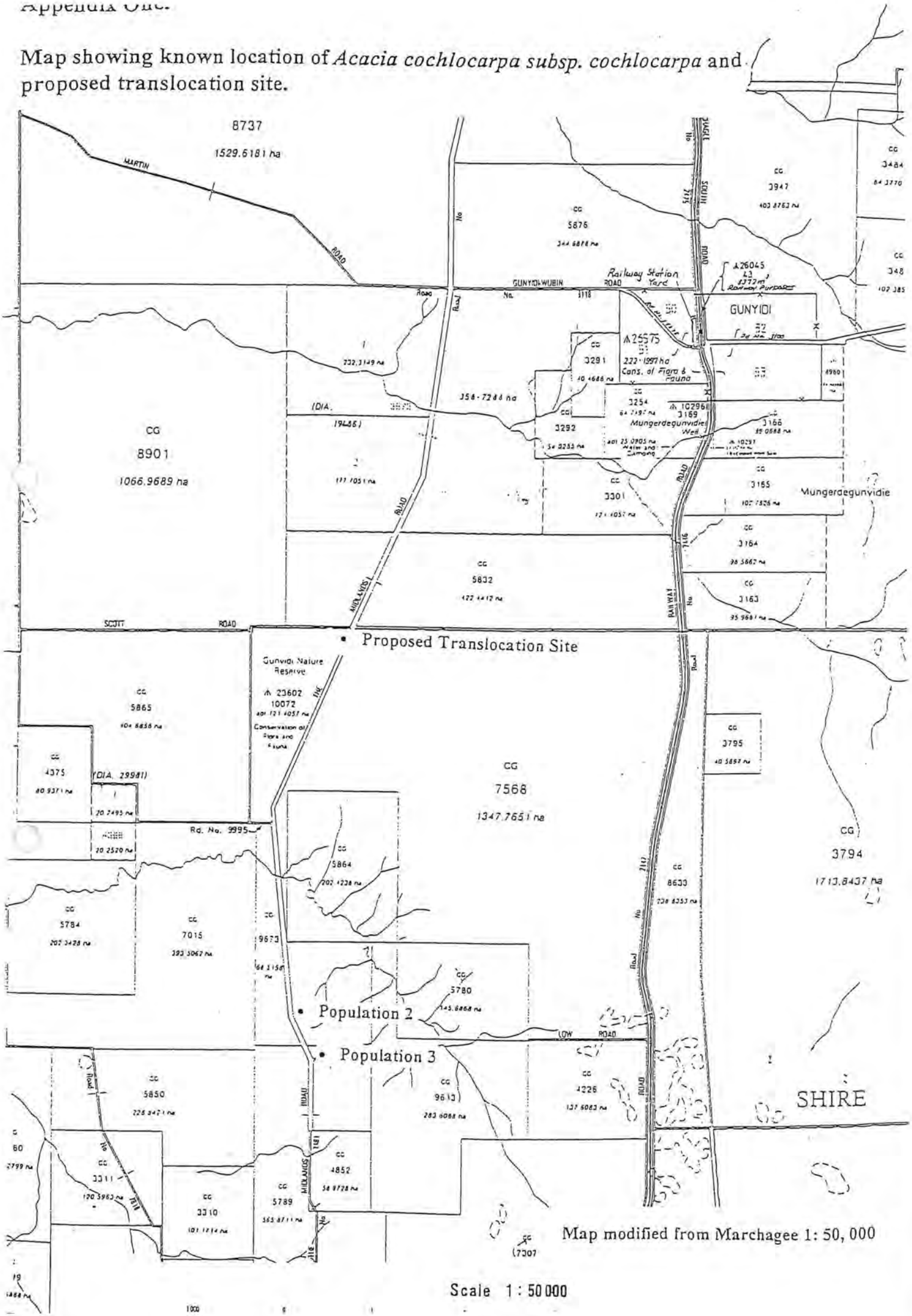
Stack G. and Brown A. (In Prep) Spiral-fruited Wattle *(Acacia cochlocarpa* subsp. *cochlocarpa)* Interim Recovery Plan.

Appendix One.

Map showing known location of *Acacia cochlocarpa subsp. cochlocarpa* and proposed translocation site.

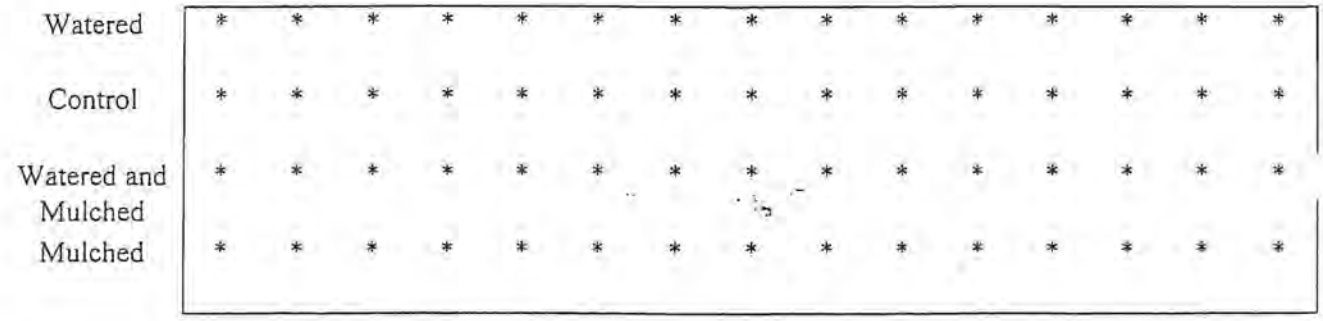


Appendix Two.

Site Diagram for Proposed Translocation of *Acacia cochlocarpa subsp. cochlocarpa*

1500 seeds will be planted with 5 seed planted per hole to ensure at least one seedling per hole will eventuate. These will be planted as shown in the diagram below, with five seeds planted at each point marked with an asterix (*).
The four treatments of control, watered and mulched, watered and mulched will be assigned as per the diagram below.

Replicate 1



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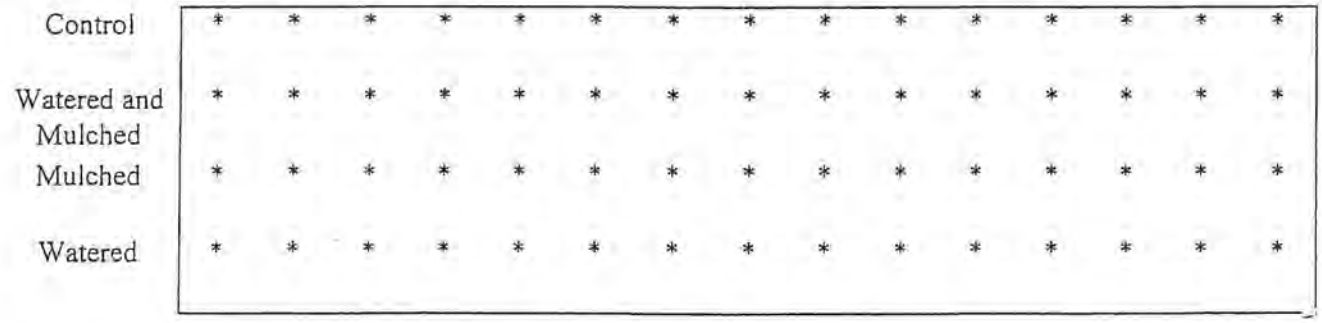

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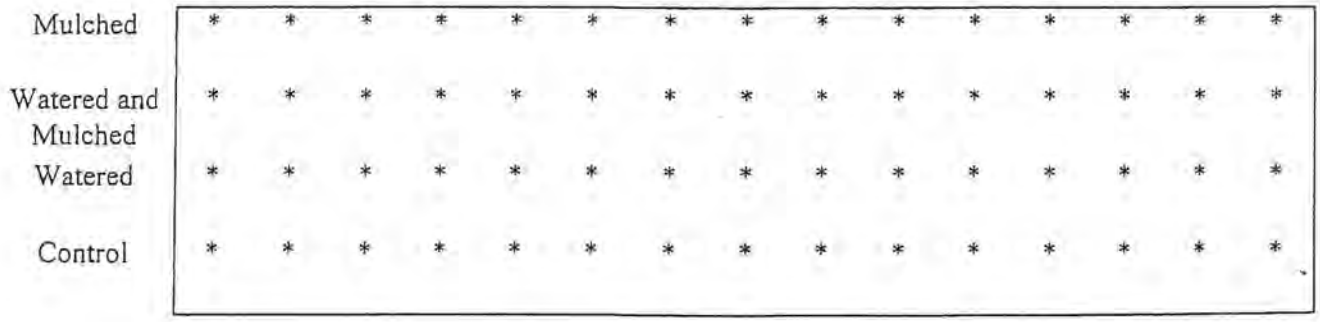

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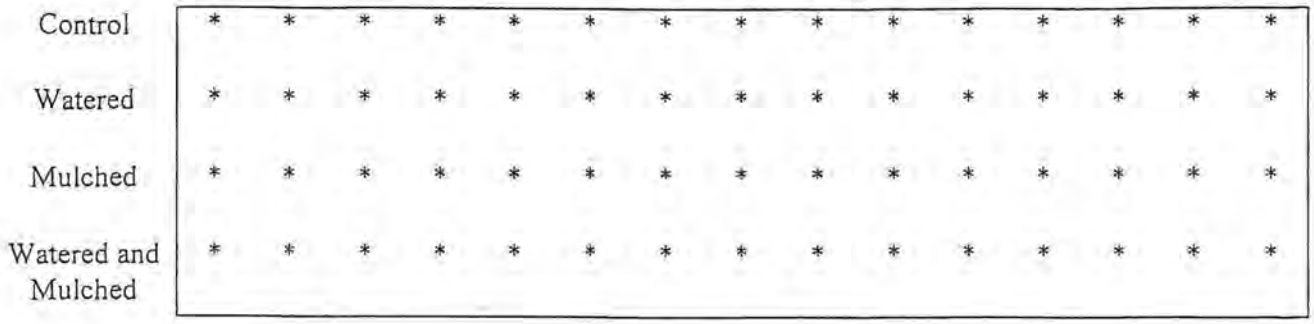

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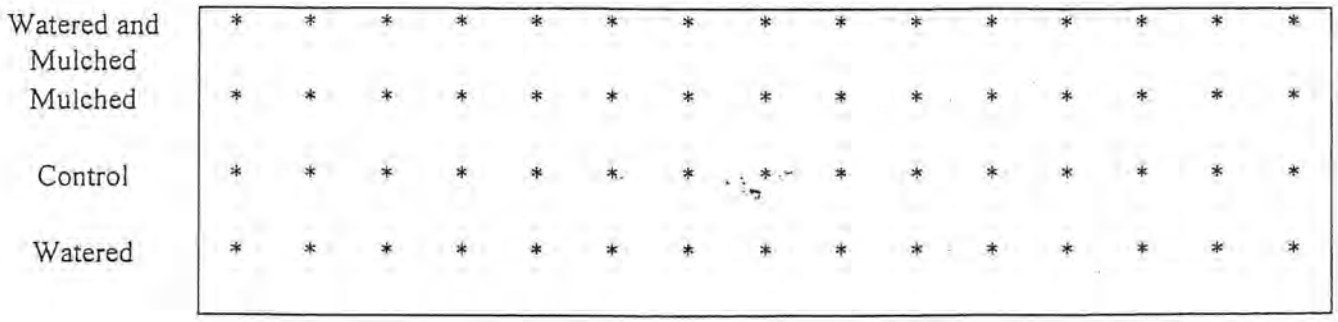


Scale: 1 m

Appendix Three.

Regional Endorsement of the Translocation Proposal.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
Midwest Regional Headquarters, Geraldton - Telephone 099 21 5955 Facsimile 099 21 5713

To : Leonie Monks. Research Scientist, Woodvale.

Your ref :
Our ref : 20L32
Enquiries : Ron Shepherd

Subject : **Translocation Proposals for Critically Endangered Flora – Moora District**

I refer to your letter of 20 May 1998, seeking Midwest Region approval for four translocation proposals for critically endangered flora in the Moora District.

I provide the following comments on the four translocation proposals:

- *Acacia aprica*. Proposal endorsed.
- *Acacia cochlocarpa* subsp. *cochlocarpa*. Proposal endorsed subject to "Necessary Operations" approval being obtained for the activities that are planned to occur on Gunyidi Nature Reserve (No. 23602).
- *Davesia bursarioides*. Proposal endorsed subject to written confirmation of permission to utilise the proposed translocation site is obtained from the land owner.
- *Grevillea calliantha*. Proposal endorsed subject to written confirmation of permission to utilise the proposed translocation site is obtained from the Shire of Dandaragan.

The endorsement forms are attached as requested.

Kelly Gillen
Regional Manager – Midwest Region
MIDWEST REGION

Wednesday, June 10, 1998

Received 19 June '98

Following discussions between David Coates, Andrew Burbidge + Neil Burrows it was decided that there was no need for "Necessary Operations" approval. Kelly Gillen agreed to this and endorsed the translocations of Acacia cochlocarpa subsp. cochlocarpa without this condition

Appendix Four.

Guidelines under which seed was collected for the translocation.

IMPORTANT CONSIDERATIONS

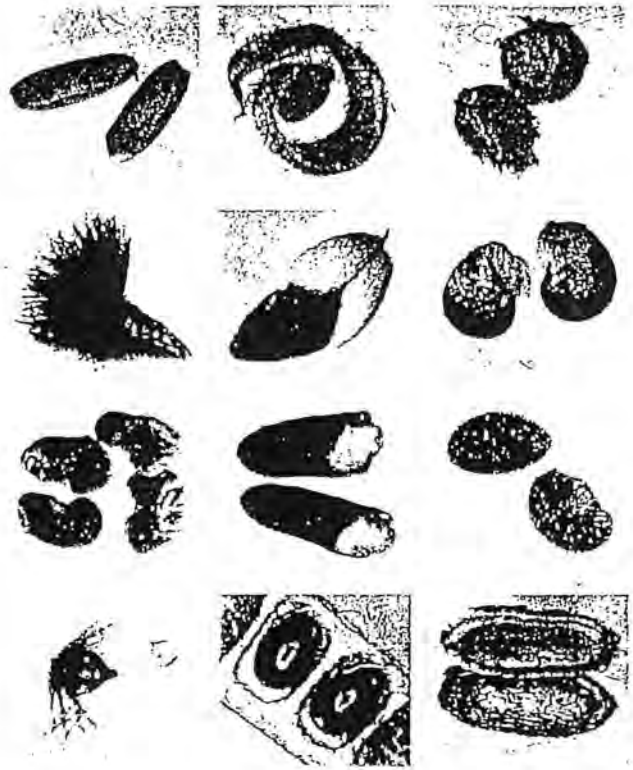
Make sure that seed is mature. If fruits are green the seed is probably still immature. If brown or black the seed is probably mature. If in doubt, sacrifice 1or 2 seed to check maturity. The inside of the seed (endosperm) should be white and solid, not soft and translucent. Also check to see that the fruits have seed inside. Seed may have dehisced so don't waste your time with collecting empty fruits.

Use secateurs rather than breaking seed or stems. This will cause less damage to the plant and there is less likelihood that insect predators or disease will enter a clean cut.

Store seed or fruits in paper or calico, never in plastic. Plastic can sweat and seeds can easily go mouldy. Mould can kill seed and high moisture contents can reduce viability.

Send seed as soon as possible for processing and storage as viability can decrease considerably over time. Also insect pests can be a problem and seed may require fumigation.

Adequate information about the collection is required, such as species, location, date of collection and number of plants collected from.



Threatened Flora Seed Centre
Western Australian Herbarium
Department of Conservation and Land Management
Locked Bag 104, Bentley Delivery Centre
Western Australia 6983

phone (08) 93340502
fax (08) 93340515

BASIC GUIDELINES FOR CONDUCTING SEED COLLECTIONS FOR CONSERVATION PURPOSES

Compiled by the
Threatened Flora Seed Centre

APPENDIX 4

TRANSLOCATION PROPOSAL
Three Springs Daviesia,
Daviesia bursarioides Crisp. (Fabaceae)

1. SUMMARY

Daviesia bursarioides is a member of the family Fabaceae. It is a straggling shrub to 2 m tall. The branchlets are divaricate (spreading widely in different directions), terete and spiny with a waxy bloom. The phyllodes are scattered, 3 - 20 mm, narrowly obovate, fleshy and jointed with a sharp point at the tip. The flowers, which are produced between July and September, are small, typically pea-shaped, yellow and maroon. The fruit is a triangular pod, 9 mm x 10 mm.

D. bursarioides was first collected by W.E. Blackall between Coorow and Arrino in 1932. By 1978 only one surviving population, with three adult plants, was known. Since 1990, Three Springs Shire gardener, Charles Strahan has located four new populations, and CALM Consultant Diana Papenfus has found one new population, bringing the total number of populations to six.

D. bursarioides is probably a disturbance opportunist, as are many species of the genus *Daviesia* (Schwarten 1995). Schwarten (1995) recommends some form of disturbance every 6 - 8 years as a management technique. The response of *D. bursarioides* to a disturbance event such as fire is unknown. Experiments by Schwarten (1995) showed several *Daviesia* species had a significant decrease in germination after treatment with various levels of smoke. He speculated that it was the heat, rather than the smoke of a fire which promoted germination of *Daviesia* species.

A. Cochrane (pers. comm.) observed germination in the laboratory of between 6 and 77% for *D. bursarioides*. Schwarten (1995) found that this species has a low seed set, with around 98% of ovules being aborted. Of the seeds set, a germination of 7% was recorded. In addition seed that was lightly buried rapidly lost viability. Viability was 100% after being buried for six months, but was only 65% after being buried for 12 months, which means it is unlikely that there is a significant soil stored seed bank. Schwarten (1995) found that *D. bursarioides* has a multi-aged stand, with most plants declining after 6 years and dying after 8 - 10 years.

Daviesia bursarioides is endemic to the Three Springs area occurring over a range of just seven kilometres. It is known from six populations with a combined total of around 123 plants. It is found growing in shallow soils of brown sandy loams with extensive lateritic gravel that supports open shrub mallee habitat.

Due to the low number of plants and the threats associated with growing on narrow, degraded road reserves or near areas that are disturbed often, *D. bursarioides* was declared as Rare Flora in September 1987 and then ranked as Critically Endangered in September 1995.

The aim of this translocation is to conserve the wild genetic stock of the species by restocking the most secure population of *D. bursariodes*. This translocation proposal outlines the need for translocation of the critically endangered *D. bursariodes*, the site selection process, the design of the translocation site and the provisions for monitoring. In addition it outlines the criteria for success or failure of this proposed translocation.

2. PROPONENTS

Dr David Coates
Principal Research Scientist
Dept. Conservation and
Land Management
KENSINGTON WA 6151
(08) 9334 0490

Leonie Monks
Research Scientist
Dept. Conservation and
Land Management
KENSINGTON WA 6151
(08) 9334 0495

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3. BACKGROUND

3.1 History, Taxonomy and Status

Daviesia bursarioides Crisp. is a member of the family Fabaceae, commonly known as the pea family. It is a straggling shrub to 2 m tall. The branchlets are divaricate (spreading widely in different directions), terete and spiny with a waxy bloom. The phyllodes are scattered, small (3 - 20 mm), narrowly obovate, fleshy and jointed with a sharp point at the tip. The flowers, which are produced between July and September, are small, typically pea-shaped, yellow and maroon. The fruit is a triangular pod, 9 mm x 10 mm. The name *bursarioides* refers to the resemblance of this species, when not in flower, to members of the genus *Bursaria.*

D. bursarioides was first collected by W.E. Blackall between Coorow and Arrino in 1932. By 1978 only one surviving population (population 1) with three adult plants was known. Attempts by Dr M. Crisp in 1979 to save this species by propagation from cuttings did not succeed. This population was severely damaged by construction of a fence adjacent to the area in 1979, fortunately several plants regenerated and recruitment of seedlings occurred following this disturbance. Since 1990, Three Springs Shire gardener, Charles Strahan has located four new populations, and CALM Consultant Diana Papenfus has found one new population, bringing the total number of populations to six with 123 individuals.

D. bursarioides is probably a disturbance opportunist, as are many species of the genus *Daviesia* (Schwarten 1995). In the largest population, plants that are growing in a disused gravel pit are more abundant and vigorous than those observed in the adjoining remnant vegetation. Schwarten (1995) recommends some form of disturbance every 6 - 8 years as a management technique.

The response of *D. bursarioides* to a disturbance event such as fire is unknown. Fire is usually a stimulus for regeneration from seed for most Australian legumes (Crisp 1985). Experiments by Schwarten (1995) showed several *Daviesia* species had a significant decrease in germination after treatment with various levels of smoke. He speculated that it was the heat, rather than the smoke of a fire which promoted germination of *Daviesia* species.

Schwarten (1995) found that *D. bursarioides* has a low seed set, with a fruit: flower ratio of 3.8% and a seed: ovule ratio of 1.9%. Around 98% of ovules were aborted and this may be due to insufficient numbers of pollinators in the area. Of seeds set, a germination of 7% was recorded (Schwarten 1995). Germination of between 6 and 70% has been observed for *D. bursarioides* (A. Cochrane pers. comm). Schwarten (1995) found that seed that was lightly buried rapidly lost viability over a six month period. Viability was 100% after being buried for six months, but was only 65% after being buried for 12 months (Schwarten 1995), which means it is unlikely that there is a significant soil stored seed bank.

Schwarten (1995) found that *D. bursarioides* has a multi-aged stand, with most plants declining after 6 years and dying after 8 - 10 years.

Due to the low number of plants and the threats associated with growing on narrow, degraded road reserves or near areas that are disturbed often, *D. bursarioides* was declared as Rare Flora in September 1987 and then ranked as Critically Endangered in September 1995.

3.2 Distribution and Habitat

Daviesia bursarioides is endemic to the Three Springs area occurring over a range of just seven kilometres. It is known from six populations with a combined total of around 123 plants (see Table 1).

D. bursarioides is found growing in shallow soils of brown sandy loams with extensive lateritic gravel that supports an open shrub mallee habitat dominated by *Eucalyptus gittinsii* and *Allocasuarina campestris*, *Dryandra* sp., *Hakea* sp., and *Grevillea* sp.

Table 1. Population details for *Daviesia bursarioides*.

Population no.	Number of individuals	Land tenure
1	19	Shire road verge
2	11	Shire road verge
3	17	Shire road verge
4	12	MRD road verge
5	60	Private property
6	4	Nature reserve

4. THE TRANSLOCATION

4.1 The Need to Translocate

The rarity of *D. bursarioides* is probably due to a lack of available habitat due to land clearing and as a result it is exposed to threats associated with a small population size and a highly restricted distribution. In addition, most of the populations of *D. bursarioides* occur on narrow degraded road verges and are exposed to weed invasion from surrounding farmland. Populations are also vulnerable to accidental destruction from road maintenance activities. Several incidents involving road maintenance activities have resulted in damaged plants, despite ongoing liaison and cooperation with the Shire of Three Springs.

Crisp (1985) recommended translocation to a "better protected locality nearby" as the only long term solution for the survival of this species. In addition an Interim Recovery Plan has been written for this species (Papenfus, Brown and Bunny, in prep) and this plan recommends the restocking of the known population or translocation to another site. Due to the extremely small population sizes of this species, and the numerous threats to these populations, translocation is considered to be urgent.

4.2 Translocation Site Selection

A site in the north east corner of the Sweetman Nature Reserve (#32906) was chosen as the translocation site. This is the site where population six already occurs, so soil type and associated vegetation type and structure is suitable for this species. As the species already occurs at this site this translocation can be considered a restocking under the definitions provided by Policy Statement 29 and the Guidelines for Translocation of Threatened Plants in Australia.

The proposed restocking site is only 4 km in a direct line from population five, from where the seed was sourced. Due to the short distance between sites it is unlikely that there are significant genetic differences between population 5 and population 6 (D. Coates pers. comm).

The area where the species occurs is managed by CALM, as it occurs within the boundaries of a Nature Reserve, and so no conflict of interest over land use is anticipated. Endorsement of this translocation was received from the CALM Midwest Region (Appendix four).

4.3 Translocation Design

A total of 205 seedlings of *D. bursarioides* have been raised for this years restocking from seed. Seed was sourced from a bulk collection from 30 adult plants within population 5.

At the proposed restocking site four replicates of 14m x 4m each will be measured. Plots will not be cleared of vegetation, instead seedlings will be planted in gaps in the vegetation, adhering as close as possible to the grid pattern presented in this proposal. In this way there will be minimal disturbance to the natural vegetation. There appears to be no reason that there would be adverse effects on the conservation values of the reserve from this translocation.

Each replicate will be divided into a grid of 51 holes, arranged in three rows of 13, and one row of 12, with 1m between each hole (see Appendix two for site diagram).

A total of four treatments will be tested: control, watered and mulched, mulched or watered (see Table 2). Treatments will be randomly assigned to one row in the grid (see Appendix two for site diagram).

Seedlings have been raised at the accredited nursery at Kings Park and Botanic Gardens and therefore are considered disease free. All equipment used during seedling planting will be maintained under strict disease hygiene.

Table 2. Description of experimental treatments.

Treatment	Description of Treatment
Control	Plants not given any treatment.
Mulched	A layer of mulch is placed around the plant to see whether it enhances survival by increasing water retention.
Watered	Plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether watering over the first summer enhances survival
Watered and mulched	A layer of mulch is placed around the plant and in addition plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether it is a combination of both watering and mulching that enhances survival.

An irrigation system will be set up during planting out of the seedlings to water those plants assigned to the watering treatment (see Table 2). A soil wetting agent will be added to the soil around these plants. Each plant will be permanently tagged so that each individual will always be identifiable. A small cage of rabbit netting will be placed around each plant to prevent predation of the seedlings by large herbivores.

Monitoring of the restocked population will be undertaken every second month commencing one month after the planting out of the seedlings. Monitoring will include counting the number of surviving germinants, height of the surviving seedlings, width of the crown of the surviving seedlings in two directions (so that crown volume can be calculated), reproductive state, number of flowers and pods, whether second generation plants are present and general health of the plants. A set photo point will be allocated for each plot and a photo will be taken each time monitoring takes place.

Monitoring of the original populations will also occur every second month in conjunction with monitoring of the restocked population. This will provide essential baseline data for assessing the performance of the translocated population. Monitoring will include counting the number of individuals, height and crown width of the individuals, reproductive state, number of flowers and pods and general health of the plants.

4.4 Source of Plants

Seed was collected under guidelines outlined in Appendix three. Seed has been sourced from population 5 from a bulk collection from 30 plants for planting at the translocation site in 1998. Seedlings are being raised at Kings Park and Botanic Gardens nursery after being germinated at the Threatened Flora Seed Centre.

4.5 Criteria for Success or Failure

Criteria for Success

- Short Term: establishment of translocated seedlings
  production of flowers and seed
  after one generation the number of individuals is sustained by natural recruitment
- Long Term: after two or more generations the number of individuals is sustained by natural recruitment, and a soil stored seed bank has been established.
- The production of guidelines for the establishment of future translocations of related species.

Criteria for Failure

- Short Term: failure of translocated seedlings to establish
  failure of plants to produce flowers and seed
- Long Term: there is a significant decline in the size of the translocated population due to lack of natural recruitment

5. TIMETABLE

Time	Action
October 1997	Seeds collected
October 1997	Seeds put down for germination. Resulting seedlings raised at Kings Park and Botanic Gardens.
March 1998	Translocation site selected.
April 1998	Translocation proposal submitted for review and approval.
July - August 1998	Translocation of seedlings into Sweetman Nature Reserve, where population 6 occurs.
August - September 1998	Follow up monitoring and maintenance of translocation site.
September 1998 - May 1999	Monitoring and maintenance of translocation site.
October 1998	Translocation proposal for 1999 translocation submitted for review.
November 1998	Second batch of seeds put down for germination. Resulting seedlings raised at Kings Park and Botanic Gardens.
April 1999	Progress report.
May - June 1999	Further translocation of seedlings into population 6.
June - July 1999	Follow up monitoring and maintenance of translocation site.
August 1999 - May 2001	Monitoring and maintenance of translocation site.
May 2001	Final Report

6. FUNDING

This project is fully funded for three years under National Heritage Trust ESP project number 566.

7. ACKNOWLEDGMENTS

I would like to thank Rob Brazell (CALM Mornington District), Bob Fitzgerald (CALM Central Forest Region), Les Robson (CALM Swan Region), Greg Durell (CALM Narrogin District), Andrew Batty (Kings Park and Botanic Gardens), and Kingsley Dixon (Kings Park and Botanic Gardens) for the opportunity to view their translocation projects or proposals, and for advice given.

8. REFERENCES

Crisp M.D. (1985). Conservation of the genus *Daviesia. Australian National Botanic Gardens Occasional Publication No. 6.* Australian Government Publishing Service, Canberra.

Crisp M.D. (1995) Contributions towards a revision of *Daviesia (Fabaceae: Mirbelieae)* III. A synopsis of *Daviesia. Australian Systematic Botany* 8 (6), pp 1155 - 1249.

Guidelines for the Translocation of Threatened Australian Plants. (1997) Produced by The Australian Network for Plant Conservation Translocation Working Group. Canberra, Australia.

Papenfus D., Brown A. and Bunny F. (In Prep). Three Springs Daviesia (*Daviesia bursarioides*) Interim Recovery Plan. Department of Conservation and Land Management. Perth WA.

Schwarten T. (1995) The Biology and Ecology of Threatened *Daviesia* Species in Western Australia. Final Report to Australian Nature Conservation Authority. Perth Western Australia.

Appendix Two.

Site Diagram for Proposed Restocking of *Daviesia bursarioides* population 6.

There is a total of 205 seedlings of *Daviesia bursarioides* available.
These will be planted as shown in the diagram below, with one seedling at each point marked with an asterix (*).
The four treatments of control, watered and mulched, watered and mulched will be assigned as per the diagram below.

Replicate 1

Watered	*	*	*	*	*	*	*	*	*	*	*	*	*
Control	*	*	*	*	*	*	*	*	*	*	*	*	
Watered and Mulched	*	*	*	*	*	*	*	*	*	*	*	*	*
Mulched	*	*	*	*	*	*	*	*	*	*	*	*	*

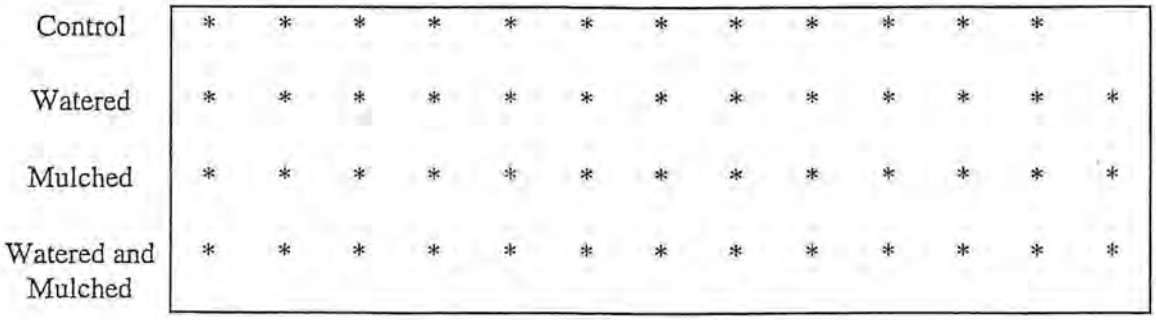
Replicate 2

Watered and Mulched	*	*	*	*	*	*	*	*	*	*	*	*	
Mulched	*	*	*	*	*	*	*	*	*	*	*	*	*
Control	*	*	*	*	*	*	*	*	*	*	*	*	*
Watered	*	*	*	*	*	*	*	*	*	*	*	*	*

Replicate 3

Mulched	*	*	*	*	*	*	*	*	*	*	*	*	*
Watered and Mulched	*	*	*	*	*	*	*	*	*	*	*	*	*
Watered	*	*	*	*	*	*	*	*	*	*	*	*	*
Control	*	*	*	*	*	*	*	*	*	*	*	*	

Replicate 4



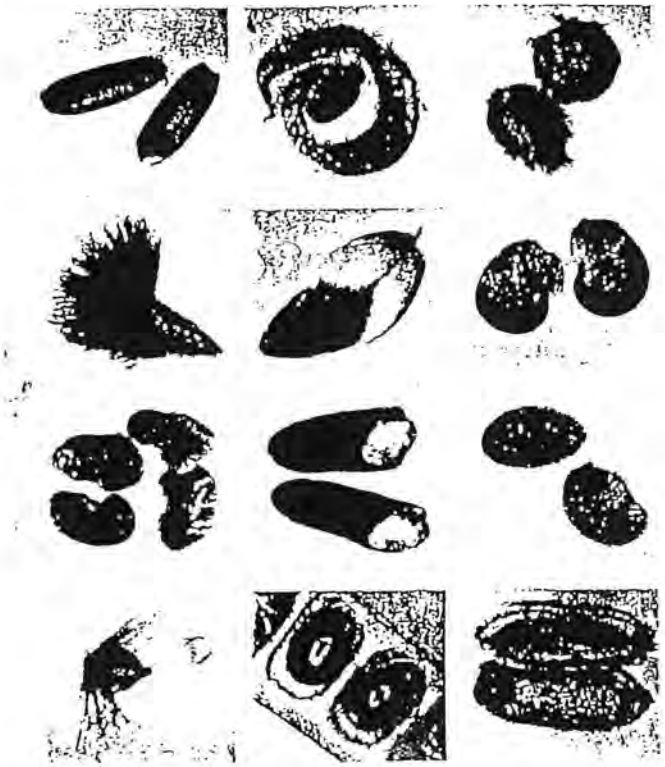
Scale: 1 m

Appendix Three.

Guidelines under which seed was collected for the translocation.

BASIC GUIDELINES FOR CONDUCTING SEED COLLECTIONS FOR CONSERVATION PURPOSES

Compiled by the
Threatened Flora Seed Centre



Threatened Flora Seed Centre
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IMPORTANT CONSIDERATIONS

Make sure that seed is mature. If fruits are green the seed is probably still immature. If brown or black the seed is probably mature. If in doubt, sacrifice 1or 2 seed to check maturity. The inside of the seed (endosperm) should be white and solid, not soft and translucent. Also check to see that the fruits have seed inside. Seed may have dehisced so don't waste your time with collecting empty fruits.

Use secateurs rather than breaking seed or stems. This will cause less damage to the plant and there is less likelihood that insect predators or disease will enter a clean cut.

Store seed or fruits in paper or calico, never in plastic. Plastic can sweat and seeds can easily go mouldy. Mould can kill seed and high moisture contents can reduce viability.

Send seed as soon as possible for processing and storage as viability can decrease considerably over time. Also insect pests can be a problem and seed may require fumigation.

Adequate information about the collection is required, such as species, location, date of collection and number of plants collected from.

APPENDIX 5

TRANSLOCATION PROPOSAL
Kamballup Dryandra,
Dryandra ionthocarpa A.S. George (PROTEACEAE)

1. SUMMARY

This species was first discovered by Peter Luscombe in 1987. It is named for the tuft of hairs at the top of the fruit, *ionthas* meaning 'shaggy' and *carpos* meaning 'a fruit'. It is a prostrate shrub to 60cm wide. The leaves are divided almost to the midrib, 8-25 cm long and 5-20 mm wide. The pink-mauve and yellow flowers are contained in a terminal inflorescence. Flowering occurs in September and October (George 1996).

D. ionthocarpa was listed as Declared Rare Flora in July 1989, and then ranked as Critically Endangered in September 1995. This ranking was due to the low numbers of individuals, the threat from a nearby mine, and the possibility of a disturbance event destroying the single known population (Kershaw *et al.* 1997).

A research project is currently investigating various aspects of the biology and ecology of *D. ionthocarpa*. Experimental burns showed that this species is killed by fire, regenerating entirely from seed. Seed viability is variable, ranging between 6 and 100% (A. Cochrane pers. comm.).

D. ionthocarpa is found growing in mallee-heath and is restricted to the spongolite soils of the Kamballup area. There are two subpopulations, 1a, with 682 individuals, and 1b, with 475 individuals, both are located on reserves vested in the Shire of Plantagenet.

The aim of this translocation proposal is to conserve the wild genetic stock of the species by establishing at least one more viable population of *D. ionthocarpa*. This will be achieved by translocating this species to another reserve. This translocation proposal outlines the need for translocation of the critically endangered *D. ionthocarpa*, the site selection process, the design of the translocation site and the provisions for monitoring. In addition it outlines the criteria for success or failure of this proposed translocation.

2. PROPONENTS

Dr David Coates Principal Research Scientist Dept. Conservation and Land Management KENSINGTON WA 6151 (08) 9334 0490	Leonie Monks Research Scientist Dept. Conservation and Land Management KENSINGTON WA 6151 (08) 9334 0495	Ellen Hickman Assistant Conservation Officer Dept. Conservation and Land Management ALBANY WA 6330 (08) 9842 4521	Sarah Barrett Acting Assistant Conservation Officer Dept. Conservation and Land Management ALBANY WA 6330 (08) 9842 4521

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3. BACKGROUND

3.1 History, Taxonomy and Status

This species was first discovered by Peter Luscombe in 1987. It is named for the tuft of hairs at the top of the fruit, *ionthas* meaning 'shaggy' and *carpos* meaning 'a fruit'. The species, although resembling the common prostrate *Dryandra nivea*, has been placed in a series all of its own within the genus due to the distinctiveness of the fruit. It is a prostrate shrub to 60 cm wide. The leaves are divided almost to the midrib, with 15-35 lobes on each side, 8-25 cm long and 5-20 mm wide. There are between 40 and 60 flowers within the terminal inflorescence. The perianth is 39-43 mm long, pink-mauve with a 7-8 mm long yellow limb. Flowering occurs in September and October. The fruit is 43-44 mm long with an apical tuft of long rusty hairs (George 1996).

D. ionthocarpa was listed as Declared Rare Flora in July 1989, and then ranked as Critically Endangered in September 1995. This ranking was due to the low numbers of individuals, the threat from a nearby mine, and the possibility of a disturbance event destroying the single known population (Kershaw *et al.* 1997).

In 1995 a Masters research project began which sought to investigate various aspects of the biology and ecology of *D. ionthocarpa*. Experimental burns as part of this project showed that this species is killed by fire, regenerating entirely from seed. Only small amounts of seed were found to be retained in the canopy after one year, and no seed was found to be stored in the soil after a year. It appears that postfire regeneration is reliant on the current years crop of seed. Seed viability is variable, ranging between 6 and 100% (A. Cochrane pers. comm.) and seed predation ranges between 31 and 98% of the total seed crop per plant (Monks in prep).

Experimental translocations were undertaken to test whether *D. ionthocarpa* could establish in different soil types (Monks in prep.). Survival after nine months was variable with the highest survival at site 8, a spongolite soil-type in a nearby nature reserve (table 1).

Table 1. Percentage survival of translocated *D. ionthocarpa* seedlings at eight sites after nine months.

Site	Soil type of site	Seed sourced from subpopulation 1a	Seed sourced from subpopulation 1b
1	Spongolite	7	27
2	Spongolite	36	67
3	Clay	0	20
4	Clay	14	67
5	Sandy loam	0	10
6	Sandy loam	7	53
7	Spongolite	0	3
8	Spongolite	50	87

Plant deaths observed in 1994 was initially thought to be caused by a plant disease, however tests for both *Phytophthora cinnamomi* and canker were negative. Further research has linked these plant deaths, and the bright orange colour of some plants foliage in summer, to water stress (Monks in prep.).

3.2 Distribution and Habitat

D. ionthocarpa is restricted to spongolite soils near Kamballup. It is found growing in mallee-heath with *Eucalyptus tetragona* (Beard 1979). Subpopulation 1a, with 682 individuals, is located on a Plantagenent Shire reserve (↑27607) vested for the purpose of Recreation. Subpopulation 1b, with 475 individuals, is located some 500m to the south of Subpopulation 1a, on a reserve (↑800) vested for the purpose of public utility.

4. THE TRANSLOCATION

4.1 The Need to Translocate

D. ionthocarpa is known from only one population, with two subpopulations, where there are approximately 1157 individuals. Research (Monks in prep) has shown that this species is susceptible to drought, with 40 plants dying over the summer of 1994/1995 (pers. obs.). It is probable that individuals will continue to succumb to drought, and as there is no seedling recruitment (Monks in prep.), it appears the population is in decline. Research has shown that a fire triggers recruitment, however, detrimental conditions, such as a drier than average summer drought, following such an event can result in the death of the seedlings (Monks in prep.).

This could result in a rapid decline in the number of individuals. As such translocation to another locality is considered a high priority. Translocation of this species is also considered desirable under the Interim Recovery Plan (Kershaw *et al.* 1997) and has been recommended as a management action as part of the research into this species (Monks in prep.)

4.2 Translocation Site Selection

An area on the western boundary of the Kalgan Plains Nature Reserve (#25583) has been identified by preliminary translocation (Monks in prep) as being a suitable habitat for this species. In August 1996, as part of a Masters research project, six translocation sites were established throughout the Kamballup Reserve and two within the Kalgan Plains Nature Reserve. After nine months the highest survival and growth was at one of the sites within the Kalgan Plains Nature Reserve (Table 1). As such this site is considered to be suitable habitat for this species.

As this species has not previously been recorded from this reserve this translocation can be considered an introduction under the definitions provided by Policy Statement 29 and the Guidelines for Translocation of Threatened Plants in Australia. A map of the proposed translocation site in relation to the known populations is shown in Appendix 1.

This reserve is only a short distance (6.5 km in a direct line) from the Kamballup populations and is *P. cinnamomi* free (M. Grant, pers. comm.). Strict hygiene procedures will be followed to prevent infection of the site during translocation planting and monitoring.

Both the translocation site and the known *D. ionthocarpa* populations have similar vegetation structure of Mid-Dense Low-Heath (using Muir's (1977) classification). Kershaw *et al.* (1997) lists this species as also occurring in open shrub mallee, however, whilst it is sometimes on the fringes of this habitat type, it never extends more than a few meters under the Eucalypt canopy (Monks in prep.). The translocation site has many associated species in common with the known populations, none of these are listed as rare or threatened. These are shown below in Table 2.

Table 2. Main associated species of *D. ionthocarpa* at the proposed translocation site within Kalgan Plains Nature Reserve compared to the associated vegetation at the known populations.

Main associated species of the original population of *D. ionthocarpa*	Main associated species of the proposed translocation site
Acacia assimilis	
Acacia sulcata var. planoconvexa	
Agonis spathulata	
Allocasurina microstachya	*Allocasurina microstachya*
Allocasurina trichodon	
Astroloma pallidum	
Beaufortia micrantha	
Borya sp.	
	Calothamnus ?huegelii
Daviesia dilatata	*Daviesia dilatata*
	Daviesia ?incrassata
Dryandra nivea	
Dryandra tenuifolia	*Dryandra tenuifolia*
Eucalyptus falcata	*Eucalyptus falcata*
Eucalyptus tetragona	*Eucalyptus tetragona*
	Hakea marginata
Isopogon buxifolius	*Isopogon buxifolius*
	Isopogon teretifolius subsp. *petrophiloides*
Melaleuca pentagona	*Melaleuca pentagona* subsp. *pentagona*
Petrophile squamata	*Petrophile squamata*
Petrophile teretifolia	
Verticordia chrysantha	
Verticordia pennigera	

Monks (in prep) indicates that the pollinators of this taxon are likely to be either small marsupials, such as honey possums, or birds, such as honeyeaters. It is difficult to assess whether these potential pollinators are likely to occur at the proposed translocation site. However *D. ionthocarpa* at its natural location produces large amounts of viable seed, which suggest the presence of pollinators, and it is therefore likely that in the nearby Kalgan Plains Nature Reserve, which has similar vegetation, the same pollinators will also be present.

The proposed translocation site has the same soil type as the known populations of sandy-loam over spongolite. Both sites are underlaid by a geological formation known as the Plantagenet Group which consists of siltstone and spongolite (Muhling and Brakel 1985).

The proposed translocation site was therefore chosen because the environmental attributes of climate, soil type, vegetation structure and associated vegetation are almost identical to the known Kamballup populations of this species and preliminary translocations show that this site is suitable.

4.3 Translocation Design

A total of 154 seedlings of *D. ionthocarpa* have been raised for this years translocation from seed collected from a bulk of 50 adult plants.

At the proposed translocation site four replicates of 24m x 4m each will be measured. Each replicate will be divided into a grid of 38 or 39 holes, arranged in three rows of 13 or in two rows of 13 with a third row of 12. A distance of 2m will be left between each hole (see Appendix two for site diagram).

A total of three treatments will be tested: control, shaded or watered (see Table 3). Treatments will be randomly assigned to one row in the grid (see Appendix two for site diagram).

Seedlings have been raised at the accredited nursery at Kings Park and Botanic Gardens and therefore are considered disease free. All equipment used during seedling planting will be maintained under strict disease hygiene. All effort will be taken to minimise the movement of soil into, out of, and within the site during translocation planting.

An irrigation system will be set up during planting out of the seedlings to water those plants assigned to the watering treatment (see Table 3). Water will be collected in tanks in-situ, or scheme water will be brought in, therefore, all water used will be considered disease free.

Table 3. Description of experimental treatments.

Treatment	Description of Treatment
Control	Plants not given any treatment.
Shaded	A circle of wire netting, approximately 1m in diameter covered in shade cloth is placed around the plant after planting to see whether survival is enhanced by the creation of a shaded environment around the plant.
Watered	Plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether watering over the first summer enhances survival.

Each plant will be permanently tagged so that each individual will always be identifiable. A small cage of rabbit netting will be placed around each plant to prevent predation of the seedlings by large herbivores.

Monitoring of the translocated population will be undertaken every third month commencing at planting out of the seedlings. Strict disease hygiene measures will be followed during monitoring. Monitoring will include counting the number of surviving seedlings, height of the surviving seedlings, width of the crown of the surviving seedlings in two directions (so that crown volume can be calculated), reproductive state, number of inflorescences and follicles, whether second generation plants are present and general health of the plants. A set photo point will be allocated for each plot and a photo will be taken each time monitoring takes place.

Monitoring of the original population will also occur every third month in conjunction with monitoring of the translocated population. This will provide essential baseline data for assessing the performance of the

translocated population. Monitoring will include counting the number of individuals, height and crown width of the individuals, reproductive state, number of inflorescences and follicles and general health of the plants.

4.4 Source of Plants

Seed was collected under guidelines outlined in Appendix four. Seed has been sourced from population 1a and b from a bulk of 50 adult plants for planting at the translocation site in 1998. Seedlings have been raised at Kings Park and Botanic Gardens nursery after being germinated at both the Kings Park and Botanic Gardens and Threatened Flora Seed Centre.

4.5 Criteria for Success or Failure

Criteria for Success

- Short Term (2 years):

1. establishment of translocated seedlings
2. production of flowers and seed

- Long Term (5 years):

1. after two or more generations the number of individuals is sustained by natural recruitment. However, recruitment of further plants into the population will only follow a fire, therefore an alternate criteria of success will be the establishment of a canopy stored seed bank (at least 120 cones per plant (Monks in prep.)).
2. the production of guidelines for the establishment of future translocations of related species.
3. levels of genetic diversity in the existing population are currently being assessed and will be compared to levels of genetic diversity in the translocated population following the establishment of a canopy stored seed bank.

Criteria for Failure

- Short Term (2 years):

1. failure of translocated seedlings to establish
2. failure of plants to produce flowers and seed

- Long Term (5 years):

1. there is a significant decline in the size of the translocated population due to lack of natural recruitment

5. TIMETABLE

Time	Action
Nov 1998	Seeds put down for germination. Resulting seedlings raised at Kings Park and Botanic Gardens.
Jan 1999	Translocation site selected.
Feb 1999	Translocation proposal submitted for review and approval.
June 1999	Translocation of seedlings into Kalgan Plains Nature Reserve.
Sept 1999 – Jun 2000	Monitoring and maintenance of translocation site.
Dec 1999	Seeds collected.
Dec 1999	Second batch of seeds put down for germination. Resulting seedlings raised at Kings Park and Botanic Gardens.
Feb 2000	Translocation proposal for 2000 translocation submitted for review.
June 2000	Further translocation of seedlings into Kalgan Plains Nature Reserve.
Sept 2000 – Feb 2001	Monitoring and maintenance of translocation site.
Feb 2001	Final Report

6. FUNDING

This project is fully funded for three years from February 1998 under National Heritage Trust ESP project number 566.

7. ACKNOWLEDGMENTS

Rob Brazell (CALM Mornington District, Bob Fitzgerald (CALM Central Forest Region), Les Robson (CALM Swan Region), Greg Durell (CALM Narrogin District), Andrew Batty (Kings Park and Botanic Gardens), and Kingsley Dixon (Kings Park and Botanic Gardens) are thanked for the opportunity to view their translocation projects or proposals, and for advice given.

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Kershaw K., Holland E. and Brown A. (1997). Kamballup Dryandra (*Dryandra ionthocarpa*) interim recovery plan. In: Interim Recovery Plans 4-16 for Western Australian Critically Endangered Plants and Animals. Eds: Pryde J., Brown A. and Burbidge A. Department of Conservation and Land Management. Perth Western Australia.

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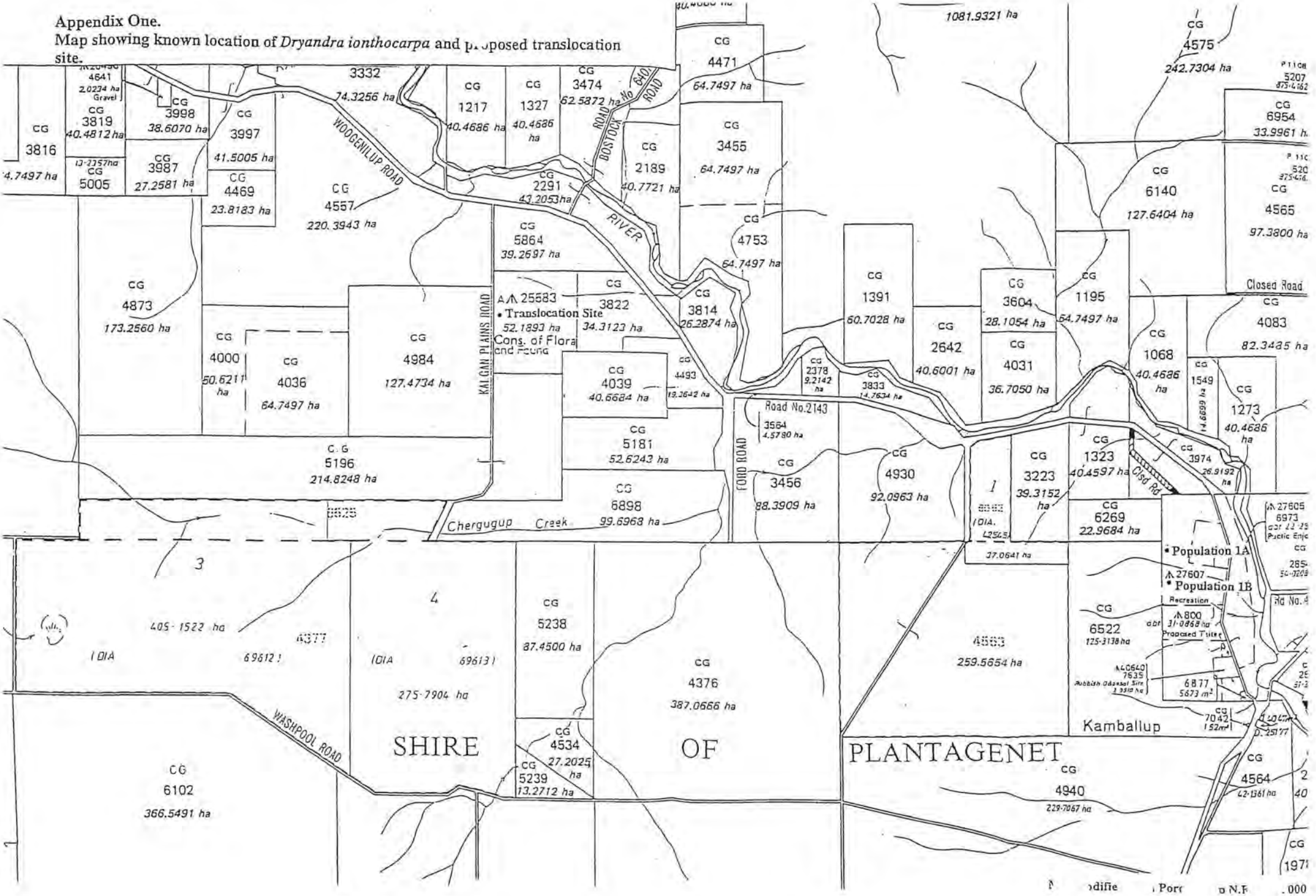
Muhling P.C. and Brackel A.T. (1985) Mount Barker - Albany Western Australia 1:250 000 Geological Series - Explanatory Notes. Geological Survey of Western Australia. Perth, Western Australia.

Appendix One.
Map showing known location of *Dryandra ionthocarpa* and proposed translocation site.

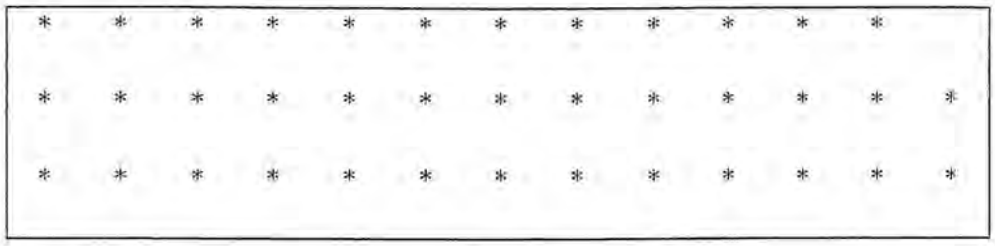


Appendix Two.

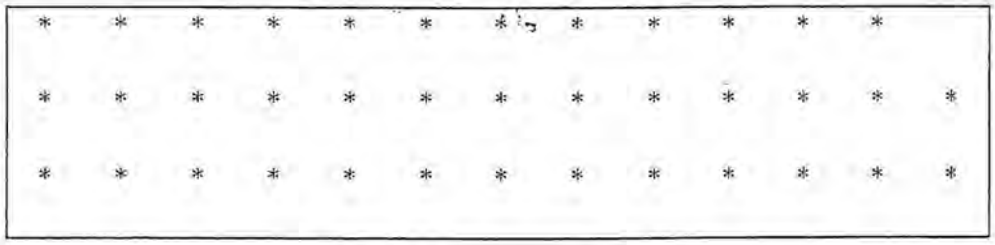
Site Diagram for Proposed Translocation of *Dryandra ionthocarpa*

There is a total of 154 seedlings of *Dryandra ionthocarpa* available.
These will be planted as shown in the diagram below, with one seedling at each point marked with an asterix (*).
The three treatments of control, watered and shaded will be assigned as per the diagram below.

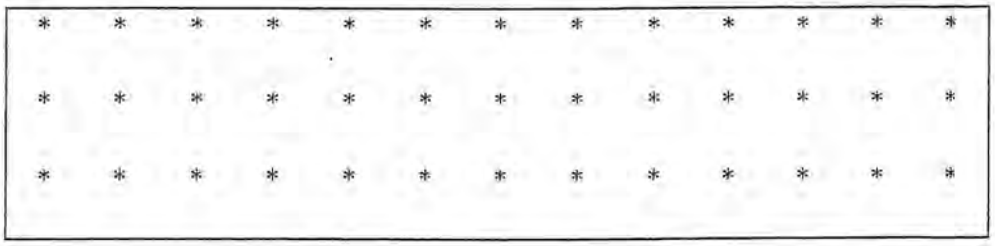
Replicate 1



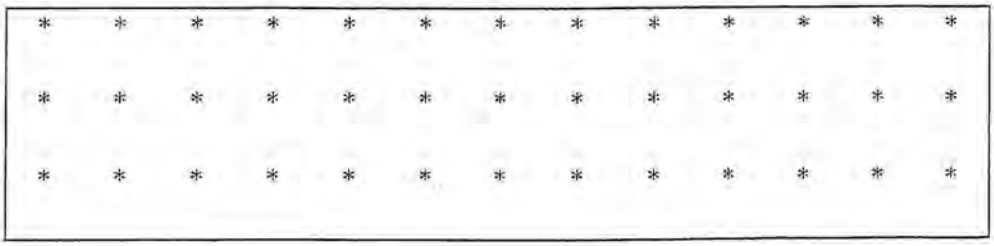
Replicate 2



Replicate 3



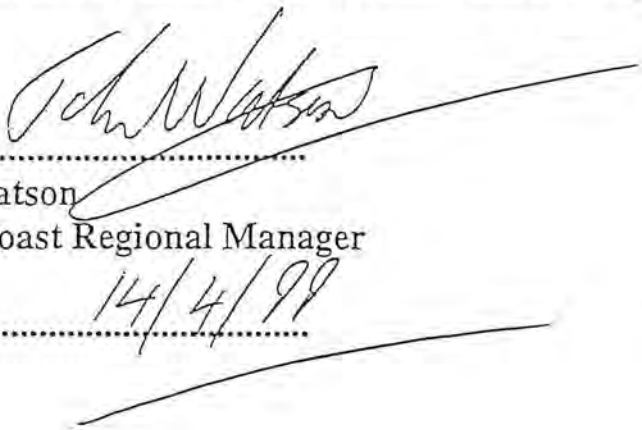
Replicate 4



Scale: 2 m

Appendix Three.

Regional Endorsement of the Translocation Proposal.



.....

John Watson
South Coast Regional Manager

Date: 14/4/99

IMPORTANT CONSIDERATIONS

ake sure that seed is mature. If fruits are een the seed is probably still immature. If brown black the seed is probably mature. If in doubt, icrifice 1or 2 seed to check maturity. The inside the seed (embryo/endosperm) should be white id solid, not soft and translucent. Also check to ie that the fruits have seed inside. Seed may ive dehisced so don't waste your time with llecting empty fruits.

se secateurs rather than breaking seed or ems. This will cause less damage to the plant d there is less likelihood that insect predators disease will enter a clean cut.

ore seed or fruits in paper or calico, never lastic. Plastic can sweat and seeds can easily mouldy. Mould can kill seed and high moisture ntents can reduce viability.

nd seed as soon as possible for ocessing and storage as viability can decrease nsiderably over time. Also insect pests can be roblem and seed may require fumigation.

cumentation is vital: note down the species, ation (lat/longs), collector, date of collection and nber of plants collected from.

Guidelines under which seed was collected for the translocation.

Threatened Flora Seed Centre
Western Australian Herbarium
Department of Conservation and Land Management
Locked Bag 104, Bentley Delivery Centre
Western Australia 6983

phone (08) 93340502
fax (08) 93340515
email annec@calm.wa.gov.au

BASIC GUIDELINES FOR CONDUCTING SEED COLLECTIONS FOR CONSERVATION PURPOSES

Compiled by the
Threatened Flora Seed Centre

APPENDIX 6

TRANSLOCATION PROPOSAL
Foote's Grevillea
Grevillea calliantha R.O. Makinson & P.M. Olde (Proteaceae)

1. SUMMARY

G. calliantha was first discovered in 1981 by Nick Foote, but was not named until 1991. The name *calliantha* is derived from the Greek *callos* meaning "beauty" and *anthos* meaning "a flower" (Olde and Marriott 1995) referring to the spectacular and prolific displays of inflorescences that this species produces.

Grevillea calliantha, is a compact shrub, which grows to around one metre tall and two to three metres wide. The leaves are greyish, yellow-green in colour, between 4 and 7.5 cm long, divided almost to the midrib, with lobes 1 - 1.1 cm wide. Lobes at the apex sometimes have a pungent point. Leaf margins are rolled under enclosing the lower surface except for the midrib. Midrib conspicuous on the upper leaf surface. The inflorescences on older plants are often located beneath and at the edge of the layered foliage, they are initially greenish-yellow, ageing to apricot-orange with a dark red style. Between 15 and 30 flowers are contained per inflorescence which is borne terminally or on short lateral branches. Flowering occurs between September and February, peaking from September to November. Large quantities of nectar are produced which encourages visitation by honeyeaters. Two seed per follicle are produced and are released from mid-October to February (Makinson and Olde 1991, Olde and Marriott 1995).

Much of the site of the first collections has since been cleared and due to the small size of these populations, the restricted range of the species and its vulnerability to accidental destruction and weed invasion, *G. calliantha* was declared as Rare Flora in 1989 and ranked as Critically Endangered in September 1995.

G. calliantha is endemic to an area near Dandaragan where it is known to occur over a range of just eight kilometres. There are only six populations of this species that occur within an eight kilometre radius with a combined total of just 137 individuals. *G. calliantha* grows in soils of grey to yellow-brown sand over laterite. It occurs in areas of low heath with scattered, emergent *Eucalyptus todtiana* on lower to mid level slopes to low hills.

An Interim Recovery Plan has been drafted for this species. Under section 3.3.8 this plan recommends the consideration of translocation to a secure site and also recommends that steps should be taken to initiate this (Papenfus, Brown, Bunny, in draft). Due to the small number of individuals of this species and the presence of most of these populations on narrow degraded road verges or on land that is not managed for conservation purposes the need for translocation is considered to be high.

The aim of this translocation proposal is to conserve the wild genetic stock of the species by establishing at least one more viable population of *G. calliantha*. This will be achieved by translocating this species to another part of the C Class Water Reserve where population 1 already occurs. This translocation proposal outlines the need for translocation of the critically endangered *G. calliantha*, the site selection process, the design of the translocation site and the provisions for monitoring. In addition it outlines the criteria for success or failure of this proposed translocation.

2. PROPONENTS

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A

3. BACKGROUND

3.1 History, Taxonomy and Status

The name *calliantha* is derived from the Greek *callous* meaning "beauty" and *anthos* meaning "a flower" (Olde and Marriott 1995) referring to the spectacular and prolific displays of inflorescences that this species produces.

Grevillea calliantha, is a compact shrub, which grows to around one metre tall and two to three metres wide. The leaves are greyish, yellow-green in colour, subsessile, or with petioles up to 3 mm long. The leaves are between 4 and 7.5 cm long, divided almost to the midrib (pinnatipartite), with lobes 1 - 1.1 cm wide. Lobes at the apex sometimes have a pungent point. Leaf margin rolled under enclosing the lower surface except for the midrib. Midrib conspicuous on the upper leaf surface. The inflorescences on older plants are often located beneath and at the edge of the layered foliage, they are initially greenish-yellow, ageing to apricot-orange with a dark red style. Between 15 and 30 flowers are contained per inflorescence which is borne terminally or on short lateral branches. Flowering occurs between September and February, peaking from September to November. Large quantities of nectar are produced which encourages visitation by honeyeaters. Two seed per follicle are produced and are released from mid-October to February. Seed is slightly curved, 12.5 mm long and 2 - 2.5 mm wide (Makinson and Olde 1991, Olde and Marriott 1995).

G. calliantha was first discovered in 1981 by Nick Foote, a commercial plant collector. Subsequent searches by Dr Steve Hopper of CALM located five small populations. The type specimen was collected in 1989 from near Cataby, by B.J. Conn, however, the species was not named until 1991.

This species is known to be a both a nonsprouter (Olde and Marriott 1995) and a resprouter (regeneration from rootstock was observed following a fire in Population one in May 1993). Viability of the seed ranges from 80 to 100% (A. Cochrane pers. comm.).

Much of the area where the first collections were made have since been cleared and the species is currently known from just six, mostly small populations. Due to the size of these populations, the restricted range of the species and its vulnerability to accidental destruction and weed invasion, *G. calliantha* was declared as Rare Flora in 1989 and ranked as Critically Endangered in September 1995.

3.2 Distribution and Habitat

G. calliantha is endemic to an area near Dandaragan where it is known to occur over a range of just eight kilometres. Four populations consisting of a mere 27 mature plants occur on extremely narrow, degraded road reserves. The largest population of around 100 plants occurs on private property. A total of 10 plants occur in a C Class Water Reserve that is managed by the Shire of Dandaragan.

G. calliantha grows in soils of grey to yellow-brown sand over laterite. It occurs in areas of low heath with scattered, emergent *Eucalyptus todtiana* on lower to mid level slopes to low hills. Other associated species are listed below in Table 1.

4. THE TRANSLOCATION

4.1 The Need to Translocate

The rarity of this species is probably due to extensive habitat clearance for agricultural purposes in the Dandaragan area. The small remnant populations of this species are exposed to threats such as weed invasion, grazing by kangaroos and rabbits, road maintenance activities, inappropriate fires, adverse effects from adjacent agricultural practices and potentially Dieback (*Phytophthora cinnamomi*).

There are only six populations of this species, that occur within an eight kilometre radius. There is a combined total of just 137 individuals with over 100 of these occurring in one population on private property. A further population occurs in a Class C Water Reserve vested in the Shire of Dandaragan. In 1988 the Shire Council

opposed a CALM recommendation that the Reserve become a Class A Nature Reserve for the purposes of Conservation of Flora and Fauna, so that "they could keep their options open".

An Interim Recovery Plan has been drafted for this species. Under section 3.3.8 this plan recommends the consideration of translocation to a secure site and also recommends that steps should be taken to initiate translocation (Papenfus, Brown, Bunny, in draft). Due to the small number of individuals and the presence of most of these populations on narrow degraded road verges, or on land that is not managed for conservation purposes, the need for translocation is considered to be high.

4.2 Translocation Site Selection

A search was made of areas around the known populations at Cataby on 24th February 1998 to locate a suitable translocation site. An area on the south western corner of the C Class Water Reserve was chosen as the translocation site. A buffer of at least 100 meters will be allowed between the proposed site and the edge of the reserve. This site was chosen because is only approximately 800 metres from the existing population 1 as well as having several attributes in common with the existing populations. A map of the proposed translocation site in relation to the known populations is shown in Appendix one.

Endorsement for the use of this site was received from the Midwest Region (Appendix three) and from the Shire of Dandaragan (Appendix four). The neighbouring landowners have been contacted by telephone on 25 June 1998 and informed of the translocation.

The proposed translocation site has a soil type of yellow-brown sand over laterite, with an underlying geology of Colluvium (soils found at the foot of a slope) - quartz sand and soil (Carter and Lipple 1982) which is similar to the know populations. The know populations have a soil type of grey to yellow-brown sand over laterite, which has an underlying geology of Colluvium quartz sand and soil or laterite and associated sand (Carter and Lipple 1982).

Table 1. A comparison of the associated vegetation at the proposed translocation site within the C Class Water Reserve with the known populations of *Grevillea calliantha*.

Associated species of the proposed translocation site within the C Class Water Reserve	Associated species of the original populations of *Grevillea calliantha*.
Acacia pulchella	*Acacia pulchella*
Adenanthos cygnorum	*Adenanthos cygnorum*
	Allocasuarina humilis
	Anigozanthos humilis
	Anigozanthos pulcherrimus
	Banksia attenuata
Calothamnus quadrifidus	*Calothamnus quadrifidus*
	Conostylis teretifolia
Eucalyptus calophylla	*Eucalyptus calophylla*
	Eucalyptus todtiana
	Gastrolobium spinosum
	Grevillea uncinulata
	Grevillea synapheae
	Hakea auriculata
	Hakea trifurcata
Hibbertia hypericoides	*Hibbertia hypericoides*
	Hypocalymma angustifolium
	Jacksonia sp.
	Lambertia multiflora
	Lechenaultia linariodes
	Nuytsia floribunda
	Synaphea spinulosa
	Xanthorrhoea sp.

Both the translocation site and the existing populations have a similar vegetation structure of Low Heath C with Open Low Woodland A (using Muir's classification). The translocation site has many associated species in common with the know populations. These are listed in Table 1.

The proposed translocation site was chosen because the environmental attributes of climate, soil type, vegetation structure and associated vegetation are almost identical to the known populations of this species. The proposed translocation site is only 800 metres from the nearest known occurrence of this species (population 1). Therefore, it is considered highly likely that the pollinators of this species, most likely Honeyeaters (Olde and Marriott 1995), will also visit the proposed translocation site as well the know populations, which is essential for self perpetuation of the translocated population and therefore the creation of a viable self sustaining population.

4.3 Translocation Design

A total of 95 seedlings of *G. calliantha* have been raised for this years translocation.

At the proposed translocation site three replicates of 12m x 4m each will be measured. Each replicate will be divided into a grid of 30 holes, arranged in three rows of ten, with 1m between each hole and a border of 1m on each side of the plot.

A total of three treatments will be tested: control, mulched or watered (see Table 2). Treatments will be randomly assigned to one row in the grid (see Appendix two for site diagram).

Seedlings have been raised at the accredited nursery at Kings Park and Botanic Gardens and therefore are considered disease free. All equipment used during seedling planting will be maintained under strict disease hygiene.

An irrigation system will be set up in November 1998 to water weekly those plants assigned to the watering treatment (see Table 2). A soil wetting agent will be added to the soil around these plants.

Table 2. Description of experimental treatments.

Treatment	Description of Treatment
Control	Plants not given any treatment.
Mulched	A layer of mulch is placed around the plant to see whether it enhances survival by increasing water retention.
Watered	Plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether watering over the first summer enhances survival.

Each plant will be permanently tagged so that each individual will always be identifiable. A small cage of rabbit netting will be placed around each plant to prevent large herbivores from eating the plants.

Monitoring of the translocated population will be undertaken every second month commencing one month after the planting out of the seedlings. Monitoring will include counting the number of surviving germinants, height of the surviving germinants, width of the crown of the surviving germinants in two directions (so that crown volume can be calculated), reproductive state, number of inflorescences and follicles, whether second generation plants are present and general health of the plants. A set photo point will be allocated for each plot and a photo will be taken each time monitoring takes place.

Monitoring of the original populations will also occur every second month in conjunction with monitoring of the translocated populations. This will provide essential baseline data for assessing the performance of the translocated population. Monitoring will include counting the number of individuals, height and crown width of the individuals, reproductive state, number of inflorescences and follicles and general health of the plants.

4.4 Source of Plants

Seed was collected under guidelines outlined in Appendix five. Seed has been sourced from population two and six for planting at the translocation site in 1998. These populations are only 7.75 km and 2.8 km away from the proposed translocation site respectively, and are not considered likely to be genetically different (D. Coates pers. comm). No seed was sourced from population one, which is only 800 m from the translocation site as plants were juveniles, having produced no fruit since a fire several years ago. No seed was sourced from populations three, four or five as insufficient seed was available. Seedlings are being raised at Kings Park and Botanic Gardens nursery after being germinated at the Threatened Flora Seed Centre.

4.5 Criteria for Success or Failure

Criteria for Success

- Short Term: after one generation the number of individuals is sustained by natural recruitment
- Long Term: after two or more generations the number of individuals is sustained by natural recruitment

Criteria for Failure

- There is a significant decline in population size due to lack of natural recruitment

5. TIMETABLE

Time	Action
November 1997	Seeds put down for germination.
February 1998	Translocation site selected.
April 1998	Translocation proposal submitted for review.
May - June 1998	Translocation of seedlings into the C Class Water Reserve.
June - July 1998	Follow up monitoring and maintenance of translocation site.
August 1998 - May 1999	Monitoring and maintenance of translocation site.
November 1998	Setting up of irrigation system.
October 1998	Translocation proposal for 1999 translocation submitted for review.
November 1998	Second batch of seeds put down for germination. Resulting seedlings raised at Kings Park and Botanic Gardens.
April 1999	Progress report.
May - June 1999	Further translocation of seedlings into the C Class Water Reserve.
June - July 1999	Follow up monitoring and maintenance of translocation site.
August 1999 - May 2001	Monitoring and maintenance of translocation site.
May 2001	Final Report

6. FUNDING

This project is fully funded for three years under National Heritage Trust ESP project number 566.

7. ACKNOWLEDGMENTS

Rob Brazell (CALM Mornington District, Bob Fitzgerald (CALM Central Forest Region), Les Robson (CALM Swan Region), Greg Durell (CALM Narrogin District), Andrew Batty (Kings Park and Botanic Gardens), and Kingsley Dixon (Kings Park and Botanic Gardens) are thanked for the opportunity to view their translocation projects or proposals, and for advice given.

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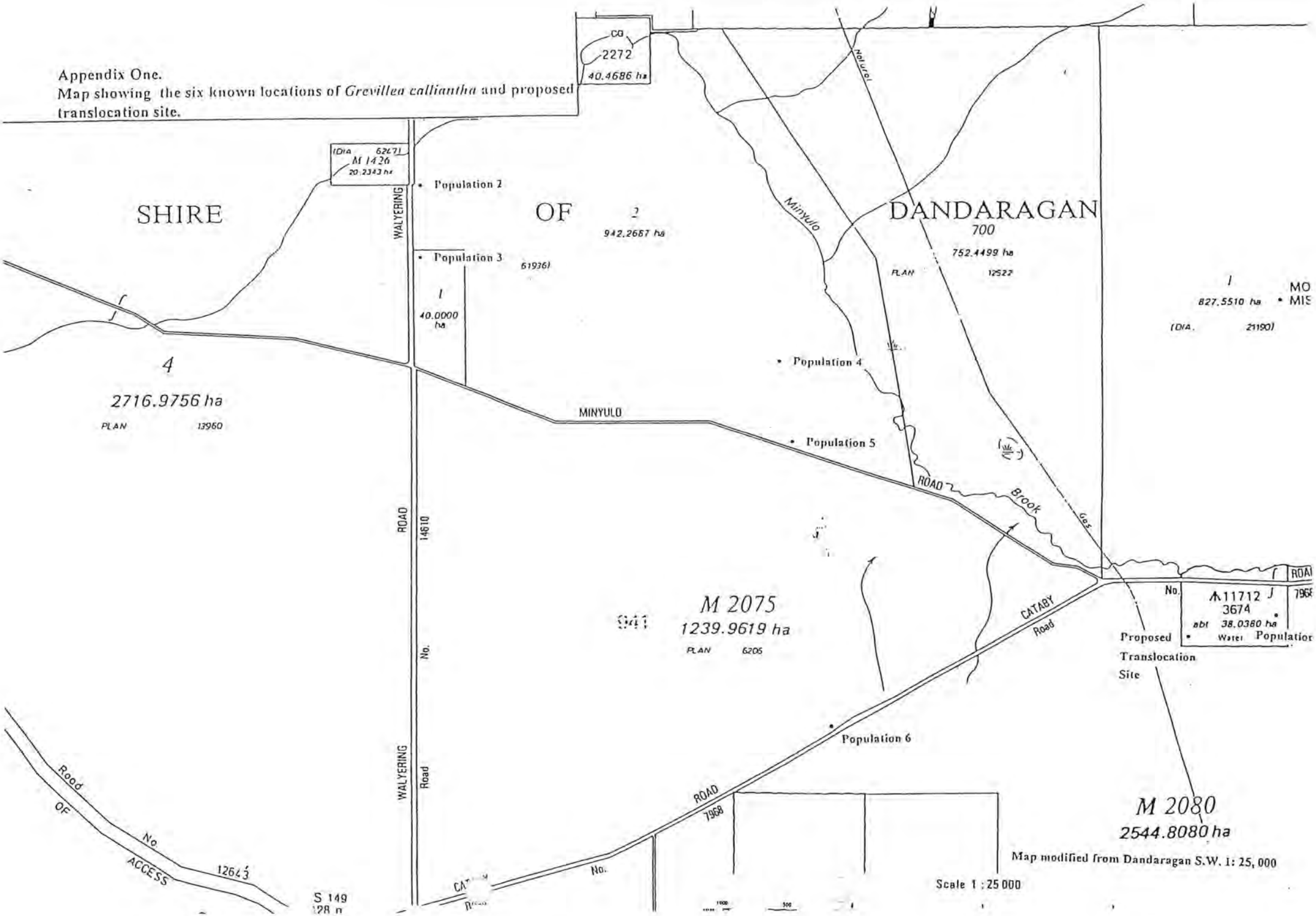
Olde P. and Marriott N. (1995) *The Grevillea Book* Vol 2. Kangaroo Press, Kenthurst NSW

Papenfus D., Brown A. and Bunny F. (in draft) Foote's Grevillea (*Grevillea calliantha*) Interim Recovery Plan Department of Conservation and Land Management. Perth WA

Appendix One.
Map showing the six known locations of *Grevillea calliantha* and proposed translocation site.

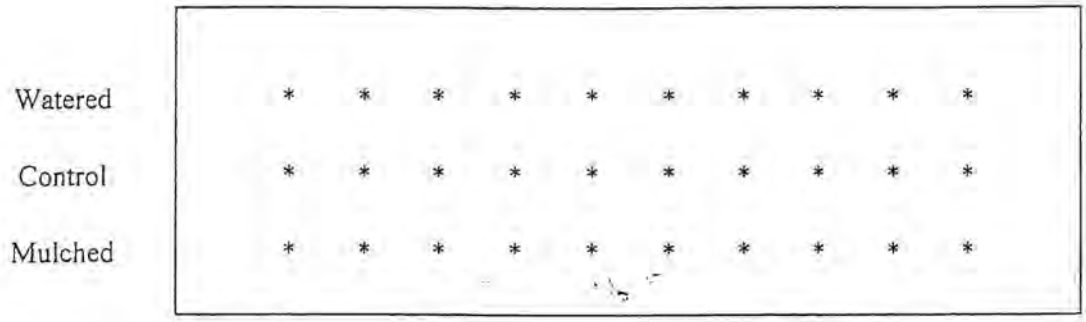


Appendix Two.

Site Diagram for Proposed Translocation of *Grevillea calliantha*

There is a total of 95 seedlings of *Grevillea calliantha* available.
These will be planted as shown in the diagram below, with one seedling at each point marked with an asterix (*).
The three treatments of control, mulched, watered will be assigned as per the diagram below.

Replicate 1



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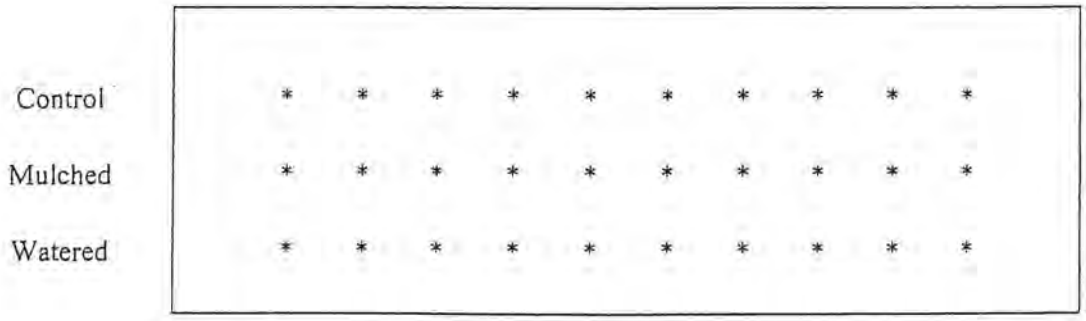
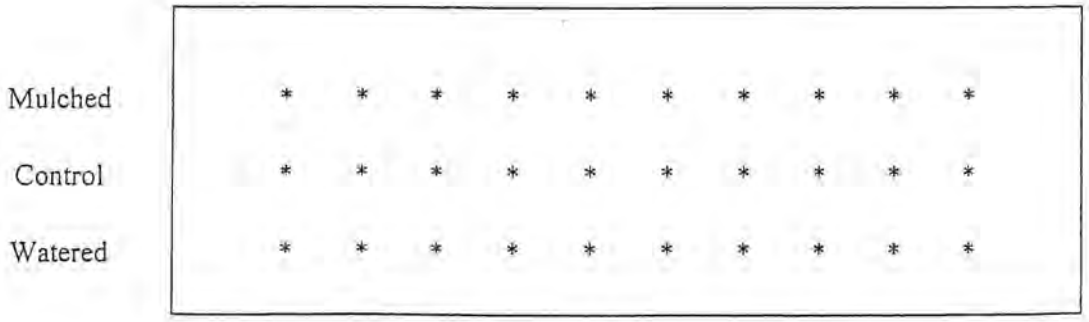


Replicate 3



Scale: 1 m

Appendix Three.

A copy of the letter from the Shire of Dandaragan granting permission for the translocation site to be located within the Shire's C Class Water Reserve.

Shire of Dandaragan

COUNCIL OFFICES:
Dandaragan, W.A. 6507
Telephone: (08) 9651 4010
Facsimile: (08) 9651 4057

HEALTH & BUILDING:
Bashford St, Jurien, W.A. 6516
Telephone: (08) 9652 1020
Facsimile: (08) 9652 1310

All correspondence to be addressed to the Chief Executive Officer

Our Ref: GEN 10 DJS:MAG
Your Ref:
Enquiries: David Seinor

29th June, 1998

Leoni Monks
Research Scientist
Department of Conservation and Land Management
Locked Bag 104
BENTLEY DELIVERY CENTRE WA 6983

Dear Leoni,

C CLASS WATER RESERVE NO: 11712

I refer to your letter dated 20th April, 1998 in which you requested Council's approval to utilise the C Class Water Reserve No. 11712 to translocate the critically endangered species Grevillea calliantha.

Following your inspection with Terry Powell on 24th June, 1998, I wish to advise that approval is given to translocate this species to the area as defined at the meeting. Council wish to preserve an area which is set aside on the C Class Water Reserve, which is currently used for stockpiling of road making material.

I wish to take this opportunity to thank you and Sue Patrick for visiting the Shire and locating a number of declared rare and priority species that required to be re-surveyed.

If you require any further information, please contact this office.

Yours faithfully,

D J SEINOR
CORPORATE SERVICES MANAGER

Appendix Four.

Regional Endorsement of the Translocation Proposal.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
Midwest Regional Headquarters, Geraldton - Telephone 099 21 5955 Facsimile 099 21 5713

To : Leonie Monks. Research Scientist, Woodvale.

Your ref :
Our ref : 20L32
Enquiries : Ron Shepherd

Subject : **Translocation Proposals for Critically Endangered Flora – Moora District**

I refer to your letter of 20 May 1998, seeking Midwest Region approval for four translocation proposals for critically endangered flora in the Moora District.

I provide the following comments on the four translocation proposals:

- *Acacia aprica.* Proposal endorsed.
- *Acacia cochlocarpa* subsp. *cochlocarpa.* Proposal endorsed subject to "Necessary Operations" approval being obtained for the activities that are planned to occur on Gunyidi Nature Reserve (No. 23602).
- *Davesia bursarioides.* Proposal endorsed subject to written confirmation of permission to utilise the proposed translocation site is obtained from the land owner.
- *Grevillea calliantha.* Proposal endorsed subject to written confirmation of permission to utilise the proposed translocation site is obtained from the Shire of Dandaragan.

The endorsement forms are attached as requested.

Kelly Gillen
Regional Manager – Midwest Region
MIDWEST REGION

Wednesday, June 10, 1998

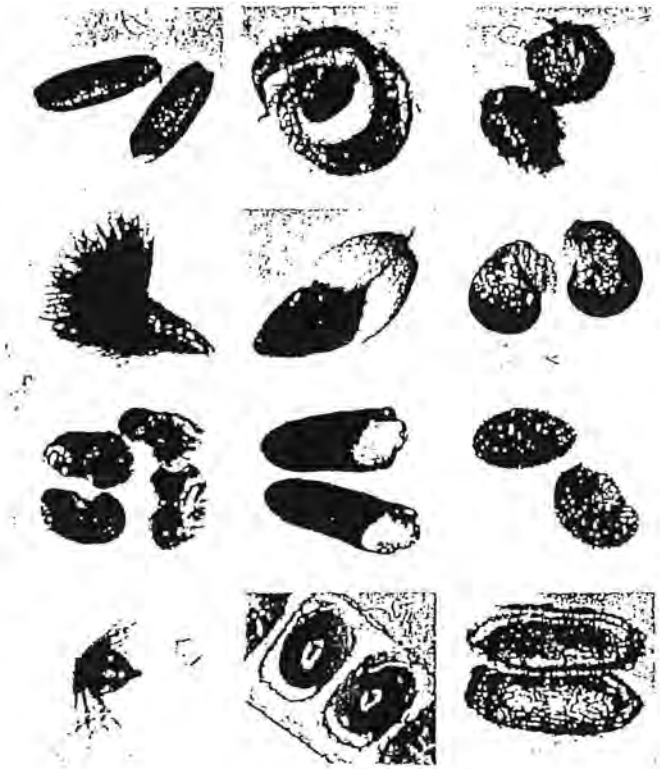
C:\MY DOCUMENTS\DRFTRANS.DOC

Appendix Five.

Guidelines under which seed was collected for the translocation.

BASIC GUIDELINES FOR CONDUCTING SEED COLLECTIONS FOR CONSERVATION PURPOSES

Compiled by the
Threatened Flora Seed Centre



Threatened Flora Seed Centre
Western Australian Herbarium
Department of Conservation and Land Management
Locked Bag 104, Bentley Delivery Centre
Western Australia 6983

phone (08) 93340502
fax (08) 93340515

IMPORTANT CONSIDERATIONS

Make sure that seed is mature. If fruits are green the seed is probably still immature. If brown or black the seed is probably mature. If in doubt, sacrifice 1or 2 seed to check maturity. The inside of the seed (endosperm) should be white and solid, not soft and translucent. Also check to see that the fruits have seed inside. Seed may have dehisced so don't waste your time with collecting empty fruits.

Use secateurs rather than breaking seed or stems. This will cause less damage to the plant and there is less likelihood that insect predators or disease will enter a clean cut.

Store seed or fruits in paper or calico, never in plastic. Plastic can sweat and seeds can easily go mouldy. Mould can kill seed and high moisture contents can reduce viability.

Send seed as soon as possible for processing and storage as viability can decrease considerably over time. Also insect pests can be a problem and seed may require fumigation.

Adequate information about the collection is required, such as species, location, date of collection and number of plants collected from.

APPENDIX 7

TRANSLOCATION PROPOSAL
Prickly Honeysuckle,
Lambertia echinata R.Br. subsp. *echinata* Hnatiuk (PROTEACEAE)

1. SUMMARY

Lambertia is a genus within the family Proteaceae, of which nine of the ten species are endemic to southwest Western Australia. *Lambertia echinata* R.Br subsp. *echinata* Hnatiuk. is a shrub to 1 m with spreading branches. Leaves narrowly triangular 3 - 4 cm long with 3 - 5 spines on the margins and prominent raised veins on the underside. The inflorescence is 7 flowered, with numerous bracts. The perianth is orange-red to pink between 2.5 and 4 cm long and loosely enclosed by bracts. Flowers are produced from September to January.

Robert Brown first collected *Lambertia echinata* whilst in the Esperance area, it was then described by him in 1810. He also described *L. propinqua* from material collected from Albany in 1830. Further taxonomic work (Hnatiuk 1995) considered *L. propinqua* a synonym for *L. echinata* subsp. *citrina*, and so *L. echinata* became *L. echinata* subsp. *echinata*. More recently a newly discovered *Lambertia* was described as *L. echinata* subsp. *occidentalis* (Keighery 1997), bringing the number of subspecies in the complex to three.

L. echinata subsp. *echinata* grows in lateritic gravels and sandy clay soils that are found on the windswept rocky coastal slopes in the Lucky Bay area in association with *Dryandra falcata*, *Eucalyptus doratoxylon* and *E. tetragona*.

The only live population of *L. echinata* subsp. *echinata* grows on two islands left in a gravel pit and consisting of three adult and four seedlings. The extraction of gravel was stopped after this subspecies was found there and then rehabilitation of the gravel pit began in 1994. Seed was collected from the three remaining adult plants, germinated and planted into the gravel pit in 1995. In 1998 only one of these translocated seedlings was found alive.

L. echinata subsp. *echinata* was declared as Rare Flora in November 1980 and ranked as critically endangered in September 1995 due to threats associated with low population numbers, restricted distribution, habitat destruction and potential *P. cinnamomi* infection.

The aim of this translocation proposal is to conserve the wild genetic stock of the subspecies by restocking the single known population of *L. echinata* subsp. *echinata*. This translocation proposal outlines the need for translocation of the critically endangered *L. echinata* subsp. *echinata*, the site selection process, the design of the translocation site and the provisions for monitoring. In addition it outlines the criteria for success or failure of this proposed translocation.

2. PROPONENTS

Dr David Coates
Principal Research Scientist
Dept. Conservation and Land Management
KENSINGTON WA 6151
(08) 9334 0490

Leonie Monks
Research Scientist
Dept. Conservation and Land Management
KENSINGTON WA 6151
(08) 9334 0495

Klaus Tiedemann
District Manager
Dept. Conservation and Land Management
ESPERANCE WA 6450
(08) 9071 3733

Bernie Haberley
District Wildlife Officer
Dept. Conservation and Land Management
ESPERANCE WA 6450
(08) 9071 3733

TABLE OF CONTENTS

3. BACKGROUND

3.1 History, Taxonomy and Status

Lambertia is a genus within the family Proteaceae, of which nine of the ten species are endemic to southwest Western Australia. The genus is named for the English horticulturalist Aylmer Lambert. The name *echinata* is derived from the Latin word *echinus* meaning hedgehog-like, referring to the prickly nature of the species.

Lambertia echinata R.Br. subsp. *echinata* Hnatiuk. is a shrub to 1 m with spreading branches. Leaves may or may not have a petiole to 2 mm long. Leaves narrowly cuneate (triangular) 3 - 4 cm long with 3 - 5 spines on the margins and prominent raised veins on the underside. The inflorescence is 7 flowered, with numerous bracts that may be up to two thirds of the length of the perianth. The perianth is orange-red to pink between 2.5 and 4 cm long and loosely enclosed by bracts. Flowers are produced from September to January. The shiny grey fruits are ovoid in shape 0.5 - 0.8 cm in diameter and covered in spines. Each fruit contains 2 circular seeds with narrow angular wings.

Robert Brown first collected *Lambertia echinata* whilst in the Esperance area, it was then described by him in 1810. He also described *L. propinqua* from material collected from Albany in 1830. Further taxonomic work (Hnatiuk 1995) considered *L. propinqua* a synonym for *L. echinata* subsp. *citrina*, and so *L. echinata* became *L. echinata* subsp. *echinata*. More recently a newly discovered *Lambertia* was described as *L. echinata* subsp. *occidentalis* (Keighery 1997), bringing the number of subspecies in the complex to three.

The only live population of *L. echinata* subsp. *echinata* grows on two islands left in a gravel pit consisting of three adult plants and four seedlings. The extraction of gravel was stopped after this subspecies was found there and rehabilitation of the gravel pit began in 1994. Seed was collected from the three remaining adult plants and germinated. Four seedlings resulted from this and these were planted into the gravel pit in 1995. Inspection of these seedlings in 1996 showed that only two had survived and further inspections in 1997 and 1998 found only one seedling.

L. echinata subsp. *echinata* was declared as Rare Flora in November 1980 and ranked as critically endangered in September 1995 due to threats associated with low population numbers, restricted distribution, habitat destruction and potential *P. cinnamomi* infection.

The genus *Lambertia* is considered to be highly susceptible to Dieback (*Phytophthora* spp) (Obbens and Coates 1997). They are known to lack a lignotuber (Hnatiuk 1995) and are killed by fire, regenerating from seed (Obbens and Coates 1997). Seed collected from this subspecies appears to be highly viable (75 - 100%) and this high viability is retained in low temperature (-18° C) storage after one year (A. Cochrane pers. comm.).

3.2 Distribution and Habitat

L. echinata subsp. *echinata* grows in lateritic gravels and sandy clay soils that are found on the windswept rocky coastal slopes in the Lucky Bay area. It grows in association with *Dryandra falcata*, *Eucalyptus doratoxylon* and *E. tetragona*. A full list of associated species is given below in Table 1.

This species is only known from two small subpopulations. Subpopulation 1a has three adults and four seedlings, and subpopulation 1b (500 metres to the north east of subpopulation 1a) has seven dead adult plants. The cause of the deaths of the seven plants in population 1b is not known, however, Dieback is suspected. Extensive searches for this subspecies were undertaken in the Lucky Bay area in 1995, however, no new populations were located.

Table 1. Main associated species found in the gravel pit where *L. echinata* subsp. *echinata* occurs

Main associated species
Adenanthos sericeus subsp. *sphalma*
Agonis obtusissima
Bossiaea dentata
Dryandra falcata
Eucalyptus aquilina
Eucalyptus conferruminata
Eucalyptus doratoxylon
Eucalyptus tetragona
Hakea drupacea
Hakea trifurcata
Lambertia inermis
Melaleuca striata
Mirbelia dilatata
Nuytsia floribunda
Verticordia sp.

4. THE TRANSLOCATION

4.1 The Need to Translocate

L. echinata subsp. *echinata* is known from only one live subpopulation consisting of three adult plants and four seedlings and these occur in the middle of a disused gravel pit. Land clearing for gravel extraction is thought to have reduced the number of individuals in subpopulation 1a and dieback may have been the cause of the death of population 1b, although this has not been confirmed. *Phytophthora* has been identified in many areas of Cape Le Grand National Park (Obbens and Coates 1997), and visual observations indicate that *Phytophthora* is in the vegetation surrounding the gravel pit.

An Interim Recovery Plan has been written for this subspecies (Monks and Brown in draft) and this plan recommends the restocking of the known population or translocation to another site. Due to the extremely small population size of this subspecies translocation is considered to be urgent.

4.2 Translocation Site Selection

The gravel pit where this taxon already grows (see Appendix one) is considered the best site to concentrate translocation efforts, as the remaining adult plants are healthy and recruitment has occurred over the last few years. This translocation can therefore be considered a restocking under the definitions provided by Policy Statement 29 and the Guidelines for Translocation of Threatened Plants in Australia. The gravel pit site was chosen so that there will be no further disturbance of the area as a result of the translocation. In addition, rehabilitation of the gravel pit by CALM has already commenced. This involved deep ripping the site and allowing natural rehabilitation to occur. The translocation will be closely integrated into the rehabilitation process. The area where the subspecies occurs is managed by CALM, as it occurs within the boundaries of Cape Le Grande National Park, and so no conflict of interest over land use is anticipated. The translocation has been endorsed by the CALM South Coast Region (Appendix three).

The issue of *Phytophthora* species, particularly *P. cinnamomi* will be addressed using the chemical Phosphite (Komorek and Shearer 1997), and therefore it is not considered to be a factor influencing site selection. The gravel pit area will be aerially sprayed prior to seedlings being planted out. Seedlings will be individually sprayed with Phosphite when they are considered to be old enough to warrant such treatment. Repeat sprayings will be undertaken when necessary. Whilst the presence of *P. cinnamomi* is often the reason for translocation to another site, here translocation back into a site where *P. cinnamomi* has been confirmed is still considered the best option. This is because *P. cinnamomi* is widespread throughout the Cape Le Grande National Park, and we believe that *P. cinnamomi* can be controlled adequately using regular applications of Phosphite. Phosphite spraying will have to continue indefinitely, for this to be a viable population in the long term.

4.3 Translocation Design

A total of 165 seedlings of *L. echinata* subsp. *echinata* have been raised for this years restocking from seed collected from a bulk of three adult plants.

At the proposed restocking site four replicates of 14m x 4m each will be measured. Each replicate will be divided into a grid of 41 holes, arranged in two rows of 14, and one row of 13, with 2m between each hole (see Appendix two for site diagram).

A total of three treatments will be tested: control, shaded or watered (see Table 2). Treatments will be randomly assigned to one row in the grid (see Appendix two for site diagram).

Seedlings have been raised at the accredited nursery at Kings Park and Botanic Gardens and therefore are considered disease free. All equipment used during seedling planting will be maintained under strict disease hygiene. All effort will be taken to minimise the movement of soil into, out of, and within the site during translocation planting.

An irrigation system will be set up during planting out of the seedlings to water those plants assigned to the watering treatment (see Table 2). Water will be collected in tanks in-situ, or scheme water will be brought in, therefore, all water used will be considered disease free. A soil wetting agent will be added to the soil around those plants assigned to the watering treatment.

Table 2. Description of experimental treatments.

Treatment	Description of Treatment
Control	Plants not given any treatment.
Shaded	A circle of wire netting, approximately 1m in diameter covered in shade cloth is placed around the plant after planting to see whether survival is enhanced by the creation of a shaded environment around the plant.
Watered	Plants will be watered with a set amount of water once a week for 24 weeks from the start of November to the end of April to see whether watering over the first summer enhances survival.

Each plant will be permanently tagged so that each individual will always be identifiable. A small cage of rabbit netting will be placed around each plant to prevent predation of the seedlings by large herbivores.

Monitoring of the restocked population will be undertaken every second month commencing one month after the planting out of the seedlings. Strict disease hygiene measures will be followed during monitoring. In particular, due to the inaccessibility of the site by vehicle, the strict washdown of boots into, and out of the site will be followed. Monitoring will include counting the number of surviving germinants, height of the surviving seedlings, width of the crown of the surviving seedlings in two directions (so that crown volume can be calculated), reproductive state, number of inflorescences and follicles, whether second generation plants are present and general health of the plants. A set photo point will be allocated for each plot and a photo will be taken each time monitoring takes place.

Monitoring of the original population (subpopulation 1a only) will also occur every second month in conjunction with monitoring of the restocked population. This will provide essential baseline data for assessing the performance of the translocated population. Monitoring will include counting the number of individuals, height and crown width of the individuals, reproductive state, number of inflorescences and follicles and general health of the plants.

4.4 Source of Plants

Seed was collected under guidelines outlined in Appendix four. Seed has been sourced from population 1a from a bulk of three adult plants for planting at the translocation site in 1998. Seedlings have been raised at Kings Park and Botanic Gardens nursery after being germinated at the Threatened Flora Seed Center.

4.5 Criteria for Success or Failure

Criteria for Success

- Short Term: establishment of translocated seedlings
  production of flowers and seed
  after one generation the number of individuals is sustained by natural recruitment
- Long Term: after two or more generations the number of individuals is sustained by natural recruitment, and a soil stored seed bank has been established.
- The production of guidelines for the establishment of future translocations of related species.

Criteria for Failure

- Short Term: failure of translocated seedlings to establish
  failure of plants to produce flowers and seed
- Long Term: there is a significant decline in the size of the translocated population due to lack of natural recruitment

5. TIMETABLE

Time	Action
October 1997	Seeds put down for germination. Resulting seedlings raised at Kings Park and Botanic Gardens.
March 1998	Translocation site selected.
April 1998	Translocation proposal submitted for review and approval.
June - July 1998	Translocation of seedlings into the gravel pit where population 1a occurs.
July - August 1998	Follow up monitoring and maintenance of translocation site.
August 1998 - May 1999	Monitoring and maintenance of translocation site.
October 1998	Translocation proposal for 1999 translocation submitted for review.
~ November 1998	Seeds collected
November 1998	Second batch of seeds put down for germination. Resulting seedlings raised at Kings Park and Botanic Gardens.
April 1999	Progress report.
May - June 1999	Further translocation of seedlings into the gravel pit where population 1a occurs.
June - July 1999	Follow up monitoring and maintenance of translocation site.
August 1999 - May 2001	Monitoring and maintenance of translocation site.
May 2001	Final Report

6. FUNDING

This project is fully funded for three years under National Heritage Trust ESP project number 566.

7. ACKNOWLEDGMENTS

Rob Brazell (CALM Mornington District, Bob Fitzgerald (CALM Central Forest Region), Les Robson (CALM Swan Region), Greg Durell (CALM Narrogin District), Andrew Batty (Kings Park and Botanic Gardens), and Kingsley Dixon (Kings Park and Botanic Gardens) are thanked for the opportunity to view their translocation projects or proposals, and for advice given.

8. REFERENCES

Guidelines for the Translocation of Threatened Australian Plants. (1997) Produced by The Australian Network for Plant Conservation Translocation Working Group. Canberra, Australia.

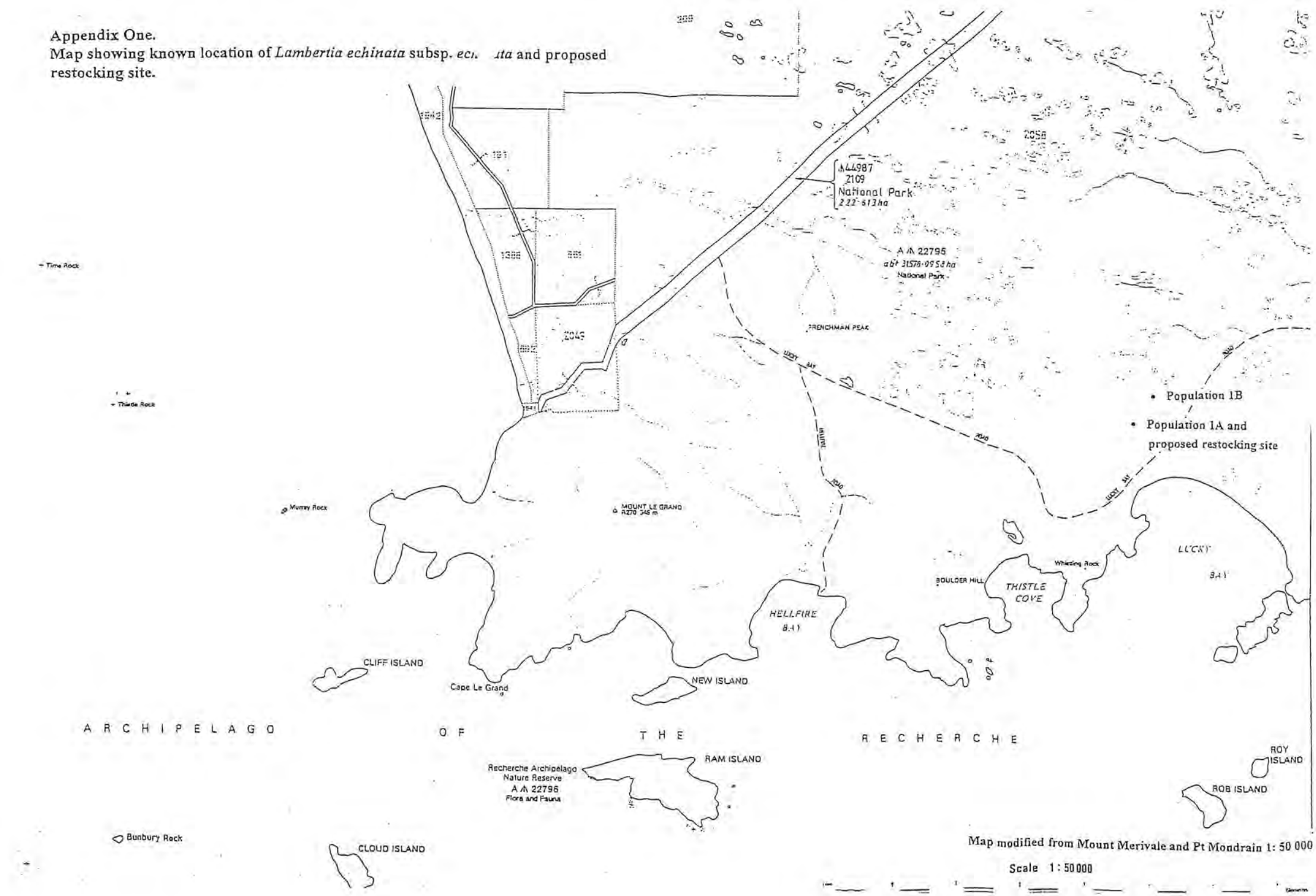
Komorek B. M. and Shearer B. L. (1997) The control of *Phytophthora* in native plant communities. Part A. Application technologies and phosphonate movement in the host. In: Control Of *Phytophthora* and *Diplodina* canker in Western Australia. Final report to the Threaten Species and Communities Unit, Biodiversity Group Environment Australia. Department of Conservation and Land Management. Bentley W. A.

Monks L. and Brown A. (in draft) Prickly Honeysuckle (*Lambertia echinata* subsp. *echinata*) Interim Recovery Plan. Department of Conservation and Land Management, Perth W.A.

Obbens F. J. and Coates D. J. (1997) Conservation biology and management of endangered Lambertia species. Final Report Submitted to the Commonwealth Threatened Species and Communities Section, Biodiversity Group, Environment Australia. Department of Conservation and Land Management, Perth W.A.

Sainsbury R. M. (1991) A Field Guide to Smokebushes and Honeysuckles *(Conospermum* and *Lambertia)* University of Western Australia Press.

Appendix One.
Map showing known location of *Lambertia echinata* subsp. *ec.* *.ta* and proposed restocking site.

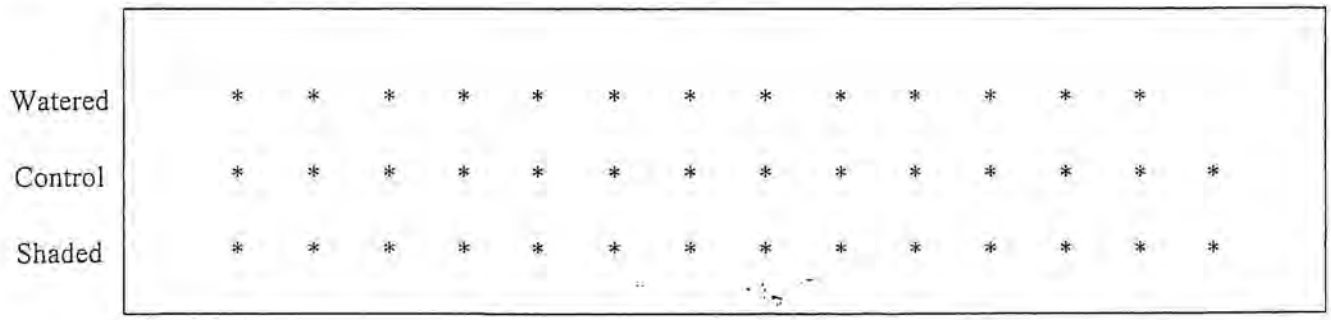


Appendix Two.

Site Diagram for Proposed Translocation of *Lambertia echinata* subsp. *echinata*

There is a total of 165 seedlings of *Lambertia echinata* subsp. *echinata* available.
These will be planted as shown in the diagram below, with one seedling at each point marked with an asterix (*).
The three treatments of control, watered and shaded will be assigned as per the diagram below.

Replicate 1



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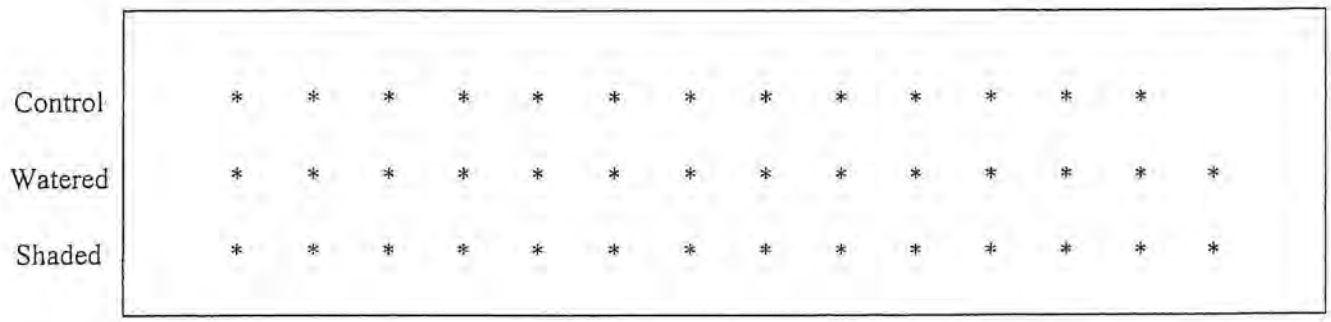

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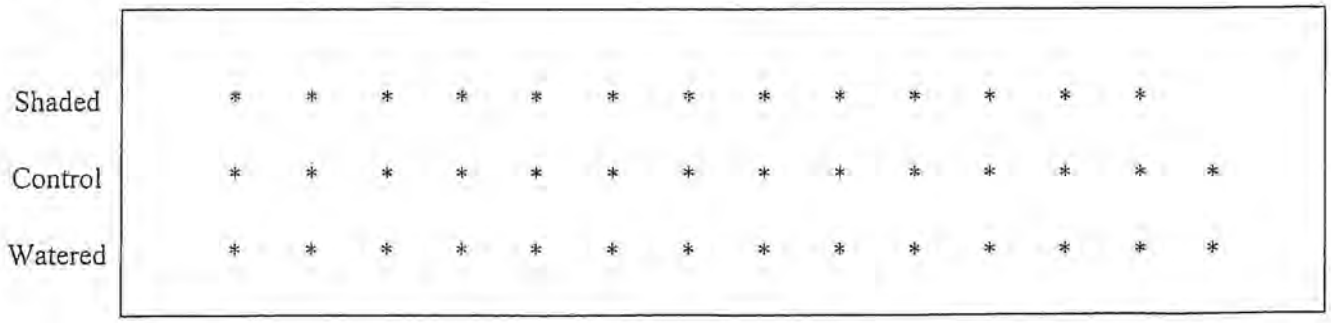
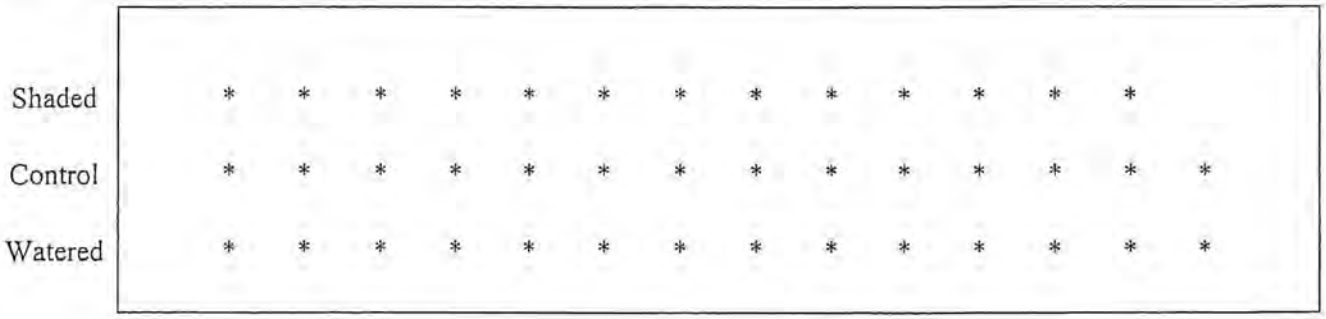


Replicate 4



Scale: 2 m

Tambopata edoarta

Appendix Three.

Regional Endorsement of the Translocation Proposal.

.....

John Watson
South Coast Regional Manager

Date: 5/8/98

Appendix Four.

Guidelines under which seed was collected for the translocation.

IMPORTANT CONSIDERATIONS

Make sure that seed is mature. If fruits are green the seed is probably still immature. If brown or black the seed is probably mature. If in doubt, sacrifice 1or 2 seed to check maturity. The inside of the seed (endosperm) should be white and solid, not soft and translucent. Also check to see that the fruits have seed inside. Seed may have dehisced so don't waste your time with collecting empty fruits.

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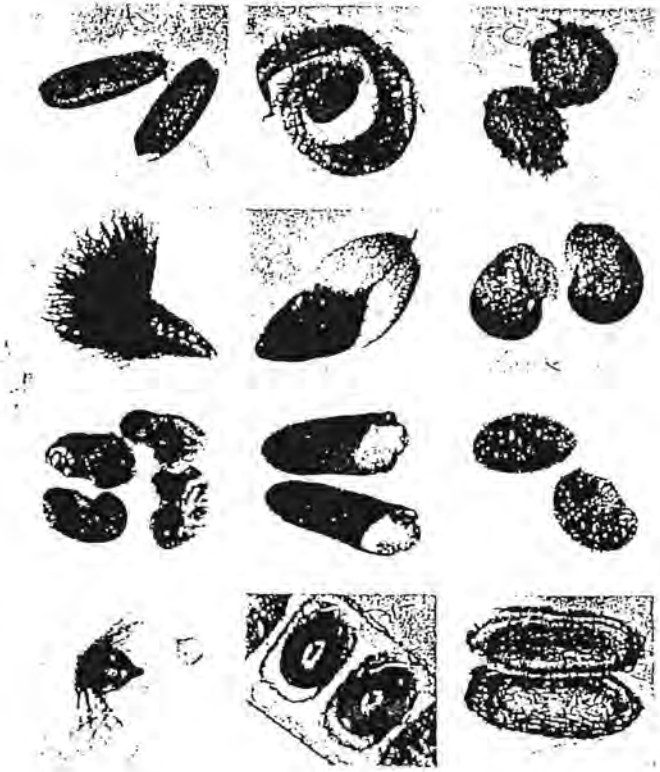
Store seed or fruits in paper or calico, never in plastic. Plastic can sweat and seeds can easily go mouldy. Mould can kill seed and high moisture contents can reduce viability.

Send seed as soon as possible for processing and storage as viability can decrease considerably over time. Also insect pests can be a problem and seed may require fumigation.

Adequate information about the collection is required, such as species, location, date of collection and number of plants collected from.



Threatened Flora Seed Centre
Western Australian Herbarium
Department of Conservation and Land Management
Locked Bag 104, Bentley Delivery Centre
Western Australia 6983

phone (08) 93340502
fax (08) 93340515

BASIC GUIDELINES FOR CONDUCTING SEED COLLECTIONS FOR CONSERVATION PURPOSES

Compiled by the
Threatened Flora Seed Centre

APPENDIX 8

TRANSLOCATION PROPOSAL
Western Prickly Honeysuckle
Lambertia echinata subsp. *occidentalis* Keighery (Proteaceae)

1. SUMMARY

Lambertia echinata subsp. *occidentalis* is a recently described member of the endemic Australian genus. It is a shrub to 3 m, much branched at the base and with a few long erect floral branches. There are two types of leaves - vegetative and floral. The vegetative leaves are entire and linear-lanceolate with a pungent tip. The floral leaves, which are smaller than the vegetative leaves, are either entire or lobed with three to five points. Flowers are yellow, 2.3 - 2.6 cm long, with recurved lobes and occur between October and December. Floral bracts are thin and membranous, narrowly obovate with a sharp point at the apex. Inflorescences are 7-flowered and crowded at ends of long floral branches (Keighery, 1997).

It was first found by Bronwen Keighery and Neil Gibson in Oct 1992 when they were undertaking field work for the Swan Coastal Plain survey. Initially it was thought that it was *L. echinata* subsp. *citrina*, with a few differences. However, population genetic studies showed it that warranted further taxonomic work and subsequently it was named as a new subspecies within the *L. echinata* complex (cited in Obbens and Coates. 1997).

Despite the scope of the Swan Coastal Plain survey, which covered large areas in the Busselton region where this subspecies might be expected, no other populations were located. Due to the low number of plants, restricted distribution, threats associated with growing in a highly specialised habitat and susceptibility to *Phytophthora cinnamomi*, known to be present in the area, *L. echinata* subsp. *occidentalis* was declared to be Rare Flora in October 1996, and then ranked as Critically Endangered (Stack and Brown in draft).

Lambertia echinata subsp. *occidentalis* is endemic to the southern ironstones near Busselton. It is found on shallow sandy soils over sheet ironstone, which support rich scrub heath and sedges with scattered Banksias and Marri. The rarity of *L. echinata* subsp. *occidentalis* is probably due to the amount of clearing that has occurred for agricultural purposes in the Whicher Range area in conjunction with the loss of suitable habitat due to the introduction of *Phytophthora* spp. (Stack and Brown in draft). The death of one plant, of only 17 plants has already been confirmed due to *P. cinnamomi*. *P. cinnamomi* is considered to be such a serious threat to the survival of the only known population, that translocation to a disease free site is now an urgent priority (D. Coates pers. comm, Stack and Brown, in draft).

This translocation proposal outlines the need for translocation of the critically endangered *L. echinatat* subsp. *occidentalis*, the site selection process, the design of the translocation site and the provisions for monitoring. In addition it outlines the criteria for sucess or failure of this proposed translocation.

2. PROPONENTS

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3. BACKGROUND

3.1 History, Taxonomy and Status

Lambertia echinata subsp. *occidentalis* is a recently described member of the endemic Australian genus Lambertia (named after the English horticulturist Aylmer Lambert). It is a small genus of ten species, nine of which are from the south west of Western Australia. The name *echinata* is derived from the Latin word meaning hedgehog-like, referring to the prickly nature of the species. The name *occidentalis* is derived from the Latin word meaning western, which refers to the disjunct western occurrence of this subspecies (Keighery, 1997).

Lambertia echinata subsp. *occidentalis* is a shrub to 3 m, much branched at the base and with a few long erect floral branches. There are two types of leaves - vegetative and floral. The vegetative leaves are entire and linear-lanceolate with a pungent tip. The floral leaves, which are smaller than the vegetative leaves, are either entire or lobed with three to five points. Flowers are yellow, 2.3 - 2.6 cm long, with recurved lobes and occur between October and December. Floral bracts are thin and membranous, narrowly obovate with a sharp point at the apex. Inflorescences are 7-flowered and crowded at ends of long floral branches (Keighery, 1997).

It was first found by Bronwen Keighery and Neil Gibson in Oct 1992 when they were undertaking field work for the Swan Coastal Plain survey. Initially it was thought that it was *L. echinata* subsp. *citrina*, with a few differences. However, population genetic studies showed that there was a level of genetic divergence between this new species and *L. echinata* subsp. *citrina*, that warranted further taxonomic work and subsequently it was named as a new subspecies within the *L. echinata* complex (cited in Obbens and Coates, 1997).

Despite the scope of the Swan Coastal Plain survey, which covered large areas in the Busselton region where this subspecies might be expected, no other populations were located. Due to the low number of plants, restricted distribution, threats associated with growing in a highly specialised habitat and susceptibility to the effects of *Phytophthora*, known to be present in the area, *L. echinata* subsp. *occidentalis* was declared to be Rare Flora in October 1996, and then ranked as Critically Endangered (Stack and Brown in draft).

L. echinata subsp. *occidentalis* lacks a lignotuber. It is considered to be a nonsprouter, as it is known to be killed by fire, and regenerates solely from seed (Obbens and Coates 1997). Initial germination of the seed is high, between 93 and 100% (A. Cochrane pers. comm), which is another characteristic common to nonsprouters.

Like most other members of the genus, it is very susceptible to dieback disease caused by the fungus *Phytophthora cinnamomi*. The only known population of this subspecies is known to be infected with *P. cinnamomii* and a recent plant death has been confirmed to be due to that pathogen.

3.2 Distribution and Habitat

Lambertia echinata subsp. *occidentalis* is apparently confined to the Whicher Range area near Busselton. It is found on shallow sandy soils over sheet ironstone, which support rich scrub heath and sedges with scattered Banksias and Marri.

4. THE TRANSLOCATION

4.1 The Need to Translocate

The rarity of *L. echinata* subsp. *occidentalis* is probably due to the amount of clearing that has occurred for agricultural purposes in the Whicher Range area in conjunction with the loss of suitable habitat due to the introduction of *Phytophthora* spp. (Stack and Brown in draft). At present there are only seven adult and ten juvenile plants.

Obbens and Coates (1997) suggest that, whilst there is sufficient material of high genetic diversity to support a successful translocation, that translocation should only be considered if there has been no recruitment after two years. However, *P. cinnamomi* is such a serious threat to the survival of the only known population, that

translocation to a disease free site is now considered a high priority (D. Coates pers. comm). The draft Interim Recovery Plan for *L. echinata* subsp. *occidentalis* (Stack and Brown, in draft) also recommends that translocation is essential for the survival of this subspecies. Gibson *et al.* (1994) lists the community in which this species occurs as threatened, and the Interim Recovery Plan lists the community as critically endangered (English, in draft). Therefore the need for translocation of this species is considered to be extreme.

4.2 Translocation Site Selection

An area along Smith Road within Treeton Block (approximately 27 km from the original site) was inspected on the 11th March 1998 to locate a suitable disease free site for translocation. This is an area of state forest that is adjacent to a critically endangered community (Occurrence 9 of the Southern Ironstones (English in draft)) which is protected from logging and planned burns (English and Blyth 1997). Therefore, protection can be readily extended to the translocation site. The critically endangered community will not be disturbed by this proposed translocation, as the translocation is intended for an area adjacent (across the road) to the community. As this species has not previously been recorded from this area this translocation can be considered an introduction under the definitions provided in the Guidelines for Translocation of Threatened Plants in Australia. A map of the proposed translocation site in relation to the known population is shown in Appendix 1.

The proposed translocation site has a soil type of sand over ironstone, which is very similar to the soil type of the area where *L. echinata* subsp. *occidentalis* presently grows. There are very few areas of natural vegetation left which grow on this soil type (Gibson et al. 1994).

Table 1. A comparison of the associated vegetation at the proposed translocation site within Treeton Block with the known populations of *Lambertia echinata* subsp. *occidentalis*.

Associated species of the proposed translocation site on Smith Road within Treeton Block.	Associated species of the original population of *Lambertia echinata* subsp. *occidentalis*.
	Adenanthos obovatus
Agonis ?parviceps	
Allocasurina sp.	
	Banksia grandis
	Banksia meisneri
	Casuarina obesa
Dasypogon sp.	
Dryandra squarrosa subsp. *argillacea*	
Dryandra sp.	
	Eucalyptus calophylla
Eucalyptus marginata	
Hakea ruscifolia.	*Hakea ruscifolia*
	Hemigenia pungens
	Hypolaena exsulca
	Kunzea aff. *micrantha*
	Lepidosperma augustatum
	Lyginia barbata
	Nuytsia floribunda
Pericalymma ellipticum	*Pericalymma ellipticum*
Petrophile serruriae	*Petrophile lateriticola*
Stirlingia latifolia	*Stirlingia latifolia*
	Xanthorrhoea preissii

Both the translocation site and the *L. echinata* subsp. *occidentalis* population are listed by Gibson et al. (1994) as having a vegetation type of shrublands on southern ironstones. The proposed translocation site has several associated species in common with the know populations. These are shown in Table 1.

The proposed translocation site is therefore considered the most suitable because the environmental attributes of climate, soil type, vegetation structure and associated vegetation are very similar to the known population of this species. Whilst the translocation site is approximately 27km away from the known population, it is the closest disease free site with almost identical attributes.

4.3 Translocation Design

Three plots of 11m by 4m will be selected and then measured at the translocation site (see Appendix 2 for site diagram). Within each plot a grid of two rows by eleven columns will be measured, so that there is 2m between rows and 2m between columns.

Seedlings will be randomly assigned to either the control or the mulched treatment, so that there are 33 seedlings in either treatment. They will then be randomly assigned to one of the three plots, so that each plot contains 22 plants each: 11 controls and 11 mulched.

Seedlings have been raised at the accredited nursery at Kings Park and Botanic Gardens and therefore are considered disease free. All equipment used during seedling planting will be maintained under strict disease hygiene.

Table 2. Description of experimental treatments.

Treatment	Description of Treatment
Control	Plants not given any treatment.
Mulched	A layer of mulch is placed around the plant to see whether it enhances survival by increasing water retention.

A metal tag with information pertaining to the individual will be attached to a metal peg next to each individual seedling. Each plant will then be enclosed with rabbit netting to prevent predation of the seedlings by large herbivores such as kangaroos and rabbits.

Monitoring of the translocated population will be undertaken every second month. Monitoring will include counting the number of surviving germinants, height of the surviving germinant width of the crown of the surviving germinants in two directions (so that crown volume can be calculated), reproductive state, number of flowers and seed pods, whether second generation plants are present and general health of the plants. A set photo point will be allocated for each plot and a photo will be taken each time monitoring takes place.

Monitoring of the original population (population 1) will also be undertaken every second month. Monitoring will include counting the number of individuals, height and crown width of the individuals, reproductive state, number of flowers and seed pods and general health of the plants.

4.4 Source of Plants

Seed was collected under guidelines outlined in Appendix 4. Seed has been sourced from the original population from a bulk of 7 plants (from a total of seven adult plants) for planting at the translocation site in 1998, and all subsequent plantings.

Seeds were germinated at the Threatened Flora Seed Centre. Seeds were surface sterlised with a 10% solution of 4g/L sodium hypochlorite for five minutes prior to being placed on agar plates. Agar plates were placed in germination cabinents at 15°C with a photoperiod of 12 hours of light and 12 hours of darkness. Seedlings have been raised at Kings Park and Botanic Gardens nursery.

4.5 Criteria for Success or Failure

Criteria for Success

- Short Term: after one generation the number of individuals is sustained by natural recruitment
- Long Term: after two or more generations the number of individuals is sustained by natural recruitment

Criteria for Failure

- There is a significant decline in population size due to lack of natural recruitment

5. TIMETABLE

Time	Action
October 1997	Seeds put down for germination.
February 1998	Translocation site selected.
April 1998	Translocation proposal submitted for review and approval.
May - June 1998	Translocation of seedlings into the Smith Road site.
June - July 1998	Follow up monitoring and maintenance of translocation site.
August 1998 - May 1999	Monitoring and maintenance of translocation site.
November 1998	Second batch of seeds put down for germination. Resulting seedlings raised at Kings Park and Botanic Gardens.
April 1999	Progress report.
May - June 1999	Further translocation of seedlings into the Smith Road site.
June - July 1999	Follow up monitoring and maintenance of translocation site.
August 1999 - May 2001	Monitoring and maintenance of translocation site.
May 2001	Final Report

6. FUNDING

This project is fully funded for three years under National Heritage Trust ESP project number 566.

7. ACKNOWLEDGMENTS

Rob Brazell (CALM Mornington District, Bob Fitzgerald (CALM Central Forest Region), Les Robson (CALM Swan Region), Greg Durell (CALM Narrogin District), Andrew Batty (Kings Park and Botanic Gardens), and Kingsley Dixon (Kings Park and Botanic Gardens) are thanked for allowing me to view their translocation projects or proposals, and for advice given.

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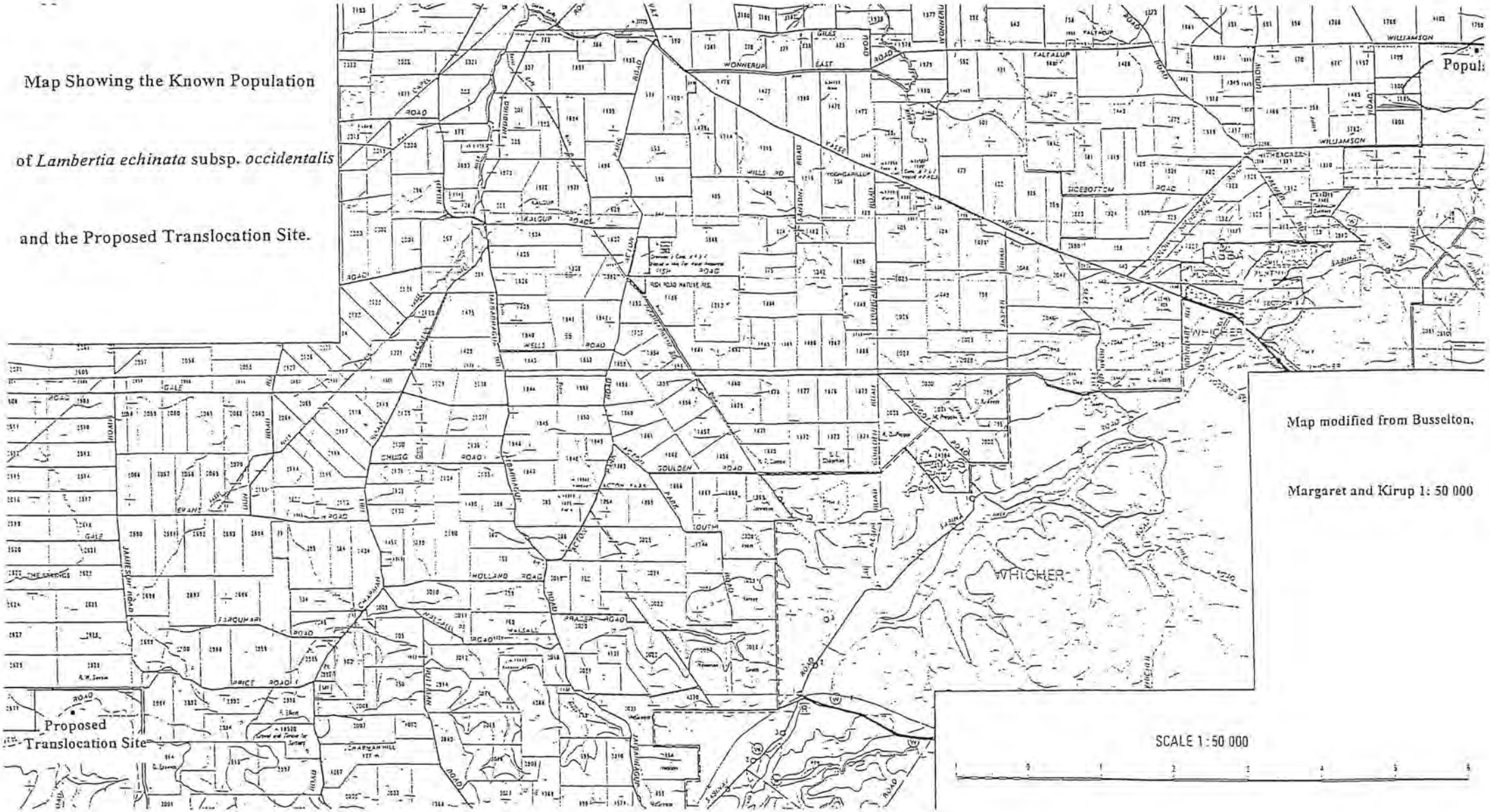
Obbens F. J. and Coates D. J. (1997) Conservation biology and management of endangered Lambertia species. Final Report Submitted to the Commonwealth Threatened Species and Communities Section, Biodiversity Group, Environment Australia. Department of Conservation and Land Management, Perth W.A.

Stack G. and Brown A. (in draft) Western Prickly Honeysuckle (*Lambertia echinata* subsp. *occidentalis*) Interim Recovery Plan. Department of Conservation and Land Management, Perth W.A.

Map Showing the Known Population

of *Lambertia echinata* subsp. *occidentalis*

and the Proposed Translocation Site.



Map modified from Busselton,

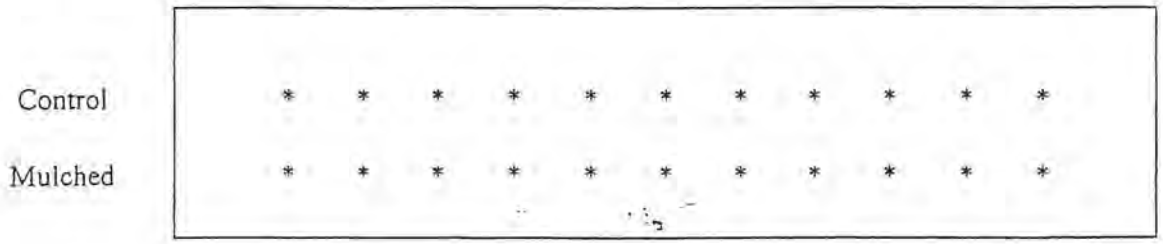
Margaret and Kirup 1: 50 000

Appendix Two.

Site Diagram for Proposed Translocation of *Lambertia echinata* subsp. *occidentalis*.

There is a total of 66 seedlings of *Lambertia echinata* subsp. *occidentalis* available grown from seed collected from a bulk of 6 plants.
These will be planted as shown in the diagram below, with one seedling at each point marked with an asterix (*).
The two treatments of control and mulched will be assigned as per the diagram below.

Replicate 1



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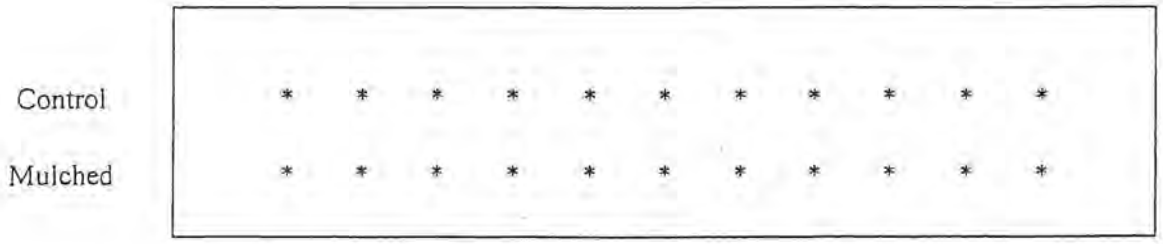
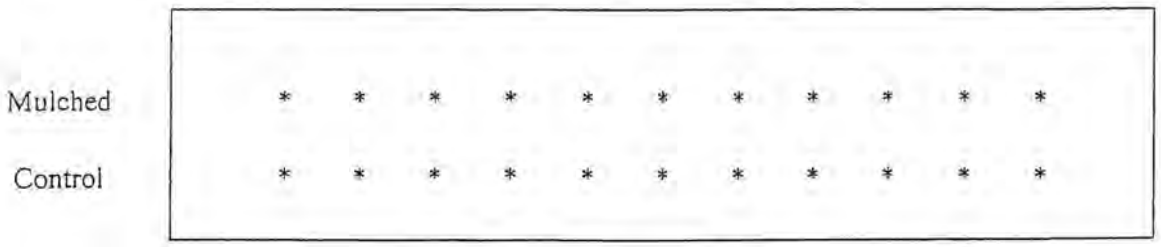


Replicate 3



Scale: 2 m

Appendix Three.

Regional Endorsement of the Translocation Proposal.

.....

Bob Chandler
Central Forest Regional Manager

Date: 27/5/98

IMPORTANT CONSIDERATIONS

Make sure that seed is mature. If fruits are green the seed is probably still immature. If brown or black the seed is probably mature. If in doubt, sacrifice 1or 2 seed to check maturity. The inside of the seed (endosperm) should be white and solid, not soft and translucent. Also check to see that the fruits have seed inside. Seed may have dehisced so don't waste your time with collecting empty fruits.

Use secateurs rather than breaking seed or stems. This will cause less damage to the plant and there is less likelihood that insect predators or disease will enter a clean cut.

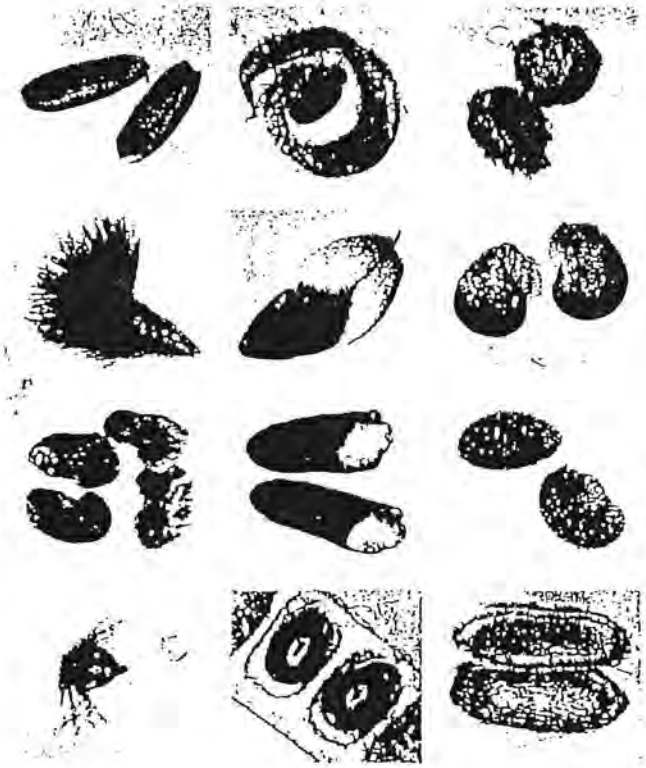
Store seed or fruits in paper or calico, never in plastic. Plastic can sweat and seeds can easily go mouldy. Mould can kill seed and high moisture contents can reduce viability.

Send seed as soon as possible for processing and storage as viability can decrease considerably over time. Also insect pests can be a problem and seed may require fumigation.

Adequate information about the collection is required, such as species, location, date of collection and number of plants collected from.

Appendix Four.

Guidelines under which seed was collected for the translocation.



BASIC GUIDELINES FOR CONDUCTING SEED COLLECTIONS FOR CONSERVATION PURPOSES

Compiled by the
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Department of Conservation and Land Management
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APPENDIX 9

TRANSLOCATION PROPOSAL
Round Leaf Honeysuckle, *Lambertia orbifolia* C.A. Gardner (PROTEACEAE)

1. SUMMARY

Lambertia orbifolia was first collected at Scott River in January 1945, and named in 1964 by Charles Gardner. It is a shrub that grows to 3m in height. The branches are erect and spreading, or arching with young branches brown and covered in soft hairs. Leaves are opposite, sessile rounded in shape, with a 1.5 - 2 cm diameter. Flowering occurs all year round with peaks from December to January (Hnatiuk 1995) and from May to July (Blackall and Grieve 1988). Between four and six orange-red coloured flowers form the inflorescence. The perianth is 4 - 5 cm long, tubular with hairs on the outside. The New Holland Honeyeater is believed to be the major pollinator for this species (Whitaker and Collins 1997). The fruit is between 0.7 - 1 cm in diameter, with a short beak and contains up to two seed. Initial percentage viability of the seed ranges from 77 - 100%. Percentage viability after one year storage at -18°C ranged from 53 - 100% (A. Cochrane pers. comm)

Lambertia orbifolia is an obligate seeder. It has been recorded as being killed by fire (Sage 1994), with a major recruitment event following fire and low levels of establishment occurring in the interfire period (Sage 1994, D. Coates *pers. comm*).

L. orbifolia is known from seven populations in two widely disjunct locations. Five populations occur on the sandy ironstone soils, grey sand over ironstone soils or shallow sands associated with ironstone soils near winter wet areas around the Scott River Plains. These populations have a combined total of about 24, 000 individuals. Two populations occur some 200 km to the east near Narrikup with a combined total of just 169 individuals. The Narrikup form occurs on grey sands over laterite.

The Narrikup and Scott River Plains populations have been shown to have a level of genetic divergence that can equate to species differences. The Narrikup form of *L. orbifolia* is critically endangered and in need of translocation to a secure site. *Lambertia orbifolia* is considered to be very susceptible to *Phytophthora cinnamomi* (Obbens and Coates 1997). Both of the Narrikup populations have had *P. cinnamomi* and Canker (spp.) confirmed as being present at the sites and deaths of numerous adult plants have been attributed to *P. cinnamomi*. Both Narrikup populations occur on narrow degraded Shire Road verges where damage from road maintenance activities has already resulted in the deaths of ten adult plants, and there is a possibility of this occurring again. Due to the number of threats to the genetically distinct Narrikup populations of *L. orbifolia* the translocation of this form should now be considered to be of extreme urgency.

This translocation proposal outlines the need for translocation of the critically endangered Narrikup form of *L. orbifolia,* the site selection process, the design of the translocation site and the provisions for monitoring. In addition it outlines the criteria for success or failure of this proposed translocation.

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3. BACKGROUND

3.1 History, Taxonomy and Status

Lambertia orbifolia C.A. Gardner (Proteaceae) was first collected at Scott River in January 1945 by R. D Royce. It was named in 1964 by Charles Gardner from a collection made by A. J. Gray at King River. Gardner named it *orbifolia*, derived from the Latin words *orbis* and *folia* referring to the rounded shape of the leaves.

It is a shrub that grows to 3m in height, apparently lacking a lignotuber (Hnatiuk 1995). The branches are erect and spreading, or arching with young branches brown and covered in soft hairs. Leaves are opposite (or rarely whorled in groups of three), sessile or with a short petiole, orbicular to cordate (rounded) in shape, with a 1.5 - 2cm diameter.

Flowering occurs all year round with peaks from December to January (Hnatiuk 1995) and from May to July (Blackall and Grieve 1988). Between four and six orange-red coloured flowers form the inflorescence in the upper leaf axils. The perianth is 4 - 5 cm long, tubular in shape with a slight bulge in the middle and hairs on the outside. A small whorl of bracts subtend the flowers, allowing the flowers to spread widely so that they can be easily probed by honeyeaters (Hnatiuk 1995). The New Holland Honeyeater is believed to be the major pollinator for this species (Whitaker and Collins 1997).

The fruit is asymmetrical, between 0.7 - 1 cm in diameter, flattened, smooth with a short oblique beak. Each fruit may contain up to two seed. Initial percentage viability of the seed ranges from 77 - 100%. Percentage viability after one year storage at -18°C ranges from 53 - 100% (A. Cochrane pers. comm).

Hnatiuk (1995) considers *L. orbifolia* to be most closely related to *L. ericifolia* and *L. inermis*. This is due to these species having outward facing flowers, lacking bracts at the base of the inflorescence (which allows easy access for the Honeyeater pollinators which perch on the stems below the flowers), having asymmetric, cuneate seeds and obtuse leaves.

L. orbifolia is an obligate seeder. It has been recorded as being killed by fire (Sage 1994), with a major recruitment event following fire and low levels of establishment occurring in the interfire period (Sage 1994, D. Coates *pers. comm*). The mean age of plants in population 2 is 15 years, with the maximum age observed to be 20 years (Sage 1994). It is not known at what age this species sets its first flowers or seeds, however, a six month old seedling grown for this translocation has set its first flower whilst being raised at the Kings Park and Botanic Gardens.

L. orbifolia is considered to be very susceptible to *Phytophthora cinnamomi* (Obbens and Coates 1997). At this stage only one Scott River population (1E) is considered to be at risk of being infected with the disease. However, both Narrikup populations have tested positive to the presence of *P. cinnamomi*, and Canker (spp.) A total of 20 individuals died in the largest of the two Narrikup populations during a two month period in 1995 due to *P. cinnamomi*. As a result Phosphite was applied at a rate of 0.2% on two occasions (42 days apart) at both Narrikup sites in autumn/winter 1995 (Obbens and Coates 1997). This spray program appears to have halted the high death rate, however sick looking adult plants have still been observed and this is considered to be due to *P. cinnamomi* (E. Hickman *pers. comm*).

At present there is no recovery plan for this species. However, it is anticipated that a full Recovery Plan will be written for this species soon.

3.2 Evolutionary Status of the Narrikup Populations

Population genetic structure and patterns of differentiation among populations have been investigated using isozyme markers. (Coates and Hamley, in prep). Single locus genetic diversity measures *A* (mean number of alleles per locus), *P* (mean percentage polymorphic loci), *He* (expected panmictic heterozygosity), and *Ho* (the average observed heterozygosity) are presented in Table 1. These data indicate that *L. orbifolia* has relatively high levels of genetic diversity for an endemic species although there are marked differences between

populations (see Hamrick and Godt, 1989). These population differences are particularly evident when comparing the Scott River Plains populations with the Narrikup populations.

Both Narrikup populations have significantly higher genetic diversity levels, based on all single locus diversity. These results are unexpected given the small fragmented nature of the Narrikup populations compared with the three larger populations in the Scott River Plains area. They suggest that quite different evolutionary mechanisms may be operating in the two population systems. These results also indicate that there is a suitable broad range of genetic diversity in the each of the Narrikup populations to support successful translocation and population enhancement programs.

The large discrepancy between the observed heterozygosity (*Ho*) and the expected panmictic heterozygosity (*He*) also suggest significant levels of inbreeding within all populations. The apparent level of inbreeding was unexpected when compared to other bird pollinated Proteaceae although heterozygote deficits are not unusual in plants with mixed mating systems and significant population structuring (Sampson *et al.*, 1996).

Table 1. Single locus genetic diversity measures: *A* (mean number of alleles per locus), *P* (mean percentage polymorphic loci), *He* (expected panmictic heterozygosity), and *Ho* (the average observed heterozygosity) for each population of *L. orbifolia*.

Population		N_e	A	P	H_e	H_o
Scott River Plains	1E	≈100	1.2	15.0	0.066(0.038)	0.031(0.022)
	4	60	1.4	30.0	0.080(0.038)	0.038(0.016)
	5	68	1.4	35.0	0.119(0.046)	0.060(0.023)
	6	6810	1.4	35.0	0.081(0.036)	0.052(0.028)
	7	≈10,000	1.4	35.0	0.095(0.038)	0.048(0.023)
Mean			1.36	30.0	0.088	0.046
Narrikup	2	139	1.5	45.0	0.149(0.047)	0.076(0.025)
	3	30	1.6	65.0	0.116(0.034)	0.063(0.027)
Mean			1.55	0.55	0.133	0.067
Mean			1.41	37.1	0.129	0.053

A UPGMA analysis of genetic differentiation between populations reveals striking genetic differences between the Narrikup and Scott River Plains areas (See Figure 1). The level of genetic divergence between these two population groups (> 0.20) is indicative of species differences in some plant groups (Gottleib, 1981). This result clearly supports the view that these two population groups are distinct evolutionary units or evolutionary significant units (ESUs) as discussed by Moritz (1995). This is despite the fact that there are no detectable morphological differences between the two groups (Keighery *pers comm*).

These two population groups appear to have been isolated historically from each other for a long period of time and are relic populations from a previously more continuous population system which linked the two groups. These conclusions are further supported by recent molecular studies (Byrne in prep) which show that

the Narrikup populations are characterised by six unique mutations in the chloroplast DNA. The critically endangered Narrikup populations should therefore be considered a distinct conservation unit for the purposes of management, particularly translocation.

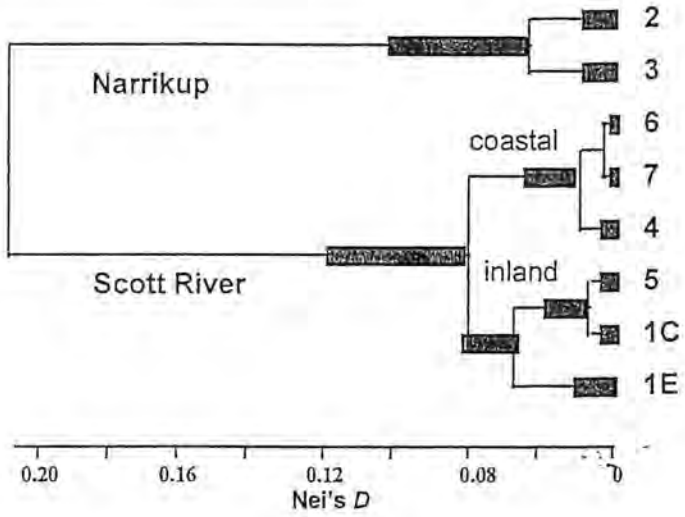

Figure 1. UPGMA clustering (based on Nei's genetic distance, *D*) of *Lambertia orbifolia* populations. A cluster in the UPGMA phenogram is significant if the shaded standard error bar is half the branch length.

3.3 Distribution and Habitat

L. orbifolia is known from seven populations in two widely disjunct locations. Five populations occur on the sandy ironstone soils, grey sand over ironstone soils or shallow sands associated with ironstone soils near winter wet areas around the Scott River Plains. Two populations occur some 200 km to the east near Narrikup, on grey sands over laterite.

At the Scott River Plains *L. orbifolia* is found in two habitat types. The coastal form is found adjacent to low *Agonis flexuosa* and *Eucalyptus marginata* woodlands, forming dense thickets with *Banksia littoralis*, *B. grandis* and *B. ilicifolia*. The inland form occurs in seasonally inundated dense shrub heath associated with *Calothamnus* aff. *crassus*, *Agonis flexuosa* and several *Banksia* species. The Narrikup form occurs in an open low woodland of *Eucalyptus marginata* and *E. calophylla*, with *Banksia grandis*, *Agonis parviceps*, *Hakea ferruginea* and *Xanthorrhoea preissii*.

4. THE TRANSLOCATION

4.1 The Need to Translocate

Genetic studies show that there is a level of genetic divergence between the Narrikup and Scott River Plains populations that is indicative of species level differences and substantial historical isolation. These data show that the Narrikup populations are a distinct conservation unit and need to be considered separately for management, particularly translocation.

The Scott River Plains populations have a combined total of around 24,000 individuals in five populations. The genetically distinct Narrikup populations have a combined total of just 169 individuals in only two populations. The presence of *Phytophthora cinnamomi* and Canker (spp.) has been confirmed at both of these populations and, as mentioned previously, the deaths of 20 adult plants have been confirmed as being due to *P. cinnamomi*. Both Narrikup populations occur on narrow degraded Shire Road verges, with population three extending into remnant vegetation on private property. Damage to the Spencer Road population from road maintenance activities occurred in 1995, with ten adult plants being killed. With the high turn over of Shire staff and the use of contract shire employees it is difficult to ensure that every person undertaking maintenance activities adjacent to the *L. orbifolia* populations received information vital to the conservation of this taxon. Further damage is likely from routine road maintenance activities.

Due to the number of threats to the genetically distinct Narrikup populations of *L. orbifolia* the translocation of this form to a secure, disease free area should now be considered to be of extreme urgency.

4.2 Translocation Site Selection

A search was carried out on the 10th March 1998 to locate a suitable disease free area in the vicinity of the known Narrikup populations. An area on the south western corner of the Narrikup Nature Reserve (#25965) was selected. As this species has not previously been recorded from this reserve this translocation can be considered an introduction under the definitions provided by Policy Statement 29 and the Guidelines for Translocation of Threatened Plants in Australia. A map of the proposed translocation site in relation to the known populations is shown in Appendix 1.

This area was chosen because it is only a short distance (in a direct line) from the Narrikup populations (3.1 km from population 2 and 3.6 km from population 3) and is *P. cinnamomi* free. It is the opinion of the District Dieback Interpreter (M. Grant pers. comm) that *P. cinnamomi* is highly unlikely to infect the translocation site. Strict hygiene procedures will be followed to prevent infection of the site during translocation planting and monitoring.

The proposed translocation site has a soil type of grey sand over laterite, with an underlying geology of white, grey or brown sand overlying laterite and commonly containing iron pisoliths (conglomerates of spherical bodies) (Muhling and Brakel 1985). The known Narrikup populations have a similar soil type of sand to the depth of 18 m, with laterite beginning at a depth of 15 - 30 cm. They have an underlying geology of alluvially (soils deposited from river systems) and colluvially (soils found at the foot of a slope) deposited pebbles, sand, silt and clay, as well as soils of white, grey or brown sand overlying laterite and commonly containing iron pisoliths (Muhling and Brakel 1985).

Both the translocation site and the Narrikup *L. orbifolia* populations have similar vegetation structure of Open Low Woodland over Mid-Dense Heath A (using Muir's (1977) classification). The translocation site has many associated species in common with the known populations, none of these are listed as rare or threatened. These are shown below in Table 1.

The pollinators of this species, New Holland Honeyeaters (Whitaker and Collins 1997), have been confirmed as being present at the proposed translocation site. The presence of pollinators is necessary for perpetuation of the translocated population through outcrossed seed and therefore the creation of a viable self sustaining population.

Table 1. Main associated vegetation at the proposed translocation site within Narrikup Nature Reserve compared to the associated vegetation at the known Narrikup populations of *Lambertia orbifolia*.

Main associated species of the proposed translocation site within Narrikup Nature Reserve	Main associated species of the original populations of *Lambertia orbifolia* at Narrikup
	Agonis hypercifolia
Agonis parviceps	*Agonis parviceps*
Banksia grandis	*Banksia grandis*
Beaufortia anisandra	
	Bossiaea ornata
Eucalyptus calophylla	*Eucalyptus calophylla*
Eucalyptus marginata	*Eucalyptus marginata*
Eucalyptus staeri	
Hakea ceratophylla	
Hakea ferruginea	*Hakea ferruginea*
	Hakea ruscifolia
	Isopogon formosus
Leucopogon glabellus	
	Leucopogon verticillata
	Xanthorrhoea platyphylla
Xanthorrhoea preissii	*Xanthorrhoea preissii*

The proposed translocation site was therefore chosen because the environmental attributes of climate, soil type, vegetation structure and associated vegetation are almost identical to the known Narrikup populations of this species.

4.3 Translocation Design

Five 14 metre by 5 metre plots will be selected and then measured out at the translocation site. Plots will not be cleared of vegetation, instead seedlings will be planted in gaps in the vegetation, adhering as close as possible to the grid pattern presented in this proposal. In this way there will be minimal disturbance to the natural vegetation.

Within each plot a grid of 13 m by 4 m will be measured so that a 1 metre border will be left between the outer of the grid and the inner of the plot. Four treatments will be chosen: control, mulched, shaded or gro-cone (see Table 2). A total of 65 seedlings will be randomly assigned to each treatment. Each group of 65 seedlings will be randomly divided in to 5 smaller groups of 13 and then assigned to a plot, such that each plot has 52 seedlings: 13 controls, 13 mulched, 13 shaded and 13 gro-cones.

Each of the four treatments will be randomly assigned to one of the four lines in the grid. The plot will be planted with the seedlings spaced at a distance of 1m apart within the grid (see Appendix 2). Each plot will be fenced with rabbit netting to prevent predation of the plants from large herbivores.

Seedlings have been raised at the accredited nursery at Kings Park and Botanic Gardens and therefore are considered disease free. All equipment used during seedling planting will be maintained under strict disease hygiene.

Table 2. Description of experimental treatments.

Treatment	Description of Treatment
Control	Plants not given any treatment
Mulched	A layer of mulch is placed around the plant to see whether it enhances survival by increasing water retention.
Shaded	A circle of wire netting, approximately 1m in diameter covered in shade cloth is placed around the plant after planting to see whether survival is enhanced by the creation of a shaded environment around the plant.
Gro-cone	A Gro-cone is placed around the plant after planting to see whether it enhances survival by creating a sheltered environment around the plant

Monitoring of the translocated population will be undertaken every second month over the length of the project. Monitoring will include counting the number of surviving seedlings, height of the surviving seedlings, width of the crown of the surviving seedlings in two directions (so that crown volume can be calculated), reproductive state, number of flowers and fruit, whether second generation plants are present and general health of the plants.

Monitoring of the original populations of *L. orbifolia* (population 2 and 3) will also occur every second month. Monitoring will include counting the number of individuals, height and crown width of the individuals, reproductive state, number of flowers and fruit and general health of the plants.

At the end of this project monitoring will continue on a yearly basis until such a time as the long term criteria for success is considered to have been met. Yearly monitoring will include the above information.

4.4 Source of Plants

Seed was collected under guidelines outlined in Appendix 3. Seed has been sourced from a bulk collection from 40 plants from population two, and from a bulk of 10 plants from population 3 for planting at the translocation site in 1998. Seeds were germinated at the Threatened Flora Seed Centre. Seeds were surface sterilised with a 10% solution of 4g/L sodium hypochlorite for five minutes prior to being placed on agar plates. Agar plates were placed in germination cabinets at 15°C with a photoperiod of 12 hours of light and 12 hours of darkness.

A total of 268 seedlings were raised from seed sourced from population 2 and 30 seedlings were raised from seed sourced from population 3. Any subsequent plantings will also be grown from seed collected from these sources. Seedlings from the two populations were mixed together at the translocation site. Seedlings have been raised at Kings Park and Botanic Gardens accredited nursery.

4.5 Criteria for Success or Failure

Criteria for Success

- Short Term: after one generation (juvenile transplant to seed producing adult plant) the number of individuals is sustained by natural recruitment
- Long Term: after two or more generations the number of individuals is sustained by natural recruitment

Criteria for Failure

- There is a significant decline in population size due to lack of natural recruitment

5. TIMETABLE

Time	Action
October 1997	Germination of seed started.
March 1998	Translocation site selected.
April 1998	Translocation proposal submitted for review and approval.
June - July 1998	Translocation of seedlings into the Narrikup Nature reserve.
July - August 1998	Follow up monitoring and maintenance of translocation site.
September 1998 - May 1999	Monitoring and maintenance of translocation site.
October 1998	Translocation proposal for 1999 translocation submitted for review.
November 1998	Further seed collection if necessary
November 1998	Second batch of seeds put down for germination. Resulting seedlings raised at Kings Park and Botanic Gardens.
April 1999	Progress report.
May - June 1999	Further translocation of seedlings into the Narrikup Nature Reserve.
June - July 1999	Follow up monitoring and maintenance of translocation site.
August 1999 - May 2001	Monitoring and maintenance of translocation site.
May 2001	Final Report

6. FUNDING

This project is fully funded for three years under National Heritage Trust ESP project number 566.

7. ACKNOWLEDGMENTS

Rob Brazell (CALM Mornington District, Bob Fitzgerald (CALM Central Forest Region), Les Robson (CALM Swan Region), Greg Durell (CALM Narrogin District), Andrew Batty (Kings Park and Botanic Gardens), and Kingsley Dixon (Kings Park and Botanic Gardens) are thanked for allowing me to view their translocation projects or proposals, and for advice given.

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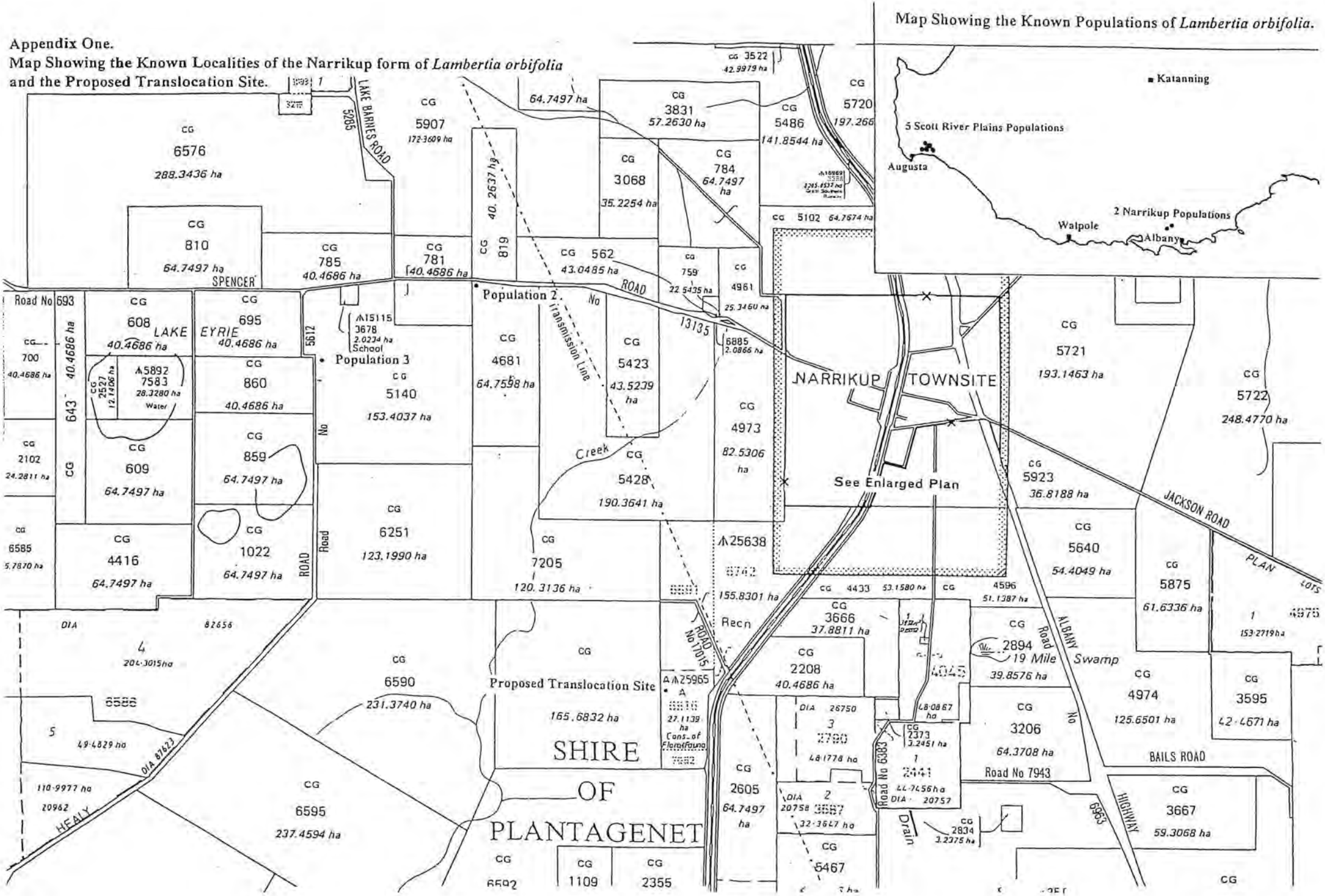
Appendix One.

Map Showing the Known Localities of the Narrikup form of *Lambertia orbifolia* and the Proposed Translocation Site.

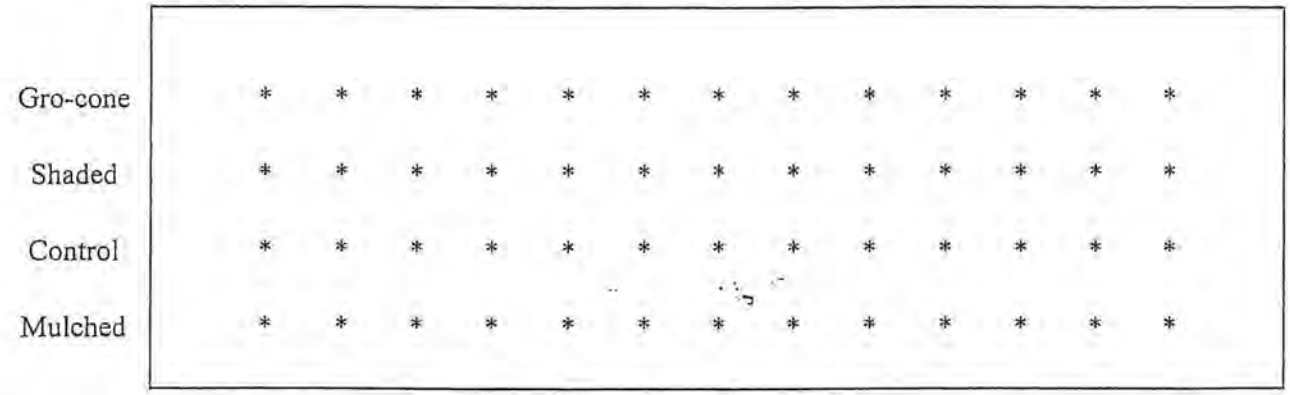


Appendix Two.

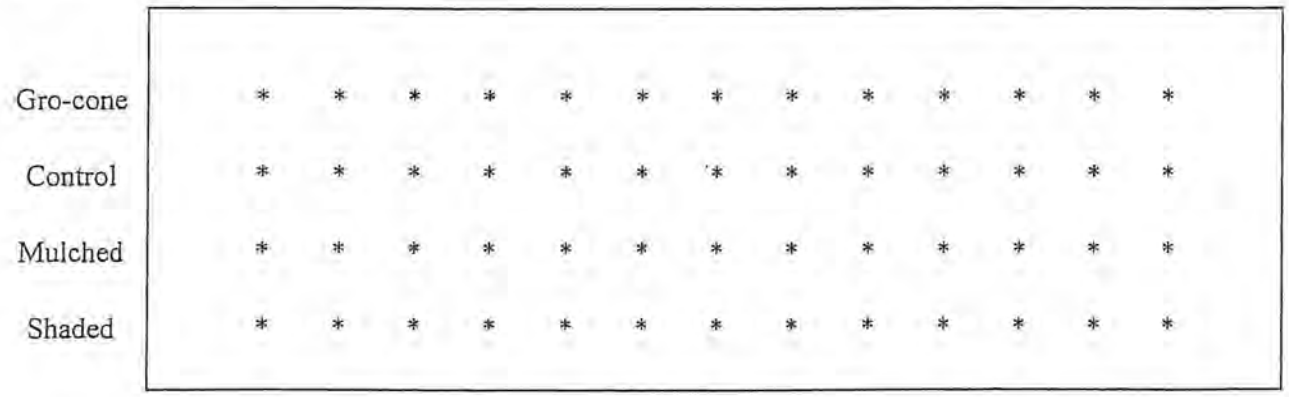
Site Diagram for Proposed Translocation of *Lambertia orbifolia*

There is a total of 270 seedlings of *Lambertia orbifolia* available.
These will be planted as shown in the diagram below, with one seedling at each point marked with an asterix (*).
The four treatments of control, mulched, shaded or Gro-cone will be assigned as per the diagram below.

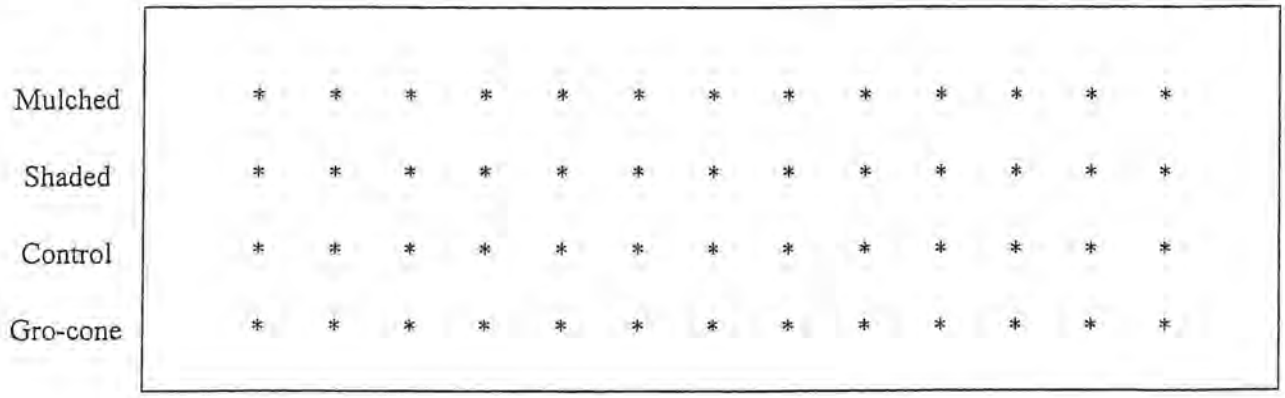
Replicate 1



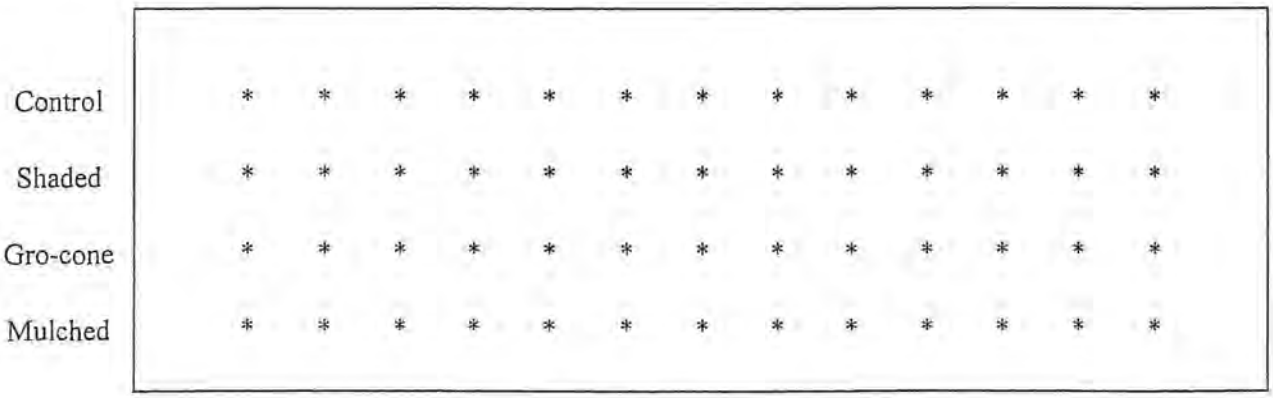
Replicate 2



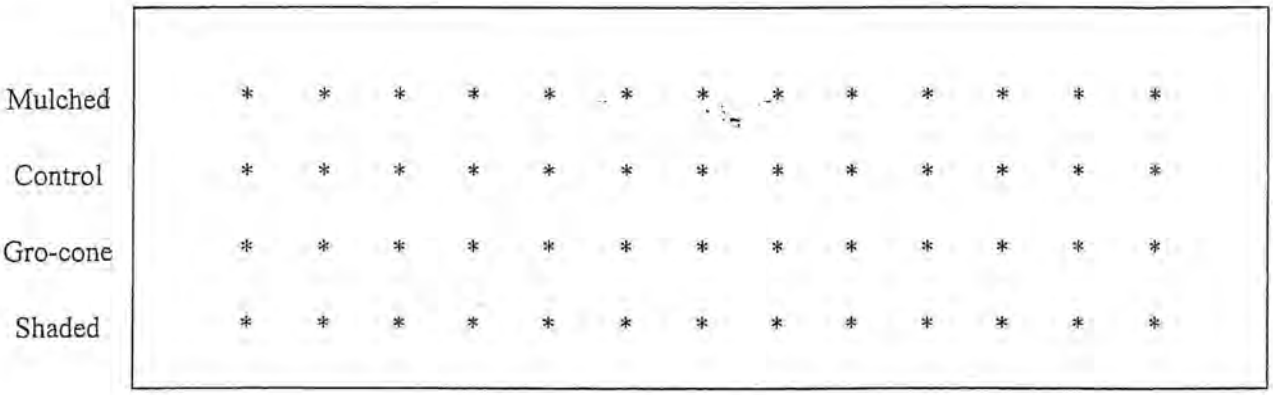
Replicate 3



Replicate 4



Replicate 5



Scale: 1 m

IMPORTANT CONSIDERATIONS

Make sure that seed is mature. If fruits are green the seed is probably still immature. If brown or black the seed is probably mature. If in doubt, sacrifice 1or 2 seed to check maturity. The inside of the seed (endosperm) should be white and solid, not soft and translucent. Also check to see that the fruits have seed inside. Seed may have dehisced so don't waste your time with collecting empty fruits.

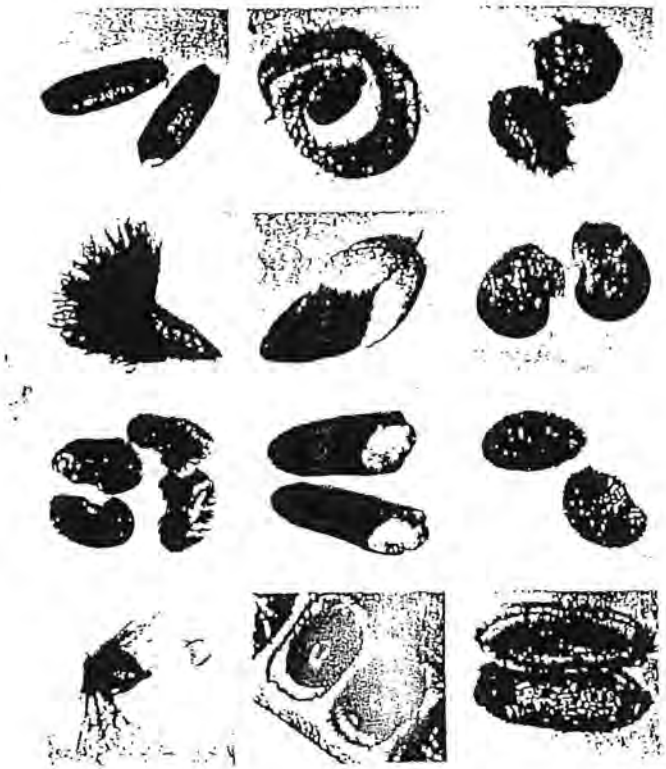
Use secateurs rather than breaking seed or stems. This will cause less damage to the plant and there is less likelihood that insect predators or disease will enter a clean cut.

Store seed or fruits in paper or calico, never in plastic. Plastic can sweat and seeds can easily go mouldy. Mould can kill seed and high moisture contents can reduce viability.

Send seed as soon as possible for processing and storage as viability can decrease considerably over time. Also insect pests can be a problem and seed may require fumigation.

Adequate information about the collection is required, such as species, location, date of collection and number of plants collected from.

Guidelines under which seed was collected for the translocation.



Threatened Flora Seed Centre
Western Australian Herbarium
Department of Conservation and Land Management
Locked Bag 104, Bentley Delivery Centre
Western Australia 6983

phone (08) 93340502
fax (08) 93340515

BASIC GUIDELINES FOR CONDUCTING SEED COLLECTIONS FOR CONSERVATION PURPOSES

Compiled by the
Threatened Flora Seed Centre

APPENDIX 10

Date:_____

Monitoring data for translocated population of *Grevillea calliantha*.
All measurements are in metres. Crown 1 is the widest crown width, Crown 2 is perpendicular to Crown 1.

CALM plant no.	Replicate	Treatment	Height	Crown 1	Crown 2	Health/ comments
109	1	Early				
110	1	Early				
111	1	Early				
112	1	Early				
113	1	Early				
114	1	Early				
115	1	Early				
116	1	Early				
117	1	Early				
118	1	Early				
119	1	Early				
120	1	Early				
121	1	Early				
122	1	Early				
123	1	Early				
124	1	Early				
125	1	Early				
126	1	Early				
127	1	Early				
128	1	Early				
129	1	Late				
130	1	Late				
131	1	Late				
132	1	Late				
133	1	Late				
134	1	Late				
135	1	Late				
136	1	Late				
137	1	Late				
138	1	Late				
139	1	Late				
140	1	Late				
141	1	Late				
142	1	Late				
143	1	Late				
144	1	Late				
145	1	Late				
146	1	Late				
147	1	Late				
148	1	Late				
149	2	Early				
150	2	Early				
151	2	Early				
152	2	Early				
153	2	Early				
154	2	Early				
155	2	Early				
156	2	Early				
157	2	Early				
158	2	Early				

Date:_____

CALM plant no.	Replicate	Treatment	Height	Crown 1	Crown 2	Health/ comments
159	2	Early				
160	2	Early				
161	2	Early				
162	2	Early				
163	2	Early				
164	2	Early				
165	2	Early				
166	2	Early				
167	2	Late				
168	2	Late				
169	2	Late				
170	2	Late				
171	2	Late				
172	2	Late				
173	2	Late				
174	2	Late				
175	2	Late				
176	2	Late				
177	2	Late				
178	2	Late				
179	2	Late				
180	2	Late				
181	2	Late				
182	2	Late				
183	2	Late				
184	2	Late				
185	3	Early				
186	3	Early				
187	3	Early				
188	3	Early				
189	3	Early				
190	3	Early				
191	3	Early				
192	3	Early				
193	3	Early				
194	3	Early				
195	3	Early				
196	3	Early				
197	3	Early				
198	3	Early				
199	3	Early				
200	3	Early				
201	3	Early				
202	3	Early				
203	3	Early				
204	3	Early				
205	3	Late				
206	3	Late				
207	3	Late				
208	3	Late				
209	3	Late				
210	3	Late				
211	3	Late				
212	3					

Date:_____

CALM plant no.	Replicate	Treatment	Height	Crown 1	Crown 2	Health/ comments
213	3	Late				
214	3	Late				
215	3	Late				
216	3	Late				
217	3	Late				
218	3	Late				
219	3	Late				
220	3	Late				
221	3	Late				
222	3	Late				
223	3	Late				