INTERIM RECOVERY PLAN NO. 163

THREE SPRINGS DAVIESIA (*DAVIESIA BURSARIOIDES*)

INTERIM RECOVERY PLAN

2004-2009

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Photograph: Andrew Brown

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FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos. 44 and 50.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

CALM is committed to ensuring that Critically Endangered taxa are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by the Minister.

This Interim Recovery Plan will operate from June 2004 to May 2009 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked Critically Endangered, this IRP will be reviewed after five years and the need for a full Recovery Plan assessed.

This IRP was given regional approval on 8 June, 2004 and was approved by the Director of Nature Conservation on 22 June, 2004. The allocation of staff time and provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate in June 2004.

ACKNOWLEDGMENTS

The following people have provided assistance and advice in the preparation of this Interim Recovery Plan:

Andrew Crawford	Technical Officer, CALM's Threatened Flora Seed Centre
Leonie Monks	Research Scientist (Translocation), CALM Science
Amanda Shade	Horticulturalist, Botanic Garden and Parks Authority
Charles Strahan	Gardener, Shire of Three Springs

Thanks also to the staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information, and CALM's Wildlife Branch for assistance.

SUMMARY

Scientific Name:	*Daviesia bursarioides*	**Common Name:**	Three Springs Daviesia
Family:	Papilionaceae	**Flowering Period:**	July - September
CALM Region:	Midwest	**CALM District:**	Moora
Shire:	Three Springs	**Recovery Team:**	Moora District Threatened Flora Recovery Team

Illustrations and/or further information: Brown, A., Thomson-Dans, C. and Marchant, N. (Eds) (1998) *Western Australia's Threatened Flora,* Department of Conservation and Land Management, Western Australia; M.D. Crisp (1985) *Conservation of the genus Daviesia,* Australian National Botanic Gardens, Occasional Paper No. 6; M.D. Crisp (1995) Contributions towards a revision of *Daviesia* (Fabaceae: Mirbelieae) III: A synopsis of *Daviesia, Australian Systematic Botany* 8(6), 1178-79.

Current status: *Daviesia bursarioides* was declared as Rare Flora in September 1987, and is currently ranked as Critically Endangered (CR) under the *Wildlife Conservation Act* 1950. It currently meets Red List (IUCN 2000) Category 'CR' under criteria B2ab(iii); C1+2a(i) due to the fragmented populations, low number of plants, and continuing decline in the quality of the habitat. *D. bursarioides* is also listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The main threats are edge effects, degraded habitat, road, fence and firebreak maintenance, weed invasion, competition due to shading, inappropriate disturbance regimes and possibly disease.

Description: *Daviesia bursarioides* is a straggling, divaricately branching shrub to 2 m tall, with blue-green spine-tipped branches. The leaves are distinctive among Daviesias, being scattered and small, obovate in shape narrowing to the base, to 20x2.5 mm. The flowers appear between July and September, and are grouped in 3-8 flowered racemes in the axils of the leaves, on a long stem to 35 mm, giving the raceme an open appearance. They are small and typically pea-shaped. Each flower has an upper standard petal 7x9 mm, yellow in colour and maroon towards the base. The wing petals are 6x3 mm and deep pink, and the keel is 5x2 mm, and maroon in colour. The fruit is a triangular pod, 9x10 mm (Patrick and Brown 2001; Crisp 1995).

Habitat requirements: *Daviesia bursarioides* is endemic to the Three Springs area of Western Australia, and is known from approximately 120 plants in six populations over a range of about 15 km. Populations occur on Shire road reserve, Main Road reserve, private property and Nature Reserve. *D. bursarioides* is found in open shrub mallee habitat dominated by *Eucalyptus gittinsii* and *Allocasuarina campestris*, with a range of *Acacia*, *Dryandra*, *Hakea* and *Grevillea* species. Soils are shallow brown sandy loams with extensive lateritic gravel. Population 5 (the largest population) occurs on the periphery of a dense *Allocasuarina campestris* thicket on deep lateritic gravel. Species diversity at most sites is poor, and the nutrient levels in the soil are low.

Critical habitat: The critical habitat for *Daviesia bursarioides* comprises the area of occupancy of the known populations (wild and translocated); similar habitat within 200 metres of known populations; corridors of remnant vegetation that link populations and additional nearby occurrences of similar habitat that do not currently contain the species but may have done so in the past and may be suitable for translocations.

Habitat critical to the survival of the species, and important populations: Given that this species is listed as Critically Endangered, it is considered that all known habitat for wild and translocated populations is habitat critical to its survival, and that all wild and translocated populations are important populations.

Benefits to other species or ecological communities: There are no other known listed threatened species or ecological communities in the habitat of *Daviesia bursarioides*. However, recovery actions such as improving the security of tenure of *D. bursarioides* populations will also help protect the habitats in which the populations are located.

International obligations: This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that convention. The taxon is not listed under any specific international treaty, however, and therefore this IRP does not affect Australia's obligations under any other international agreements.

Role and interests of indigenous people: Indigenous communities interested or involved in the regions affected by this plan have not yet been identified. The Aboriginal Sites Register maintained by the Department of Indigenous Affairs does not list any significant sites in the vicinity of the populations. However, not all significant sites are listed on the Register. Input and involvement will be sought from any indigenous groups that have an active interest in the areas that are habitat for *Daviesia bursarioides*, and this is discussed in the recovery actions.

Social and economic impact: The implementation of this recovery plan has the potential to have some limited social and economic impact, where populations are located on private property or road reserves. One population of *D. bursarioides* occurs on private land, in an area previously used as a source of gravel, and negotiations will continue with regard to the future management of this population. In addition, the Nature Reserve used for the translocation must be accessed through private property. Recovery actions refer to continued liaison between stakeholders with regard to these areas.

Evaluation of the plan's performance: The Department of Conservation and Land Management will evaluate the performance of this IRP in conjunction with the Moora District Threatened Flora Recovery Team. In addition to annual reporting on progress with listed actions and comparison against the criteria for success and failure, the plan is to be reviewed within five years of its implementation.

Existing Recovery Actions: The following recovery actions have been or are currently being implemented:

1. Relevant land managers have been made aware of the location and threatened status of the species.
2. Declared Rare Flora (DRF) markers are in place for all roadside populations of the species. These alert road maintenance workers to the presence each population, and enable them to take appropriate care.
3. Population 5 on private property has been fenced to exclude stock.
4. Approximately 3000 seeds collected from Populations 1, 2, 3, 5 and 6 are stored at CALM's Threatened Flora Seed Centre.
5. The Botanic Garden and Parks Authority currently hold 13.93g seed from six clones, and 8 plants in the nursery in fairly poor health.
6. A translocation was implemented with approximately 600 juveniles planted out over the years 1998, 1999 and 2000. Approximately 60 plants are still surviving.
7. An information sheet that describes and illustrates the species has been printed and distributed.
8. Staff from CALM's Moora District regularly monitor populations of the species.
9. The Moora District Threatened Flora Recovery Team (MDTFRT) will oversee the implementation of this IRP and will include information on progress in an annual report to CALM's Corporate Executive and funding bodies.

IRP objective: The objective of this Interim Recovery Plan is to abate identified threats and maintain or enhance viable *in situ* populations to ensure the long-term preservation of the species in the wild.

Recovery criteria

Criteria for success: The number of individuals within populations and/or the number of populations have increased by ten percent or more over the period of the plan's adoption under the EPBC Act.

Criteria for failure: The number of individuals within populations and/or the number of populations have decreased by ten percent or more over the period of the plan's adoption under the EPBC Act.

Recovery actions

1. Coordinate recovery actions
2. Map critical habitat
3. Liaise with land managers
4. Seek long-term protection of habitat
5. Reduce shading by associated vegetation
6. Implement disturbance regime
7. Implement weed control as required
8. Collect seed
9. Monitor populations
10. Conduct further surveys
11. Develop and implement a fire management strategy
12. Undertake and monitor translocation
13. Promote awareness
14. Obtain biological and ecological information
15. Review the need for a full Recovery Plan

1. BACKGROUND

History

Daviesia bursarioides was first collected by W.E. Blackall between Coorow and Arrino in 1932. Further collections were made in 1958 by R.T. Lange, and in 1972 and 1973 by C. Chapman. The sites were re-visited in 1978 but only one surviving population containing 3 plants (Population 1a) was located. This population was damaged in 1979 by construction of a fence between the narrow road verge and the adjacent paddock, but several plants regenerated and recruitment of seedlings occurred following this disturbance.

Since 1993, C. Strahan[1] has located four new populations. Three occur on road verges and the fourth population of over 30 plants is on private property. Part of this land is accessed by the Shire for gravel extraction, and protocols are in place to minimise impact on this species. *Daviesia bursarioides* occupies previously disturbed areas at this site, rather than adjacent undisturbed areas of native vegetation. A sixth population was located on a Nature Reserve in 1997 by D. Papenfus. A translocation commenced at this site in 1998.

It is probable that the species is naturally geographically restricted to the Three Springs area and extensive vegetation clearance has significantly reduced available habitat. Due to the small size of all known populations and the occurrence of most populations in narrow areas of habitat adjacent to roads, it is particularly vulnerable to weed invasion and damage by road maintenance, fire and grazing.

Description

Daviesia bursarioides is a straggling, divaricately branching shrub to 2 m tall, with blue-green spine-tipped branches. The leaves are distinctive among Daviesias, being scattered and small (measuring up to 20 x 2.5 mm) obovate in shape narrowing to the base. The flowers appear between July and September, and are grouped in 3-8 flowered racemes in the axils of the leaves, on a long stem to 35 mm, giving the raceme an open appearance. Flowers are small and typically pea-shaped. Each flower has an upper standard petal 7 x 9 mm, yellow in colour and maroon towards the base. The wing petals are 6 x 3 mm and deep pink, and the keel is 5 x 2 mm, and maroon in colour. The fruit is a triangular pod, 9 mm x 10 mm (Patrick and Brown 2001; Crisp 1995).

Distribution and habitat

Daviesia bursarioides is endemic to the Three Springs area of Western Australia, and is known from appriximately 120 plants in six populations over a range of about 15 km. Populations occur on Shire road reserves, Main Road reserves, private property and a Nature Reserve.

Daviesia bursarioides is found in open shrub mallee habitat dominated by *Eucalyptus gittinsii*, *Allocasuarina campestris*, *Dryandra* spp., *Hakea* spp., and *Grevillea* spp. Soils are shallow brown sandy loams with extensive lateritic gravel. Population 5 (the largest population) occurs on the periphery of a dense *Allocasuarina campestris* thicket on deep lateritic gravel. Species diversity at most sites is poor, and the nutrient levels in the soil are low. An analysis of soil from one population indicated that pebbles greater than 2 mm comprised 44% of the sample, and of the remainder, 85.5% was sand. All nutrients analysed (nitrogen, phosphorus and potassium) were present in extremely small quantities (Schwarten 1995).

Biology and ecology

Schwarten (1995) found that *Daviesia* species first produce seed when three years old. *Daviesia bursarioides* and other *Daviesia* species often die after 8-10 years. It appears that after six years the plant crown starts to die, sometimes very rapidly, which affects plant growth, assimilation, flower production and therefore reproductive success.

Daviesia bursarioides responds to disturbance, as do many species of the genus *Daviesia*. In the largest population, plants that were found growing in disused areas of a gravel pit were more abundant and vigorous than those observed in the adjoining remnant vegetation, and seedlings have been observed after soil disturbance such as roadworks and fence construction. Schwarten (1995) recommends some form of disturbance every 6-8 years as a management technique for *Daviesia* species, after seed-set has occurred (approximately 3

[1] Charles Strahan, Gardener, Shire of Three Springs

months after flowering, or longer if the season is particularly hot and dry). This would optimise management of young seed with relatively high viability, and minimise predation of seed by vertebrates and insects. If flowering occurs early in the season (July), seed-set may have occurred by October, when fire may be utilized to stimulate germination, under appropriate weather conditions. If seed-set doesn't occur until later in the summer, fire may not be an appropriate tool for stimulating germination, and mechanical disturbance of the topsoil, or another similar method, may be a better alternative.

The specific response of *Daviesia bursarioides* to fire is unknown. Fire is usually a stimulus for regeneration from seed in most Australian legumes (Crisp 1985). Schwarten (1995) found that several *Daviesia* species had a significant decrease in germination after treatment with various levels of smoke. He suggested that it may be the heat of a fire rather than chemicals in the smoke that breaks the dormancy of *Daviesia* seed, and that scarification of the seed coat during mechanical disturbance is also effective in stimulating germination.

Most Daviesias are adapted for bee pollination. *Daviesia bursarioides* is a good food resource for native bees and European honey bees, as the peduncles are sticky from early in the flowering season through to the end of seed set. Daviesia seeds have a starchy elaisome which makes the seed attractive to ants and a range of vertebrates. Seeds collected by ants are usually stored below the soil surface. The seed bank in the top-soil around the plants contains a small number of seeds but it is assumed that most of the seed produced is stored at depth without contributing to the viable seed bank. Seed buried by ants in deeper profiles of the soil may be more immune to predation but it is not clear if this seed is returned to germination depth (Schwarten 1995).

Daviesia bursarioides has a very low seed set, possibly as a result of a decline in pollinators. Schwarten (1995) observed a fruit:flower ratio (F:F) of 3.8% and a seed:ovule (S:O) ratio of 1.9%, meaning that approximately 98% of ovules were aborted. Ratios were calculated for *Daviesia spiralis* over the course of a flowering season, and it was found that the S:O ratio declined from 3.89% in early flowering season (October) to 0.47% in late flowering season (December). This may reflect the influence of hot, dry periods in decreasing seed production, and/or a preferential nutrient supply within the plant to keep developing existing seed (Schwarten 1995).

Staff from CALM's Threatened Flora Seed Centre (TFSC) have conducted germination trials on *Daviesia bursarioides* seed over a number of years. Germination levels have varied from 6-80% initially (mean ca. 50%), with tests conducted after seed has been stored for 12 months showing germination of 50-100% (mean ca. 75%) (unpublished data A. Cochrane[2]).

Schwarten (1995) studied the longevity of *Daviesia bursarioides* seed over a 12 month period. He found that 100% of buried seed remained viable after 6 months, with seed showing a slight reduction in size. The seed coat of viable seed became harder over time and the embryo was green, whereas nonviable seed had a soft seed coat and the embryo was yellow. Viability of *D. bursarioides* seed was reduced to 65% after being buried for 12 months. Seed bags were also fixed to the soil surface in full sun or part shade, but all were eaten by vertebrates within three weeks of setting up the experiment. Whether the rate of decline observed in buried seed continues over time or plateaus, and if so for how long, is essential knowledge for the management of this species and other endangered *Daviesias*.

Daviesia bursarioides was found to be highly susceptible to infection by the plant pathogen *Phytophthora cinnamomi* (dieback) when tested by CALM Science Division (Shearer, Crane and Cochrane, submitted). This finding is preliminary as the number of replicates has necessarily been low. If monitoring suggests that dieback may be present in the habitat of *D. bursarioides*, formal testing for presence of *Phytophthora* species should be conducted as a matter of urgency.

Schwarten (1995) suggests that all *Daviesia* species thrive more in an open stand in full sun without dominance of taller species. He suggests that *Daviesia bursarioides* plants growing under *Allocasuarina campestris* plants suffer greatly from a lack of light and water, responding with slow growth and even lower seed set. The short life cycle of *D. bursarioides* in combination with low number of years of seed production, low levels of seed set each year and potentially short term viability of seed all indicate that this species will require ongoing active management to ensure its survival.

[2] Anne Cochrane, Manager, CALM's Threatened Flora Seed Centre

Threats

Due to the low number of plants and the threats associated with growing mainly on narrow, degraded road reserves, *Daviesia bursarioides* was declared as Rare Flora in September 1987 and ranked as Critically Endangered under the *Wildlife Conservation Act* 1950. *D. bursarioides* is also listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). *D. bursarioides* currently meets Red List (IUCN 2000) Category 'CR' under criteria B2ab(iii); C1+2a(i) due to the highly fragmented populations, low number of plants, and continuing decline in the quality of the habitat. It has a highly restricted distribution in a widely cleared landscape. The main threats are edge effects, degraded habitat, road, fence and firebreak maintenance, weed invasion, competition due to shading (this may be occurring as a consequence of a disturbance regime that is not particularly favorable to *D. bursarioides*), inappropriate disturbance regimes and disease.

- **Edge effects** severely affect narrow linear populations such as those on road reserves through exposure to influences from adjacent cleared land. In addition to the proximity of a weed seed source, effects include increased wind speed, fertiliser and herbicide spray drift and runoff, modified hydrology and altered disturbance regimes, including fire.

- **Degraded habitat** represents a threat to all roadside populations, which occur on narrow reserves with cleared land beyond. The lack of associated native vegetation increases the likelihood that pollinators will be infrequent or absent. In addition, the lack of available habitat for recruitment is of concern.

- **Road, firebreak and fence maintenance activities** have the potential to threaten existing plants. Threats include grading, chemical spraying, construction of drainage channels, the mowing of roadside vegetation and movement of machinery. Several of these actions also encourage weed invasion. However, soil disturbance by machinery often stimulates germination of seed in this species. Road maintenance has damaged existing *Daviesia bursarioides* plants in the past, but CALM Moora District staff and Shire of Three Springs operational staff have a very effective working relationship, and this threat has therefore been minimised. Currently proposed roadworks will involve a slight realignment to accommodate this species, and soil displaced will be used in the rehabilitation of cleared areas adjacent to Population 2.

- **Gravel extraction** has the potential to threaten Population 5. However, the Shire of Three Springs operational staff are aware of this population and have guidelines in place to minimise impact on this species when extracting gravel from this area.

- **Weed invasion and competition** is a threat to roadside populations, although current weed levels are low. The populations all occur in very narrow (3-4 m wide) road reserves that are adjacent to cleared farmland or wide firebreaks. These populations are constantly being invaded by weed seeds blown in from adjoining paddocks. The hard, impoverished soil protects the populations to a certain extent, limiting the level of weed invasion.

- **Shading and competition** from associated *Allocasuarina campestris* has been said to detract from the health of the *Daviesia bursarioides* causing slower growth and lowering seed set. Schwarten (1995) suggested that all *Daviesias* grew best in an open position, and that the *Allocasuarinas* crowding these plants should be cut back.

- **Inappropriate disturbance regimes** (by fire or machinery) may affect the viability of populations, as these kill adult plants but stimulate germination in *Daviesia bursarioides*. If this is the case, the soil seed bank would rapidly be depleted if these events recurred before regenerating or juvenile plants reached maturity and replenished the soil seed bank. However, an absence of disturbance for too long will reduce germination events and therefore recruitment, possibly causing the extinction of a population if the interval between disturbance events exceeds the longevity of soil-stored seed.

- **Disease** could be a serious threat to populations, as this species has been found to be highly susceptible to the plant pathogen *Phytophthora cinnamomi* (dieback). This plant pathogen causes the roots to rot and results in death from drought stress. The pathogen is not known to be present in the vicinity of populations, but will require careful management if future monitoring indicates that it is present. It is possible that areas subject to

ponding, even in relatively dry areas such as the natural habitat of this species, are conducive to the introduction, spread and amplification of the disease.

- **Grazing** by kangaroos impacted heavily on juveniles translocated into Population 6T in 1999 and 2000. Mature *Daviesia bursarioides* plants are spiny and not subject to grazing, but young seedlings are vulnerable. Grazing of juveniles was not marked in 1998, suggesting that grazing pressure varies according to the availability of alternative feed.

Summary of population information and threats

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
1a. S of Three Springs	Shire road reserve	1984 11 1991 11 (2) 1994 19 1999 9 2000 12	Healthy	Road and fence maintenance, weed invasion, edge effects, degraded habitat, inappropriate disturbance regimes
1b. S of Three Springs	Private property	1984 1	Moderate	Fence maintenance, weed invasion, edge effects, degraded habitat, inappropriate disturbance regimes
2. Three Springs	Shire road reserve	1993 4 1994 6 (5) 2000 4 2002 1 2003 2 (7)	Moderate	Road and fence maintenance, weed invasion and competition, edge effects, degraded habitat, inappropriate disturbance regimes
3. N of Three Springs	MRWA road reserve	1993 5 1994 5+ (12) 2000 15	Moderate	Road and fence maintenance, weed invasion and competition, edge effects, degraded habitat, inappropriate disturbance regimes
4. N of Three Springs	MRWA road reserve	1994 9 (3) 2000 11 2002 5	Moderate	Road and fence maintenance, weed invasion and competition, edge effects, degraded habitat, inappropriate disturbance regimes
5. SW of Three Springs	Private property	1995 60+ 2001 35+	Healthy	Gravel extraction, fence maintenance, weed invasion and competition, shading and competition, inappropriate disturbance regimes
6. W of Three Springs	Nature reserve	1997 4 1998 12 2000 14	Healthy	Firebreak maintenance, weed invasion, inappropriate disturbance regimes
6T. W of Three Springs	Nature reserve	1998 (192) 1999 (47+144) 2000 (46+22+262) 2001 (41+20+13) 2002 37 (16+5)	Healthy	Grazing by kangaroos, inappropriate disturbance regimes

Numbers in brackets = number of juveniles. Plants in 6T are listed by year of planting; (ie in order figures represent: numbers of plants from 1998 planting + from 1999 + from 2000); MRWA = Main Roads Department of Western Australia.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Any on-ground works (clearing, firebreaks, roadworks etc) in the immediate vicinity of *Daviesia bursarioides* will require assessment. On-ground works should not be approved unless the proponents can demonstrate that they will not have an impact on the species, or on its habitat or potential habitat.

Critical habitat

Critical habitat is habitat identified as being critical to the survival of a listed threatened species or listed threatened ecological community. Habitat is defined as the biophysical medium or media occupied (continuously, periodically or occasionally) by an organism or group of organisms or once occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind have the potential to be reintroduced (*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)).

Daviesia bursarioides is listed as Critically Endangered, and it is therefore considered that all known habitat for wild and translocated populations is critical habitat. This includes:

- the area of occupancy of wild and translocated populations;

- areas of similar habitat within 200 metres of populations, i.e. yellow sand or brown sand with gravel in low scrub or heath (these provide potential habitat for natural range extension);
- corridors of remnant vegetation that link populations (these are necessary to allow pollinators to move between populations and are usually road and rail reserves);
- additional occurrences of similar habitat that do not currently contain the species but may have done so in the past (these represent possible translocation sites).

Benefits to other species or ecological communities

There are no other known listed threatened species or ecological communities in the habitat of *Daviesia bursarioides*. However, recovery actions such as improving the security of tenure of *D. bursarioides* populations will also help protect the habitat in which the populations are located.

International obligations

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that convention. The taxon is not listed under any specific international treaty, however, and therefore this IRP does not affect Australia's obligations under any other international agreements.

Role and interests of indigenous people

Indigenous communities interested or involved in the areas affected by this plan have not yet been identified. The Aboriginal Sites Register maintained by the Department of Indigenous Affairs does not list any significant sites in the vicinity of these populations. However, not all significant sites are listed on the Register. Input and involvement will be sought from any indigenous groups that have an active interest in the areas that are habitat for *Daviesia bursarioides*, and this is discussed in the recovery actions.

Social and economic impacts

The implementation of this recovery plan has the potential to have some limited social and economic impact, where populations are located on private property. One population of *Daviesia bursarioides* occurs on private land, in an area previously used as a source of gravel, and negotiations will continue with regard to the future management of this population. In addition, the Nature Reserve used for the translocation must be accessed through private property. Recovery actions refer to continued liaison between stakeholders with regard to these areas.

Evaluation of the plan's performance

CALM will evaluate the performance of this IRP in conjunction with the Moora District Threatened Flora Recovery Team. In addition to annual reporting on progress with listed actions and comparison against the criteria for success and failure, the plan is to be reviewed within five years of its implementation.

2. RECOVERY OBJECTIVE AND CRITERIA

Objectives

The objective of this Interim Recovery Plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term preservation of the species in the wild.

Criteria for success: The number of individuals within populations and/or the number of populations have increased by ten percent or more over the period of the plan's adoption under the EPBC Act.
Criteria for failure: The number of individuals within populations and/or the number of populations have decreased by ten percent or more over the period of the plan's adoption under the EPBC Act.

3. RECOVERY ACTIONS

Existing recovery actions

All relevant land managers have been notified of the location and threatened status of the species. The notification details the Declared Rare status of *Daviesia bursarioides* and associated legal obligations, and provides contact details of CALM District staff for future liaison.

Declared Rare Flora (DRF) markers are in place for all roadside populations of the species. These alert road maintenance workers to the presence of each population, and help avoid damage to the vegetation in the area. An excellent working relationship has been established between CALM's Moora District and Shire of Three Springs with regard rare flora management. The road near Population 2 is undergoing maintenance work. The road will be slightly realigned to accommodate this species, and any gravel moved through this work will be re-spread in the gravel pit adjacent to Population 2. The gravel pit has already been deep ripped in preparation for this rehabilitation to counter soil compaction brought about by movement of heavy machinery during gravel extraction.

Population 5 on private property has been fenced. CALM supplied the materials for 3 km of fencing and organized a contractor to erect the fence in 1997.

Approximately 3,000 seeds collected between 1995 and 1998 from Populations 1, 2, 3, 5 and 6 are stored at the TFSC. The viability of seeds produced has been found to vary from year to year, with germination as low as 6% from 1995 collections. A high proportion of this seed was shriveled. Germination from collections made in 1997 was 80-100% 1997 (unpublished data A. Cochrane). Additional seed was collected in 2002 by G. Broun and J. Borger of the Moora District Threatened Flora Recovery Team, but this has not yet been processed.

The germinants resulting from TFSC viability trials were delivered to the Botanic Garden and Parks Authority (BGPA) nursery to allow them to grow to maturity. A number of these are still growing in the nursery, although all are in fairly poor condition. There were 8 plants remaining in October 2003. Another seven plants were previously planted in the Botanic Gardens, but these have since died. BGPA also hold 13.93g of seed from six clones (A. Shade[3], pers. comm.).

Plants were propagated for translocation by TFSC and BGPA. Seed was germinated at TFSC, and then transferred to the BGPA nursery for hardening off and establishment (Cochrane *et al.* 2000a). *Daviesia bursarioides* was considered easy to establish and the survival rate of germinants was high. The species remained disease free and there were no problems in cultivating them. However, initial growth was slow and not particularly vigorous, so at least six months of growing time was required before seedlings were ready for planting into the wild (Cochrane *et al.* 2000b).

Translocation of this species commenced in September 1998 with the planting of 192 seedlings into the Nature Reserve that contains Population 6. Three treatments were trialed to determine optimal techniques for future translocations: mulching; watering; and mulching with watering. However as fauna, (probably cockatoos), cut the irrigation pipe at this site over summer 1998-1999, the delivery of water during the driest time of year was unreliable. That is, plants in watered treatments would not have received as much water as intended and perhaps not much more than unwatered treatments. There was relatively little difference across treatments in mean height and width of translocated plants. In November 1998, mean height ranged from 10 cm in control to 12 cm in watered and mulched treatment. In November 1999, mean height ranged from 40 cm in control to 47 cm in mulched treatment. However, the benefit of even a little more water was reflected in survival statistics, with survival rates of translocated plants in watered treatments approximately double those of translocated plants in unwatered treatments. In March 1999, survival rates were 18.8% for control, 14.6% for mulch only, 37.5% for water only and 41.7% for watered and mulched.

An additional 144 seedlings were planted into the same site with the same range of treatments (mulching, watering, and mulching with watering) in August 1999. There was heavy grazing of these seedlings across all treatments, probably by kangaroos. A total of 45 seedlings (31%) survived to November 1999. The remaining seedlings were fenced to prevent further losses.

In August 2000, 262 additional plants were translocated into this site with caging as a treatment. Unfortunately, no watering system was used for these plants due to a lack of funding. Monitoring suggested that most uncaged

[3] Amanda Shade, Horticulturalist, Botanic Garden and Parks Authority

plants died from grazing, whereas most caged plants died from a lack of moisture. Two years after planting, only 5 plants (2%) of the original 262 remained.

Survival of *Daviesia bursarioides* after translocation

1998 plantings			1999 plantings			2000 plantings		
Year	No. surviving	% survival	Year	No. surviving	% survival	Year	No. surviving	% survival
Initial (Sep 1998)	192		Initial (Aug 1999)	144		Initial (Aug 2000)	262	
Nov 1998	180	94	Nov 1999	45	31	Jun 2001	13	5
Aug 1999	47	24	Aug 2000	22	15	Aug 2002	5	2
Jul 2000	46	24	Jun 2001	20	14			
Jun 2001	41	21	Aug 2002	16	11			
Aug 2002	37	19						

The success of translocated plants has been relatively poor due to grazing and a lack of watering as described above. To ensure these constraints don't limit the success of future translocation trials, the following method will be adopted:

- Irrigation pipes will be buried to prevent damage by fauna
- Watering systems will be run and maintained throughout the first summer
- Seedlings will be caged to prevent grazing
- Seedlings will be mulched to maximise the effect of the watering

A double-sided information sheet has been printed, and includes a description of *Daviesia bursarioides*, its habitat, threats, recovery actions and photos. This will continue to be distributed to the community through the Shire of Three Springs office and library, wildflower shows and so on. It is hoped that this may result in the discovery of new populations.

Staff from CALM's Moora District regularly monitor all populations of this species. The growth of translocated plants at Population 6T continues to be monitored to assess the effects of each treatment and the success of the translocation overall. Twelve plants at Population 6 have permanent metal tags, and growth and reproductive data were collected from these in 2000 for comparison with translocated plants.

The Moora District Threatened Flora Recovery Team is overseeing the implementation of this IRP and will include information on progress in its annual report to CALM's Corporate Executive and funding bodies.

Future recovery actions

Where populations occur on lands other than those managed by CALM, permission has been or will be sought from appropriate land managers prior to recovery actions being undertaken. The following recovery actions are roughly in order of descending priority; however this should not constrain addressing any of the priorities if funding is available for 'lower' priorities and other opportunities arise.

1. Coordinate recovery actions

The Moora District Threatened Flora Recovery Team will coordinate recovery actions for *Daviesia bursarioides* and other Declared Rare Flora in the district. They will include information on progress in their annual report to CALM's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $1,000 per year

2. Map critical habitat

It is a requirement of the EPBC Act that spatial data relating to critical habitat be determined. Although critical habitat is described in Section 1, the areas as described have not yet been mapped and that will be redressed under this action. If any additional populations are located, then critical habitat will also be determined and mapped for these locations.

Action: Map critical habitat
Responsibility: CALM (Moora District, WATSCU) through the MDTFRT
Cost: $2,000 in the first year

3. Liaise with relevant land managers

Staff from CALM's Moora District will continue to liaise with relevant land managers and landowners to ensure that populations are not accidentally damaged or destroyed. Input and involvement will also be sought from any indigenous groups that have an active interest in areas that are habitat for *Daviesia bursarioides*.

Action: Liaise with relevant land managers
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $1,000 per year

4. Seek long-term protection of habitat

Ways and means of improving the security of populations and their habitat will be investigated. On private land, this may include conservation covenants with a range of agencies or registration through the Land for Wildlife scheme.

Action: Seek long-term protection of habitat
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $1,200 in the first and third years.

5. Reduce shading by associated vegetation

Tall *Allocasuarina campestris* plants are overshadowing *D. bursarioides* plants at Population 5, more successfully competing for light and water. It is thought that *D. bursarioides* responds with slow growth and lower seed set (Schwarten 1995). The *A. campestris* plants close to *D. bursarioides* plants will be trimmed as required if monitoring indicates that dense shading appears to be impacting on growth and seed-set in *D. bursarioides*. It may be, however, that when a strategy of regular disturbance such as burning is introduced, this competition will be reduced.

Action: Reduce shading by associated vegetation
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $1,300 per year in first and fifth years

6. Implement disturbance regime

Schwarten (1995) researched the biology and ecology of a number of threatened *Daviesia* species, including *Daviesia bursarioides*. He recommends actively managing these populations with some form of disturbance every six to eight years. Disturbance will take place after seed-set has occurred (approximately 3 months after flowering, or longer if the season is particularly hot and dry). This ensures seed is young with relatively high viability, and minimises predation of seed by vertebrates and insects. The form of disturbance will depend on the timing of seedset. If seedset is early enough, weather conditions may be mild enough for burning to be considered. When temperatures increase the risk associated with use of fire, careful mechanical disturbance of the topsoil is likely to be a better alternative. Disturbance by either method is likely to increase the invasion of weeds, and follow-up weed control will be undertaken as necessary. Monitoring will detail the response of associated habitat as well as that of *D. bursarioides*, and will also record any negative impacts such as the level and type of weed invasion. Monitoring of regeneration will continue for at least three years, and monitoring of *D. bursarioides* recruitment will continue as for all populations.

Action: Implement disturbance regime
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $2,500 per year

7. Implement weed control as required

The current level of threat from weeds is low at most populations, with the harsh nature of the habitat limiting invasion. If required, weed control will be undertaken in consultation with the land managers. This will be by hand weeding or localised application of herbicide during the appropriate season to minimise the effect of

herbicide on the species and the surrounding native vegetation. All weed control will be followed by a report on the method, timing and success of the treatment against weeds, and the effect on *Daviesia bursarioides* and associated native plant species.

Action: Implement weed control as required
Responsibility: CALM (Moora District) through the MDTFRT; relevant land managers
Cost: $900 per year

8. Collect seed

It is necessary to store germplasm as a genetic resource, ready for use in translocations and as an *ex situ* genetic 'blueprint' of the species. Some seed has been collected from most populations, but additional collections are required from all populations to maintain adequate representation of the remaining genetic diversity of this species, and to replace seed used in translocations to date.

Action: Collect seed
Responsibility: CALM (TFSC, Moora District) through the MDTFRT
Cost: $2,800 in the first, third and fifth years

9. Monitor populations

Annual monitoring of factors such as habitat degradation (including weed invasion and salinity), population stability (expansion or decline), pollination activity, seed production, recruitment, longevity and predation is essential. The visibility of DRF markers will also be monitored to ensure they remain effective, and have not faded or been covered by vegetation. There is no evidence to suggest that dieback (*Phytophthora* species) is present at any populations. However, testing has found that this species is highly susceptible to *Phytophthora* infection, so if there is evidence of dieback in future appropriate action will be required.

Action: Monitor populations
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $1,000 per year

10. Conduct further surveys

Community volunteers will be encouraged to be involved with further surveys supervised by CALM staff to be conducted during the flowering period of the species (June-July). Records of areas surveyed will be sent to Wildlife Branch and retained at the District, even if *Daviesia bursarioides* is not located. Nature Reserves in the Three Springs area will be particularly targeted, and any areas appropriate for future translocations recorded.

Action: Conduct further surveys
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $2,500 per year in the first, third and fifth years

11. Develop and implement a fire management strategy

Fire kills adult plants of this species and regeneration occurs from seed. Frequent fire may prevent the accumulation of sufficient soil-stored seed for recruitment to occur. Fire also promotes the introduction and proliferation of weed species. Frequent fire should therefore be prevented from occurring in the habitat of populations. A fire management strategy will be developed in consultation with land managers to recommend fire intensity, control measures and fire frequency for the habitat.

Action: Develop and implement a fire management strategy
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $2,500 in first year, and $1,700 per year in subsequent years

12. Undertake and monitor translocation

A three year experimental translocation program has been implemented for this species, and has provided much information about how best to ensure survival of translocated plants. However, less than 60 plants (some still juvenile) survive after almost 600 seedlings have been planted. If this species is to be made less vulnerable to extinction, larger and additional populations are needed on land of secure tenure.

A second Translocation Proposal will be developed. The propagation of plants in readiness for translocation will also be undertaken, and when appropriate, these will be planted in accordance with the approved Translocation Proposal. Information on the translocation of threatened plants and animals in the wild is provided in CALM's Policy Statement No. 29 *Translocation of Threatened Flora and Fauna*. All Translocation Proposals require endorsement by CALM's Director of Nature Conservation. Following the results of the earlier translocation, translocated plants will be watered and caged, and irrigation pipes will be buried. In the first year, two watering systems will be employed off one tank to deliver different rates of water over summer months. This will help refine future watering regimes.

Monitoring of the translocation is essential and will be undertaken according to the timetable developed for the Translocation Proposal.

Action: Undertake and monitor translocation
Responsibility: CALM (Moora District, TFSC) and BGPA through the MDTFRT
Cost: $18,800 in the first year, and $14,500 per year in subsequent years

13. Promote awareness

The importance of biodiversity conservation and the need for the long-term protection of wild populations of this species will be promoted to the community through poster displays and the local print and electronic media. Formal links with local naturalist groups and interested individuals will also be encouraged. An information sheet will be produced, and will include a description of the plant, its habitat, threats, recovery actions and photos. This will be distributed to the public through CALM's Moora District office and at the office and library of the Shire of Three Springs. Such information distribution may lead to the discovery of new populations.

Action: Promote awareness
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $1,700 in first year, and $1,100 per year in subsequent years

14. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Daviesia bursarioides* will provide a scientific basis for its management in the wild. An understanding of the following is necessary for effective management:

1. Seed longevity in soil.
2. Factors affecting flower and fruit abortion.
3. The pollination biology of the species.
4. The requirements of pollinators.
5. The population genetic structure, levels of genetic diversity and minimum viable population size.

Schwarten (1995) found that seed viability fell from 100% to 65% after 12 months in the soil. Of particular relevance is whether the viability rate plateaus or continues to decline, and if it declines, whether the decline is slow or rapid. This information will have an impact on the disturbance regime implemented.

Action: Obtain biological and ecological information
Responsibility: CALM (Science Division, Moora District) through the MDTFRT
Cost: $12,000 per year in the second, third and fourth years

15. Review the need for a full Recovery Plan

At the end of the fourth year of its five-year term this Interim Recovery Plan will be reviewed and the need for further recovery actions will be assessed. If the species is still ranked as Critically Endangered at that time a full Recovery Plan may be required.

Action: Review the need for further recovery actions and/or a full Recovery Plan
Responsibility: CALM (WATSCU, Moora District) through the MDTFRT
Cost: $500 in the fifth year

4. TERM OF PLAN

This Interim Recovery Plan will operate from June 2004 to May 2009 but will remain in force until withdrawn or replaced. If the taxon is still ranked Critically Endangered after five years, the need to review this IRP or to replace it with a full Recovery Plan will be determined.

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6. TAXONOMIC DESCRIPTION

Excerpt from: Crisp, M.D. (1995) Contributions towards a revision of *Daviesia* (Fabaceae: Mirbelieae) III. A synopsis of *Daviesia*. *Australian Systematic Botany* 8(6), 1178-79.

Daviesia bursarioides

Straggling *shrubs*, to 2 m high. *Branchlets* regularly divaricate at 45°, terete, striate, spinescent, pruinose. *Phyllodes* spreading or ascending, narrow-obovate, apiculate, tapered to the base, articulate, 3-20 mm long, rather fleshy, glaucescent; mid-rib and veins obscure. *Racemes* 3-8 flowered, sub-umbelliform, very diffuse owing to the long (25-35 mm) rachis, viscid on rachis, pedicels and bracts; *pedicels* 3-5 mm long. *Calyx* c. 4 mm long including the stipe-like receptacle, slightly 5-ribbed when dry, viscid; lobes subequal. *Standard* with two calli above claw, 9-10 mm broad, yellow towards margins, maroon on veins and towards centre; *wing* rounded and incurved at apex, deep pink; *keel* maroon. *Stamens* strongly dimorphic, inner whorl with filaments compressed and anthers versatile, very broad-ovoid, with cells confluent; outer whorl slightly longer, with filaments flattened and anthers basifixed, broad-ellipsoid, 2-celled. *Pod* compressed, acuminate, stipe-like at base, 10-14 mm long, coriaceous.

Distribution: Three Springs.

Etymology: The specific epithet refers to the superficial resemblance between the habit of *D. bursarioides* and certain species of *Bursaria* (Pittosproaceae).

Notes: Daviesia bursarioides is a very distinctive species which cannot be confused with any other in the genus. The regular, divaricate branching pattern in combination with the spinescent branchlet apices and the small, narrowly obovate phyllodes diagnose a unique plant which looks for all the world like a *Bursaria* (Pittosporaceae). The elongated partly umbelliform, partly racemiform inflorescences, as well as details of the flowers and fruits, suggest a relationship to *D.*

costata and *D. longifolia*. It also shows similarity to *D. pedunculata* in the inflorescence, viscid pedicels and pruinose branchlets; however, the latter has larger, pungent leaves and non-divaricate, non-spinescent branchlets.

SUMMARY OF RECOVERY ACTIONS AND COSTS (not for publication)

Recovery Action	Year 1			Year 2			Year 3			Year 4			Year 5		
	CALM	**Other**	**Ext.**	**CALM**	**Other**	**Ext.**	**CALM**	**Other**	**Ext.**	**CALM**	**Other**	**Ext.**	**CALM**	**Other**	**Ext.**
Coordinate recovery actions	500	500		500	500		500	500		500	500		500	500	
Map critical habitat	1,500		500												
Liaise with land managers	400		600	400		600	400		600	400		600	400		600
Seek long-term protection of habitat	600	100	500				600	100	500						
Reduce shading by vegetation	200		1,100										200		1,100
Implement disturbance regime	1,000		1,500	1,000		1,500	1,000		1,500	1,000		1,500	1,000		1,500
Implement weed control	500		400	500		400	500		400	500		400	500		400
Collect seed	800		2,000				800		2,000				800		2,000
Monitor populations	400		600	400		600	400		600	400		600	400		600
Conduct further surveys	800	800	900				800	800	900				800	800	900
Develop and implement a fire management strategy	1,000	1,000	500	600	600	500	600	600	500	600	600	500	600	600	500
Undertake and monitor translocation	6,900		11,900	7,400		7,100	7,400		7,100	7,500		7,100	7,500		7,100
Promote awareness	1,100		600	1,100			1,100			1,100			1,100		
Obtain biological and ecological information				5,000		7,000	5,000		7,000	5,000		7,000			
Review the need for a full Recovery Plan													300	200	
Total	15,700	2,400	21,100	16,900	1,100	17,700	19,100	2,000	21,100	17,000	1,100	17,700	14,100	2,100	14,700
Yearly Total		**39,200**			**35,700**			**42,200**			**35,800**			**30,900**	

Ext. = External funding (funding to be sought), Other = funds contributed by NHT, in-kind contribution and BGPA.

Total CALM:	$82,800
Total Other:	$8,700
Total External Funding:	$92,300
Total Costs:	**$183,800**