INTERIM RECOVERY PLAN NO. 167

PAYNES FIND MALLEE (*EUCALYPTUS CRUCIS* SUBSP. *PRAECIPUA*)

INTERIM RECOVERY PLAN

2004-2009

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Photograph: Gillian Stack

June 2004

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DEPARTMENT OF Conservation AND LAND MANAGEMENT
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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This Interim Recovery Plan will operate from June 2004 to May 2009 but will remain in force until withdrawn or replaced.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 this IRP will be reviewed after five years.

This IRP was given regional approval on 4 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
Amanda Shade	Horticulturalist, Botanic Garden and Parks Authority
Colin Yates	Senior Research Scientist (Ecology), CALM’s Science Division

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:	*Eucalyptus crucis* subsp. *praecipua*	**Common Name:**	Paynes Find Mallee
Family:	Myrtaceae	**Flowering Period:**	August - November
CALM Region:	Midwest	**CALM District:**	Geraldton
Shire:	Yalgoo	**Recovery Team:**	Geraldton District Threatened Flora Recovery Team

Illustrations and/or further information: Brooker, M.I.H. and Hopper, S.D. (1993) New series, subseries, species and subspecies of *Eucalyptus* (Myrtaceae) from Western Australia and from South Australia. *Nuytsia* 9(1), 1-68; Brown, A., Thomson-Dans, C. and Marchant, N. (Eds) (1998) *Western Australia's Threatened Flora*, Department of Conservation and Land Management, Western Australia; Sampson, J.F., Hopper, S.D. and James, S.H. (1988) Genetic Diversity and the Conservation of *Eucalyptus crucis* Maiden. *Australian Journal of Botany* 36, 447-460.

Current status: *Eucalyptus crucis* subsp. *praecipua* was declared as Rare Flora in July 1989. It is currently ranked as Endangered (EN) under World Conservation Union (IUCN) Red List criterion D (IUCN 2000), as less than 250 mature individuals are known. *Eucalyptus crucis* subsp. *praecipua* is also listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The main threat is grazing by feral goats, with inappropriate fire regimes and lack of recruitment posing a potential threat in the long term.

Description: *Eucalyptus crucis* subsp. *praecipua* is a large erect mallee (or sometimes single-stemmed tree) to 15 m tall with stems to about 30 cm diameter. It has thick, grey, rough bark on lower stems, and red-brown minni ritchi bark above. Young branchlets are smooth, white and glaucous. Juvenile leaves remain opposite for many nodes, lack a petiole and are more or less round with a conspicuous mucro. Intermediate leaves are opposite or nearly so, and are ovate with small petioles. Adult leaves are alternate, on slender petioles, and are lanceolate to narrow-lanceolate tapering to a fine, sometimes curved point, with many minute black oil dots. Inflorescences are cream-yellow, axillary and 7-flowered, with slender petioles and peduncles. Buds are glaucous with an obtusely or acutely conical operculum that is lost early in bud development. Fruits are 8-13 mm long and 14-20 mm in diameter (Brooker and Hopper 1982; Brooker and Hopper 1993; Nicolle 2001).

Eucalyptus crucis subsp. *praecipua* differs from subspecies *lanceolata* in the larger adult leaves, buds and fruits (Brooker and Hopper 1993). In addition, a study by Sampson *et al.* (1988) found that the genetic distance between the morphologically similar *Eucalyptus crucis* subsp. *lanceolata* and *Eucalyptus crucis* subsp. *praecipua* was much larger than the distance of *Eucalyptus crucis* subsp. *lanceolata* from the morphologically dissimilar *Eucalyptus crucis* subsp. *crucis*.

Habitat requirements: *Eucalyptus crucis* subsp. *praecipua* is currently known from a single granite outcrop in the Paynes Find area. It occurs on red-brown loam over granite in woodland with *Allocasuarina campestris*, *Acacia* sp., *Dodonaea* spp. and sedges.

Critical habitat: The critical habitat for *Eucalyptus crucis* subsp. *praecipua* comprises the area of occupancy of the known populations; 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 taxon but may have done so and may be suitable for translocations.

Habitat critical to the survival of the taxon, and important populations: Given that this taxon is listed as 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: *Acacia cerestes* and *Baeckea* sp. Paynes Find are both Priority 1 species that occur in the habitat of *Eucalyptus crucis* subsp. *praecipua*. These species appear to be rare but are poorly known, and need further survey to clarify their conservation status before they can be formally gazetted rare. Recovery actions such as reducing goat numbers in the vicinity of *E. crucis* subsp. *praecipua* populations will also help protect the plant community 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: An Aboriginal Corporation holds the pastoral lease over the rocky habitat in which *Eucalyptus crucis* subsp. *praecipua* occurs. The Corporation is involved in the conservation of these populations and also a proposed Indigenous Protected Area elsewhere on the station. The granite rock on which these populations occur is

listed as a ceremonial and mythological site on the Register of Aboriginal Sites maintained by the Department of Indigenous Affairs. Artefacts are also associated with this site. Input and involvement will be sought from any indigenous groups that have an active interest in the areas that are habitat for *E. crucis* subsp. *praecipua*, 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 as both populations of *Eucalyptus crucis* subsp. *praecipua* occur on a pastoral lease. Negotiations between stakeholders will continue with regard to the future management of these populations.

Evaluation of the plan's performance: The Department of Conservation and Land Management in conjunction with the Geraldton District Threatened Flora Recovery Team will evaluate the performance of this IRP. 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 taxon.
2. The managers of the station on which *Eucalyptus crucis* subsp. *praecipua* occurs have mustered feral goats to reduce numbers.
3. Approximately 2250 seeds were collected from Population 1 in 2001 and are stored in CALM's Threatened Flora Seed Centre at –18°C. Additional seed was collected in 2003.
4. The Botanic Garden and Parks Authority currently hold 0.31 g seed from a single plant, and 7 plants in the Botanic Gardens derived from the same clone are approximately 4 years old.
5. Staff from CALM's Geraldton District regularly monitor all populations of the taxon.
6. The Geraldton 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.

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 taxon in the wild.

Recovery criteria

Criteria for success: The number of individuals within populations and/or the number of populations have increased or remained stable 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 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 relevant land managers
4. Monitor populations
5. Conduct further surveys
6. Collect seed
7. Develop and implement fire management strategy
8. Promote awareness
9. Obtain biological and ecological information
10. Review the need for further recovery actions

1. BACKGROUND

History

Eucalyptus crucis subsp. *praecipua* was first collected by Southcott in 1979 as *E. crucis*. Subspecies *lanceolata* was distinguished from the type subspecies by Brooker and Hopper (1982). *E. crucis* subspecies *praecipua* was also recognised as distinct by Brooker and Hopper (1993), following the results of genetic analysis of *Eucalyptus crucis* populations by Sampson *et al.* (1988). The name *praecipua* is derived from the Latin word for 'special', alluding to its distinct isozyme constituents. Subspecies *praecipua* has one allele unique to it, and completely lacks an allele that is either fixed or most common in all other populations examined (both subsp. *lanceolata* and subsp. *crucis*) (Sampson *et al.* 1988).

Only two populations are known, and both occur on a large granite outcrop west of Paynes Find. This area lies within a pastoral lease that supports sheep and numerous feral goats.

Description

Eucalyptus crucis subsp. *praecipua* is a large erect to spreading mallee (or sometimes single-stemmed tree) to 15 m tall with stems to about 30 cm diameter. It has thick, grey, rough bark on lower stems, and red-brown minni ritchi bark above. Brooker and Kleinig (1990) describe minni ritchi as a bark type in which "the outer rich, red-brown smooth bark splits both longitudinally and horizontally, the free edges rolling back without completely detaching to expose new green bark beneath". Young branchlets are smooth, white and glaucous. Juvenile leaves remain opposite for many nodes, lack a petiole and are more or less round with a conspicuous mucro (fine point at the tip). Intermediate leaves are opposite or nearly so, and are ovate with very small to small petioles. Adult leaves are alternate, on slender petioles, and are lanceolate to narrow-lanceolate tapering to a fine, sometimes curved point, with many minute black oil dots. Inflorescences are cream-yellow, axillary and 7-flowered, with slender petioles and peduncles. Buds are glaucous with an obtusely or acutely conical operculum that is lost early in bud development. Fruit are 8-13 mm long and 14-20 mm in diameter (Brooker and Hopper 1982; Brooker and Hopper 1993; Nicolle 2001).

Eucalyptus crucis subsp. *praecipua* differs from subspecies *lanceolata* in the larger adult leaves, buds and fruits (Brooker and Hopper 1993). In addition, a study by Sampson *et al.* (1988) indicated that the genetic distance between the morphologically similar subsp. *lanceolata* and subsp. *praecipua* was much larger than the distance of subsp. *lanceolata* from the morphologically dissimilar subsp. *crucis*.

Distribution and habitat

Eucalyptus crucis subsp. *praecipua* is currently known from a single granite rock west of Paynes Find, which lies within a pastoral lease. A total of 56 plants are known from 2 populations. It is found on red-brown loam to sandy loam over granite in low woodland with open low scrub. Associated species include *Allocasuarina campestris*, *Acacia* sp., *Grevillea* sp. and *Dodonaea* sp.

Biology and ecology

No juveniles have been observed at any of the subpopulations. A seedling was observed in 2002, but in 2003 it was clear that this was a different species. Recruitment would naturally be very low for this large, long-lived taxon, but is necessary to ensure eventual replacement of existing adult trees.

It is thought probable that adults of this taxon resprout after fire and that fire triggers germination of seed, as is the case for many other eucalypts endemic to granite rocks. This pattern is true of close relative *E. crucis* subsp. *lanceolata* (Yates *et al*. 2003). It is likely that most seed is stored in the canopy and therefore avoids most predation. The trees produce abundant fruit. Fruits collected in 2001 contained numerous seeds, which were found to be 90% viable.

Some eucalypt species are known to produce enzymes that inhibit growth of other plants. It is not known whether *Eucalyptus crucis* subsp. *praecipua* produces these enzymes, but if so, it would inhibit germination of

seed in the vicinity of an adult until the enzyme was no longer produced. This mechanism reduces fatal germination, where germinants are unable to survive the existing level of competition. Available moisture and/or light may also be factors limiting germination.

Feral goats have had an impact on the habitat in the past. Their numbers have been reduced on the station through mustering, and in 2003 there was a wetter winter than in the previous two years, and this resulted in better feed elsewhere on the station. Reduced grazing pressure was evident in 2003.

Threats

Eucalyptus crucis subsp. *praecipua* was declared as Rare Flora in July 1989, and is currently ranked as Endangered (EN) under World Conservation Union (IUCN) Red List criterion D (IUCN 2000) as less than 250 mature individuals are known. *Eucalyptus crucis* subsp. *praecipua* is also listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The main threat is grazing by feral goats, with inappropriate fire regimes and lack of recruitment posing a potential threat in the long term.

- **Grazing** by feral goats and perhaps sheep threatens both populations. Although these animals don't graze the adult eucalypts, they severely restrict recruitment of juveniles to the populations. They can also impact heavily on the supporting habitat through direct grazing, breaking of branches to bring them within reach, soil compaction and introduction of weed seeds. The impact is currently low due to some destocking and goat mustering undertaken by the pastoral leaseholders, and the availability of good feed elsewhere on the lease after a wetter winter than the previous two years.
- **Inappropriate fire regimes** may affect the viability of populations, as *Eucalyptus crucis* subsp. *praecipua* almost certainly resprouts following fire. If this is the case, the lignotubers may be depleted if fires recur before they can build up resources again. This taxon is likely to be adapted to require fire or other disturbance for recruitment. However, as it is likely that the taxon has a long lifespan, there is no urgent need for fire, or other disturbance in the short to mid-term (C. Yates[1], pers. comm.).
- **Lack of recruitment** is apparent at all populations as no juvenile plants have been observed. As there is abundant seed, and seed viability has been found to be high, this seems most likely to be due to an absence of germination triggers or possibly poor seedling survival.
- **Inappropriate water catchment design** may be a threat if there is any attempt to capture water off this granite rock by diverting the flow of rainfall.

[1] Dr Colin Yates, Senior Research Scientist (Ecology), CALM's Science Division

Summary of population information and threats

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
1a. W of Paynes Find	Pastoral lease	1981 13 1991 7 2000 12 2003 12	Healthy	Grazing, frequent fire, lack of recruitment
1b. W of Paynes Find	Pastoral lease	1981 12 1991 23 2000 23 2003 23	Healthy	Grazing, frequent fire, lack of recruitment
1c. W of Paynes Find	Pastoral lease	1981 2 1991 4 1992 3 2000 3 2003 3	Healthy	Grazing, frequent fire, lack of recruitment
1d. W of Paynes Find	Pastoral lease	1981 10 1991 10 2000 10 2003 10	Healthy	Grazing, frequent fire, lack of recruitment
2. W of Paynes Find	Pastoral lease	1981 8 1991 8 2000 8 2003 8	Healthy	Grazing, frequent fire, lack of recruitment

Guide for decision-makers

Section 1 provides details of current and possible future threats. Any on-ground works (clearing, water harvesting works etc) in the immediate vicinity of *Eucalyptus crucis* subsp. *praecipua* will require assessment. On-ground works should not be approved unless the proponents can demonstrate that they will not have an impact on the taxon, 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)).

Eucalyptus crucis subsp. *praecipua* is listed as Endangered, and as such it is considered that all known habitat for wild or translocated populations is critical habitat. This includes:

- the area of occupancy of known populations;
- areas of similar habitat within 200 metres of known populations, i.e. woodland in pockets of red-brown loam on domed granite (these provide potential habitat for natural range extension);
- corridors of remnant vegetation that link populations (these are other pockets of vegetation on the rock that are necessary to allow pollinators to move between populations); and
- additional occurrences of similar habitat that do not currently contain the taxon but may have done so in the past (these represent possible translocation sites).

Benefits to other species or ecological communities

Acacia cerestes and *Baeckea* sp. Paynes Find are both Priority 1 species that occur in the habitat of *Eucalyptus crucis* subsp. *praecipua*. These species seem to be rare but are poorly known, and would need further survey to clarify their conservation status before they could be formally gazetted rare. Recovery actions such as reducing goat numbers in the vicinity of *Eucalyptus crucis* subsp. *praecipua* populations will also help to protect the ecological community 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

An Aboriginal Corporation holds the pastoral lease over the rock on which *Eucalyptus crucis* subsp. *praecipua* occurs. The group is involved in the conservation of these populations and also a proposed Indigenous Protected Area elsewhere on the station. The granite rock on which these populations occur is listed as a ceremonial and mythological site on the Register of Aboriginal Sites maintained by the Department of Indigenous Affairs. Artefacts are also associated with this site. Input and involvement will be sought from any indigenous groups that have an active interest in the areas that are habitat for *E. crucis* subsp. *praecipua*, 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 as both populations of *Eucalyptus crucis* subsp. *praecipua* occur on a pastoral lease. Negotiations between stakeholders will continue with regard to the future management of these populations.

Evaluation of the plan's performance

CALM will evaluate the performance of this IRP in conjunction with the Geraldton 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 taxon in the wild.

Criteria for success: The number of individuals within populations and/or the number of populations have increased or remained stable 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 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 taxon. The notification details the Declared Rare status of *Eucalyptus crucis* subsp. *praecipua* and associated legal obligations.

The current managers of the station have mustered feral goats to reduce their numbers.

Approximately 2250 seeds were collected from Population 1 in 2001. These have been found to have high viability with an initial germination rate of 90% (unpublished data A. Cochrane[2]). The seed is stored in CALM's Threatened Flora Seed Centre (TFSC) at –18°C. Additional seed was collected in 2003. This has not been processed yet, and so the quantity and viability of that seed are as yet unknown.

Botanic Garden and Parks Authority (BGPA) currently holds 0.31 g of seed from a single plant. Seven plants in the Botanic Garden that are derived from the same clone are now approximately 4 years old (A. Shade[3], pers. comm.).

Staff from CALM's Geraldton District regularly monitor all populations of this taxon.

[2] Anne Cochrane, Manager, CALM's Threatened Flora Seed Centre
[3] Amanda Shade, Horticulturalist, Botanic Garden and Parks Authority

The Geraldton 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 Geraldton District Threatened Flora Recovery Team (GDTFRT) will coordinate recovery actions for *Eucalyptus crucis* subsp. *praecipua* and other Declared Rare Flora in their 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 (Geraldton District) through GDTFRT
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 (Geraldton District, WATSCU) through GDTFRT
Cost: $1,000 in the first year

3. Liaise with relevant land managers

Staff from CALM's Geraldton District will continue to liaise with relevant land managers to ensure that populations are not accidentally damaged or destroyed, and that the impact of stock and feral goats is minimised. Grazing pressure will be of particular significance after any fires in the populations. Water harvesting has not been raised as a possibility, but if the issue arises, CALM will seek to ensure that the design will not affect populations of this taxon. An Aboriginal Corporation holds the pastoral lease over the rocky habitat in which *Eucalyptus crucis* subsp. *praecipua* occurs. The Corporation is involved in the conservation of these populations and also a proposed Indigenous Protected Area elsewhere on the station. Input and involvement will also be sought from any indigenous groups that have an active interest in other areas that are habitat for *E. crucis* subsp. *praecipua*.

Action: Liaise with relevant land managers
Responsibility: CALM (Geraldton District) through GDTFRT
Cost: $800 per year

4. Monitor populations

Annual monitoring of factors such as habitat degradation (including feral goat damage or weed invasion), population stability (expansion or decline), pollination activity, seed production, recruitment and longevity is essential. Regeneration of any burnt population will be monitored, and will provide useful information for management.

If goat damage is found to be increasing, action may need to be taken with regard to fencing to protect the health of the habitat, and particularly to protect any potential germinants. Goat mustering will also ideally continue to reduce goat numbers.

It is considered that the low recruitment rate is natural for such a long-lived taxon. This will not pose a problem for the future viability of the taxon provided that the adult plants remain healthy and producing seed. Plants may

live for 600 or 1200 years, and a high rate of recruitment is not necessary for a population to remain viable. However, if plant health declines in the future action may be needed to stimulate germination by disturbance such as a management burn. Any germinants would then need to be protected from grazing to provide the best chance of juveniles recruiting to the population, and this may include consideration of the need for fencing.

Action: Monitor populations
Responsibility: CALM (Geraldton District) through GDTFRT
Cost: $1,200 per year

5. Conduct further surveys

Community volunteers will be encouraged to be involved in further surveys supervised by CALM staff. The time of year is not particularly important as the taxon is conspicuous and readily identifiable by bark type when not in flower. Records of areas surveyed will be sent to Wildlife Branch and retained at the district, even if no new populations of *E. crucis* subsp. *praecipua* are located.

Action: Conduct further surveys
Responsibility: CALM (Geraldton District) through GDTFRT
Cost: $1,900 per year in the first, third and fifth years

6. 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 taxon. The germplasm stored will include seed and live plants in cultivation. Some seed has been collected from Populations 1a and 1c but additional collections are required from these and other populations to maintain adequate representation of the existing genetic diversity of this taxon.

Action: Collect seed
Responsibility: CALM (TFSC, Geraldton District) through GDTFRT
Cost: $1,000 in the second and fourth years

7. Develop and implement a fire management strategy

It is thought likely that adult plants of this taxon resprout after fire. Fire probably drives germination flushes, allowing recruitment from seed if the germinants survive subsequent conditions. Typically, resprouters show rapid and high mortality of the high numbers of post-fire germinants. *E. crucis* subsp. *lanceolata* has been found to fit this pattern (Yates *et al.*, 2003). However, such long-lived species usually have many such chances to recruit new individuals before adults reach senescence, and Dr C. Yates considers that neither presence nor absence of fire are a threat at this time.

Frequent fire may deplete the lignotubers of adult plants, and kill fire-stimulated juveniles before they can recruit into the population. If a population is burnt, population and habitat regeneration will be monitored. Whatever measures possible will be implemented in cooperation with the leaseholders to ensure the population is not burnt again before plants reach maturity and produce seed for a number of years. Possible measures will vary with the location of the population, but may involve installation of firebreaks or fire suppression.

No recruitment has been noted in this taxon, but this is likely to be quite normal for a long-lived eucalypt. If the health of the adult plants declines in future, a fire or other disturbance is likely to be required to stimulate regeneration of adults and germination of seed. Grazing will ideally be excluded post-fire to maximise the chances of some juveniles recruiting.

Action: Develop and implement a fire management strategy
Responsibility: CALM (Geraldton District) in cooperation with the leaseholders, through GDTFRT
Cost: $2,500 in the fifth year, if required

8. Promote awareness

The importance of biodiversity conservation and the need for the long-term protection of wild populations of this taxon 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 Geraldton District office and at the office and library of the Shire of Yalgoo. Such information distribution may lead to the discovery of new populations.

Action: Promote awareness
Responsibility: CALM (Geraldton District) through GDTFRT
Cost: $1,700 in first year, and $500 per year in subsequent years

9. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Eucalyptus crucis* subsp. *praecipua* will provide a scientific basis for its management in the wild. An understanding of the population genetic structure, levels of genetic diversity and gene flow, and minimum viable population size is desirable.

Action: Obtain biological and ecological information
Responsibility: CALM (Science Division, Geraldton District) through GDTFRT
Cost: $8,000 per year in the second, third and fourth years

10. Review the need for further recovery actions

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.

Action: Review the need for further recovery actions
Responsibility: CALM (WATSCU, Geraldton District) through GDTFRT
Cost: $200 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 Endangered after five years, the need for further recovery actions will be determined.

5. REFERENCES

Brooker, M.I.H. and Hopper, S.D. (1982) New subspecies in *Eucalyptus caesia* and in *E. crucis* (Myrtaceae) of Western Australia. *Nuytsia* 4(1), 113-128.

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6. TAXONOMIC DESCRIPTION

Brooker, M.I.H. and Hopper, S.D. (1993) New series, subseries, species and subspecies of *Eucalyptus* (Myrtaceae) from Western Australia and from South Australia. *Nuytsia* 9(1), 1-68.

Eucalyptus crucis* subsp. *praecipua

It differs from subspecies *lanceolata* in the larger adult leaves, buds and fruits.

Distribution: Only known from the type locality.

Conservation status: Vulnerable, declared as Rare Flora.

Flowering period: Not known.

Etymology: From the Latin *praecipua* – special, in allusion to its distinct morphology and isozyme constituents.

Notes: Apart from the morphological distinction of the new subspecies, a study by Sampson *et al.* (1988) on isozymes showed that the maximum genetic distance between the morphologically similar subsp. *lanceolata* and subsp. *praecipua* was much larger than the distance of subsp. *lanceolata* from the morphologically dissimilar subsp. *crucis*.

Brooker, M.I.H. and Hopper, S.D. (1982) New subspecies in *Eucalyptus caesia* and in *E. crucis* (Myrtaceae) of Western Australia. *Nuytsia* 4(1), 113-128.

Eucalyptus crucis* subsp. *lanceolata

A large erect mallee to 15 m tall with imperfectly decorticated, crisped 'Minni Ritchi' bark on stems to about 30 cm diameter. *Young branchlets* smooth, white, glaucous. *Seedling and juvenile leaves* remaining opposite for many nodes, sessile, orbicular or broader than long, conspicuously mucronate, to 5 x 3.5 cm, with minute black oil dots, greyish green. *Intermediate leaves* opposite or sub-opposite, sub-sessile or shortly and distinctly petiolate, ovate, to 6 x 2 cm, grey-green. *Adult leaves* alternate, on slender petioles 5-15 mm long, lanceolate to narrow-lanceolate, to 10 x 2 cm, tapering to a fine, sometimes curved point, with many minute, black oil dots. *Inflorescences* axillary, 7-flowered; *peduncles* and *pedicels* slender; *buds* glaucous, to 6 x 4 mm, hypanthium hemispherical, operculum obtusely or acutely conical, outer operculum lost early in bud development. *Fruit* on long, slender pedicels, hemispherical, glaucous, to 16 x 10 mm; *disc* broad, flat or slightly ascending; *valves* 4, stout, strongly exserted.

Distribution. (Figure 5) Restricted to a number of granite rocks in the central wheatbelt of Western Australia.

Ecology. Eucalyptus crucis subsp. lanceolata occurs in shallow granitic sands and loams associated with large outcrops of granite rocks. It displays a clumped distribution at any particular location. It is sometimes associated with *Eucalyptus caesia* subsp. *magna* (e.g. at Chiddarcooping Hill, Ballyacatting Hill), and with *E. orbifolia* at Jouerdine Hill. It has not been found in sympatry with *E. crucis* subsp. *crucis*.

Discussion. Eucalyptus crucis subsp. *lanceolata* and *E. crucis* subsp. *crucis* differ in having adult leaves and juvenile leaves respectively in their mature canopies. They show no obvious differences in the morphology of their fruits, buds or flowers. Elsewhere in *Eucalyptus*, related adult-leaved and juvenile-leaved taxa have been recognised as distinct species (e.g. *E. gamophylla* F. Muell. – *E. odontocarpa* F. Muell., *E. risdonii* Hook. f. – *E. tenuiramis* Miq., *E. fruticosa* M.I.H. Brooker – *E. foecunda* Schau.). However, in *E. crucis*, the typical subspecies shows a range in leaf form from populations stabilised for orbicular, apetiolate, fully juvenile leaves (e.g. at Sandford Rock) to populations with ovate, shortly petiolate leaves that are intermediate between the juvenile and adult conditions (e.g. at Moorine Rocks or Warren Double Cunyan) (Figure 5 and Table 1). These intermediate populations indicate that the genetic fixation of a fully juvenile-leaved form in *E. crucis* subsp. *crucis* has not yet occurred. Hence we feel it appropriate to recognise the two forms in *E. crucis* as subspecies rather than separate species.

Previously, *E. crucis* subsp. *lanceolata* has been confused with a number of species, including *E. leptopoda*, *E. drummondii* and *E. orbifolia* (e.g. Gardner, 1954). However it is clearly distinct from the first two of these three taxa in having crisped 'Minni Ritchi' bark and in its restriction to granite rocks. It differs from *E. orbifolia* in having acute, non-emarginate, lanceolate to narrow-lanceolate leaves.

SUMMARY OF RECOVERY ACTIONS AND COSTS (not for publication)

Recovery Action	Year 1			Year 2			Year 3			Year 4			Year 5		
	Dept	**Other**	**Ext.**	**Dept**	**Other**	**Ext.**	**Dept**	**Other**	**Ext.**	**Dept**	**Other**	**Ext.**	**Dept**	**Other**	**Ext.**
Coordinate recovery actions	500	500		500	500		500	500		500	500		500	500	
Map critical habitat	700		300												
Liaise with land managers	600		200	600		200	600		200	600		200	600		200
Monitor populations	700		500	700		500	700		500	700		500	700		500
Conduct further surveys	700		1,200				700		1,200				700		1,200
Collect seed				600		400				600		400			
Develop and implement a fire management strategy													1500	500	500
Promote awareness	1,100		600	500			500			500			500		
Obtain biological and ecological information				4,000		4,000	4,000		4,000	4,000		4,000			
Review the need for further recovery actions													200		
Total	4,300	500	2,800	6,900	500	5,100	7,000	500	5,900	6,900	500	5,100	4,700	1,000	2,400
Yearly Total		**7,600**			**12,500**			**13,400**			**12,500**			**8,100**	

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

Total Department: $29,800
Total Other: $3,000
Total External Funding: $21,300
Total Costs: $54,100