INTERIM RECOVERY PLAN NO. 133

WESTERN PRICKLY HONEYSUCKLE

(*LAMBERTIA ECHINATA* SUBSP. *OCCIDENTALIS*)

INTERIM RECOVERY PLAN

2003-2008

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Photograph: Andrew Brown

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Natural Heritage Trust
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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 (DCLM) 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.

The Department 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 IRP results from a review of IRP number 36 (G. Stack, Rebecca Evans and V. English, 1999-2002) and replaces it. The revised IRP will operate from April 2003 to March 2008 but will remain in force until withdrawn or replaced.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 will be assessed.

This IRP was approved by the Director of Nature Conservation on 20 June, 2003. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting the Department, as well as the need to address other priorities.

Information in this IRP was accurate at April 2003.

SUMMARY

Scientific Name:	*Lambertia echinata* subsp. *occidentalis*	**Common Name:**	Western Prickly Honeysuckle
Family:	Proteaceae	**Flowering Period:**	October – December
Dept Region:	South West	**Dept District:**	Blackwood
Shire:	Busselton	**Recovery Team:**	South West Region Threatened Flora Recovery Team (SWRTFRT)

Illustrations and/or further information: A. Brown, C. Thomson-Dans and N. Marchant (Eds) (1998) *Western Australia's Threatened Flora*; V. English (1999) *Shrubland Association on Southern Swan Coastal Plain Ironstone, Draft Interim Recovery Plan*; G.J. Keighery (1997) A new subspecies of *Lambertia echinata* (Proteaceae). *Nuytsia,* 11 (2): 283-284.

Current status: *Lambertia echinata* subsp. *occidentalis* was declared as Rare Flora in October 1996 and ranked as Critically Endangered in November 1998. It currently meets World Conservation Union (IUCN, 2000) Red List Category 'CR' under criteria A2c,B1+2ce,C1,D as it is known from a single wild population comprised of less than 100 mature individuals and there is a continuing decline in the quality of the habitat due to *Phytophthora cinnamomi* infection. The main threats to the subspecies are disease, inappropriate fire regimes, mineral sand mining, waterlogging, weeds and rabbit grazing.

Critical habitat: The critical habitat for *Lambertia echinata* subsp. *occidentalis* comprises the area of occupancy of the known population; area of occupancy of translocated populations; similar habitat within 200 metres of known and translocated populations; corridors of remnant vegetation that link populations; the local catchment area; and additional nearby occurrences of similar habitat that do not currently contain the species but may have done so in the past and may still be suitable for further translocations.

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

Benefits to other species/ecological communities: *Lambertia echinata* subsp. *occidentalis* occurs on the threatened ecological community "Shrubland Association on Southern Swan Coastal Plain Ironstones (Busselton Area)". Also, several other threatened plant taxa (*Brachysema papilio, Petrophile latericola, Chamelaucium roycei* ms, *Dryandra squarrosa* subsp. *argillacea* and *Dryandra nivea* subsp. *uliginosa*) will benefit from recovery actions put in place for the subspecies. Recovery actions for this subspecies will also improve the condition of the associated remnant bushland.

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. However, as *Lambertia echinata* subsp. *occidentalis* is not listed under any international agreement, the implementation of other international environmental responsibilities is not affected by this plan.

Role and interests of indigenous people: There are no known indigenous communities interested or involved in the management of areas affected by this plan. Therefore no role has been identified for indigenous communities in the recovery of this species.

Social and economic impacts: The implementation of this recovery plan has the potential to have some minimal economic impact as the subspecies occurs in an area adjacent to a Mining tenement.

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

Habitat requirements: *Lambertia echinata* subsp. *occidentalis* is known from a single wild population at the base of the Whicher Range where it is confined to highly restricted ironstone habitat. The habitat is a winter-wet area of shrubland over shallow sandy soils over ironstone. The plant association in which the taxon occurs is the Threatened Ecological Community (TEC) 'Shrublands on southern Swan Coastal Plain Ironstones', which is ranked Critically Endangered (English 1999).

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

1. Appropriate land managers have been notified of the presence and threatened status of the taxon.

2. Seed has been collected from Population 1 on several occasions, and is stored in DCLM's Threatened Flora Seed Centre at –18°C.
3. The Botanic Garden and Parks Authority currently have 88 plants of *Lambertia echinata* subsp. *occidentalis* from six clones.
4. An experimental translocation has been implemented in stages in 1998, 1999, 2000, 2001 and 2002. Plantings during the translocation have occurred in the area of the original population and in two newly vested Nature Reserves.
5. In 1997 staff of DCLM's Science Division took samples that positively identified the presence of the plant pathogen *Phytophthora cinnamomi* (dieback) in the habitat of the subspecies.
6. To combat dieback disease, the site containing the *Lambertia echinata* subsp. *occidentalis* population was first sprayed with phosphite in April 1998. This action is ongoing.
7. Implementation of the recovery actions outlined in the IRP for the TEC 'Shrublands on southern Swan Coastal Plain Ironstones' (English 1999) has commenced and is ongoing. Actions being put in place to protect this community also protect *Lambertia echinata* subsp. *occidentalis*.
8. An information sheet that describes and illustrates the taxon, threats and recovery actions has been produced.
9. A separate information sheet describing and illustrating the TEC in which it occurs has also been produced.
10. Blackwood District staff have produced a map that defines areas that are not available for commercial wildflower picking to help prevent illegal picking in the area of the population.
11. Staff from DCLM's Blackwood District regularly monitor wild and translocated populations of the taxon.
12. The South West Region Threatened Flora Recovery Team is overseeing the implementation of this IRP and will include information on progress in an annual report to DCLM's Corporate Executive and funding bodies.

IRP Objective: 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.

Recovery criteria

Criteria for success: The number of individuals within populations and/or the number of populations have increased by 10% or more.

Criteria for failure: The number of individuals within populations and/or the number of populations have decreased by 10% or more.

Recovery actions

1. Coordinate recovery actions
2. Maintain disease hygiene
3. Apply phosphate every two years and monitor impact
4. Map critical habitat
5. Implement the fire management strategy
6. Continue translocation
7. Liaise with land managers
8. Monitor population
9. Continue weed control
10. Continue rabbit control
11. Conduct further surveys
12. Collect seed and cutting material
13. Obtain biological and ecological information
14. Stimulate the germination of soil-stored seed
15. Promote awareness
16. Review the need for a further recovery actions and/or a full Recovery Plan
17. Rehabilitate habitat, if necessary

1. BACKGROUND

History

Greg Keighery and Neil Gibson made the first collection of *Lambertia echinata* subsp. *occidentalis* in October 1992. A number of surveys in Whicher Range, Swan Coastal Plain and other areas of similar habitat were then undertaken to locate additional populations. However, none were successful.

A hot fire occurred in the area of the population in 1993 but it is not known if *Lambertia echinata* subsp. *occidentalis* was affected and may have in fact been missed by the fire. It is expected that the taxon is killed by intense fire, as it does not have a lignotuber, however, the seven adult plants recorded in 1992 were all healthy in 1997.

In 1998 just four extant adult plants and seventeen juveniles were recorded for the wild population. A further two plants within the population were recorded as dead, presumably as a consequence of the plant pathogen *Phytophthora cinnamomi.*

The natural population and its habitat have been sprayed with phosphite to address the presence of dieback in the area. However, it now appears that species of *Lambertia* may not respond in the same way to treatment with phosphite as many other native species, with the uptake of phosphite into plant tissue appearing to be much greater and protection afforded much lower. In 2003, DCLM's Science Division will be investigating the response of a number of species of *Lambertia* (including *Lambertia echinata* subsp. *occidentalis*) to offer insight into how to better protect *Lambertia* species from dieback.

Translocations have been undertaken for this species in 1998, 2000, 2001 and 2002, with the majority of plants going into two Nature Reserves, recently acquired for this purpose. Other DRF ironstone species are also being translocated into these Nature Reserves.

In 2002, an additional 70 plants were found near the original population, increasing the number of mature plants known five-fold. This area has also been treated with phosphite to combat *Phytophthora cinnamomi*.

Description

Lambertia echinata is a small shrub with five-flowered terminal flower heads. Three subspecies of *L. echinata* are recognised: *L. echinata* subsp. *echinata*, *L. echinata* subsp. *citrina* and *L. echinata* subsp. *occidentalis*. *L. echinata* subsp. *echinata* is also ranked Critically Endangered.

Lambertia echinata subsp. *occidentalis* is a shrub to 3 m, branched at the base and with a few long erect floral branches. It has no lignotuber. There are two types of leaves. Vegetative leaves are entire and linear-lanceolate with a pungent apex. Floral leaves are smaller and may be entire or lobed with three to five points. Inflorescences are yellow and crowded at the ends of the branchlets.

Lambertia echinata subsp. *echinata* differs from the subspecies *occidentalis* in having pink-red flowers borne on short branchlets within the body of the plant. *L. echinata* subsp. *citrina* differs in that all vegetative and floral leaves have 3-5 rigid points. *L. propinqua* has been treated as a synonym of *L. echinata* subsp. *citrina* by Hnatiuk (1995). Population genetic studies suggest that, given the extreme genetic distance between *L. echinata* subsp. *echinata* and the other two subspecies, it may warrant species status (Obbens and Coates 1997).

Distribution and habitat

Lambertia echinata subsp. *occidentalis* is known from a single winter-wet area of shrubland over shallow sands over ironstone at the base of the Whicher Range. The ecological community, the 'Shrublands on southern Swan Coastal Plain Ironstones' in which the taxon occurs is also ranked Critically Endangered. There are a total of 13 occurrences of this species-rich plant community located on seasonal wetlands on ironstone on the Swan Coastal Plain near Busselton. *L. echinata* subsp. *occidentalis* has been translocated into three of those occurrences, although one of these has failed (all plants dead).

Native species common to the ironstone community are *Kunzea* aff. *micrantha*, *Pericalymma ellipticum*, *Hakea* sp. Williamson, *Hemiandra pungens* and *Viminaria juncea*, and the herbs *Aphelia cyperoides* and *Centrolepis aristata* (Gibson *et al*. 1994). Associated species include *Hakea varia*, *Loxocarya magna* and *Chamelaucium roycei*. Six additional species of Declared Rare Flora, three of which are also Critically Endangered, and five Priority taxa are found in the ironstone community in the vicinity of *Lambertia echinata* subsp. *occidentalis*. These are listed in the table below.

DRF and Priority flora found in the ironstone community near *Lambertia echinata* subsp. *occidentalis*

SPECIES	STATUS	RANK
Brachysema papilio	DRF	CR
Darwinia sp. *Williamson*	DRF	CR
Petrophile latericola ms	DRF	CR
Dryandra nivea subsp. *uliginosa*	DRF	EN
Dryandra squarrosa subsp. *argillacea*	DRF	EN
Chamelaucium roycei ms	DRF	VU
Andersonia ferricola ms	Priority	1
Schoenus pennisetis	Priority	1
Hakea oldfieldii	Priority	3
Isopogon formosus subsp. *dasylepis*	Priority	3
Loxocarya magna	Priority	3

The IRPs for Critically Endangered flora that occur in the same area as *Lambertia echinata* subsp. *occidentalis* will be complementary to, and implemented in conjunction with this IRP and the IRP for the 'Shrublands on southern Swan Coastal Plain Ironstones' (English 1999).

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. However, as *Lambertia echinata* subsp. *occidentalis* is not listed under any international agreement, the implementation of other international environmental responsibilities is not affected by this plan.

Role and interests of indigenous people

There are no known indigenous communities interested or involved in the management of areas affected by this plan. Therefore no role has been identified for indigenous communities in the recovery of this species.

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 is habitat critical. In addition all populations, including any translocated populations, are considered important to the survival of the species. Recovery actions include survey for further populations that would lead to the identification of additional habitat critical.

Benefits to other species/ecological communities

Lambertia echinata subsp. *occidentalis* occurs on the threatened ecological community "Shrubland Association on South Swan Coastal Plain Ironstones (Busselton Area)". Also, several other threatened plant taxa (*Brachysema papilio, Petrophile latericola, Chamelaucium roycei* ms, *Dryandra squarrosa* subsp. *argillacea* and *Dryandra nivea* subsp. *uliginosa*) will benefit from recovery actions put in place for the subspecies. Recovery actions for this subspecies will also improve the condition of the associated remnant bushland.

Social and economic impacts

The implementation of this recovery plan has the potential to have some minimal economic impact as the subspecies occurs in an area adjacent to a Mining tenement.

Evaluation of the Plan's Performance

The Department of Conservation and Land Management (DCLM), in conjunction with the South West Region Threatened Flora Recovery Team will evaluate the performance of this recovery plan. In addition to annual reporting on progress against the criteria for success and failure, the plan is to be reviewed within five years of its implementation. Any changes to management / recovery actions made in response to monitoring results will be documented accordingly.

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*).

The critical habitat for *Lambertia echinata* subsp. *occidentalis* comprises:

- the area of occupancy of the known population;
- occurrences of similar habitat currently containing translocated plants of this species (these may in time become self-sustaining populations);
- areas of similar habitat within 200 metres of the wild and translocated populations, i.e. winter-wet areas of shrubland over shallow sands over ironstone (these provide potential habitat for natural range extension);
- corridors of remnant vegetation that link wild and translocated populations (these are necessary to allow pollinators to move between populations and are mainly road reserves);
- the local catchment area (the species occurs on winter-wet areas which are dependent on the maintenance of local surface and ground water hydrology); and
- additional occurrences of similar habitat that do not currently contain the subspecies but may have done so in the past (these represent possible translocation sites).

Biology and ecology

Lambertia echinata subsp. *occidentalis* is thought to be killed by fire and recruit from seed. Approximately 10 seedlings were located in 1996, three years after the last fire in the area. For comparison, *Lambertia formosa* appears to produce its maximum number of flowers two to three years after a summer fire, and seed production is thought to peak during this period. The seed of *Lambertia echinata* subsp. *occidentalis* is released from the two flat follicles as soon as it is ripe and germination rates are highest when the seed is fresh (Fox *et al.* 1987).

Like most other members of the genus, *Lambertia echinata* subsp. *occidentalis* is highly susceptible to the plant pathogen *Phytophthora cinnamomi* (dieback), which is present in the immediate area of the only known wild population (Keighery 1997). A site approximately 300 m to the south of the population near the access road tested positive for *P. cinnamomi*, and serious infections are known to have occurred upslope of the population in State Forest (Obbens and Coates 1997).

Despite the population being treated with phosphite in 2000 and 2001, and tissue analysis indicating phosphite concentrations within the plants to be relatively high, four plants died in 2001 all of which tested positive for *P.cinnamomi*. The levels of phosphite absorption were up to 10 times higher than other Proteaceous species in the same ironstone community. This raises questions of possible phosphite toxicity. Research will be conducted by DCLM in 2003 examining patterns of *P.cinnamomi* susceptibility and the uptake of phosphite in other *Lambertia* species (personal communication C. Crane[1]).

[1] Colin Crane, Research Scientist, DCLM's Science Division

Seeds collected from the population have a high level of viability.

There is currently little information available about pollinators, flower and fruit predation, germination triggers, the taxon's response to herbicide application or higher water tables due to land clearance. This information is essential to the recovery of *Lambertia echinata* subsp. *occidentalis*.

Threats

Lambertia echinata subsp. *occidentalis* was declared as Rare Flora in October 1996 and ranked as Critically Endangered in November 1998. It currently meets World Conservation Union (IUCN, 2000) Red List Category 'CR' under criteria A2c; B1+2ce; C2a; C2b and D (IUCN 1994) as it is known from a single wild population comprising less than 50 mature individuals, with a continuing decline in the quality of the habitat and the number of mature plants due to the pathogen *Phytophthora cinnamomi*. The main threats are disease, inappropriate fire regimes, mineral sand exploration, waterlogging, weeds and rabbit grazing.

- **Dieback disease** is a serious threat to *Lambertia echinata* subsp. *occidentalis* as the subspecies is highly susceptible to *Phytophthora cinnamomi* (Keighery 1997) which is known to have impacted bushland near the population. Phosphite treatment was implemented in 2000 and 2001 but did not appear to afford the level of protection that it does for other taxa. Later analysis of four dead plants found to be infected with *P. cinnamomi* has shown them to have a relatively high concentration of phosphite in the plant tissues.

- **Canker** (probably *Armillaria luteobubalina*) may have caused deaths of the DRF taxon *Dryandra nivea* subsp. *uliginosa* which grows near *Lambertia echinata* subsp. *occidentalis.* The susceptibility of *Lambertia echinata* subsp. *occidentalis* to this plant pathogen is unknown.

- **Inappropriate fire regimes** are likely to affect the viability of the single population. *Lambertia echinata* subsp. *occidentalis* seed probably germinates after fire and, if this is the case, the soil seed bank would rapidly be depleted if fires recur before regenerating or juvenile plants reach maturity. However, it is likely that occasional fires are needed for the taxon to recruit.

- **Mineral sand extraction** is to occur in privately owned land adjacent to the area of State Forest which contains *Lambertia echinata* subsp. *occidentalis*. Liaison between the proponent, DCLM and relevant government bodies is ongoing. Potential impacts include modification of the hydrology of the area and the proponent has designed an artificial recharge system to be monitored by several piezometers.

- **Waterlogging** is a potential threat to the ironstone habitat in which *Lambertia echinata* subsp. *occidentalis* occurs (Tille and Lantzke 1990). Extensive clearing for agriculture in the area is likely to have increased surface runoff and recharge of the groundwater. Waterlogging is not an immediate threat but requires monitoring. Hirschberg (1989) measured levels of salinity in the groundwater in the area, and found the water near this population to range between 200-400 per litre total dissolved solids, which is reasonably fresh.

- **Weeds** are a problem at all translocation sites. These partially cleared areas were purchased by DCLM in 1999 and are gradually being rehabilitated. Weeds suppress early plant growth by competing for soil moisture, nutrients and light. They also exacerbate grazing pressure and increase the fire hazard due to the easy ignition of high fuel loads which are produced annually by many grass weed species.

- **Rabbits** are a threat to the single known population. While posing little threat to adult plants they may prevent recruitment by selectively grazing seedlings and young growth.

- **Borer and other insect damage** has been observed on the branches of some plants, however, at this stage the threat this represents to the long term survival of the taxon is unknown.

Summary of population information and threats

Natural population

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
1a. Whicher Range	State Forest	1992 7 1996 7 (10) 1998 4 (17) 2000 3 (15) 2002 14	Moderate	Dieback disease, inappropriate fire regimes, nearby mining activities, hydrological changes, weeds, rabbits, insect damage
1b. Whicher Range	State Forest	2000 1 2002 0	Poor	Dieback disease, inappropriate fire regimes, nearby mining activities, hydrological changes, weeds, rabbits, insect damage
1c. Whicher Range	State Forest	2002 70	Moderate	Dieback disease, inappropriate fire regimes, mining activities, hydrological changes, weeds, rabbits, insect damage

Translocated populations

1T. Whicher Range	State Forest	2000 (19) 2001 0	Poor	Dieback disease, inappropriate fire regimes, weeds, rabbits
2T. Whicher Range	State Forest	1998 (11) 1999 (4) 2000 (0)	Poor	Dieback disease, inappropriate fire regimes, weeds, rabbits
3T. Whicher Range	Nature Reserve	2000 (60) 2001		Dieback disease, inappropriate fire regimes, weeds, rabbits
4T. Whicher Range	Nature Reserve	2000 (140) 2001		Dieback disease, inappropriate fire regimes, weeds, rabbits

Numbers in brackets = number of juveniles. T = translocated population.

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 *Lambertia echinata* subsp. *occidentalis* 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, its habitat or potential habitat, or on the local surface hydrology such that drainage in the habitat of the species would be altered.

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 more than 10%.
Criteria for failure: The number of individuals within populations and/or the number of populations have decreased by more than 10 %.

3. RECOVERY ACTIONS

Existing recovery actions

The Department of Minerals and Energy was formally notified of the presence of *Lambertia echinata* subsp. *occidentalis* in October 1996 and the adjacent private property owners in February 1999. The mining company with a tenement over the single known population was notified of the presence of two other critically endangered species *(Petrophile latericola* and *Brachysema papilio)* in October 1994, and of the occurrence of *Lambertia echinata* subsp. *occidentalis* in June 1999.

Liaison with these stakeholders is ongoing as the area is still under a Mineral lease. A Notice of Intent to mine Location 4102 adjacent to the wild population was issued in 2000. There was considerable discussion of the proposal and its possible impact on the various threatened species, and the threatened ecological community of which they are part, between DCLM, other Government agencies and the proponent. Environmental assessment resulted in the project being given approval under State law, with conditions attached. These include the establishment of an artificial recharge system, and intensive monitoring, to guard against the possibility of the threatened ecological community drying out as a result of the adjacent mining pit. The proposal has also been approved, with conditions, under Federal legislation. Continuing concerns include the significant changes to local hydrology that may result in the longer term, and the general impact of having large numbers of people and heavy machinery in the near vicinity. The proponent has installed several piezometers to monitor local water levels.

Two areas of private property containing ironstone soil substrate were recently purchased by DCLM, with the intention of rehabilitating cleared sections and using the land as translocation sites for threatened ironstone species. Both areas have now been vested as Class A Nature Reserves for the purpose of conservation. One area, adjacent to the only wild population of *Grevillea maccutcheonii*, has been fenced with rabbit-proof netting and contains the translocated Population 3T of *Lambertia echinata* subsp. *occidentalis*. The second area has been wire-strand fenced and contains the translocated Population 4T of *Lambertia echinata* subsp. *occidentalis*.

Six collections of seed have been made from the natural population, the first in 1995, with a total of about 1100 seeds now placed in storage at DCLM's Threatened Flora Seed Centre (TFSC). A small number of these have been germinated as part of an approved Translocation Proposal. Staff of the TFSC test the viability of seed soon after collection and again after one year in storage. The initial germination percentage of *Lambertia echinata* subsp. *occidentalis* seed ranged between 93% and 100%, and after one year in storage between 90% and 93% (unpublished data A. Cochrane[2]).

The Botanic Garden and Parks Authority (BGPA) currently have 88 plants of *Lambertia echinata* subsp. *occidentalis* from six clones. Propagation of this species from cuttings has been variable, with strike rates ranging from 0% to 98%. There is evidence that both young and established plants are quite susceptible to fungal infection (personal communication A. Shade[3]).

In July 1998, 11 *Lambertia echinata* subsp. *occidentalis* seedlings were planted into State Forest near Busselton, according to an approved Translocation Proposal as required under DCLM's Policy Statement Number 29. All seedlings were alive in December 1998, but deaths were noted in 1999, probably due to *Phytophthora cinnamomi* or poor root establishment. All plants were dead by 2000.

A second Translocation Proposal was approved in 2000, and 179 plants were translocated into the two previously mentioned Nature Reserve sites that year. Fifty plants were introduced to an area of ironstone north of the wild population (Population 3T) and 129 to a second area north east of the wild population (Population 4T). Different treatments being trialled include ripping and mounding, mounding, watering and shading. Control sites were also established. Problems were (and continue to be) experienced with the death of translocated plants due to *Phytophthora* infection and possibly poor root establishment.

Five months after planting, there was 82% survival at translocated Population 3T, but after 18 months this number had declined to 44%. Similarly, there was 80% survival after 5 months at translocated Population 4T, but this declined to 27% 18 months after planting. *Phytophthora cinnamomi* is implicated but many plants also appear to be failing to develop efficient root systems and may be dying as a result of this. A number of hypotheses have been developed about why this is so, and all are being investigated (Spencer 2002).

Additional plantings were made in 2001 with 168 rooted cuttings planted at Population 3T and 11 at Population 4T. Survival of the 2001 plantings was mixed. Rabbits, weeds, strong winds and inundation, followed by a longer than average summer drought all contributed to plant deaths with initial survival being poor. Watering systems were set up at both sites, weed and rabbit control continued and windbreaks planned.

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

In 2002 further plants were put into Populations 3T and 4T. Research was conducted at that time to ascertain the optimum age of translocated plants.
Disease hygiene measures are implemented during all operations. This includes limiting vehicle access to tracks, and cleaning all tools used. In 1999, bollards were installed across the main access track to prevent unauthorized vehicle access into the population.

Plant samples were taken from the wild population by DCLM's Science Division in May 1997 and the presence of *P. cinnamomi* was positively identified. As there had been several deaths of susceptible species at the site, including *Lambertia echinata* subsp. *occidentalis,* it was sprayed with phosphite in April and December 1998 and again in 2000 and 2001 following a detected increase in *P. cinnamomi* activity. However, the program was not completed due to adjacent land managers' concerns about aerial spraying. The site, including the newly discovered Population 1c, was treated again in March and April 2002. There is evidence of dieback at Population 1c with deaths of nearby indicator species and one *Lambertia* plant but no formal analysis has been made.

Phytophthora spp. were also implicated in the deaths of translocated plants at Population 3T. *P. cinnamomi* was recorded from roots and soil, while *P. cryptogea* was also isolated from soil in early 2002.

A phosphite monitoring program was established in 1998, and is ongoing. This involves the monitoring of plots by checking the health of a number of tagged plants and recording changes over time. Photographic records are also kept for comparison.

Tissue analysis of phosphite concentrations in plants from the wild population was undertaken in 2001, two months after phosphite spraying. This analysis was extended to include translocated plants in 2002. Analysis indicated relatively high levels of phosphite in the tissue, especially compared to that of other ironstone species. Despite this, four plants died with infections from *Phytophthora* spp. Studies indicate that for most plant species disease infection generally decreases with increasing phosphite application, however, the interactions are complex and may not always provide a specific correlation between concentrations and disease control. Resistance to disease appears to last several years post treatment. Resistance may, however, differ between species (Barrett, Shearer & Hardy, date unknown). Further research into the *Phytophthora* susceptibility and response to phosphite treatment of *Lambertia echinata* subsp. *occidentalis* is urgently required, and will be undertaken by DCLM's Science Division in 2003.

A coordinated fire response plan for the taxon has been developed and incorporated into the Fire Control Working Plan. This includes strategies for fire control at each location of the taxon, including translocation sites. The information will also be communicated to other fire response organisations.

In 2001, volunteers and Department staff controlled invasive weeds immediately around translocated Population 3T by hand. To control Guilford Grass (*Romulea* sp.) in open areas away from translocated plants herbicide was applied via a blanket wiper mounted on a four-wheel motorbike. The remaining weed species are mostly annuals and these will be controlled by application of herbicide and slashing as required. The aim is to eventually smother the weed species with re-introduced native vegetation.

The fence surrounding translocated Population 3T was observed to have deteriorated in some sections and rabbit activity noted. Repairs have now been undertaken and 1080 poisoned oats, gassing and shooting used to reduce the rabbit population. However, rabbits continue to threaten newly translocated plants and rabbit control will continue.

Implementation of recovery actions as outlined in the IRP entitled 'Shrublands on southern Swan Coastal Plain Ironstones' (English 1999) has commenced.

A double-sided A4 poster has been produced and includes a description of *Lambertia echinata* subsp. *occidentalis*, its habitat, threats, recovery actions and photos. It will be distributed to community members through local libraries, wildflower shows and hand outs. It is hoped that it may result in the discovery of new populations. A second information sheet that describes and illustrates the Threatened Ecological Community in which this taxon occurs, including its values and threats, has also been produced.

Staff from DCLM's Blackwood District have developed a map delimiting the areas not available for commercial wildflower picking to help ensure that pickers do not enter the area in which *Lambertia echinata* subsp. *occidentalis* occurs.

Staff from DCLM's Blackwood District regularly monitor the wild and translocated populations of this taxon. Monitoring includes recording changes to vegetation condition caused by weeds, *Phytophtora cinnamomi* and other plant diseases, grazing activity, fire, fencing and other types of disturbance.

The South West Region Threatened Flora Recovery Team (SWRTFRT) is overseeing the implementation of this IRP and will include information on progress in its annual report to DCLM's Corporate Executive and funding bodies.

Future recovery actions

Where populations occur on lands other than those managed by DCLM, permission has been or will be sought from appropriate land managers prior to recovery actions being undertaken.

1. Recovery coordination

The South West Region Threatened Flora Recovery Team (SWRTFRT) will coordinate recovery actions for *Lambertia echinata* subsp. *occidentalis* and other Declared Rare flora in the region. It will include information on progress in its annual report to DCLM's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $6,200 per year (note: this covers all Threatened Flora species in the Region)

2. Disease hygiene

The ironstone habitat in which *Lambertia echinata* subsp. *occidentalis* occurs becomes highly saturated over the winter months. This favours the establishment and spread of *Phytophthora* species, with many species including *Lambertia echinata* subsp. *occidentalis* being susceptible. Dieback hygiene (outlined in DCLM 1992a) will be adhered to wherever possible, particularly during the installation and maintenance of firebreaks and when walking into the population during wet soil conditions. Signs advising of the dieback risk will be made and installed.

Action: Maintain disease hygiene
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $2,000 in the first year for signs (note: this covers all Threatened Flora species in the ironstone habitat)

3. Phosphate application

Phytophthora cinnamomi (dieback) is a serious threat to *Lambertia echinata* subsp. *occidentalis* which is highly susceptible to the pathogen. Research conducted between 1992 and 1997 has shown that phosphite application is very effective in controlling the impact of dieback disease for a wide range of species (Murray 1997) and, on that basis, aerial spraying of phosphite has been implemented. This action also protects the associated Threatened Ecological Community which includes several other threatened flora. However, given that recent monitoring suggests that phosphite may not be as beneficial to *Lambertia* species as to those in other genera, research will be undertaken by DCLM to assess the response of a range of species in the genus (personal communication C. Crane).

The impact of both dieback and phosphite application on this taxon and its habitat will be monitored at least annually.

Action: Apply phosphate every two years and monitor impact
Responsibility: DCLM (Blackwood District, Dieback Disease Coordinator) through SWRTFRT

Cost: $3,800 in the first, third and fifth years, plus $500 per year for monitoring

4. 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 done 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: The Department (Blackwood District, WATSCU) through the SWRTFRT
Priority: Moderate
Cost: $2000 in the first year

5. Fire management strategy

It is thought that fire kills adult plants of the species and regeneration is largely from soil-stored seed. Overly frequent fire that occurs before seedlings reach maturity may prevent the accumulation of sufficient seed for recruitment and should be prevented from occurring if possible. A fire response plan has been developed for this site and is incorporated into the Blackwood District's Fire Control Working Plan. Other fire fighting agencies will be informed of appropriate responses to fire threatening this site. Firebreaks will continue to be maintained.

Action: Implement the fire management strategy
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $1000 per year

6. Translocation

Due to a range of threats to the single small wild population of *Lambertia echinata* subsp. *occidentalis* translocation is thought to be essential for the long-term conservation of the taxon. Information on the translocation of threatened plants and animals in the wild is provided in DCLM's Policy Statement No. 29 *Translocation of Threatened Flora and Fauna*.

A Translocation Proposal has been developed and has been endorsed by DCLM's Director of Nature Conservation. It is currently being implemented, with plants propagated and planted into three sites in 1998, 2000, 2001 and 2002. Additional plantings will take place in accordance with the proposal. Monitoring of the translocation is essential and will continue according to the timetable developed for proposal.

Action: Continue translocations
Responsibility: DCLM (Blackwood District, TFSC) and BGPA through the SWRTFRT
Cost: $9,500 per year

7. Liaison

Staff from DCLM's Blackwood District will continue to liaise with the holder of the mining tenement and adjacent land managers to ensure that populations are not accidentally damaged or destroyed during their operations.

Action: Liaise with land managers
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $500 per year

8. Monitoring

Annual monitoring of habitat degradation (weed invasion, salinity and plant diseases), groundwater quality and levels, population stability (expansion or decline), pollination activity, seed production, recruitment, longevity

and predation is essential. Periodic assessment of the level of insect damage will be made and, if found to be significant, remedial action taken.

Action: Monitor population
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $500 per year

9. Weed control

Following previous weed control the current level of threat from weeds is moderate. However, if weed numbers increase they are likely to impact on *L. echinata* subsp. *occidentalis* by competing for resources, degrading habitat, exacerbating grazing pressure and increasing the risk and severity of fire. Remaining weeds are mostly annuals and weed control will be undertaken as needed. This will be by hand weeding or localised application of herbicide. All weed control will be followed by a report on the method, timing and success of the treatment and any side effects on *L. echinata* subsp. *occidentalis* and associated native plant species.

Action: Continue weed control
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $500 per year

10. Rabbit control

Following some previous control the current level of threat from rabbits is moderate and is mainly centred on the translocated populations. Population 3T has had a rabbit proof-fenced erected to protect the translocated plants. However, rabbits continue to have some impact through grazing and digging. Some continuing control is therefore necessary and will be done in consultation with relevant landholders.

Action: Continue rabbit control
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $200 per year

11. Surveys

Although the ironstone community in which *Lambertia echinata* subsp. *occidentalis* occurs has been extensively surveyed over the last decade it is possible that additional populations of this or other ironstone species may be discovered on private land. Once permission has been obtained, surveys during the flowering period of the species (October to December) will target remnant vegetation on private lands.

Action: Conduct further surveys
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $2000 per year

12. Germplasm

Preservation of germplasm is essential to guard against extinction if wild populations are lost. Such collections are also needed to propagate plants for translocations. A small quantity of seed and cutting material has been collected from Population 1 but further collections are required. In addition, seed collections from the translocated populations will be made when possible.

Action: Collect seed and cutting material
Responsibility: DCLM (TFSC, Blackwood District) and BGPA through the SWRTFRT
Cost: $2,800 in the second and fourth years

13. Biology and ecology

Improved knowledge of the biology and ecology of *Lambertia echinata* subsp. *occidentalis* will provide a better scientific basis for its management in the wild. An understanding of the following is particularly necessary for the effective management of the species:

1. Soil seed bank dynamics and the role of various disturbances (including fire), competition, rainfall and grazing in germination and recruitment.
2. The pollination biology of the taxon.
3. The requirements of pollinators.
4. The reproductive strategies, phenology and seasonal growth of the species.
5. The population genetic structure, levels of genetic diversity and minimum viable population size.
6. The impact of dieback disease and control techniques on *Lambertia echinata* subsp. *occidentalis* and its habitat.
7. The impact of changes in the level of salinity on *Lambertia echinata* subsp. *occidentalis* and its habitat.

Action: Obtain biological and ecological information
Responsibility: DCLM (Science Division, Blackwood District) through the SWRTFRT
Cost: $17,200 per year in the second, third and fourth years

14. In situ germination

Burning, smoke-water and soil disturbance may be effective in stimulating the germination of soil-stored seed. These trials will be conducted as appropriate at the base of dead mature plants.

Action: Stimulate the germination of soil-stored seed
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $1000 in second and fourth years

15. 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.

Action: Promote awareness
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $600 per year

16. 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: DCLM (WATSCU, Blackwood District) through the SWRTFRT
Cost: $20,300 in the fifth year (if full Recovery Plan required)

17. Habitat rehabilitation

If identified as a need following weed control, DCLM will undertake habitat restoration at the site of *Lambertia echinata* subsp. *occidentalis*, including the addition of local provenance species.

Action: Rehabilitate habitat, if necessary
Responsibility: DCLM (Blackwood District) through the SWRTFRT
Cost: $2,900 in third and fourth years and $1,000 in subsequent years

4. TERM OF PLAN

This Interim Recovery Plan will operate from May 2003 to April 2008 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.

5. ACKNOWLEDGMENTS

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7. TAXONOMIC DESCRIPTION

Keighery, G.J. (1997). A new subspecies of *Lambertia echinata* (Proteaceae). *Nuytsia* 11 (2): 283-284.

Lambertia echinata* subsp. *occidentalis

Shrub, to 3 m tall, not lignotuberous, much branched at the base with many short vegetative branches and a few long erect floral branches. *Vegetative leaves* entire, 17-45 mm long, linear-lanceolate, apex pungent. *Floral leaves* on erect branches, a few immediately below the inflorescence with up to 5 points, the remainder either trifid (50-80%) or entire (20-50%), 12-30 mm long. *Flowers* yellow. *Inflorescences* crowded at ends of branchlets, 7-flowered. *Floral bracts* scarious, entire, brown, acute, narrowly obovate, 15-19 mm long. *Perianth* 23-26 mm long; lobes recurved, 3-5 mm long. *Style* yellow, 33-36 mm long.

Lambertia echinata subsp. *echinata* is a compact shrub to 1 m tall that has inflorescences of pink-red flowers on short branchlets in the main body of the plant. Both subspecies *citrina* and *occidentalis* have inflorescences of yellow flowers on short branchlets borne on long erect flowering branches to 3 metres tall above the main body of the plant. In *Lambertia echinata* subsp. *citrina* all vegetative and floral leaves have 3-5 rigid points, whereas *L. echinata* subsp. *occidentalis* has entire vegetative leaves and most floral leaves 3-pointed or entire. The floral bracts of subsp. *occidentalis* are longer, measuring 15-19 mm compared to 12-16 mm in subspecies *citrina*. There is also a difference in length between the floral leaves of all subspecies, 30-40 mm in subsp. *echinata*, 15-35 mm in subsp. *citrina* and 12-30 mm in subsp. *occidentalis*.