

INTERIM RECOVERY PLAN NO. 36

**WESTERN PRICKLY HONEYSUCKLE**  
**(*LAMBERTIA ECHINATA* SUBSP. *OCCIDENTALIS*)**  
**INTERIM RECOVERY PLAN**  
**1999-2002**

by

Gillian Stack, Rebecca Evans and Val English



Photograph: Andrew Brown

July 1999

Department of Conservation and Land Management  
Western Australian Threatened Species and Communities Unit  
PO Box 51, Wanneroo, WA 6946.



Natural Heritage Trust  
*Helping Communities Helping Australia*



Department of Conservation and Land  
Management

## 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This Interim Recovery Plan will operate from July 1999 to June 2002 but will remain in force until withdrawn or replaced.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 replaced by a full Recovery Plan after three years.

This IRP was approved by the Director of Nature Conservation on 1 September 1999. The 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 at July 1999.

## SUMMARY

<b>Scientific Name:</b>	<b><i>Lambertia echinata</i> subsp. <i>occidentalis</i></b>
<b>Common Name:</b>	Western Prickly Honeysuckle
<b>Family:</b>	Proteaceae
<b>Flowering Period:</b>	October - December
<b>CALM Region:</b>	Central Forest
<b>CALM District:</b>	South West Capes
<b>Shire:</b>	Busselton
<b>Recovery Team:</b>	Central Forest Region Threatened Flora Recovery Team (CFRTFRT).

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

**Current status:** *Lambertia echinata* subsp. *occidentalis* was first declared as Rare Flora in October 1996 and was ranked in November 1998 as Critically Endangered (CR). It currently meets World Conservation Union (IUCN) Red List category 'CR' under criteria A2c; B1+2c; C2a; C2b and D (IUCN 1994), as it is only known from a single wild population comprised of less than 50 mature individuals, with continued decline in the quality of the habitat.

**Habitat requirements:** *Lambertia echinata* subsp. *occidentalis* is known from a single wild population at the base of the Whicher Range and is confined to a highly restricted ironstone habitat. The habitat is a winter-wet area of shrubland over shallow sandy soils over ironstone. The plant community in which the taxon occurs is one of 13 occurrences of the CR Threatened Ecological Community (TEC) 'Shrublands on southern Swan Coastal Plain Ironstones' (English 1999).

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

1. All adjacent landholders and relevant authorities have been notified of the presence of the taxon.
2. Seed collected in 1995, 1997 and 1998 is stored in CALM's Threatened Flora Seed Centre (TFSC).
3. Cuttings have been taken for Kings Park and Botanic Gardens (KPBG) by staff of the TFSC.
4. An experimental translocation has begun.
5. Samples taken in May 1997 by CALM Science staff to determine the presence of the plant pathogen *Phytophthora cinnamomi* in the habitat were positive.
6. The site of the wild *Lambertia echinata* subsp. *occidentalis* population has been treated for dieback disease.
7. Implementation of the recovery actions outlined in the IRP for the TEC 'Shrublands on southern Swan Coastal Plain Ironstones' has commenced.
8. South West Capes District Staff have developed a map that defines areas not available for commercial wildflower picking to help prevent illegal picking in the population.
9. An information sheet has been created.
10. The Central Forest Region Threatened Flora Recovery Team (CFRTFRT) is overseeing the implementation of this IRP.
11. Staff from CALM's South West Capes District regularly monitor the population.

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

### Recovery Criteria

**Criterion for success:** The number of individuals within populations and/or the number of populations have increased.

**Criterion for failure:** The number of individuals within populations and/or the number of populations have decreased.

## Recovery actions

1. Coordinate recovery actions.
2. Implement disease treatment.
3. Monitor the impact of phosphite treatment.
4. Implement disease hygiene measures.
5. Develop and implement a fire management strategy.
6. Liaise with mining tenement holder and adjacent land managers.
7. Monitor population.
8. Collect seed and cutting material.
9. Obtain biological and ecological information.
10. Continue translocations.
11. Write full Recovery Plan.

## 1. BACKGROUND

### History

G. J. Keighery and N. Gibson first collected this taxon in October 1992. Since then, there have been a number of surveys of the Whicher Range, the Swan Coastal Plain and the coastal Warren areas but no additional populations have been located. In 1996 a drill rig line was put through adjacent to the only known population of the taxon, and affected other Declared Rare Flora in the vicinity. In 1998 there were only four adult plants and seventeen juveniles recorded in the wild population. Another two plants within the population were dead, presumably as a consequence of the plant pathogen *Phytophthora cinnamomi*.

A hot fire occurred in the area in 1993, however, there are no records to indicate if the taxon was affected. It is expected that the taxon is killed by fire, as it has no lignotuber, however, the original seven adult plants recorded in 1992 were healthy in 1997.

### 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 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 wild population located at the base of the Whicher Range, in a winter-wet area of shrubland over shallow sands over ironstone. The ecological community, the 'Shrublands on southern Swan Coastal Plain Ironstones' in which the subspecies 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 another occurrence of the ironstone community that also occurs at the base of the Whicher Range, about 25 km west south west of the original population.

Much of the species diversity in this ironstone community comes from annuals and geophytes. Typical and common native species are the shrubs *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 Declared Rare Flora, three of which are also Critically Endangered, and six 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* (Western Australian Herbarium, 1999)**

STATUS	LEVEL	SPECIES
Priority	1	<i>Andersonia ferricola</i> ms
Priority	1	<i>Schoenus pennisetis</i>
Priority	2	<i>Hakea oldfieldii</i>
Priority	3	<i>Isopogon formosus</i> subsp. <i>dasylepis</i>
Priority	3	<i>Stylidium mimeticum</i>
Priority	3	<i>Synaphea whicherensis</i>
DRF	CR	<i>Brachysema papilio</i>
DRF	CR	<i>Darwinia</i> sp. Williamson
DRF	CR	<i>Petrophile latericola</i> ms
DRF	VU	<i>Chamelaucium roycei</i> ms
DRF	VU	<i>Dryandra squarrosa</i> subsp. <i>argillacea</i>
DRF	EN	<i>Dryandra nivea</i> subsp. <i>uliginosa</i>

The IRPs for all of the Critically Endangered flora that occur near *Lambertia echinata* subsp. *occidentalis* will be complementary to, and implemented in conjunction with, the IRP for the ‘Shrublands on southern Swan Coastal Plain Ironstones’ (English 1999).

### Biology and ecology

Little is known about the biology and ecology of *Lambertia echinata* subsp. *occidentalis*, however the taxon is thought to be killed by fire. Approximately 10 seedlings were located in 1996, three years after the last fire in the area.

There is more known about other species of *Lambertia*, however. *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 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, the taxon is very susceptible to the plant pathogen *Phytophthora cinnamomi*, 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 located some distance upslope in State Forest (Obbens and Coates 1997).

Seeds have been collected from the population by the TFSC, and these have a high viability.

There is currently little information available about pollinators, predation of flowers and fruit, germination triggers, response to *Phytophthora* infection, herbicide application and increasing salinity. 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 was ranked in November 1998 as Critically Endangered (CR). It currently meets IUCN Red List category ‘CR’ under criteria A2c; B1+2c; C2a; C2b and D (IUCN 1994) as it is only known from a single population comprised of less than

50 mature individuals that occur over a very small range, with continued decline in the quality of the habitat from dieback disease caused by *Phytophthora cinnamomi*.

- **Dieback disease** has been recorded very close to, and is a serious threat to *Lambertia echinata* subsp. *occidentalis* as the subspecies is very susceptible to *Phytophthora cinnamomi* (Keighery 1997). As this is the only *in situ* population, it is extremely important to protect it from dieback. There have also been deaths of the DRF taxon, *Dryandra nivea* subsp. *uliginosa* near *Lambertia echinata* subsp. *occidentalis*. These are likely to have been caused by canker (probably *Armillaria luteobubalina*). The susceptibility of *Lambertia echinata* subsp. *occidentalis* to this additional plant pathogen is unknown.
- **Inappropriate fire regimes** are likely to affect the viability of the population, as *Lambertia echinata* subsp. *occidentalis* seed probably germinates after fire. If this is the case, the soil seed bank would rapidly be depleted if fires recurred before regenerating or juvenile plants reached maturity and replenished the soil seed bank. However, it is likely that occasional fires are needed for reproduction of the subspecies.
- **Mineral sand exploration** and extraction leases exist over the area of State Forest in which *Lambertia echinata* subsp. *occidentalis* occurs.
- **Waterlogging and salinity** are becoming threats on the ironstone soil type on 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. Neither waterlogging nor salinity are immediate threats, but require 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.
- **Borer / insect damage** has been observed on some branches, however, at this stage the threat this represents to the long term survival of the taxon is unknown.

### Summary of population information and threats

Location	Land Status	Year / No. of Plants	Condition	Threats
Whicher Range ( <b>wild population</b> )	State Forest	1992 7	healthy	Dieback disease, inappropriate fire regimes, mining activities, and insect damage
		1995 7		
		1996 7		
		1996 7 (10)	2 deaths	
		1998 4 (17)		
Whicher Range ( <b>translocated population</b> )	State Forest	1998 (11)	1 plant unhealthy	Dieback disease, inappropriate fire regimes
		1999 (3)		

Note: No. = number of adult plants (number of juvenile plants).

## 2. RECOVERY OBJECTIVE AND CRITERIA

### Objective

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

**Criterion for success:** The number of individuals within populations and/or the number of populations have increased.

**Criterion for failure:** The number of individuals within populations and/or the number of populations have decreased.

## 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. The adjacent private property owners were notified in February 1999. The mining company with a tenement over this block 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.

Seed was collected from *Lambertia echinata* subsp. *occidentalis* in 1995, 1997 and 1998, and there are now 533 seeds in storage in CALM's TFSC. Where seed numbers are low, germination trials have sometimes not been conducted. Seed viability is generally high.

#### Seed collection and germination rate of *Lambertia echinata* subsp. *occidentalis*

Date Collected	Number of seeds collected	Initial germination rate	Germination rate after one year in storage
12/95	62	-	-
02/97	104	93%	93%
01/98	196	100%	90%
09/98	171	98%	-

(Data from the TFSC)

Ten cuttings were taken from each of seven labelled plants by staff of the TFSC and provided to KPBG in December 1995. Additional cuttings have been collected since then, and there are now 206 cuttings and 35 seedlings held in the KPBG nursery.

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 CALM Policy Statement number 29. All seedlings were surviving as at December 1998. Subsequent deaths, noted in 1999, are probably due to *Phytophthora cinnamomi*. The translocation is being conducted on an experimental basis, and will provide information about effective techniques for future translocations. The site will be monitored bi-monthly until May 2001, and annually after that date.

Dieback disease (caused by *Phytophthora cinnamomi*) is known to exist at the site in which *Lambertia echinata* subsp. *occidentalis* occurs. This site, within a State Forest Block, was sprayed with phosphite in April 1998 and December 1998. CALM District staff are assessing the effectiveness of this treatment by monitoring the local, key dieback indicator species - *Lambertia* sp. and *Dryandra nivea* (personal communication, R. Smith<sup>1</sup>).

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

An information sheet, that includes a description of the plant, its habitat type, threats and management actions, and photos, has been produced.

To ensure that wildflower pickers do not enter the area that contains the population, a map that defines areas not available for commercial picking has been developed by staff of the South West Capes District.

The Central Forest Region 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.

Staff from CALM's South West Capes District Office regularly monitor the population.

### Future recovery actions

Where recovery actions are implemented on lands other than those managed by CALM, permission has been or will be sought from the appropriate land managers prior to recovery actions being undertaken.

<sup>1</sup> Russell Smith, Ecologist, Phosphite Program, CALM.

### 1. Coordinate recovery actions

The Central Forest Region Threatened Flora Recovery Team (CFRTFRT) will continue to oversee the implementation of recovery actions for *Lambertia echinata* subsp. *occidentalis*.

**Action:** Coordinate recovery actions  
**Responsibility:** CALM (South West Capes District) through the CFRTFRT  
**Cost:** \$6,200 per year.

### 2. Implement disease treatment

Research conducted between 1992 and 1997 indicated that phosphite application is a very effective tool in controlling the effects of dieback disease (Murray 1997). On that basis, the community that contains *Lambertia echinata* subsp. *occidentalis* has been aerial sprayed with phosphite. The treatment will be repeated as required.

**Action:** Implement disease treatment  
**Responsibility:** CALM (South West Capes District, Dieback Disease Coordinator) through the CFRTFRT  
**Cost:** \$3,800 in the first and third years.

### 3. Monitor the impact of phosphite application

CALM's South West Capes District staff are monitoring the results of dieback treatment. In particular, the effects on *Lambertia echinata* subsp. *occidentalis* and on the control of *Phytophthora* spp. will continue to be examined. The monitoring will also indicate the requirement for follow-up treatment.

**Action:** Monitor the impact of phosphite application  
**Responsibility:** CALM (South West Capes District, Dieback Disease Coordinator) through the CFRTFRT  
**Cost:** \$500 per year.

### 4. Implement disease hygiene measures

The ironstone habitat in which *Lambertia echinata* subsp. *occidentalis* occurs is moist over the winter months, and this favours the establishment and spread of *Phytophthora* spp. Many plant species in the ironstone community are presumed to be susceptible to this disease, including *Lambertia echinata* subsp. *occidentalis*. It is necessary to maintain disease hygiene measures to reduce the risk of introducing or amplifying the impacts of the disease. Hygiene measures will primarily involve restricting access to the area, especially when the soil is wet. Signs advising of the dieback risk will be posted at this site.

**Action:** Implement disease hygiene measures  
**Responsibility:** CALM (South West Capes District) through the CFRTFRT  
**Cost:** \$2,000 in the first year.

### 5. Develop and implement a fire management strategy

Fire is thought to kill adult plants of *Lambertia echinata* subsp. *occidentalis* and this area last experienced a fire in 1993. It is likely that the subspecies requires occasional fire for recruitment from soil stored seed, but frequent fire may deplete the soil seed bank. No planned burns will therefore occur in the area that contains *Lambertia echinata* subsp. *occidentalis* for the life of this plan. A fire management strategy will be developed that will describe fire regimes and control measures.

**Action:** Develop and implement a fire management strategy  
**Responsibility:** CALM (South West Capes District) through the CFRTFRT  
**Cost:** \$1,400 in the first year, \$900 in subsequent years.



**Liaise with mining tenement holder and adjacent land managers**

Liaison with the mining tenement holder and the adjacent landowners will be continued to ensure the population is not subject to accidental damage.

**Action:** Liaise with tenement holder and adjacent land managers  
**Responsibility:** CALM (South West Capes District) through the CFRTFRT  
**Cost:** \$500 per year.

**7. Monitor population**

Monitoring of factors such as weed invasion, habitat degradation, groundwater quality and levels, salinity levels and population stability (expansion or decline), pollinator activity, seed production, recruitment, and longevity is essential. The population will be inspected annually.

**Action:** Monitor population  
**Responsibility:** CALM (South West Capes District) through the CFRTFRT  
**Cost:** \$500 per year.

**8. Collect seed and cutting material**

Some seed and cuttings have been collected from Population 1. However, additional material will be required for storage, and for propagation of plants for use in future translocations.

**Action:** Collect seed and cutting material  
**Responsibility:** CALM (South West Capes District, TFSC), and KPBG, through the CFRTFRT  
**Cost:** \$2,800 in the second and third years.

**9. Obtain biological and ecological information**

Increased knowledge of the biology and ecology of the taxon will provide a scientific basis for management of *Lambertia echinata* subsp. *occidentalis* in the wild. Investigations will ideally include:

1. Study of the soil seed bank dynamics and the role of various factors (including disturbance, competition, rainfall, grazing) in recruitment and seedling survival.
2. Determination of reproductive strategies, phenology and seasonal growth.
3. Investigation of the mating system and pollination biology.
4. Investigation of population genetic structure, levels of genetic diversity and minimum viable population size.
5. Investigation of the impacts of dieback disease and control techniques on *Lambertia echinata* subsp. *occidentalis* and its habitat.

**Action:** Obtain biological and ecological information  
**Responsibility:** CALM (CALMScience, South West Capes District) through the CFRTFRT  
**Cost:** \$17,200 per year.

**10. Continue translocations**

A report by Obbens and Coates (1997) suggests that additional plants should not be translocated into the existing population of *Lambertia echinata* subsp. *occidentalis* for two years, to allow the continuation of natural recruitment. If natural recruitment does not occur, enhancement of the known population is recommended.

Although translocations are generally undertaken under full Recovery Plans, it is extremely important to continue the current translocations due to low numbers of plants and known threatening processes operating in the known population. The future translocations will be coordinated by the CFRTFRT. A Translocation Proposal has been developed and has been endorsed by the Director of Nature Conservation.

**Action:** Continue translocations  
**Responsibility:** CALM (South West Capes District, CALMScience), and KPBG through the CFRTFRT  
**Cost:** \$2,800 in the first year and \$6,700 in the second and third years.

## 11. Write full Recovery Plan

At the end of the three-year term of this Interim Recovery Plan, the need for further recovery will be assessed. If the taxon is still ranked Critically Endangered, a full Recovery Plan will be written to describe action required for long-term maintenance of the taxon.

**Action:** Write full Recovery Plan  
**Responsibility:** CALM (WATSCU, South West Capes District) through the CFRTFRT  
**Cost:** \$19,000 in the final year.

## 4. TERM OF PLAN

This Interim Recovery Plan will operate from July 1999 to June 2002 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 replaced by a full Recovery Plan after three years.

## 5. ACKNOWLEDGMENTS

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

Anne Cochrane	Manager, CALM Threatened Flora Seed Centre
Dave Coates	Principal Research Scientist, CALMScience
Neil Gibson	Senior Research Scientist, CALMScience
Greg Keighery	Senior Research Scientist, CALMScience
Leonie Monks	Research Scientist, CALMScience
Frank Obbens	Consultant, CALMScience
Russell Smith	Ecologist, Phosphite Program, CALM Bunbury
Meredith Soutar	Conservation Officer, South West Capes District
Andrew Webb	Previously Conservation Officer, South West Capes District
Kim Williams	Program Leader, Nature Conservation, Central Forest Region

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

## 6. REFERENCES

- Brown, A., Thomson-Dans, C. and Marchant, N. (Eds). (1998). *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia.
- CALM (1995). Policy Statement No. 29 *Translocation of Threatened Flora and Fauna*. Department of Conservation and Land Management, Western Australia.
- CALM (1992). Policy Statement No. 44 *Wildlife Management Programs*. Department of Conservation and Land Management, Western Australia.
- CALM (1994). Policy Statement No. 50 *Setting Priorities for the Conservation of Western Australia's Threatened Flora and Fauna*. Department of Conservation and Land Management, Western Australia.
- English, V. (1999). Shrubland Association on Southern Swan Coastal Plain Ironstone (Busselton Area) (Southern Ironstone Association), Draft Interim Recovery Plan. Department of Conservation and Land Management, Western Australia.
- Fox, J., Dixon, B. and Monk, D. (1987). Germination in Other Plant Families\*. Pp 83-97 in *Germination of Australian Native Plant Seed*. P.L. Langkamp (ed). Inkata Press, Melbourne.
- Gibson, N., Keighery, B., Keighery, G., Burbidge, A. and Lyons, M. (1994). *A floristic survey of the Southern Swan Coastal Plain*. Unpublished report for the Australian Heritage Commission prepared by the

Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.).

- Hirschberg, K.J.B. (1989). Busselton shallow-drilling groundwater investigations, Perth Basin. *Professional Paper, Geological Survey of Western Australia*. Report 25, pp 17-37.
- Hnatiuk, R.J. (1995). *Lambertia*. *Flora of Australia* 16: 425-436.
- Keighery, G.J. (1997). A new subspecies of *Lambertia echinata* (Proteaceae). *Nuytsia* 11 (2): 283-284.
- Murray, D. (Ed.) (1997). *Control of Phytophthora and Diplodina Canker in Western Australia*. Final Report to the Threatened Species and Communities Unit, Biodiversity Group Environment Australia prepared by Department of Conservation and Land Management, Western Australia.
- Obbens, F.J. and Coates, D.J. (1997). *Conservation biology and management of endangered Lambertia species*. Project 443. Final report by Department of Conservation and Land Management submitted to Environment Australia.
- Tille, P. J. and Lantzke, N. C. (1990). Busselton – Margaret River – Augusta land capability study; methodology and results. Volume 2 Appendices. Technical Report 109. Division of Resource Management. Western Australian Department of Agriculture, Perth.
- Western Australian Herbarium (1999). FloraBase - Information on the Western Australian Flora. Department of Conservation and Land Management, Western Australia. <http://www.calm.wa.gov.au/science/>
- World Conservation Union (1994). *IUCN red list categories prepared by the IUCN Species Survival Commission*, as approved by the 40th meeting of the IUCN Council. Gland, Switzerland.

## 7. TAXONOMIC DESCRIPTION

Keighery (1997).

### *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*.

