INTERIM RECOVERY PLAN NO.227

HIDDEN BEARD HEATH

(*LEUCOPOGON OBTECTUS*)

INTERIM RECOVERY PLAN

2006-2011

February 2006

Department of Conservation and Land Management
Species and Communities Branch (SCB)
Kensington

Government of Western Australia

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA


Natural Heritage Trust
Helping Communities Helping Australia

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 Threatened taxa are conserved through the preparation and implementation of Recovery Plans (RPs) or IRPs and by ensuring that conservation action commences as soon as possible and, in the case of Critically Endangered (CR) taxa, always within one year of endorsement of that rank by the Minister.

This IRP will operate from February 2006 to January 2011 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked CR, this IRP will be reviewed after five years and the need for further recovery actions assessed.

This IRP was given regional approval on 2 March, 2006 and approved by the Director of Nature Conservation on 21 March, 2006. The allocation of staff time and provision of funds identified in this IRP 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 February 2006.

IRP PREPARATION

This IRP was prepared by Ben Bayliss[1], Heather Taylor[1], Gina Broun[2] & Andrew Brown[3]

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ACKNOWLEDGMENTS

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

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Anne Cochrane	Manager, CALM's Threatened Flora Seed Centre
Duanne Ginger	Environmental Officer, Eneabba Operations Iluka Resources Ltd.
Kelly Poultney	Technical Officer (Rare Flora Database), Species and Communities Branch, CALM
Amanda Shade	Horticulturalist, Botanic Garden and Parks Authority

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Cover photograph by Steve Hopper

CITATION

This Interim Recovery Plan should be cited as:

Department of Conservation and Land Management (2006). Hidden Beard Heath (*Leucopogon obtectus*) Interim Recovery Plan 2006-2011. Interim Recovery Plan No. 227. Department of Conservation and Land Management, Perth, Western Australia.

SUMMARY

Scientific Name:	*Leucopogon obtectus*	**Common Name:**	Hidden Beard Heath
Family:	Epacridaceae	**Flowering Period:**	October - March
CALM Region:	Midwest	**CALM District:**	Moora
Shire:	Carnamah, Coorow, Irwin, Three Springs and Dandaragan	**Recovery Team:**	Moora District Threatened Flora Recovery Team

Illustrations and/or further information: Brown, A., Thomson-Dans, C. and Marchant, N. (Eds) (1998) *Western Australia's Threatened Flora*, Department of Conservation and Land Management, Western Australia; Leigh, J., Boden, R. and Briggs, J. (1984) *Extinct and Endangered Plants of Australia*. The Macmillan Co. of Australia Pty Ltd. Hong Kong; *FloraBase - Information on the Western Australian Flora.* Department of Conservation and Land Management, Western Australia. http://www.calm.wa.gov.au/science/.

Leucopogon obtectus was first collected from between the Moore and Murchison rivers by James Drummond and was named by Bentham in 1868. It was then not until 1978 that the species was again seen and collected. A comprehensive survey by CALM in 1981 found about 100 plants in 25 small populations, many of which consisted of a single plant. A reserve northwest of Eneabba in which populations of *L. obtectus* occur was gazetted for flora and fauna conservation in 1989.

Leucopogon is derived from the Greek *leucos* (white) and *pogon* (beard), referring to the white bearded corolla lobes while the species name *obtectus*, is derived from the latin *obtego* (to cover, conceal, protect), referring to the complete covering of the branches by the overlapping leaves (Leigh *et. al*, 1984).

Current status: *Leucopogon obtectus* was declared as Rare Flora in September 1987 under the Western Australian *Wildlife Conservation Act 1950* and is currently ranked as Endangered (EN) under World Conservation Union (IUCN) criterion D (IUCN 2001) as there were less than 250 mature individuals known at that time. However, following recent surveys, there are now over 500 plants known and it strictly meets VU under criterion D. *Leucopogon obtectus* is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

The main threats are clearing, degradation of habitat, mining, road and rail maintenance, weed invasion and inappropriate fire regimes.

Description: *Leucopogon obtectus* is an erect, open shrub to about 1.5 m tall with broad, almost heart-shaped, concave, stalkless leaves that overlap and conceal the stem. The leaves are about 1 cm long and 1 cm wide, a pale bluish-green colour and rigid with a short point at the tip. Two or 3 creamy yellow flowers are held on very short stalks in each leaf axil. Each flower has 6 petals, united to form a tube towards the base. Five of the petal lobes spread outwards to show the dense hairs on the inner surface. Five stamens alternate with the petals. Smooth, green, egg-shaped fruits hold a single seed (Brown *et. al*, 1998).

Distribution and habitat: The main distribution of *Leucopogon obtectus* is north-west and south-east of Eneabba over a range of about 30 km. Generally the species is found as small, scattered groups in low, open heath on the crests and upper slopes of sand dunes, or more rarely in interdunal swales in grey-white or pale yellow sand (Brown *et. al*, 1998). The taxon is generally taller than the surrounding low heath. It grows in association with *Banksia hookeriana, B. menziesii, B. candolleana, Calothamnus sanguineus* and *Hakea* sp.

Habitat critical to the survival of the species, and important populations: The habitat critical to the survival of *Leucopogon obtectus* comprises the vegetation in which important populations occur; areas of similar habitat within 200 metres of known populations; remnant vegetation linking populations, the local surface and ground water catchments that maintain the habitat of the species and additional occurrences of similar habitat that may contain the species.

Given that this species is listed as Endangered, it is considered that all known habitat is habitat critical to its survival, and that all are important populations. Currently, a significant proportion of the species' known occurrence is within mineral sands mining rehabilitation plots. As such, these occurrences should also be interpreted as representing important populations.

Benefits to other species or ecological communities: Other listed and priority flora and one Threatened Ecological Community (TEC) also occur in the wider habitat of *Leucopogon obtectus.* Recovery actions implemented for *L. obtectus* will also protect these species and the ecological community.

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. *Leucopogon obtectus* is not specifically listed under any international treaty, and therefore this plan does not affect Australia's obligations under any other international agreements.

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

Social and economic impact: The implementation of this recovery plan has the potential to have some limited social and economic impact as some populations of *Leucopogon obtectus* occur on land leased for mining activity. Negotiations will continue with regard to their future management and recovery actions will involve liaison and cooperation with stakeholders.

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

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

1. Relevant land managers have been made aware of the location and threatened status of the species.
2. Staff from the Botanic Garden and Parks Authority (BGPA) have 3 clones of the taxon, one from tissue material and two originating from seed. At present 4.35 g of seed, collected in 1999 from the vicinity of "Beekeepers Reserve", is stored in the BGPA seed store, Factors associated with observed low germination rates are currently being examined. Shoot-tip tissue material has been used to develop micropropagation techniques, with some measure of successful growth being achieved in laboratory media. Survival of plants generated by these techniques when transferred to soil media has been poor. Factors contributing to this low survival rate are currently being examined, such as, the absence of required mycorrhizal fungi. Mycorrhizal fungi have been successfully isolated from natural populations of *Leucopogon obtectus* and maintained in laboratory culture.
3. Research and development initiatives under the Iluka Resources Eneabba Operations Environmental Program 1999 - 2000 have supported studies relating to *Leucopogon obtectus*. These include:
   - A PhD project supervised by the BGPA that is examining Genetic Diversity of *Leucopogon obtectus* through DNA analyses.
   - A Curtin University student project (co supported by Alcoa and MERIWA) that is attempting somatic embryogenesis of *Leucopogon obtectus*.
4. A comprehensive survey of populations 1, 2 (north of Eneabba) and 4 (Alexander Morrison National Park) were conducted for RGC Mineral Sands Limited by Landcare Services in 1988.
5. In November 2005 a census of *Leucopogon obtectus* within the Iluka Resources mining lease was conducted by the Eneabba Operations staff.
6. Staff from CALM's Moora District periodically monitor populations of the species.
7. The Moora District Threatened Flora Recovery Team is overseeing the implementation of this IRP and includes information on progress in its annual reports to CALM's Corporate Executive and funding bodies.

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

Recovery criteria

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

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

Recovery actions

1 Coordinate recovery actions
2 Liaise with relevant land managers
3 Achieve long-term protection of habitat
4 Map habitat critical to the survival of the species
5 Monitor populations
6 Conduct further surveys
7 Obtain biological and ecological information
8 Collect and preserve genetic material
9 Research and develop techniques for propagating *Leucopogon obtectus* for translocation
10 Stimulate regeneration
11 Implement weed control if required
12 Research fire ecology
13 Implement a fire management strategy
14 Promote awareness
15 Undertake and monitor translocation
16 Install DRF markers
17 Review the IRP and assess the need for further recovery actions

1. BACKGROUND

History

Leucopogon obtectus was first collected between the Moore and Murchison rivers by James Drummond and was named by Bentham in 1868. It was then not until 1978 that the species was again seen and collected. Following its discovery, a comprehensive survey by CALM in 1981 (Lewis. 1981) discovered about 100 plants in 25 small populations, many of which consisted of a single plant.

A significant proportion of the northern sandplain habitat of *Leucopogon obtectus* coincides with mineral sand deposits and, since the early 1970's, has been subject to a number of exploration licenses and mining leases. Mining has been active in the area of known occupancy of the species and one population (pop. 3) is largely the result of rehabilitation activities.

A reserve northwest of Eneabba in which populations of *Leucopogon obtectus* occur was gazetted for flora and fauna conservation in 1989 (Brown *et. al*, 1998).

Leucopogon obtectus was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in September 1987.

Description

Leucopogon obtectus is an erect, open shrub to about 1.5 m tall with a few long, erect branches that are completely covered by the foliage. The stalkless, concave, rigid leaves are about 1 cm long and 1 cm wide and have fine lines. They are also a pale bluish-green colour, broadly heart-shaped (to ovate or orbicular), end in a small sharp point, and overlap along the stems. *Flowers* are creamy-yellow, very small, borne 2 or 3 together on very short peduncles arising singly from the lead axils and not projecting beyond the leaves. Each flower has 6 petals, united to form a tube towards the base. Five of the petal lobes spread outwards to show the dense hairs on the inner surface. Five stamens alternate with the petals. Smooth green egg-shaped fruits hold a single seed (Brown *et. al*, 1998 and Leigh *et. al*, 1984).

The generic name *Leucopogon* is derived from the Greek *leucos* (white) and *pogon* (beard) and refers to the white bearded corolla lobes found on all species. The species name *obtectus*, is derived from the latin *obtego* (to cover, conceal, protect), referring to the complete covering of the branches by the overlapping leaves (Leigh *et. al*, 1984)

Distribution and habitat

Leucopogon obtectus has been recorded from Alexander Morrison National Park at the south-eastern end of its known distribution to just north of Nature Reserve 39744 at the northern end, representing a distance of about 60 km. A single unconfirmed record has been made of a population 40 km south of Eneabba. Most populations of *L. obtectus* are found over a range of about 30 km extending northwest and southeast of Eneabba. The species grows as a taller component of low open heath in open scattered populations, mainly on the crests and upper slopes of sand dunes (or more rarely in interdunal swales) comprised of grey-white or pale yellow sands (Brown *et. al*, 1998). Associated species include *Xylomelum angustifolium* and *Xanthorrhoea preissii*.

Summary of population land vesting, purpose and tenure

Pop. No. & Location	CALM District	Shire	Vesting	Purpose	Tenure

1a. N of Eneabba	Moora	Irwin	Main Roads WA	Road Reserve	Other Crown Reserve
1b. N of Eneabba	Moora	Irwin	Unallocated[1]	-	Unallocated Crown Land
1c. N of Eneabba	Moora	Carnamah	Conservation Commission	Conservation of flora and fauna	Nature Reserve
1d. N of Eneabba	Moora	Three Springs	Main Roads WA	Road Reserve	Other Crown Reserve
1e. N of Eneabba	Swan	Carnamah	Conservation Commission	Conservation of flora and fauna	Nature Reserve
1f. N of Eneabba	Moora	Carnamah	Unallocated	-	Unallocated Crown Land
1g. N of Eneabba	Moora	Three Springs	Unallocated	-	Unallocated Crown Land
2. S of Eneabba	Moora	Carnamah	Unallocated	-	Unallocated Crown Land
3a. S of Eneabba	Moora	Carnamah	Unallocated	-	Unallocated Crown Land
3b. S of Eneabba	Moora	Carnamah	Unallocated	-	Unallocated Crown Land
3c. S of Eneabba	Moora	Carnamah	Conservation Commission	Conservation of flora and fauna	Nature Reserve
3d. S of Eneabba	Moora	Carnamah	Conservation Commission	Conservation of flora and fauna	Nature Reserve
3e. S of Eneabba	Moora	Carnamah	Main Roads WA	Road Reserve	Other Crown Reserve
3f. S of Eneabba	Moora	Carnamah	Conservation Commission	Conservation of flora and fauna	Nature Reserve
3g. S of Eneabba	Moora	Carnamah	Main Roads WA	Road Reserve	Other Crown Reserve
4a. SE of Eneabba	Moora	Coorow	Conservation Commission	Conservation of flora and fauna	National Park
4b. SE of Eneabba	Moora	Coorow	Conservation Commission	Conservation of flora and fauna	National Park
5. S of Eneabba	Moora	Dandaragan	Conservation Commission	Conservation of flora and fauna	Nature Reserve

Biology and ecology

Information specific to *Leucopogon obtectus* is limited. However, characteristics generally associated with the genus and its family, the Epacridaceae, may be applicable to the species.

Leucopogon obtectus is a relatively short lived disturbance opportunist in that it is killed by fire, regenerating from seed rather than resprouting from lignotuberous/perennial root stock. It is therefore likely that, in common with most other Australian Epacridaceae, *L. obtectus* recruits only from soil stored seed. It has been suggested that a certain period of seed ageing may be required to break down the hard seed coat and initiate germination. Few *L. obtectus* seedlings have been observed amongst mature living plants.

The species is thought to be both insect and bird pollinated.

Single age, undisturbed stands of mature *Leucopogon obtectus* that are associated with mine rehabilitation plots established in the mid 1980's are showing evidence of senescence. A number of plants in these stands, recorded as alive in 1998 have since died, suggesting that the life span for the species may be no more than 20 years.

Natural seed-set does not appear to be prolific (Bunn, personal communication) suggesting that it may take some years for soil seed reserves to accumulate. There is a risk of rapid depletion if seed reserves are subject to frequent disturbance such as fire.

As with many other members of the Epacridaceae, *Leucopogon* species are difficult to propagate. Seed germination rates are very low and, although some species may occasionally be propagated from

[1] The Department for Conservation and Land Management is the management agency for fire prevention, feral animals and weeds in areas of Unallocated Crown Land in WA

cuttings, they rarely establish successfully under cultivation (Leigh *et. al*, 1984). In the mid 1980's BGPA staff had some success in tissue culturing *Leucopogon obtectus.* At this time they propagated a number of healthy plants in laboratory media using shoot tip culture techniques in one of the few published studies on microprogation of the Epacridaceae. However, plants produced by this technique failed to survive and develop after transfer to soil based media (Bunn 1989). *Leucopogon obtectus*, in common with most other Epacridaceae, is dependent on forming symbioses with mycorrhizal fungi and an absence of such mycorrhizae has been suggested as a possible factor in the poor survival of micropropagated plants. BGPA staff are currently examining this relationship and have successfully isolated and maintained cultures of appropriate mycorrhizal fungi for future work in examining their role in the long term establishment of transplanted seedlings.

Recent molecular genetic studies conducted by BGPA staff have indicated that there is a high level of genetic variability amongst individual plants but no significant population differentiation. It has been suggested that the species comprises a single genetically diverse group associated with an outcrossing reproductive strategy. This has implications for restoration management of the species and it has been suggested that utilising seeds collected from natural populations enables high genetic diversity and outbreeding processes in restored populations to be maintained (Zawko *et al* 2001). From these genetic studies, recruitment from the soil seed bank appears to have been sufficient to replenish a similar degree of genetic diversity in post mine rehabilitated populations when compared with undisturbed natural populations.

Threats

Leucopogon obtectus was declared as Rare Flora in September 1987 under the Western Australian *Wildlife Conservation Act 1950* and is currently ranked as Endangered (EN) under World Conservation Union (IUCN) criterion D (IUCN 2000) as there were less than 250 mature individuals known at the time of ranking. Following recent surveys, there are now over 500 plants known and it strictly meets Vulnerable (VU) under criterion D. *Leucopogon obtectus* is listed as EN under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The main threats are degradation of habitat (largely through mining and exploration), inappropriate fire regimes, lack of appropriate disturbance, road and rail maintenance, weed invasion, poor recruitment and dieback. Threats include:

- **Mining** leases and mineral exploration licenses cover habitat containing most of the known occurrences of *Leucopogon obtectus.* Mining reduces the species' available natural habitat and constitutes a significant threat.

- **Disease:** Although *Leucopogon obtectus* is presumed to be susceptible to *Phytophthora* related dieback (Brown *et al.* 1998), the degree of susceptibility is unknown. Keighery (1988) indicates that the genus *Leucopogon* is variable in its response to infection and the comparatively rapid maturing characteristics of some species may enable recruitment within a population before succumbing to the disease. Larger slower maturing species such as *L. obtectus* may be more susceptible. *Phytophthora* related dieback has been recorded within the vicinity of the species' habitat and is known to affect associated heathland plant species. Mining and exploration activities have the potential to exacerbate and spread dieback and it should therefore be considered a potential threat in the management of *L. obtectus*. Management practices should incorporate disease control as part of an overall habitat management strategy.

- **Inappropriate fire regimes** may affect the viability of populations. Although fire is the stimulus for germination and occasional fires are needed for reproduction and maintenance of populations, the soil seed bank has the potential to be depleted if fires recur before regenerating or juvenile plants reach maturity.

- **Poor recruitment:** As few seedlings or juvenile plants have been observed in association with mature living plants, lack of appropriate disturbance may present a threat where populations are

mature or senescent. Unburnt 20 year old mine rehabilitation sub-populations are showing signs of senescence with little evidence of recruitment

- **Road, rail and firebreak maintenance** threatens all road and rail reserve populations and most populations that may occur on private property. Threats include grading, chemical spraying, construction of drainage channels and mowing of roadside vegetation. Several of these actions also encourage weed invasion. At least one example of plant death from local flooding has been documented. Natural gas pipeline Station No.1 is located within Population 1c and an access track from Beekeepers Rd to the station also runs through the population. Activities associated with this access facility present threats with respect to introduction and spread of weeds and disease.

- **Weed invasion** is a potential threat to all populations, although most remain largely weed-free at present. Weed incursions are a potential threat where they exclusively occupy the postfire regeneration niche of the species. Weeds suppress plant growth and recruitment by competing for soil moisture, nutrients and light. They also exacerbate grazing pressure and increase the fire hazard due to the ready ignition and high energy output of increased fuel loads, which are produced annually by many grass weed species. *Acacia blakelyi* is a significant invasive species of recent mine rehabilitation blocks and, although native to the region, may limit the establishment of other local native species.

- **Seed Predation:** Seed examined during surveys conducted by BGPA staff in the 1980s showed apparent high levels of predation with estimates of up to 80% predated seed found. Predator damage included signs of borers and small larvae within mature fruit from which the endosperm had presumably been consumed. These observations represent one season's data, derived mainly from mine rehabilitation sites where most seed collections took place (Eric Bunn, personal communication) and it needs to be determined if this phenomenon is typical of all populations, including those in undisturbed natural habitats. It is nonetheless a potential threat to the maintenance of a viable soil seedbank.

Summary of population information and threats

Pop. No. & Location	Year	No. plants	Condition	Threats
1a. N of Eneabba	1993 2000	2 2	Poor	Flooding, Road/firebreak maintenance
1b. N of Eneabba	1995	2	Healthy (1995). Unknown following 1998 – 2002 burns/wildfires	Wildfire (if too frequent)
1c. N of Eneabba	1981 1995 1998	14 12 50	Healthy (1981). Unknown following 1998 – 2002 burns/wildfires	Activities associated with access track to gas (pipeline) within reserve eg: track maintenance, weed, dieback spread.
1d. N of Eneabba	1992 found 1998	Not 2	Not recorded 1998. Unknown following 1998 – 2002 burns/wildfires	Wildfire (if too frequent), road maintenance activities
1e. N of Eneabba	1981 1998	25 22	Healthy (1981). Unknown following 1998 – 2002 burns/wildfires	Wildfire (if too frequent)
1f. N of Eneabba	1992 1998	22 269	Healthy (1992). Unknown following 1998 – 2002 burns/wildfires	Wildfire (if too frequent)
1g. N of Eneabba	1998	1	Unknown following 1998 – 2002 burns/wildfires	Wildfire (if too frequent), track maintenance, weed, dieback spread.
2. S of Eneabba	1998	5	Not recorded	Wildfire (if too frequent)
3a. S of Eneabba	1982 1998 1999	15 44 [33] 8	Healthy (pre mining rehab – various years 1987 2004)	Mining, Invasive species *(Acacia blakelyi)* on rehab sites. Lack of appropriate fire regimes
3b. S of Eneabba	1999	6	Moderate. Undisturbed (2004)	Mining
3c. S of Eneabba	1998 1999 2000	1 16 [8] 1	Healthy (pre mining rehab – various years 1991 2004)	Mining
3d. S of Eneabba	1991 1999	2 (4 juv) 8 [5]	Healthy (1981 &1988 - pre mining rehab – 2004 in some areas)	Mining
3e.	1999	1	Not recorded	Road maintenance

				weed invasion
3f. S of Eneabba	1998 1999	2 3	Healthy (1998) post 1977/79 rehab in some areas	Mining
3g. S of Eneabba	1999	1	Not recorded	Road maintenance weed invasion
4a. SE of Eneabba	1991 1998	0 3	Healthy (1987)	Wildfire (if too frequent)
4b.	1998	2	Not recorded	Near Road Reserve
5. S of Eneabba	1998	1	Healthy (1998)	Clearing, weed invasion

Numbers in [brackets] = number of live plants removed during mining operations.

Guide for decision-makers

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

Habitat critical to the survival of the species, and important populations

The habitat critical to the survival of *Leucopogon obtectus* comprises the vegetation in which important populations occur; areas of similar habitat within 200 metres of known populations (i.e. kwongan heath - these provide potential habitat for natural range extension); remnant vegetation linking populations (this is necessary to allow pollinators to move between populations); the local catchment of surface and ground water that maintain the habitat of the species, and additional occurrences of similar habitat that may contain the species.

Given that this species is listed as Endangered, it is considered that all known habitat is habitat critical to its survival, and that all are important populations. Currently, a significant proportion of the species' known occurrence is within mineral sands mining rehabilitation plots. As such, these occurrences should also be interpreted as representing important populations.

Benefits to other species or ecological communities

There are a number of threatened and priority species and one Threatened Ecological Community (TEC) in the wider habitat of *Leucopogon obtectus*. Several Declared Rare Flora (DRF) species occur within the 500 m buffer zones that have been placed around *L. obtectus* populations and *L. obtectus* population 34d occurs within the TEC buffer for the Endangered Lesueur-Coomallo Floristic Community A1.2 (Species-rich heath with emergent *Hakea obliqua*). Recovery actions that improve the health of *L. obtectus* populations will also protect these threatened species and the TEC.

Conservation-listed flora species occurring in habitat of *Leucopogon obtectus*

Species name	**Conservation Status (Western Australia)**	**Conservation Status (EPBC Act)**
Calytrix chrysantha	Priority 3	-
Calytrix eneabbensis	Priority 3	-
Calytrix superba	Priority 3	-
Caustis gigas	Priority 2	-
Eucalyptus crispata	Declared Rare (E)	V
Grevillea biformis subsp. cymbiformis	Priority 2	-
Grevillea curviloba subsp. incurva	Declared Rare (CR)	E
Hakea megalosperma	Declared Rare (V)	V
Lasiopetalum molle subsp. boothendarrense	Priority 2	-
Loxocarya gigas	Priority 2	-
Paracaleana dixonii	Declared Rare (V)	E
Stachystemon axillaris	Priority 4	-
Verticordia aurea	Priority 4	-
Verticordia fragrans	Priority 3	-
Verticordia luteola var. rosea	Priority 1	-

For a description of the Priority categories see Atkins (2003)

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. *Leucopogon obtectus* is not specifically listed under any international treaty, and therefore this plan does not affect Australia's obligations under any other international agreements.

Role and interests of indigenous people

The Aboriginal Sites Register maintained by the Department of Indigenous Affairs does not list any significant sites in the vicinity of *Leucopogon obtectus* populations. However, not all significant sites are listed on the Register and implementation of recovery actions under this plan will include consideration of the role and interests of indigenous communities in the region. Input and involvement will be sought from any Aboriginal groups that have an active interest in the areas that are habitat for *L. obtectus*.

Social and economic impacts

The implementation of this recovery plan has the potential to have social and economic impact as some populations of *Leucopogon obtectus* occur on land leased for mining. Negotiations will continue with regard to their future management and recovery actions will involve liaison and cooperation with stakeholders.

Evaluation of the plan's performance

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

2. RECOVERY OBJECTIVE AND CRITERIA

IRP Objectives

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

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

3. RECOVERY ACTIONS

Existing recovery actions

All relevant land managers have been notified of the location and threatened status of *Leucopogon obtectus*. The notification details the Declared Rare status of the species and associated legal obligations.

Staff of The Botanic Garden and Parks Authority (BGPA) who are examining techniques for propagating *Leucopogon obtectus* have found that seed germination rates are low. The likely contributing factors are currently being examined as part of a broader inquiry into stimulation of native species germination. Methods for vegetative propagation of *Leucopogon obtectus* involving shoot tip tissue culture and somatic embryogenesis have had some measure of success in laboratory culture. Research to address issues of subsequent transplantation failure of cultured material into soil based media is being pursued. This includes examining the mycorrhizal requirements of the species and relationship between micro propagated plants and symbiotic fungi on subsequent development and

long term survival. To assist in these studies, mycorrhizal fungi associated with *L. obtectus* in its natural habitat have been successfully isolated and maintained in pure culture.

The BGPA has completed a research project examining the molecular genetics of *Leucopogon obtectus*. A PhD thesis has developed from this study along with a paper outlining the implications for the conservation genetics of the species. This work was supported by a research grant provided through the Iluka Resources Limited. Eneabba Operations Environmental Program for research and development

The BGPA has three clones of the taxon, one from tissue material and two from seed. At present 4.35 g of seed, collected in 1999 from the vicinity of "Beekeepers Reserve", is stored in the BGPA seed store.

In November 2005 a census of *Leucopogon obtectus* within the Iluka Resources mining lease was conducted by Eneabba Operations staff.

Staff from CALM's Moora District periodically monitor all populations of this species.

The MDTFRT 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 generally in order of descending priority; however this should not constrain addressing any of the priorities if funding is available for 'lower' priorities and as other opportunities arise.

1. Coordinate recovery actions

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

Action: Coordinate recovery actions
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $2,000 per year

2. Liaise with relevant land managers

Staff from CALM's Moora District will continue to liaise with relevant land managers and landowners to ensure that populations are not accidentally damaged or destroyed. Managers associated with the natural gas pipeline Station No 1 and access track within Population 1c should be made aware, if not already notified, of the presence of *Leucopogon obtectus.* In particular, managers of mining operations that are being undertaken on land that contains or may have an impact on populations of *L. obtectus* need to be aware of their obligations. Such obligations may include:

- Ensuring that occurrences of *Leucopogon obtectus* and habitat critical to its survival are protected from any damage that may arise from activities carried out by the proponent or operator.
- Rehabilitation of areas disturbed by mining. This will include a demonstration that existing *Leucopogon obtectus* populations and their habitat are restored according to criteria acceptable to CALM.

- Contributing resources for carrying out research and contributing knowledge that facilitates the long term viability of populations and their habitat.

Action: Liaise with relevant land managers
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $1,400 per year

3. Achieve long-term protection of habitat

Ways and means of improving the security of populations and their habitat should be investigated. On private land this may include conservation covenants with a range of agencies or registration through the Land for Wildlife scheme. The reservation status of the land parcels that support Populations 1f and 3a (Unallocated Crown Land) and Populations 1c, 1e and 3c (class C Nature Reserve) should be reviewed, and the possibility of additional protection through the reserve system investigated.

Action: Achieve long-term protection of habitat
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $1,500 per year

4. Map habitat critical to the survival of the species

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

Action: Map habitat critical to the survival of the species
Responsibility: CALM (Moora District, Species and Communities Branch (SCB)) through the MDTFRT
Cost: $4,000 in the first year

5 Monitor populations

Annual monitoring of factors such as habitat degradation (including weed invasion, salinity and plant diseases such as *Phytophthora cinnamomi*), population stability (expansion or decline), pollination activity, seed production, recruitment, longevity and predation is important

The visibility of DRF markers should also be monitored to ensure they remain effective, and have not faded or been covered by vegetation growth.

Fire is likely to have a significant impact on *Leucopogon obtectus* populations. Fire occurrence and frequency should be monitored in relation to known or likely areas of occupancy for the species. This includes:

- Monitoring and determining the impact of occasional and concurrent fires on known populations and their subsequent recovery.
- Monitoring the impact of fires on possible recruitment of *Leucopogon obtectus* populations from latent seed bank reserves in areas where plants have died.

Status of soil seedbanks should be monitored for all populations where inappropriate disturbance may be:

- diminishing reserves though repeated stimulation without replenishment or
- gradual decline through loss of viability of seed not exposed to required germination stimuli.

Monitoring programs should be undertaken by mining agencies responsible for rehabilitation of disturbed habitat. Data and regular reports from these programs should be made available to the recovery team as required.

Action: Monitor populations
Responsibility: CALM (Moora District), Main Roads Western Australia and MERIWA through the MDTFRT. Also Curtin and Melbourne Universities through Iluka Resources.
Cost: $1,600 per year

6. Conduct further surveys

Further surveys by CALM staff and community volunteers should be conducted during the flowering period of the species (October to March). As populations of the species are impacted upon in some areas by mineral sand mining, permission to take plants in the course of such mining operations should involve reference to the percentage of plants to be taken in comparison to the total numbers of known plants. In this context the mining operator or proponent should be encouraged to contribute to the costs and/or labour involved in surveying current population numbers within and outside the current mining lease.

Particular attention should be given to surveying population 1 north of Eneabba to ascertain its current status following the recent fires that have occurred in the area. Other areas of likely habitat should also be surveyed periodically, particularly areas that have been disturbed by fire which may stimulate recruitment from a latent seedbank. Records of areas surveyed should be sent to Species and Communities Branch and retained at the district office, even if *Leucopogon obtectus* is not found.

Action: Conduct further surveys
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $2,500 per year in the first, third and fifth years with contribution from Mining operator (Iluka Resources Ltd)

7 Obtain biological and ecological information

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

1. Soil seed bank dynamics, including seedbank location and viability and replacement or reduction.
2. The role of various disturbances (including fire), competition, rainfall and grazing in germination and recruitment.
3. The pollination biology of the species.
4. The requirements of pollinators.
5. The reproductive strategies, phenology and seasonal growth of the species.
6. Characterisation of fungal symbiots and their presence at existing and potential *Leucopogon obtectus* sites
7. Determine if current seed predation is of sufficient impact to warrant further investigation
8. Determine required levels of genetic diversity and minimum viable population size.

Action: Obtain biological and ecological information
Responsibility: CALM (Science Division, Moora District), MERIWA and BGPA through the MDTFRT. Also Curtin and Melbourne Universities through Iluka Resources.
Cost: $12,000 per year in the second, third and fourth years

8 Collect and preserve genetic material

It is necessary to store germplasm as a genetic resource, ready for use in translocations and as an *ex situ* genetic “reservoir” of the species. The germplasm stored will include, if possible, seed and live

plants in cultivation. As only limited seed has been collected from one population of *Leucopogon obtectus* additional collections should be made from a wider variety of locations. This is important to maintain adequate representation of the genetic diversity of the species as well as maintain the historical processes.that have shaped the genetic character of the species. Poor germination of seed tested to date indicates the need for other sources of germplasm. This will require the development of effective techniques for long term storage of such material. To achieve this, alternative sources of effective plant material may need to be identified, collected and tested. Mycorrhizal fungi are likely to be an important symbiot and should be collected and stored in conjunction with any plant germplasm.

Action: Collect viable seed, vegetative and micorrhizal material. Develop techniques and protocols for storing and maintaining these materials as living *ex situ* collections.
Responsibility: CALM (TFSC, Moora Districts) and BGBA through the MDTFRT
Cost: $2,200 in the first, third and fifth years

9 Research and Develop techniques for propagating *Leucopogon obtectus* for translocation.

Further research should be conducted to improve techniques for propagating plants suitable for translocation. This may involve:

- improving the current low ex situ germination rate of seed
- improving the survival of plants generated from micro propagated tissue material
- Establishing the symbiotic requirements for long term survival of propagated plants at translocation sites.

Action:
Responsibility: CALM (TFSC, Moora District), MERIWA and BGBA through the MDTFRT. Also Curtin University through Iluka Resources.
Cost: $9000 over first 3 years

10. Stimulate regeneration

Techniques should be researched and developed for facilitating *in situ* recruitment of *Leucopogon obtectus* populations. Where a significant proportion of the species occurrence shows signs of senescence with little recruitment experimental disturbance trials may need to be considered. The purpose of such trials would be to ascertain those methods most effective, in facilitating *in situ* recruitment. If a fire trial is found to be necessary, it should be undertaken with care and its impact limited to a small area. As fire has the potential to encourage the invasion of weeds effective follow-up weed control will need to be undertaken as necessary. Monitoring of trials will include documenting the response of associated species and any negative impacts such as the level weed invasion. Monitoring of regeneration should continue for at least three years and preferably until it is established that the regenerated plants have reached reproductive maturity and are actively contributing to the seedbank.

Action: Stimulate regeneration
Responsibility: CALM (Moora District) through the MDTFRT
Cost: $2,000 per year

11. Implement weed control if required

The current level of threat from weeds is low at most populations. However, an increase in weed numbers (such as after fire) could impact on *Leucopogon obtectus* by competing for resources, degrading habitat, exacerbating grazing pressure, and increasing the risk and severity of fire. Recruitment is likely to be particularly affected. If during monitoring it is deemed that the threat from weeds has increased, weed control may need to be undertaken in consultation with the land managers. The methods employed will need to accommodate seasonal considerations and impact on the

surrounding native vegetation. All applications of weed control should be followed by a report on the method, timing and success of the treatment against weeds, and the effect on *Leucopogon obtectus* and associated native plant species.

Action: Implement weed control if required
Responsibility: CALM (Moora District) and relevant land managers through the MDTFRT
Cost: $700 per year

12. Research fire ecology

Long-term research is required to determine the longevity of *Leucopogon obtectus* and the time required to replenish seed stores following germination. As this information becomes known, a full fire management strategy will be developed.

Action: Research fire ecology
Responsibility: CALM (Science Division and Moora District) through the MDTFRT
Cost: $6,000 in year 1; $2,500 in years 2, 3, 4 and 5

13. Implement a fire management strategy

No planned burns will occur in the habitat of populations until a full fire management strategy has been developed. This will include recommendations on prescription fire frequency and intensity, precautions to prevent fire, a strategy for reacting to wildfire and the need, method of construction and maintenance of firebreaks. This will be implemented by CALM District staff in consultation with land managers.

Action: Implement a fire management strategy
Responsibility: CALM (Moora District) and Iluka through the MDTFRT
Cost: $3,500 in year 5

14. Promote awareness

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

Action: Promote awareness
Responsibility: CALM (Moora and Merredin Districts) through the Recovery Teams
Cost: $1,700 in first year, and $1,100 per year

15. Undertake and monitor a translocation

If attempts to stimulate regeneration are not successful, translocations may need to be considered for the conservation of this species. This approach will require the development of a translocation proposal and selection of suitable translocation sites. Normal protocols involve the propagation of material prior to planting out in accordance with an approved Translocation Proposal. Given the difficulties associated with seed germination for the species and the experimental nature of vegetative micropropagation techniques to date, alternative methods, other than *ex-situ* propagation, may need to be investigated. For example, seedbank augmentation from relocated topsoil or harvested vegetation, accompanied by appropriate germination stimuli. Information on the translocation of threatened plants and animals in the wild is provided in the Department's Policy Statement No. 29 *Translocation of Threatened Flora and Fauna*. All translocation proposals require endorsement by the Department's Director of Nature Conservation.

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

Action: Undertake and monitor translocation
Responsibility: CALM (Moora District, TFSC) and BGPA through the MDTFRT. Also Iluka.
Cost: **$10000** in the third year and $5000in the fifth year

16. Install DRF markers

DRF markers may be required at Populations 1a, 1d and 3g on Brand Highway, and Population 1c on Beekeepers Road. The installation of these markers will take place during monitoring of the species in its flowering period. These will help road maintenance workers to avoid accidental damage to the plants or their habitat.

Action: Install DRF markers
Responsibility: Various (Iluka Resources, Main Roads Western Australia, Shire of Coorow/Carnamah) with assistance from CALM (Moora District) through the MDTFRT
Cost: $200 in first year

17. Review the IRP and assess the need for further recovery actions

At the end of the fourth year of the five-year term of this IRP the plan will be reviewed and the need for further recovery actions will be assessed.

Action: Review the IRP and assess the need for further recovery actions
Responsibility: CALM (SCB, Moora District) through the MDTFRT
Cost: $1,000 in the fifth year

4. TERM OF PLAN

This IRP will operate from February 2006 to January 2011 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

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6. TAXONOMIC DESCRIPTION

Leigh, J., Boden, R. and Briggs, J. (1984) *Extinct and Endangered Plants of Australia*. The Macmillan Co. of Australia. Pp 190-191.

Shrub to about 1.5m high with a few long, erect branches completely covered by the foliage. *Leaves* are stalkless, with a pale bluish-green bloom, broadly heart-shaped to ovate or orbicular, about 1 cm in diameter and ending in a small sharp point, rigid, concave and overlapping along the stems. *Flowers* are creamy-yellow, very small, borne 2 or 3 together on very short peduncles arising singly from the lead axils and not projecting beyond the leaves. The lanceolate sepals are 4 mm long and the corolla tube is nearly as long as the calyx and has rather short lobes. *Fruit* is not described. *Flowering* October to November.

NOTE: *Fruit* is described by Brown, *et. al*, (1998) as; Smooth, green, egg-shaped and containing a single seed.