Government of **Western Australia**
Department of **Environment and Conservation**

INTERIM RECOVERY PLAN NO. 334

STIRLING RANGE BEARD HEATH

(*Leucopogon gnaphalioides*)

INTERIM RECOVERY PLAN

2013-2018

February 2013
Department of Environment and Conservation
Kensington

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. Note: the Department of CALM formally became the Department of Environment and Conservation (DEC) in July 2006. DEC will continue to adhere to these Policy Statements until they are revised and reissued.

Plans 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.

DEC 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 taxa, always within one year of endorsement of that rank by the Minister.

This plan will operate from February 2013 to January 2018 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked as Critically Endangered, this plan will be reviewed after five years and the need for further recovery actions assessed.

This plan was given regional approval on 14TH January 2013 and was approved by the Director of Nature Conservation on 7th February 2013. The provision of funds identified in this plan is dependent on budgetary and other constraints affecting DEC, as well as the need to address other priorities.

Information in this plan was accurate at February 2013.

PLAN PREPARATION

This plan was prepared by Robyn Luu[1], Sarah Barrett[2] and Andrew Brown[3].

[1] Project Officer, DEC Species and Communities Branch, Locked Bag 104, Bentley Delivery Centre, WA 6983.
[2] Flora Conservation Officer, DEC Albany District, 120 Albany Highway Albany 6330.
[3] Threatened Flora Coordinator, DEC Species and Communities Branch, Locked Bag 104, Bentley Delivery Centre, WA 6983.

ACKNOWLEDGMENTS

The following people provided assistance and advice in the preparation of this plan:

Andrew Crawford	Principal Technical Officer (Threatened Flora Seed Centre), DEC Science Division
Rebecca Dillon	Research Scientist, DEC Science Division
Mia Podesta	Ecologist – TEC database, DEC Species and Communities Branch
Damien Rathbone	Ravensthorpe Flora Survey Coordinator, DEC Albany District
Amanda Shade	Assistant Curator (Nursery), Botanic Gardens and Parks Authority

Thanks also to the staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information, and DEC Species and Communities Branch for assistance.

Cover photograph by Sarah Barrett.

CITATION

This plan should be cited as:

Department of Environment and Conservation (2013) Stirling Range Beard Heath (*Leucopogon gnaphalioides*) Interim Recovery Plan 2013-2017. Interim Recovery Plan No. 334. Department of Environment and Conservation, Western Australia.

SUMMARY

Scientific Name:	***Leucopogon gnaphalioides***	**Common Name:**	Stirling Range Beard Heath
Family:	Ericaceae	**Flowering Period:**	August to September
DEC Region:	South Coast	**DEC District:**	Albany
Shire:	Gnowangerup	**NRM Region:**	South Coast
Recovery Team:	Albany District Threatened Flora and Communities Recovery Team (ADTFCRT)	**IBRA region:**	Esperance Plains
		IBRA subregion:	Fitzgerald

Distribution and habitat: *Leucopogon gnaphalioides* is endemic to WA where it is restricted to rocky mountain summits in the Stirling Range National Park. Habitat is thick scrub/heath on shallow, brown, sandy, clay over schist.

Habitat critical to the survival of the species, and important populations: *Leucopogon gnaphalioides* is ranked in WA as CR and as such it is considered that all known habitat for wild populations is habitat critical to the survival of the species, and that all wild populations are important populations. Habitat critical to the survival of *L. gnaphalioides* includes the area of occupancy of populations, areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion and for pollinators), additional occurrences of similar habitat that may contain undiscovered populations of the species or be suitable for future translocations, and the local catchment for the surface and/or groundwater that maintains the habitat of the species.

Conservation status: *Leucopogon gnaphalioides* is declared as rare flora (DRF) under the Western Australian *Wildlife Conservation Act 1950* and is ranked as Critically Endangered (CR) in WA under International Union for Conservation of Nature (IUCN 2001) criteria A1ae; B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v); C1 due to a reduction of greater than 90% in population size based on the effects of the plant pathogen *Phytophthora cinnamomi*; the extent of occurrence being less than 100km^2; area of occupancy less than 10km^2; severely fragmented or known to exist at no more than one locations; a continuing decline in area of occupancy, area, extent and/or quality of habitat, number of locations or subpopulations, and number of mature individuals; and an estimated continuing decline of at least 25% within three years or one generation whichever is the longer. The extent of occurrence is 59.33km^2 and the area of occupancy is approximately 26.5hectares. The species is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999).

Threats: The main threats to the species are Phytophthora dieback, inappropriate fire regimes, grazing and trampling.

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

1. Tests undertaken by DEC's Science Division in 1995 found that samples of *Leucopogon gnaphalioides* taken from Bluff Knoll were infected with *Phytophthora cinnamomi*. Further testing of the species for *Phytophthora cinnamomi* susceptibility in 2006 resulted in 100% mortality indicating that the species is highly susceptible.
2. Aerial spraying with phosphite commenced in 1997.
3. Populations of *Leucopogon gnaphalioides* are regularly monitored in relation to the impact of *Phytophthora cinnamomi* and the effectiveness of phosphite.
4. In 2011 in excess of 488 fruits were collected from *Leucopogon gnaphalioides* Populations 1, 2 and 3 were stored in DEC's Threatened Flora Seed Centre (TFSC) at –18°C.
5. Cuttings collected between 1999 and 2011 were sent to the Botanic Gardens and Parks Authority (BGPA) for propagation.
6. Several articles have been written about the species.
7. A three year research program investigating the impact of fire ecology on the eastern Stirling Range Montane Heath and Thicket Community was initiated by DEC's Science Division and Albany District (Yates and Barrett 2001).
8. A program for rabbit control was implemented in 2001 and included scatter laying 1080 one shot oats from the ground and air (Blechynden 2001).
9. Caging and fencing of plants has been implemented in Populations 3, 6 and 10 with plants tagged for monitoring.
10. A translocation proposal aimed at conserving the wild genetic stock of *Leucopogon gnaphalioides* by establishing it at another site was developed and implemented by DEC in 2005 (Barrett and Monks 2005).
11. Monitoring of the translocated population was undertaken initially, six monthly and then annually after planting and includes the number of surviving plants, height and width of crown in two directions, reproductive state, number of flowers and drupes, and general health of plants.
12. Directional/markers and 'Let it Grow' signs were erected along Bluff Knoll track (Population 3) to assist with limiting visitor trampling and spread of disease.
13. Staff from DEC's Albany District regularly monitor populations.
14. Stirling Range National Park Rangers are aware of the Critically Endangered status of *Leucopogon gnaphalioides* and where it occurs in the park.
15. DEC with assistance from the ADTFCRT is overseeing the implementation of this plan and will include information on progress in the annual report to DEC's Corporate Executive and funding bodies.

Plan Objective: The objective of this 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 populations has increased and/or the number of mature individuals has increased by 10 per cent or more over the term of the plan.

Criteria for failure: The number of populations has decreased and/or the number of mature individuals has decreased by 10 per cent or more over the term of the plan.

Recovery actions

1. Coordinate recovery actions
2. Apply phosphite
3. Monitor the impact of phosphite
4. Maintain disease hygiene
5. Implement the SRNP fire management strategy
6. Implement a rabbit control and grazing prevention strategy
7. Monitor populations
8. Collect and store seed
9. Implement additional translocations
10. Monitor translocated populations
11. Conduct genetic studies to ascertain taxonomic status
12. Obtain biological and ecological information
13. Liaise with indigenous communities
14. Map habitat critical to survival
15. Promote awareness
16. Review this plan and assess the need for further recovery actions

1. BACKGROUND

Review of approved Western Australian recovery plan adopted as a national recovery plan under the EPBC Act (Fairs 2008).

The criteria for success in the previous plan (the number of individuals within populations and/or the number of populations have increased) was met with the overall number of individuals increasing from 150 to 300 during the term of the plan. The main recovery actions from the plan and their results are listed in Table 1 below.

Table 1: Status of specific recovery actions from previous plan (2001-2003)

Recovery Action	% Implemented	Result
Coordinate recovery actions	Started, ongoing	Recovery actions are coordinated by the Albany District Flora Conservation Officer with assistance from the Albany District Threatened Flora and Communities Recovery Team. The team met biannually over the term of the plan.
Apply phosphite	Started, ongoing	During the term of the plan (2001-2003) l phosphite was aerially applied to Populations 1, 3 6 and 9 with good survival of individuals at Populations 1 and 3.
Monitor the impact of phosphite	Started, ongoing	Staff from DEC's Albany District have monitored the effectiveness of phosphite application and the impact of *P. cinnamomi* annually (2002 to 2011) at Population 3. Observations indicate an overall net decline in number of deaths during the term of the plan.
Collect seed, cutting and tissue culture material	Started, ongoing	90 plants propagated from cutting material are held at the BGPA. A seed orchard was established in 2005 from cutting material collected from Population 3.
Develop a fire and implement a management strategy	Complete	Fire management is included as a specific draft strategy (#23) in the Stirling Range and Porongurup National Park Management Plan. The Fire Management Strategy has taken into consideration the vulnerability of threatened species to frequent fire regimes and has included all populations in "no planned fire" cells.
Monitor populations	Ongoing	Population monitoring has occurred annually at Population 3 and less frequently at other populations. Population size, health, habitat status, threat assessments, post fire recruitment and other notable attributes recorded on Rare Flora Report Forms.
Develop and implement a rabbit control strategy	10% complete and ongoing	Although a rabbit control strategy has included baiting using 1080 oats, grazing is still apparent.
Undertake weed control	0% complete	Weed control is now considered low priority.
Conduct further surveys	100% complete	The species has been extensively surveyed for in areas of suitable habitat annually. One additional population was located in 2004.
Obtain biological and ecological information	20% complete	A three year research program was initiated by CALM Science Division in 2001. Part of the aim was to study the demography of *Leucopogon gnaphalioides* and the impact of grazing on the species. No results are available to date.
Promote awareness	100% complete	Several articles have been written about the species including "A safe haven for threatened plants", "Endangered flora's new lease of life" and "WATSNU". A paper was presented at the 2007 Medecos Conference.
Write full Recovery Plan	0% complete	DEC does not generally produce full recovery plans for flora and current interim recovery plans have been extended to a five year term.

The majority of the recovery actions included in the previous plan have been fully or partially implemented. *Action 8* "Undertake weed control", was deemed as not being required and is not included in the revised plan. *Action 9* "Conduct further surveys" is not in the revised plan as all potential habitat for the species has been surveyed. *Action 12* "Develop a full Recovery Plan" is redundant as DEC does not generally produce full recovery plans for flora and current interim recovery plans have been extended to a five year term. Ongoing recovery actions included in the previous plan are included in the revised plan. New recovery actions included in the revised plan are: maintain disease hygiene, monitor translocated populations, investigate genetic diversity and confirm taxonomic status, undertake additional translocations, Liaise with Indigenous communities, map habitat critical to the survival of *Leucopogon gnaphalioides* and review this plan and assess the need for further recovery actions.

History

Leucopogon gnaphalioides was first collected from Stirling Range National Park by C.A. Gardner in 1928. All subsequent collections have also been made from the park.

As part of the 'Biological Survey of Mountains in southern Western Australia' project, surveys of six mountain peaks were conducted in the Stirling Range National Park by S. Barrett in 1996. One new population of *Leucopogon gnaphalioides* was discovered at that time and three previously reported populations confirmed (Barrett 1996). Surveys conducted by staff from DEC's Albany District in 1997, 2000, 2004 and 2009 resulted in a further four new populations being discovered..

Most populations of *Leucopogon gnaphalioides* have been burnt at least once over the last 20 years. Population 2 was burnt in 1983, Populations 1, 3 and 7 in 1991 and Population 5 in summer 1996. Seedlings of *Leucopogon gnaphalioides* have been observed following fire. A fire which occurred in October 2000 burnt most populations of *L. gnaphalioides*.

Leucopogon gnaphalioides is currently known from seven extant populations comprising 826 mature plants. Two other previously known populations no longer have extant plants and all populations are infected with dieback (*Phytophthora cinnamomi*).

Description

Leucopogon gnaphalioides has densely hairy branches. Leaves are dense, imbricate, sub-appressed, erect, ovate to lanceolate, concave and convex, multi-nerved and dull grey. The leaf apex is acute. The top of the leaf is glabrous, basal inside of leaf has appressed hairs. The leaf margin has long, dense hairs. The inflorescence is comprised of a cluster of short spikes at the end of branches, branchlets are hairy, short bracts are keeled. Calyx is white, tips acute, margin has long, dense cilia. *Leucopogon gnaphalioides* differs from *L. elegans* and *L. ovata* in having larger flowers, hairy bracts and larger, hairy leaves (Stschegleew 1859).

Morphological differences in the fruit and seed have been observed between Population 2 and other populations to the east. Subspecific status for this population may be warranted and further investigation is required.

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; Western Australian Herbarium (1998−) *FloraBase − The Western Australian Flora*. Department of Environment and Conservation. http://florabase.dec.wa.gov.au/.

Distribution and habitat

Leucopogon gnaphalioides is endemic to Western Australia where it is restricted to rocky mountain summits in the Stirling Range National Park. Habitat is thick scrub/heath on shallow, brown, sandy, clay over schist. Associated species include *Actinotus rhomboideus*, *Sphenotoma* sp. Stirling Range, *Acacia drummondii*, *Kunzea montana*, *Calothamnus montanus*, *Beaufortia anisandra*, *Taxandria floribunda*, *Lepidosperma* sp., *Helichrysum macranthum*, *Leucopogon atherolepis* and *Velleia foliosa*.

Table 2. Summary of population land vesting, purpose and manager

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager
1. Isongerup Peak	Albany	Gnowangerup	Conservation Commission of WA	National Park	DEC
2. Mondurup Peak	Albany	Gnowangerup	Conservation Commission of WA	National Park	DEC
3. Bluff Knoll Plateau	Albany	Gnowangerup	Conservation Commission of WA	National Park	DEC
4. Ellen Peak	Albany	Gnowangerup	Conservation Commission of WA	National Park	DEC
5. Toolbrunup Peak	Albany	Gnowangerup	Conservation Commission of WA	National Park	DEC
6. Pyungoorup Peak	Albany	Gnowangerup	Conservation Commission of WA	National Park	DEC
7. Coyanerup Peak	Albany	Gnowangerup	Conservation Commission of WA	National Park	DEC
8. East Bluff	Albany	Gnowangerup	Conservation Commission of WA	National Park	DEC
9. Bakers Knob	Albany	Gnowangerup	Conservation Commission of WA	National Park	DEC

Biology and ecology

Little is known about the biology and ecology of *Leucopogon* species, however, a study by Keighery (1996) on the Western Australian Ericaceae reports that the greatest species diversity in *Leucopogon* is on the south coastal sandplains. *Leucopogon* species have unspecialised flowers and are mainly pollinated by bees, but are also visited by a range of other insects including flies, wasps, butterflies and moths. Most genera in the Ericaceae contain species that are susceptible to *Phytophthora cinnamomi* (dieback), with those taxa most at threat being geographically restricted and including *L. gnaphalioides* (Keighery 1996). A quantified risk assessment undertaken by Barrett *et al*. (2008) scored the species as having a 'Very High' risk of extinction with 0% survival in a glasshouse experiment.

Post fire observations of *Leucopogon gnaphalioides* suggest that adult plants are killed by fire, with recruitment occurring from soil-stored seed. The taxon has a primary juvenile period of approximately five years and this may considerably longer where grazing is prevalent. Therefore, the long-term conservation of populations would be compromised if fire recurs before seedlings have had a chance to reach maturity.

Conservation status

Leucopogon gnaphalioides is declared as rare flora (DRF) under the Western Australian *Wildlife Conservation Act 1950* and is ranked as Critically Endangered in WA under International Union for Conservation of Nature (IUCN 2001) criteria A1ae; B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v); C1 due to a reduction of greater than 90% in population size based on the effects of the plant pathogen *Phytophthora cinnamomi*; the extent of occurrence being less than 100km^2; area of occupancy less than 10km^2; severely fragmented or known to exist at no more than one locations; a continuing decline in area of occupancy, area, extent and/or quality of habitat, number of locations or subpopulations, and number of mature individuals; and an estimated continuing decline of at least 25% within three years or one generation whichever is the longer. The extent of occurrence is 59.33km^2 and the area of occupancy is approximately 26.5 hectares. The species is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999).

Threats

The main threats to the species are:

- **Phytophthora dieback.** *Phytophthora cinnamomi* is present in all populations.
- **Inappropriate fire regimes.** Fires in 1983, 1991, 1996 and October 2000 killed many adult plants. Although soil-stored seed germinates following fire, frequent fire may have depleted the soil seed store.
- **Grazing**. In Populations 3, 4, 5, 6 7, 8 and 9 rabbits appear to be the primary herbivore but quokkas and brushtail possums are also present.
- **Trampling.** Currently, visitors do not tend to deviate from the Eastern Peak walking Route, however, the alignment and condition of the route requires assessment to ensure *Leucopogon gnaphalioides* populations are not compromised by disease introduction, trampling or track formation.

The intent of this plan is to provide actions that will deal with immediate threats to *Leucopogon gnaphalioides*. Although climate change may have a long-term effect on the species, actions taken directly to prevent the impact of climate change are beyond the scope of this plan.

Table 3. Summary of population information and threats

Pop. No. & Location	Land Status	Year / No. of plants	Current condition (habitat)	Threats
1. Isongerup Peak	National Park	2002 50+ (50+) 2008 1000+ 2010 300+ (500+)	Moderate	Disease, fire
2. Mondurup Peak	National Park	2000 12 (5) [2] 2004 (520+) 2011 25 (15+) [100+]	Poor	Disease, fire
3. Bluff Knoll	National Park	2001 (350+) [20+] 2002 100+ (600+) [10+] 2011 500+/- (2000+)	Moderate	Grazing, disease, fire, trampling

4. Ellen Peak	National Park	1995 50 [20] 2002 0	Moderate	Grazing, disease, fire
5. Toolbrunup Peak	National Park	1996 15 1999 2 2007 0	Presumed locally extinct	Grazing, disease, fire, trampling
6. Pyungoorup Peak	National Park	2002 6 (400+) 2011 (100)	Poor	Grazing, disease, fire
7. Coyanerup Peak	National Park	2000 5+ [2] 2011 1	Poor	Grazing, disease, fire
8. East Bluff	National Park	2004 (1) 2012 0(20)	Poor	Grazing, disease, fire
9. Bakers Knob	National Park	2009 (5) 2011 (5)	Poor	Grazing, disease, fire

Populations in **bold text** are considered to be important populations; () = number of seedlings/juveniles; [] = number of dead.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Actions for development and/or land clearing in the immediate vicinity of *Leucopogon gnaphalioides* may require assessment.

Actions that could result in any of the following may potentially result in a significant impact on the species:

- Damage or destruction of occupied or potential habitat.
- Alteration of the local surface hydrology or drainage.
- Reduction in population size.
- A major increase in disturbance in the vicinity of a population.
- Spread or amplification of dieback disease.

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

Leucopogon gnaphalioides is ranked in WA as CR, and as such it is considered that all known habitat for wild populations is habitat critical to the survival of the species, and that all wild populations are important populations. Habitat critical to the survival of *L. gnaphalioides* includes the area of occupancy of populations, areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion and for pollinators), additional occurrences of similar habitat that may contain undiscovered populations of the species or be suitable for future translocations, and the local catchment for the surface and/or groundwater that maintains the habitat of the species.

Benefits to other species or ecological communities

Recovery actions implemented to improve the quality or security of the habitat of *Leucopogon gnaphalioides* will also improve the status of associated native vegetation. Thirteen threatened and 12 priority flora also occur within 500m of *L. gnaphalioides*. This plan will be implemented in conjunction with the plans for *Persoonia micranthera* (Stack and Brown 2003), *Andersonia axilliflora* (Evans *et al*. 2003) and *Banksia montana* (formerly *Dryandra montana*, Gilfillan *et al*. 2005). Management of the species has also been incorporated into the Stirling Range and Porongurup National Parks Management Plan (CALM, 1999).

Table 4. Conservation–listed flora species occurring within 500m of *Leucopogon gnaphalioides*

Species name	**Conservation Status (WA)**	**Conservation Status (EPBC Act 1999)**
Andersonia axilliflora	DRF (Critically Endangered)	Endangered
Banksia brownii	DRF (Critically Endangered)	Endangered
Banksia montana	DRF (Critically Endangered)	Endangered
Latrobea colophona	DRF (Critically Endangered)	
Persoonia micranthera	DRF (Critically Endangered)	Endangered
Darwinia collina	DRF (Endangered)	Endangered
Darwinia nubigena	DRF (Endangered)	Vulnerable
Darwinia oxylepis	DRF (Endangered)	Endangered
Daviesia obovata	DRF (Endangered)	Endangered
Gastrolobium vestitum	DRF (Endangered)	
Sphenotoma drummondii	DRF (Endangered)	Endangered

Darwinia squarrosa	DRF (Vulnerable)	Vulnerable
Deyeuxia drummondii	DRF (Vulnerable)	Endangered
Deyeuxia inaequalis	Priority 1	
Daviesia mesophylla	Priority 2	
Gastrolobium crenulatum	Priority 2	
Gastrolobium leakeanum	Priority 2	
Gonocarpus rudis	Priority 2	
Leucopogon lasiophyllus	Priority 2	
Microcorys sp. Stirling Range (S. Barrett 1392)	Priority 2	
Andersonia echinocephala	Priority 3	
Andersonia grandiflora	Priority 3	
Darwinia macrostegia	Priority 4	
Gonocarpus benthamii subsp. Stirling (C.J. Robinson 1080)	Priority 4	
Leucopogon pogonocalyx	Priority 4	

For a description of the Priority categories see Smith (2012).

Leucopogon gnaphalioides occurs within 1km of one Threatened Ecological Community (TEC) and two Priority Ecological Communities (PECs). The implementation of this plan will be in conjunction with the interim recovery plan for the TEC (Barrett 2000). For a description of Threatened Ecological Categories see DEC (2007).

Table 5. Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) in which *Leucopogon gnaphalioides* occurs within a 1km radius

TEC Title	**Conservation Status (WA)**	**Conservation Status (EPBC Act 1999)**
Montane mallee thicket community of the Stirling Range	Priority 1	–
Montane Thicket of the eastern Stirling Range	Critically Endangered	Endangered
Coyanerup Wetland Suite: microscale paluslopes associated with seepage and creeks in the area between Coyanerup Peak and Bluff Knoll in the Stirling Ranges	Priority 1	–

For a description of the TEC categories see DEC (2007).

International obligations

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993 and will assist in implementing Australia's responsibilities under that Convention. The species is not listed under Appendix II in the United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES) and this plan does not affect Australia's obligations under any other international agreements.

Indigenous consultation

A search of the Department of Indigenous Affairs Aboriginal Heritage Sites Register revealed one significant site in the vicinity of populations of *Leucopogon gnaphalioides*. The Kojaneerup site (#5145) is listed as a site with artefacts. The species also occurs within the Stirling Range National Park which is known to be a culturally significant site to Indigenous people. Input and involvement has been sought through the South West Aboriginal Land and Sea Council (SWALSC) and Department of Indigenous Affairs to determine if there are any issues or interests. Indigenous opportunity for future involvement in the implementation of the Recovery plan is included as an action in the plan. Indigenous involvement in management of the land is also provided for under the joint management arrangements in the *Conservation and Land Management Act 1984.*

Social and economic impacts

The implementation of this recovery plan will have some social and economic impact as populations occur in a National Park and there are costs involved with recovery and impacts on land management practices. The management of the Stirling Range National Park is, however, undertaken under the guidance of the Stirling Range and Porongurup National Park Management Plan (DEC 1999). The management of threatened flora and ecological communities, including *Leucopogon gnaphalioides*, is included in this plan and consequently such

management requirements and costs are within the scope of the management of this park. The habitat is also in an area that is culturally significant to Indigenous people.

Affected interests

DEC and Aboriginal groups.

Evaluation of the plan's performance

DEC, with assistance from the Albany District Threatened Flora and Communities Recovery Team (ADTFCRT) will evaluate the performance of this plan. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following five years of implementation.

2. RECOVERY OBJECTIVE AND CRITERIA

Objective

The objective of this 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 populations has increased and/or the number of mature individuals has increased by 10 per cent or more over the term of the plan.

Criteria for failure: The number of populations has decreased and/or the number of mature individuals has decreased by 10 per cent or more over the term of the plan.

3. RECOVERY ACTIONS

Existing recovery actions

Testing conducted by DEC's Science Division in 1995 found that samples of *Leucopogon gnaphalioides* taken from Bluff Knoll were infected with *Phytophthora cinnamomi*. Additional testing the species for *Phytophthora cinnamomi* susceptibility in 2006 resulted in 100% mortality, indicating that the species is highly susceptible.

To protect *Leucopogon gnaphalioides* from *Phytophthora cinnamomi*, aerial spraying with phosphite commenced in 1997 with additional populations sprayed in 1998. The spraying program also covered other threatened species and a threatened community. The following table outlines dates during which populations were sprayed with phosphite.

Table 6. Phosphite application dates for populations of *Leucopogon gnaphalioides*

Population No.	Location	Area sprayed	Dates
1	Isongerup Peak	8 hectares	1997, 2000, 2002, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011
2	Mondurup		2010, 2011
3	Bluff Knoll	22 hectares	1997, 2000, 2001, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011
4	Ellen Peak (summit)	1 hectare	1998, 1999, 2001
6	Pyungoorup Peak	3.5 hectares	1998, 1999, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011
8	East Bluff		1997, 2000, 2001, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011

Populations of *Leucopogon gnaphalioides* are regularly monitored in relation to the impact of *Phytophthora cinnamomi* and the effectiveness of phosphite application. Six control and six spray plots were set up on Bluff Knoll in 1997 and survival of other members of the Ericaceae was found to be significantly higher in sprayed quadrats three years later (Barrett 2003).

Attempts to collect seed were made in December 1999 and early January 2000 but were unsuccessful as it was found that fruits had not forming properly. In 2011 in excess of 488 fruits were collected from *Leucopogon gnaphalioides* from Populations 1, 2 and 3 were stored in DEC Threatened Flora Seed Centre (TFSC) at –18°C (see table 7). Cut tests have been conducted for accession number 03447 and the seeds have been set up for germination. Some of the seeds were observed 'spitting out' their embryos, but still appeared to be developing. The cut test average for these individuals was about one seed per fruit. Germination results wee yet to be completed at the time of writing.

Table 7. Threatened Flora Seed Centre collection details for *Leucopogon gnaphalioides*

Accession Number	Date collected	Population number	Collection type	Number of fruit	Germination rate (%)
03447	11/3/2011	1	B/16, I/54	433 (229 seed)	Cut-test conducted
03448	21/02/2011	2	B/3, I/10	55	Insufficient fruit to test
03461	28/02/2011	3	I/56, B/3	Not yet processed	Yet to be cleaned and quantified

Note: 'I' = a collection of individuals and the number of plants collected; 'B' = a bulked collection and the number of plants sampled

Cuttings collected between 1999 and 2011 were sent to the Botanic Gardens and Parks Authority (BGPA) for propagation (see table 8 for results). A number of different hormone treatments were trialled but no one treatment was more successful than the others.

Table 8. BGPA propagation results for cuttings of *Leucopogon gnaphalioides*

Date	Number treated	Number resulted	Percentage resulted
10-Dec-99	67	10	15
10-Oct-01	37	18	48
16-Apr-04	18	18	100
16-Apr-04	4	2	50
16-Apr-04	4	3	75
16-Apr-04	18	17	94
16-Apr-04	60	23	38
24-Jun-04	9	5	55
24-Jun-04	4	3	75
24-Jun-04	7	4	57
24-Jun-04	10	4	40
24-Jun-04	3	1	33
24-Jun-04	9	3	33
24-Jun-04	11	4	36
24-Jun-04	3	0	0
24-Jun-04	1	0	0
24-Jun-04	2	0	0
24-Jun-04	3	0	0
24-Jun-04	13	0	0
2-Dec-04	3	1	33
2-Dec-04	12	11	92
2-Dec-04	49	17	35
15-Sep-06	20	4	20
15-Sep-06	11	0	0
15-Sep-06	21	0	0
28-Mar-08	81	18	22
10-Dec-09	61	1	2
5-Aug-10	58	4	7
5-Aug-10	50	0	0
5-Aug-10	59	4	7
5-Aug-10	42	1	2
22-Feb-11	108	22	20

Several articles have been written about the species including "A safe haven for threatened plants" (Cochrane and Barrett 2005), "Endangered flora's new lease of life" (in Weekender 2005) and "WATSNU" (Brown *et al*. 2005). A paper was presented at the 2007 Medecos Conference and published in 2008 (Barrett *et al*. 2008).

A three year research program investigating the impact of fire ecology on the eastern Stirling Range Montane Heath and Thicket Community was initiated by DEC's Science Division and Albany District (Yates and Barrett 2001). The study aimed to:

- Map the fire history of the community.
- Investigate fire life histories, growth rates, juvenile periods and recovery of seed banks of threatened and other taxa in the community.
- Investigate the impact of vertebrate herbivore grazing on plant species and vegetation recovery following fire.

Following a fire in November 2000, surveys of emergent vegetation revealed significant levels of grazing by rabbits. A proposal for rabbit control recommended scatter laying 1080 one shot oats both from the ground and air (Blechynden 2001). This was implemented in 2001 at Populations 1, 4 and 8. However, the oats were unlikely to have been effective due to rainfall at that time which would have leached the 1080 from the oats. Trial hand-baiting commenced in 2008 and continued in 2009, 2010 and 2011 primarily targeting Populations 3 and 8 as well population 6. 1080 hand-baiting at all sites has been limited by access to qualified personnel, weather, baits and the logistics of transporting oats by foot to mountain populations. Some caging and fencing of individuals plants commenced after the 2000 fire but was implemented more comprehensively in 2011 with 89 plants protected on Bluff Knoll (Population 3), 20+/- on Isongerup (Population 10) and 40+/- on Pyungoorup (Population 6). These plants have had GPS readings taken and all caged plants on Bluff Knoll have been tagged and measured for monitoring (Rathbone and Spencer 2011).

A translocation proposal developed by DEC in 2005 was aimed at conserving the wild genetic stock of *Leucopogon gnaphalioides* by establishing it at another site as a seed orchard. This was done with the goal of maximising seed production and providing an opportunity to study its reproductive biology (Barrett and Monks 2005). Cutting material was sourced from five plants in Population 3 in 1999, 12 plants in 2001 and 17 plants in 2004. Plants were raised at the BGPA with 55 plants planted out in winter 2005. The plants were irrigated over the first summer and all were protected from grazing by fencing, thereby increasing survival and hence seed production.

Monitoring of the translocated population was undertaken six months after planting and annually thereafter. Monitoring included the number of surviving plants, height and width of crown in two directions, reproductive state, number of flowers and drupes, and general health of plants. Monitoring of the original populations was also undertaken to provide essential baseline data for assessing the performance of the translocated population. Seed harvest was to have occurred when the plants were reproductive (Barrett and Monks 2005). In 2010, 16 of the 71 plants were alive and eight of them had flowered.

Signage was erected along Bluff Knoll track (Population 3) both directional/markers and 'Let it Grow' signs to assist with visitor trampling problems and spread of disease.

Staff from DEC's Albany District regularly monitor all populations.

Stirling Range National Park Rangers are aware of the Critically Endangered status of *Leucopogon gnaphalioides* and where it occurs in the park.

DEC, with assistance from the ADTFCRT, will coordinate recovery actions for *Leucopogon gnaphalioides* and will include information on progress in annual reports to DEC's Species and Communities Branch and funding bodies.

Future recovery actions

Where recovery actions are to occur on lands other than those managed by DEC, permission has been or will be sought from appropriate owners/land managers prior to recovery actions being undertaken. The following recovery actions are generally in order of descending priority, influenced by their timing over the life of the plan. However this should not constrain addressing any of the actions if funding is available and other opportunities arise.

1. Coordinate recovery actions

DEC with assistance from the ADTFCRT will coordinate recovery actions for *Leucopogon gnaphalioides*.

Action: Coordinate recovery actions
Responsibility: DEC (Albany District) with assistance from the ADTFCRT
Cost: $6,000 per year

2. Apply phosphite

The habitat in which *Leucopogon gnaphalioides* occurs is severely infested with *Phytophthora cinnamomi*. DEC will continue applying phosphite to Populations 1, 2, 3, 6 and 8. Population 4 will no longer be sprayed due to the absence of plants. Application of Phosphite to the habitat of *L. gnaphalioides* will also protect a number of other threatened plant species in the area.

Action: Apply phosphite
Responsibility: DEC (Albany District, Dieback Disease Coordinator)
Cost: $25,000 per year

3. Monitor the impact of phosphite application

Following the application of phosphite, monitoring of its impact on *Phytophthora cinnamomi* activity and *Leucopogon gnaphalioides* will be undertaken.

Action: Monitor the impact of phosphite application
Responsibility: DEC (Albany District, Dieback Disease Coordinator)
Cost: $5,000 per year

4. Maintain disease hygiene

The species is highly susceptible to *Phytophthora cinnamomi* which is present in all populations and strict hygiene measures are required. Dieback hygiene (outlined in CALM 2003) will be followed for activities such as walking into the populations in wet soil conditions. Purpose built signs advising of the dieback risk and high conservation values of the sites will be installed if required.

Action: Maintain disease hygiene
Responsibility: DEC (Albany District)
Cost: $3,000 per year

5. Implement SRNP fire management strategy

Fire is known to kill adult *Leucopogon gnaphalioides* and could be detrimental to the species' long-term survival if it occurs at high frequencies and before soil seed stores have been replenished. Fire should therefore be prevented from occurring in the area of the populations, except where it is being used as a recovery tool. As stated in the SRNP Fire Management Strategy (2010) all populations are to be excluded from fire for the foreseeable future (Barrett *et al*. 2010).

Action: Implement SRNP fire management strategy
Responsibility: DEC (Albany District)
Cost: $4,000 per year

6. Implement a rabbit control and grazing prevention strategy

A proposal for rabbit control was drafted for Populations 3, 6 and 8 in 2001. Hand-baiting with 1080 oats should continue to be implemented. Fencing or caging of plants or groups of plants should continue to be implemented as appropriate in areas which are being heavily grazed.

Action: Iimplement a rabbit control and grazing prevention strategy
Responsibility: CALM (Albany District)
Cost: $10,000 in year 1; $8,000 per years 2-5

7. Monitor populations

Monitoring of factors such as grazing, weed invasion, habitat degradation, population stability (expansion or decline), pollinator activity, seed production, recruitment, and longevity is essential. The populations will be inspected and an accurate location recorded.

Action: Monitor populations
Responsibility: DEC (Albany District)
Cost: $10,000 per year

8. Collect and store seed

Preservation of genetic material is essential to guard against extinction of the species if the wild populations are lost. It is recommended that seed be collected and stored at TFSC. Fruit has been collected from Populations 1, 2 and 3 but further collections which aim to sample and preserve the maximum range of genetic diversity are required.

Action: Collect and store seed
Responsibility: DEC (Albany District, TFSC)
Cost: $5,000 per year

9. Implement additional translocations

Leucopogon gnaphalioides is known from nine populations, two of which no longer contain extant plants. Using knowledge gained from the current translocation, another site will be selected and a translocation proposal developed. Information on the translocation of threatened plants and animals in the wild is provided in DEC's Policy Statement No. 29 *Translocation of Threatened Flora and Fauna* (CALM 1995), and the Australian Network for Plant Conservation translocation guidelines (Vallee *et al*. 2004). All translocation proposals require endorsement by DEC's Director of Nature Conservation. Monitoring of translocations is essential and will be included in the timetable developed for the Translocation Proposal.

Action: Implement additional translocations
Responsibility: DEC (Science Division, Albany District), BGPA
Cost: $20,000 in year 1; and $10,000 in years 2-5

10. Monitor translocated populations

In 2005, a translocation was undertaken. Continued monitoring of this and future translocations will determine their long-term success. Monitoring will be undertaken as per approved Translocation Proposals (see Barrett and Monks 2005).

Action: Monitor translocated populations
Responsibility: DEC (Albany District, Science Division)
Cost: $10,000 per year

11. Conduct genetic studies to acertain taxonomic status

Population 2 on Mondurup Peak appears to vary in morphology from the more eastern populations. It is recommended that genetic testing be conducted to determine if there are two subspecies.

Action: Conduct genetic studies to ascertain taxonomic status
Responsibility: DEC (Albany District, Science Division)
Cost: $10,000 in years 1 and 2

12. Obtain biological and ecological information

Improved knowledge of the biology and ecology of the species will provide a scientific basis for management of *Leucopogon gnaphalioides* in the wild and should include:

1. soil seed bank dynamics and the role of various factors including disturbance, competition, drought, inundation and grazing in recruitment and seedling survival
2. reproductive strategies, phenology and seasonal growth
3. reproductive sucess and pollination biology
4. minimum viable population size and
5. the impact of dieback disease and the effectiveness of control techniques on *Leucopogon gnaphalioides* and its habitat.

Action: Obtain biological and ecological information
Responsibility: DEC (Science Division, Albany District)
Cost: $10,000 per year

13. Liaise with indigenous communities

Leucopogon gnaphalioides occurs within the Stirling Range National Park which is culturally sensitive to Aboriginals. Indigenous consultation will take place to determine if there are any issues or interests in areas that are habitat for *L. gnaphalioides*.

Action: Liaise with indigenous communities
Responsibility: DEC (Albany District)
Cost: $2,000 per year

14. Map habitat critical to the survival of *Leucopogon gnaphalioides*

Although habitat critical to the survival of the species is alluded to in Section 1, it has not yet been mapped and will be addressed under this action. If additional populations are located, habitat critical to their survival will also be determined and mapped.

Action: Map habitat critical to the survival of *Leucopogon gnaphalioides*
Responsibility: DEC (SCB, Albany District)
Cost: $6,000 in year 2

15. Promote awareness

The importance of biodiversity conservation and the protection of *Leucopogon gnaphalioides* will be achieved through an information campaign using local print and electronic media and by setting up poster displays. An information sheet, which includes a description of the plant, its habitat type, threats, management actions and photos will be produced. Formal links with local naturalist groups and interested individuals will also be encouraged.

Action: Promote awareness
Responsibility: DEC (Albany District, SCB, Strategic Development and Corporate Affairs Division) with assistance from the ADTFCRT
Cost: $4,000 in year 1 and $2,000 in years 2-5

16. Review this plan and assess the need for further recovery actions

If *Leucopogon gnaphalioides* is still ranked as Critically Endangered at the end of the five-year term of this plan, the need for further recovery actions, or a review of this plan will be assessed and a revised plan prepared if necessary.

Action: Review this plan and assess the need for further recovery actions
Responsibility: DEC (SCB, Albany District) with assistance from the ADTFCRT
Cost: $3,000 in year 5

Table 9. Summary of Recovery Actions

Recovery Action	Priority	Responsibility	Completion Date
Coordinate recovery actions	High	DEC (Albany District) with assistance from the ADTFCRT	Ongoing
Apply phosphite	High	DEC (Albany District, Dieback Disease Coordinator)	Ongoing
Monitor the impact of phosphite	High	DEC (Albany District, Dieback Disease Coordinator)	Ongoing
Maintain disease hygiene	High	DEC (Albany District)	Ongoing
Implement SRNP fire management strategy	High	DEC (Albany District)	Ongoing
Implement a rabbit control and grazing prevention strategy	High	DEC (Albany District)	Ongoing
Monitor populations	High	DEC (Albany District)	Ongoing
Collect and store seed	High	DEC (Albany District, TFSC)	2017
Implement additional translocations	High	DEC (Albany District, Science Division)	2017
Monitor translocated populations	High	DEC (Albany District, Science Division)	Ongoing
Conduct genetic studies to ascertain taxonomic status	High	DEC (Albany District, Science Division)	2014
Obtain biological and ecological information	High	DEC (Science Division, Albany District)	2017
Liaise with indigenous communities	Medium	DEC (Albany District)	Ongoing
Map habitat critical to the survival of *Leucopogon gnaphalioides*	Medium	DEC (SCB, Albany District)	2014
Promote awareness	Medium	DEC (Albany District, SCB, Strategic Development and Corporate Affairs Division) with assistance from the ADTFCRT	Ongoing
Review this plan and assess the need for further recovery actions	Medium	DEC (SCB, Albany District) with assistance from the ADTFCRT	2017

4. TERM OF PLAN

This plan will operate from February 2013 to January 2018 but will remain in force until withdrawn or replaced. If the species is still ranked Critically Endangered after five years, the need for further recovery actions will be determined.

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6. TAXONOMIC DESCRIPTION

Leucopogon gnaphalioides

Stschegleew, S. (1859) Descriptio epacridearum novarum, *Bulletin de la Societe Imperiale des naturalistes de Moscou*, 32(1): 14.

Leucopogon gnaphalioides has tomentose branches. Leaves are dense, imbricate, subappressed, erect, ovate to lanceolate, concave and convex, multinerved and dull grey. Apex is acute. The top of the leaf is glabrous, basal inside of leaf has appressed hairs, leaf margin has long, dense hairs. Inflorescence is composed of cluster of short spikes at the end of branches, branchlets are hairy, short bracts are keeled. Calyx is white, tips acute, dorso is pubescent, margin has long, dense cilia.

Brown, A., Thomson-Dans, C. and Marchant, N. (Eds). (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia.

Leucopogon gnaphalioides is an erect shrub growing up to 1m in height. The leaves are ribbed, have hairs on the edges and tightly overlap along the length of the stem. Flowers are white with beards of hair in the throat and are packed into dense spikes at the ends of the stem.