# National Recovery Plan for Southern Shepherd's Purse Ballantinia antipoda

# **Geoff Nevill and Mary Camilleri**





Australian Government



Prepared by Geoff Nevill and Mary Camilleri (Department of Sustainability and Environment, Victoria).

Published by the Victorian Government Department of Sustainability and Environment (DSE) Melbourne, February 2010.

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ISBN 978-1-74208-776-4

This is a Recovery Plan prepared under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, with the assistance of funding provided by the Australian Government.

This Recovery Plan has been developed with the involvement and cooperation of a range of stakeholders, but individual stakeholders have not necessarily committed to undertaking specific actions. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the plan due to changes in knowledge.

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Citation: Nevill, G.R. and Camilleri, M. 2010. National Recovery Plan for Southern Shepherd's Purse *Ballantinia antipoda*. Department of Sustainability and Environment, Victoria.

**Cover photograph:** Southern Shepherd's Purse *Ballantinia antipoda* by Norm Stimson (Enviro Images).

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# Summary

The Southern Shepherd's Purse *Ballantinia antipoda* is a small annual herb endemic to Victoria and Tasmania. The species has disappeared from almost all sites from which it was known, and currently exists only at a single location at Mount Alexander in central Victoria. It is listed as 'Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999, 'Threatened' under the Victorian *Flora and Fauna Guarantee Act* 1988, and 'Presumed Extinct' under the Tasmanian *Threatened Species Protection Act* 1995. Major threats include weed invasion, disturbance by people and animals, and climate change. This national Recovery Plan for Southern Shepherd's Purse is a revision of the first Recovery Plan for the species (Alexander 1999), and details the species' distribution and biology, conservation status, threats, and recovery objectives and actions necessary to ensure its long-term survival.

# **Species Information**

# Description

The Southern Shepherd's Purse *Ballantinia antipoda* (also called Southern Ballantine or Ballantine) is a small annual plant belonging to the Cresses (family Brassicaceae). The sparsely haired stems up to 5cm tall arise from a rosette of stalked, spoon-shaped leaves that are often divided into three parts. Small, stalked white flowers to 4 mm diameter occur along the upper stems, developing into small elliptical fruits (siliculae) 3–5mm long (Alexander 1999).

Southern Shepherds Purse usually germinates in winter and is in full flower by mid to late September, dying off as the moss mats dry out in late spring. The length of flowering is dependent on prevailing weather conditions, with flowering being extended in wet conditions or curtailed in dry conditions. The conspicuous white flowers attract a variety of insects including native ants and introduced honeybees. As an annual species, the maintenance of the population is totally dependent on the seed bank stored in the thin layer of soil beneath the moss mat. It appears that the plants may not germinate every year, and that the germination, growth and flowering of the species may be reliant on the timing and intensity of autumn and winter rains, and perhaps the degree of desiccation of the moss mats in mid-spring. Seed viability is thought to be several years, in common with other species of Brassicaceae.

# Distribution

Southern Shepherd's Purse is endemic to south-eastern Australia, where it once occurred in central and western Victoria, in the Victorian Volcanic Plains and Victorian Midlands bioregions (*sensu* DEH 2000), and in Tasmania around the Glen Leith/Macquarie Plains area towards Bushy Park (Curtis & Morris 1975) in the Tasmanian Southern Ranges IBRA bioregion) (Figure 1). The species is currently known from a single location, Mount Alexander, in central Victoria, in the Victorian Midlands bioregion.

Maps showing the detailed distribution of Southern Shepherd's Purse are available from the Department of Sustainability and Environment Flora Information System (DSE-FIS). The FIS is a state-wide repository for flora grid and site distribution data, photographs and text descriptions. This information is available on request in a variety of formats for natural resource management purposes.

# **Population Information**

Southern Shepherds Purse is currently restricted to ten small populations on Mount Alexander, within the Mount Alexander Regional Park. Population numbers fluctuate according to seasonal conditions, with recent counts indicating total population size at about 7,000 plants. Densities of up to 200 plants per m<sup>2</sup> have been recorded.





#### Habitat

Little is known of the broad habitat requirements of Southern Shepherd's Purse. Previous records indicated the species occurred in stony or rocky areas on the volcanic plains south-west of Melbourne (Werribee and Carisbrook), and low granite hills and mountains, including Mount Emu, Mount Cole, Mount Langi Ghiran and Mount Buangor, in western Victoria. In Tasmania, the species was reported from dry, stony sites and the banks of streams (Curtis & Morris 1975).

At the remaining location on Mount Alexander, the species occurs on gently to steeply sloping granite rockplates, usually with an easterly or south-westerly aspect, where it grows on seasonally moist moss mats on a shallow soil layer, and occasionally growing directly in shallow soil pockets lacking moss mats. It is absent from moss mats growing on the deeper soils in depressions or cracks in rock faces. The sites are usually exposed, with only a light canopy cover from surrounding trees including Manna Gum *Eucalyptus viminalis* and Messmate Stringybark *Eucalyptus obliqua*. This habitat falls within the Granitic Hills Woodland Ecological Vegetation Class.

The dominant species of moss is *Breutelia affinis*, with other common species including *Bartramia papillata*, *Bryum billardeiri*, *Campylopus introflexus*, *Grimmia pulvinata* and *Polytrichum juniperinum*. Other native flora species sharing this moss mat habitat include Dwarf Arrow-grass *Triglochin centrocarpa*, Rayless Daisy *Brachyscome perpusilla*, Yellow Pennywort *Hydrocotyle foveolata*, Moss Sunray *Hyalosperma demissum*, Common Bow-flower *Millotia muelleri*, Tiny Star *Hypoxis glabella*, Adder's Tongue *Ophioglossum lusitanicum*, Common Sunray *Triptilodiscus pygmaeus*, Spoon Cudweed *Stuartina muelleri*, Small Wrinklewort *Siloxerus multiflora*, Sieber Crassula *crassula sieberiana*, Pink Purslane *Calandrinia calyptrata*, Small Purslane *Calandrinia eremea* and Tiny Purslane *Calandrinia granulifera* (Cook 1998).

# **Decline and Threats**

The decline of Southern Shepherd's Purse has been poorly documented. Most Victorian records and the single Tasmanian record date from the 19<sup>th</sup> Century, and the species was presumed extinct until it was re-discovered on Mount Alexander in 1983. Searches at all documented

locations in Victoria in the late 1990s failed to locate the species at any site other than Mount Alexander (Alexander 1999). Searches of rockplate and grassland habitat in Tasmania in recent years have also failed to relocate the species (W. Potts, DPIW Tas pers. comm.)

#### **Historical Threats**

It is probable that habitat loss due to the clearing of native vegetation for agriculture has undoubtedly been a major factor in the decline of Southern Shepherd's Purse in Victoria. The Granitic Hills Woodland EVC is classified as Vulnerable in the Goldfields Bioregion, with less than 20% of its original extent remaining (NRE 1997), and the Victorian Volcanic Plains bioregion has been substantially modified, with less than 1% of its original vegetation now remaining (NRE 1997). The extremely high numbers of European Rabbit *Oryctolagus cuniculus* across much of Victoria prior to the introduction of myxomatosis may have had a role in the decline of populations.

#### **Current Threats**

The Southern Shepherd's Purse on Mount Alexander is subject to the range of current threats. The steep rock faces, tenuous hold of the moss mats, and their dependence on seepage flow means that the habitat of Southern Shepherds Purse is easily disrupted, damaged or destroyed. Given the small population size of Southern Shepherd's Purse and the fact that its distribution is restricted to a small area of Mt. Alexander Regional Park, the survival of the species is extremely vulnerable to one-off events such as fire. At present little is known of the impact on, or response of the species to fire, and the build-up of fuel below some sites on the western side of Mt. Alexander could result in a fire of high intensity with unknown consequences for the adjacent moss mat habitat. Current major threats include:

#### Weed invasion

Many weed species invade the moss mats inhabited by Southern Shepherds Purse, providing significant competition for the species. Weeds are particularly prevalent on the more disturbed rock faces, where they completely dominate the native species. Introduced weeds include Elegant Hair-Grass *Aira elegans*, Chickweed *Cerastium glomeratum*, Small Quaking Grass *Briza minor*, Smooth Cat's-ear *Hypocheoris glabra*, Five-anthered Corn Spurrey *Spergularia pentandra*, and Whitlow Grass *Erophila verna* (Alexander 1999). St. John's Wort *Hypericum perforatum*, a perennial noxious weed common on Mt Alexander, is also encroaching on moss mats at some sites (Brendan Smith Parks Victoria pers. obs.). Due to the fragile nature of the moss mat habitat, weed removal itself may impact on the integrity of the moss mats and thus threaten Southern Shepherds Purse. Suitable weed control management practices need to be researched and trialed.

#### Animal grazing and disturbance

Grazing and disturbance by both introduced herbivores and native fauna has the potential to severely degrade the moss mat habitat crucial to the survival of this species. Rabbits have caused considerable damage by digging in the moss mats and some Southern Shepherd's Purse sites have been badly affected. European Rabbit *Oryctolagus cuniculus* numbers at present are low but have the potential to rapidly increase if not continually controlled. Wild pigs *Sus scrofa*, deliberately introduced to Mt Alexander in the 1990s, were formerly considered to be a serious threat, but have not been seen for several years. A potential threat may exist in the proliferation of small-scale goat-farming in the surrounding district. Feral goat *Capra hircus* populations have established in a number of public land reserves as a result of escapes from farms, and their presence in Mt Alexander Regional Park could pose a significant threat to populations of Southern Shepherd's Purse.

In recent years, possibly due to continuing dry conditions, White-winged Choughs *Corcorax melanoramphos* have caused significant damage to moss mats while foraging for invertebrates such as millipedes. The population of Swamp Wallaby *Wallabia bicolor* on Mt. Alexander appears to be increasing and may represent an increased risk of grazing and disturbance of the moss mat habitat.(Brendan Smith. pers. obs). Protective measures taken on some sites have proven effective in reducing this damage, but will require regular maintenance and monitoring, and may need to be implemented on additional sites in the future.

#### Human disturbance

Mt Alexander Regional Park is used for a range of recreational activities such as bushwalking, orienteering, hunting, mountain bike riding, and abseiling. These have the potential to cause damage, although unintentional, to the habitat of Southern Shepherd's Purse if the park users

diverge from tracks or areas set aside for these activities. Unauthorised off-track trail bike riding and four-wheel driving across the rock faces can strip away the moss mat cover, disrupt local seepage patterns, and initiate further removal of moss mats by water flow after heavy rain. Serious damage of this kind occurred at one site during the winters of 2001 and 2002. The deliberate removal of moss mats by fishermen (to keep scrub worms moist) and plant growers (for use in bonsai pots) has also been an issue in the past.

Inappropriately placed access tracks, walking tracks and firebreaks can damage sites directly, and by altering hydrology or causing siltation which can compromise the viability of the moss mats. Quarrying for granite, and the construction of additional transmission towers have the potential to affect the hydrology on the slopes of Mt. Alexander and cause overland silt flow that may impact on populations of Southern Shepherd's Purse at considerable distances from the site of disturbance. There is also a risk of damage to moss mats and associated flora by zinc leachate from galvanised materials used in the construction of transmission towers and similar infrastructure.

#### **Climate Change**

The effects of climate change potentially threaten Southern Shepherd's Purse. Increased temperatures and decreased rainfall expected with global warming will probably lead to further loss of habitat, as the shallow moss mats become increasingly dry. Lower rainfall could lead to less seed germination and higher loss of seedlings. Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases is listed as a Key Threatening Process under the EPBC Act.

# **Recovery Information**

### **Existing Conservation Measures**

A number of initiatives are already in place to conserve the Southern Shepherd's Purse, as a result of actions implemented under the previous Recovery Plan, and other efforts. These include:

- All sites are regularly monitored and census data collected each year at flowering time.
- Walking track closures and diversions have been implemented to protect sites.
- Barrier fencing has been erected to prevent damage to one site from off-track driving.
- Protective fencing / caging and visual deterrents have been erected at some sites to prevent damage by White–winged Choughs.
- Regular rabbit-baiting has been carried out in Mt. Alexander Regional Park.
- Interpretative signage featuring Southern Shepherd's Purse has been erected at Mt Alexander Regional Park.
- Local community groups have been informed of the values of the area.
- Conservation of Southern Shepherd's Purse has been promoted with displays at local community festivals.
- Surveys carried out in 2003 located one new site in Mt. Alexander Regional Park.
- Research project into moss mat ecology by University of Ballarat.

#### **Strategy for Recovery**

The extremely restricted occurrence of Southern Shepherd's Purse means that location of additional populations and / or identification of suitable re-introduction sites are a high priority. Actions to be implemented under this plan include surveys that will identify areas of critical and potential habitat vital to the long-term survival of the species. These surveys will target the areas where Southern Shepherd's Purse was previously known to occur, and areas that may support potentially suitable habitat. Further investigation in to the biology and ecology of the species is required to determine optimum habitat requirements and formulate appropriate propagation / reintroduction procedures.

### **Recovery Objectives**

The **overall objective** of recovery is to minimise the probability of extinction of Southern Shepherd's Purse in the wild and to increase the probability of important populations becoming self-sustaining in the long term.

Within the life span of this Recovery Plan, the **specific objectives** for recovery of Southern Shepherd's Purse are to:

- Determine distribution, abundance and population structure
- Identify habitat requirements
- Ensure that all populations and their habitat are protected and managed appropriately
- Identify key biological functions
- Manage threats to populations
- Determine the growth rates and viability of populations
- Establish populations in cultivation
- Establish new populations in the wild
- Build community support for conservation

#### **Program Implementation**

This Recovery Plan guides recovery actions and will be managed by the Department of Sustainability and Environment. A Threatened Flora Recovery Team, consisting of scientists, land managers and field naturalists has been established to oversee threatened flora recovery in Victoria in general. Technical, scientific, habitat management or education components of the Recovery Plan will be referred to specialist sub-committees on research, *in situ* management, community education and cultivation. Regional Recovery Teams will be responsible for preparing work plans and monitoring progress toward recovery.

#### **Program Evaluation**

The Recovery Team will be responsible for annual assessments of progress towards recovery. This Recovery Plan will be reviewed within five years of the date of its adoption under the EPBC Act.

# **Recovery Objectives, Actions and Performance Criteria**

No.	Action		Performance Criteria				
Specific	Objective 1: Determine distribution, abundance and population structure						
1.1	Determine extent & abundance of existing populations in Mt Alexander Regional Park.	٠	Surveys of all populations determine area occupied/number of				
	Responsibility: DSE		plants.				
1.2	Search for new populations, including locations of previously recorded populations and other potential locations with similar habitat type. Target areas include Mt Cole, Mt. Buangor, Mt Langi Ghiran, Mt Tarrengower, Mt Beckworth and Cobaw Ranges.	•	Searches planned and implemented at previously recorded locations in Victoria, South Australia, New South Wales and Tasmania.				
	Responsibility: DSE						
1.3	Map existing and new populations.	٠	Population maps prepared and used in conservation				
	Responsibility: DSE		management.				
Specific	Objective 2: Identify habitat requirements						
2.1	Survey known habitat and collect floristic and environmental information describing community ecology and condition.	•	Habitat critical for survival identified and defined.				
	Responsibility: DSE						
2.2	Identify and survey potential habitat, using ecological and bioclimatic information indicating habitat preference.	•	Predictive model for potential habitat developed and tested.				
	Responsibility: DSE						
2.3	Map areas of important and potentially suitable habitat.	•	Habitat critical for survival and potential habitat mapped.				
	Responsibility: DSE						
Specific	Objective 3: Ensure that all populations and their habitat are protected and manag	ed a	ppropriately				
3.1	Incorporate protective actions in Mt Alexander Regional Park management plan.	٠	Actions to protect species incorporated in relevant management				
	Responsibility: DSE/PV		plans.				
Specific	Objective 4: Identify key biological functions						
4.1	Determine longevity, fecundity, recruitment levels and seed viability.	•	Seed bank/regenerative potential quantified for each population.				
	Responsibility: DSE						
4.2	Determine seed germination requirements.	٠	Stimuli for recruitment/regeneration identified.				
	Responsibility: RBG						
4.3	Investigate impacts of soil disturbance, fire, salinity and inundation on recruitment.	٠	Management strategies identified to maintain, enhance or				
	Responsibility: DSE		restore processes fundamental to reproduction and survival.				

5.1       Identify current and potential threats to the species and its habitat.       Prescriptions prepared for threat abatement.         Responsibility: DSE/PV       S.2       Control invasive weeds.       A measurable reduction in impact of weeds on all sites.         Responsibility: PV       S.3       Control grazing through fencing, maintenance of pest animal control programs.       A measurable reduction in impact of grazing on all sites.         Responsibility: PV       Specific Objective 6: Determine the growth rates and viability of populations       A measurable reduction in impact of trampling on all sites.         6.1       Develop population monitoring protocols.       • Techniques for monitoring developed and implemented. <b>Responsibility: DSE</b> • Annual census data collected, population growth rates determined and Populations in cultivation         7.1       Maintain ex situ collections for display, research and to safeguard against loss.       • At least 10 mature genetically distinct plants in cultivation.         7.2       Collect and store reproductive material.       • Seed from all populations in long-term storage.         8.4       Identify potential reintroduction, ensuring maximum possible genetic diversity.       • At least 20 healthy, genetically diverse plants in cultivation.         7.2       Propagate plants for reintroduction plan.       • Criteria for site suitability identified and 10 suitable sites selected.         8.1       Identify potential reintroduction plan.       • Prep	Specif	ic Objective 5: Manage threats to populations	
Responsibility: DSE/PV       - A measurable reduction in impact of weeds on all sites.         5.2       Control invasive weeds.       - A measurable reduction in impact of weeds on all sites.         Responsibility: PV       - A measurable reduction in impact of grazing on all sites.         5.4       Erect barriers & signs to restrict or discourage pedestrian and vehicle access.       - A measurable reduction in impact of trampling on all sites. <b>Specific Objective 6: Determine the growth rates and viability of populations</b> - A measurable reduction in impact of trampling on all sites.         6.1       Develop population monitoring protocols.       - Monitor population monitoring protocols.       - Monitor population growth rates determined and response against recovery actions.         6.2       Monitor population trends and responses against recovery actions.       - Annual census data collected, population growth rates determined and Population Sites.         7.1       Maintain ex situ collections for display, research and to safeguard against loss.       - A tleast 10 mature genetically distinct plants in cultivation.         7.2       Collect and store reproductive material.       - Seed from all populations in long-term storage.         8.2       Responsibility: RBG       - Criteria for site suitability diverse plants in cultivation.         8.2       Propagate plants for reintroduction, ensuring maximum possible genetic diversity.       - A tleast 200 healthy, genetically diverse plants in cultivation.	5.1	Identify current and potential threats to the species and its habitat.	Prescriptions prepared for threat abatement.
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Specific Objective 6: Determine the growth rates and viability of populations <ul> <li>Example 1</li> <li>Develop population monitoring protocols.</li> <li>Responsibility: DSE</li> <li>Monitor population trends and responses against recovery actions.</li> <li>Responsibility: DSE</li> <li>Annual census data collected, population growth rates determined and Population Viability Analysis completed.</li> </ul> Specific Objective 7: Establish populations in cultivation <ul> <li>Antual census data collected, population growth rates determined and Population Viability Analysis completed.</li> </ul> 7.1         Maintain ex situ collections for display, research and to safeguard against loss.                   At least 10 mature genetically distinct plants in cultivation.           7.2         Collect and store reproductive material.         Seed from all populations in long-term storage.           Specific Objective 8: Establish new populations in the wild             8.1         Identify potential reintroduction sites.                         Criteria for site suitability identified and 10 suitable sites selected.           8.2         Propagate plants for reintroduction plan.                           Preparate initroduction plan.           8.3         Prepare reintroduction plan.                           Preparation of reintroduction plan with agreement from all stakeholders.           8.4 <td></td> <td>Responsibility: PV</td> <td></td>		Responsibility: PV	
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<ul> <li>8.1 Identify potential reintroduction sites. Responsibility: DSE</li> <li>8.2 Propagate plants for reintroduction, ensuring maximum possible genetic diversity. Responsibility: RBG</li> <li>8.3 Prepare reintroduction plan. Responsibility: DSE</li> <li>8.4 Implement reintroduction plan. Responsibility: DSE</li> </ul>	Specif	ic Objective 8: Establish new populations in the wild	
Responsibility: DSE       selected.         8.2       Propagate plants for reintroduction, ensuring maximum possible genetic diversity.       • At least 200 healthy, genetically diverse plants in cultivation.         8.3       Prepare reintroduction plan.       • Preparation of reintroduction plan with agreement from all stakeholders.         8.4       Implement reintroduction plan.       • Plants established at three new sites.         8.4       Responsibility: DSE	8.1	Identify potential reintroduction sites.	Criteria for site suitability identified and 10 suitable sites
<ul> <li>8.2 Propagate plants for reintroduction, ensuring maximum possible genetic diversity.</li> <li>8.3 Responsibility: RBG</li> <li>8.3 Prepare reintroduction plan.</li> <li>Responsibility: DSE</li> <li>8.4 Implement reintroduction plan.</li> <li>Responsibility: DSE</li> <li>8.4 Implement reintroduction plan.</li> <li>Responsibility: DSE</li> <li>Plants established at three new sites.</li> </ul>		Responsibility: DSE	selected.
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Responsibility: DSE       stakeholders.         8.4       Implement reintroduction plan. <ul> <li>Plants established at three new sites.</li> <li>Responsibility: DSE</li> <li>Implement reintroduction plan.</li> <li>Plants established at three new sites.</li> <li>Responsibility: DSE</li> <li>Implement reintroduction plan.</li> <li>Plants established at three new sites.</li> <li>Implement reintroduction plan.</li> <li>Implement reintro</li></ul>	8.3	Prepare reintroduction plan.	Preparation of reintroduction plan with agreement from all
<ul> <li>8.4 Implement reintroduction plan.</li> <li>Plants established at three new sites.</li> <li>Responsibility: DSE</li> </ul>		Responsibility: DSE	stakeholders.
Responsibility: DSE	8.4	Implement reintroduction plan.	Plants established at three new sites.
		Responsibility: DSE	
8.5 Maintain and monitor reintroduced plants.  • Minimum 50% survival of reintroduced plants after two years	8.5	Maintain and monitor reintroduced plants.	• Minimum 50% survival of reintroduced plants after two years.
Responsibility: DSE		Responsibility: DSE	

No.	Action	Performance Criteria
Specifi	c Objective 9: Build community support for conservation	
9.1	Identify opportunities for community involvement in the recovery plan.	<ul> <li>Presentation(s) to community nature conservation groups.</li> </ul>
	Responsibility: DSE	<ul> <li>Inform private landholders of fencing incentives provided by DSE and the threatened species network.</li> </ul>
		Educate local shires, including contractors of roadside work.

Abbreviations: DSE - Department of Sustainability and Environment; PV - Parks Victoria; RBG - Royal Botanic Gardens, Melbourne

#### Affected interests

All currently known populations of Southern Shepherd's Purse occur within Mt Alexander Regional Park, managed by Parks Victoria, who have been consulted and have approved the actions outlined in this recovery plan.

#### Role and interests of indigenous people

Indigenous communities on whose traditional lands Southern Shepherd's Purse occurs are being advised, through the relevant DSE Regional Indigenous Facilitator, of this Recovery Plan and invited to provide comments. Indigenous communities will be invited to be involved in the implementation of the Recovery Plan.

#### Benefits to other species / ecological communities

The Recovery Plan includes a number of potential biodiversity benefits for other species and vegetation communities in Victoria. Principally, this will be through the protection and management of habitat. The adoption of broad-scale management techniques and collection of baseline data will also benefit a number of other plant species growing in association with Southern Shepherds Purse, particularly those species with similar life forms and/or flowering responses. Two rare moss species – *Leptodon smithii and Campylopus flindersii* – have been recorded in the moss mats on Mt. Alexander (Alexander 1999), and will benefit directly from conservation actions designed to protect Southern Shepherd's Purse. Other rare plants such as Clover Glycine *Glycine latrobeana* and Striped Milfoil *Myriophyllum striatum* are also found on Mt Alexander. In addition the reserve provides habitat for the Brush-tailed Phascogale and the Powerful Owl, both of which are listed as threatened under the Victorian FFG Act. The Recovery Plan will also provide an important community education role as threatened flora have the potential to act as 'flagship species' for highlighting broader nature conservation and biodiversity issues such as land clearing, pest animal and weed invasions, and habitat degradation.

#### Social and economic impacts

The implementation of this Recovery Plan is unlikely to cause significant adverse social and economic impacts, as all populations of Southern Shepherds Purse occur on public land where management for conservation purposes is already a high priority. Some minor works likely to impact on people, such as re-routing walking tracks and restricting vehicle access, have already occurred to protect the species. Actions associated with the implementation of this recovery plan are unlikely to affect any existing industry, commercial enterprise or individual party.

# **Management Practices**

On-ground site management will aim to mitigate threatening processes and thereby insure against extinction. Major threats requiring management include accidental destruction, competition from pest plants, and inappropriate fire regimes. A range of strategies will be necessary to alleviate these threats including protective fencing, signage, weed control, and fire management.

Broadscale protection measures applicable to all populations include legal protection of sites, habitat retention and liaison with land managers including private landholders. In addition, searches of known and potential habitat should continue to better define the distributions and size of populations.

The Recovery Plan also advocates strategies to fill some of the major gaps in our knowledge to date. These include an understanding of the mechanisms underlying recruitment and regeneration. Successful *in situ* population management will be founded on understanding the relationships between Southern Shepherd's Purse and associated flora, and its response to environmental processes. Demographic censusing will be necessary to gather life history information and to monitor the success of particular management actions.

In addition to the above, *ex situ* conservation measures will be required and will include seed storage and plant cultivation. Cultivating *ex situ* populations will also aim to increase the amount of seed available for reintroduction to sites. Reintroduction of cultivated plants will be considered as there is a high chance of success where secure site(s) can be found.

Community participation in recovery actions will be sought, particularly in regard to recovery team membership and implementation of on-ground works.

#### Management practices required for conservation of Southern Shepherd's Purse include:

- Control of pest plants and animals.
- Investigation of the biology and ecology of the species to enable better targeted conservation management actions.
- Maintenance of ex-situ populations.
- Establishment of new populations at protected sites.

# Acknowledgments

The authors would like to thank the following people who provided advice or assistance in developing this plan: Pam Clunie, Deanna Marshall, Anna Murphy, Vanessa Craigie and Terri Williams (Department of Sustainability and Environment); Brendan Smith and Tim Buttle (Parks Victoria), Ian Higgins (North Central Catchment Management Authority) and Dr Wendy Potts (Department of Primary Industries and Water, Tasmania). Much of the information in this document was derived from the first Recovery Plan for Southern Shepherd's Purse (Alexander 1999).

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# Priority, Feasibility and Estimated Costs of Recovery Actions

Action	Description	Priority	Feasibility	Responsibility	Cost estimate					
					Year 1	Year 2	Year 3	Year 4	Year 5	Total
1	Distribution abundance				\$0	\$0	\$0	\$0	\$0	\$0
1.1	Extent & abundance	1	100%	DSE	\$3,000	\$3,000	\$0	\$0	\$0	\$6,000
1.2	Searches for new pops.	2	75%	DSE	\$6,000	\$6,000	\$6,000	\$6,000	\$6,000	\$30,000
1.4	Map populations	2	100%	DSE	\$0	\$1,000	\$0	\$1,000	\$1,000	\$3,000
2	Habitat requirements				\$0	\$0	\$0	\$0	\$0	\$0
2.1	Survey known habitat	1	100%	DSE	\$3,000	\$3,000	\$0	\$0	\$0	\$6,000
2.2	Identify, survey potential habitat	2	75%	DSE	\$0	\$5,000	\$5,000	\$5,000	\$0	\$15,000
2.3	Map habitat	1	100%	DSE	\$0	\$0	\$2,000	\$2,000	\$2,000	\$6,000
3	Habitat protection				\$0	\$0	\$0	\$0	\$0	\$0
3.1	Public land management plans	1	100%	DSE	\$1,000	\$0	\$0	\$0	\$0	\$1,000
4	Biology & ecology				\$0	\$0	\$0	\$0	\$0	\$0
4.1	Determine longevity, viability	2	75%	DSE	\$5,000	\$5,000	\$3,000	\$0	\$0	\$13,000
4.2	Determine seed germination	2	75%	RBG	\$3,000	\$3,000	\$0	\$0	\$0	\$6,000
4.3	Investigate disturbance impact	2	75%	DSE	\$0	\$0	\$10,000	\$10,000	\$5,000	\$25,000
5	Threat management				\$0	\$0	\$0	\$0	\$0	\$0
5.1	Identify current, potential threats	1	100%	DSE/PV	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$7,500
5.2	Control weeds	1	100%	PV	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$25,000
5.3	Control herbivores	1	100%	PV	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$25,000
5.4	Control disturbance	2	50%	PV	\$2,500	\$2,500	\$2,500	\$2,500	\$2,500	\$12,500
6	Growth rates, pop. viability				\$0	\$0	\$0	\$0	\$0	\$0
6.1	Develop monitoring protocols	1	100%	DSE	\$2,000	\$0	\$0	\$0	\$0	\$2,000
6.2	Monitor population trends	1	100%	DSE	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$15,000
7	Cultivation				\$0	\$0	\$0	\$0	\$0	\$0
6.1	Maintain ex-situ populations	2	100%	RBG	\$4,000	\$4,000	\$4,000	\$4,000	\$4,000	\$20,000
6.2	Collect, store reprod. material	2	100%	DSE/RBG	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$5,000

Action	Description	Priority	Feasibility	Responsibility	Cost estimate					
					Year 1	Year 2	Year 3	Year 4	Year 5	Total
8	New populations				\$0	\$0	\$0	\$0	\$0	\$0
8.1	Identify sites	2	75%	DSE	\$3,000	\$3,000	\$3,000	\$0	\$0	\$9,000
8.2	Propagate plants	2	100%	RBG	\$2,000	\$2,000	\$2,000	\$2,000	\$2,000	\$10,000
8.3	Prepare reintroduction plan	2	100%	DSE	\$0	\$0	\$3,000	\$0	\$0	\$3,000
8.4	Implement reintrod. plan	2	75%	DSE	\$0	\$0	\$1,000	\$2,000	\$2,000	\$5,000
8.5	Maintain, monitor reintrod. pops.	2	100%	DSE	\$0	\$0	\$2,000	\$2,000	\$5,000	\$9,000
9	Community support				\$0	\$0	\$0	\$0	\$0	\$0
9.1	Community extension	1	100%	DSE	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$15,000
	TOTAL				\$53,000	\$56,000	\$62,000	\$55,000	\$48,000	\$274,000