National Recovery Plan for the Stiff Groundsel Senecio behrianus

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.

© State of Victoria Department of Sustainability and Environment 2010

This publication is copyright. No part may be reproduced by any process except in accordance with the provisions of the *Copyright Act* 1968.

Authorised by the Victorian Government, 8 Nicholson Street, East Melbourne.

ISBN 978-1-74208-781-8

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.

Disclaimer

This publication may be of assistance to you but the State of Victoria and its employees do not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence that may arise from you relying on any information in this publication.

An electronic version of this document is available on the Department of the Environment, Water, Heritage and the Arts website www.environment.gov.au

For more information contact the DSE Customer Service Centre 136 186

Citation: Nevill, G.R. and Camilleri, M. 2010. National Recovery Plan for the Stiff Groundsel *Senecio behrianus*. Department of Sustainability and Environment, Victoria.

Cover photograph: Stiff Groundsel Senecio behrianus by Ben Thomas.

Table of Contents

Summary3
Species Information
Description3
Distribution3
Habitat4
Population Information4
Decline and Threats5
Recovery Information6
Existing Conservation Measures6
Strategy for Recovery
Recovery Objectives7
Program Implementation7
Program Evaluation7
Recovery Objectives, Actions and Performance Criteria8
Affected interests11
Role and interests of indigenous people11
Benefits to other species/ecological communities11
Social and economic impacts11
Management Practices11
Acknowledgments12
Bibliography12
Priority, Feasibility and Estimated Costs of Recovery Actions13
Figure 1. Current distribution of the Stiff Groundsel4
Table 1. Population location, management and status4

Summary

The Stiff Groundsel Senecio behrianus is a small shrub that is endemic to south-eastern Australia, where it once occurred in South Australia, New South Wales and Victoria. The species has apparently suffered a widespread decline in distribution and abundance. It is presumed extinct in South Australia and New South Wales, and is now known only from five wild and two reintroduced populations in Victoria. The species shoots from rhizomes, forming dense patches, but because of this rhizomatous habit, it is not possible to estimate numbers of genetically distinct plants. All wild populations are small, <0.25 ha in extent. The Stiff Groundsel is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Major threats include weed invasion, road and channel maintenance, altered hydrology, grazing and trampling by stock, inappropriate fire regimes and small population size. This national Recovery Plan for Stiff Groundsel 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 Stiff Groundsel is an erect, woolly perennial plant growing to about one metre high. Plants form extensive rhizomatous clumps. Leaves are grey-green, alternate, linear, about 25 mm long (the upper ones shorter), entire or irregularly denticulate, with the margins rolled under. The tiny yellow flowers are borne in loose clusters at the ends of the stems. Seeds are dark brown, flattened, 1–2 mm long, hairless or downy, and crowned with a tuft of numerous feathery bristles. Flowering occurs from January to May (description from Walsh 1999).

The ecology of Stiff Groundsel is poorly understood. The species can resprout after disturbance such as fire (Alexander 1999). Seed germination is high under favorable experimental conditions (J. Lindner pers. comm.), although recruitment from seed has not been observed in the field (G. Nevil pers. comm.). Many of the plants in a population are connected by woody rhizomes, so the number of genetically distinct plants may be quite low. The pollination mechanism is unknown.

Distribution

The Stiff Groundsel is endemic to south-eastern Australia. It previously occurred along the Murray River in South Australia, the Darling River in New South Wales, and along the Glenelg River near Casterton in south-western Victoria, but these populations are now believed extinct. The species is currently known from five wild populations, all in Victoria: four at Corop (in the Riverina and Murray-Darling Depression bioregions *sensu* DEH 2000) and one near Ballarat (in the Victorian Midlands bioregion *sensu* DEH 2000) (Fig. 1). Total population size is unknown due to the rhizomatous habit of the species, but all wild populations occupy <0.25 ha in extent. There are also two reintroduced (planted) populations at Corop.



Figure 1. Current distribution of the Stiff Groundsel

Maps showing the detailed distribution of Stiff Groundsel are available from the Department of Sustainability and Environment, Victoria.

Habitat

Little is known of the historical habitat of the Stiff Groundsel. The species was once widespread on the floodplains of the Murray-Darling river system. Information with herbarium records indicates plants were growing in 'swampy soil' and 'sandy clay' in seasonally inundated areas on flats or banks close to rivers (Alexander 1999).

Remaining populations grow on poorly-drained sedimentary grey clays or sandy clays on or close to floodplains, and on basalt-derived grey cracking clays in periodically flooded depressions. Native plants that grow in association with Stiff Groundsel at Corop include Cumbungi *Typha* species, Lignum *Meuhlenbeckia florulenta* Common Nardoo *Marsilea drummondii*, Grey Gernander *Teucrium racemosum* and Blue Devil *Eryngium ovinum*. At the Ballarat site, other native species include Cotton Fireweed *Senecio quadridentatutus*, Common Blown-grass *Arostis avenaceae* and Prickfoot *Eryngium vesiculosum*.

A common feature seems to be that habitats are seasonally inundated, and hydrological regime is probably an important aspect of habitat, although the optimal timing and extent of flooding are unknown. Plant growth appears to be more prolific in areas that are flooded to a depth of 30 cm or more, perhaps due to lack of competition (Alexander 1999). Populations at Corop tend to grow on slightly raised areas such as drainage channel banks and natural mounds, rather than in the bottom of depressions.

Recovery actions include mapping of habitat that is critical to survival of the Stiff Groundsel.

Population Information

Currently, the Stiff Groundsel survives in five wild populations and two reintroduced (planted) populations (Table 1). An additional wild population recorded on private land adjacent to the Murrabit-Benjaroop Rd (Murrabit West) is recently extinct. Two additional planted populations at Mansfield Swamp and Greens Lake (Corop) have failed to establish. The species shoots from rhizomes, and can form dense patches; for instance, the population at Corop contains at least 18,000 stems. However, because of this rhizomatous habit, it is not possible to estimate numbers of genetically distinct plants. All wild populations are small, <0.25 ha in extent.

Location	Tenure	Land Manager	Population status
Miners Rest, Ballarat	wetland reserve	City of Ballarat	Wild
Gilmore Rd, Corop	roadside/private	Shire of Campaspe & landowner	Wild; population spreads from road reserve 30 m into private land
Grinter Rd, Corop	roadside/private	Shire of Campaspe & landowner	Wild; mostly on road reserve, spreads onto private land by only 1 m

Table 1. Population location, management and status

Location	Tenure	Land Manager	Population status
Wallenjoe Rd , Corop	private	landowner	Wild
McGilvray Rd, Corop	roadside	Shire of Campaspe	Wild
Two Tree Swamp, Corop	wildlife reserve	Parks Victoria	Planted; comprising two plantings, in 2003 & 2005, of 100 plants
Wallenjoe Swamp, Corop	wildlife reserve	Parks Victoria	Planted, 50 plants; very few remain alive; planting largely failed

Decline and Threats

There is little information on the decline of the Stiff Groundsel. It was apparently once widespread in the lower Murray-Darling river system, but was last seen there in the late 1800s. The species was presumed extinct until it was rediscovered at Corop (Victoria) in 1991. Reasons for the historical decline are largely speculative, but its habitat has been substantially impacted by a variety of changes. Water flow regimes have been altered greatly with the construction of dams, weirs and levees along the Murray River, leading to reduced flooding and more drying out of the floodplain. Much of the floodplain has been subject to grazing or conversion to horticulture. Increasing soil salinity may have also contributed to the decline of the Stiff Groundsel.

Remaining populations are all small, isolated and subject to a range of threats, including weed invasion, road and channel maintenance, altered hydrology, grazing and trampling by stock, inappropriate fire regimes, rising salinity and small population size. Many of the plants within a population are connected by woody rhizomes and, with recruitment from seed not observed in the field, the number of genetically distinct plants may be quite low. Poor understanding of the species' biology and ecology, especially habitat requirements and ecological conditions necessary for seed germination, makes it difficult to formulate management strategies for conservation.

Current threats are detailed as follows:

<u>Weed invasion</u>: Invasion by exotic perennial grasses and woody weeds is a serious issue at all sites. At Corop, vigorous perennials such as Blackberry *Rubis fruticosis* and Canary Grass *Phalaris aquatica* and annual grasses such as Wild Oats *Avena fatua* can quickly dominate sites and out-compete native species. At the Ballarat site, the Stiff Groundsel population is surrounded by introduced weeds including Canary Grass, Onion Grass *Romulea rosea*, Strawberry Clover *Trifolium fragiferum* and numerous thistle species.

<u>Altered hydrology</u>: The hydrology of the existing habitat has been extensively modified through the construction of weirs, channels, drains and banks, reducing the frequency and extent of flooding. The sites of current wild populations at Corop and Ballarat would have once been periodically flooded, but no longer retain their natural flooding regime. The timing, depth and duration of inundation appear to be important in the growth of Stiff Groundsel, but as the habitat has been altered so much, it is difficult to determine the flooding regime naturally suited this species. At both wild and reintroduced sites, plant growth appears to be more prolific in areas that are flooded to a depth of 30 cm or more, perhaps due to reduced competition from other plants in this zone (Alexander 1999). Recruitment from seed may be dependent upon suitable conditions, which may not have occurred in recent years, due to drought, altered hydrology or grazing impacts.

The ecological niche occupied by current populations of Stiff Groundsel suggests that the species may be vulnerable to rising watertables as a result of native vegetation clearance and irrigation practices. The shallow water table (<2m at times) suggests that the area has the potential to develop soil salinity, which may pose a major threat to some existing populations.

<u>Grazing/trampling</u>: Much of the habitat of the Stiff Groundsel has been converted to agriculture, and grazing and trampling by stock may have been a factor in the decline of the species.

Although many of the more common *Senecio* species are reported to be unpalatable or toxic to domestic stock (Cunningham *et al.* 1981), the palatability of Stiff Groundsel to native and introduced herbivores is uncertain. Remaining populations are fenced to prevent domestic stock access, although populations are still accessible to rabbits, hares and native herbivores, which could be a threat to existing populations.

<u>Inappropriate biomass reduction / fire regimes</u>: Inappropriate fire regimes may pose a threat to existing populations. While it appears that fire may have an important role to play in the life cycle of Stiff Groundsel, fires that are too frequent, too intense, or that occur at a vulnerable growth stage of the species may affect long-term survival. At least one of the current wild population sites was regularly burnt over a long period whenever it was dry enough in autumn or winter (Alexander 1999), and Stiff Groundsel appears to resprout readily after burning (authors pers. obs.). Whether this regrowth is due to temporarily reduced competition from other native or introduced plants or other factors is uncertain, and further investigation into the fire ecology of this species is required.

Low population size: Although populations comprise several thousands of stems, many of the plants within a population are connected by woody rhizomes. Recruitment from seed has not been observed in the field, so the number of genetically distinct plants may be quite low. Low genetic variability resulting from limited populations with predominantly vegetative reproduction may render existing wild and planted populations vulnerable to pests and diseases, and heightens the risk of population extirpation due to stochastic events.

<u>Road and channel maintenance</u>: Roads and irrigation channels where the Stiff Groundsel occurs are subject to periodic maintenance such as grading and herbicide spraying that could inadvertently damage populations. Plants did re-sprout after road grading at one site (Alexander 1999). The risk of accidental damage has been reduced with fencing and signposting of sites.

Recovery Information

Existing Conservation Measures

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

- Wild roadside and private property populations have been fenced, signposted and included on local government planning overlays.
- Weed competition is being managed through burning and herbicide application.
- *Ex situ* populations have been established in cultivation at the Royal Botanic Gardens, Melbourne and White Hills Botanic Gardens, Bendigo.
- Genetic analysis is being undertaken at the Royal Botanic Gardens, Melbourne.
- Reintroductions to establish new populations have commenced, although only one population has so far become established.

Strategy for Recovery

Existing populations of Stiff Groundsel are under some protection. However, the extremely restricted occurrence and tenuous nature of existing populations and long-term changes to habitat, such as reduced flooding, mean that location of additional populations and identification of suitable re-introduction sites is 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 Stiff Groundsel was previously known to occur, and areas that may support potentially suitable habitat. Further investigation into reproductive strategies, fecundity and recruitment levels, including identification of pollinators is also needed. Further research is required into the flooding regime required to sustain this species, and its fire ecology.

Recovery Objectives

The **overall objective** of recovery is to minimise the probability of extinction of Stiff Groundsel 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** of recovery for Stiff Groundsel are to:

- 1. Determine distribution, abundance and population structure
- 2. Identify habitat requirements
- 3. Ensure that all populations and their habitat are protected and managed appropriately
- 4. Manage threats to populations
- 5. Identify key biological functions
- 6. Determine the growth rates and viability of populations
- 7. Maintain more plants in cultivation
- 8. Establish new populations in the wild
- 9. 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 will be 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 the extent and abundance of existing populations.	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.	 Searches planned and implemented at previously recorded locations in Victoria, South Australia and New South Wales. 							
	Responsibility: DSE								
1.3	Determine the genetic variability and structure of existing and new populations.	Population structure and variability determined and information							
	Responsibility: DSE/RBG	used for conservation management.							
1.4	Map existing and new populations.	 Population maps prepared and used in conservation 							
	Responsibility: DSE	management.							
Specifi	c 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								
Specifi	c Objective 3: Identify key biological functions								
3.1	Determine longevity, fecundity, recruitment levels and seed viability.	Seed bank/regenerative potential quantified for each population.							
	Responsibility: DSE								
3.2	Determine seed germination requirements.	Stimuli for recruitment/regeneration identified.							
	Responsibility: RBG								
3.3	Investigate impacts of soil disturbance, fire, salinity and inundation on recruitment.	 Management strategies identified to maintain, enhance or restore processos fundamental to reproduction and suprimal 							
	Responsibility: DSE	restore processes rundamental to reproduction and Survival.							

No.	Action	Performance Criteria							
Specific Objective 4: Manage threats to populations									
4.1	Identify current and potential threats to the species and its habitat.	Prescriptions prepared for threat abatement.							
	Responsibility: DSE								
4.2	Control invasive weeds especially Blackberry and Canary Grass.	A measurable reduction in the impact of weeds on all sites.							
	Responsibility: DSE/PV								
4.3	Upgrade and maintain fences at existing sites to exclude stock, native and feral herbivores, and fence any new sites.	 Appropriate vegetation structure maintained and seedling recruitment/vegetative regeneration occurring at all sites. 							
	Responsibility: DSE/LGA/PV								
4.4	Develop and implement an ecological burning regime at population sites.	Ecological burning regime developed and implemented.							
	Responsibility: DSE/PV								
4.5	Ensure that hydrology necessary to sustain populations is maintained.	Appropriate hydrology maintained at all sites.							
	Responsibility: DSE/LGA/PV								
Specific	Objective 5: Ensure that all populations and their habitat are protected and ma	naged appropriately							
5.1	Incorporate protective actions in relevant park or reserve management plans.	Actions to protect species incorporated in relevant management							
	Responsibility: DSE/PV	plans.							
5.2	Incorporate actions to protect species into local government documents and procedures – Campaspe Shire, City of Ballarat.	 Actions to protect species incorporated into current local government documents and procedures. 							
	Responsibility: DSE								
5.3	Initiate private land management agreements with private land owners.	Private land management agreements concluded.							
	Responsibility: DSE								
Specific	Objective 6: Determine the growth rates and viability of populations								
6.1	Develop population monitoring protocols.	Techniques for monitoring developed and implemented.							
	Responsibility: DSE								
6.2	Monitor population trends and responses against recovery actions.	 Annual census data collected, population growth rates 							
	Responsibility: DSE	determined and Population Viability Analysis completed.							
Specific	Objective 7: Maintain plants 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.							
	Responsibility: RBG								
7.2	Collect and store reproductive material.	 Seed from all populations in long-term storage. 							
	Responsibility: RBG/DSE								

No.	Action	Performance Criteria				
Specifi	c Objective 8: Establish new populations in the wild					
8.1	Identify potential reintroduction sites. Responsibility: DSE	 Criteria for site suitability identified and 10 suitable sites selected. 				
8.2	Propagate plants for reintroduction, ensuring maximum possible genetic diversity. Responsibility: RBG	• At least 200 healthy, genetically diverse plants in cultivation.				
8.3	Prepare reintroduction plan, following the protocols in Vallee et al. (2004) Responsibility: DSE	 Reintroduction plan prepared with agreement from all stakeholders. 				
8.4	Implement reintroduction plan. Responsibility: DSE	Plants established at three new sites.				
8.5	Maintain and monitor reintroduced plants. Responsibility: DSE	• Minimum 50% survival of reintroduced plants after two years.				
Specifi	c Objective 9: Build community support for conservation					
9.1	Identify opportunities for community involvement in the recovery plan.	• Presentation(s) to community nature conservation groups made.				
	Responsibility: DSE	 Private landholders informed of fencing incentives provided by DSE and the threatened species network. 				
		 Local shires, including contractors, educated about roadside work. 				

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

Affected interests

Populations of Stiff Groundsel occur on public land managed by DSE Crown Land Management, Parks Victoria and the City of Ballarat, and on roadsides managed by the Shire of Campaspe. Some populations occur on private land, and landowners have been identified. All relevant land managers have been consulted and have approved the actions outlined in this plan, subject to the availability of resources to implement the actions.

Role and interests of indigenous people

Indigenous communities on whose traditional lands Stiff Groundsel occurs have been advised, through the relevant DSE Regional Indigenous Facilitator, of the preparation of this Recovery Plan and invited to comment and 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, in particular swamps and marshes, many of which have been cleared, drained or otherwise highly modified. The Miner's Rest Wetland Reserve near Ballarat, where Stiff Groundsel was recently found, is also an important site for Latham's Snipe, a migratory bird species listed under the *Environment Protection and Biodiversity Conservation Act 1999*. The Recovery Plan will also provide an important public 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, grazing, weed invasions and habitat degradation.

Social and economic impacts

Actions associated with the recovery of Stiff Groundsel are unlikely to affect any existing industry or private individual. Some populations occur on private land but recovery actions are unlikely to significantly impact on the landholder, and protective measures will be achieved though negotiation with affected landowners. There are various incentives available to assist in protection on private land. The remainder of the populations, wild and planted, are on Crown Land managed by DSE Crown Land Management (CLM), Parks Victoria and City of Ballarat, and on roadsides managed by Campaspe Shire. All relevant land managers have been consulted and have approved the actions outlined in this plan.

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 Stiff Groundsel 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 the Stiff Groundsel include:

- Maintenance and improvement of hydrological regimes to facilitate population survival and enable regeneration.
- Control of pest plants and animals.
- Identification and protection of populations in instruments such as public land management plans and planning overlays under local government procedures.
- 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.

Management practices potentially detrimental to the Stiff Groundsel include:

- Changes to hydrology that would lead to further drying out or prolonged flooding of sites, or an increase in soil salinity.
- Grazing by stock, feral and native herbivores.
- Road upgrading, widening or realignment.
- Inappropriate burning regimes.

Acknowledgments

The authors would like to thank the following people who provided advice or assistance in developing this plan: Elizabeth James, Val Stajsic and Neville Walsh (Royal Botanic Gardens, Melbourne); Andy Arnold, Pam Clunie, Deanna Marshall and Rolf Weber (Department of Sustainability and Environment, Victoria); Kim Dyson (Department of Primary Industries, Victoria); Ron Davies and J. Lindner. Much of the information in this document was derived from the first Recovery Plan for Stiff Groundsel (Alexander 1999).

Bibliography

Alexander, J. 1999. *Stiff Groundsel* (Senecio behrianus) *Recovery Plan 1999-2001*. Department of Natural Resources and Environment, Victoria.

Cunningham, G.M., Mulham, W.E., Milthorpe, P.L. and Leigh, J.H. 1981. *Plants of Western New South Wales*. Soil Conservation Service, Sydney.

DEH 2000. Revision of the Interim Biogeographic Regionalisation of Australia (IBRA) and the Development of Version 5.1. - Summary Report. Department of the Environment and Heritage, Canberra.

Vallee, L., Hogbin, T., Makinson, B., Matthes, M. and Rossetto, M. 2004. *Guidelines for the Traslocation of Threatened Plants in Australia* – Second Edition. Australian Network for Plant Conversation, Canberra.

Walsh, N.G. 1999. Senecio pp 941–965 in: Walsh, N.G. and Entwisle, T.J. (eds.) Flora of Victoria. Vol. 4 – Dicotyledons: Cornaceae to Asteraceae. Inkata Press, Melbourne

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									
1.1	Extent & abundance	1	100%	DSE	\$5,000	\$5,000	\$0	\$0	\$0	\$10,000
1.2	Searches for new pops.	2	75%	DSE	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$25,000
1.3	Determine genetic variability	1	100%	RBG	\$5,000	\$5,000	\$0	\$0	\$0	\$10,000
1.4	Map populations	2	100%	DSE	\$0	\$1,000	\$0	\$1,000	\$1,000	\$3,000
2	Habitat requirements									
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	Biology & ecology									
3.1	Determine longevity, viability	2	75%	DSE	\$5,000	\$5,000	\$3,000	\$0	\$0	\$13,000
3.2	Determine seed germination	2	75%	RBG	\$3,000	\$3,000	\$0	\$0	\$0	\$6,000
3.3	Investigate disturbance impact	2	75%	DSE	\$0	\$0	\$10,000	\$10,000	\$5,000	\$25,000
4	Threat management									
4.1	Identify current, potential threats	1	100%	DSE	\$1,500	\$1,500	\$1,500	\$1,500	\$1,500	\$7,500
4.2	Control weeds	1	100%	DSE/PV/LGA	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$25,000
4.3	Upgrade & maintain fences	1	100%	DSE/PV	\$3,000	\$3,000	\$2,000	\$2,000	\$2,000	\$12,000
4.4	Develop burning regime	2	50%	DSE	\$2,500	\$2,500	\$2,500	\$2,500	\$2,500	\$12,500
4.5	Maintain hydrology	1	50%	DSE	\$2,000	\$2,000	\$2,000	\$2,000	\$2,000	\$10,000
5	Habitat protection									
5.1	Public land management plans	1	100%	DSE	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$5,000
5.2	Local govt plans, overlays	1	100%	DSE/LGA	\$1,000	\$1,000	\$1,000	\$1,000	\$1,000	\$5,000
5.3	Private land mgt agreements	1	100%	DSE	\$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
6	Growth rates, pop. viability									
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	\$6,000	\$6,000	\$8,000	\$26,000
7	Cultivation									
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
8	New populations									
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									
9.1	Community extension	1	100%	DSE	\$3,000	\$3,000	\$3,000	\$3,000	\$3,000	\$15,000
	TOTAL				\$61,000	\$65,000	\$66,000	\$59,000	\$54,000	\$305,000