National Recovery Plan for the Turnip Copperburr Sclerolaena napiformis

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Australian Government





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Contents

ISBN 978-1-74208-971-3	1
Summary	3
Species Information	3
Description	3
Distribution	3
Habitat	3
Population Information	4
Decline and Threats	
Recovery Information	8
Existing Conservation Measures	8
Recovery Objectives	9
Program Implementation and Evaluation	9
Recovery Actions and Performance Criteria	10
Affected Interests	13
Role and Interests of Indigenous People	13
Biodiversity Benefits	13
Social and Economic Impacts	13
Management Practices	13
Acknowledgments	
References	
Priority, Feasibility and Estimated Costs of Recovery Actions	15
Figure 1. Distribution of Turnip Copperburr	4
Table 1. Population and threat information for the Turnip Copperburr	5

Summary

The Turnip Copperburr *Sclerolaena napiformis* is small perennial chenopod shrub endemic to south-eastern Australia. The species occurs in New South Wales and Victoria, growing on inland plains in native grasslands and grassy woodlands on clay-loam soils. A total of 25 sites with perhaps 30,000 plants have been recorded. Many populations are in decline and several may have become extinct in recent years. Most of its habitat has been cleared for agriculture, and remaining populations are mostly small and isolated, and at risk from a variety of threats including weed invasion, grazing and road works. The Turnip Copperburr is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999. This national Recovery Plan for the Turnip Copperburr is the first recovery plan for the species, 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 Turnip Copperburr *Sclerolaena napiformis* is a small, procumbent to erect perennial shrub growing to 30 cm tall, belonging to the saltbush family Chenopodiaceae. It has slender branches sparsely covered in short erect or curled hairs and linear to narrowly obovate leaves 5–15 mm long, covered with appressed hairs. Flowers are green, tiny, solitary and occur in the leaf axils. Fruits have 5–6 spines and are sparsely to moderately pubescent. Flowers and fruits occur from November to May (description from Wilson1984).

Little is known of the biology and ecology of the Turnip Copperburr. Plants apparently become senescent in autumn, dying back to a thick taproot in the autumn and winter, and shoot again in late spring. Rupture of the fruit wall may be required to break dormancy, with almost 100% germination occurring when seeds were removed from the dispersal unit, but almost no germination when dispersal units were not removed (Carta 1999). Viability of seed remained high (80%) after two years of storage (Carta 1999), suggesting that seed may remain viable in the soil during unfavourable conditions (e.g. drought), with germination potentially occurring when sufficient moisture becomes available. Plants can reach maturity and flower within six months (Carta 1999). The Turnip Copperburr is often observed growing around ant nests. Several ant species consume the fleshy pad located at the base of some fruiting bodies and discard the fruit and seed outside the nest (Davidson & Morton 1981). The Turnip Copperburr also has a fleshy pad located on the underside of the fruit (Carta 1999), so ants may be involved in dispersal of its seeds.

Distribution

The Turnip Copperburr is apparently restricted to inland south-eastern Australia, where it occurs in the Riverina and Murray-Darling Depression IBRA bioregions (*sensu* DEH 2000) of New South Wales and Victoria (Figure 1). Maps showing the distribution of the Turnip Copperburr are available from the Department of Sustainability and Environment (for Victoria) and from the Department of Environment, Climate Change and Water (for NSW).

Habitat

The Turnip Copperburr grows in native grasslands and grassy woodlands on relatively fertile clay-loam soils. In Victoria the species grows on red clay to red loam soils, and associated species include Common Wallaby-grass *Austrodanthonia caespitosa*, Rough Spear-Grass *Austrostipa scabra*, Spurred Spear-Grass *Austrostipa gibbosa*, Common Everlasting *Chrysocephalum apiculatum* sens.lat., various bluebush *Maireana* species and Buloke *Allocasuarina luehmannii*. Anecdotal evidence suggests that Turnip Copperburr can tolerate waterlogging in the spring, and all remaining populations are located in close vicinity to a water course or swamp (Cook 1997; Alexander 2002).

In NSW, the species occurs in Knotty Spear-Grass *Austrostipa nodosa* and Windmill Grass *Chloris truncata* tussock grasslands on grey to red-brown cracking clays and clay loams. Other common species in these habitats include wallaby-grasses *Austrodanthonia* species, Spider Grass *Enteropogon acicularis*, Paper Sunray *Rhodanthe corymbiflora*, several Swainson-peas *Swainsona* species and several chenopod species.

Vegetation structure may play an important role in the location of populations, with the species apparently absent from sites dominated by thick swards of grass. Actions in this Recovery Plan include survey of actual and potential habitat that will lead to the identification of habitat critical to the survival of the species.



Figure 1. Distribution of Turnip Copperburr

Population Information

A total of 25 populations of Turnip Copperburr have been identified, with upper estimates of total numbers of plants likely to be less than 30,000 (Table 1). Seventeen important populations have been identified: 11 in Victoria and six in New South Wales. Eight additional sites in Victoria have been recorded since 1990, although there is no recent information regarding population presence, size or threats. There are an estimated 19,000–23,000 plants in Victoria and several hundred to several thousand plants in NSW. At least one-half of the total number of plants occur at just a single site, on private property at Avon Plains (Vic), making this the single most important population for this species in Australia.

Table 1 Population and threat information for the Turnip Copperburr

Location/Site	Pop size (year)	Manager	Threats and Risk	Comments			
Victoria							
private property, Avon Plains	2001: est 15,000 plants	private	 changing land management (e.g. to cropping) (H) grazing by sheep (L-M); grazing often removed during spring/summer months 	population trend unknown; largest known population of Turnip Copperburr; site contains remnant native grassland in excellent condition, most of which was never cultivated; not covenanted			
roadside, McKinley Road, Marnoo	1997: 2430 plants 1999: >1000 plants 2000: 1000 plants 2004: 1500–2500 plants	Northern Grampians Shire	 Weed invasions, esp. Avena species (H) Vehicle movement (M) 	population in decline?			
Echuca Aerodrome, Echuca	2004: 1–2000 plants	Campaspe Shire	 mowing/slashing (H) habitat destruction (proposed runway extension; building & infrastructure construction) (H) weed invasion (M) 	population trend unknown; site is mown/slashed for aviation safety; disturbance has been reduced in last few years due to drought reducing veg growth			
roadside, Anderson's Road, Echuca	1997: 400 plants 1999: 200 plants 2004: 1–200 plants	Campaspe Shire	 weed invasion, esp. <i>Echium plantagineum</i> (H) fire break construction & maintenance (H) road/utilities construction/maintenance works (M) Soil and garden waste dumping (M) 	population in decline; many plants were destroyed by road works in 1997			
roadside, Donald-Avon Plains Road, Avon Plains	1997: 1800 plants 2000: >1000 plants 2004: 700–1500 plants	Northern Grampians Shire	 Fire break construction & maintenance (H) Weed invasion (M) Soil dumping (M) 	population stable?			
roadside, Donald-Stawell Rd, south of Donald	2000: >1000 plants	Shire of Buloke	 Fire break construction & maintenance (H) Weed invasion (L) 	population trend unknown			
roadside, Trevaskis Road, Wyuna	1997: 570 plants 1999: 500–1000 plants 2004: 615 plants	Campaspe Shire	 Weed invasion (H) Road works (H) Grazing (M) Vehicle movement (M) 	In 1997 plants occurred on both sides of road and were fenced for protection. By 2004, fence on western roadside had been removed and site had been cleared and ploughed, apparently eliminating all plants there. Plants remain on eastern side of the road, mostly inside fence, few outside fence; fence in disrepair and requires maintenance to adequately protect plants			
roadside, Echuca-Serpentine Road, Mitiamo	1997: 730 plants 2003: 400–600 plants	Campaspe Shire	 Road works (H) Vehicle movement (H) Weed invasion (M) Road works (M) Soil dumping (M) 	population trend unknown; soil was dumped on part of the population in 1997			

Location/Site	Pop size (year)	Manager	Threats and Risk	Comments
roadside, O'Deas Road, Koyunga (Vic)	1997: 100 plants 2004: 200–500 plants	Campaspe Shire	 Road works (H) Vehicle movement (H) Altered hydrology (H) Weed invasion (M) Stock grazing (M) 	population trend unknown; the site was ploughed for tree planting in 1986 and some plants were destroyed
Creswick's Well Wildlife Reserve, Avon Plains	1985: 20 plants 1997: 370 plants 2004: 150 plants	Parks Victoria	 weed invasion, esp. Avena species (H) grazing (L) 	population in decline
Avon Plains Swamp Wildlife Reserve, Avon Plains	1997: est. 200 plants 2004: no plants seen	Parks Victoria	not known	population in decline, possibly extinct
South of O'Brees Rd, Remlaw	not known	Rural City of Horsham	not known	population trend unknown; site not recently surveyed
Boyle Rd, Marnoo East	not known	Northern Grampians Shire	not known	population trend unknown; site not recently surveyed
east & southeast of Banyera, near Richardson River	not known	Northern Grampians Shire/Shire of Yarriambiack	not known	population trend unknown; site not recently surveyed
Raynes Rd, Grey's Bridge	not known	Northern Grampians Shire	not known	population trend unknown; site not recently surveyed
Longerenong Rd, east of Longerenong	not known	Shire of Yarriambiack	not known	population trend unknown; site not recently surveyed
Pimpinio Rd, Rupanyup	not known	Shire of Yarriambiack	not known	population trend unknown; site not recently surveyed
Stawell-Warracknabeal Rd, south of Rupanyup	not known	Shire of Yarriambiack	not known	population trend unknown; site not recently surveyed
Tennis Rd, Watchem West	not known	Shire of Buloke	not known	population trend unknown; site not recently surveyed
New South Wales				1
Cobb Hwy nth of Moama	1991: plants present (pop size not determined 2001: few plants 2005: 'several hundred'	Murray Shire Council; Livestock Health and Pest Authority	 grazing/trampling by stock (M) weed invasion (H) 	1991 & 2001 records from eastern side of hwy; 2005 record from western side of hwy, over ~20 ha; site is on Barnes Crossing Travelling Stock Route
roadside, Elliot Lane, east of Jerilderie	2000: 25 plants	Shire of Jerilderie	 vehicle movement (H) altered hydrological regimes (M) biomass accumulation (M) 	population trend unknown
roadside, Urana-Jerilderie Rd, 1km south of Cocketgedong	1993: plants present (pop size not determined) 2001: no plants seen	Shire of Jerilderie	• grazing (H)	population trend unknown

Location/Site	Pop size (year)	Manager	Threats and Risk	Comments
roadside, junction of Urana & Old Urana Road	1993: plants present (pop size not determined) 2001: no plants seen	Shire of Jerilderie; Livestock Health and Pest Authority	 weed invasion (H) altered fire regime (H) grazing/trampling by stock (M) 	population in decline?; site is on Travelling Stock Route; a fenced enclosure exists at the site but is dominated by thick swards of native & exotic plants
Sth Coree Rd, Jeriliderie	1991: plants present at several sites (pop size not determined 2000: no plants seen	Shire of Jerilderie	 fire break construction & maintenance (H) road works (H) herbicide spraying (M) grazing/trampling by stock (M) 	population in decline?; site is in Travelling Stock Route
private land Conargo Road, Conargo	1993: plants present (pop size not determined) 2001: no plants seen	private land	• altered fire regime (H)	population in decline? site is 'reserved' for flora conservation but is covered by a dense sward of native and exotic plants

H = High Risk; M = Medium Risk; L = Low Risk

Decline and Threats

The Turnip Copperburr was described in 1984, and previous distribution and abundance are not known. However, judging from current distribution and habitat preferences, it is likely that the species was once distributed across a wide area of the Murray-Darling Basin in New South Wales and Victoria, in grassland and grassy woodland communities. These habitats are now largely cleared for agriculture or grazed by domestic stock, and are highly threatened, with less than 1% of their original cover remaining (Lunt *et al.* 1998).

As a consequence, the Turnip Copperburr has almost certainly suffered a substantial decline in abundance and probably distribution. Remaining populations are now largely restricted to roadsides and occasionally on private land in paddocks that are lightly grazed but have not been ploughed or cropped. Only two populations occur in conservation reserves, and one of these has declined and may be extinct. All surviving populations are at risk from a range of threats including habitat loss and degradation, grazing, road works and weed invasion (Table 1). Many populations, especially along roadsides, are apparently still in decline, and several appear to have become extinct in recent years.

Major current threats are discussed in further detail below:

<u>Weed invasion</u>: Weed invasion is considered a major threat, as a large component of the surrounding vegetation at the majority of sites comprises weeds. Serious weeds include Wild Oats *Avena* species, Paterson's Curse *Echium plantagineum*, Annual Beard-grass *Polypogon monspeliensis* and various introduced pasture grasses.

<u>Habitat degradation/destruction</u>: This is a major threat to populations on roadsides and on private land. Many populations are still subject to habitat degradation or destruction, through activities such as ploughing, road maintenance, vehicle movement, utilities installation and maintenance and firebreak construction and maintenance. Several populations have recently been damaged by road works and ploughing, including one during tree planting on a road reserve.

<u>Altered fire regimes</u>: The native grassland habitat of the Turnip Copperburr was likely to have experienced periodic fires that reduced the amount of biomass, opening up the grassland habitat and making conditions more suitable for germination and growth. In the absence of fire, some sites have developed thick swards of native and introduced grasses, and Turnip Copperburr populations have apparently declined or become extinct at these sites.

<u>Grazing</u>: The Turnip Copperburr is probably palatable to stock, and is apparently absent from sites subject to heavy and/or long-term grazing. Grazing by stock also causes other problems such as trampling, soil compaction and altered drainage. However, in some circumstances, light grazing may be beneficial to the species, as it would remove some plant biomass to retain an open sward, mimicking the effects of fire. Light grazing, at a non-sensitive time of the year, could be used as a management tool to maintain or enhance some populations of Turnip Copperburr.

<u>Increasing soil salinity</u>: Several populations of Turnip Copperburr occur within irrigation districts (e.g. Echuca Vic and Moama NSW) where nearby land has been degrade by rising soil salinity. The risk of this is not known but needs to be assessed.

Recovery Information

Existing Conservation Measures

A number of initiatives are completed or underway to protect and enhance populations of Turnip Copperburr, including:

- A research project (Honours thesis at La Trobe University (Vic)) examined aspects of the ecology and biology of Turnip Copperburr (Carta 1999).
- A report on the location and size of populations in Victoria (Cook 1997).
- Annual monitoring of 14 populations in Victoria and New South Wales.

- Ongoing weed control at Andersons Rd (Vic).
- Signage of roadside populations including Andersons Rd, Donald-Avon Plains Rd, Echuca-Serpentine Rd and McKinley Road (Vic).
- Fencing at O'Deas Rd and Trevaskis Rd populations (Vic), and fencing and management grazing at Avon Plains Swamp Wildlife Reserve (Vic).
- Light seasonal grazing of the native grassland community containing Tunrip Copperburr at the private property site at Avon Plains (Vic).
- Suspension of grazing in the Barnes Crossing TSR.

Recovery Objectives

The Overall Objective of recovery is to minimise the probability of extinction of the Turnip Copperburr in the wild and to increase the probability of populations becoming self-sustaining in the long term. Within the duration of this Recovery Plan, the Specific Objectives for the recovery of the Turnip Copperburr are to:

- 1. Determine distribution, abundance and population structure
- 2. Determine habitat requirements
- 3. Manage threats to populations
- 4. Identify key biological characteristics
- 5. Determine life history and viability of populations
- 6. Establish an ex situ collection in cultivation
- 7. Build community support for its conservation

Program Implementation and Evaluation

This Recovery Plan guides recovery actions for the Turnip Copperburr and will be implemented and managed by the Department of Sustainability and Environment (for Victoria) and the Department of Environment, Climate Change and Water(for NSW), supported by other agencies, educational institutions, regional natural resource management authorities and community groups as appropriate. Technical, scientific, habitat management or education components of the Recovery Plan will be referred to specialist groups on research, *in situ* management, community education and cultivation as required. Contact will be maintained between the State agencies on recovery issues concerning conservation of the Turnip Copperburr. The Recovery Plan will run for a maximum of five years from the date of its adoption under the EPBC Act, and will be reviewed and revised within five years of the date of its adoption.

Recovery Actions and Performance Criteria

Action	Description	Performance Criteria				
Specific Objective 1: Determine distribution, abundance and population structure						
1.1	Undertake surveys to determine the area and extent of populations, the number, size and structure of populations, and inference or estimation of population change.	Ten populations mapped for population size, condition and habitat.				
	Responsibility: DSE/DECCW					
Specific	Objective 2: Determine habitat requirements					
2.1	Accurately survey known habitat and collect floristic and environmental information relevant to community ecology and condition in Victoria and NSW.	Habitat critical to survival mapped for 10 populations.				
	Responsibility: DSE/DECCW					
2.2	Identify and survey potential habitat, using ecological and bioclimatic information that may indicate habitat preference in Victoria and NSW.	Predictive model for potential habitat developed and tested at five sites.				
	Responsibility: DSE/DECCW					
Specific	Objective 3: Manage threats to populations					
3.1	Protect populations on public land.	 Public Authority Management Agreements negotiated under the FFG Act 1988 at Echuca Aerodrome and with relevant Shires 				
	Responsibility. DSE/DECCW/LG	where the species occurs, particularly along roadsides.				
		 Joint management agreements negotiated between DECC and Livestock Health and Pest Authority for Travelling Stock Reserves in Jerilderie and Moama areas. 				
3.2	Protect populations on private property.	Discussions initiated and joint management agreements negotiated				
	Responsibility: DSE/DECCW	with three private landholders in NSW and three in Victoria.				
3.4	Control pest plants and animals to maintain and enhance Turnip Copperburr populations.	 Significant measurable reduction of weed cover annually at six sites (site specific targets to be identified for individual sites). 				
	Responsibility: DSE/DECCW/PV/LG	 Eight populations fenced so that grazing pressures can be appropriately managed. 				
		 Agreements obtained from land owners or public land managers for management of pest plants and animals threatening populations in NSW. 				

3.5	Control threats from road and roadside management works Responsibility: DSE/DECCW/LG/PV	 All roadside populations marked with a Significant Roadside Area sign and incorporated into council planning overlays and regional planning processes. 				
		 All adjoining landholders aware of significance of adjacent roadside populations. 				
		 Management authorities with an interest in the Barnes Crossing (NSW) population (electricity supply, railway, travelling stock) informed to ensure that infrastructure maintenance does not impact on populations. 				
3.6	Control threats from a lack of biomass removal.	 Management guidelines prepared regarding biomass reduction where dense vegetation may be a threat 				
	Responsibility: DSE/DECCW/LG	Management grazing or burning implemented at four sites				
3.7	Investigate and assess the threat of dryland salinity. Responsibility: DSE/DECCW	 Threat from salinity determined for three populations and, where required, information incorporated into regional salinity planning and management strategies. 				
Specif	ic Objective 4: Identify key biological characteristics					
4.1	Evaluate current reproductive status, seed bank status, longevity, fecundity and	Age of reproductive maturity documented				
	Responsibility: DSE/DECCW	Techniques for monitoring developed and implemented.				
4.2	Identify key stimuli for seed germination requirements.	Stimuli for recruitment identified.				
	Responsibility: DSE/DECCW	 Management strategies identified to maintain, enhance or restore processes fundamental to reproduction and survival. 				
4.3	Identify disturbance regimes to maintain or improve habitat.	 Management prescriptions for ecological burning/grazing at target sites prepared. 				
		Management prescriptions at three sites implemented.				
Specif	ic objective 5: Determine life history, population trends and viability of population	IS				
5.1	Measure population trends and responses against recovery actions by collecting	Techniques for monitoring developed and implemented.				
	Responsibility: DSE	 Population growth rates determined and Population Viability Analysis completed for six important populations. 				
Specif	ic objective 6: Establish ex situ collections in cultivation					
6.1	Establish a seed bank and determine seed longevity and viability. Responsibility: DSE/DECCW	Seed from 10 important populations across range in storage; longevity and viability determined.				

Specific Objective 7: Build community support for its conservation

7.1 Identify opportunities for community involvement in the conservation of Turnip Copperburr and implement them

Responsibility: DSE/DECCW

 Community nature conservation and Landcare groups aware of the species and support its conservation.

Abbreviations: CMA – Catchment Management Authority; DECC – Department of Environment, Climate Change and Water (NSW); DPI – Department of Primary Industries (Vic); DSE – Department of Sustainability and Environment (Victoria); LG – Local Government; PV – Parks Victoria; RBG – Royal Botanic Gardens, Melbourne

Affected Interests

Primary organisations with an interest include the Department of Sustainability and Environment (Vic), Parks Victoria and the Department of Environment, Climate Change and Water(NSW), plus other government agencies and local government as identified in Table 1 (page 5). Several populations also occur on private land, and the private property owners of the single largest stand of Turnip Copperburr have been contacted and are cooperating in its conservation. Working with other private landowners to initiate conservation agreements to protect the species and its habitat is a priority in this Recovery Plan.

Role and Interests of Indigenous People

Indigenous communities on whose traditional lands the Turnip Copperburr occurs are being advised, through the relevant regional Indigenous facilitator, of this Recovery Plan. Indigenous communities will be invited to be involved in the implementation of the Recovery Plan.

Biodiversity Benefits

The Turnip Copperburr is predominantly found in grasslands and grassy woodlands, two highly threatened vegetation communities in Australia estimated to have less than 1% of their original cover remaining (Lunt *et al.* 1998). The implementation of recovery actions will serve to protect these habitats, which also contain other threatened plants including *Cullen parvum, Swainsonia plagiotropis* and *Swainsonia murrayana*. 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

The implementation of this Recovery Plan is unlikely to cause significant adverse social and economic impacts. Many populations occur on public land, although most of these are in highly vulnerable locations such as roadsides. Protection measures such as providing information to managers, erection and maintenance of fencing and signposts can generally be achieved at minimal cost. Conservation of populations on private land will be achieved through voluntary agreements with landowners, supported by incentives available through community grants programs. The owner of the site where the largest single population occurs is already cooperating in conservation measures for the species.

Management Practices

Management practices required to conserve the Turnip Copperburr include:

- Fencing and signposting to protect and prevent inadvertent damage.
- Weed control.
- Burning or light seasonal grazing to reduce plant competition and maintain an open sward.
- Consultation with public land managers and private landholders where the species occurs or is likely to occur.
- Investigation of the purchase of suitable areas of private land through the national reserves scheme.
- Covenants or other conservation agreements for protection of significant private land sites, though negotiation with landowners.
- Encouraging and facilitating community participation in recovery actions.
- Surveys and publicity to locate new populations, especially on roadsides and private land.
- Research into the ecology and management of the species and its native grassland and grassy woodland habitats on the Riverina plains.

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References

- Alexander, J. 2002. Flora and Fauna Guarantee Action Statement # 171 Turnip Copperburr Sclerolaena napiformis, Department of Natural Resources and Environment, Melbourne.
- Carta, F.E. 1999. The Ecology of the Threatened Chenopod *Sclerolaena napiformis* (Paul G. Wilson)-Honours Thesis, Department of Botany, La Trobe University, Melbourne.
- Cook, D. 1997. The Distribution and Abundance of Turnip Copperburr, *Sclerolaena napiformis*, In Victoria-Report, Natural Resources and Environment, Bendigo.
- Davidson, D.W. and Morton, S.R. 1981. Myrmecochory in some plants (F. Chenopodiaceae) of the Australian arid zone, *Oecologia* **50**, 357-366.
- 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.
- Lunt, I., Barlow, T. and Ross, J. 1998. Plains Wandering: Exploring the Grassy Plains of South-east Australia. Victorian National Parks Association and Trust for Nature, Melbourne.
- Wilson, P.G. 1984. Chenopodiaceae Flora of Australia Volume 4 Sclerolaena napiformis Paul G. Wilson sp. nov (p. 330), Bureau of Flora and Fauna, Canberra, Australian Government Publishing Service, Canberra.

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.	Surveys	1	100%	DSE, DECCW	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$50,000
2	Habitat requirements									
2.1	Survey known habitat	1	100%	DSE, DECCW	\$15,000	\$15,000	\$15,000	\$0	\$0	\$45,000
2.2	Identify, survey potential habitat	2	75%	DSE, DECCW	\$0	\$10,000	\$10,000	\$10,000	\$10,000	\$40,000
3	Manage threats									
3.1	Protect public land pops.	1	75%	DSE, DECCW, PV, NPWS, LG	\$10,000	\$10,000	\$10,000	\$5,000	\$5,000	\$40,000
3.2	Protect private land pops.	1	50%	DSE, DECCW	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$50,000
3.3	Control pest plants & animals	1	75%	DSE, DECCW, PV	\$15,000	\$10,000	\$10,000	\$5,000	\$5,000	\$45,000
3.4	Control roadside threats	1	75%	DSE, DECCW, LG, PV	\$10,000	\$10,000	\$10,000	\$5,000	\$5,000	\$40,000
3.5	Control biomass	1	75%	DSE, DECCW, LG	\$8,000	\$5,000	\$5,000	\$5,000	\$5,000	\$28,000
3.6	Assess salinity threat	2	75%	DSE, DECCW	\$0	\$5,000	\$5,000	\$5,000	\$0	\$15,000
4	Biology, ecology									
4.1	Reproductive status	2	75%	DSE, DECCW	\$15,000	\$10,000	\$10,000	\$8,000	\$8,000	\$51,000
4.2	Seed germination stimuli	2	75%	DSE, DECCW	\$0	\$0	\$0	\$10,000	\$10,000	\$20,000
4.3	Identify disturbance regimes	2	75%	DSE, DECCW	\$0	\$10,000	\$10,000	\$0	\$0	\$20,000
5	Population viability									
5.1	Determine population trends	2	75%	DSE, DECCW	\$5,000	\$5,000	\$7,000	\$10,000	\$10,000	\$37,000
6	Cultivation									
6.1	Establish seed bank	3	50%	DSE	\$0	\$0	\$5,000	\$2,000	\$2,000	\$9,000
7	Community support									
7.1	Community extension	3	100%	DSE, DECCW	\$4,000	\$4,000	\$4,000	\$4,000	\$4,000	\$20,000
				Total	\$102,000	\$114,000	\$121,000	\$89,000	\$84,000	\$510,000