

National Recovery Plan for the
Spiny Peppercross
Lepidium aschersonii

Oberon Carter



Prepared by Oberon Carter, Arthur Rylah Institute for Environmental Research, Department of Sustainability and Environment, Victoria.

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Cover photograph: Spiny Peppercreess *Lepidium aschersonii* at Lake Beeac Victoria, by Oberon Carter.

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Summary

The Spiny Peppercross *Lepidium aschersonii* is a small perennial herb endemic to mainland southern Australia, where it is widely but patchily distributed from New South Wales to Western Australia. Much of its habitat has been lost to agriculture, and remaining populations are mostly small, isolated and at risk from a range of threats including grazing, weed invasion, wetland drainage and other forms of habitat destruction. There are an estimated 25,000–100,000 plants remaining in about 30 wild populations. The Spiny Peppercross is listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In New South Wales, it is listed as Vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act). In Victoria it is listed as Threatened under the *Flora and Fauna Guarantee Act 1988*. In Western Australia, it is listed as Declared Rare Flora under the *Wildlife Conservation Act 1950*. This national Recovery Plan for the Spiny Peppercross is the first recovery plan for the species, and details its distribution and biology, conservation status, threats, and recovery objectives and actions necessary to ensure its long-term survival.

Species Information

Description

The Spiny Peppercross *Lepidium aschersonii* Thell. is a perennial, although apparently short-lived, herb of the family Brassicaceae. It grows to about 30 cm tall, with several erect, intricately branched stems arising annually from perennial underground rootstock. Small branches become spinescent with age, and in dry conditions all branches become woodier and spinier. Stems are covered with spreading or deflexed hairs. Basal leaves are pinnately lobed and quite fleshy, to 12 cm long and reducing in size up the stem, but usually not persistent (see photograph). Stem leaves are lanceolate to narrowly tapering, hairy, with toothed or entire margins, and become smaller with increasing height up the stems. The inflorescence is a tiny greenish raceme terminating in a spine. The sepals are c. 0.8 mm long, the petals reduced and linear, there are two stamens and the stigma is subsessile. The fruit is a hairless, two-chambered, ovate pod 3.5–4.5 mm long and 2.5–3 mm wide, with narrow wings forming a small apical notch. The fruit is borne on a pedicel 2–4 mm long that is hairy above but hairless below. Flowering occurs from spring to autumn (description from Hewson 1981, 1982; Retter & Harden 1990; Entwisle 1996; Harris & Smith 2000). The Spiny Peppercross may be generally distinguished from co-occurring native and introduced *Lepidium* species in having inflorescences that terminate in a spine.



A: basal leaves



B: seedling (photos by O. Carter at Lake Beeac Vic)

Little is known of the biology and ecology of the Spiny Peppercross. Abundant seed production has been noted in many populations, although numbers of established plants fluctuate greatly from year to year (Harris & Smith 2000). Increased numbers of plants have been observed during dry periods, perhaps due at least in part to the increased area of bare soil available for

seedling establishment (Harris & Smith 2000). The species occurs at some sites that are occasionally flooded, and shows some adaptation to the seasonal filling and drying of wetlands. At Lake Omeo (Vic), a seasonal lake, seed is stored in the lake bed and germinates when the lake dries out (Scarlett 1984). Established plants can also apparently withstand some period of submergence (Harris & Smith 2000).

Distribution

The Spiny Peppergrass is endemic to mainland southern Australia, where it is widely but patchily distributed from north-eastern New South Wales to Western Australia (Figure 1). Within this range, the species has been recorded from New South Wales, Victoria and Western Australia (Table 1). Historical records from South Australia are in error and most probably refer to *L. hyssopifolium* (Harris & Smith 2000). Maps showing the distribution of the Spiny Peppergrass in Victoria are available from the Department of Sustainability and Environment (DSE), in New South Wales from the Department of Environment, Climate Change and Water (DECCW), and in Western Australia from the Department of Environment and Conservation (DEC) (<http://florabase.dec.wa.gov.au/>).

Table 1. Distribution of Spiny Peppergrass by IBRA Bioregion* (*sensu DEH 2000)

State	Current distribution	Now absent from
New South Wales	Brigalow Belt South, Darling Riverine Plains, Cobar Penplain, Riverina	South Eastern Highlands
Victoria	Victorian Volcanic Plains, South Eastern Highlands	Victorian Midlands
Western Australia	Esperance Plains	

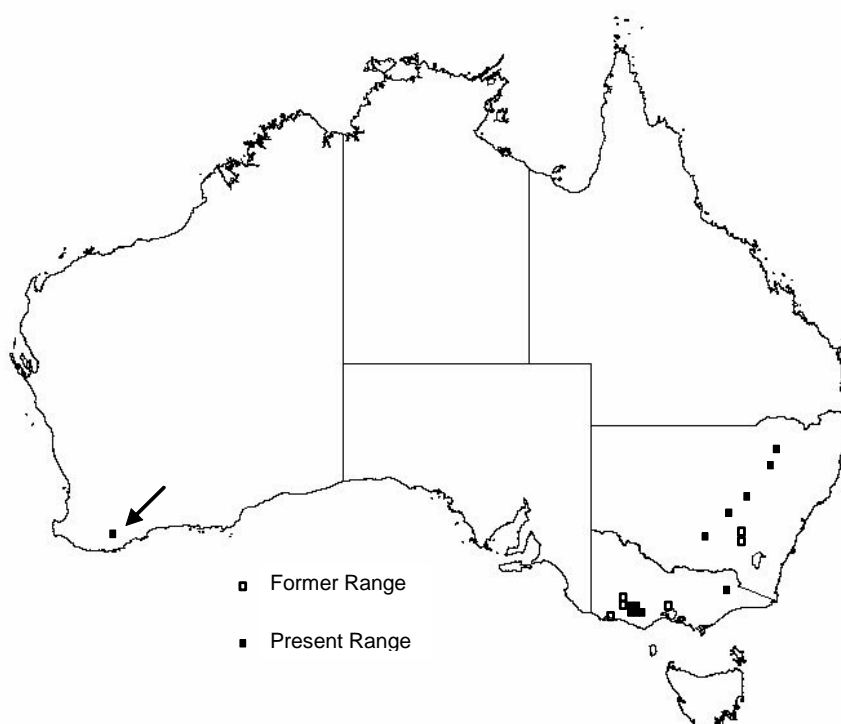


Figure 1. Distribution of the Spiny Peppergrass

Population Information

There are currently thought to be about 30 populations of Spiny Peppergrass, containing an estimated 25,000–100,000 plants (Table 2).

New South Wales

The Spiny Peppergrass has been recorded from at least 14 locations in New South Wales in the last 20 years, ranging from Moree in the north to near Leeton in the south. Two sites are in nature reserves, six occur on roadsides and at least five occur on private land. One population in Brigalow Park Nature Reserve near Narrabri contains 'many thousands' of individuals (M. White DSE pers. comm.) and may be the largest remaining population of Spiny Peppergrass.

Victoria

There are about 25 sites from two widely separated geographic locations in Victoria where the Spiny Peppergrass has been recorded in the last 30 years. The precise locations of several records are not known, while some others have not been seen in the last 10 years, so the species currently occurs at perhaps 18 sites. Almost all sites occur about 100–200 km west of Melbourne, mostly within the area bordered by Mortlake, Cressy, Colac and Ararat. There is also an isolated occurrence in eastern Victoria at Lake Omeo, near Benambra. Most sites (at least 14) occur on private property, while two sites occur within wildlife reserves, another four sites occur on public land, with one roadside site and one rail reserve site.

Western Australia

The only recent record of the Spiny Peppergrass in Western Australia is from 1976, at Corackerup, 30 km south east of Ongerup (Harris & Smith 2000). The precise collection site is not known, although it may have been within the Corackerup Nature Reserve (K. Atkins DEC pers. comm.). However, subsequent surveys in 1992 and 1993 failed to relocate the species, either within the reserve or in nearby habitat (K. Atkins DEC pers. comm.), and it is not known if the population is still extant. Collections of the species in an adjacent river catchment to the west in 1903 indicate that it may have once occurred over a broader part of this region.

Habitat

The Spiny Peppergrass occurs in periodically wet sites such as gilgai depressions and the margins of freshwater and saline marshes and shallow lakes, usually on heavy clay soil (Harris & Smith 2000). Almost all sites receive some degree of soil waterlogging or seasonal flooding. In northern NSW, sites are likely to be periodically inundated and remain wet for a few months each year, and plants often occur close to gilgai depressions that fill up with water seasonally (DEC 2002). However, some sites may not be wet each year. At Lake Omeo (Vic) the site is inundated about once every 5–10 years. The species also appears to be able to tolerate a range of salinity conditions, ranging from freshwater to highly saline sites such as Lake Corangamite and Lake Beac. Mean annual rainfall at all known sites is 500–800 mm.

In Victoria, other native species commonly occurring with Spiny Peppergrass include *Apium annuum*, *Atriplex australasica*, *Carex tereticaulis*, *Centaureum spicatum*, *Chenopodium glaucum*, *Chloris truncata*, *Dichondra repens*, *Distichlis distichophylla*, *Eleocharis acuta*, *Epilobium billardierianum*, *Geranium homeanum*, *Lachnagrostis aemula* s.l., *Lachnagrostis billardierei* s.l., *Lac. filiformis*, *Leptinella reptans* s.l., *Leptorhynchos waitzia*, *Lobelia pratiodes*, *Lythrum hyssopifolia*, *Poa labillardierei*, *Puccinellia stricta*, *Ranunculus glabrifolius*, *Ran. rivularis* s.l., *Rumex dumosus*, *Samolus repens*, *Sarcocornia quinqueflora*, *Schoenus nitens*, *Selliera radicans*, *Senecio glomeratus*, *Sonchus hydrophilus*, *Spergularia media* s.l., *Suaeda australis* and *Wilsonia rotundifolia*. In New South Wales the species grows in a range of woodland types including Brigalow *Acacia harpophylla*, Belah *Casuarina cristata*, Buloke *Allocasuarina luehmanii* and Grey Box *Eucalyptus microcarpa*, Bull Mallee *E. behriana* and Green Mallee *E. viridis*. At many sites, the ground layer is dominated by introduced plants, including *Bromus diandrus*, *B. hordeaceus* subsp. *hordeaceus*, *Cen. erthraea*, *Cirsium vulgare*, *Critesion hystrix*, *Cri. murinum* subsp. *leporinum*, *Hypochoeris radicata*, *Lactuca saligna*, *Lolium loliaceum*, *Lol. perenne*, *Melilotus indicus*, *Plantago coronopus*, *Rum. crispus*, *Scorzonera laciniata*, *Son. asper* s.l., *Spe. rubra* s.l., *Trifolium fragiferum* var. *fragiferum* and *Vicia* spp.

Recovery actions include appropriate surveys for determination and mapping of habitat that is critical to survival of the species.

Table 2. Population and threat information for the Spiny Peppercross

Location/site	Pop. size & year	Manager	Threats (H = High; M = Medium; L = Low)	Comments
New South Wales				
Brigalow Park Nature Reserve, Narrabri	15 plants (1994) 'thousands' (1998)	DECCW	<ul style="list-style-type: none"> Grazing/disturbance by feral animals, notably pigs (H) 	possibly largest extant population
Claremont Nature Reserve (proposed), Narrabri	~2,000 plants (1994) ~5,000 plants (2002)	DECCW	<ul style="list-style-type: none"> Grazing/disturbance by feral animals, notably pigs (H) 	proposed nature reserve (not yet gazetted)
roadside site 1, Narrabri	~600 plants (1994)	Shire of Narrabri	<ul style="list-style-type: none"> Roadworks (M) Weed invasion (M) 	
roadside site 2, Narrabri	18 plants (1994)	Shire of Narrabri	<ul style="list-style-type: none"> Roadworks (M) Weed invasion (M) 	
roadside site 3, Narrabri	~160 plants (1994)	Shire of Narrabri	<ul style="list-style-type: none"> Roadworks (M) Weed invasion (M) 	
roadside site 4, Narrabri	~200 plants (1994)	Shire of Narrabri	<ul style="list-style-type: none"> Roadworks (M) Weed invasion (M) 	
private land, Narrabri district	~500 plants (1993)	Private	<ul style="list-style-type: none"> Grazing by introduced herbivores and livestock (H) Weed invasion (M) 	'several sites' on private land
private land, Pilliga Rd, Narrabri	~150 plants (1993)	Private	<ul style="list-style-type: none"> Grazing by introduced herbivores and livestock (H) Weed invasion (M) 	count across 1,000m ² ; full extent of population not assessed
roadside, Barmedman	? (2004)	?	?	
Wyrra	? (2004)	?	?	
Eumungerie	? (2003)	private	?	
Bellata	? (2002)	private	?	
West Wyalong	? (1999)	private	?	
Leeton	? (1993)	?	?	
Victoria				
Lake Omeo, Benambra	'many' plants (1975) 1 plant (1982) 1-500 plants (1984) ~80 plants (1999) 0 plants (2000) 2 plants (2003) 0 plants (2004)	Shire of Omeo (as Committee of Management)	<ul style="list-style-type: none"> Altered hydrology (H) Grazing by introduced herbivores and livestock (H) Site disturbance from recreational activities (M) 	most plants occur at eastern end of lake bed, scattered over ~30 ha; few plants at south-western end.

Location/site	Pop. size & year	Manager	Threats	Comments
Victoria (cont.)				
Lake Beeac Wildlife Reserve	~100 plants (1981) ~100 plants (1993) ~40 plants (1999)	Parks Victoria	<ul style="list-style-type: none"> • Weed invasion, esp. <i>Lycium</i> and <i>Phalaris</i> (H) • Dumping of garden and household rubbish (L) • Rising saline water table (?) • Chemical seepage from former tip site (?) 	on eastern shore; few plants on western shore in 1993 but none seen since
Rossbridge – wildlife reserve and private land	~160 plants (1999)	Parks Victoria; private	<ul style="list-style-type: none"> • Weed invasion (H) • Grazing by introduced herbivores and livestock (M) 	50 plants in reserve, 110 on private land
Beeac Swamp – nature reserve and private land	~530 plants (1996) 6 plants (2003)	Parks Victoria; private	<ul style="list-style-type: none"> • Weed invasion (H) • Grazing/disturbance by livestock and introduced herbivores (M) 	mostly on north & west sides of wetland; 460 plants in reserve; 70 on private land
Lake Corangamite site 1	107 plants (1984) 6 plants (1998) 0 (2003)	Parks Victoria and a Committee of Management	<ul style="list-style-type: none"> • Weed invasion, esp. by <i>Lycium ferocissimum</i> (H) • Grazing/disturbance by livestock and introduced herbivores (?) 	across 1000m ²
Lake Corangamite site 2	30–40 plants (2002) 10–20 plants (2003)	Parks Victoria and a Committee of Management	<ul style="list-style-type: none"> • Weed invasion, esp. <i>Phalaris aquatica</i> (H) • Altered hydrology – site unlikely to reflood (H) • Trampling from recreational activities (M) 	across c. 25m ²
private land, Cundare North	~350 plants (1983)	private	<ul style="list-style-type: none"> • Grazing by livestock and introduced herbivores (H) • Weed invasion (H) • Changed land use (eg. grazing to cropping) (?) • Altered hydrology (?) 	across 10 ha
private land, Balintore, 7 km NNW of Colac	~350 plants (1986)	private	<ul style="list-style-type: none"> • Grazing by livestock and introduced herbivores (H) • Weed invasion (H) • Changed land use (eg. grazing to cropping) (?) • Altered hydrology (?) 	across 5 ha
private land, Larra Rd, Derrinallum	1983: 1000 plants	private	<ul style="list-style-type: none"> • Grazing by livestock and introduced herbivores (H) • Weed invasion (H) • Changed land use (eg. grazing to cropping) (?) • Altered hydrology (?) 	across <20 ha
private land, Wolbunya, 19 km N of Camperdown	1986: ~350 plants	private	<ul style="list-style-type: none"> • Grazing by livestock and introduced herbivores (H) • Weed invasion (H) • Changed land use (eg. grazing to cropping) (?) • Altered hydrology (?) 	across 5000 m ²
private land, Breeite-Beeac Rd, NW of Lake Beeac	1986: ~750 plants	private	<ul style="list-style-type: none"> • Grazing by livestock and introduced herbivores (H) • Weed invasion (H) • Changed land use (eg. grazing to cropping) (?) • Altered hydrology (?) 	across 12 ha

Location/site	Pop. size & year	Manager	Threats	Comments
Victoria (cont.)				
private land, W of Lake Beeac	1983: >1000 plants	private	<ul style="list-style-type: none"> • Grazing by livestock and introduced herbivores (H) • Weed invasion (H) • Changed land use (eg. grazing to cropping) (?) • Altered hydrology (?) 	across 8 ha
private land, Mortlake	1983: 70 plants	private	<ul style="list-style-type: none"> • Grazing by livestock and introduced herbivores (H) • Weed invasion (H) • Changed land use (eg. grazing to cropping) (?) • Altered hydrology (?) 	across 2500 m ²
private land, Cororooke	1998: ~400 plants	private	<ul style="list-style-type: none"> • Grazing by livestock and introduced herbivores (H) • Weed invasion (H) • Changed land use (eg. grazing to cropping) (?) • Altered hydrology (?) 	
private land, Coads Lane, Colac	1988: 'few thousand' plants	private	<ul style="list-style-type: none"> • Grazing by livestock and introduced herbivores (H) • Weed invasion (H) • Changed land use (eg. grazing to cropping) (?) • Altered hydrology (?) 	about 2 ha
private land, Ondit, 8 km NNE of Colac	<1000 plants (1988) 1 plant (1993)	private	<ul style="list-style-type: none"> • Grazing by livestock and introduced herbivores (H) • Weed invasion (H) • Changed land use (eg. grazing to cropping) (?) • Altered hydrology (?) 	plants occurred over 2 ha
private land, north shore of Lake Colac	12 plants (1988)	private	?	2500 m ²
private land, N of Lake Colac	6 plants (1988)	private	?	
private land, E of Lake Colac	?	private	?	plants not able to be re-located
private land, Lough Calvert	27 plants (1986)	private	?	across 170–250 m ²
railway reserve, Derrinallum	4 plants (1990) 0 (1993)	V Line	<ul style="list-style-type: none"> • Weed invasion, esp. by <i>Phalaris</i> spp (H) 	
south of Derrinallum	'few plants' (2004)	unknown	?	accurate location unknown
Omeo area	5 plants (1999)	unknown	?	accurate location unknown
Western Australia				
Corackerup, 30 km SE of Ongerup	1976: 'few plants'	unknown	Unknown	location unknown (Corackerup Nature Reserve?)

Decline and Threats

The Spiny Peppergrass has suffered an extensive decline in distribution and abundance since European settlement, and remaining populations are patchily distributed and isolated, often occurring in degraded remnant habitat. If the species no longer occurs in Western Australia, then that would result in a major contraction in current range. The Spiny Peppergrass was certainly once more common and widespread. There are many early records (generally prior to 1950, mostly from the late 19th and early 20th centuries) in areas where the species no longer occurs, such as in the Temora, Barmedman and West Wyalong areas (NSW; Smith 1994; Harris & Smith 2000), and from Skipton, the Grampians, Williamstown, Port Fairy and Lake Bolac (Vic; herbarium records). The species is very poorly reserved, with only four of the 16 or so known populations, comprising only 7–11% of total known abundance, occurring on public land. Most populations and plants occur on private land. Destruction and degradation of habitat through agricultural development has been the major cause of this decline in distribution and abundance, and the decline is continuing in many areas. Drainage, cultivation and livestock grazing have destroyed much of the habitat suitable for this species in Victoria. Current major threats are detailed as follows.

Weed invasion: Competition with introduced plant species is a problem at all populations. For example, at Lake Beeac (Vic) introduced Canary Grass *Phalaris aquatica*, Fog Grass *Holcus lanatus* and Perennial Rye Grass *Lolium perenne* have invaded the saltmarsh community, suppressing Spiny Peppergrass plants and inhibiting seedling regeneration (Harris & Smith 2000). Boxthorn *Lycium ferocissimum* is also spreading at this and the Lake Corangamite site. Populations at Lake Beeac and Beeac Swamp fenced to exclude livestock grazing subsequently declined due to growth of introduced pasture grasses outcompeting Spiny Peppergrass.

Grazing: Grazing by domestic stock can be a major threat. Sheep can destroy plants by grazing down to ground level and by digging out and eating roots, while cattle will eat young basal rosettes of leaves before the spiny branches develop. Heavy grazing by cattle or sheep can result in the loss of plants due to trampling, soil compaction and 'pugging' of waterlogged soils. Decline in plant numbers following increased cattle stocking rates has been observed at a number of locations (Harris & Smith 2000). European rabbit *Oryctolagus cuniculatus* eat Spiny Peppergrass shoots, leaves and roots and the effects of this may be more severe during drought conditions (Harris & Smith 2000). Grazing and soil disturbance by feral Pig *Sus scrofa* is a serious threat to NSW populations, notably in Brigalow Park and Claremont Nature Reserves.

Light, seasonal grazing may however be beneficial in some circumstances, by preventing pasture grasses from dominating sites and outcompeting Spiny Peppergrass. Occasional light grazing by domestic stock may also keep the field layer vegetation suitably open to allow seedling regeneration. Any grazing is preferable in winter, when plants have died down (Harris & Smith 2000).

Altered hydrology: Wetland drainage, as well as destroying or degrading habitat, has also altered the flooding/drying cycle at many sites, especially in Victoria. Water erosion or prolonged flooding may threaten plants close to lake shorelines (Harris & Smith 2000). At Lake Omeo, in eastern Victoria, it is highly likely that the natural flooding/drying cycles have been substantially altered, as the lake has filled only twice in last 40 years. There are over 50 dams on inflowing creeks that have reduced inflow, and drainage of adjacent marshland has possibly reduced groundwater levels.

Habitat destruction: Much of the habitat of Spiny Peppergrass has already been cleared or has been highly modified, and ongoing habitat destruction is still an issue in NSW. In the Narrabri area of NSW, the range of Spiny Peppergrass has been greatly reduced in the past four decades due to agricultural developments (DEC 2002). Even in the 1980s, about 8,000 ha of Brigalow woodland still remained, but much of this has since been cleared. Remaining habitat on private land is still at risk from clearing. If reported plans to create a permanent lake at Lake Omeo (Vic) are implemented, the species may be eliminated at this site (Scarlett 1984). The region where Spiny Peppergrass was recorded in Western Australia has been extensively cleared for agriculture, with remaining habitat areas being isolated conservation reserves and narrow river corridors that are often affected by secondary salinity (K. Atkins pers. comm.).

Roadworks: Several populations (mostly in NSW) occur on roadsides and are potentially at risk from roadworks, firebreak construction and utilities installation and maintenance.

Recovery Information

Recovery Objectives

The Overall Objective of recovery is to minimise the probability of extinction of the Spiny Peppercross 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 Spiny Peppercross are to:

1. Determine distribution, abundance and population structure
2. Determine habitat requirements
3. Identify and manage threats to populations
4. Identify key biological functions
5. Determine growth rates and viability of populations
6. Establish a seedbank in storage
7. Build community support for conservation

Program Implementation and Evaluation

This Recovery Plan will run for five years from the date of its adoption under the EPBC Act, and will be managed by the nature conservation agency in each State. In Victoria, the program will be managed by the Department of Sustainability and Environment. Recovery actions in NSW will be managed by the Department of Environment, Climate Change and Water. Recovery actions in Western Australia will be managed by the Department of Environment and Conservation (coordinated through the South Coast Threatened Flora and Ecological Communities Recovery Team). Each agency will be responsible for preparing work plans and monitoring progress toward recovery. Liaison between responsible agencies on recovery issues and actions will be maintained. This Recovery Plan will be reviewed and revised within five years of the date of its adoption under the EPBC Act.

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. Responsibility: PV, DSE, DECCW, DEC	<ul style="list-style-type: none"> Ten populations mapped for population size, condition and habitat. Status of species in WA determined.
Specific Objective 2: Determine habitat requirements		
2.1	Accurately survey known habitat and collect floristic and environmental information relevant to community ecology and condition. Responsibility: PV, DSE, DECCW	<ul style="list-style-type: none"> Habitat critical to survival mapped for 10 populations.
2.2	Identify and survey potential habitat, using ecological and bioclimatic information that may indicate habitat preference. Responsibility: DSE, DECCW, DEC	<ul style="list-style-type: none"> Predictive model for potential habitat developed and tested at five sites.
Specific Objective 3: Identify and manage threats to populations		
3.1	Protect populations on public land. Responsibility: PV, DSE, DECCW	<ul style="list-style-type: none"> Joint management agreements developed under the <i>TSC Act 1995</i> for populations at Narrabri. Negotiation undertaken with Lake Omeo Management Committee to manage grazing and flooding regime at Lake Omeo for conservation of Spiny Peppercross. Public Authority Management Agreements negotiated under the <i>FFG Act 1988</i> with relevant Shires where the species occurs, particularly along roadsides.
3.2	Protect populations on private land. Responsibility: DSE, DECCW	<ul style="list-style-type: none"> Discussions initiated and joint management agreements negotiated with 2 private landholders in NSW and 8 in Victoria.
3.3	Control threats from livestock and feral animals. Responsibility: PV, DECCW	<ul style="list-style-type: none"> Pig control programs continued at Narrabri. Fence maintained at Lake Beeac, Lake Corangamite, Rossbridge Wildlife Reserve, Beeac Swamp, Claremont Nature Reserve and Brigalow Park, in conjunction with management grazing (see below) Rabbit populations controlled, especially at Lakes Beeac & Corangamite.
3.4	Control threats from pest plants. Responsibility: PV, DSE	<ul style="list-style-type: none"> The size and extent of weed invasion at Beeac Swamp, Lake Beeac, Lake Corangamite, and Lake Omeo is assessed and mapped. Boxthorn controlled at Lake Corangamite and Lake Beeac. <i>Phalaris</i> and other environmental weeds controlled at

- 3.5 Control threats from physical damage, maintenance works and recreational activities.
Responsibility: DSE
- Weeds controlled at Lake Omeo.
 - Light management grazing regimes implemented at Beeac Swamp, Rossbridge Wildlife Reserve and Lake Omeo to control pest plants and enhance Spiny Peppercress populations.
 - Habitat loss during ongoing construction and maintenance works at Derrinallum Railway Reserve prevented through establishing signage and creating awareness.
 - Negotiations undertaken regarding the proposal to alter drainage patterns and permanently fill Lake Omeo.
 - VLine staff and contractors are able to identify Spiny Peppercress, and are aware of the locations of existing populations, notably at Derrinallum Railway Reserve.

Specific Objective 4: Identify key biological functions

- 4.1 Evaluate current reproductive status, seed bank status, longevity, fecundity and recruitment levels.
Responsibility: DSE, DECCW
- 4.2 Identify key stimuli for seed germination requirements.
Responsibility: DSE, DECCW
- 4.3 Identify disturbance regimes to maintain or improve habitat.
Responsibility: DSE, DECCW
- Reproductive ecology and regenerative potential quantified for four representative sites.
 - Seed bank potential quantified for 10 representative sites.
 - Stimuli for recruitment identified.
 - Management strategies identified to maintain, enhance or restore processes fundamental to reproduction and survival.
 - Preparation of management prescriptions for ecological burning/grazing undertaken at target sites.
 - Management prescriptions implemented at three sites.

Specific Objective 5: Determine the growth rates and viability of populations

- 5.1 Measure population trends and responses against recovery actions by collecting demographic information including recruitment and mortality, timing of life history stages and morphological data.
Responsibility: PV, DSE, DECCW
- Techniques for monitoring developed and implemented.
 - Population growth rates determined and Population Viability Analysis completed for six important populations.

Specific objective 6: Establish a seed bank

- 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 conservation

- 7.1 Identify opportunities for community involvement in the conservation of Spiny Peppercress.
Responsibility: DSE, DECCW
- Community nature conservation and Landcare groups aware of the species and support its conservation.

Abbreviations: DEC – Department of Environment and Conservation (WA); DECCW – Department of Environment ,Climate Change and Water (NSW); DPI – Department of Primary Industries (Vic); DSE – Department of Sustainability and Environment (Victoria); PV – Parks Victoria

Affected Interests

Important populations of Spiny Peppergrass are under the jurisdiction of the Department of Sustainability and Environment (Vic), Parks Victoria, the Department of Environment, Climate Change and Water (NSW), the Shire of Omeo (Lake Omeo Management Committee) and Narrabri Shire Council, who have been contacted and have approved actions outlined in this Recovery Plan, subject to available funding. Private landholders have been contacted where management actions are proposed, and other private landholders will be contacted upon implementation of this plan. Should the Spiny Peppergrass be re-located in Western Australia, the Department of Environment and Conservation (WA) would be the primary agency with an interest, along with the respective manager of the land on which it is found.

Role and Interests of Indigenous People

Indigenous communities on whose traditional lands the Spiny Peppergrass occurs are being advised, through the relevant regional Indigenous Facilitator, of this Recovery Plan. Indigenous communities with interests in lands on which the species occurs will be invited to be involved in the implementation of the Recovery Plan.

Biodiversity Benefits

Implementing recovery actions for the Spiny Peppergrass will also be of potential biodiversity benefit for other threatened or declining species and vegetation communities in Victoria, New South Wales and potentially Western Australia. In NSW, populations occur within Brigalow woodland, a vegetation community that has minimal representation within nature reserves in NSW, and is a listed Endangered Ecological Community under the EPBC Act 1999 and the NSW TSC Act 1995. The vegetation at the Lake Omeo (Vic) site has been classified as Montane Lakebed Herbland, a highly significant Ecological Vegetation Class, known from no other location in Victoria. Efforts to protect Spiny Peppergrass will complement the conservation of other threatened or declining grassland species including Button Immortelle *Leptorhynchus waitzia*, Slender Bindweed *Convolvulus angustissimus*, Plains Yam-daisy *Microseris* sp. 1, Australian Anchor Plant *Discaria pubescens* and Omeo Stork's-bill *Pelargonium* sp. 1. 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. Several 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.

Management Practices

Management practices required to conserve the Spiny Peppergrass include:

- Fencing and signposting to protect sites 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, through 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 habitat, especially in disturbance regimes required to maintain populations.

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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									
1.1	Pop surveys	1	100%	PV, DSE, DEC, DECCW	\$15,000	\$10,000	\$10,000	\$10,000	\$5,000	\$50,000
2	Habitat requirements									
2.1	Survey known habitat	1	100%	PV, DSE, DECCW	\$10,000	\$10,000	\$10,000	\$0	\$0	\$30,000
2.2	Identify survey potential habitat	2	75%	DSE, DEC, DECCW	\$0	\$20,000	\$20,000	\$20,000	\$0	\$60,000
3	Manage threats									
3.1	Protect public land pops	1	75%	PV, DSE, DECCW	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$75,000
3.2	Protect private land pops	1	50%	DSE, DECCW	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$75,000
4.2	Control feral animals	1	75%	PV, DECCW	\$15,000	\$10,000	\$10,000	\$10,000	\$10,000	\$55,000
4.3	Control pest plants	1	75%	PV, DSE	\$15,000	\$10,000	\$10,000	\$10,000	\$10,000	\$55,000
4.4	Control threats from works	1	75%	DSE	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$25,000
4	Biology, ecology									
4.1	Reproductive status		75%	DSE, DECCW	\$0	\$12,000	\$12,000	\$12,000	\$0	\$36,000
4.2	Seed germination stimuli		75%	DSE, DECCW	\$0	\$12,000	\$12,000	\$0	\$0	\$24,000
4.3	Identify disturbance regimes	1	75%	PV, DSE	\$0	\$15,000	\$15,000	\$5,000	\$5,000	\$40,000
5	Growth rates, pop. viability									
5.1	Determine pop. trends	2	75%	PV, DSE, DECCW	\$5,000	\$10,000	\$10,000	\$10,000	\$10,000	\$45,000
6	Establish seed bank									
6.1	Establish seed bank	3	75%	DSE, DECCW	\$0	\$3,000	\$3,000	\$0	\$0	\$6,000
7	Community support									
7.1	Community extension	2	100%	DSE, DECCW	\$4,000	\$4,000	\$4,000	\$4,000	\$4,000	\$20,000
TOTALS					\$99,000.00	\$151,000.00	\$151,000.00	\$116,000.00	\$79,000.00	\$596,000.00