Recovery Plan for *Prostanthera eurybioides* (Monarto Mintbush)

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Environmental and Biodiversity Services

Written on behalf of the South Australian Department for Environment and Heritage

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Australian Government

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A Recovery Plan prepared under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*.

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Note: This recovery plan sets out the actions necessary to stop the decline of, and support the recovery of, the listed threatened species or ecological community. The Australian Government is committed to acting in accordance with the plan and to implementing the plan as it applies to Commonwealth areas.

The plan has been developed with the involvement and cooperation of a broad 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.

Further copies of this Recovery Plan are available from:
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Cover photograph of Monarto Mintbush flowers by Manfred Jusaitis (DEH).

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Summary

Conservation Status

Table 1. Status of *Prostanthera eurybioides*.

Scientific name	Synonym	Common name	*EPBC Act* 1999 (national)	*NPW Act* 1972 (SA)	Regional status (Lang & Kraehenbuehl 2002)
Prostanthera eurybioides	None	Monarto Mintbush	Endangered	Endangered	Endangered (MU) Endangered (SE)

MU – Murray Herbarium Region, SE – South Eastern Herbarium Region of SA.

Recovery Objectives

1. Short Term: To improve the age structure of the community by enhancing recruitment within the populations.

2. Medium Term: To increase the probability of survival of *Prostanthera eurybioides* across the entire range of the species.

3. Long Term: To improve the conservation status of *P. eurybioides* from Endangered to Vulnerable.

Specific Objectives

1. To maintain and increase the area of occupancy of the species.

2. To improve the quality of habitat of the species.

3. To maintain or increase the abundance of the species.

4. To preserve the degree of genetic variability within the species.

5. To reduce the grazing impact of rabbits, sheep and kangaroos.

Performance Criteria

1. The current known area of occupancy is increased over five years.

2. The total number of mature plants is increased from its current level of approximately 2230 to 4500 in five years by planting from seed stock and increasing recruitment.

3. Weed control measures substantially reduce the abundance of *Avena* spp., *Ehrharta calycina*, *Lycium ferocissimum* and *Vulpia* spp. in areas of habitat currently occupied by *Prostanthera eurybioides,* within five years.

4. A 250m buffer is established around habitat currently occupied by *P. eurybioides*, where *Asparagus asparagoides* is to be substantially reduced in abundance within five years.

5. Rabbits within the habitat critical to the survival of *P. eurybioides* are controlled by baiting and ripping, with a 100% reduction in the number of warrens present within five years.

6. The possibility of including additional habitat containing *P. eurybioides* in the National Reserve System (NRS) is investigated within five years.

7. Where appropriate, fencing is erected within two years to exclude sheep from populations on private property in the Monarto area.

8. The impacts of kangaroo grazing and numbers in the area are investigated, with a control program, including fencing or caging where appropriate, implemented within two years if considered necessary.

9. Roadside markers are installed at the site of roadside populations of *P. eurybioides*, and roadside maintenance staff is alerted to the presence and significance of the plants within two years.

10. Through the development of community awareness, and fencing where appropriate, the impacts of trail bike damage and illegal collecting and / or illegal rubbish dumping are significantly reduced within five years.

11. Seed from each regional location is collected and stored within one year to boost current seed stores and provide seed to conduct seed longevity tests.

12. Seed germination tests and seedbank trials are conducted within three years, to establish the longevity of seed maintained in storage and the extent and viability of the seedbank.

Recovery Actions

1. Continue seed collection and storage to minimise loss of genetic variability.

2. Undertake weed control.

3. Undertake rabbit control.

4. Investigate kangaroo grazing damage.

5. Fence to control stock.

6. Prevent damage from recreational activities.

7. Install roadside markers.

8. Search for new populations.

9. Undertake strategic research and trials.

10. Investigate the possibility of additional legal protection for *P. eurybioides* habitat within the National Reserve System.

11. Continue monitoring of all known sites.

12. Manage the recovery program through the recovery team.

13. Undertake ongoing educational programs.

14. Enhance recruitment.

Duration and Costs

Task	Task Description	Priority	Location	Cost Estimate ($)					
				Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
1	Collection and storage of seed	1	MT & MM	3500	200	200	200	1000	5,100
2	Weed control	1	MT & MM	10000	10000	8000	5000	5000	38,000
3	Rabbit control	1	MT & MM	4000	2000	1000	1000	1000	9,000
4	Investigate kangaroo damage	1	MM	2000	1000	1000	1000	1000	6,000
5	Fence to control stock	1	MT	6000	4000				10,000
6	Prevention of damaging activities	1	MT & MM	1000	10000	1000	1000	1000	14,000
7	Installation of roadside markers	1	MT	3000					3,000
8	Search for new populations	2	MT & MM	2000	2000	1000	1000		6,000
9	Undertake strategic research & trials	2	MT & MM	6000	6000	3000	3000		18,000
10	Explore additional habitat in reserves	2	MT & MM	2000	2000				4,000
11	Population monitoring	2	MT & MM	5000	5000	5000	5000	5000	25,000
12	Recovery team	2	MT & MM	5000	5000	5000	5000	5000	25,000
13	Ongoing educational programs	3	MT & MM	3000	3000	3000	3000	3000	15,000
14	Enhance recruitment	3	MT & MM		1000	1000	1000	1000	4,000
		TOTAL		52500	51200	29200	26200	23000	182,100

MT = Monarto population, MM = Mt Monster population

Part A: Species Information and General Recovery Plan Requirements

Species

This recovery plan is for *Prostanthera eurybioides* (Family Lamiaceae), which is listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Conservation Status / Taxonomy / Description of Species

Table 1. Status of *Prostanthera eurybioides*.

Scientific name	Synonym	Common name	*EPBC Act* 1999 (national)	*NPW Act* 1972 (SA)	Regional status (Lang & Kraehenbuehl 2002)
Prostanthera eurybioides	None	Monarto Mintbush	Endangered	Endangered	Endangered (MU) Endangered (SE)

MU – Murray, SE – South Eastern.

Description

Prostanthera eurybioides is a low spreading shrub growing to a height of less than 1 m with branches that are densely covered with curled, 0.1 to 0.2 mm long hairs. Leaves are clustered on short shoots and are thick, glabrous or sparsely hairy and sparsely to moderately glandular. Petioles are either absent or to 0.1 mm long and the leaf blades are elliptic to ovate, 1.5-2.5 mm long, 0.6-2.2 but usually 1-2 mm wide, the base is obtuse to rounded, and the margins are entire. The leaf apex is obtuse, and venation (including the midrib) is not visible (Jessop and Toelken, 1986).

A more detailed description of the species can be found in Jessop and Toelken (1986).

International obligations

As *P. eurybioides* is not listed under any international agreement, the implementation of Australia's international environmental responsibilities is not affected by this plan. However, the plan has been written with a view to meeting Australia's international environmental responsibilities in so much as a co-operative approach will be encouraged through the involvement of a wide range of stakeholders.

Affected interests

The community groups and statutory organisations presented in Table 2 have been identified as current and potential stakeholders in the management of *Prostanthera eurybioides*.

Role and interests of Indigenous people

The Aboriginal Partnerships Section (APS) of the Department for Environment and Heritage (DEH) has been contacted regarding the development of this recovery plan. The locations of *Prostanthera eurybioides* populations have been provided to APS and forwarded to the Department of Aboriginal and Indigenous Services. This consultation was an initial approach to identifying the relevant Indigenous people that may have an interest in *P. eurybioides* and the area in which it occurs. The Aboriginal heritage organisations that were identified as being potentially interested have since been contacted but no comments have been received from these organisations.

The relevant provisions of the *Native Title Act* 1993 should be considered before undertaking any future acts that might affect Native Title. The requirements of the *Native Title Act* 1993 only apply to land where Native Title rights and interests may exist. However, when implementing any recovery actions in this threatened species plan where there has been no Native Title determination, or where there has been no clear extinguishment of Native Title, there needs to be consideration of the possibility that Native Title may continue to exist. Nothing in the plan is intended to affect Native Title. Furthermore, this Recovery Plan will be adopted subject to any Native Title rights and interests that may continue in relation to the land and/or waters. Procedures under the *Native Title Act* 1993 are also additional to those required to comply with the *Aboriginal Heritage Act* 1998.

Benefits to other species/ecological communities

The following plant communities similar to those in which *Prostanthera eurybioides* is found, located within the Murray-Darling Basin, are classed as regionally threatened:

- *Eucalyptus porosa* low open-woodland,
- *Eucalyptus leucoxylon* woodland with grassy understorey (Kahrimanis *et al.*, 2001).

It is likely that these communities will benefit from the recovery plan due to abatement of threats in any of these communities directly overlapping habitat for *P. eurybioides.* Further benefit may be gained by protection and rehabilitation of these communities due to their potential for future habitat of *P. eurybioides*.

At least five plant communities overlap to some degree with the habitat of *P. eurybioides* and should benefit from the implementation of actions recommended under this recovery plan. Furthermore, improving the habitat for *P. eurybioides* will improve the quality of the native vegetation, which may directly benefit any fauna within the area that depend on native ecosystems.

Table 2. List of current and potential stakeholders in the management of *Prostanthera eurybioides*.

National Stakeholders	**Person Contacted**
Department of the Environment, Water, Heritage, and the Arts	Andrew Chalklen, Peter Latch
General Public	
State Stakeholders	
Department for Environment and Heritage	Doug Bickerton, Peter Copley
• Botanic Gardens of South Australia	Manfred Jusaitis
• Seed Conservation Centre, BG of SA	Phil Ainsley
Department for Transport, Energy and Infrastructure	
Threatened Plant Action Group	Tim Jury
Mega Minerals Pty Ltd	
Boral Pty Ltd	
Regional Stakeholders	
Threatened Flora and Habitat Recovery Officer, Dept. Environment & Heritage, Mt Gambier	Cath Dickson
Murray Mallee Local Action Planning Board Inc	Rowena Danks
Tatiara District Council	Parks and Gardens Officer
The Rural City of Murray Bridge	John Williams, Glen Dean
Friends of the Upper South-east Parks	John Samuel-White
PIRSA Rural Solutions	Janet Kuys
Eastern Hills & Murray Plains Catchment Group Inc	Steve Coombe
Friends of Parks	
Lacepede, Tatiara and Robe Councils	Lindsay Cadzow
Tattyara Aboriginal Heritage Consultancy	Kerry Hunt
Kungari Heritage Association Inc.	Noeline Casey
Ngarrindjeri Heritage Committee Inc.	Tom Trevorrow
South Australian Murray Darling Basin Natural Resource Management Board	
South East Natural Resource Management Board	

Social and economic impacts

Overall, the implementation of this recovery plan is unlikely to cause significant adverse social and economic impacts. The only possible exception to this relates to the disused quarry adjacent to Mt Monster Conservation Park. It is considered that mining activities at this site would be detrimental to the 250 *Prostanthera eurybioides* found adjacent to the quarry, and therefore recommencement of mining activities would not be recommended. This may result in a negative economic impact.

Through the implementation of actions outlined in the recovery plan, there will be direct positive social impacts to local communities through their involvement with the recovery plan. Community involvement with the recovery plan will foster the building of strong community links and community empowerment.

Part B: Distribution and Location

An endemic of South Australia, *Prostanthera eurybioides* has a limited distribution and is located in two disjunct areas, Monarto (near Murray Bridge) and the Mt Monster area in the south east of the State near Keith (Figure 1). Given the specific habitat requirements of this species, it is likely most populations are known; although some populations may remain undiscovered on private property.

To determine the locations of populations, information was collected from past reports, personal communications with individuals previously involved with the species and observations in the field. The following databases were consulted at DEH: the Threatened Plant Population Database (DEH, 2008a), the Opportune Sighting Database (DEH, 2008b), the Reserve Database (DEH, 2008c), the Survey Database (DEH, 2008d) and the State Herbarium of South Australia Database (AD, 2008).

Extent of occurrence

The extent of occurrence of populations of *P. eurybioides* that have been sighted since 1980 is 937.9 km^2.

Area of occupancy

For the purposes of this recovery plan, populations are defined as geographically or otherwise distinct groups within a species between which there is little chance of demographic or genetic exchange (typically one successful migrant individual or gamete per year or less). The area of occupancy of *Prostanthera eurybioides* populations is yet to be defined adequately and measured accurately.

The area of occupancy was estimated by using the following method:

- Records from all DEH databases were consulted. These records were all of sites where the species is found naturally occurring.
- DEH database records from 1980 onwards were considered to be of extant populations. Records prior to 1980 were considered historical and were excluded from the calculation.
- All records found to be within 1 km of another record were considered to be of the same population.
- All single records found more than 1 km from another record were given an arbitrary area of occupancy of 1 ha.
- The area of occupancy at three disjunct translocated sites was also included.

The area of occupancy in the Monarto area is estimated to be approximately 253 ha. The largest population in this area measured 162 ha. There are nine distinct populations, including seven records of approximately 1 ha each.

The area of occupancy in the Mt Monster area is estimated to be approximately 213 ha. There are three distinct populations, including the two planted populations at Christmas Rocks and Kongal Rocks, which are known to cover less than 1 ha each (Johnson, pers. comm. 2007). All other records in this area are considered to be of the one population.

Based on these calculations and assumptions the total area of occupancy of both planted and naturally occurring *P. eurybioides* individuals is approximately 466 ha, in twelve populations.

Population size

It is estimated that the total species population in the wild is approximately 2233, consisting of 1216 naturally occurring plants and 1017 translocated plants.

Monarto

It is estimated that there are approximately 1058 *P. eurybioides* individuals in nine populations within the general Monarto area. Of these, approximately 193 occur naturally in four populations, ranging in abundance from 123 to one. Three of these sites have been supplemented with planted individuals, and another three sites have only planted individuals. In total approximately 865 planted individuals survive in the Monarto area.

In 2003, State Flora Murray Bridge planted approximately 1,000 individuals at Rocky Gully Reserve (Collins, pers. comm. 2004), however by 2005 only 452 of these were found alive (Obst, 2005). These plants were all propagated from cuttings from seven old remnant shrubs within the reserve (Collins, pers. comm. 2004). The location of this recent planting has not been included on the maps presented within this plan, as accurate spatial information could not be obtained.

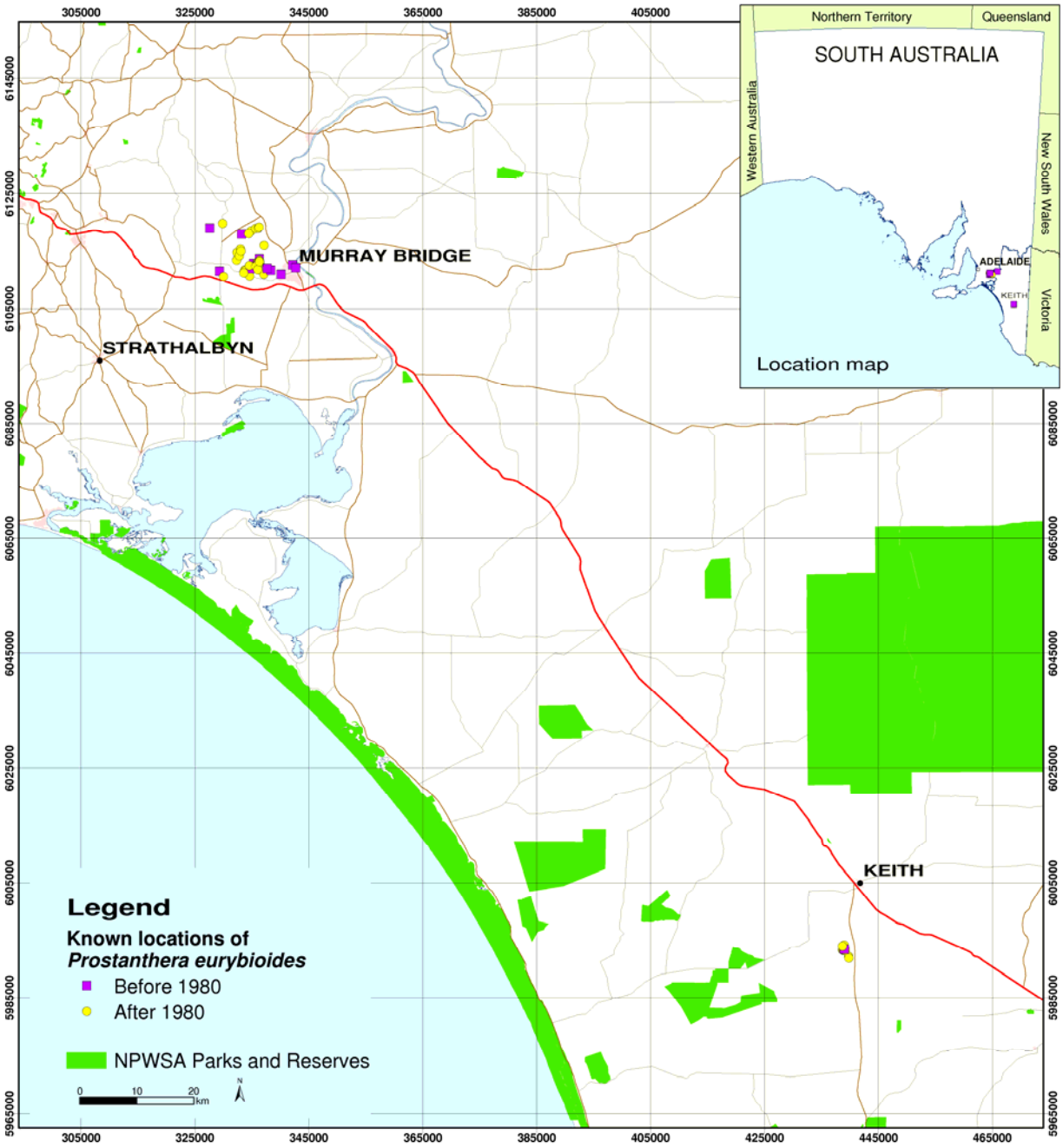
Other planted individuals within this area were seedlings propagated from locally collected seed. A total of 130 are located within the grounds of Monarto Zoo, 67 were planted by a landholder in the south-western portion of a Heritage Agreement at Monarto (Jusaitis and Smith, 1999), and 196 were translocated to Section 530, Hundred of Monarto (Jusaitis *et al*., 1998). A further 10 plants survive from an initial 30 plants that were planted on private land in 1996 (Jusaitis and Smith, 1999) and another 10 plants were planted on a property under a Scientific Heritage Agreement (grazing prohibited), however their origins are unclear.

Mount Monster

In February 2007 a thorough survey was conducted in the Mount Monster area, and approximately 1175 individuals were recorded, with populations occurring within the Mount Monster Conservation Park and surrounding areas including Christmas Rocks, Kongal Rocks and Monster Rock (Johnson, pers. comm. 2007). Of this total, approximately 1023 plants are naturally occurring and approximately 152 individuals were planted. The planted individuals are the survivors of 182 plants translocated during 1997 and 1998 (Jusaitis and Smith, 1999); seedlings propagated from locally collected seed, with 50 seedlings translocated to Christmas Rocks and Kongal Rocks, and 132 seedlings planted on rocky outcrops near the southern boundary in Mount Monster Conservation Park (Jusaitis and Smith, 1999).

The location of all records can be seen in Figure 1. Records prior to 1980 are considered historic and have been identified separately on the map.

Figure 1. The location of known populations of Monarto mintbush *(Prostanthera eurybioides)* in South Australia



Habitat critical to the survival of the species/community

The EPBC Act requires recovery plans to identify habitats that are critical to the survival of the species concerned. Under Regulation 7.09 of the *Environment Protection and Biodiversity Regulations 2000* (EPBC Regulations), habitat critical to survival might comprise:

- Sites to meet essential life cycle requirements,
- Sites of food sources, water, shelter, fire and flood refuges or those used at other times of environmental stress,
- Essential travel routes between the above sites,
- Sites necessary for seed dispersal mechanisms to operate or to maintain populations of species essential to the threatened species or ecological community,
- The habitat used by important populations,
- Habitat that is required to maintain genetic diversity,
- Areas that may not be occupied by the species and/or ecological community but are essential for the maintenance of those areas where they do occur.

Potential habitat is defined as habitat which may be currently unoccupied by a particular species, but which could present opportunities for reintroduction or reinvasions, or may maintain only a dormant seed bank. Potential habitat needs to be identified, protected and/or rehabilitated to ensure the long-term future of the species and/or ecological community.

Given that *P. eurybioides* is endangered it is considered that all known habitat is critical to the survival of the species because:

- The habitat meets essential life cycle requirements including growth and reproduction,
- The habitat provides necessary water and required nutrients for the species,
- All sites are necessary for seed dispersal mechanisms to operate and are likely to maintain populations of pollinating species essential to the threatened species,
- This habitat is required to maintain genetic diversity.

The known critical habitat of *P. eurybioides* is comprised of the following characteristics of topography, soil type, plant associations and climate.

Topography and Soil Type

Davies (1992) reports that *P. eurybioides* grows on sandy loam, fine sandy loam and loam of pH 6 to 7. These soils were brown, reddish brown or dark brown in colour when dry and dark brown or dark reddish brown when wet. At all known locations *P. eurybioides* were growing in association with rocky outcrops of gneissic schist, granodiorite or granite. All individuals within the Monarto area were present on gentle slopes of low broad hills or ridges, or on undulating plains. In the Mt Monster area individuals were only found on rocky outcrops on south to west facing slopes, of up to 40º inclination on the ridges of Mt Monster (Davies, 1992).

Plant Associations

Prostanthera eurybioides occurs in the following plant associations within the Monarto region:

- *Eucalyptus porosa* low open-woodland +/- *E. leucoxylon* (Jusaitis 1991; Davies 1992),
- *Eucalyptus leucoxylon* very low open-woodland +/- *E. porosa* or *E. odorata* (Davies, 1992),
- *Eucalyptus dumosa* and/or *E. leptophylla* +/- *E. incrassata* tall shrubland (closed to open) (Davies, 1992),
- *Melaleuca uncinata* tall shrubland/heathland +/- *Acacia rhigiophylla* (Davies, 1992),
- *Melaleuca uncinata* shrubland +/- *Eucalyptus phenax* subsp. *phenax*, *E. incrassata*, *E. socialis*, *E. porosa* and *E. leptophylla* (Obst, 2005).

Within the Mount Monster Conservation Park *P. eurybioides* grows in the following plant association:

- *Acacia paradoxa* or *Babingtonia behrii* sparse heathland or shrubland, (Jusaitis 1991; Davies 1992).

Climate

Temperature and rainfall data from the closest weather stations to *P. eurybioides* populations (Murray Bridge and Keith) indicate that *P. eurybioides* prefers a climate of cool moist winters and warm to hot dry summers. Monthly average temperatures in both districts range from 6^{o}C (min) and 16^{o}C (max) in July to 13^{o}C (min) and 30^{o}C (max) in February. The average annual rainfall is approximately 340mm near Monarto and approximately 470mm near Keith.

Fire and disturbance

The impact of fire on *P. eurybioides* is not thoroughly understood; however plants have been reported to regenerate after a fire on one property in 1988 and seed germination is known to be stimulated by the use of smoked water (Jusaitis and Smith, 1999). Jusaitis *et al*. (1998) also found seeds germinated well after 1m^2 plots were burnt.

Mapping of habitat critical to the survival of the species

It is considered that all currently occupied habitat of *Prostanthera eurybioides* is critical to the survival of the species, as discussed above. The locations of all areas of habitat critical to the survival of *P. eurybioides* are presented in Figures 2 and 3. For the purposes of this recovery plan the habitat considered critical to the survival of *P. eurybioides* is the currently occupied habitat, including any native vegetation occurring within a buffer of 500 metres around each population.

Important populations

All populations of *Prostanthera eurybioides* are considered important due to the small total population size of this species; hence all populations should be managed for the protection of this species. The distribution of *P. eurybioides*, including all populations of importance, is shown in Figure 1.

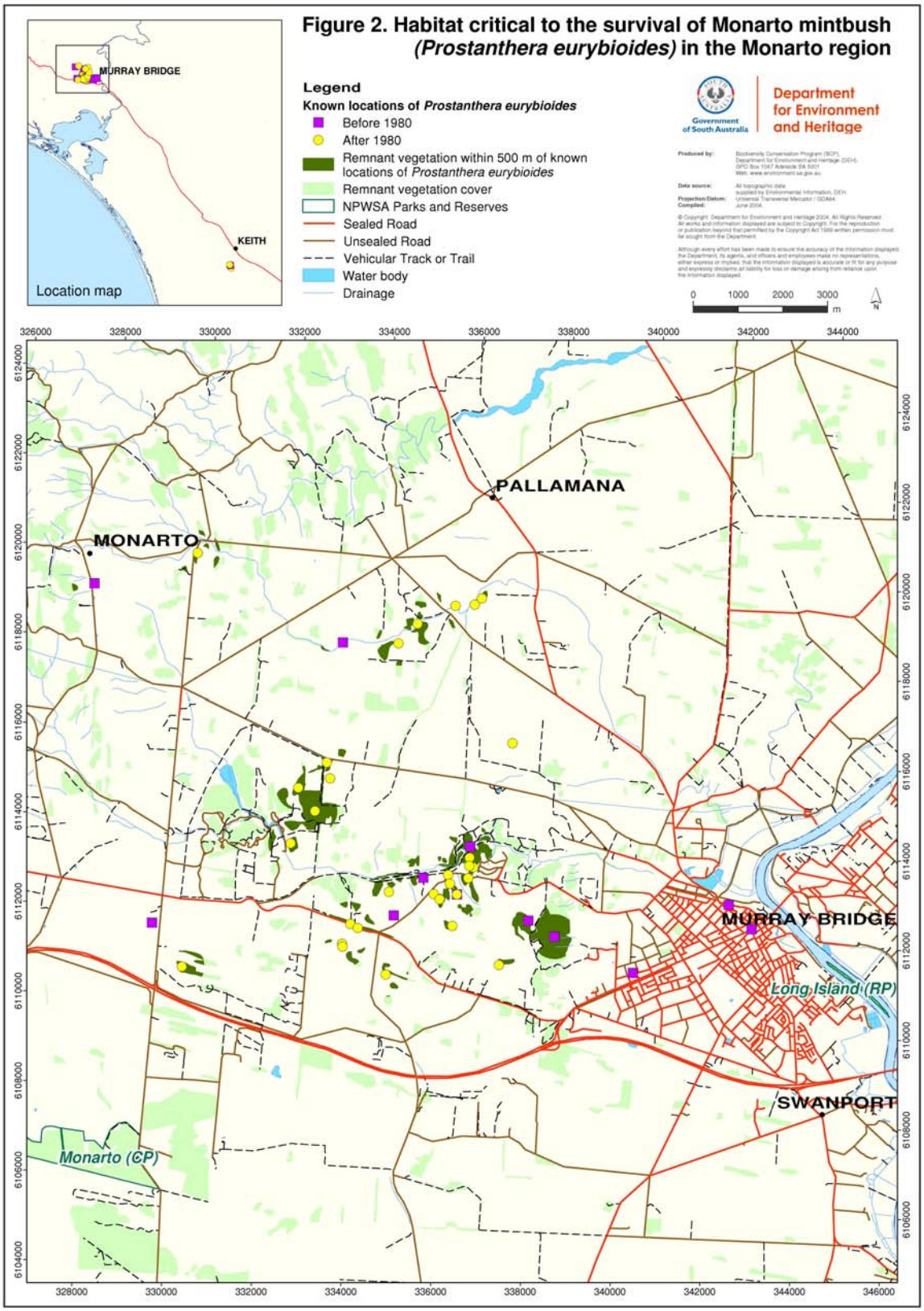


Figure 2. Habitat critical to the survival of Monarto mintbush (Prostanthera eurybioides) in the Monarto region
Legend
Known locations of Prostanthera eurybioides
Before 1980
After 1980
Remnant vegetation within 500 m of known locations of Prostanthera eurybioides
Remnant vegetation cover
NPWSA Parks and Reserves
Sealed Road
Unsealed Road
Vehicular Track or Trail
Water body
Drainage
Department for Environment and Heritage
Government of South Australia
0 1000 2000 3000 m
MURRAY BRIDGE
KEITH
Location map
PALLAMANA
MONARTO
MURRAY BRIDGE
Long Island (RP)
SWANPORT
Monarto (CP)
326000 328000 330000 332000 334000 336000 338000 340000 342000 344000
6124000 6122000 6120000 6118000 6116000 6114000 6112000 6110000 6108000 6106000 6104000
328000 330000 332000 334000 336000 338000 340000 342000 344000 346000

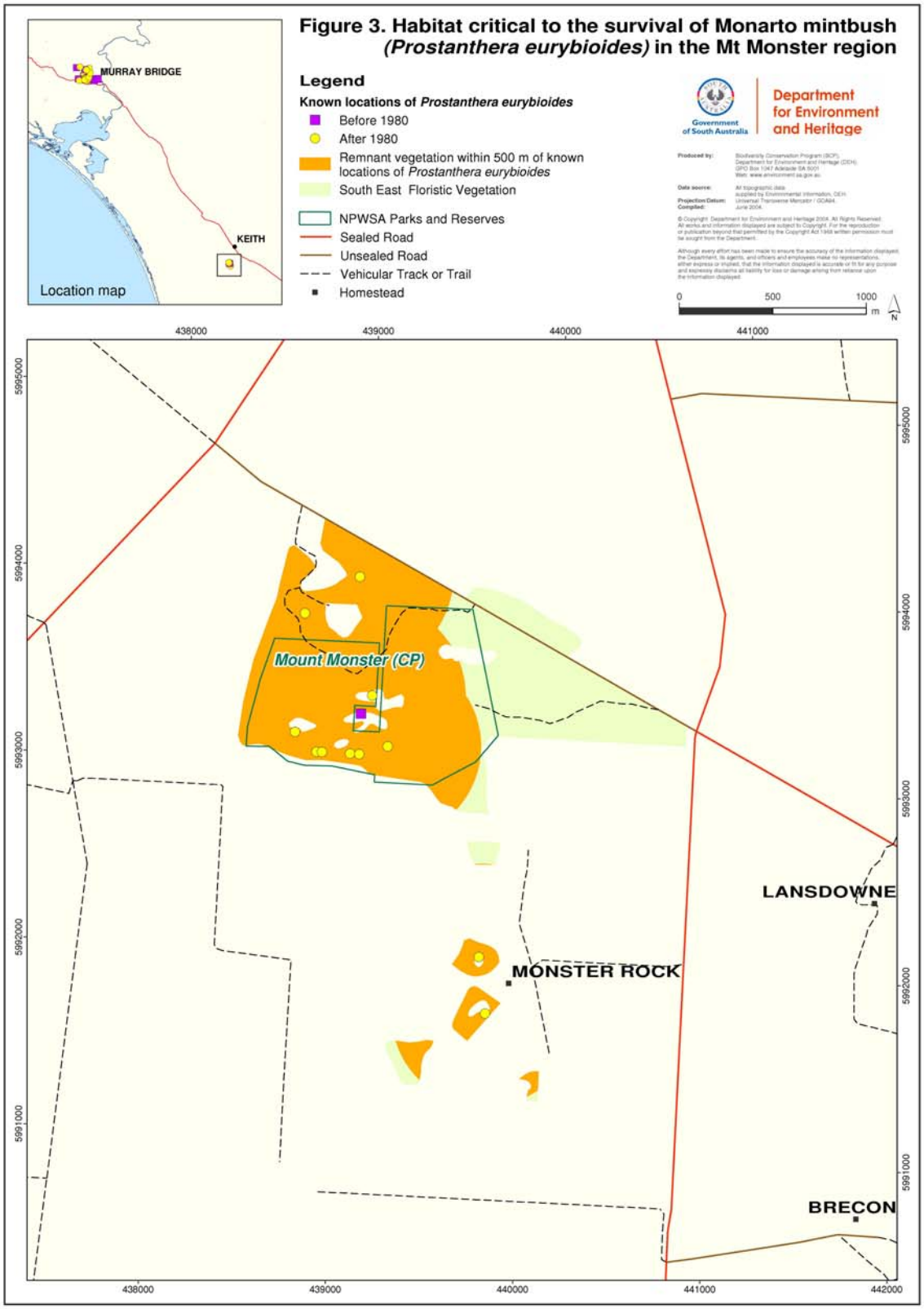


Figure 3. Habitat critical to the survival of Monarto mintbush (Prostanthera eurybioides) in the Mt Monster region
Legend
Known locations of Prostanthera eurybioides
Before 1980
After 1980
Remnant vegetation within 500 m of known locations of Prostanthera eurybioides
South East Floristic Vegetation
NPWSA Parks and Reserves
Sealed Road
Unsealed Road
Vehicular Track or Trail
Homestead
Department for Environment and Heritage
Government of South Australia
0
500
1000
m
N
MURRAY BRIDGE
KEITH
Location map
Mount Monster (CP)
LANSDOWNE
MONSTER ROCK
BRECON
438000
439000
440000
441000
442000
5995000
5994000
5993000
5992000
5991000

Part C: Known and Potential Threats

Biology and ecology relevant to threatening processes

Limited data are available on the biology and ecology of this species. *Prostanthera eurybioides* usually flowers from September to November (Jessop and Toelken 1986), although a flower was observed on an individual plant during a field trip at Mt Monster in March 2004 and collections of flowering material have also been made during January, March and April (Davies, 1992).

There exists an apparent discrepancy in the recruitment of plants between the Monarto and Mt Monster populations. In 1992 an estimated one-third of individuals located in the Mt Monster Conservation Park were considered to be juveniles (Davies, 1992), whereas sites observed within the Monarto area had no evidence of regeneration (Jusaitis 1991; Davies 1992). These observations led to genetics and seed germination studies (Ainsley *et al.* 2008a, 2008b) to determine the reasons for lack of recruitment at Monarto. No significant difference in genetic diversity or inbreeding was detected when comparing Monarto and Mt Monster populations; however the germination study found that the plant's seed-bearing mericarp (fruit segment) is more likely to release its seed in moist conditions, which indicates that recruitment is more likely following a year of higher rainfall.

Identification of threats

Small isolated populations

Prostanthera eurybioides is located in two geographic areas that are separated by greater than 150 km. As such, each group of populations is effectively geographically and genetically isolated. Although Ainsley *et al.* (2008a) detected no significant difference in genetic diversity and no evidence of inbreeding when comparing Monarto and Mt Monster populations, the potential for inbreeding depression to develop in these isolated populations is high.

Land clearance

Clearance of land for agricultural use, road works and mining is considered a serious threat to *P. eurybioides* (Jusaitis, 1991). Land clearance not only reduces the natural habitat that *P. eurybioides* populations can occupy but reduces the potential for recovery and future expansion of populations. Disturbance of land near *P. eurybioides* populations can also increase the negative response to edge effects.

Quarry operation

A portion of the Mt Monster population of *P. eurybioides* occurs adjacent to a disused quarry, and would be under threat from physical removal, trampling, dust and potential disturbance of pollinator species, if the quarry were to be reopened. In February 2007 this population was surveyed and found to contain 250 plants (Johnson, pers. comm. 2007), approximately 24% of the naturally occurring Mt Monster population. For this reason the site is considered to be extremely significant.

Weed competition

Competition from weed species is a threat to different life stages of *P. eurybioides* individuals (Jusaitis, 1991). The establishment of *P. eurybioides* seedlings is inhibited by competition from species including *Avena* spp. (oats), *Ehrharta calycina* (perennial veldt grass) and *Lycium ferocissimum* (African boxthorn) (Threatened Plant Recovery Committee 1998, cited in Kahrimanis *et al*. 2001; Jusaitis 1991). *Asparagus asparagoides* (bridal creeper), which is listed as a Weed of National Significance, *Avena barbata* (wild oats) and *Vulpia* spp. (silver grass) also compete with both mature plant growth and seedling establishment (Jusaitis, 1991). Whilst not considered a weed species, *Melaleuca uncinata* (broombush) competes with mature *P. eurybioides* individuals (Jusaitis, 1991).

It should be noted that the presence of weeds is often the result of other causes of ecosystem degradation, such as land clearance and the spread of feral animals.

Grazing

Prostanthera eurybioides is highly palatable and is susceptible to grazing by rabbits (identified under the EPBC Act as a key threatening process), domestic stock and kangaroos (Jusaitis 1991; Samuel-White pers. comm. 2004). Davies (1992) suspected that many of the juveniles within the population present in Mt Monster Conservation Park were being prevented from reaching maturity due to rabbit browsing, particularly during the summer months. Observed dieback of adult plants was also assumed to be due to rabbit browsing within this population (Davies, 1992). Browsing by both rabbits and sheep was also evident at several of the populations within the Monarto region, and this was believed to be responsible for the lack of regeneration observed at these sites (Davies, 1992).

Grazing may have a negative impact upon population structure and size. For example, preferential grazing of seedlings by macropods can alter plant population composition by greatly reducing recruitment (Hussey, 2002). Grazing by sheep may also result in compaction of soil around individuals and an increase in nutrients from manure (Cropper, 1993). Soil compaction can reduce the ability of seedlings to penetrate the soil and germinate, whilst an increase in nutrients may facilitate the spread of weed seeds or be detrimental to some vegetation types (Cropper, 1993).

Climate change

Since monitoring of populations began in the 1980s no recruitment has been observed in the Monarto area; however in the Mt Monster area there was noticeable recruitment following the unusually high rainfall received in spring 1992. Studies by Ainsley *et al.* (2008a) have shown that the lack of recruitment near Monarto is not due to genetic causes, and is likely caused by the lower rate of rainfall in this area in recent decades. If climate change does indeed lead to a sustained reduction in rainfall around Monarto, the consequences will be of serious concern for the survival of *P. eurybioides.*

Illegal rubbish dumping

Illegal dumping of rubbish has been reported to be a threat to some populations of *P. eurybioides* (Bundey and Mowling 1976, cited in Davies 1992). This activity can cover and flatten young individuals and can reduce the available ground area for seedling recruitment.

Removal by collectors

One potential threat to *P. eurybioides* is removal of individuals by collectors, as several holes dug by persons have been observed in an area in which *P. eurybioides* was previously recorded (Davies, 1992). Removal of individuals has the potential for direct impact upon the total population numbers, and therefore may reduce both genetic variability within populations and the ability of individual plants to successfully reproduce.

Trampling

Trampling by tourists is considered to pose a future threat to regeneration if walking path access through conservation areas is improved (Davies, 1992). Trampling may also pose a significant threat to other populations, such as the plants located at the quarry site. Both soil compaction and juvenile destruction are also possible outcomes of trampling.

Trail bike damage

Trail bikes are believed to pose a threat to one population of *Prostanthera eurybioides* growing in a road reserve within the Monarto region (Davies, 1992). Riding of trail bikes through areas containing *P. eurybioides* populations is a potential threat (Davies, 1992). Trail bikes may cause severe physical damage to *P. eurybioides* individuals and have the potential to completely destroy young seedlings. Damage to older plants would be manifest in destruction of growth and form, which would reduce the ability for successful reproduction and subsequent establishment. Furthermore, trail bike riding can cause compaction of soil that may damage the root structure and development of *P. eurybioides*, and disturb the soil surface, encouraging the establishment of weeds.

Areas under threat

Prostanthera eurybioides in the Monarto area is at risk from the following threats:

- Small population size
- Grazing by cattle, sheep and rabbits
- Competition from species including exotic grasses, *Avena barbata*, *Vulpia* spp., *Asparagus asparagoides* and *Melaleuca uncinata*
- Trail bike damage
- Illegal rubbish dumping
- Removal by collectors
- Land clearance for agricultural use and road works
- Climate change.

Prostanthera eurybioides in the Mt Monster area is at risk from the following threats:

- Small population size
- Potential land clearance for agriculture, road works or mining
- Grazing by rabbits and kangaroos
- Competition from exotic plants, including *Asparagus asparagoides*
- Trampling.

Part D: Objectives, Criteria and Actions

Recovery Objectives and timelines

The overall objectives are:

1. Short Term: To improve the age structure of the community by enhancing recruitment within the populations.

2. Medium Term: To increase the probability of survival of *Prostanthera eurybioides* across the entire range of the species.

3. Long Term: To improve the conservation status of *P. eurybioides* from Endangered to Vulnerable.

Specific Objectives

The improvement in conservation status of *Prostanthera eurybioides* is targeted by objectives one to three with objectives four and five vital for the long-term survival of the species.

1. To maintain and increase the area of occupancy of the species.

2. To improve the quality of habitat of the species.

3. To maintain or increase the abundance of the species.

4. To preserve the degree of genetic variability within the species.

5. To reduce the grazing impact of rabbits, sheep and kangaroos.

Performance Criteria

In order to determine whether the objectives of this recovery plan are being met the following performance criteria have been established.

1. The current known area of occupancy is increased over five years.

2. The total number of mature plants is increased from its current level of approximately 2230 to 4500 in five years by planting from seed stock and increasing recruitment.

3. Weed control measures substantially reduce the abundance of *Avena* spp. (wild oats), *Ehrharta calycina* (perennial veldt grass), *Lycium ferocissimum* (African boxthorn) and *Vulpia* spp. (silver grass) in areas of habitat currently occupied by *Prostanthera eurybioides,* within five years.

4. A 250m buffer is established around habitat currently occupied by *P. eurybioides*, where *Asparagus asparagoides* (bridal creeper) is to be substantially reduced in abundance within five years.

5. Rabbits within the habitat critical to the survival of *P. eurybioides* are controlled by baiting and ripping, and there is a 100% reduction in the number of warrens present within five years.

6. The possibility of including additional habitat containing *P. eurybioides* in the National Reserve System (NRS) is investigated within five years.

7. Where appropriate, fencing is erected within two years to exclude sheep from populations on private property in the Monarto area.

8. The impacts of kangaroo grazing and numbers in the area are investigated, with a control program including fencing or caging where appropriate, implemented within two years if considered necessary.

9. Roadside markers are installed at the site of roadside populations of *P. eurybioides*, and roadside maintenance staff is alerted to the presence and significance of the plants within two years.

10. Through the development of community awareness, and fencing where appropriate, the impacts of trail bike damage and illegal collecting and / or illegal rubbish dumping are significantly reduced within five years.

11. Seed from each regional location is collected and stored within one year to boost current seed stores and provide seed to conduct seed longevity tests.

12. Seed germination tests and seedbank trials are conducted within three years, to establish the longevity of seed maintained in storage and the extent and viability of the seedbank.

Evaluation of success or failure

The monitored evaluation of this recovery plan and the planning and implementation of actions will be conducted by a recovery team within five years. In this way, scientific experts and community representatives with relevant qualifications or interests can regularly review the progress of the project. The recovery team will also ensure all on ground works are conducted in an integrated manner with respect to any regional recovery plans that may incorporate *Prostanthera eurybioides*.

Recovery Actions

1. Continue seed collection and storage to minimise loss of genetic variability.

Due to the small total number of *Prostanthera eurybioides* individuals, the loss of genetic variability is a serious threat. The collection of seed would aid in maintaining genetic variability for the future as needed. Whilst *P. eurybioides* seed has already been collected from both Monarto and Mt Monster sites and stored (Jusaitis and Smith, 1999), further seed should be collected from all populations and be stored separately to maintain genetic differences between populations (provenance variation). This work could be conducted in conjunction with the Seed Conservation Centre (DEH) as they conduct similar work with nationally and state threatened species treated as a priority. This seed can also be used in trials on germination requirements and seed longevity in storage.

2. Undertake weed control.

Spot spraying of *Asparagus asparagoides* (bridal creeper) with glyphosate has been conducted at regular intervals at Monarto under the *P. eurybioides* recovery plan, with Friends of the Upper South East continuing weed control programs in Mt Monster Conservation Park (Jusaitis and Smith, 1999). Control of weed species should be continued within areas of habitat currently occupied by *P. eurybioides*, especially of bridal creeper, which is listed as a Weed of National Significance. Frequency of weed control activities will be ascertained from routine monitoring of the reduction in weed presence within *P. eurybioides* habitat. A reduction of competition from weed species will aid the ability of *P. eurybioides* to capture essential nutrients, light, water and space, and may encourage natural regeneration.

The potential for negative effects on *P. eurybioides* from exposure to herbicide should be investigated and the use of biological controls should be implemented. Biological control methods to be used should include bridal creeper rust (*Puccinia myrsiphylli*) and / or leafhoppers (*Zyginia* sp.). These methods will be most suitable in dense infestations of bridal creeper, whereas traditional minimal impact techniques of bridal creeper control should be targeted towards smaller isolated infestations. In the longer term as biological control agents take effect, they can be complimented by the introduction of other minimal impact techniques to have a greater impact. In sensitive areas the use of weed wands or wiping is recommended.

Other priority weed species to be controlled within areas of habitat critical to survival include *Ehrharta calycina* (perennial veldt grass) and *Lycium ferocissimum* (African boxthorn).

3. Undertake rabbit control.

Rabbit control programs have been conducted at both Monarto and Mt Monster Conservation Park as part of the *Prostanthera eurybioides* Recovery Plan (Jusaitis and Smith, 1999). No active rabbit warrens were detected in Mt Monster Conservation Park during an inspection in 1998 (Jusaitis and Smith, 1999). Control of rabbits should be continued on an annual basis, with monitoring designed to establish if any rabbit activity has resumed within the control areas. Fumigation of warrens has been carried out in Mt Monster Conservation Park by Friends of the Upper South East Parks. The recovery team should endeavour to ensure that financial and technical support is provided to the Friends group so that this work continues.

4. Investigate kangaroo grazing damage.

It is suspected that kangaroo grazing is having a negative impact on the population at Mt. Monster, as grazing damage has been found on plants located within an area fenced with rabbit proof fencing and where rabbit control has occurred (Jusaitis and Smith 1999; Samuel-White pers. comm. 2004). An investigation is needed to determine how much grazing damage is occurring from kangaroos and how this is affecting the species. If the damage to this population is considered to be excessive, and it is reducing seed production and regeneration, then a kangaroo control program should be designed and implemented as part of this action. The impact of kangaroo grazing on the Monarto population should also be investigated.

5. Fence to control stock

Sheep are also known to be causing damage to plants in the Monarto populations. Where appropriate, fences should be placed around the populations where damage from livestock is occurring.

6. Prevent damage from recreational activities.

Activities such as bike riding, recreational walking, plant removal and illegal rubbish dumping that may be found, through monitoring, to be damaging to the populations or habitat of *P. eurybioides,* should be discouraged or prevented. Efforts to prevent damaging activities may include developing community awareness of *P. eurybioides* and the current or potential threats to its survival, or if necessary, fencing to inhibit human traffic.

7. Install roadside markers.

Roadside markers should be installed at those populations that are currently unmarked and located within roadside vegetation. This will improve the recognition of vegetation communities containing *P. eurybioides* and of habitat which is vital for the ongoing survival of this species. It will also alert maintenance personnel and road workers of the presence of significant native vegetation and of the appropriate management practices within these sections of roadside.

8. Search for new populations.

While it is likely that most natural populations have been found in past surveys, it is essential that areas of possible habitat are searched, potentially increasing the known extent of occurrence of the species. When planning the survey search strategy, consideration must be made regarding knowledge of the existing distribution and any information relating to the predicted distribution and dispersal mechanisms of the species.

9. Undertake strategic research and trials.

Studies by Ainsley *et al.* (2008a, 2008b) have now determined the genetic variability within and between populations, and optimal germination triggers under nursery and laboratory conditions. However, further research is required on the age structure of populations, pollination biology (including pollinating species), seedling survival within populations, and the longevity of seed maintained within the soil seed bank.

Further research into the ecology of *P. eurybioides* in the field should be undertaken. Specifically, trials and experiments should be conducted to explicitly identify factors that facilitate natural regeneration, including disturbance of soil, the effect of fire and the effect of smoked water on seed germination. Results from such trials will aid in future management of the species.

Seeds have been germinated within petri dishes, with an addition of an anti-fungal agent to reduce the problem of fungal infection of seeds (Jusaitis and Smith, 1999). A problem with the larvae of fungus gnats (Family SCIARIDAE) has been encountered during the establishment of potted seedlings. These larvae have been feeding on the roots, and destroying many seedlings (Jusaitis and Smith, 1999). Research is required into the conditions that will reduce the problem of fungus gnats.

The scope of all of the above research may be suitable for one or more university Honours projects or for other research institutes.

10. Investigate the possibility of additional legal protection for *P. eurybioides* habitat.

Where possible and feasible, landowners and managers should be encouraged to place Heritage Agreements on remnant vegetation containing *P. eurybioides.* Additionally, Section 499, Hundred of Stirling and Allotment 11 (DP13037), adjacent to Mt Monster Conservation Park contain 24% of the naturally occurring population of *P. eurybioides* in the region. The annexation of this Section to the Conservation Park would afford protection to these significant sub-populations of *P. eurybioides*.

11. Continue monitoring of all known sites.

Monitoring of all *P. eurybioides* populations is essential for collecting vital information to aid in the future direction of the management of the species. Such information should include ascertaining population size and trends over time, the rate of reproduction, identifying new threats to populations, establishing whether current actions are successful and how often they are required, and any new changes to management that may be required.

12. Manage the recovery program through the recovery team.

A recovery team will be required to continue the planning and implementation of all actions and monitor the success of the recovery program. This will ensure scientific experts and community representatives regularly review progress. The team will also be accountable for the funding and administrative costs involved in running a recovery team and preparing reports. If a project officer is employed for this recovery plan, this person will be responsible for all planning and implementation of actions, not the recovery team.

13. Undertake ongoing educational programs.

An ongoing effort is required to inform and educate those landowners with *P. eurybioides* populations either on, adjacent or near their properties. Specifically, landowners should be fully aware of the location of *P. eurybioides* populations and should be encouraged to continue to manage their properties in a manner that is not, or not potentially, threatening to populations. Protection of these populations is to be encouraged.

Where small populations are still present along roadsides, road maintenance personnel should be reminded to be watchful for *P. eurybioides* plants prior to the start of work within the area. Awareness is required of the presence of *P. eurybioides* plants, combined with an emphasis to take extra care with works conducted near or within populations.

14. Enhance recruitment.

Ainsley *et al.* (2008a, 2008b) have shown that lack of recruitment is most likely due to insufficient rainfall, and that climate change is a potential threat in particular to the Monarto populations of *P. eurybioides.* Pending the results of Action 9 (trials to facilitate natural regeneration and techniques to enhance germination), any successful techniques to enhance recruitment will be applied to the appropriate sites.

The recovery team will also determine the sites most suitable for translocation to occur. Plants for translocation should be grown from seed, not cuttings, and care must be taken to ensure that appropriate stock from the correct population is planted in order to maintain both the genetic integrity and variability of the population, using the results of Ainsley *et al.* (2008a, 2008b). Careful records of where these plants are planted, and how many, should also be maintained, in order that those plants that have been translocated can be differentiated from those that have grown naturally.

Part E: Management Practices

Management practices which are required to avoid a significant impact on *Prostanthera eurybioides* include: continuation of voluntary conservation management schemes; continuation of the Roadside Marker System; maintenance of the Seed Conservation Centre; and continued management of reserves areas in which the species occurs.

It is important for the overall effectiveness of a recovery plan that any proposed development activities or current management issues that may have a significantly negative impact upon the species covered in the plan are carefully considered.

Actions that result in any of the following in or in the vicinity of *P. eurybioides* populations or within habitat critical to survival could have a significant impact on the species:

- increased grazing pressure;
- removal of fencing or tree guards from *P. eurybioides* sites
- increased competition from native or exotic plants;
- removal of vegetation;
- change of fire regimes;
- removal or destruction of *P. eurybioides* plants;
- damage to *P. eurybioides* plants; and
- compaction of soil or disturbance to soil surface

Part F: Duration of recovery plan and estimated costs

Resource allocation

Responsibility for recovery of the *Prostanthera eurybioides* population within the Monarto area near Murray Bridge will be with the SA Murray Darling Basin Threatened Flora Recovery Project, and the portion of the population located in the Mount Monster area will be covered in the South East Threatened Flora Recovery Project, South Australia. Cost estimates are therefore potentially an overestimate for those actions that are to be undertaken as part of the two regional plans. It will be the responsibility of the recovery team to liaise with regional recovery teams to ensure there is no overlap or gaps in efforts with regard to specific actions.

Duration and costs

The estimated costs and duration of undertaking the actions outlined in this plan are presented in Table 3, with the following qualifications:

1. The cost estimates are estimates only and are intended to act as a guide as to the approximate cost of implementing the actions in this recovery plan. The necessity and full cost of all actions will only be determined once field visits have been carried out.

2. Not all of the actions may be necessary (e.g. fencing, translocation); however an allowance has been made for these actions.

3. The recovery team will be responsible for coordinating all actions.

Table 3. Estimated duration and costs required to undertake recovery actions for *Prostanthera eurybioides*

Task	Task Description	Priority	Location	Cost Estimate ($)					
				Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
1	Collection and storage of seed	1	MT & MM	3500	200	200	200	1000	5,100
2	Undertake weed control	1	MT & MM	10000	10000	8000	5000	5000	38,000
3	Undertake rabbit control	1	MT & MM	4000	2000	1000	1000	1000	9,000
4	Investigate kangaroo damage	1	MM	2000	1000	1000	1000	1000	6,000
5	Fence to control stock	1	MT	6000	4000				10,000
6	Prevention of damaging activities	1	MT & MM	1000	10000	1000	1000	1000	14,000
7	Installation of roadside markers	1	MT	3000					3,000
8	Search for new populations	2	MT & MM	2000	2000	1000	1000		6,000
9	Undertake strategic research & trials	2	MT & MM	6000	6000	3000	3000		18,000
10	Investigate additional habitat in reserves	2	MT & MM	2000	2000				4,000
11	Population monitoring	2	MT & MM	5000	5000	5000	5000	5000	25,000
12	Recovery team	2	MT & MM	5000	5000	5000	5000	5000	25,000
13	Ongoing educational programs	3	MT & MM	3000	3000	3000	3000	3000	15,000
14	Enhance recruitment	3	MT & MM		1000	1000	1000	1000	4,000
		TOTAL		52500	51200	29200	26200	23000	182,100

MT = Monarto population, MM = Mt Monster population

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