Recovery Plan for *Acanthocladium dockeri*

(Spiny Daisy)

2013

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Disclaimer

The opinions expressed in this document are the views of the Recovery Team and do not necessarily reflect those of the Department of Environment, Water and Natural Resources.

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 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.

Citation

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A Recovery Plan prepared in accordance with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Cover Photo: *Acanthocladium dockeri* planted at the Laura Parklands (A. Clarke, May 2005).

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Abbreviations

DEH	Department of Environment and Heritage, South Australia (now DEWNR)
DENR	Department of Environment and Natural Resources, South Australia (previously DEH, now DEWNR)
DEWNR	Department of Environment, Water and Natural Resources, South Australia (previously DENR)
DPTI	Department for Planning, Transport and Infrastructure, South Australia
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999
IUCN	International Union for the Conservation of Nature
NRM	Natural Resource Management
OEH	Office of Environment and Heritage, New South Wales
TPAG	Threatened Plant Action Group

PART 1: Species Information

1.1 Species description

Acanthocladium is a monotypic genus of the Asteraceae (Compositae in Jessop & Toelken 1986). Its single representative, the Spiny Daisy, *Acanthocladium dockeri* (also known as spiny everlasting) is a low shrub to about half a metre in height with spindly branches that end in a '∠' shaped pair of spines. It is whitish grey in colour due to the fine pale-grey 'felt' that covers the small oval-shaped leaves and the branches. The flowers are small and yellow, with grey felted bracts and lack the ring of showy 'ray' petals that is characteristic of many daisy species. *Acanthocladium dockeri* has a well-developed, woody perennial root system that suckers readily. Further taxonomic description can be found in Jessop & Toelken (1986, pp. 1493-4) and Leigh *et al.* (1994, pp. 154-5).

Plate 1: *Acanthocladium dockeri* in flower (Photo: A. Everaardt)

1.2 Conservation status

Acanthocladium dockeri has been transferred from listed as 'Presumed Extinct' to 'Critically Endangered' under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); it is listed as "Endangered" under the SA *National Parks and Wildlife Act* 1972, and "Presumed Extinct" under the *NSW Threatened Species Conservation Act* 1995. The species is "Critically Endangered" by International Union for the Conservation of Nature (IUCN) criteria CRB1 & CRB2, due to its limited area of occupancy (less than 10 km^2), severely fragmented subpopulations, its presence in vulnerable habitats and its inferred continuing decline (IUCN 2001).

It should be noted that in the context of this recovery plan, the IUCN definitions are used for "population" (the species in its entirety) and "subpopulation" (a group of

individuals that have little or no gene flow with the rest of the population) (IUCN 2001).

1.3 Distribution

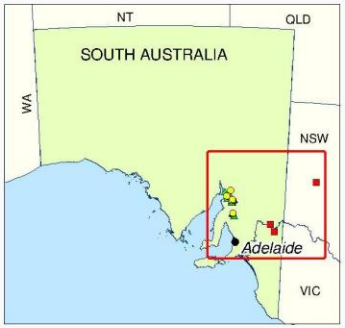
Acanthocladium dockeri was first recorded by Dr H. Beckler from the Burke and Wills expedition, in 1860, near the Darling River in Central-western New South Wales (Davies 1992). The species was not recorded again until 1910, when herbarium specimens were collected at the Overland Corner on the Murray River in South Australia (Figure 1) (Davies 1992). By 1992, there had been no further records of this species, despite searching of known localities, and the species was believed to be extinct (Davies 1992). It is likely that rabbits and sheep have degraded former habitats, while river regulation and irrigation developments have also transformed these districts since the historical collections. In 1999, a subpopulation of Spiny Daisy was discovered at Thornlea near Laura, in the Mid-North of South Australia (Jusaitis and Bond 1999). A further five subpopulations have since been located in the region (Figure 1): "Rusty Cab" and Yangya to the east of Laura; one near Hart, approximately 65 km to the south; the fourth at Telowie, north of Port Pirie (Jusaitis 2007b) and finally the most recent, discovered 8 kms east of Melrose in 2012 (Rees 2012a). The Hart, Melrose and three Laura subpopulations occur in remnant native grassland, while the Telowie subpopulation occurs in a remnant shrubland. Precise locations are recorded in the Biological Database of SA maintained by the Department of Environment, Water and Natural Resources (DEWNR).

Seven translocation sites have been established for education and awareness purposes; six in public gardens and the seventh (sourced from all natural clones except Melrose) at an electricity substation on the outskirts of Clare. The six public gardens are the Laura Parklands (Thornlea clone), the Arid Lands Botanic Gardens in Port Augusta (Hart clone), Hart Field Day Site (Hart clone), the Mid-North Plant Diversity Nursery in Blyth (Hart clone), the Adelaide Botanic Gardens and the Australian National Botanic Gardens in Canberra (Hart and Thornlea clones). These education sites have not been shown in Figures 1 and 2.

Another 10 new translocation sites, including a mixed-clone translocation, have been set up in areas of relatively natural habitat to provide back-up for the natural extant subpopulations (Figures 1 and 2). These will be considered established subpopulations of the species when they are self-sustaining, i.e. they proliferate naturally. Appendix 4 lists these translocations and their sources. A population of the "Telowie" genotype was established in Mount Remarkable National Park in 2005, representing the only population of this species within a conservation reserve. Four of the translocation sites are on private property, three on land managed by local government, and two on roadsides. An eleventh translocation was set up on private property but the plants did not survive.

There is also the possibility that some illicit translocation has occurred without the knowledge of the Spiny Daisy Recovery Team. This is to be discouraged.

Figure 1.
Distribution of historic and extant populations of *Acanthocladium dockeri*



Legend

Distribution of *Acanthocladium dockeri*

- Extant natural population
- Translocated - natural population back up
- Historic location

- DENR Parks and Reserves
- Waterbody
- Main Road
- Drainage
- State Border
- Coastline
- Locality

0 10 20 30 40 50 km

N

Produced by SMK, Regional GIS - N&Y
Department of Environment, Water and Natural Resources (DEWNR).
GPO Box 1047 Adelaide SA 5001
Web: www.environment.sa.gov.au

Data Source Flora records from Biological Databases of South Australia and State Herbarium of South Australia, DEWNR.
All topographic data supplied by Corporate & Client Services, DEWNR.

Projection Lambert Conformal Conic
Datum Geocentric Datum of Australia, 1994
Compiled April 2013

Government of South Australia
Department of Environment, Water and Natural Resources

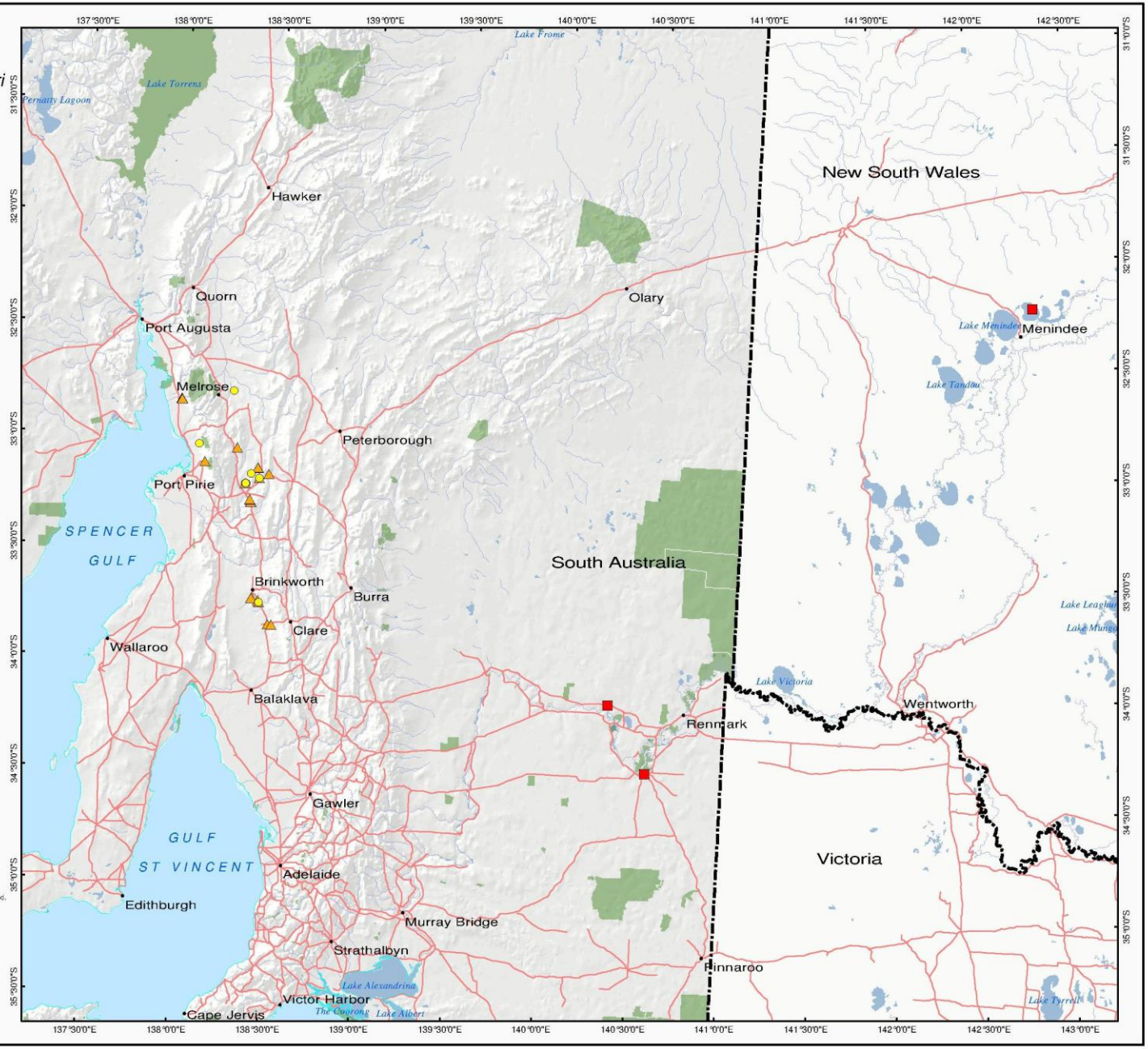
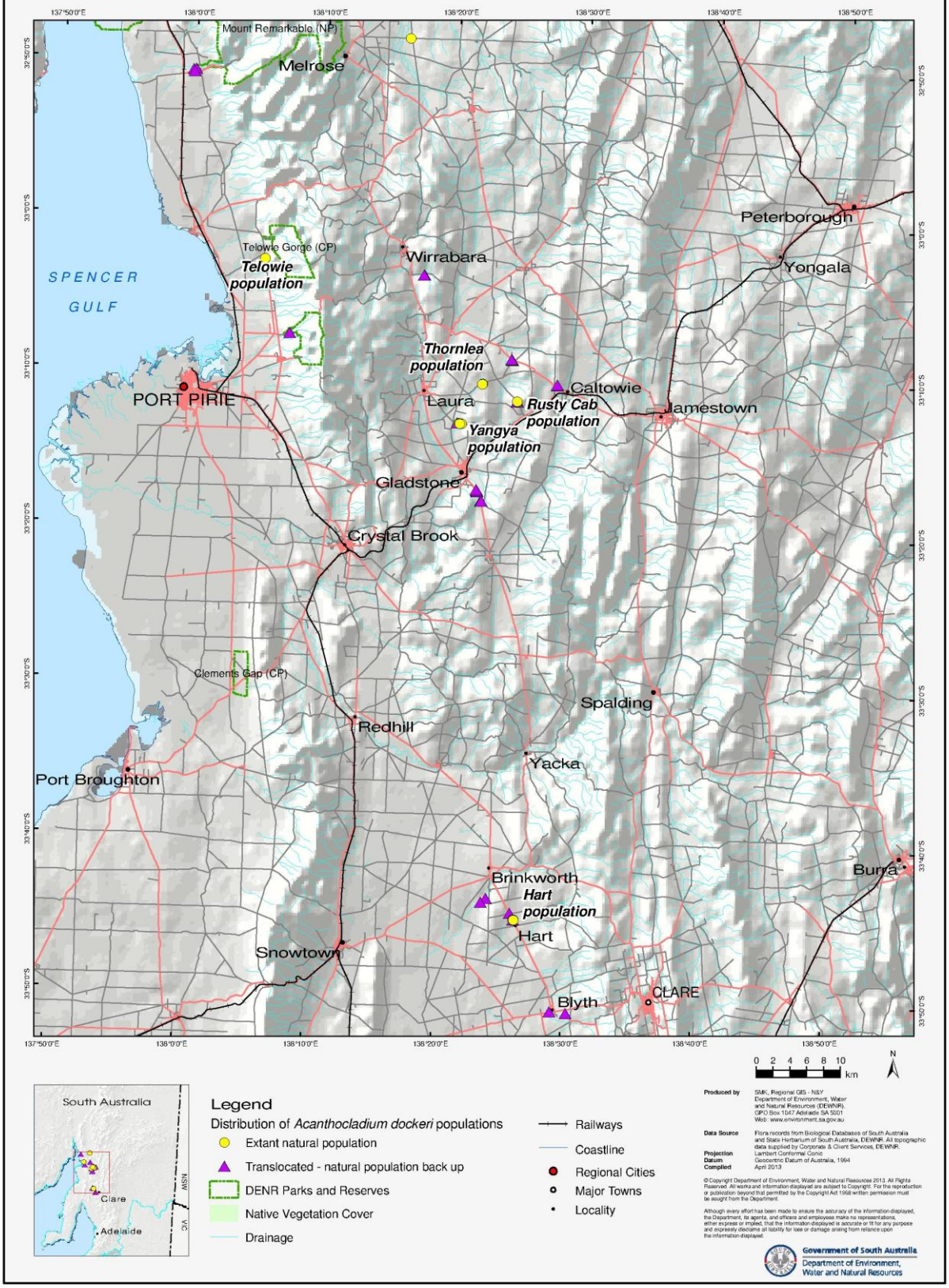


Figure 2.
Areas of habitat critical to *Acanthocladium dockeri*



1.4 Habitat that is critical to the survival of the species

Knowledge of the habitat critical to the survival of *Acanthocladium dockeri* is mainly based on that of known extant subpopulations. Specific information on the historic habitat of the species is limited to notes included with herbarium specimens (low sand hills near Darling River and Overland Corner, River Murray) and soil attached to the roots of one specimen (reddish sand). This information suggests that the species may have occurred in landscapes of a different soil type and rainfall from those currently occupied.

Habitat of the Hart, Laura and Melrose subpopulations of *A. dockeri* is remnant grassland on low hills and plains in the Mid-North of South Australia. The Melrose and three Laura subpopulations are found at 270 – 350 m altitude, and the Hart site at 180 m. Soils at the Laura and Hart sites are light brown light clay to clay loam; pH approximately 7.4 (slightly alkaline) with very low salinity (Jusaitis, DEWNR, pers. comm. 2002). However, the Telowie subpopulation occurs within a remnant shrubland, with sandy loam soils (Jusaitis 2007b), at a much lower altitude (60 m). As yet no soil description has been recorded for the Melrose site. The climate of all the extant subpopulation sites is typically Mediterranean, with cool, wet winters and hot, dry summers (average annual rainfall 426 mm at Thornlea, 429 mm at Blyth, 450 mm at Telowie and 350-400 mm east of Melrose).

All known extant subpopulations of *A. dockeri* occur on narrow road reserves that have been repeatedly disturbed in the past. The main indigenous plant species occurring with *A. dockeri* at the Hart and 3 Laura sites are: Scented Mat-rush (*Lomandra effusa*), Spear Grasses (*Austrostipa* spp.) and Wallaby Grasses (*Rytidosperma* spp.) and various native forbs (Rees 2012a). The Melrose site is predominantly Umbrella Grass (*Enteropogon acicularis*) with Spear Grasses (*Austrostipa* spp.), Wallaby Grasses (*Rytidosperma* spp.), some chenopods and forbs. The Telowie site contains many species not present at the five other sites (Rees 2012a); it is a degraded shrubland dominated by Sweet Bursaria (*Bursaria spinosa* subsp. *spinosa*), Umbrella Bush (*Acacia ligulata*) and Mealy Saltbush (*Rhagodia parabolica*) (Jusaitis 2007b). Both types of habitat have largely been cleared for winter cereal cropping throughout the region. See Appendix 2 for a full list of indigenous plant species found at all natural sites.

As this species is critically endangered, with a limited distribution, all known habitat in which *Acanthocladium dockeri* occurs, including established translocations in natural habitat, should be considered to be habitat critical to the survival of this species. These areas have been mapped and are presented in Figure 2. Whilst some searching for additional subpopulations has taken place in the past, there is the possibility that the species may still exist in the historic locations. If new subpopulations are found the habitat in which they occur will be considered habitat critical to survival.

1.5 Populations

All six naturally occurring subpopulations, representing the six known genotypes, are critical for the species' survival, due to the limited genetic variation within the species. All known subpopulations of *Acanthocladium dockeri* occur on roadside

verges in the Mid-North of South Australia (Figure 2) and are surrounded by agricultural land. The three subpopulations east of Laura occur within a distance of 4 km of each other (maximum of 7.5 km between sites). The fourth subpopulation occurs near Hart, approximately 65 km to the south, between a major sealed road and a disused rail reserve. The Telowie subpopulation is located approximately 9 km north of Nelshaby, it is approximately 30 km north-west of its nearest neighbouring Laura subpopulation (Jusaitis 2007b). The Melrose subpopulation is the most northerly site, being 8 kms ENE of Melrose, and 31 kms NE of its nearest site, Telowie. The largest subpopulation (Yangya) occupies both road verges for more than 300 metres, while all other subpopulations occupy less than 75 m along the road verge. The verges have a width of five metres or less.

Population monitoring surveys have been set up to occur annually. Due to the clonal and suckering nature of the species, monitoring is focused on measuring the area of occupancy and estimating the density of plants (individuals or ramets) at each site. As the Yangya subpopulation occurs on both the north and south verges of Yangya Road, for monitoring purposes it has been split into two separate survey sites: Yangya South and Yangya North. Since it is very difficult to accurately count the number of ramets at the Hart site, due to the high density of the *A. dockeri* plants, monitoring at this site has focused on estimating cover. For more details on the monitoring technique see the *Acanthocladium dockeri* Monitoring Plan (DEH 2005b).

Results from population monitoring conducted in January/February 2007 showed density of *A. dockeri* ramets was typically low, ranging from 0.375 per m^2 at Yangya South to 7 at Rusty Cab. The average percentage cover at the Hart site was 77.75% with a standard error of 9.2.

Table 1: Area occupied and size of known *A. dockeri* subpopulations in 2007

Site	Length (m)	Average width (m)	Total (m^2)	Average density / m^2	Estimated Total no. plants
Yangya North	320	3.51	1123.2	1.42	1600
Yangya South	361	2.39	862.79	0.37	323
Thornlea	64.5	14.04	905.58	2.85	2581
Rusty Cab	24.5	4.76	116.62	7.05	822
Hart	70.4	23.03	1621.31		NA
Telowie	17.4	5	87.5	1.1	96
			4717		5422
		Total	(0.47ha)		

The total number of plants at each site was estimated by measuring the average density of *A. dockeri* within the survey quadrats and extrapolating this over the whole site. The total area of occupancy of *A. dockeri* in 2007 was 0.47 ha compared with 0.33 ha in 2005 and estimated 0.34 ha in 2001 (Robertson 2002). The 2007 figure includes the recently discovered Telowie subpopulation, however this site only accounts for 1.85% of the overall population. The area of occupancy in 2011 was similar; however the density of plants was greater, possibly due to relatively high summer rainfall. Since the Melrose site was not discovered until 2012 its area of occupancy has not been accurately measured.

In addition to annual population monitoring, a permanently pegged photo point site consisting of ten contiguous, one square metre plots has been monitored at each subpopulation. For the Yangya, Thornlea and Hart subpopulations, monitoring has occurred since 2000. Monitoring of the Rusty Cab subpopulation commenced after the site's discovery in 2001. Density has increased slightly at the Rusty Cab, Thornlea, Hart and Yangya sites. Monitoring has commenced at the Telowie site following its recent discovery. Future monitoring will include the Melrose site.

1.6 Biology and ecology relevant to threatening processes

Spiny Daisy is a rather inconspicuous shrub, generally less than one metre tall, and its known distribution is within an area of agricultural production where the majority of the native vegetation has been cleared. The six naturally occurring subpopulations are isolated from each other. Each subpopulation reproduces clonally and while each subpopulation is genetically distinct, no genetic variation has been detected within subpopulations (Jusaitis & Adams 2005b). The predominant form of plant proliferation appears to be vegetative spread, via root suckering (Jusaitis & Bond 1999). Seed production is negligible and the few seeds that have been found characteristically produce a high proportion of abnormal seedlings with a low survival rate (Jusaitis 2008). No seedlings have been observed in the field and sexual reproduction appears to be limited by pollen viability (Jusaitis & Adams 2005b). To an untrained observer, this species may resemble a weed and therefore may have been specifically targeted for eradication in the past.

Spiny Daisy appears to respond well to fire. Jusaitis (2007a) studied the re-growth at the Rusty Cab site following a wildfire in 2001. New shoots emerged from below-ground within seven weeks, and from above-ground stems that not been fatally singed. Flowers were visible within a year and plant density stabilised within two years. Seed production did not increase.

1.7 Identification of threats

The threats to the survival of *A. dockeri* are identified in Table 2 and addressed in more detail below.

Table 2: Identified threats to the recovery of *Acanthocladium dockeri*

Threats	Threat to Short-term Survival	Threat to Long-term Survival
Competition from weeds	High	High *
Herbivory	High	High*
Lack of formal protection	Medium	High*
Small, isolated populations	Medium	High
Adjoining land-use	Medium	Medium*
Lack of genetic diversity	Low	High
Inappropriate revegetation	Low	Medium*
Lack of sexual reproduction	Low	High
Lack of knowledge	Low	Medium
Climate change	Low	Unknown- potentially high

* Threats posed by these factors in the long term could be high; however the appropriate management actions in the short to medium-term may be able to reduce the threat of these factors in the longer term.

1.7.1 Weed competition

The most dominant exotic annual weed at all sites is Bearded Oat (**Avena barbata*). Salvation Jane (**Echium plantagineum*) is a significant weed at all sites except Telowie. The main perennial weed species are Wild Sage (**Salvia verbenaca*), present at all sites; Scabious (**Scabiosa atropurpurea*) at the Hart and three Laura sites; and Onion Weed (**Asphodelus fistulosus*) at the Thornlea, Hart and Melrose sites. Horehound (**Marrubium vulgare*) is a high priority weed at Yangya, Hart and Melrose. Soursob (**Oxalis pes-caprae*) is present at the Yangya, Hart and Telowie sites (Rees 2012a). See Appendix 3 for a list of weeds present at all six natural sites.

Although numerous healthy Spiny Daisy plants have been observed amongst dense, tall stands of Bearded Oat, Salvation Jane and cruciferous annuals, it is possible that weed competition may limit its growth during dry winters. Snails may be expected to feed on the weeds; however there is no evidence that they are significantly limiting weed abundance. Competition from environmental weeds reduces the potential habitat available to *Acanthocladium dockeri,* limits the availability of resources and inhibits growth of other native grassland species.

1.7.2 Herbivory

The introduced Common White, or Vineyard Snail, *Cernuella virgata* has a dramatic impact on individuals of *A. dockeri* during the wetter months. Trials have shown that the snails actively graze on both stems and leaves of the plant during winter and spring (Jusaitis 2007a). This activity removes the epidermal layer, resulting in weakening or ringbarking of the stems, death of leaves, and often the death of complete shoots above the site of injury. Plants may re-sprout below, or occasionally above the injury. The snails aestivate during summer on plants and fence posts to avoid heat from the soil surface.

Acanthocladium dockeri may also be negatively affected by stock grazing with younger shoots particularly susceptible. Kangaroo densities are low around the *A. dockeri* sites, therefore their impact is considered to be negligible. Temporary tree guards that excluded rabbits were found to increase survival rates in one translocation trial.

1.7.3 Lack of formal site protection

Currently there are no extant natural subpopulations of *A. dockeri* occurring within any areas formally protected for conservation. The subpopulations occur along roadsides under the control of local government or the Department of Planning, Transport and Infrastructure (DPTI). The recovery effort is largely dependent on the continued support of these agencies. Roadside markers have been erected at each site; however this does not necessarily ensure their protection. The lack of formal protection of any of these sites is potentially a threat to the long-term survival of this species and some type of legal protection is desirable. This may be in the form of a Heritage Agreement, and although this type of agreement may not be entirely appropriate, it is likely to be the only current legal option.

Ten of the seventeen surviving translocated subpopulations are either managed by local councils or maintained in nursery or garden environments and may therefore be considered to have a higher degree of protection than the naturally occurring subpopulations

1.7.4 Small isolated populations

The six small, isolated naturally occurring extant subpopulations of *A. dockeri* each represent a single genet. Such subpopulations are vulnerable to extinction by a single catastrophic event. Extinction of any of the remaining subpopulations would have a significant impact on the species' potential for long-term survival. The species is confined to narrow road verges, adjacent to agricultural land, and all subpopulations have a high edge to area ratio with a resulting higher susceptibility to factors such as exposure to fertiliser drift, road dust, grazing and weed invasion.

1.7.5 Adjoining land-use

Since 1999, the extant subpopulations have been variously subjected to road maintenance activities, including road widening (Thornlea), roadside slashing (Yangya, Telowie and Hart) and herbicide spraying (Yangya). The Melrose, Telowie and three Laura subpopulations are all located adjacent to gravel roads that require periodic grading and this activity is a potential threat to the subpopulations.

The Melrose and three Laura subpopulations are immediately adjacent to intensively cropped land and the Telowie subpopulation is adjacent to an olive grove. There is an ongoing risk of chemical drift from surrounding agricultural land. It has been the usual practice for adjacent landowners to apply broad-spectrum non-selective herbicide to at least one of the roadsides (Yangya) to create a firebreak. Local farmers often follow recommendations to remove grass along fence lines, using herbicide to reduce snail problems in crops. The presence of plants that are declared (weeds) under the *Natural Resources Management Act* 2004 (e.g. Horehound at Yangya) within

Spiny Daisy populations represents a risk of non-target damage from spraying by adjacent landholders or Natural Resource Management (NRM) Authorised Officers.

1.7.6 Lack of genetic diversity

Genetic variation in the known population of Spiny Daisy appears to be low. Research has found that there is variation between, but not within each of the (six) extant sub-populations (Jusaitis 2007b; Adams 2013). While there appears to be a number of ramets (individuals at ground level) at each of the subpopulations, these are all thought to represent a single genetic individual. As a result, the total known population of *A. dockeri* is only six individuals, giving the species little adaptive potential in the face of changing environmental conditions.

1.7.7 Inappropriate revegetation

Non-indigenous trees have been planted on roadsides at Yangya and Rusty Cab (since destroyed by fire at the latter site) prior to the discovery of the Spiny Daisy. The introduction of non-indigenous trees and shrubs into grassland alters the habitat significantly, posing a potential threat to Spiny Daisy subpopulations.

1.7.8 Lack of sexual reproduction

No seedlings have been observed in the field and seed production is extremely low. The few seeds that have been found characteristically produce a high proportion of abnormal seedlings with a low survival rate. Trials have shown that seed set is erratic, probably as a result of pollen sterility (Jusaitis & Adams 2005b). *Acanthocladium dockeri* is therefore not currently able to increase its genetic diversity and new genetic individuals are not being added to the population; this may be a concern in the future as the life span of each clone is currently unknown. However all clones of the species do exhibit vigorous suckering.

1.7.9 Lack of knowledge

There is a lack of knowledge regarding many aspects of the biology and ecology of *A. dockeri*. In future this may impact on the ability of the Recovery Team to make appropriate management decisions, particularly in the face of climate change.

Little is known of the historic distribution of the species and its habitat requirements, which would assist the Recovery Team to undertake targeted searches for any extant undiscovered sites. There is also an incomplete understanding of the specific cause of the reduction in the species' distribution. *Acanthocladium dockeri* is generally assumed to have declined as the result of clearance and modification of its habitat for agriculture. However, it is unclear why the species has not survived in a greater number of 'refuge' areas. There is no documentation of the species occurring in the Mid-North region before 1999. Lack of knowledge regarding the species' distribution and environmental tolerances may also affect the success of future translocations.

1.7.10 Climate change

Climate change is a particular threat to *A. dockeri* due to its extremely low level of genetic diversity and thus reduced ability to adapt to change. There are few options available to protect this species against the threats of climate change. At present, the best insurance against the risk of climate-induced extinction is to conserve genetic material *ex-situ*, maximise the number of *in-situ* subpopulations and attempt to promote genetic diversity within subpopulations.

1.8 Areas and subpopulations under threat

The threatening processes described above in section 3.2 affect all known natural areas and subpopulations of *A. dockeri*. The Telowie, Melrose and three Laura subpopulations are at a greater risk from road maintenance due to their location on unsealed roads that require regular grading. These subpopulations may also be at greater risk from farm maintenance (e.g. from chemical spraying), compared to the Hart site, due to their closer proximity to areas of agricultural activity. Herbivory by white snails is also less prevalent at the Hart subpopulation. The translocated garden plantings are less threatened by factors such as weed competition, herbivory, and road and farm maintenance.

PART 2: Recovery Program

2.1 Past and Current Management Actions

The Spiny Daisy Recovery Team was established in 1999 following the rediscovery of the species. To date, the Team has undertaken the following activities:

- All sites have been registered as sites of significant roadside vegetation and roadside markers have been installed to alert road maintenance workers.
- Other roadsides and rail reserves in the Mid-North have been searched for *A. dockeri*. This indirectly led to the discovery of the Telowie and Melrose sites.
- Part of the Thornlea subpopulation, which had expanded into the adjacent farm paddock, has been fenced with agreement of the landowner.
- Annual and perennial herbaceous weeds have been controlled, using minimal disturbance techniques (e.g. cut and swabbed, spot-sprayed, hand pulled).
- Aspects of the biology of Spiny Daisy have been studied, including:
  1) propagation techniques (cuttings, seed and tissue culture),
  2) the effects of snail grazing, pruning and road grading on regeneration,
  3) genetic studies to determine the levels of genetic variability (Jusaitis and Adams 2005a),
  4) floral biology,
  5) the regular monitoring of abundance (including photo points) at each subpopulation,
  6) Response to fire (Jusaitis 2007a), and
  7) Clonal hybridisation and inter-clonal crosses (Jusaitis and Adams 2005b).
- The subpopulations have been mapped, associated plant species and soil types recorded and a project herbarium compiled.
- Population size, plant growth rates, population demographics, and threats are being monitored.
- The species is in cultivation from cuttings at seven sites designed as exhibition sites to raise public awareness.
- Cuttings of five of the six clones are being held in nurseries for research purposes.
- Cutting-derived plants have been translocated to augment the extant subpopulations at Hart, Rusty Cab and Yangya. These have established and at least two sites have recorded significant suckering.
- A translocation program is currently in process to increase abundance and the number of subpopulations. Eight additional sites have been set up in natural habitat through translocation, including an experimental mixed-gene translocation site. Translocation proposals and plans have been written (DEH 2002, 2006a, 2006b; Haase 2012) in accordance with ANPC guidelines (Vallee *et al* 2004). The mixed-gene trial has resulted in successful establishment of the Hart, Telowie and three Laura clones (Melrose is yet to be included), although only Rusty Cab, Hart and Telowie clones have started spreading by suckering at this stage.
- Snail bait has been laid through autumn to spring around all sites, particularly translocation sites, since 2001. Subsequent monitoring has indicated that baiting has had minimal effect on plant survival, but that it was difficult to gauge the

influence of seasonal conditions on snail damage (Sharp *et al* 2010). The earlier translocations were conducted in drought years, when the drier conditions were likely to exacerbate the effect of snail damage. Consequently, with the recent return to average rainfall, the Recovery Team has decided to continue with snail baiting, albeit at more frequent intervals.

- A fact sheet has been produced on the species, and information has been presented to the local community at agricultural field days and other events in the region.
- Liaison with owners of land adjacent to the subpopulations regarding favourable site management has occurred.
- A monitoring plan has been developed for the species (DEH 2005b). Monitoring has been conducted intermittently since then, with data collected on the survival rate of naturally occurring and translocated plants, size and health, and presence of new ramets.
- Attempts to raise seedlings were unsuccessful, because of the low proportion of seed set (0.6%) and the low survival rate of seedlings (Jusaitis & Adams 2005b, Jusaitis 2008).
- Site action plans, focusing on extrinsic threats (weeds, grading, herbivory), have been prepared for the three Laura sites and the Hart site (DEH 2005a). Subsequently a site action plan was formulated for the Telowie site (DEH 2009). More recently these plans have been updated (Rees 2012a), and site action plans have been written for the new Melrose site (Rees 2012a), as well as the four translocation sites placed on public land (Rees 2012b). These Action Plans contain details of threat abatement activities at each site, and all are being implemented.

2.2 Recovery objectives and timelines

The overall recovery objective is to prevent extinction of *Acanthocladium dockeri*, maintain its genetic variation and improve its conservation status in the wild.

Over the next five years, the specific recovery objectives are to:

1. Prevent total extinction and maintain genetic variation by ex situ cultivation of material from all subpopulations.

2. Maintain or increase area of occupancy and extent of occurrence by managing subpopulations in the wild.

3. Increase the number of known subpopulations by searching for unknown subpopulations, and by implementing a translocation program. The associated actions, if successful, could increase area of occupancy and possibly extent of occurrence.

2.3 Performance criteria

The following performance criteria will be used to gauge whether the recovery objectives have been achieved over five years:

1. a) All five existing wild subpopulations and area occupied remain at current levels or increase;
   b) The density of annual weeds decreases and the number of remnant native species increases at *A. dockeri* sites.

2. Self sustaining populations of all genotypes exist at no less than two locations in the field (one natural occurrence site and an additional translocation site).
3. Collections of all six genotypes are maintained in laboratories or nurseries.
4. Further searches for the species are undertaken throughout the Mid-North and Murray Darling Basin, particularly in the general area of historic records (Bambamero and Overland Corner), and in the vicinity of the newly discovered Melrose site.
5. Participation of a range of stakeholders in the recovery process is maintained over the duration of the recovery plan. There is a high level of awareness and active involvement of the local community in the implementation, monitoring and promotion of recovery.

2.4 Evaluation of this recovery plan

The Recovery Team will take an active role in planning and implementing all actions, and in monitoring the success of the project. The Recovery Team provides linkages between local and non-local participants and its membership is listed in Appendix 1. The Recovery Team meets twice a year in the Mid-North. Contact amongst members of the Recovery Team, and between the Team and the local community is maintained throughout the year.

The progress of the Spiny Daisy Recovery Project will be assessed against the recovery plan at each meeting of the Spiny Daisy Recovery Team. The recovery plan should be thoroughly reviewed within five years of its adoption under the EPBC Act, when it may need to be updated.

2.5 Recovery Actions

Site action plans, focusing on extrinsic threats (weeds, grading, herbivory), have been prepared for, and are being implemented at, the six naturally occurring subpopulations and four of the translocation sites. A translocation program is currently in process to increase abundance and number of subpopulations. Attempts to increase the genetic diversity of the species will occur and its public profile will be raised.

All actions are to be co-ordinated by and managed through the Threatened Flora Ecologist for the DEWNR Northern and Yorke Region and the Spiny Daisy Recovery Team. The actions required are listed below, and then described, in priority order. All management action will be appropriately recorded and documented.

Action 1. Continue threat abatement, site management and monitoring in accordance with the site action plans prepared for all naturally occurring subpopulations.

Action 2. Maintain existing translocations and establish an additional site to provide back-up for the Melrose subpopulation.

Action 3. Conduct trials to increase genetic diversity.

Action 4. Identify extant unknown subpopulations.

Action 5. Maintain stakeholder participation in the Recovery Team and increase the involvement of the local community in the recovery program.

Action 6. Conduct targeted research into the ecology and biology of *A. dockeri* in order to manage the species better.

Action 1. Threat abatement for existing known subpopulations

The aim is to improve the quality of *A. dockeri* habitat in order to reduce the possibility of a reduction in the species' abundance and/or subpopulation extinction. This will be achieved by increasing the potential habitat for this species by reducing competition from weeds, and reducing the impacts of herbivory and road or farm maintenance activities.

a) Direct site management

Weed control is the main form of intervention at all Spiny Daisy sites and carries potential risks as well as benefits for other native plants. The Recovery Team will adopt weed control guidelines in consultation with adjacent landowners to ensure that all herbicide use, slashing and hand weeding at Spiny Daisy sites is selective, appropriately timed and targeted to the main problem species with minimal impact on Spiny Daisy and other native species. Potential accumulation of flammable dead plant material in summer from annual weed species will be managed in conjunction with Spiny Daisy recovery. All agencies with an interest in vegetation control along roadsides will be informed of site management requirements and will be consulted annually on their proposed work programs. This may benefit native grassland conservation more generally along roadsides, including possible new subpopulations or translocation sites. Specific weed species at each naturally occurring *A. dockeri* site and the appropriate control techniques are listed in the Site Action Plans (Rees 2012a).

The existing fences at all sites will be maintained and any new subpopulations threatened by stock grazing will be fenced as required. In order to reduce the impact of snail herbivory on *A. dockeri,* baiting will occur at least annually.

b) Limit impacts of maintenance activities and increase legal protection

Through liaison with the Northern Areas Council, District Council of Mount Remarkable and DPTI, all naturally occurring subpopulations have been identified with significant roadside markers. It is the responsibility of these organisations, with the support of the Spiny Daisy Recovery Team, to maintain road markers and training of road maintenance crews. They will be asked to notify the Recovery Team of proposed road works that could affect Spiny Daisy sites. The Recovery Team will liaise regularly with these authorities to ensure that their maintenance activities have no negative impact on *A. dockeri*. The Recovery Team will also liaise with neighbouring landholders to ensure that they are aware of the management requirements of *A. dockeri* and that their activities have no negative impact on the species. As the species is not known to occur within any areas formally reserved for conservation, legal avenues to increase the protection of *A. dockeri* will be explored. This may be in the form of Heritage Agreements, and although this type of agreement may not be entirely appropriate, it is likely to be the only current legal option available.

c) Monitor extant subpopulations

All extant subpopulations will be monitored yearly to gauge the effectiveness of management actions (particularly weeding and snail baiting) and to assess population trends. All monitoring will be undertaken in accordance with the monitoring plan (DEH 2005b), to ensure consistency. Monitoring of extant subpopulations will have two components: the photo-point monitoring that has occurred since 2000 and the population monitoring developed in 2005.

Action 2. Establish and maintain translocation sites to provide back-up for known subpopulations

In order to decrease the risk of extinction for any *A. dockeri* genotype, the Recovery Team will ensure that all clones are present in at least two locations in the field. This will entail monitoring and management of existing translocation sites and the additional translocation of any new genet. The aim is to establish self-sustaining subpopulations as indicated by natural proliferation via suckering. If successful, this action will increase the number of subpopulations and possibly the extent of occurrence.

a) Site selection and planning

Potential sites will be selected in the Mid-North region, where the land is not required for other incompatible purposes. In choosing a site, emphasis will be placed on land subjected to conservation agreements and areas where active management can occur. A thorough translocation plan will be prepared in accordance with ANPC translocation guidelines (Vallee *et al* 2004) prior to the introduction of any propagules to the translocation site.

b) Collect and propagate cuttings

Cuttings of the *A. dockeri* clone will be taken during spring and propagated at the Mid-North Plant Diversity Nursery. Plants will remain there until the break of the season, when they will be planted at the selected translocation site.

c) Site preparation, planting and maintenance

A suitable site will be prepared through fencing, weeding, signage, snail baiting and the planting of other native grassland species as appropriate.

d) Monitor all translocation sites

For the Melrose translocation the appropriate monitoring technique will be developed prior to translocation and outlined in the relevant translocation plan. When developing this technique, reference will be made to the monitoring plan (DEH 2005b) used at the naturally occurring sites. For the other single genotype sites, monitoring will occur as per their translocation plans. The monitoring data will be analysed to gauge the effectiveness of threat abatement, i.e. fencing, tree guards, weeding and snail baiting.

e) Manage all translocated sites

The appropriate management for each translocation site will continue for the life of the recovery plan.

Action 3. Trials to increase genetic diversity

Any increase in the genetic diversity of *A. dockeri* would be a major boost to the recovery effort. Attempts to increase diversity will be made via cross-pollination trials in both a laboratory/nursery and field setting. A mixed-gene translocation experiment is currently in progress and all clones have become established. Attempts to raise seedlings will also continue.

a) Cross-pollination trials

Cross-pollination trials are being conducted in a laboratory/nursery setting at the Adelaide Botanic Gardens. This trial will attempt to cross the different genotypes in all possible combinations, with the aim of producing viable seedlings and increasing genetic diversity.

b) Add Telowie genotype to mixed-gene translocation site

A mixed-gene translocation site has been set up involving the Hart, Telowie and three Laura genotypes, on a native grassland roadside reserve on the Caltowie – Stone Hut Road. The Telowie genotype has been added to the site to complete the full complement of genetic combinations. This mixed-gene translocation field trial is an extension of the cross-pollination experiments conducted at the Adelaide Botanic Gardens. This trial will be a valuable opportunity to study competitive interactions between genotypes.

c) Monitor mixed-gene translocation site

The appropriate monitoring technique is outlined in the mixed-gene translocation plan (DEH 2006a). The growth, survivorship and establishment of translocated *A. dockeri* will be assessed, following techniques used by DEWNR at other Spiny Daisy sites. Any viable seed produced will be genetically tested.

d) Attempt to raise seedlings ex-situ

The Recovery Team will continue with efforts to raise seedlings from the seeds that are naturally produced at each site. The planned methodology is as follows:

1) Collect seeds at each population

Spiny Daisy flowers and produces seed sporadically throughout the year. Seeds will be collected during routine site visits.

2) Raise seedlings under nursery conditions

Attempts will be made to raise these seeds in the DEWNR laboratory at the Botanic Gardens of Adelaide.

3) Establish in suitable translocation sites if successful

If seedlings can be successfully raised *ex-situ*, they will be established in suitable translocation sites, following a translocation plan in accordance with the ANPC translocation guidelines (Vallee *et al* 2004). Suitable sites will be selected based on criteria stated in Action 2a). In future the Recovery Team may consider translocating the species to sites within its historical range (South Australian Riverland and Central-Western New South Wales). Such a translocation will not be undertaken until thorough searches for *A. dockeri* have been conducted in these areas and the results of the cross-pollination

trails are known. Re-introduction of *A. dockeri* into its historic range is unlikely to be undertaken within the life of this plan.

Action 4. Identify extant unknown subpopulations

Due to the small number of known extant subpopulations and genotypes (six), the discovery of additional naturally occurring subpopulations would be beneficial to the recovery effort. Additional subpopulations may be identified by increasing public awareness to encourage community members and other natural resource management workers to report sightings, and by active searching.

a) Increase public awareness

The Threatened Flora Ecologist and Threatened Species Community Liaison Officer will develop and circulate information on habitats where *A. dockeri* might be found, diagnostic characteristics of the species, and how to send in a herbarium specimen for identification. The Threatened Flora Ecologist and the Recovery Team will offer assistance with identifying specimens and habitat and follow up any contacts.

b) Search for new subpopulations

Targeted searches in likely habitat will be conducted. Records of any searches will be entered into the DEWNR Biological Databases of South Australia (BDBSA) and herbarium specimens lodged in the SA State Herbarium. Efficient communication within DEWNR, and between DEWNR and Threatened Plant Action Group (TPAG), is required to ensure that all those involved in the recovery effort are made aware of any new discoveries. The Threatened Flora Ecologist will perform regular searches of the Herbarium Database to ensure no collections have been made without the notification of the Recovery Team. All information regarding new subpopulations will be communicated to the Recovery Team.

Targeted searches also need to be conducted in areas of the historic distribution of *A. dockeri* in the South Australian Riverland and the Menindee region of New South Wales. It is desirable that searches of these two areas, and the Mid-North, continue throughout the life of this plan.

c) Manage any newly discovered subpopulations

A Site Action Plan will be written for any newly discovered subpopulations in order to identify threatening processes and appropriate management actions. Responsibilities for managing any newly discovered subpopulations will be determined by the Recovery Team, with landholders and the local community being encouraged to play an active role.

d) Conduct genetic analysis of any newly discovered subpopulations

Newly discovered subpopulations will be studied to determine the degree of clonality within the subpopulation and their genetic relationship to the six known natural subpopulations.

e) Monitor any newly discovered subpopulations

Monitoring of any newly discovered subpopulations will follow standard protocols (DEH 2005b) and results entered in the Biological Database of SA, as above.

Action 5. Maintain stakeholder participation and increase community involvement in the recovery program

a) Maintain current stakeholder participation in the Recovery Team

The Spiny Daisy Recovery Project is currently overseen by a Recovery Team whose membership comprises of representatives from a number of stakeholder groups (Appendix 1). The continued involvement of all these groups is essential to achieving the goals of this plan.

b) Increase community involvement in the recovery process

The Recovery Team will seek involvement of the local community through councils, schools and interested individuals. The Recovery Team will promote the project locally through local media and field days and will undertake a campaign specifically to interest landholders regarding potential translocation sites and searching for unknown subpopulations. The Threatened Species Community Liaison Officer for DEWNR in the Northern and Yorke Region has established a community group based in the Mid-North to assist in implementing recovery actions. Members of the Recovery Team will assist by training volunteers from the new Biodiversity and Endangered Species Team in site management techniques.

Action 6. Conduct targeted research

Research into various aspects of the ecology and biology of *A. dockeri* needs to be conducted in order to increase scientific understanding of the species and to assist the Recovery Team in making appropriate management decisions. Whilst some of these studies can be performed utilising the existing skills of the Recovery Team and can be incorporated into existing management activities, other projects will require additional funding. The Recovery Team will liaise with other agencies, such as universities, in order to undertake targeted research into the following:

a) Cryo-preservation of plant material

It is highly desirable that the material from *A. dockeri* be cryogenically stored for long-term preservation. Seed from many threatened plant species in South Australia has been collected for cryo-preservation at the Seed Conservation Centre of the Department of Environment, Water and Natural Resources. Due to poor seed viability this is not currently an option for *A. dockeri*; however it may be possible to develop a technique for isolating and storing meristem tissue. Plant meristems (micro shoot tips) need to be isolated from existing *in vitro* cultures (tissue culture plants) and subjected to a range of test variables to develop a cryo-preservation procedure whereby viable plant material can be maintained in perpetuity under liquid nitrogen at -196°C (P. Ainsley, DEWNR, pers. comm. 2007). The optimised procedure will be used to establish long-term e*x situ* conservation collections for the six known clones of *A. dockeri*.

b) Life history studies

Five ramets at each site were tagged in 2000 as a component of the photo point monitoring. These ramets have been regularly monitored for changes in height and width (M. Jusaitis, DEWNR, pers. comm. 2005), this activity will continue for the life of the plan. This study may need to be expanded in the future to include the Melrose subpopulation, collect more detailed information and study whole *A. dockeri* plants rather than individual ramets.

c) Herbicide sensitivity trials

DEWNR is conducting a trial looking at the impacts of various weed control techniques. Cuttings from the Yangya clone have been raised at Mid-North Plant Diversity Nursery and planted at the Yangya road site, approximately 100 m west of the naturally occurring plants on the northern side of the road verge. Ten different treatments are being trialled to assess both their effectiveness in controlling weeds and any impacts on *A. dockeri*. These will be replicated three times. It is envisaged that this trial will run for 3 years and will involve repeat application of the treatments.

d) Ecological requirements and tolerances

A study into the ecological requirements and tolerances of *A. dockeri* is needed in order to guide management actions at the existing sites. This information may also be used to focus search efforts on the most suitable habitats, and to allow more accurate identification of developments or activities with the potential for a negative impact on *A. dockeri*. This information will also allow for an assessment of the potential impacts of climate change and allow for the identification of potential translocation sites.

e) Reproductive ecology and biology

Research needs to continue into the reproductive ecology and biology of *A. dockeri* in order to determine the factors limiting sexual reproduction. Attempts to germinate seeds will continue and if successful may lead to further studies regarding the reproductive biology and ecology of the species.

2.6 Management Practices

The following actions may hamper the species' viability and recovery:

- Disturbance or narrowing of the road verge at any of the sites
- Tree planting or other inappropriate revegetation projects at any of the sites
- Spraying or slashing that is not in accordance with site action plans/guidelines
- Fire-break activities (cultivation, slashing or spraying) undertaken within road reserves instead of on adjoining land (as indicated in NAC (2001), such action would require application to the Native Vegetation Council)
- Non-target damage associated with control of weeds declared under the Natural Resources and Management Act (2004)
- Spray drift of chemicals from management of adjacent crops.
- Activities which result in increases in weeds.
- Removal or damage to *A. dockeri* plants.
- Stock grazing.

2.7 Costs, duration and responsibilities

The duration, costs and responsibilities for recovery actions are outlined in Table 3.

Table 3: Duration, responsibilities and estimated costs of recovery actions

			Year 1		Year 2		Year 3		Year 4		Year 5		Total
	Action	**Responsibility**	**Project Costs**	**Salary Costs**	**Project Costs**	**Salary Costs**	**Project Costs**	**Salary Costs**	**Project Costs**	**Salary Costs**	**Project Costs**	**Salary Costs**	
1	**Management of 5 existing sites**												
1.a)	Direct site management	DEWNR	6190	714	6500	714	6824	714	7166	714	7524	714	**37774**
1.b)	Liaison with land managers & signage	DEWNR	400	1427	420	1427	441	1427	463	1427	486	1427	**9345**
1.c)	Population monitoring	DEWNR	300	1784	100	1784	105	1784	110	1784	115	1784	**9650**
	Photo point monitoring	DEWNR	2840	0	2982	0	3131	0	3288	0	3452	0	**15693**
2	**Manage existing and establish additional translocation sites**												
2.a)	Site selection & planning*	Rec Team	6450	4282	6772	4282	0	0	0	0	0	0	**21786**
2.b)	Collect & prepare cuttings*	Blyth Nursery/DEWNR	1600	1784	1260	1784	0	0	0	0	0	0	**6428**
2.c)	Site preparation & planting*	DEWNR	2322	2854	4470	4282	4267	2854	4480	2854	4704	2854	**35941**
2.d)	Monitor translocation sites	DEWNR	200	2141	300	4281	200	4281	210	4281	220	4281	**20395**
2.e)	Manage translocated sites	DEWNR	?	?	?	?	?	?	?	?	?	?	**?**
3	**Attempt to increase genetic diversity**												
3.a)	Lab cross pollination trials	DEWNR	3000	1427	0	713	0	0	0	0	0	0	**5140**
3.b)	Combine genotypes in the field**												
3.b)1	*Site selection & planning*	Rec Team	0	0	0	0	7111	4281	0	0	0	0	**11392**
3.b)2	*Collect & prepare cuttings*	Blyth Nursery/DEWNR	0	0	0	0	441	1784	0	0	0	0	**2225**
3.b)3	*Site preparation, planting & maintenance*	DEWNR	0	0	0	0	2560	2854	2688	1427	2822	1427	**13778**
3.c)	Monitor translocated populations	DEWNR	0	0	0	0	200	2140	2500	2140	200	2141	**9321**
3.d)	Attempt to propagate seedlings												
3.d)1	*Collect seed*	DEWNR	0	357	0	357	0	357	0	357	0	357	**1785**
3.d)2	*Attempt to propagate*	DEWNR	810	357	850	713	893	713	937	713	984	713	**7683**
3.d)3	*(Establish & maintain in suitable translocation site***)*	DEWNR	(10572)	(11060)	(200)	(3568)	0	(3568)	0	(3568)	0	(3568)	**(36104)**
4	**Identify existing unknown populations**												
4.a)	Increase public awareness	DEWNR/Rec Team/OEH	1000	3925	1050	5709	1102	2854	1157	2854	1215	2854	**23720**
4.b)	Conduct targeted searches	DEWNR/Rec Team/OEH	12622	2141	13253	3568	9685	1784	10170	1784	10678	1784	**67469**
4.c)	Manage newly discovered populations	DEWNR/OEH	****	****	****	****	****	****	****	****	****	****	****
4.d)	Conduct genetic analysis of new populations	DEWNR/OEH/SA Museum	****	****	****	****	****	****	****	****	****	****	****

	Action	Responsibility	Year 1 Project Costs	Year 1 Salary Costs	Year 2 Project Costs	Year 2 Salary Costs	Year 3 Project Costs	Year 3 Salary Costs	Year 4 Project Costs	Year 4 Salary Costs	Year 5 Project Costs	Year 5 Salary Costs	Total
4.e)	Monitor newly discovered populations	DEWNR/OEH	****	****	****	****	****	****	****	****	****	****	****
5	**Stakeholder & community involvement in recovery program**												
5.a)	Stakeholder involvement	DEWNR/Rec Team	6600	3211	6930	3211	7276	3211	7640	3211	8022	3211	**52523**
5.b)	Community awareness & involvement	DEWNR/Rec Team	1000	6422	1050	5708	1102	4995	1157	4995	1215	4995	**32639**
6	**Conduct targeted research**												
6.a)	Cryo-preservation	DEWNR/Universities	0	713	5000	1070	0	0	0	0	0	0	**6783**
6.b)	Life history studies	DEWNR/Universities	0	0		1070		1070		1070		1070	**4280**
6.c)	Herbicide sensitivity trials	DEWNR/Universities	3540	1784	2485	1427	2485	1427	2485	1427	2485	1427	**20972**
6.d)	Ecology	DEWNR/Universities	0	0	0	713	3000	713	0	0	0	0	**4426**
6.e)	Reproductive biology	DEWNR/Universities	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****	*****
		Total	**59446**	**46383**	**53622**	**46381**	**50823**	**42811**	**44451**	**34606**	**44122**	**34607**	**457252**

Note: The successful implementation of this recovery plan will require one-third of the time of a regional Threatened Flora Project Officer and one-sixth the time of a Community Liaison Officer, at a cost of $30,923 and $15,460 respectively, per year (including on-costs, office and operating expenses) for the first two years. After the first two years a smaller percentage of these two officers' time should be required to implement this plan. These salary costs have been broken down for each recovery action and are included under the salaries component.

* Estimates are based on plans to translocate the Melrose clone to an additional site. A mixed-gene translocation and Rusty Cab back-up translocation occurred in June 2007. Additional translocations may be necessary during the life of this plan but have not been calculated in this document. The need for additional translocations will depend on the results of both the cross-pollination experiments and the habitat searches.

** Estimate of cost based on establishing one field-based cross-pollination site. Additional sites may be required based on the results of the laboratory based cross-pollination trial.

*** Previous attempts to propagate *A. dockeri* seed have been unsuccessful, thus this action is unlikely to be necessary and will be deferred if further attempts to propagate are unsuccessful.

****Costs cannot currently be accurately estimated, as it will depend on the number of additional subpopulations found, their location and the habitat condition at the site/s.

***** Costs cannot currently be accurately estimated without knowing the results of action 3.3.

2.8 Resource allocation

Implementation of this recovery plan will involve a co-operative approach between state government departments, local government, community groups, landholders and individual community members to ensure an efficient and effective use of resources. The Spiny Daisy Recovery Team links with organisations such as the Northern and Yorke Natural Resources Management Board, TPAG, DEWNR, Caltowie Corridors of Green, Blyth-Brinkworth Revegetation Committee, Greening Australia, DPTI, Northern Areas Council and the District Council of Mount Remarkable. The implementation of this plan will also contribute to *No Species Loss*: *A Nature Conservation Strategy for South Australia* 2007-2017 (DEH 2007).

The Recovery Team is aware of the resource limitations and has, in the past, and will continue to, consider all appropriate linkages to ensure efficient use of resources and avoid unnecessary duplication.

Acanthocladium dockeri has been identified as a conservation priority in the Northern & Yorke Biodiversity Plan (Graham *et al* 2001). The Northern and Yorke Regional NRM Plan (NYNRM 2009) outlines the development and implementation of threatened species recovery plans as an action target. The main habitat in which *A. dockeri* occurs (native grasslands in the Mid–North) is listed as a threatened ecological community under the Commonwealth EPBC Act. The activities outlined in this plan will not only assist this nationally endangered plant species but also restore a threatened ecosystem.

2.9 International obligations

Acanthocladium dockeri is not listed under any international agreement. Implementation of this Recovery Plan is in keeping with the principles of the Rio Declaration on Environment and Development (Agenda 21) (UN 1992a) and with Australia's obligations under the United Nations Convention on Biological Diversity (UN 1992b), ratified by Australia in 1993 and the subsequent National Strategy for the Conservation of Australia's Biological Diversity (Commonwealth of Australia 1996).

2.10 Affected interests

Eighteen community groups, land managers and private landholders have been identified as current stakeholders in the management of *A. dockeri*. Of these, nine directly own or manage critical habitat for this species. Many of these groups and individuals have been actively managing the species since its rediscovery in 1999. These groups are identified in Appendix 1.

The involvement of all stakeholders, particularly those already performing valuable recovery actions, has been sought during the recovery planning process. Stakeholders were informed of the recovery plan during its development and were invited to comment. The Spiny Daisy Recovery Team, which contains representatives and individuals from a number of stakeholder groups, allows for wide involvement and for the co-operative management of the species. The continuation of this co-operative management approach is one objective of this plan. An additional goal is to increase

the involvement of the local and regional community, and this is described under Section 2.5.5.

2.11 Role and interests of indigenous people

The relevant indigenous communities in South Australia affected by this plan (Mid North Region) have been contacted and consulted through the Aboriginal Partnerships Unit, DEWNR. The implementation of recovery actions under this plan will consider the role and interest of such communities.

The requirements of the *Native Title Act* 1993 only apply to land where Native Title rights and interests may exist. 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.

Generally the *Native Title Act* 1993 requires certain procedures to be followed prior to undertaking activities – known as future acts that may include certain recovery actions in this plan – which may affect Native Title rights and interests. This threatened species plan will only be adopted subject to any Native Title rights and interests that may continue in relation to the land and/or waters. Nothing in the plan is intended to affect Native Title. The relevant provisions of the *Native Title Act* 1993 should be considered before undertaking any future acts that might affect Native Title. Procedures under the *Native Title Act* 1993 are additional to those required to comply with the *Aboriginal Heritage Act* 1998.

2.12 Benefits to other species/ecological communities

This Recovery Plan has potential localised biodiversity benefits for other species and communities. In a general sense, this will be through the conservation and management of habitat. This plan and the public consultation process included in the recovery process may also provide an important public education role, i.e. highlighting broad environmental issues and drawing attention to threats to biodiversity in the region.

The Melrose, Hart and three Laura *A. dockeri* subpopulations occur in remnant native grassland, ranging in condition from a weed dominated site (Hart subpopulation) to relatively intact grassland (Thornlea subpopulation). Much of the remnant lowland grassland in the region occurs on road verges and other minor public lands such as cemeteries, rail reserves and parklands. Other species of conservation significance such as *Lachnagrostis limitanea* (Spalding Blown Grass) are similarly confined to such areas. The increased community liaison and on-ground actions included in this recovery plan will complement other initiatives to improve management of small native grassland remnants on roadsides, public reserves and private land in the region. The Telowie *A. dockeri* subpopulation occurs in a degraded remnant shrubland, which is weed dominated. Shrublands of the Northern and Yorke region do not have a conservation rating, however some provide habitat for threatened species (Graham *et al*. 2001).

The implementation of this recovery plan should not have a negative impact on any other native species or ecological community. *Acanthocladium dockeri* has a high

potential for vegetative spread, which could potentially result in the species becoming a localised weed problem in translocated areas. However, this is only considered to be a risk in areas where it would receive greater moisture than it does under natural conditions (e.g. if planted on drainage areas, irrigated, or translocated to higher rainfall areas). While this risk is thought to be slight, the weed potential for this species will be considered thoroughly prior to undertaking any translocations.

2.13 Social and economic impacts

The implementation of this recovery plan is unlikely to cause any significant adverse social or economic impacts. All six currently known natural subpopulations are located on roadside verges surrounded by agricultural land. This may necessitate minor changes in the manner in which road maintenance works are carried out by the local government agency (Northern Areas Council at the three Laura sites, District Council of Mount Remarkable at the Telowie and Melrose sites) and by DPTI at the Hart site. While some additional financial cost may be incurred by these organisations, any increase in required expenditure is likely to be minimal. For the Northern Areas Council and District Council of Mount Remarkable, this cost may be offset by the assistance they receive in the management of their roadside reserves.

At one site (Thornlea) the subpopulation has expanded out from the road verge into the adjacent paddock. This area has been fenced off, with the consent of the landholder. If other subpopulations expand in this way it may be necessary to fence off additional areas of paddock, which may have a negative impact on adjacent landholders by reducing the area available for production. Such fencing would only occur with the agreement of the landholder.

The implementation of this recovery plan is also likely to result in a number of positive social and economic impacts. Beneficial economic impacts may come about through the management of introduced species that have the potential for negative impact on agricultural productivity. Social benefits will come through community education regarding natural resource management theory and its practical applications, enhancing social capital.

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APPENDIX 1: List of current regional, state and nationally based stakeholders in the management of *Acanthocladium dockeri*

Stakeholder Group	Group	Manage /own	Recovery Team Representatives
Regional Stakeholders			
General Mid-North Community	General community/ neighbouring landholders	X	4
DEWNR	Conservation Programs Unit, Northern & Yorke Region	X	Conservations Program Manager, Threatened Species Community Liaison Officer
Community Groups	Blyth-Brinkworth Revegetation Committee	X	
	Mid-North Plant Diversity Nursery	X	Nursery Co-ordinator
	Biodiversity & Endangered Species Team	X	
	Caltowie Corridors of Green	X	
	Greening Australia		Bushcare Support Officer
Natural Resources Management Board	Northern & Yorke Natural Resources Management Board		
Council	Northern Areas Council	X	Councillor, Planning Officer
	District Council of Mount Remarkable	X	Deputy Works Manager
Department for Planning, Transport & Infrastructure	Mid-North Region	X	Environmental Officer
State Stakeholders			
General public			
Indigenous community			
DEWNR	Threatened Species Unit		Threatened Flora Ecologist
Office of Environment & Heritage, NSW	Threatened Species Unit, Dubbo		
Community Groups	Threatened Plant Action Group	X	Project Co-ordinator
Contractors	Trees For Life	X	Threatened Flora Project Officer
National Stakeholders			
General public			
Department of Sustainability, Environment, Water, Population & Communities			

APPENDIX 2: Native plant species occurring with *Acanthocladium dockeri* at the six naturally occurring sites.

From Site Action Plans prepared by Rees (2012a)

Sites: H = Hart, near Blyth; M = Melrose; RC = "Rusty Cab" (near Laura); Te = Telowie; Th = Thornlea (near Laura); Y = Yangya (near Laura)

Conservation Status: Aus = Australia (EPBC Act); SA = South Australia (NPW Act); N&Y = Northern and Yorke Region (DEWNR); CR = Critically Endangered; E = Endangered; NT = Near Threatened; VU = Vulnerable.

SPECIES	Common name	Sites						Conservation Status		
								Aus	SA	N&Y
Acacia ligulata	Umbrella Bush				Te					
Acacia victoriae subsp. *victoriae*	Elegant Wattle		Y		Te					
Acacia wattsiana	Dog Wattle			H						NT
Acanthocladium dockeri	Spiny Daisy / Spiny Everlasting	Th	Y	RC	H	Te	M	CR	E	CR
Alectryon oleifolius subsp. *canescens*	Bullock Bush					Te				
Aristida behriana	Brush Wire-grass				H					
Arthropodium strictum	Common Vanilla-lily	Th	Y	RC	H		M			NT
Atriplex semibaccata	Berry Saltbush	Th	Y				M			
Austrostipa blackii	Crested Spear-grass	Th	Y	RC	H					NT
Austrostipa elegantissima	Feather Spear-grass					Te				
Austrostipa eremophila	Rusty Spear-grass	Th	Y		H					
Austrostipa nodosa	Tall Spear-grass	Th	Y		H					
Austrostipa scabra	Rough Spear-grass					Te				
Austrostipa sp.	Spear-grass			RC			M			
Boerhavia diffusa	Tar Vine	Th	Y							RA
Bursaria spinosa subsp. *spinosa*	Sweet Bursaria			RC	H	Te				
Chamaesyce drummondii	Flat Spurge	Th								
Convolvulus erubescens	Australian Bindweed		Y		H					
Convolvulus erubescens/remotus	Native Bindweed					Te				
Dodonaea viscosa	Sticky Hop-bush					Te				
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush				H	Te				
Enneapogon nigricans	Black-head Grass	Th				Te	M			
Enteropogon acicularis	Umbrella Grass	Th				Te	M			
Eremophila longifolia	Weeping Emu Bush					Te				
Goodenia pinnatifida	Cut-leaf Goodenia		Y							NT
Goodenia pusillifora	Small-flowered Goodenia	Th								
Halgania cyanea	Rough Blue-flower		Y							NT
Lomandra effusa	Scented Mat-rush	Th	Y	RC	H					
Lomandra multiflora subsp. *dura*	Hard Mat-rush				H					

SPECIES	Common name		Sites					Conservation Status		
								Aus	SA	N&Y
Maireana brevifolia	Short-leaf Bluebush					Te	M			
Maireana enchylaenoides	Wingless Fissure-plant	Th	Y	RC						
Maireana rohrlachii	Rohrlach's Bluebush	Th	Y						R	VU
Olearia decurrens	Winged daisy-bush					Te				NT
Pimelea micrantha	Silky Rice-flower	Th	Y		H	Te				VU
Rhagodia parabolica	Mealy Saltbush					Te				
Rhytidosperma caespitosa	Common Wallaby-grass		Y							
Rhytidosperma sp.	Wallaby-grass	Th	Y	RC	H		M			
Salsola australis	Buckbush	Th								
Scaevola humilis	Inland Fanflower	Th	Y							NT
Sclerolaena sp.	Bindyi						M			
Senna artemisioides	Senna		Y		H	Te				NT
Sida corrugata	Corrugated Sida	Th	Y	RC						
Solanum esuriale	Quena		Y							
Teucrium racemosum	Grey Germander		Y							
Velleia paradoxa	Spur Velleia	Th	Y							VU
Vittadinia blackii	Narrow-leaf New Holland Daisy	Th	Y							
Vittadinia gracilis	Woolly New Holland Daisy	Th	Y	RC						
Vittadinia sp.	New Holland daisy		Y			Te	M			
Whalleya proluta	Rigid Panic				H					NT

APPENDIX 3: Exotic plant species occurring with *Acanthocladium dockeri* at the six naturally occurring sites.

From Site Action Plans prepared by Rees (2012a)

Sites: H = Hart, near Blyth; M = Melrose; RC = "Rusty Cab" (near Laura); Te = Telowie; Th = Thornlea (near Laura); Y = Yangya (near Laura)

SPECIES	Common name	Sites					
Arctotheca calendula	Cape Weed		Y	RC			
Asphodelus fistulosus	Onion Weed	Th			H	Te	M
Avena barbata	Bearded Oat	Th	Y	RC	H	Te	M
Brachypodium distachyon	False Brome	Th	Y	RC	H		
Bromus rigidus	Rigid Brome	Th	Y		H		
Bromus rubens	Red Brome	Th					
Carrichtera annua	Ward's Weed	Th	Y	RC		Te	M
Centaurea calcitrapa	Star Thistle		Y	RC			
Cucumis myriocarpus	Paddy Melon		Y				
Cynara cardunculus	Artichoke Thistle				H		
Cynodon dactylon	Couch Grass						M
Desmazeria rigida	Rigid Fescue				H		
Echium plantagineum	Salvation Jane	Th	Y	RC	H		M
Erodium sp.	Heron's-bill/Crowfoot	Th	Y	RC			
Galenia pubescens	Coastal Galenia					Te	
Gazania sp.	Gazania		Y				
Hedypnois rhagadioloides	Cretan Weed		Y				
Heliotropium europaeum	Potato Weed	Th	Y		H		
Hordeum sp.	Barley-grass	Th	Y		H		M
Lepidium africanum	Common Peppercress	Th					
Lolium perenne	Perennial Ryegrass		Y				
Lolium perenne/rigidum	A Ryegrass			RC			
Malva sp.	Mallow	Th	Y				
Marrubium vulgare	Horehound		Y		H		M
Medicago sp.	Medic	Th	Y	RC			M
Moraea setifolia	Thread Iris	Th	Y	RC			
Muscari armeniacum	Grape Hyacinth		Y				
Oxalis pes-caprae	Soursob		Y		H	Te	
Pallenis spinosa	Golden Pallenis			RC			
Pennisetum clandestinum	Kikuyu				H		
Phalaris aquatica	Phalaris				H		
Piptatherum miliaceum	Rice Millet				H		
Polygonum aviculare	Wireweed	Th					
Polypogon monspeliensis	Annual Beard-grass				H		
Rapistrum rugosum subsp. *rugosum*	Wild Turnip	Th	Y	RC	H		
Romulea sp.	Guildford Grass			RC			
Salvia verbenaca	Wild Sage	Th	Y	RC	H	Te	M

SPECIES	Common name			Sites			
Scabiosa atropurpurea	Pincushion	Th	Y	RC	H		
Sisymbrium orientale	Indian Hedge mustard					Te	
Solanum nigrum	Black Nightshade				H		
Sonchus oleraceous	Common Sow-thistle	Th	Y	RC			M
Tribulus terrestris	Caltrop		Y				
Trifolium angustifolium	Narrow-leaf Clover		Y				
Vicia sp.	Vetch	Th			H		M
Vulpia sp.	Fescue		Y				

APPENDIX 4: Summary of all *Acanthocladium dockeri* plantings.

Refer to Figure 2 for map of locations in South Australia**.**

ID	Site	Year	Status	Clone	Comments	Zone	E	N
1	Caltowie - Stone Hut Rd NE of Thornlea	2007	Back up	All 5 clones		54	258523	6329295
2	Caltowie cemetery	2007	Back up	Rusty Cab		54	264070	6326490
3	Gladstone road reserve	2007	Back up	Yangya		54	255155	6313518
4	Napperby Block (MRNP) S of Telowie	2005	Back up	Telowie	On road reserve within Mt Remarkable NP. 24 planted, 2 plants surviving @ 29 June 2011	54	231893	6331090
5	Haase's property, Mambray Ck	2009	Back up	Telowie	Private property	53	780629	6361901
6	Hunt's property, near Wirrabara	2009	Back up	Telowie	Private property	54	247547	6338807
7	Wamsley's property near Nelshaby. NOT MAPPED	2009	Backup	Telowie	Private property at Napperby, 50 planted, 23 Sept 09 last visit. NB NONE HAVE SURVIVED.	54	234975	6323103
8	Jaeschke's property, Murrumbeena Lane, NW of Hart	2009	Backup	Hart	Michael/Kevin Jaeschke's property - adj. old railway line, on west side of rail ballast:- 15 or 16 plants surviving	54	261921	6263346
9	Charles Street Blyth W of Blyth	2006	Back up	Hart (2 plants)	Adj. to water intake channel for town run-off dam. Planted with other plants indigenous to the Blyth Plains	54	267265	6251934
10	Lomandra Walk, Blyth Golf Course S of Blyth	0	Back up	Hart	Sthn boundary of Golf Course; 2 plants included in a revegetated native grassland area	54	269200	6251800

ID	Site	Year	Status	Clone	Comments	Zone	E	N
11	Blyth nursery and hospital grounds	2006	Education/ demonstration	Hart (2 plants)	Garden area adjacent to northern in-ground rainwater tank. Spread well	54	268027	6252035
12	Hart Field Day site	2010	Education/ demonstration	All 5 clones	Survival rates variable, due to limited number of tree guards	54	260365	6261646
13	Arid Lands Botanic Garden	2002	Education/ demonstration	Hart		53	757849	6404935
14	Adelaide Botanic Garden	2010	Education/ demonstration			54	282040	6133546
15	Canberra Botanic Gardens	?	Education/ demonstration	Hart and Thornlea		55	691756	6094329
16	ElectraNet substation, Slaughterhouse Rd, Clare	2009	Education/ demonstration	All clones	4 – 6 plants	54	280300	6254600
17	Gladstone - Balaklava railway line, near Hart	2007	Augmentation of extant subpopulation	Hart	Native grassland strip behind Gladstone - Balaklava railway line, near Hart	54	262380	6262531
18	Laura Parklands	2000	Education/ demonstration	Thornlea	Laura parklands	54	248137	6325437
19	Jaeschke's property, Magpie Creek, Hart	2009	Back up	All 5 clones	Magpie Creek, Spiny Daisy translocated populations on Michaels property, Source = Hart population	54	258389	6264477
20	Rusty Cab	2006	Augmentation of extant subpopulation	Rusty Cab	On the 'Rusty Cab' track, 1.8 km N of the Caltowie to Gladstone Road	54	259420	6324318
21	Yangya	2004	Augmentation of extant subpopulation	Yangya	62 planted just west of main population; 96 counted in 2011 (M Jusaitis, DEWNR, pers. comm. 2012)	54	252250	6321220