NATIONAL RECOVERY PLAN FOR

Olearia macdonnellensis, Minuria tridens (Minnie Daisy) and *Actinotus schwarzii* (Desert Flannel-flower)

Olearia macdonnellensis
© D. Albrecht

Actinotus schwarzii
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Minuria tridens
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Australian Government

Department of Environment and Conservation

Northern Territory Government

Title: National Recovery Plan for *Olearia macdonnellensis*, *Minuria tridens* (Minnie Daisy) and *Actinotus schwarzii* (Desert Flannel Flower)

Threatened Species Officer

Biodiversity Conservation Unit

NRETAS

PO Box 1120

ALICE SPRINGS NT 0871

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.

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Copies of the plan are available at:
http://www.environment.gov.au/biodiversity/threatened/recovery-list-common.html

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Abbreviations

APS	Australian Plant Society, a non-profit, independent, incorporated community organisation with members throughout Australia that encourages the growing, propagating, preservation and conservation of Australian plants.
ASDP	Alice Springs Desert Park, a Northern Territory government run park that displays plants and animals in typical central Australian settings
CLC	Central Land Council, a statutory authority representing Aboriginal people in the southern Northern Territory under the *Aboriginal Land Rights (Northern Territory) Act 1976*. It also has functions under the *Native Title Act 1993* and the *Pastoral Land Act 1992*
CLMA	Central Land Management Association
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth Government Legislation
GA	Greening Australia
MSBP	Millennium Seed bank Project
NP	National Park
NRETAS	Department of Natural Resources, Environment, the Arts & Sport (formerly Department of Infrastructure, Planning and Environment) of the Northern Territory; includes the Parks and Wildlife Service
NT	Northern Territory
OPBG	Olive Pink Botanic Garden, a 16 ha arid zone gardens in Alice Springs that displays over 300 species of central Australian plants and is administered by a voluntary Board of Trustees.
PWSNT	Parks and Wildlife Service, Alice Springs, Northern Territory, a service within NRETAS
TSN	The Threatened Species Network is a joint the Australian Government and WWF- Australia. The TSN is a national network developed to involve the community in conservation programs for threatened species
WA DEC	The Western Australian Department of Environment and Conservation

SUMMARY

This Recovery Plan covers two species of daisy, *Olearia macdonnellensis* (D.A.Cooke) and *Minuria tridens* (D.A.Cooke) Lander (Asteraceae) (Minnie Daisy), and *Actinotus schwarzii* F.Muell. (Apiaceae) (desert flannel flower). All three species are classified as Vulnerable under the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) and under the Northern Territory *Territory Parks and Wildlife Conservation Act 2000.*

These species are similar in three respects: all occur as small, highly fragmented populations, they face a similar suite of threatening processes, and they are each poorly understood in terms of their general biology and critical life history processes.

Olearia macdonnellensis and *Actinotus schwarzii* are endemic to the MacDonnell Ranges Bioregion in the arid southern region of the Northern Territory of Australia. *Minuria tridens* is known mainly from the MacDonnell Ranges Bioregion and the Simpson-Strzelecki Dunefields Bioregion in the NT and from a single record from the Murchison Bioregion of Western Australia.

Olearia macdonnellensis occurs as several fragmented populations in gullies and at the base of rocky slopes and breakaways. *Actinotus schwarzii* is known from six small populations in the Chewings and Heavitree Ranges, west of Alice Springs. In the NT, *Minuria tridens* occurs as several scattered populations on south-facing slopes of dolomite, limestone and calcrete-impregnated sandstone hills and ranges.

Olearia macdonnellensis may be undergoing a downward trend in overall population size while the other two species appear stable. All three species are intrinsically rare and face a number of actual and potential threats including exotic perennial grass invasion, inappropriate fire regimes, restricted gene flow, habitat degradation, climate change and predation. This plan describes these threats and outlines actions required to help maintain or improve the conservation status of these three species. More detailed information on the biology of each species can be found in the background document appended to this plan.

SPECIES INFORMATION

Olearia macdonnellensis

Distribution

Olearia macdonnellensis is endemic to the arid southern region of the Northern Territory of Australia (Figure 1). This species is confined to the MacDonnell Ranges Bioregion where it is currently known from several isolated populations, mainly in the central-western portion of the MacDonnell Ranges (Cooke 1986). There is an additional record of a highly disjunct population in the central East MacDonnell Ranges. All populations are small, usually widely spaced and surrounded by apparently suitable habitat.

The latitudinal range of *O. macdonnellensis* is 31 km and the longitudinal range is 187 km. The total area of occupancy is estimated to be < 20 km^2 (Kerrigan *et al*. 2006). Its eastern limit is approximately 8 km south of Arltunga Historic Reserve and its western limit is approximately 12 km west of Serpentine Gorge. Most records are from the Northern Territory Parks estate, specifically West MacDonnell National Park (Figure 1). The remaining two are from unreserved tenure. One is situated just east of Ellery Creek Big Hole Nature Park on the Roulpmaulpma Aboriginal Land Trust and the other on Loves Creek Pastoral Station.

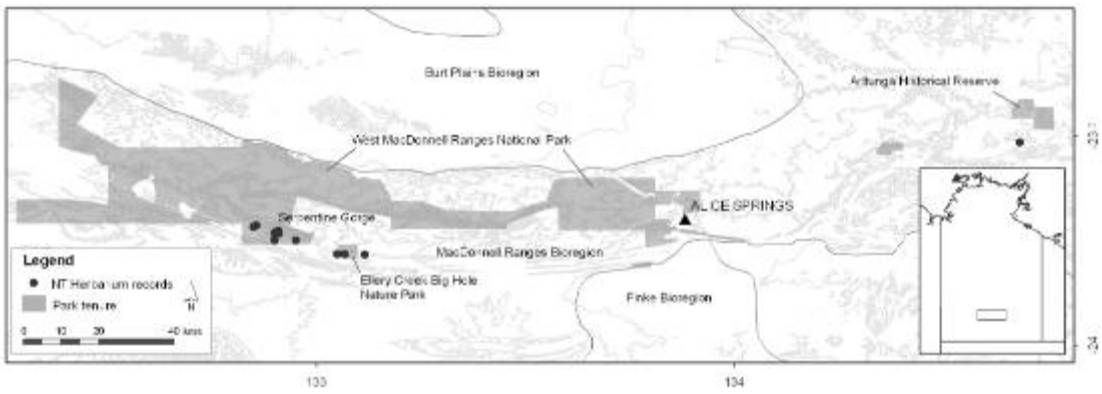

Figure 1: Map of the distribution and locations of populations of *Olearia macdonnellensis*

Populations

There are nine recorded occurrences of *O. macdonnellensis*. The largest cluster of sites occurs within the Alice Valley, at and west of Serpentine Gorge. Within this area the species has been collected along four minor watercourses and from a site adjacent to a major road (Namatjira Drive). The Ellery Creek cluster (three widely-spaced records) is separated by a distance of 10 km from the eastern-most Alice Valley record. The outlier population in the East MacDonnell Ranges is a potentially important source of intraspecific genetic variation. As a result of the rarity of this species, all populations are considered necessary for its long-term survival and recovery.

Habitat critical to survival

Unlike other closely related but widespread species (e.g. *O. calcarea* and *O. muelleri*), *O. macdonnellensis* exhibits a high level of habitat specialisation. The species is largely confined to a single valley on the south side of the Heavitree Range where it occurs in gullies and drainage lines and at the base of rocky slopes (Cooke 1986). Dominant canopy species in these habitats include *Eucalyptus trivalvis* and *Acacia aneura* (mulga) (Kerrigan *et al*. 2006). Records further indicate a close association with deeply weathered Tertiary deposits.

It is likely that *O. macdonnellensis* has an additional requirement for fire-protected habitat (Kerrigan *et al*. 2006). Low fire-return intervals are critical to the long term survival of this species because it is killed by fire and is probably slow to mature. Research on other species of *Olearia* suggests that buried seed of *O. macdonnellensis* probably requires light for germination (Ogle 2004). This means that habitat remaining free of the light-inhibiting invasive perennial grass *Cenchrus ciliaris* (buffel grass) will be critical to the long term survival of the species. Where possible, fire and weed management should be undertaken to maintain habitat quality.

Existing data layers are not of a fine enough scale to produce accurate maps of habitat critical to survival without further on-ground work. As a result of the rarity of this species, all locations where it occurs are regarded as habitat critical for its survival. These sites provide suitable climatic, edaphic and biological conditions for its continued persistence.

Minuria tridens - Minnie Daisy

Distribution

Apart from a single occurrence in the Murchison Bioregion of Western Australia (Lander 1987), *Minuria tridens* is restricted to the arid southern region of the Northern Territory. The majority of records are from the MacDonnell Ranges Bioregion, with one other in the Simpson-Strzelecki Dunefields Bioregion (Figure 2).

In the NT, the latitudinal range of this species is 71 km and the longitudinal range is 310 km. Its western limit is on Haasts Bluff Aboriginal Land Trust (ALT) and its eastern limit is on Loves Creek Pastoral Station. The known NT distribution of *M. tridens* extents approximately 200 km west of Alice Springs and 100 km east of Alice Springs. The total area of occupancy in the NT is estimated to be <2000 km^2 (Kerrigan & Albrecht 2006a).

M. tridens occurs across a range of land tenures. Four populations are reserved: two in the West MacDonnell NP, one at Trephina Nature Park, and one at Palm Valley in Finke Gorge NP. The remaining populations occur on pastoral lease (Henbury, Loves Creek, Owen Springs and Todd River Stations), on Aboriginal Land Trusts (Ntaria; Santa Teresa; Roulpmaulpma; Haasts Bluff and Uruna) or in the Alice Springs municipality.

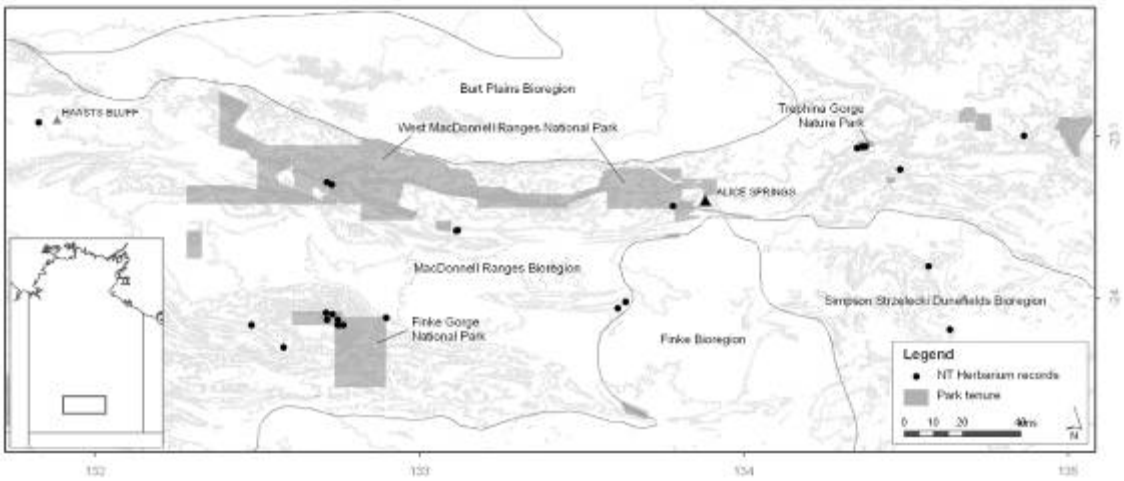

Figure 2: Map of the distribution and locations of populations of *Minuria tridens*

Populations

There are approximately 20 populations (including six known sites in the Alice Springs municipality) of *M. tridens*. All populations are small, highly fragmented and surrounded by apparently suitable habitat. The single occurrence recorded from Western Australia has not been relocated in the field, and its status is unknown.

It is not currently possible to determine which populations of *M. tridens* are of greatest conservation value because of an absence of population and genetic data for this species. The largest known concentration of *M. tridens* is at Palm Valley in Finke Gorge NP. In the absence of population genetic data, conservation effort should focus on protecting sites throughout the geographic and ecological range of *M. tridens*. Maintenance of a selection of populations from the eastern and western extremities and from the central region may aid gene flow. Conservation effort should also encompass the range of habitat types as this may further help capture and maintain genetic diversity.

Habitat critical to survival

M. tridens exhibits a narrower geographic range and greater habitat specificity than many of its arid zone congeners. In the NT it is closely associated with high pH soils derived from dolomite, limestone and calcrete parent materials (Kerrigan & Albrecht 2006a). It typically occurs on the south side of ranges and rises in low shrubland habitat. Associated species include *Acacia kempeana, Senna artemisioides* and *Indigofera leucotricha*. Alkaline-tolerant hummock grasses (e.g. *Triodia longiceps* and *T. brizoides*) may be present in the wider-habitat area but are generally absent from the immediate population site (Kerrigan & Albrecht 2006a). This negative association with hummock grasses may reflect an intolerance of competition and/or repeated firing. By implication, habitat that remains free of the aggressive perennial *Cenchrus ciliaris* (buffel-grass) will be critical to the long term survival of *M. tridens*. No habitat information is available for the Western Australian record.

Where possible, fire and weed management should be undertaken to maintain habitat quality across the geographic and ecological range of this species. Existing data layers are not of a fine enough scale to produce maps of habitat critical to survival without further on ground work.

Actinotus schwarzii F.Muell - Desert Flannel Flower

Distribution

Actinotus schwarzii is the only species of flannel flower in the Northern Territory. It is endemic to the MacDonnell Ranges Bioregion, occurring only in the Chewings and Heavitree Ranges, west of Alice Springs (Figure 3). Its western limit is at Mt Sonder and its eastern limit is at Standley Chasm. It has a very restricted area of occupancy (<20 km^2) and the number of mature individuals is estimated to be <1000. The majority of records are from the West MacDonnell National Park. Of the remaining two, one occurs on Iwupataka ALT and the other on Owen Springs Station. There are additional reports of this species in the Petermann Ranges in the Central Ranges Bioregion, but these are as yet unverified.

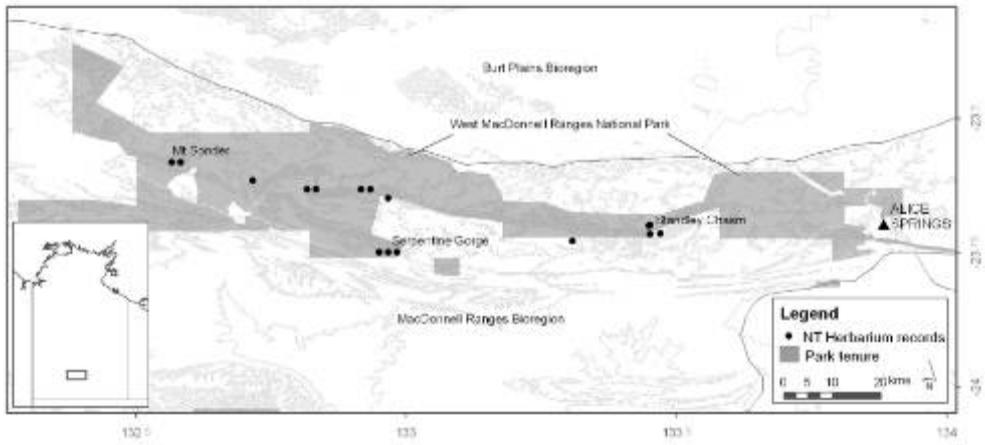

Figure 3: Map of the distribution and locations of populations of *Actinotus schwarzii*.

Populations

A. schwarzii is known from less than 20 small populations. All are considered necessary for its long-term survival and recovery. Threat assessment needs to be carried out at all known sites.

Habitat critical to survival

A. schwarzii grows in soil pockets in sheltered gorges and on steep south-facing precipitous cliff faces of the Chewings and Heavy Tree Ranges (Kerrigan & Albrecht 2006b). This positioning optimises soil moisture retention through the provisioning of shade and low evaporation rates. The habitat is therefore markedly different from its otherwise arid surroundings. Some level of fire management may be required in neighbouring habitat to reduce the chances of uncontrolled wildfire incursion, but fire is otherwise not of immediate concern for this species. Given the rarity of *A. schwarzii*, all sites where it occurs are considered habitat critical to its survival.

Existing data layers are not of a fine enough scale to produce maps of habitat critical to survival without further on ground work.

THREATS

Specific details relating to the biology and genetics of the three species are lacking, therefore it is currently difficult to predict the likely impacts of stochastic processes such as reduced gene flow or major disturbances. Identified actual and potential threats common to all three species include exotic perennial grass invasion, inappropriate fire regimes, disrupted gene flow, climate change and natural enemies (predators and pathogens).

Exotic grass invasion

M. tridens is threatened by the invasion of the exotic perennial grass *Cenchrus ciliaris* (buffel grass) into core habitat areas. The Alice Springs Municipality sites are most severely affected (Kerrigan & Albrecht 2006a). *O. macdonnellensis* is potentially threatened by this same process. Buffel-grass is highly abundant in run on areas throughout the MacDonnell Ranges and is therefore likely to occupy the creek lines where *O. macdonnellensis* occurs. The habitat of *A. schwarzii* is, by contrast, possibly more resilient to invasion given its broader edaphic parameters.

Once established, buffel-grass has the ability to negatively affect both *M. tridens* and *O. macdonnellensis* directly through resource competition. This is likely to be especially intense at early life stages, leading to heightened recruitment failure if germination and establishment requirements can no longer be met. *O. macdonnellensis* would be particularly affected if, like many of its congeners, it has a light requirement for germination. Both species are additionally potentially threatened by increased fire intensity and frequency in severely affected sites. Buffel-grass produces large amounts of biomass which, when dried, represents a significant increase in site fuel load.

Fire

O. macdonnellensis is threatened by wildfire (Kerrigan *et al*. 2006). No fire-management plan currently exists for this species. In 2002 many populations were exposed to uncontrolled hot summer wildfires that swept through core habitat areas in the West MacDonnell National Park. Fire-mapping indicates that seven of the known *O. macdonnellensis* sites may have been exposed to wildfire over the 2000-2003 period. Subsequent field observation revealed that this species has little capacity to cope with this form of disturbance. Adult mortality was reportedly extremely high (if not absolute) and there was no evidence of stand replacement at surveyed sites some three years after the event (Kerrigan *et al*. 2006). This suggests that continued exposure to fire regimes outside of the tolerance range of this species will result in its extirpation.

Many of the *M. tridens* populations were also exposed to the 2002 wildfires. While this species has some resprouting capacity, its overall fire response is poorly known. This species is potentially facing increased levels of fire exposure with ongoing incursions of buffel grass into its habitat. Inappropriate fire regimes therefore represent a potential threat to *M. tridens*.

Climate change

The specific threats posed by climate change for these three threatened species are currently poorly understood. The process represents a future threat given its potential to disrupt reproductive output and germination and to decrease adult vigour and survival. It is also

possible that species such as these with limited dispersal may be unable to adapt to shifting climate zones.

Low inter-population gene exchange

All three species are potentially threatened by small-population effects such as inbreeding depression and genetic drift through disrupted gene flow. There is no information on the population genetics of any of the species in this plan, but given their fragmented distribution, it is possible that in each case there is little genetic exchange among populations and a high level of inbreeding within.

In all three species, subpopulations are highly clumped, but it is uncertain whether this is more the result of limited dispersal than of a restriction on suitable microsites for germination and establishment. Inter-population connectivity is also potentially constrained by pollinator availability and behaviour (Vamosi & Vamosi 2005) but data on this are lacking.

Low seed set

Preliminary assessment indicates that seed set in *M. tridens* is poor and highly variable (Kerrigan & Albrecht 2006a). This species is patchily distributed and a restriction on the movement of pollinators among populations may constrain viable seed production (see above). Alternatively, seed set in *M. tridens* may be resource (i.e. nutrient) limited given that it occupies extremely high pH soils. This would mean that reproductive output cannot be increased by the action of pollinators. It is important to note too, that the disk florets of *M. tridens* usually produce sterile achenes (Lander 1987). The combination of functionally male disc florets and bisexual ray florets is common throughout the genus (Harden 1992) and means that *Minuria* species innately produce relatively few fertile seeds per head. While research is needed to examine these contrasting hypotheses, there is enough evidence to suggest that *M. tridens* is potentially threatened by low seed set.

Habitat degradation

Populations of *M. tridens* in the Alice Springs municipality are potentially threatened by urban and rural development. Increased disturbance associated with house and road construction will potentially facilitate the spread of buffel-grass into *M. tridens* habitat (Kerrigan & Albrecht 2006a). Road maintenance may also threaten the Western Australian occurrence as this was found on a roadside.

M. tridens and *O. macdonnellensis* are also potentially threatened by a range of processes associated with stock production on pastoral land. Trampling of seedlings and soil disturbance by cattle are potential concerns.

Collection of wild stock

Flannel Flowers are highly sought-after attractive plants that have additional value as ingredients in natural therapeutic products. Certain species (e.g. *A. helianthi*, see von Richter & Offord, 2000) are thought to be at risk from over collection of wild stock. It is possible that accessible populations of *A. schwarzii* are being targeted by collectors but data are lacking.

The species has recently been propagated from tissue culture at the ASDP so there would be opportunity to provide an alternative to wild harvest if collection becomes more intensified in the future.

Predators and pathogens

Little is known about the effect of plant pathogens in deserts, but seed predation is known to be intense (Morton 1985; Guttermann 1993). High level seed predation may further constrain rare and highly fragmented species that have little ability to satiate predator demand through mass seed production. Seed predation thereby represents a potential threat to each species in this plan. Intense herbivore attack on other plant parts may also threaten these species. Other species of *Minuria* and *Olearia* are known to be palatable to macropods, stock (Urban 1990; Department of Sustainability and Environment 2004) and caterpillars (Haase 1986).

RECOVERY INFORMATION

Overall Objective

To improve (or at least maintain) the current conservation status of the three species covered in this plan.

Specific Objectives

- Quantify distribution, abundance and population dynamics using long-term monitoring surveys.
- Maintain or increase habitat quality and extent of occurrence.
- Understand critical biological attributes including the fire response, life history characteristics, reproductive- and seed-biology, and population dynamics.
- Implement *ex-situ* conservation measures that ensure the long-term preservation of the species' genetic diversity.
- Define management units for widely spaced populations.
- Incorporate traditional ecological knowledge and management practices into recovery planning.
- Inform and involve the community and all stakeholders in the recovery process.

Performance Criteria

- The distribution limits and dynamics of populations of all species are understood and documented.
- Habitat quality and extent is maintained or increased.
- Knowledge of the biology, population dynamics, and disturbance response traits is advanced and used to inform management.

- Seeds from different populations of each species are held in properly maintained *ex-situ* storage facilities.
- Inter-population genetic variation is understood.
- Indigenous knowledge relating to the biology and cultural significance of the species is incorporated into recovery programmes.
- Community and stakeholder-based networks are maintained and enhanced.

Performance of the plan will be evaluated by an independent consultant within five years of adoption as a national recovery plan.

Table 1: Relationship between specific objectives, performance criteria and actions.

Specific objectives		Performance criteria		Actions
Quantify distribution, abundance and population dynamics using long-term monitoring surveys.	⇔	The distribution limits and dynamics of populations are understood.	⇔	1. Carry out targeted surveys for additional populations within the MacDonnell Ranges (all species) and in the Petermann Ranges (*A. schwarzii*) and Western Australia (*Minuria tridens*). 2. Mapping of subpopulations (all species)
Maintain or enhance habitat quality and extent.	⇔	Habitat quality and extent is maintained or enhanced.	⇔	3. Negotiate conservation agreements to secure significant subpopulations on pastoral leasehold and Aboriginal land trust properties. 4. Carry out population and habitat monitoring at selected sites. 5. Implement management strategies for key threatening processes as required.
Understand critical ecological attributes including the fire response, life history characteristics, and reproductive and seed biology.	⇔	Adequate knowledge of the influence of fire and other ecological processes on the persistence of the species is available.	⇔	6. Undertake research on fire ecology, reproductive biology, and seed storage potential.
Implement *ex-situ* conservation measures that ensure representative sampling of each species' genetic diversity.	⇔	*Ex-situ* seed collections are sourced from widely dispersed subpopulations.	⇔	7. Store seeds from many different subpopulations in seed-banks.

Define management units for widely spaced populations.	⇔	The genetic structure of populations is understood.	⇔	8. Determine the degree of genetic differentiation in each species using molecular techniques.
Incorporate traditional ecological knowledge and management practice into the recovery process.	⇔	Management of the species is informed by traditional ecological knowledge.	⇔	9. Engage traditional ecologists to provide advice on biological aspects, threatening processes and cultural and economic significance of the species.
Inform and involve the community and all stakeholders in the recovery process.	⇔	Community and stakeholder based networks are maintained and enhanced.	⇔	10. Community and stakeholder education and information.

Actions

Action 1

Ensure that important populations are continuously monitored on a regular basis to detect any changes in habitat quality or declines in population size, health and age structure. All information will need to be analysed in the context of prevailing environmental conditions including rainfall, drought and fire events as well as of the degree of isolation from other populations. Site selection should encompass the range of population sizes and tenures and results should be used to guide future management practice. Potential stakeholders include NRETAS, CLC and Aboriginal ranger groups, TSN, CLMA, and interested daisy experts. Monitoring should be designed to enable an assessment of:

- population size and age-structure dynamics;
- fire responses of seed, seedling and adult life-stages;
- pollinator and seed disperser activity;
- flowering and fruiting timing;
- seedling establishment and attrition;
- insect predation;
- habitat condition especially in relation to weed abundance; and
- presence of other threatening processes.

Action 2

Produce maps of *O. macdonnellensis*, *M. tridens* and *A. schwarzii* habitat which is critical to survival, with related spatial information on population density and fire and weed risk assessments. Delineation of mapping polygons that are attributed with density estimates and fire and weed threat ratings will help prioritise management effort. Standard park mapping procedures will be followed as part of the existing broader NT Parks mapping project currently being undertaken by NRETAS staff.

Action 3

Establish protection agreements for significant subpopulations of *M. tridens* and potentially *O. macdonnellensis* and *A. schwarzii* (pending the outcome of Action 1) on non-reserved lands. Avenues for effective protection of off-park populations of the three species should be pursued by NRETAS with the assistance of non-government agencies and the CLC. Local government planning agencies will be informed of the location of any newly discovered *M. tridens* populations. In the NT, provision exists for the NT government, after consultation with the relevant landowner, to declare areas of essential habitat under section 37 of the *Territory Parks and Wildlife Conservation Act 2000*. Section 73 of the Act allows the NT government to assist, co-operate in or enter into agreements relating to the management of Aboriginal land for wildlife conservation. Stakeholders may include NRETAS, GA, TSN, CLMA and the CLC.

Action 4

Search for additional populations of *O. macdonnellensis* and *A. schwarzii* in suitable habitat. Sampling of long-isolated outlier populations is required to take full account of the level of intra-specific variation. The record of a highly disjunct population of *O. macdonnellensis* in the East MacDonnell Ranges requires further investigation. Survey work should also be carried out for *A. schwarzii* in the Petermann Ranges. Further sampling within the core habitat areas will allow for better-informed assessment of threatening processes and of total wild counts. Additional surveys for each species will be carried out by experienced NRETAS staff in the MacDonnell Ranges bioregion. Opportunistic surveys for the presence of *M. tridens* will be conducted to determine whether the recorded population in Western Australia is natural and/or still occurs in the region. Stakeholders include NRETAS staff in the Biodiversity Conservation and Park Management divisions, Aboriginal traditional owners and ranger groups, the CLC and WA DEC.

Action 5

Manage populations of *O. macdonnellensis*, *M. tridens* and *A. schwarzii* using an adaptive management approach that enables a response to threats as each is identified. Action 6 has been developed to provide information on the ecology and the threats faced by the three species. Until such data are available, it is important to carry out adequate monitoring and to develop the capacity to respond to changes in existing conditions. Management strategies will be developed and implemented following the outcomes of action 6. Stakeholders will include NRETAS, CLC, pastoralists and CLMA.

Action 6

Undertake research on the biology and ecology of the three species to assist the formulation of appropriate management strategies. Stakeholders include NRETAS, Kew Gardens Millennium Seed Bank Project, relevant Australian Universities. Main areas of investigation recommended are:

- Fire research (e.g. field observations of established plant responses to wildfire and laboratory experiments on seed and seedling survival) to determine the optimum fire regimes.
- Seedling emergence and survival experiments to determine the influence of microhabitat constraints on establishment.
- Reproductive studies to examine the role of climate (especially rainfall, drought and temperature) on flower and fruit production.
- Pollinator studies (e.g. presence/absence of pollinators at core and outlier populations) to help determine minimal viable population size for these species.
- Seed dispersal studies to aid estimates of the level of inter-population seed exchange.
- Seed biology studies through the joint NRETAS-Kew Gardens MSBP to determine optimum seed germination conditions and seed storage potential.

Action 7

Collect seeds from core and outlying populations of each species and store them in seed-banks. These three species are at risk of extinction from fire effects, weed invasion and from stochastic processes as a consequence of their small and highly fragmented populations. The longevity of seed banks in the wild is unknown. If above-ground populations decline and conditions are not favourable for recruitment then populations may become extinct. The joint NRETAS-Kew MSBP provides an opportunity to establish a properly-managed seed collection of each species as an insurance against extinction in the wild.

Action 8

Determine the degree of intraspecific genetic variation among populations/subpopulations that are widely spaced and that have been separated for long time periods. Molecular analysis of genetic variation in each species is necessary to understand whether populations should be treated as separated management units: subpopulations at remote sites might be genetically different and reflect adaptation of the species to different habitat parameters. Genetic research may also reveal much about impediments to gene flow and frequency of long distance dispersal (Farnsworth 2007). Stakeholders will include relevant researchers at Australian Universities and NRETAS.

Action 9

Engage indigenous ecologists to provide advice on biological aspects, threatening processes and the cultural and economic significance of these species. Engagement of Aboriginal people with knowledge of these species will enable the incorporation of traditional ecological knowledge and management practice into the recovery process.

Action 10

Improve the profile of *O. macdonnellensis*, *M. tridens* and *A. schwarzii* within the community and ensure that all stakeholders are informed of recovery actions and the results of ongoing research and monitoring. The co-ordinator of Threatened Species projects in the NT (NRETAS) will ensure that information on research and management projects is disseminated to stakeholders. Profiles of each species have been prepared and are available on the NRETAS website. Efforts will be made to direct people to this existing source of information.

Costs

The total cost of the recovery program is $572,500 over five years.

Estimated costs of recovery (in $1000s)

Actions	Year 1	Year 2	Year 3	Year 4	Year 5	TOTAL
1	25.0	25.0	25.0	25.0	25.0	125.0
2			20.0			20.0
3		15.0	15.0	15.0		45.0
4	25.0	10.0				35.0
5			30.0	30.0	30.0	90.0
6		25.0	25.0	25.0		75.0
7	7.0	7.0	7.0	7.0	7.0	35.0
8			45.0	45.0		90.0
9		45.0				45.0
10	2.5	2.5	2.5	2.5	2.5	12.5
Total	59.5	129.5	169.5	149.5	64.5	572.5

Management practices

A significant portion of the population of each species occurs within conservation reserves. Management practices necessary to avoid a significant adverse impact on these species include:

- Fire management plans that aim to reduce fire frequency;
- Weed management; and
- *Ex-situ* conservation measures, for example, continued propagation and display of each species at the Alice Springs Desert Park, and/or at Olive Pink Botanic Gardens.

Biodiversity benefits

This plan will help ensure the continuation of key interactions between these plant species and their pollinator and seed dispersal agents. This applies to any non-symbiotic interactions between the species subject to this plan and other organisms. It is known, for example, that various species of *Olearia* are used as food plants by the larvae of some *Lepidoptera* larvae (Patrick 2000).

Recovery actions for *O. macdonnellensis*, *M. tridens* and *A. schwarzii* will also benefit a diversity of plant and animal species that do not necessarily interact with this species, but that occupy the same habitat. Populations of each species regularly occur within botanically important areas that are known to support various other endemic, rare, or fire sensitive species (White *et al.* 2000). The implementation of effective fire and weed management within the

range of each of the species in this plan will have benefits for a diversity of sympatric plants, especially fire sensitive species.

It is highly improbable that negative affects on other native species and ecological communities would arise from the implementation of this plan.

Affected interests

The species included in this Recovery Plan are known from conservation reserves jointly managed by the NT government and Aboriginal traditional owners, Crown land, private land, pastoral lease and numerous Aboriginal land trusts. All affected interests will be involved in the implementation of this plan to some degree. Identified potential affected interests include:

- NT government (particularly the ASDP and PWSNT within NRETAS);
- Finke Gorge NP traditional owners;
- Traditional owners for the Roulpmaulpma, Ntaria, Santa Teresa, Haasts Bluff, Uruna and Iwupataka Land Trusts;
- Aboriginal ranger groups especially the Tjuwanpa ranger group based at Hermannsburg;
- Central Land Council;
- Loves Creek, Henbury, Owen Springs, and Todd River pastoral station leaseholders;
- Central Land Management Association;
- Alice Springs municipality landholders;
- Main Roads Western Australian (if population re-discovered); and
- Australian Plant Society (APS).

Social and economic impacts

The implementation of this recovery plan is unlikely to have any adverse social or economic impacts. All proposed actions are on a small scale and will not significantly alter existing land uses. Some positive social and economic impacts are likely to arise from its implementation. The plan aims at the inclusion of Aboriginal people in the recovery process and at the employment and training of Aboriginal ranger groups.

International obligations

The species in this recovery plan are not specifically listed under any international agreement and the recovery plan is consistent with Australia's international obligations.

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