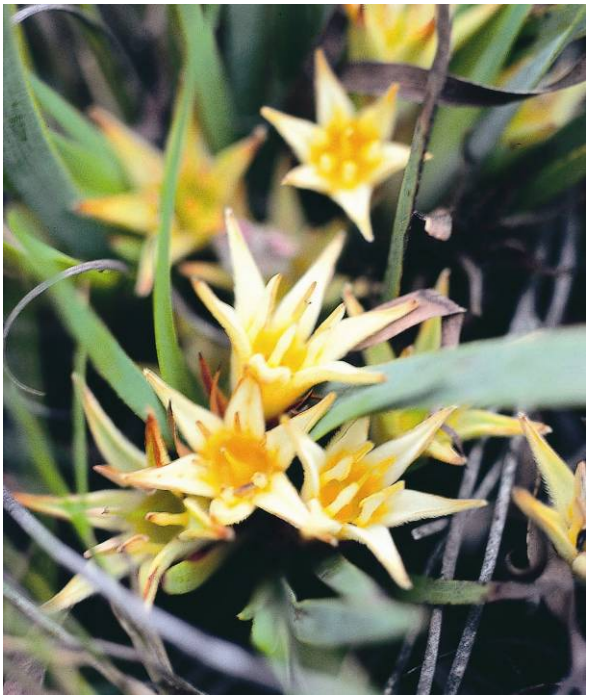
GRASS CONOSTYLIS

(*Conostylis misera*)

RECOVERY PLAN

Renée Hartley and Sarah Barrett



Australian Government

Government of Western Australia

Department of Environment and Conservation

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in WA Department of Conservation and Land Management (CALM) Policy Statements Nos. 44 and 50. Note: the Department of CALM formally became the Department of Environment and Conservation (DEC) in July 2006. DEC will continue to adhere to these Policy Statements until they are revised and reissued.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

DEC is committed to ensuring that Threatened taxa are conserved through the preparation and implementation of Recovery Plans (RPs) or IRPs and by ensuring that conservation action commences as soon as possible.

This IRP will operate from December 2005 to November 2010 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked as Vulnerable (WA), this IRP will be reviewed after five years and the need for further recovery actions assessed.

This IRP was given regional approval on 22 October, 2005 and was approved by the Director of Nature Conservation on 14 December 2005. The provision of funds identified in this IRP is dependent on budgetary and other constraints affecting DEC, as well as the need to address other priorities.

This IRP has been updated with information contained herein and is accurate as at January 2008.

This IRP was prepared with financial support from the Australian Government and has been adopted as a National Recovery Plan under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act).

ACKNOWLEDGMENTS

The following people have provided assistance and advice in the preparation of this Interim Recovery Plan:

Anne Cochrane	Manager, DEC Threatened Flora Seed Centre
Andrew Brown	Threatened Flora Coordinator, DEC Species and Communities Branch

Thanks also to staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information, and DEC Wildlife Branch for their assistance.

SUMMARY

Scientific Name:	*Conostylis misera*	**Common Name:**	Grass Conostylis
Family:	Haemodoraceae	**Flowering Period:**	October to November
DEC Regions:	South Coast	**DEC District:**	Albany Work Centre
Shires:	Albany, Plantagenet and Cranbrook	**Recovery Team:**	Albany District Threatened Flora Recovery Team

Illustrations and/or further information: Brown, A., Thomson-Dans, C. and Marchant, N. (Eds). (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia; Western Australian Herbarium (1998) FloraBase - Information on the Western Australian Flora. Department of Conservation and Land Management, Western Australia. http://www.calm.wa.gov.au/science/.

Current status: *Conostylis misera* was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in 1980 and is currently ranked as Vulnerable under World Conservation Union (IUCN 2001) Red List criterion C2a, due to a continuing decline in the number of mature individuals and no subpopulations containing more than 1000 mature individuals. The species occurs over an area of approximately 10 hectares and has a range of 65 kilometres. Nineteen extant populations and a total of approximately 1000 plants are known. The species is ranked as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Description: This prostrate, spreading herb has tufted, green leaves. The sickle-shaped leaves have parallel longitudinal lines and thin hairless margins. The old leaves often remain attached to the plant, becoming blackened and twisted. The bright yellow, solitary flowers are on a stalk within 2 or 3 sheathing bracts, which taper to a point. Short, branched hairs and longer hairs cover the flowers and fruit.

Habitat requirements: *Conostylis misera* extends from just north of the Stirling Range to Narrikup, and across to the South Stirling area. It favours seasonally waterlogged flats of sandy loam over clay duplex soils with underlying laterite in low woodland over heath or sedge, mallee heath and heath.

Habitat critical to the survival of the species, and important populations: The habitat for *Conostylis misera* comprises the area of occupancy of important populations; areas of similar habitat surrounding important populations (these areas provide potential habitat for natural range extension and for allowing pollinators or biota essential to the continued existence of the species to move between populations); and additional occurrences of similar habitat that may contain important populations of the species or be suitable for future translocations or other recovery actions intended to create important populations. It is considered that all known habitat is critical to its survival and all populations are important populations.

Benefits to other species/ecological communities: *Conostylis misera* occurs within the vicinity of a number of other threatened flora and fauna species and threatened ecological communities. Recovery actions put in place for *C. misera* will benefit these associated species and communities and reciprocally, actions put in place for the recovery of these species and communities will benefit *C. misera*.

International obligations: This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity and will assist in implementing Australia's responsibilities under that Convention. *Conostylis misera* is not specifically listed under any international treaty and therefore this plan does not affect Australia's obligations under any other international agreements.

Role and interests of Indigenous people: Involvement of the Indigenous community is being sought through the advice of the Department of Indigenous Affairs to determine whether there are any issues or interests identified in the plan. A search of the Department of Indigenous Affairs Aboriginal Heritage Sites Register has identified that two registered sites occur in close proximity to *Conostylis misera* Population 24. Where no role is identified for the Indigenous community associated with this species in the development of the recovery plan, opportunities may exist through cultural interpretation and awareness of the species. Indigenous involvement in the implementation of recovery actions will be encouraged.

Affected interests: Populations occur on freehold, Shire of Plantagenet, City of Albany, Main Roads Department and Conservation Commission land.

Social and economic impacts: The implementation of this recovery plan has the potential to have some minimal social and economic impact as populations are located on private property, Shire reserves, Main Roads reserves and DEC-managed land. However, recovery actions refer to continued negotiations between stakeholders with regard to these areas.

Evaluation of the Plan's Performance: The Department Environment and Conservation (DEC), in conjunction with the Albany District Threatened Flora Recovery Team (ADTFRT) will evaluate the performance of this IRP.

Completed Recovery Actions: The following recovery actions have been implemented:

1. All land managers have been notified of the location and threatened status of the species.
2. Volunteers and staff from the DEC Albany Work Centre have monitored populations.
3. Roadside markers have been installed at all populations where appropriate.
4. Pigott and Obbens (1997) studied the degree of weed invasion at Population 1.
5. Weed control was implemented at Population 1 by DEC Albany Work Centre and The Albany Wildflower Society, and Roadcare has assisted with weed control in the populations on Albany Hwy.
6. The Botanic Gardens and Parks Authority currently have eight cultivated specimens and 0.1g of *Conostylis misera* seed.
7. Areas of potential habitat have been surveyed for further populations by staff of the DEC Albany Work Centre.
8. Fencing materials have been purchased by DEC to exclude livestock from Population 2.

Objectives
The objective of this Interim Recovery Plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term preservation of the species in the wild.

Criteria for success: The number of populations and individuals within populations remains stable or increases over the five years of the plan.
Criteria for failure: The number of populations or the number of individuals within populations decreases over the five years of the plan.

Recovery actions

1. Coordinate recovery actions
2. Monitor populations
3. Collect seed
4. Prioritise and implement weed control
5. Implement fire management
6. Liaise with stakeholders
7. Conduct further surveys
8. Obtain biological and ecological information
9. Map habitat critical to the survival of the species
10. Promote awareness and encourage involvement
11. Review the IRP and assess the need for further recovery actions

1. BACKGROUND

History

The type specimen of *Conostylis misera* was collected in 1840 and was described by Endlicher in 1846. In 1976, a specimen was collected from Population 6, however this population has only been located once since then, in 1999. In 1982 Population 2 was located, followed by Population 1 in 1983. In 1986, a specimen was collected from Population 18, however this population has not been relocated to date. In 1990, Population 3 was found, extending the species range to the South Stirling area. In 1992, Populations 4 and 5 were found and Population 7 was located in 1998. After considerable survey effort by DEC staff, Populations 8 to 17 were located in 1999 and since then Populations 19 to 24 have been found.

After recent surveys, five formerly known populations were not relocated; one on private property, one in a nature reserve and three on road reserves that are extremely degraded primarily due to weed invasion.

Half of the *Conostylis misera* populations occur on road reserves, one third occur in other reserves and the remaining populations are located on private land. The small fragmented populations that are often in areas of poor habitat quality are a key concern for the species survival. In recent surveys, only a third of the populations were considered healthy.

Description

This prostrate, spreading herb has tufted, green leaves 5 to 18 cm long and 2 to 6 mm wide. The sickle-shaped leaves have parallel longitudinal lines and thin hairless margins. The old leaves often remain attached to the plant, becoming blackened and twisted. The bright yellow flowers have a tube, 12 to 19 mm long, with lobes up to 18 mm. The relatively large, solitary flowers are on a 3 cm stalk within 2 or 3 sheathing bracts, which taper to a point. Short, branched hairs and longer hairs cover the flowers and fruit.

Distribution and habitat

Conostylis misera has an area of occupancy of approximately 10 hectares, over a range of 65 kilometres, in which 19 extant populations and a total of approximately 1000 plants are known. The species extends from just north of the Stirling Range to Narrikup, and across to the South Stirling area. The species favours seasonally waterlogged (but not inundated) flats of brown or grey sandy loam over clay duplex soils with underlying laterite, where it inhabits low woodland over heath or sedge, mallee heath and heath**.** Associated species include *Acacia aemula* subsp. *aemula*, *Actinodium cunninghamii, Adenanthos obovatus, Agonis theiformis, Anarthria laevis, Banksia dryandroides, B. repens, Calothamnus schaueri, Chordifex laxus, Conospermum caeruleum, Conostylis serrulata, Corymbia calophylla, Darwinia oederoides, D. vestita, Dasypogon bromeliifolius, Eucalyptus decipiens, E. marginata, E. occidentalis, E. staeri, Hakea ceratophylla, H. corymbosa, H. ferruginea, H. sulcata, Harperia lateriflora, Hypolaena exsulca, Isopogon trilobus, Kunzea recurva, Meeboldina cana, Melaleuca cuticularis, M. preissiana, M. suberosa, Mesomelaena stygia, Nuytsia floribunda, Pericalymma ellipticum, Petrophile squamata, Taxandria parviceps, T. spathulata, Tremulina tremula, Tricostularia neesii* and *Xanthorrhoea platyphylla*.

Biology and ecology

Species in the genus *Conostylis* are hermaphroditic and insect or bird pollinated (Holland *et al*. 1997). However, little is known about the reproductive biology of *C. misera*. After fire, many species of *Conostylis* regenerate from subterranean regenerative buds that emerge from horizontal rhizomes, with soil-stored seed germinating following summer fire (Holland *et al*. 1997).

Conostylis misera appears to regenerate well after fire. Population 8 was burnt in July 1999. Regeneration was primarily by resprouting and plants subsequently flowered in 2002. After a hot fire in autumn 2001, Population 4 regenerated with both resprouting individuals and seedlings, though the majority were resprouting (S. Barrett, personal observation).

Large proportions of foliage death are frequently noted in the populations, the cause of which is uncertain. Increased run-off due to road works and agricultural clearing were thought to have contributed to 'black spot' disease, which affects the plant's vigour and blackens its leaves. However, this does not appear to be having a significant effect on the species at present.

Threats

Conostylis misera was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in 1980 and is currently ranked as Vulnerable under World Conservation Union (IUCN 2001) Red List criterion C2a, due to a continuing decline in the number of mature individuals and no subpopulations containing more than 1000 mature individuals. The species occurs over an area of approximately 10 hectares and has a range of 65 kilometres. Nineteen extant populations and a total of approximately 1000 plants are known. The species is ranked as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

All areas occupied by *Conostylis misera* are affected or potentially affected by one or more threats identified in this IRP. Threats include:

- **Weed invasion:** Weeds suppress early plant growth by competing for soil moisture, nutrients and light and are often blown in from adjoining pasture (Panetta and Hopkins 1991). Weed invasion is a particular threat to the roadside populations as they are relatively exposed and therefore subject to influences from adjacent farmland. All extant road verge populations are affected by weeds, which include African lovegrass (*Eragrostis curvula*), Victorian teatree (*Leptospermum laevigatum*), watsonia (*Watsonia* spp.) and kikuyu (*Pennisetum clandestinum*).

- **Grazing:** Vertebrate grazing of *Conostylis misera* foliage, most likely due to kangaroos or rabbits, has been noted at a number of the populations and can affect the plant's vigour, and possibly result in plant death. A high level of grazing across a population can threaten the population's survival.

- **Altered hydrology:** The habitat supporting *Conostylis misera* is vulnerable to changes in hydrological regimes. Such changes may result in inundation, increased nutrients and may introduce chemicals from adjacent farmland. Changes in hydrology can affect associated species and the community as a whole.

- **Inappropriate fire regime:** Poorly timed, intense and too frequent fire may be detrimental to the species. Resprouting plants need time to regenerate leaf and stem material, and store energy in a tuber or other underground storage organ (Carpenter and Recher 1979). For seedling recruitment, plants need to reach reproductive maturity and build up a seed bank. While *Conostylis misera* appears to regenerate primarily by resprouting, low levels of seedling recruitment may be important for population stability. Post-fire conditions also encourage weed invasion, which in turn encourages fire.

- **Small population size:** As population size decreases, the population may become more vulnerable to extinction for three main reasons. Firstly, loss of genetic variation and increased inbreeding are considered to be associated with a reduction in the ability of a population to adapt to short-term environmental change. Secondly, small populations are more susceptible to chance events associated with demographic and environmental stochasticity. Finally, allee effects may occur, whereby at some density or population size, reproductive capacity drops below a threshold and the organism can no longer replace itself (Hobbs and Yates 2003). Fourteen of the nineteen extant populations consist of less than one hundred mature individuals.

- **Climate change:** As *Conostylis misera* occurs on seasonally inundated wetlands, it is susceptible to the predicted decrease in rainfall and increases in temperature and evaporation. It is considered that those groups likely to be most affected by climate change include geographically localised taxon, peripheral or disjunct populations, specialised species, poor dispersers, genetically impoverished species, and coastal communities (Peters & Darling 1985).

Summary of population land vesting, purpose and tenure

Population Number and Location	Vesting	Purpose	Tenure
1. Albany Hwy	Main Roads Department	-	-
2. Salt River Rd	-	-	Freehold
3A. South Stirling	WA Conservation Commission	Conservation of Flora and Fauna	Nature Reserve
3B. South Stirling	City of Albany	-	-
4A. Yellanup Rd	Main Roads Department	-	-
4B. Yellanup Rd	Shire of Plantagenet	-	-
5. Yellanup Rd	Shire of Plantagenet	-	-
6. Yungup Rd	City of Albany	-	-
7. Albany Hwy	Main Roads Department	-	-
8A. Albany Hwy	Main Roads Department	-	-
8B. Narrikup Reserve	Shire of Plantagenet	Recreation and Showground	Non DEC Act – General
9. Yerraminup Rd	Shire of Plantagenet	-	-
10. Albany Hwy	Main Roads Department	-	-
11. Albany Hwy	Main Roads Department	-	-
12. Pfeiffer Rd	City of Albany	-	-
13A. Jackson Rd	Shire of Plantagenet	-	-
13B. Jackson Rd	Shire of Plantagenet	Landscape Protection	Non DEC Act – General
14. South Stirling	Unallocated	-	Crown
15. South Stirling	WA Conservation Commission	Conservation of Flora and Fauna	Nature Reserve
16. Pugh Rd	Shire of Plantagenet	-	-
17. Narrikup	WA Conservation Commission	-	-
18. Kwornicup NR	WA Conservation Commission	Conservation of Flora and Fauna	Nature Reserve
19. Stirling Range NP	WA Conservation Commission	National Park	National Park
20. Spencer Rd	WA Conservation Commission	-	-
21. Drawbin Rd	-	-	Freehold
22A. Drawbin Rd	-	-	Freehold
22B. Drawbin Rd	City of Albany	-	-
23A. Peaceful Valley	-	-	Freehold
23B. Peaceful Valley	-	-	Freehold
24. Stirling Range NP	WA Conservation Commission	National Park	National Park

Summary of population information and threats

Population Number and Location	Year/No. plants*	Habitat Condition	Threats
1. Albany Hwy	1983 50+/- 1987 50+ 1985 50+ 1988 50+/- 1989 50+/- 1990 50+/- 1991 50+/- 1992 30+/- 1993 50+/- 1997 50+ 1998 47 1999 48 2001 40+/- incomplete survey 2005 26	Poor - Moderate Moderate Moderate Healthy Moderate Healthy Moderate Moderate Moderate Moderate Moderate - Poor Moderate	Drought, weeds, fire Clearing

Population Number and Location	Year/No. plants*	Habitat Condition	Threats
2. Salt River Rd	1982 2 1986 2 1990 2 1992 100+/- 2005 Not found	- Healthy Healthy Healthy -	Grazing, clearing fire, weeds
3A. South Stirling	1990 50+ 1991 50+ 1992 50+/- 1999 100+ 2005 51	Healthy Healthy Healthy Moderate Moderate	Fire, road maintenance, grazing, flooding, heat stress
3B. South Stirling	Surveys included in 3A (above)		
4A. Yellanup Rd	1992 100+/- 1993 17+/- 1995 41 2000 40+ 2001 5+/-, remainder burnt 2002 2 (2) incomplete survey 2003 30+ 2005 46	Healthy Healthy Healthy Healthy Moderate Moderate Moderate Poor	Fire, weeds, clearing, road maintenance, grazing
4B. Yellanup Rd	Surveys included in 4A (above)		
5. Yellanup Rd	1992 0 1995 0 1999 Population not found	- - -	
6. Yungup Rd	1976 Voucher specimen 1992 Not found 1999 5 2005 Not Found	- - Moderate -	Weeds, road maintenance
7. Albany Hwy	1998 21+ 1999 100+ 2001 100+/- 2001 200+/- 2002 200+/- 2005 72+	Healthy Moderate Moderate Moderate Moderate Healthy	Road maintenance, weeds
8A. Albany Hwy	1999 20+ 1999 5 2001 10+ (some scattered) 2002 0 on west due to burn 2003 13+ 2005 20+/-	Moderate Moderate (post-fire) Moderate - Poor Healthy	Weeds, grazing, drought
8B. Narrikup Reserve	2001 20+ 2002 0 2003 11+ 2005 30+/-	Moderate Burnt Healthy Healthy	Weeds, grazing, drought
9. Yerraminup Rd	1999 30+/- 2005 24+	Healthy Healthy	Weeds, road maintenance
10. Albany Hwy	1999 3 2001 1 2005 1	Healthy Moderate Healthy	Weeds, drought
11. Albany Hwy	1999 10+ 2001 4+ 2005 Not found	Healthy Moderate -	Weeds, drought
12. Pfeiffer Rd	1999 30+ 2005 15+/-	Healthy Healthy	Weeds, road maintenance, grazing
13A. Jackson Rd	1999 200+/- 2005 151 (few)	Moderate Healthy	Grazing, weeds
13B. Jackson Rd	Surveys included in 13A (above)		
14. South Stirling	1999 100+ 2005 50+/-	Healthy to Moderate Moderate	Grazing, firebreak maintenance
15. South Stirling	1999 2	Moderate	Grazing, firebreak

Population Number and Location	Year/No. plants*	Habitat Condition	Threats
	2005 100+	Moderate	maintenance
16. Pugh Rd	1999 20+ 2004 20+	Healthy to Moderate Healthy	Weeds Road maintenance, grazing
17. Narrikup	1999 100+/- 2002 150+/-	Healthy Healthy	Grazing
18. Kwornicup NR	1986 Collection 1999 Not found	- -	
19. Stirling Range NP	2001 30+/- 2005 21	Moderate to Poor Moderate to Poor	Road maintenance
20. Spencer Rd	2001 100+/- 2005 50+/-	Moderate Moderate	Grazing, weeds
21. Drawbin Rd	2003 9	Moderate	
22A. Drawbin Rd	2003 10+	Healthy to Moderate	
22B. Drawbin Rd	2005 7	Moderate	Road maintenance, weeds
23A. Peaceful Valley	2003 20	Healthy-Moderate	
23B. Peaceful Valley	2003 21	Healthy-Moderate	
24. Stirling Range NP	2004 120+ (?20+)	Healthy	

*Numbers in brackets = number of juveniles.

Habitat critical to the survival of the species, and important populations

The habitat for *Conostylis misera* comprises the area of occupancy of important populations; areas of similar habitat surrounding important populations (these areas provide potential habitat for natural range extension and for allowing pollinators or biota essential to the continued existence of the species to move between populations); and additional occurrences of similar habitat that may contain important populations of the species or be suitable for future translocations or other recovery actions intended to create important populations. It is considered that all known habitat is critical to its survival and all populations are important populations.

Benefits to other species/ecological communities

The Critically Endangered species *Isopogon uncinatus* and *Lambertia orbifolia* occur adjacent to *Conostylis misera* Populations 8 and 20 respectively and the Priority flora species *Acacia aemula* subsp. *aemula* (P4) and *Dryandra calophylla* (P3) have been recorded within a number of *C. misera* populations. Populations 19 and 24 occur within Stirling Range National Park, which also houses twenty-six additional threatened flora species, seven threatened fauna species, and three threatened ecological communities. Recovery actions put in place for *C. misera* will benefit associated threatened species and ecological communities through threat abatement and close management. Reciprocally, actions put in place for the recovery of the threatened species and ecological communities will benefit *C. misera.*

International obligations

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that Convention. However, as *Conostylis misera* is not listed under any international agreement, the implementation of other international environmental responsibilities is not affected by this plan.

Role and interests of Indigenous people

Involvement of the Indigenous community is being sought through the advice of the Department of Indigenous Affairs. A search of the Department of Indigenous Affairs Aboriginal Heritage Sites Register has identified two registered sites, "Moingup Springs" and "Gold Holes" which occur approximately two kilometres from *Conostylis misera* Population 24.

Where no role is identified for the Indigenous community associated with this species in the development of the recovery plan, opportunities may exist through cultural interpretation and awareness of the species. Indigenous involvement in the implementation of recovery actions will be encouraged.

Affected interests

The majority of *Conostylis misera* populations are on road reserves with a total (combined) eleven populations and subpopulations vested in the Shire of Plantagenet or City of Albany. Six populations and subpopulations (combined) are on road verges vested in the Main Roads Department and seven populations and subpopulations (combined) are on private land. A further five populations are on land vested in the Conservation Commission of Western Australia and one is on unallocated Crown land.

Social and economic impacts

The implementation of this recovery plan has the potential to have some minimal social and economic impact as populations are located on private property, Shire reserves, Main Roads reserves, as well as DEC-managed land. However, recovery actions refer to continued negotiations between stakeholders with regard to these areas.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Developments in the immediate vicinity of the population or within the defined habitat critical to the survival of *Conostylis misera* require assessment for the potential for a significant level of impact.

Evaluation of the Plan's Performance

DEC, in conjunction with the Albany District Threatened Flora Recovery Team, will evaluate the performance of this recovery plan. In addition to annual reporting on progress against the criteria for success and failure, the plan is to be reviewed within five years of its implementation. Any changes to management and/or recovery actions made in response to monitoring results will be documented accordingly.

2. RECOVERY OBJECTIVE AND CRITERIA

Objectives

The objective of this Interim Recovery Plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term preservation of the species in the wild.

Criteria for success: The number of populations and individuals within populations remains stable or increases over the five years of the plan.
Criteria for failure: The number of populations or the number of individuals within populations decreases over the five years of the plan.

3. RECOVERY ACTIONS

Completed recovery actions

All land managers have been notified of the location and threatened status of *Conostylis misera*. The notification details the Declared Rare status of the species and the legal responsibility to protect it. The DEC Albany Work Centre has been in regular contact with the majority of stakeholders and encourages involvement with the recovery of the species.

Volunteers and staff from the DEC Albany Work Centre have monitored the populations and have installed roadside markers where appropriate to avoid accidental damage during road maintenance operations.

Pigott and Obbens (1997) conducted a study on weed invasion at Population 1 to assess the impact on *Conostylis misera*. Seventeen weed species were recorded at the site, the most significant of these being *Eragrostis curvula* (African Lovegrass), which was encroaching on the native vegetation from all sides. Other weed species considered to be a major threat to *C. misera* included *Avena fatua* (Wild Oat), *Holcus lanatus* (Yorkshire Fog) and *Phalaris minor* (Lesser Canary Grass). These are all grass weeds introduced by agriculture

and can be controlled by using grass-selective herbicides. *Gladiolus undulatus, Watsonia meriana* var. *bulbillifera* and *Disa bracteata* are significant environmental weeds that were also present at the site.

Pigott and Obbens (1997) found that *Conostylis misera* favoured small open areas of its habitat, which the introduced grasses were dominating and shading, thus posing a substantial threat to the species survival. The study highlighted the urgency for weed removal and control at Population 1 and recommended hand spraying as a favourable technique. Hand pulling was recommended for larger weeds, though the soil disturbance which results can encourage weed reinvasion. Redirection of runoff from Albany Highway was suggested to reduce the pooling of nutrient-enriched water and therefore help control weed biomass and encourage the regeneration of native vegetation.

Following the study by Pigott and Obbens (1997), hand weeding around thirty-one *Conostylis misera* clumps in Population 1 was undertaken by DEC Albany Work Centre and The Albany Wildflower Society. It was determined that the remaining clumps to the north were adequately protected from weed encroachment by surrounding dense native vegetation.

A follow-up weed control project was initiated and funding was successfully sourced from Community Conservation Grants from the Minister for Environment and the World Wide Fund for Nature "Community Grants for Community Involvement in Conservation of Threatened Species and Ecological Communities" administered by the Threatened Species Network. It was determined that drainage and runoff was not as great a concern as suggested by Pigott and Obbens (1997). Efforts were concentrated on removal, slashing and spraying of weed species. A significant reduction in the cover of *Eragrostis curvula* and the distribution of *Watsonia bulbillifera* was observed after four months and photographic monitoring points were established.

The Botanic Gardens and Parks Authority of Western Australia currently house eight *Conostylis misera* clones in their nursery. Division is the primary propagation method used for this species, though the success rate has been low and there has been difficulty establishing good specimens. The nursery also stores 0.1 grams of seed collected from Population 1 in 1998 ([1]A. Shade, personal communication).

In 1999, staff at the DEC Albany Work Centre focused survey effort on potential habitat for *Conostylis misera*. Of four Conservation Reserves surveyed, the species was not located at three but two new populations were found in the other. Nine additional locations, mainly road reserves, were surveyed, resulting in seven new populations being found and one population being relocated.

Due to the Albany Highway being widened in 2000, a number of *Conostylis misera* plants in Populations 7 and 10 were moved to avoid damage. Thirteen plants were translocated within Population 7, however by the following year, only one was found to still be alive, six were dead and the remaining individuals could not be relocated. None of the *C. misera* plants translocated from Population 10 survived.

In 2001, the Southern Aboriginal Corporation was involved in removing 99% of the Victorian teatree and watsonia infestations at Populations 1 and 7. Roadcare, in conjunction with DEC, sprayed weeds encroaching on the Albany Highway populations 1, 4, 7, 10 and 11 in 2003. Fencing materials were provided by DEC to the private property landholder of Population 2 to exclude livestock.

Ongoing and future recovery actions

Where populations occur on lands other than those managed by DEC, permission has been or will be sought from appropriate land managers prior to recovery actions being undertaken.

The following recovery actions are roughly in order of descending priority; however this should not constrain addressing any action if funding is available and other opportunities arise.

[1] Amanda Shade Botanic Gardens and Parks Authority, Western Australia

1. Coordinate recovery actions

The Albany District Threatened Flora Recovery Team (ADTFRT) is coordinating recovery actions for *Conostylis misera* and will include information on progress in their annual report to DEC's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: DEC (Albany Work Centre) through the ADTFRT
Cost: $3,000 per year

2. Monitor populations

Continue regular monitoring of all populations, recording plant survival, recruitment, health and potential threats. Volunteers and staff from the DEC Albany Work Centre have monitored the populations and have installed roadside markers where appropriate to avoid accidental damage during road maintenance operations.

Action: Monitor populations
Responsibility: DEC (Albany Work Centre)
Cost: $1,930 per year

3. Collect seed

Preservation of germplasm is essential to guard against the possible extinction of wild populations. Seed can also be used to propagate plants for future translocations. Seed will be collected from all populations where possible to maximise the genetic diversity of *ex situ* material. Seed collection will be ongoing to obtain seed from as wide a range of individuals as possible.

Action: Collect seed
Responsibility: DEC (Threatened Flora Seed Centre and Albany Work Centre)
Cost: $3,750 per year

4. Prioritise and implement weed control

Weed control is paramount in roadside populations where the weeds are out-competing and overcrowding native species. Various methods may be required for their removal and control. Organisations assisting with the control of weeds include voluntary groups such as the Albany Wildfire Society. The following actions are being implemented:

i. review weed control efforts at Populations 1 and 7 and continue photographic monitoring.
ii. liaise with Main Roads Department regarding annual weed control at roadside population.
iii. identify populations most at threat from weed encroachment based on invasiveness, size of infestation, and impact of disturbance .
iv. identify the populations most likely to benefit from weed control, taking into account population size and the influence of edge effects.
v. identify the best weed control techniques and implement a strategic weed control and revegetation program.

Action: Prioritise and implement weed control
Responsibility: DEC (Albany Work Centre)
Cost: $6,060 per year

5. Implement fire management

For the life of this Plan (5 years) or until the species response to fire is understood, fire will if possible be prevented from occurring in *Conostylis misera* populations threatened by weeds.

Action: Implement fire management
Responsibility: DEC (Albany Work Centre)
Cost: $600 per year.

6. Liaise with stakeholders

Staff from DEC Albany District will continue to liaise with all stakeholders to ensure populations on land other than that managed by DEC are not accidentally damaged or destroyed and that identified threats are minimised. Conservation agreements will be sought with landholders in the area. Input and involvement will also be sought from any Noongar groups that have an active interest in areas that are habitat for *Conostylis misera*.

Action: Liaise with land managers
Responsibility: DEC (Albany Work Centre)
Cost: $600 per year

7. Conduct further surveys

Surveys supervised by DEC staff, with assistance from local naturalists and wildflower society members, are being conducted during the species flowering period (October to November). Some potential habitat has been surveyed and information on soil and vegetation types will be used to identify similar habitat to target for further survey. Recent surveys have not located any new populations.

Action: Conduct futher surveys
Responsibility: DEC (Science Division and Albany Work Centre)
Cost: $2,440 per year

8. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Conostylis misera* is being sought to provide a better scientific basis for management of the wild populations. An understanding of the following is particularly necessary for effective management:

i. population dynamics and the role of various disturbances, such as fire, competition from weeds and hydrology, in plant survival and recruitment.
ii. reproductive biology and the role of pollinators.

Action: Obtain biological and ecological information
Responsibility: DEC (Science Division and Albany Work Centre)
Cost: $24,000 per year for the final three years

9. Map habitat critical to the survival of the species

Although habitat critical to the survival of the species is described in Section 1, all the areas described have not yet been accurately mapped and will be addressed under this action. If additional populations are located, habitat critical to their survival will also be determined and mapped.

Action: Map habitat critical to the survival of the species
Responsibility: DEC (Albany Work Centre)
Cost: $400 in first year

10. Promote awareness

The importance of biodiversity conservation and the need for the long-term protection of wild populations of this species will be promoted to the community through poster displays and the local print and electronic media. Formal links with local naturalist groups and interested individuals will also be encouraged. Members of the Albany Wildflower Society have been shown plants and encouraged to look for new populations.

Action: Promote awareness
Responsibility: DEC (Albany Work Centre) through the ADTFRT
Cost: $900 per year

11. Review the IRP and asses the need for further recovery actions

At the end of the five-year term of this IRP, the plan will be reviewed and the need for further recovery actions assessed.

Action: Review the IRP and assess the need for further recovery actions
Responsibility: DEC (Species and Communities Branch and Albany Work Centre) through the ADTFRT
Cost: $4,000 in the fifth year (if required)

4. TERM OF PLAN

Western Australia

This Interim Recovery Plan will operate from December 2005 to November 2010 but will remain in force until withdrawn or replaced. If the species is still ranked Vulnerable (WA) after five years, this plan will be reviewed and the need for further recovery actions determined.

Commonwealth

In accordance with the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) this adopted recovery plan will remain in force until revoked.

The recovery plan must be reviewed at intervals of not longer than 5 years.

5. REFERENCES

Atkins, K. (2008) *Declared Rare and Priority Flora List for Western Australia.* Department of Conservation and Land Management, Western Australia.

Brown, A., Thomson-Dans, C. and Marchant, N. (Eds) (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia.

CALM (1994) Policy Statement No. 50 *Setting Priorities for the Conservation of Western Australia's Threatened Flora and Fauna*. Department of Conservation and Land Management, Western Australia.

CALM (1998) *Western Australian Herbarium FloraBase* – Information on the Western Australian Flora. Department of Conservation and Land Management, Western Australia.

CALM (2004) Towards a biodiversity conservation strategy for Western Australia : discussion paper. Department of Conservation and Land Management, Western Australia.

Carpenter, F.L. and Recher, H.F. (1979) Pollination, Reproduction, and Fire. *The American Naturalist*, **113**: 871-879.

Hobbs, R.J. and Yates, C.J. (2003) Impacts of ecosystem fragmentation on plant populations: generalising the idiosyncratic. *Australian Journal of Botany*, **51**: 471-488.

Holland, E., Kershaw, K. and Brown, A. (1997) Small flowered Conostylis (*Conostylis micrantha*) Interim Recovery Plan 1996 – 1999. Department of Conservation and Land Management, Western Australia.

Panetta, F.D. and Hopkins, A.J.M. (1991) Weeds in corridors: invasion and management. In *Nature Conservation. 2, the Role of Corridors* (eds D.A. Saunders & R.J. Hobbs). Surrey Beatty, Sydney. pp. 341-351

Peters, R.L. and Darling, J.D.S. (1985) The greenhouse effect and nature reserves. *Bioscience* **35**(11): 707-717.

Pigott, J.P. and Obbens, F.J. (1997) *Weed invasions within populations of threatened flora in the southwest of Western Australia: A review*. Unpublished report.

World Conservation Union (2004) *IUCN red list categories prepared by the IUCN Species Survival Commission, as approved by the 51st meeting of the IUCN Council*. Gland, Switzerland.

6. TAXONOMIC DESCRIPTION

Plant tufted. Leaves flat, 5-18 cm long, 2-6 mm wide, green, often falcate, striate, glabrous; margins thin, entire or with a few small hairs, not glaucous. Flower usually solitary; scape 0.4-2 cm long, bearing 2 or 3 acuminate glabrous brown bracts, partly hidden in sheathing leaf bases. Perianth 12-19 mm long, yellow; indumentum smooth, of short branched hairs mixed with longer hairs; lobes 10.5-18 mm long. Stamens erect; filaments 0.5-3 mm long; anthers 4.5-7 mm long. Style 8-12 mm long.