INTERIM RECOVERY PLAN NO 221

SPRAWLING SPIKY ADENANTHOS

(*ADENANTHOS PUNGENS* SUBSP. *EFFUSUS*)

INTERIM RECOVERY PLAN

2006-2011

May 2006

Department of Conservation and Land Management
Species and Communities Branch (SCB)
Kensington

Natural Heritage Trust
Helping Communities Helping Australia

Government of Western Australia

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos. 44 and 50.

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.

CALM 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 and, in the case of Critically Endangered (CR) taxa, always within one year of endorsement of that rank by the Minister.

This IRP results from a review of, and replaces, IRP No. 78 *Adenanthos pungens* subsp. *effusus* (Evans, Stack, Loudon, Graham and Brown 2000).

This Interim Recovery Plan will operate from May 2006 to April 2011 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked as Critically Endangered, this IRP will be reviewed after five years and the need for a full Recovery Plan will be assessed.

This IRP was given regional approval on 13 February, 2006 and was approved by the Director of Nature Conservation on 22 February, 2006. The allocation of staff time and provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting CALM, as well as the need to address other priorities.

Information in this IRP was accurate at May 2006.

IRP PREPARATION

This Interim Recovery Plan was prepared by Heather Taylor[1], Andrew Brown[2] and Bethea Loudon[3].

[1] Former Project Officer, Species and Communities Branch, CALM, PO Box 51 Wanneroo, 6946.
[2] Threatened Flora Coordinator, Species and Communities Branch, CALM, PO Box 51 Wanneroo, 6946.
[3] Conservation Officer (Flora), Katanning District, PO Box 811, Katanning, W.A. 6317.

ACKNOWLEDGMENTS

The following people have provided assistance and advice in the preparation of this IRP:

Anne Cochrane	Manager, CALM's Threatened Flora Seed Centre
Frank Obbens	Former Consultant, CALM's Science Division
Robyn Luu	Project Officer, CALM's Species and Communities Branch

Thanks also to staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information, and CALM's Species and Communities Branch for assistance.

Cover photograph by Andrew Brown

CITATION

This Interim Recovery Plan should be cited as:

Department of Conservation and Land Management (2006) Sprawling Spiky Adenanthos (*Adenanthos pungens* subsp. *effusus*) Interim Recovery Plan 2006-2011. Interim Recovery Plan No. 221. Department of Conservation and Land Management, Perth, Western Australia.

SUMMARY

Scientific Name:	*Adenanthos pungens* subsp. *effusus*	**Common Name:**	Sprawling Spiky Adenanthos
Family:	Proteaceae	**Flowering Period:**	August to November
CALM Region:	Wheatbelt	**CALM District:**	Katanning
Shires:	Tambellup, Kojonup	**Recovery Team:**	Katanning

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; Nelson, E. C. (1978) A taxonomic revision of the genus *Adenanthos* (Proteaceae). *Brunonia*, 1: 303-406; Obbens, F. and Cochrane, A. (1998) Report on the experimental research burn on the Critically Endangered *Adenanthos pungens* subsp. *effusus.* Unpublished report, Department of Conservation and Land Management.

Current status: *Adenanthos pungens* subsp. *effusus* was declared as Rare Flora under the Western Australian *Wildlife Conservation Act* 1950 in May 1991 and ranked as Critically Endangered (CR) in November 1998. It currently meets World Conservation Union (IUCN 2000) Red List Category 'CR' under criteria A2ce; B1+2ce, as populations are severely fragmented and mature plants and habitat quality is in serious decline from dieback disease (*Phytophthora* spp.) in the area of Population 1. *A. pungens* subsp. *effusus* is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation* Act 1999 (EPBC Act).

There are currently two subspecies of *Adenanthos pungens* (*A. pungens* subsp. *pungens* and *A. pungens* subsp. *effusus*) with *A. pungens* subsp. *pungens* currently ranked as Endangered. The main threats to *A. pungens* subsp. *effusus* are disease (*Phytophthora* spp*)*, weeds, road, rail and firebreak maintenance and inappropriate fire regimes

Description: *Adenanthos pungens* subsp. *effusus* is a prostrate shrub (barely reaching 0.25 m tall) that forms mats up to 3 m in diameter. Leaves are densely sclerified, pointed and entire or trifid (segmented). In general, the leaves are 30 mm long, 1-2 mm in diameter. Numerous pale to dark pink flowers are grouped at the tips of hairy branchlets and surrounded by up to 6 bracts.

Habitat requirements: *Adenanthos pungens* subsp. *effusus* appears to be geographically restricted and is currently known only from two locations in the Katanning and Tambellup areas. Habitat is open scrub over lower mixed shrubs. The soil type is grey/white siliceous sand. Associated species are variable between the two sites but commonly include species such as *Banksia prionotes, B. violacea, B. oligantha, Conostylis drummondii, Lechenaultia* sp. and *Regelia cymbifolia.*

Critical habitat: The critical habitat for *Adenanthos pungens* subsp. *effusus* is the remnant vegetation in which it occurs, areas of similar habitat within 200 metres of the known population i.e. open scrub over mixed scrub in grey/ white siliceous sand, and additional occurrences of similar habitat that do not currently contain the species but may have done so in the past and may be suitable for translocations.

Habitat critical to the survival of the species, and important populations: Habitat critical to the survival of the species includes the area of occupancy of important populations; areas of similar habitat surrounding important populations ie. open scrub over mixed scrub in grey/ white siliceous sand – these provide potential habitat for natural range extension and are necessary to allow pollinators to move between populations; the local catchment area where the species occurs; and additional occurrences of similar habitat that may contain the species or be suitable sites for future translocations.

Given that this taxon is Critically Endangered it is considered that all known habitat for wild and translocated populations is habitat critical.

Benefits to other species/ecological communities: The Reserve that contains Population 2a also contains two other DRF species (*Banksia oligantha* and *Conostylis drummondii*) both of which are ranked as Endangered. Recovery actions implemented to improve the quality or security of the habitat of *Adenanthos pungens* subsp. *effusus* will improve the status of these threatened species and the remnant vegetation in which they occur.

International Obligations: This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity that was ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that Convention. The species is not listed under the United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES). In addition, it is not listed under any other specific international treaty and this Interim Recovery Plan (IRP) does not affect Australia's obligations under these international agreements.

Role and interests of indigenous people: The Aboriginal Sites Register maintained by the Department of Indigenous Affairs lists one *Adenanthos pungens* subsp. *effusus* site that is of indigenous importance. This site is a burial ground for

indigenous people and there are a number of unmarked graves there. Input and involvement will be sought from the Aboriginal Lands Trust and any other Aboriginal groups that have an active interest in areas that are habitat for the taxon. Implementation of recovery actions under this plan will include consideration of the role and interests of indigenous communities in the region.

Social and economic impacts: The implementation of this recovery plan is unlikely to cause significant adverse social or economic impacts. However, as two populations are located on private property and another on an area managed by the Aboriginal Lands Trust, their protection may potentially affect farming and other activities. Recovery actions refer to continued liaison between stakeholders with regard to these areas.

Affected interests: Stakeholders potentially affected by the implementation of this plan include Main Roads WA, as managers of the road reserve habitat at Population 1a, West Net Rail as managers of the rail reserve at Population 1b, the Aboriginal Lands Trust as managers of the land containing Population 2a and the owners of private land where Populations 1c and 2b occur.

Evaluation of the Plans Performance: CALM will evaluate the performance of this IRP in conjunction with the Katanning District Threatened Flora Recovery Team. In addition to annual reporting on progress with listed actions and comparison against the criteria for success and failure, the plan is to be reviewed within five years of its implementation.

Existing Recovery Actions: The following recovery actions have been or are currently being implemented:

1. All land managers have been made aware of the threatened nature of the taxon and its locations.
2. An A4 sized poster has been produced for *Adenanthos pungens* subsp. *effusus* that provides a description of the subspecies and information about major threats and future recovery actions.
3. Tests in 1999 have shown that plant deaths at Population 1 were due, at least in part; to dieback disease (*Phytophthora* sp.). Aerial phosphite spraying was conducted in March and April 2000 and April 2004.
4. DNA Testing has been carried out by staff from CALM's Science Division. The analysis showed that there is little genetic difference between the two subspecies and that further taxonomic work is required to ascertain the taxonomic status of the two subspecies. Habit differences (prostrate verses upright) may be due to developmental pathways, environmental variation or isolation (due to clearing).
5. Weed control (herbicide application) was applied to the road reserve at the site of Subpopulation 1a by Main Roads staff in 1991, under the supervision of CALM staff.
6. Declared Rare Flora (DRF) markers are installed for road reserve populations.
7. Dashboard stickers and posters that illustrate DRF markers and describe their purpose have been produced and distributed.
8. Staff from the Threatened Flora Seed Centre (TFSC) have collected 52 (1992), 63 (1994) and 332 (1997) seeds from population 1. These have been placed in storage at -18^{o}C. Initial tests have shown that the taxon has a relatively low initial germination rate, ranging from 0-30%. It also appears that viability decreases with storage time.
9. Botanic Garden and Parks Authority (BGPA) staff have achieved varied results with *Adenanthos pungens* subsp. *effusus* cuttings, with strike rates varying from 30% to 75%. This may be due to the quality of material collected or the storage of material. Longevity of cutting grown plants has also varied. In May 2004, some 191 plants were held at BGPA.
10. Weed control trials were conducted at Population 1 in 1996. Initial results indicate that plants that were subjected to weed control did marginally better than those that had no weed control.
11. A quantitative flora survey and report was prepared on the Reserve population by a private contractor in September 2000.
12. Surveys have been conducted for *Adenanthos pungens* subsp. *effusus*, however, these have failed to locate any new populations.
13. A trial burn was conducted in April 1998 at Population 1 in order to establish the regenerative characteristics of the subspecies. Many seedlings germinated following the trial, however these have since died.
14. The Katanning District Threatened Flora Recovery Team KDTFRT are overseeing the implementation of this IRP and are including it in annual reports to CALM's Corporate Executive and funding bodies.
15. Staff from CALM's Katanning District Office regularly monitor populations of *Adenanthos pungens* subsp. *effusus*.

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

Recovery criteria

Criteria for success: The number of individuals within populations and/or the number of populations have increased by ten percent or more over the period of the plan's adoption under the EPBC Act.

Criteria for failure: The number of individuals within populations and/or the number of populations have decreased by ten percent or more over the period of the plan's adoption under the EPBC Act.

Recovery actions

1. Coordinate recovery actions
2. Map total habitat
3. Review taxonomic status
4. Undertake *Phytophthora* control
5. Undertake rabbit control
6. Continue monitoring the experimental burn and weed control trials
7. Monitor the impact of phosphite applications
8. Obtain biological and ecological information
9. Monitor populations
10. Conduct further surveys
11. Collect further seed and cutting material, and propagate plants
12. Liaise with relevant land owners and managers
13. Promote awareness
14. Develop and implement a fire management strategy
15. Start the translocation process
16. Review the need for a full Recovery Plan

1. BACKGROUND

History

Adenanthos pungens was declared as rare flora in 1980 but was subsequently divided into two subspecies, *A. pungens* subsp. *pungens* (erect) and *A. pungens* subsp. *effusus* (prostrate), with *A. pungens* subsp. *effusus* declared as rare flora in May 1991 and ranked as Critically Endangered in November 1998.

There are eleven collections of *Adenanthos pungens* subsp. *effusus* held at the W.A. Herbarium, the earliest made by R. Royce in 1972. This collection corresponds roughly with the location of Population 1. A second collection made by H. Demarz in 1974 was found in an area approximately 10 km south of Population 1. However, despite extensive searches in 1987 no plants were located and the population was recorded as presumed extinct in May 1988.

Nelson (1978) recognized the two subspecies based upon their erect and prostrate habits. However plants at Population 2 of *Adenanthos pungens* subsp. *effusus* have developed erect central branches that extend to 1.5m. Additionally, several mature plants growing in a *Melaleuca* thicket at Population 1 have developed erect, central branches to about 1m. This suggests that the erect verses prostrate habit is variable and not a good character to use for separation. DNA testing carried out by Dr David Coates[1] in 2001, also indicated that the two subspecies of *A. pungens* may be insufficiently different genetically to warrant separation. The habit differences may be due to developmental pathways, environmental variations and isolation (due to clearing).This was the focus of a study and report by Chris Gage (third year university project) titled "Molecular Systematics of *Adenanthos pungens* subspecies *pungens* and subspecies *effusus*" (2001). Further taxonomic study is required to verify these conclusions and until this is done the two subspecies will remain separated.

Several *Adenanthos* species have been found to strike very easily from semi-hardwood cuttings. *A. pungens* subsp. *effusus* has been successfully propagated by the Botanic Gardens and Parks Authority (BGPA) with 30 to 100% success rate from cuttings.

Description

Adenanthos pungens is a sprawling shrub that has rigid, usually divided, terete leaves up to 3 cm long with sharp tips. Numerous pale-pink to red flowers are clustered on the ends of branchlets. When flowering, *A. pungens* is very attractive and obvious, at other times it may easily be mistaken for an *Isopogon* or *Daviesia*. There are two subspecies recognized (*A. pungens* subsp. *pungens* and *A. pungens* subsp. *effusus*).

The type description states that *Adenanthos pungens* subsp. *effusus* is a compact, prostrate, spreading shrub to 5m in diameter and 25 cm in height. However, field observations have shown that mature plants are generally taller than 25cm and grow to 10m across. A full taxonomic description by Nelson (1978) is provided in Section 6.

Distribution and habitat

Adenanthos pungens subsp. *effusus* is found in the Katanning and Tambellup areas where it is known from just two populations containing less than 1200 plants in total. Associated species are variable between the two sites. At Population 1 the subspecies occurs in heath of *Regelia cymbifolia* (Priority 4) and *Leptospermum erubescens* over open dwarf scrub and open low sedges. Associated species include *Allocasuarina acuaria, Banksia attenuata, B. meisneri* subsp. *meisneri, Chordifex ornatus* (Priority 2), *Conostylis aculeata, Hibbertia subvaginata* and *Patersonia occidentalis.* The soil type is

[1] Principal Research Scientist, CALM Science

white sand over yellow sand. At Population 2 *A. pungens* subsp. *effusus* is found in open scrub of *Banksia oligantha* over heath of *Regelia cymbifolia* (Priority 4) and lower mixed shrub. The soil type is grey/white siliceous sand. Other associated species include *Banksia prionotes, B. violacea, Conostylis drummondii* and *Lechenaultia* sp.

Summary of population land vesting, purpose and tenure

Pop. No. & Location	District	Shire	Vesting	Purpose	Tenure
1a. South of Tambellup	Katanning	Tambellup	Main Roads	Road Reserve	Non CALM Act
1b. South of Tambellup	Katanning	Tambellup	West Net Rail	Rail Reserve	Non CALM Act
1c. South of Tambellup	Katanning	Tambellup	-	Private Property	Freehold
2a. West of Katanning	Katanning	Kojonup	-	Aboriginal Reserve	Non CALM Act
2b. West of Katanning	Katanning	Kojonup	-	Private Property	Freehold

Biology and ecology

Despite prolific flowering, production of viable seed appears relatively low. Staff from the Threatened Flora Seed Centre (TFSC) have observed a high abortion level at all stages of seed formation including bud, flower and fruit formation. Anne Cochrane[2] estimated in 1994 that over 90% of seed appeared 'empty' for *Adenanthos pungens* subsp. *effusus*. High insect predation levels were also recorded in 1992.

Fire kills adult plants but promotes good recruitment from seed (Brown *et al*. 1998). Therefore, it is important to have a burning regime in place to promote recruitment, but allow time for seedlings to mature and restock the soil seed bank between burns.

Adenanthos pungens subsp. *effusus* is believed to be pollinated by insects, with field observations in 1987 documenting evidence of this.

Threats

Adenanthos pungens subsp. *effusus* was declared as Rare Flora under the Western Australian *Wildlife Conservation Act* 1950 in May 1991 and ranked as Critically Endangered (CR) in November 1998. It currently meets World Conservation Union (IUCN 2000) Red List Category 'CR' under criteria A2ce; B1+2ce, as populations are severely fragmented and mature plants and habitat quality is in serious decline from dieback disease (*Phytophthora* spp.) at Population 1. *A. pungens* subsp. *effusus* is also listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation* Act 1999 (EPBC Act). The main threats include salinity and waterlogging, disease, weeds, edge effects, road, track and firebreak maintenance, fire and grazing.

- **Increasing salinity and waterlogging** is thought to have contributed to the extinction of a population at Wansborough and may be a future threat to other populations.
- **Disease** is a serious threat to all populations. Both subspecies of *Adenanthos pungens* were thought to be showing the effects of *Phytophthora* infection as early as 1973 and recent tests have shown that plant deaths at Subpopulation 1b of *A. pungens* subsp *effusus* is due, at least in part, to this disease. *Phytophthora cinnamomi*, *P. cryptogea* and *P. drechsleri* have all been shown to be present at this site. *Armillaria* sp. has also been identified as possibly occurring at Population 1. To date, there have been no recorded losses from disease at Population 2.
  Dieback (*Phytophthora* spp.) is a pathogen that invades the young roots of a plant, feeding on the tissues as it spreads up into the larger roots towards the crown of the plant. This direct attack on the root system causes them to rot, depriving the plant of access to nutrients and water, and resulting in dying back of branches, or the sudden death of the whole plant if severe enough (Shearer and Tippet 1989). Girdling of major roots or the base of the stem can also occur.

[2] Anne Cochrane, Manager, Threatened Flora Seed Centre, CALM

In response to the invasion of the root and stem tissue by the *Phytophthora*, the plant may produce outgrowths known as tyloses (from the xylem parenchyma) into the xylem vessels. This self-defence mechanism aims at preventing further movement of the pathogen up the vessels of the plant. As the severity of the attack increases, the production of the tyloses also increases often resulting in the vessels becoming blocked by these outgrowths. In effect, the plant actually contributes to its own death from drought stress by blocking the transport of water to its tips.

- **Weed invasion** is a threat to rail and road reserve populations that are being invaded by weed seeds blown in from adjoining land. Weeds suppress early plant growth by competing for soil moisture, nutrients and light and also exacerbate grazing pressure.
- **Edge effects:** populations that are restricted to narrow road and rail reserves (Population 1) have high perimeter to area ratios. This will result in virtually the whole corridor being subjected to influences of the adjacent land, commonly referred to as edge effect (Lynch 1987; Saunders *et al*. 1987; Taylor 1987). Effects include increased wind speed, increased fertiliser runoff, modified hydrology and altered disturbance regimes, including fire.
- **Road, track and firebreak maintenance** has threatened roadside populations (Population 1) in the past. Relevant landowners and managers have been informed of the populations and the need to preserve the subspecies. The adjacent landowners have also been informed of the subspecies presence, so as to reduce the risk of damage. This resulted in the discovery of Subpopulation 1c on private property.
- **Inappropriate fire regimes** would adversely affect the long-term viability of populations of *Adenanthos pungens* subsp. *effusus*. Mature plants are killed by fire and, although soil-stored seeds germinate following fire, the soil seed bank would rapidly be depleted if fires recurred before juvenile plants reach maturity. Note, however, that occasional fires are needed for recruitment.
- **Herbivore grazing** Rabbits (*Oryctolagus cuniculus*) have been reported at Population 1 and to a lesser extent at Population 2. Whilst they are not grazing the plants and their warrens do not appear to be interfering with root systems at present, there remains a strong potential for future damage if the situation is not monitored and appropriate controls implemented. In addition, disturbance of soil by rabbit warren construction, increased nutrient levels from their droppings and the introduction of weeds may impact on the habitat of the subspecies. Grazing may also have an impact on the establishment of *Adenanthos pungens* subsp. *effusus* seedlings, limiting the natural recruitment of the subspecies.

Summary of population information and threats

Pop. No. & Location	District	Year/No. plants	Condition	Threats
1a. South of Tambellup	Katanning	1987 88 1999 128 (31) [19 dead]	Moderate	Disease, weeds, road maintenance, rabbits, salinity and inappropriate fire.
1b. South of Tambellup	Katanning	1987 713 1999 838 (2) [165 dead]	Moderate/ Poor	Disease, weeds, rail and track maintenance, rabbits, salinity and inappropriate fire.
1c. South of Tambellup	Katanning	2000 2	Healthy	Disease, weeds, firebreak maintenance, rabbits, inappropriate fire, pine plantation maintenance.
2a. West of Katanning	Katanning	1990 100 (15) 2000 767 [21]*	Healthy	Rabbits, inappropriate fire, firebreak maintenance.
2b. West of Katanning	Katanning	2000 767 [21]*	Healthy	Rabbits, inappropriate fire, firebreak maintenance

() = number of seedlings, * = total for both subpopulations.
Populations in **bold text** are considered to be Important Populations

Guide for decision-makers

Section 1 provides details of current and possible future threats. Proposed developments and on-ground works (firebreaks, roadworks etc) in the immediate vicinity of habitat critical to the survival of *Adenanthos pungens* subsp. *effusus* will require assessment. Works should not be approved unless the

proponents can demonstrate that activities will not be detrimental to the subspecies, its habitat or potential habitat, or on the local hydrology (surface and ground water).

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

Habitat critical to the survival of the species includes the area of occupancy of important populations; areas of similar habitat surrounding important populations ie. open scrub over mixed scrub in grey/ white siliceous sand – these provide potential habitat for natural range extension and are necessary to allow pollinators to move between populations; the local catchment area where the species occurs; and additional occurrences of similar habitat that may contain the species or be suitable sites for future translocations.

Given that this taxon is Critically Endangered it is considered that all known habitat for wild and translocated populations is habitat critical.

Benefits to other species or ecological communities

Population 2a contains two Declared Rare Flora (DRF) species (*Banksia oligantha* and *Conostylis drummondii*) both of which are ranked as Endangered under the *Wildlife Conservation Act* 1950 and the EPBC Act. Recovery actions implemented to improve the quality or security of the habitat of *Adenanthos pungens* subsp. *effusus* are likely to improve the status of the rare flora listed above.

International obligations

This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity that was ratified by Australia in June 1993, and will assist in implementing Australia's responsibilities under that Convention. The species is not listed under the United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES). In addition, it is not listed under any other specific international treaty and this Interim Recovery Plan (IRP) does not affect Australia's obligations under these international agreements.

Role and interests of indigenous people

The Aboriginal Sites Register maintained by the Department of Indigenous Affairs lists one *Adenanthos pungens* subsp. *effusus* site that is of indigenous importance. This site is a burial ground for indigenous people and there are a number of unmarked graves there. Input and involvement will be sought from the Aboriginal Lands Trust and any other Aboriginal groups that have an active interest in areas that are habitat for the taxon. Implementation of recovery actions under this plan will include consideration of the role and interests of indigenous communities in the region.

Social and economic impacts

The implementation of this recovery plan is unlikely to cause significant adverse social or economic impacts. However, as Populations 1c and 2b are located on private property and Population 2a is on an area managed by the Aboriginal Lands Trust, their protection may potentially affect farming and other activities. Recovery actions refer to continued liaison between stakeholders with regard to these areas.

Affected interests

Stakeholders potentially affected by the implementation of this plan include Main Roads WA, as managers of the road reserve habitat at Population 1a, West Net Rail as managers of the rail reserve at Population 1b, the Aboriginal Lands Trust as managers of the land containing Population 2a and the owners of private land where Populations 1c and 2b occur.

Evaluation of the Plans Performance

CALM will evaluate the performance of this IRP in conjunction with the Katanning District Threatened Flora Recovery Team. In addition to annual reporting on progress with listed actions and comparison against the criteria for success and failure, the plan is to be reviewed within five years of its implementation.

2. RECOVERY OBJECTIVE AND CRITERIA

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

Recovery criteria
Criteria for success: The number of individuals within populations and/or the number of populations have increased by ten percent or more over the period of the plan's adoption under the EPBC Act.
Criteria for failure: The number of individuals within populations and/or the number of populations have decreased by ten percent or more over the period of the plan's adoption under the EPBC Act.

3. RECOVERY ACTIONS

Existing recovery actions

West Net Rail, Main Roads Western Australia (MRWA) and private property owners have been formally notified of the presence and threatened nature of populations of *Adenanthos pungens* subsp. *effusus* on their land. Adjacent landowners have also been made aware of the subspecies and its location. The notification details the Declared Rare status of the taxon and the associated legal responsibilities.

An A4 sized poster, which provides a description of the subspecies, and information about threats and recovery actions, has been produced for *Adenanthos pungens* subsp *effusus*. It is hoped that the poster will result in the discovery of new populations.

Vehicles entering the rail reserve in 1998 damaged and killed several plants at Subpopulation 1b. No action was taken as it was not known who was responsible, however, contact was made with West Net Rail and the importance of protecting the subspecies reiterated.

Weeds at Subpopulation 1a have proven a continuing problem. In 1991 Main Roads, under the supervision of CALM's Katanning District staff, applied herbicides to the road shoulder area. Care was taken and there was no over-spraying or apparent risk to the *Adenanthos* plants, and as a result the action was considered a success in reducing the ongoing threat of weed invasion to the population.

Weed control trials were conducted at Population 1 during 1998-1999, with methods including no control, weed control and weed control plus disturbance (raking). Results are not finalised, however data suggest that plants that had received weed control did marginally better than those with no control. Weed control included spraying with Fusilade for narrow-leaf grass weeds, followed by hand weeding or wicking broad leaf weeds with Roundup (F. Obbens[3] pers. communication).

Declared Rare Flora (DRF) markers have been installed at subpopulations 1a and 1b. These alert workers to the presence of threatened flora and help prevent accidental damage during maintenance operations. An awareness of the markers is being promoted to relevant bodies such as Main Roads WA (MRWA) and West Net Rail through dashboard stickers and posters. These illustrate DRF markers, inform of their purpose and provide a contact telephone number if such a marker is encountered.

[3] Frank Obbens, Consultant, CALM's Science Division

Staff from the TFSC collected 52 seeds from Population 1 in December 1992, 63 seeds in January 1994 and 332 seeds in December 1997. TFSC staff test the viability of seed after one year in storage at minus 18 degrees Celsius and again after five years. The 1992 collections were tested in May 1993 with 10% germination and retested in January 1998 with 5% germination. The 1994 collections were tested in January 1998 with 0% germination and have not been re-tested while the 1997 collections were tested in January 1998 with 30% germination and re-tested in March 1999 with 20% germination. It appears that viability decreases with time/storage and a new strategy for effective long-term seed storage is required.

DNA testing of the two subspecies of *Adenanthos pungens* was carried out by Dr David Coates in 2001, and results indicate that they may be insufficiently different, genetically, to warrant separation. This was the focus of a study and report by Chris Gage (third year university project) titled "Molecular Systematics of *Adenanthos pungens* subspecies *pungens* and subspecies *effusus*" (2001).

BGPA staff have achieved varied results with cuttings of *Adenanthos pungens* subsp. *effusus*, with strike rates varying from 30% to 75%. In May 2004 there were 191 plants from 5 clones growing at BGPA. Strike rates varied greatly with quality of material collected and storage of material. The longevity of cutting grown plants has also varied greatly.

In order to establish the regenerative characteristics of the subspecies a trial burn was conducted at Population 1 in April 1998. Three plots (2 m x 2 m), each containing between one and two dead plants, were covered with dry litter and burnt. Regenerative results are outlined in the following table. Death of seedlings has been attributed to dieback. In order to establish seedling survival rates monitoring will continue (Obbens and Cochrane 1998).

Regenerative characteristics of *Adenanthos pungens* subsp. *effusus* after burn treatment

	Number of seedlings					
	Live			**Dead**		
	Plot 1	**Plot 2**	**Plot 3**	**Plot 1**	**Plot 2**	**Plot 3**
Jul-98	2	23	0			
Nov-98	5	108	0		1	
Jan-99	3	80	2	2	29	

Surveys have been conducted for *Adenanthos pungens* subsp. *effusus*, however these have failed to locate any new populations. There was also a full quantitative flora survey and report prepared by a private contractor for Ppopulation 2a in September 2000.

Staff from CALM's Katanning District Office regularly monitor populations.

The Katanning District Threatened Flora Recovery Team (KDTFRT) is overseeing the implementation of this IRP and will include information on progress in its annual report to CALM's Corporate Executive and funding bodies.

Future recovery actions

Where populations occur on lands other than those managed by CALM, 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; influenced by their timing over the term of the Plan. This does not suggest that 'lower' priorities should not be implemented if funding becomes available or if an opportunity arises to complete the action.

1. Coordinate recovery actions

The Katanning District Threatened Flora Recovery Team will continue to coordinate the implementation of recovery actions for *Adenanthos pungens* subsp. *effusus* and will include information on progress in its annual report to CALM's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: CALM (Katanning District) through the KDTFRT
Estimated Cost: $1,000 per year

2. Map total habitat

It is a requirement of the EPBC Act that spatial data relating to total habitat of the species be determined. Although habitat critical to the species' survival is described in Section 1, the areas as described have not yet been mapped and that will be redressed under this action. If any additional populations are located, then total habitat will also be determined and mapped for these locations.

Action: Map total habitat
Responsibility: CALM (Katanning District) through the KDTFRT
Estimated Cost: $4,000 in the first year

3. Review taxonomic status

The main distinction between the *Adenanthos pungens* subsp. *pungens* and *A. pungens* subsp. *effusus* is in their respective growth habits, with plants of *A. pungens* subsp. *pungens* typically being more erect than those of *A. pungens* subsp. *effusus*. However, as populations of *A. pungens* subsp. *effusus* are known to contain both erect and prostrate forms, molecular research has been conducted by CALM's Science Division. Results indicate that there may be insufficient difference to warrant separation as different subspecies. The taxonomic status of the two subspecies therefore requires review. If it is found that there is insufficient difference to warrant separation a recommendation will be made to the Threatened Species Scientific Committee (TSSC) for change.

Action: Review taxonomic status
Responsibility: CALM (Katanning District, Science Division), through the KDTFRT
Estimated Cost: $3,500 in the first year

4. Undertake *Phytophthora* control

Research conducted between 1992 and 1997 indicates that the application of phosphite is an effective tool in reducing the impact of *Phytophthora* (Murray 1997). On that basis, CALM has sought approval from land managers and adjoining landowners for CALM Katanning District staff to apply Phosphite to Population 1.

Action: Undertake *Phytophthora* control
Responsibility: CALM (Katanning District, Dieback Disease Coordinator) through the KDTFRT
Estimated Cost: $1,100 for the first and third years

5. Undertake rabbit control

Rabbit-proof fencing will be erected around plants at Population 1a and 1b if feasible. Input and involvement will also be sought from relevant land owners and managers.

Action: Conduct rabbit and weed control
Responsibility: CALM (Katanning District) through the KDTFRT
Estimated Cost: $5,200 for the first 2 years

6. Continue monitoring the experimental burn and weed control trials

CALM will continue monitoring the experimental burn and weed trials that were conducted at Population 1.

Action: Continue monitoring the experimental burn and weed control trials
Responsibility: CALM (Science Division, Katanning District) through the KDTFRT
Estimated Cost: $700 per year

7. Monitor the impact of phosphite applications

The impact of Phosphite treatment on *Adenanthos pungens* subsp. *effusus* and its effectiveness in controlling *Phytophthora* species will be monitored.

Action: Monitor the impact of phosphite applications
Responsibility: CALM (Katanning District, Dieback Disease Coordinator) through the KDTFRT
Estimated Cost: $700 per year

8. Obtain biological and ecological information

Increased knowledge of the biology and ecology of *Adenanthos pungens* subsp. *effusus* will provide a scientific basis for future management. Investigations will include:

1. Investigation of the pollination biology of the taxon.
2. A study of the soil seed bank dynamics and the effect of disturbance, competition, rainfall and grazing on recruitment and seedling survival.
3. Determining reproductive strategies, phenology and seasonal growth.
4. Investigation of population genetic structures, levels of genetic diversity and minimum viable population size.
5. Investigation of the impacts of dieback disease and control techniques on *A. pungens* subsp. *effusus* and its habitat.
6. The impact of salinity on *A. pungens* subsp. *effusus* and its habitat.

Action: Obtain biological and ecological information
Responsibility: CALM (Science Division, Katanning District) through the KDTFRT
Estimated Cost: $16,700 per year for the first 3 years

9. Monitor populations

Monitoring of factors such as weed invasion, habitat degradation, salinity levels and population stability (expansion or decline), pollinator activity, seed production, recruitment, and longevity is essential. Populations will be inspected annually (if possible) with special attention given to salinity levels and their impact. Soil salinity and pH readings will be taken annually during winter.

Action: Monitor populations
Responsibility: CALM (Katanning District) through KDTFRT
Estimated Cost: $1,700 per year

10. Conduct further surveys

Further surveys, supervised by CALM staff and with assistance of local volunteers and wildflower society members, will be conducted during the flowering period (August to November).

Action: Conduct further surveys
Responsibility: CALM (Katanning District) through the KDTFRT
Estimated Cost: $1,600 per year

11. Collect further seed and cutting material, and propagate plants

Seed has been collected from Population 1, however, further seed collections are required and collections should also be made from Population 2. Due to the difficulty in collection of seed (little viable seed) for this subspecies, CALM will implement a seed collection program over a 4 to 6 week period with the help of community groups and Conservation Volunteers Australia (CVA). Cuttings will also be collected to establish a living collection of genetic material at BGPA.

Action: Collect further seed and cutting material and propagate plants
Responsibility: CALM (Katanning District, TFSC) through the KDTFRT
Estimated Cost: $8,000 per year

12. Liaise with relevant land owners and managers

Land managers, owners and adjacent landowners of all Populations have been officially notified of the occurrence of *Adenanthos pungens* subsp. *effusus*. Staff from CALM's Katanning District will continue to liaise with them to ensure that populations are not damaged or destroyed accidentally. Land managers and landowners at Population 1 have also been advised of the occurrence of dieback (*Phytophthora* spp.) at the site. Input and involvement will also be sought from any Aboriginal groups that have an active interest in areas that are habitat for the taxon.

Action: Liaise with relevant land owners and managers
Responsibility: CALM (Katanning District) through the KDTFRT
Estimated Cost: $600 per year

13. Promote awareness

The importance of biodiversity conservation and the need for the long-term protection of *Adenanthos pungens* subsp. *effusus* in the wild will be promoted to the public through the local print, electronic media and poster displays. An information sheet that includes a description of the plant, its habitat type, threats and management actions has been produced for the taxon. This poster should be updated and distributed to the public. Formal links with local naturalist groups and interested individuals will also be encouraged.

Action: Promote awareness
Responsibility: CALM (Katanning District) through the KDTFRT
Estimated Cost: $1,500 in year one, $500 per year thereafter

14. Develop and implement a fire management strategy

Fire kills adult plants of *Adenanthos pungens* subsp. *effusus* with subsequent recruitment from soil-stored seed. Frequent fire may prevent the accumulation of sufficient seed for this to happen. Fire should therefore be prevented from occurring in the area of populations, at least in the short term, until a fire management strategy is developed which determines fire control measures and fire frequency.

Action: Develop and implement a fire management strategy
Responsibility: CALM (Katanning District) through the KDTFRT
Estimated Cost: $2,400 in the first year and $1,000 in subsequent years

15. Start the translocation process

As the total number of extant plants is quite low and the area inhabited by them quite small, translocation may be essential for the long-term conservation of *Adenanthos pungens* subsp. *effusus*. Although translocations are generally undertaken under full Recovery Plans (RPs), it is possible to develop a translocation proposal and start propagating plants within the five-year time frame of an IRP. Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No. 29 *Translocation of Threatened Flora and Fauna*. All translocation proposals require endorsement by the Director of Nature Conservation.

Action: Start the translocation process
Responsibility: CALM (Science Division, Katanning District) through the KDTFRT
Estimated Cost: $3,700 in the third year

16. Review the need for a full Recovery Plan

At the end of the fourth year of the five-year term this Interim Recovery Plan will be reviewed and the need for further recovery actions will be assessed. If the species is still ranked as Critically Endangered at that time a full Recovery Plan may be required.

Action: Review this IRP
Responsibility: CALM (Species and Communities Branch, Katanning District) through the KDTFRT
Estimated Cost: $16,700 in the fifth year (if required)

4. TERM OF PLAN

This Interim Recovery Plan will operate from May 2006 to April 2011 but will remain in force until withdrawn or replaced. If the taxon is still ranked as Critically Endangered after five years, the need for further recovery actions, or a review of this IRP will be assessed and a plan prepared if necessary.

5. REFERENCES

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6. TAXONOMIC DESCRIPTION

Nelson, E. C. (1978) A taxonomic revision of the genus *Adenanthos* (Proteaceae). *Brunonia*, 1: 303-406.

Adenanthos pungens

Erect, or prostrate shrub without a lignotuber. Branches erect or prostrate, when young with white short appressed hairs, becoming glabrous. Leaves densely sclerified, rigid, terete, to 30 mm long, 1-2 mm in diameter, entire or segmented, glabrous, usually with a few scattered sunken glands on surface, apex eglandular with pungent mucrone; if segmented usually trifid, very rarely bifid; segments terete, undivided, *c.* 10 mm long; petiole canaliculate on upper surface, *c.* 20 mm long. Inflorescences aggregated at tips of branchlets, numerous; peduncles *c.* 4 mm long, ebracteate, densely villose with short appressed white hairs; involucral bracts *c.* 6, innermost largest, not closely imbricate, ovate triangular, to 3.5 mm long, hirsute on exterior, glabrous interiorly, eglandular, margin entire, ciliate, apex obtuse. Flowers pale pink to bright red-pink; in bud perianth tube only slightly swollen above bracts, limb ± obtuse, recurved. Tepals *c.* 30 mm long, densely villose on exterior, glabrous interiorly; claw *c.* 26 mm long; lamina *c.* 3 mm long, with long hairs inside behind the anther. Anthers *c.* 3 mm long. Nectaries triangular, *c.* 1.5 mm long, attached to base of perianth for about 0.3 mm, apex emarginate. Ovary *c.* 1 mm long, glabrous; style, *c.* 40 mm long, glabrous or with long spreading hairs on distal portion; style-end *c.* 1 mm long. Fruit *c.* 5 mm long, glabrous. Initial leaves of seedling sessile, entire, not sclerified, lanceolate, ± laminar, *c.* 15 mm long, *c.* 2 mm broad, with long divaricate hairs. Many of these leaves are produced before adult sclerified leaves appear.

Two subspecies of *Adenanthos pungens* are recognised in the following key.

1. Shrubs erect, to 3 m tall, leaves mostly trifid, flowers dark pink ..... subsp. *pungens*

2. Prostrate shrubs, rarely reaching 0.25 m tall, forming mats up to 3 m in diameter, leaves entire or trifid, flowers pale pink ..... subsp. *effusus*

Adenanthos pungens* subsp. *effusus

A prostrate, spreading shrub forming large mats up to 3 m in diameter. Branches prostrate or ascending. Leaves entire or trifid. Flowers pale pink.

Distribution: Western Australia, only known from a small area south of Tambellup townsite, north of the Stirling Range.

Ecology: Where the vegetation has not been disturbed the plants form low undershrubs in *Melaleuca* scrub, in deep siliceous sand. Flowers August to November.

Notes: A. pungens is easily distinguished from all other species, as it possesses densely sclerified leaves that have a pungent, mucronate apex. The leaves of *A. gracilipes* are also densely sclerified but they have more laciniae than *A. pungens* and the apices are not mucronate and pungent.

The only known population of subsp. *effusus* contains plants that have either entire or trifid leaves, or occasionally both types of leaves. The leaves in subsp. *pungens* are usually trifid and only very rarely

do entire leaves occur. The remarkable prostrate habit of subsp. *effusus*, and the profusion of blossoms during its flowering season, make plants a spectacular sight; the subspecies is potentially of horticultural value.

Etymology: Pungens (piercing) refers to the mucronate leaf apex; *effusus* (spread out) refers to the mat-like prostrate habit.