INTERIM RECOVERY PLAN NO. 247

WUNDOWLIN WATTLE

(*Acacia sciophanes*)

INTERIM RECOVERY PLAN

2008-2013

April 2008

Department of Environment and Conservation
Kensington

Australian Government

Government of Western Australia

Department of Environment and Conservation
Our environment, our future

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

This IRP, which results from a review of, and replaces, IRP No.77 *Acacia sciophanes* (Evans *et al*. 2000), will operate from April 2008 to March 2013 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked CR, this IRP will be reviewed after five years and the need for further recovery actions assessed.

This IRP was approved by the Director of Nature Conservation on the 30 April 2008. The allocation of staff time and 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.

Information in this IRP was accurate as at April 2008.

This IRP was prepared with financial support from the Australian Government to be adopted as a National Recovery Plan under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

IRP PREPARATION

This IRP was prepared by Craig Douglas[1], Joel Collins[2], David Jolliffe[3], Wendy Johnston[4] and Andrew Brown[5]

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ACKNOWLEDGMENTS

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

Andrew Crawford	Technical Officer, Threatened Flora Seed Centre, DEC, Locked Bag 104, Bentley Delivery Centre, 6983.
Bob Dixon	Manager of Biodiversity and Extensions, Botanic Gardens and Parks Authority.
Bob Elkins	Technical Assistant, Botanic Gardens and Parks Authority.

Thanks also to the staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information. Thanks also to DEC's Species and Communities Branch and the private land holders who provided information and assistance in locating populations in the field.

Cover photograph by Rebecca Evans.

CITATION

This IRP should be cited as:

Department of Environment and Conservation (2008) Wundowlin Wattle (*Acacia sciophanes*) Interim Recovery Plan 2008-2013. Interim Recovery Plan No. 247. Department of Environment and Conservation, Western Australia.

SUMMARY

Scientific Name:	***Acacia sciophanes***	**Common Name:**	Wundowlin Wattle
Family:	Mimosaceae	**Flowering Period:**	Periodic: observed flowering in all seasons
DEC Region:	Wheatbelt	**DEC District:**	Yilgarn
Shire:	Mukinbudin	**Recovery Team:**	Yilgarn District Threatened Flora Recovery Team (YDTFRT)
NRM Region:	Avon		

Illustrations and/or further information: Atkins, K. (2008) *Declared Rare and Priority Flora List for Western Australia.* Department of Environment and Conservation, 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; Department of Environment and Conservation (2007) *Western Australian Herbarium FloraBase 2 – Information on the Western Australian Flora* (Accessed 2007) Department of Environment and Conservation, Western Australia. http://www.calm.wa.gov.au/science/; Maslin, B. R. (1977) Studies in the genus *Acacia* (Mimosaceae) No. 6 - Miscellany. *Nuytsia* **2(3)**: 145-161.

Analysis of outputs and effectiveness of *Acacia sciophanes* IRP 77 (2000-2003) prepared by Rebecca Evans, Robyn Luu (nee Phillimore) and Andrew Brown:

The criteria for failure in the previous plan (the number of individuals in populations and/or the number of populations have decreased by 10% or more over the term of the plan) has been met, as the number of known plants has decreased from 858 to 484, a decrease of 44% in numbers of mature plants.

The reduction in the number of mature plants is believed to be due to senescence and poor recruitment resulting from a lack of suitable soil disturbance, such as fire stimulating germination of soil stored seed.

Actions recommended in the previous plan that have been implemented include:

Action 11 Promotion of awareness. A two-sided poster has been distributed to relevant authorities, schools, libraries and other institutions. Maps of population locations have been provided to the Shire of Mukinbudin.

Although not a listed recovery action in the previous plan, research into the biology and ecology of *Acacia sciophanes* has provided important information on reproductive phenology, soil seed bank dynamics, seed dispersal mechanisms, conditions necessary for germination, the role of disturbance in germination, inter and intra-species genetic diversity, minimum viable population size and evolutionary affiliations.

Other recovery actions included in the previous plan are ongoing and are included in this revised plan.

New recovery actions included in this plan are:

Action 10	Seek security of tenure for subpopulations
Action 12	Map habitat critical to the survival of *Acacia sciophanes*
Action 14	Rehabilitate habitat
Action 15	Obtain biological and ecological information

Current status: *Acacia sciophanes* was declared as Rare Flora in 1995 under the Western Australian *Wildlife Conservation Act 1950* and currently meets ranking criteria for Critically Endangered (CR) under IUCN (2001) Red List criterion B1ab(iii,v)+2ab(iii,v), due to its area of occupancy being less than 10 km^2, severe fragmentation and a continuing decline in the number of mature individuals. *Acacia sciophanes* is listed as Endangered (EN) under the *Environment Protection Biodiversity Conservation Act, 1999* (EPBC Act). The main threats are road, rail and firebreak maintenance, grazing, gravel extraction, weeds, inappropriate fire regimes and poor recruitment.

Description: *Acacia sciophanes* is a diffuse, openly branched, wispy shrub to 4 m tall, dividing near ground level, or up to 0.6 m above, into a number of main trunks with pendulous, zig-zagging *branches* which are mostly circular in cross-section, and slightly resinous. The *phyllodes* are coarsely thread-like, 90-150 mm long, and 1-2 mm wide and may or may not be curved, spreading, and very slightly resinous, slightly laterally compressed, having four prominent ribs alternating with equally prominent grooves and have a hooked apex. *Flowers* are simple globular and bright yellow, numbering twenty five to thirty one, on stalks that are 5-6 mm long with one to two inflorescences per axil. Flowering occurs from late September to November, flowering has however been recorded in all seasons. The *seed pods* are linear up to 100 mm long, 1-2 mm wide and are circular in cross-section, sometimes twisted, and the margins are slightly contracted between the seeds (Maslin 1977).

Acacia sciophanes is closely related to *Acacia anfractuosa* with the two species sharing a distinctive wispy growth habit, drooping zigzag branches and a similar inflorescence and seed pod. However, they are easily separated by their phyllode characteristics. *A. sciophanes* has phyllodes which are circular to quadrangular in cross-section as a result of the longitudinal ribs. *A. anfractuosa* has phyllodes which are flat to diamond shaped in cross-section, with three to seven nerves on each face (Maslin 1977).

Habitat requirements: *Acacia sciophanes* occurs on deep, gravelly yellow sands overlying laterite in vegetation dominated by *Allocasuarina campestris*, *Allocasuarina corniculata*, *Acacia neurophylla* and hummock grassland associations.

Habitat critical to the survival of the species, and important populations: Given that *Acacia sciophanes* is ranked as CR, it is considered that all known habitat for wild populations is critical to the survival of the species, and that all wild populations are important populations. Habitat critical to the survival of *A. sciophanes* includes the area of occupancy of the populations, areas of similar habitat (i.e. deep, gravelly yellow sands overlying laterite) surrounding and linking populations (these providing potential habitat for pollinators and ant guilds that disperse seed) additional occurrences of similar habitat that may contain undiscovered populations of the species or be suitable for future translocations and the local catchment for the surface and/or groundwater that maintains the habitat of the species.

Benefits to other species or ecological communities: Recovery actions implemented to improve the quality or security of the habitat of *Acacia sciophanes* will also improve the status of remnant vegetation in which it is located. Notably vegetation dominated by *Allocasuarina campestris*, *A. corniculata*, *Acacia neurophylla* and hummock grassland associations. Additionally, a Priority 4 species *Acacia merrickiae* occurs in association with *A. sciophanes*.

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. *Acacia sciophanes* is not listed under any specific international treaty and this IRP does not affect Australia's obligations under any other international agreements.

Role and interests of indigenous people: According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register, no known Aboriginal sites of significance occur within or in close proximity to known populations of *Acacia sciophanes*. The involvement of the Indigenous community is currently being sought to determine if there are any indigenous issues identified in the Plan. If no role is identified for indigenous communities in the recovery of this species, opportunities may exist through cultural interpretation and awareness of the species.

The advice of the South West Aboriginal Land and Sea Council (SWALSC) and Department of Indigenous Affairs is being sought to assist in the identification of potential indigenous management responsibilities for land occupied by threatened species, or groups with a cultural connection to land that is important for the species' conservation.

Continued liaison between DEC and the indigenous community will identify areas in which collaboration will assist implementation of recovery actions.

Social and economic impacts: The implementation of this recovery plan is unlikely to cause significant adverse social and economic impact. However, as *Acacia sciophanes* Subpopulations 2b and 2c occur on private property the protection of the species at these sites may potentially affect development and asset protection measures. Recovery actions refer to continued liaison between stakeholders with regard to populations located on private property.

Affected interests: The implementation of this plan has some implications for land managers, particularly where populations occur on lands not specifically managed for conservation. The occurrence of *Acacia sciophanes* populations on private property will have implications for the property owners. Where it occurs on road reserves under the care, control and management of Main Roads Western Australia (MRWA) and the Shire of Muckinbudin, the authoritys' will be required to ensure protection of those populations. Where a population occurs on a rail reserve under the care, control and management of the Public Transport Authority, the Authority will be required to ensure protection of that population. Where a population occurs at a pump station the Water Corporation will be required to ensure protection of that population. Where populations occur in Conservation Estate, DEC, as the managing authority will be required to protect populations from threatening processes and potential damage from management practices such as prescribed burning and track maintenance. Recovery actions refer to continued liaison between stakeholders with regard to all of these areas.

Evaluation of the Plan's Performance: DEC in conjunction with the Yilgarn District Threatened Flora Recovery Team will evaluate the performance of this IRP. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following four years of implementation.

Completed Recovery Actions

1. Land managers including private land owners, Main Roads WA, WestNet Rail, Water Corporation and Shires with populations or parts of populations on their property have been made aware of the threatened nature of this species, its location and their legal obligations to protect it.
2. Declared Rare Flora (DRF) markers have been installed at subpopulations 1a, b and d.
3. Subpopulation 1a has been fenced.
4. Dashboard stickers and posters that illustrate DRF markers and describe their purpose have been produced and distributed.
5. An A4 sized poster that provides a description of the species and information about threats and recovery actions, has been produced and distributed.
6. A reply paid postage drop describing the species and its habitat has been distributed by DEC Yilgarn District staff to local farmers and other residents in the Shires of Mukinbudin, Beacon and Bencubbin.
7. DEC's Threatened Flora Seed Centre (TFSC) has 2,610 seeds in storage.
8. The Botanic Gardens and Parks Authority (BGPA) has 3.3g of seed in storage.
9. A report has been published on the conservation biology of six *Acacia* species, including *Acacia sciophanes*.
10. DEC's Science Division provided academic support for Marcelle Buist to complete her PhD titled: "Comparative ecology and conservation biology of two critically endangered *Acacias* (*Acacia lobulata* and *A. sciophanes*) and two common, widespread relatives (*Acacia verricula* and *Acacia anfractuosa*) from the south-west of Western Australia". Preliminary conclusions were published in 2002 (Buist *et al.* 2002).
11. DEC Yilgarn District staff fenced groups of *Acacia sciophanes* plants that have the potential to be damaged by WestNet Rail activities.

Ongoing and future recovery actions

1. The YDTFRT is overseeing the implementation of this IRP and will include it in its annual report to DEC's Corporate Executive and funding bodies.
2. Staff from DEC's Yilgarn District office are monitoring all populations.

IRP Objective: The objective of this IRP is to abate identified threats and maintain viable *in situ* populations to ensure the long-term preservation of the species in the wild.

Recovery Criteria
Criteria for success: The number of populations have increased and/or the number of mature individuals in populations have increased by ten percent or more over the term of the plan.
Criteria for failure: The number of populations have decreased and/or the number of mature individuals in populations have decreased by ten percent or more over the term of the plan.

Recovery actions

1. Coordinate recovery actions
2. Liaise with relevant land managers and Indigenous groups
3. Monitor populations
4. Develop and implement fire and disturbance trials
5. Develop and implement a fire management strategy
6. Undertake weed control
7. Collect seed and other material to preserve genetic diversity
8. Install DRF markers
9. Fence populations
10. Seek security of tenure for subpopulations
11. Undertake and monitor translocation, if required
12. Promote awareness
13. Map habitat critical to the survival of *Acacia sciophanes*
14. Conduct further surveys
15. Rehabilitate habitat
16. Review this plan and assess the need for further recovery actions

1. BACKGROUND

Analysis of outputs and effectiveness of *Acacia sciophanes* IRP 77 (2000-2003) prepared by Rebecca Evans, Robyn Luu (nee Phillimore) and Andrew Brown:

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History

Acacia sciophanes was first collected by Charles Gardner and William Blackwell in 1931. Bruce Maslin made further collections in 1975 and named the species in 1977.

Collections held by the Western Australian Herbarium indicate the species has historically had a marginally wider distribution than now. In 1931 Charles Gardner collected *Acacia sciophanes* from a location west of Welbungin, approximately 8 km further west than its current known distribution. In 1989 and again in 1998 Bruce Maslin collected specimens from a location 18 km south west of Mukinbudin. This appears to be a new population extending the species distribution south by approximately 8 km.

Frans Mollemans conducted surveys of *Acacia sciophanes* in 1990 and, at that time, accurately mapped subpopulations 1a and b, including the location of most individual plants. He also investigated a second site several kilometres south of the original population at which time he found no *A. sciophanes*. However, a survey of the same site in 1998 by DEC staff from Science Division, found a new population (Population 2).

Acacia sciophanes is currently known from two populations (7 subpopulations) in DEC's Yilgarn District that together comprise 454 plants. Approximately 75% of the vegetation in this area has been cleared for agriculture (Beeston *et al.* 1996).

Description

Acacia sciophanes is a diffuse, openly branched, wispy shrub to 4 m tall that divides near ground level or to 0.6 m above into a number of main stems with pendulous, zig-zagging branches which are mostly circular in cross-section, and slightly resinous. The phyllodes are coarsely thread-like, 90-150 mm long by 1-2 mm wide, and

may or may not be curved, spreading, and very slightly resinous. They are slightly laterally compressed, having four prominent ribs alternating with equally prominent grooves, and have a hooked apex. Flowers are simple globular and bright yellow numbering 25 to 31, occurring on stalks that are 5-6 mm long with one to two inflorescences per axil. Flowering occurs predominantly from late September to November but is recorded from all seasons. The seed pods are linear up to 100 mm long by 1 to 2 mm wide and are circular in cross-section, sometimes twisted with the margins slightly contracted between the seeds (Maslin 1977; Mollemans *et al.* 1993; Yates *et al.* 2000).

Acacia sciophanes is closely related to *A. anfractuosa* with the two species sharing the same distinctive wispy growth habit, drooping zigzag branches and similar inflorescences and seed pods. However, they are easily separated by their phyllode characteristics. *A. sciophanes* has phyllodes which are circular to quadrangular in cross-section as a result of longitudinal ribs. *A. anfractuosa* has phyllodes which are flat to diamond shaped in cross-section, with three to seven nerves on each face (Buist 2003).

Although adult plants in Population 2 have branchlets with a less 'zigzag' appearance (M. Buist personal communication) they have been verified as *Acacia sciophanes* by taxonomic and genetic analysis (D. Coates personal communication).

Distribution and habitat

Acacia sciophanes is confined to the Shire of Mukinbudin in the central eastern wheatbelt of Western Australia.

Habitat is deep, gravelly yellow sands overlying laterite in vegetation dominated by *Allocasuarina campestris*, *A. corniculata*, *Acacia neurophylla* and hummock grassland associations. No tall stratum vegetation is associated with *A. sciophanes* (Buist 2003; Yates *et al.* 2000).

Table 1. Summary of population land vesting, purpose and tenure

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager
1a NE of Bencubbin	Yilgarn	Mukinbudin	Public Transport Authority	Rail Reserve	Public Transport Authority
1b NE of Bencubbin	Yilgarn	Mukinbudin	Main Roads WA	Road Reserve	Main Roads WA
1c NE of Bencubbin	Yilgarn	Mukinbudin	Conservation Commission of WA	Conservation of flora and fauna	DEC
1d NE of Bencubbin	Yilgarn	Mukinbudin	Unvested Reserve	Road Reserve	Shire of Mukinbudin
2a W of Mukinbudin	Yilgarn	Mukinbudin	Water Corporation	Pump station	Water Corporation
2b W of Mukinbudin	Yilgarn	Mukinbudin	Freehold	Private property	Landholders
2c W of Mukinbudin	Yilgarn	Mukinbudin	Freehold	Private property	Landholders

Populations in **bold text** are considered to be Important Populations.

Biology and ecology

Acacia sciophanes possesses a persistent seed bank and regenerates from seed following wildfire. Yates *et al.* (2000) and Buist (2003) concluded that *A. sciophanes* had a much greater density of seed in soil seed banks beneath reproductive adult plants compared to *A. anfractuosa* with 5.8 times the mean number of seeds per m^2. However, *A. sciophanes* seed had a narrower range of temperature tolerance and exposure time to fire required to break dormancy compared to the more widely spread *A. anfractuosa*. This resulted in lower rates of germination. The highest rates of germination occurred following low intensity burns with temperatures of 80 to 100ºC (Buist 2003). The even age of extant populations of *A. sciophanes* indicated that synchronous germination occurred immediately following disturbance events. This makes the species vulnerable to frequent fires, as the plant requires time to reach maturity and replenish soil stored seed stocks. Although some germination also occurred in unburnt environments, plants had a lower rate of survival. In long unburnt areas populations declined as older plants senesced (Buist 2003).

Using heat or scarification for germination under laboratory conditions, up to 93% germination can be achieved from seed. The seed has been stored for one year under standard conditions, with optimum temperature for germination found to be 25ºC (Yates *et al.* 2000).

In *ex-situ* trials the germination and seedling growth of *Acacia sciophanes* was unaffected by soil type. In the establishment phase *A. sciophanes* grew taller than *Acacia anfractuosa* and this, together with rapid germination, provided *A. sciophanes* with the ability to compete for resources (Buist 2003).

Based on observations made by Yilgarn District staff, *Acacia sciophanes* flowers at any time of the year when conditions are suitable. Immature legumes have been recorded between August and November and dehisced fruit between June and August.

Acacia sciophanes exhibits greater fruit set than *A. anfractuosa* with 3.4% of *A. sciophanes* flowers developing into fruiting bodies. Seeds of *A. sciophanes* were also more viable than the more widespread *A. anfractuosa*. Little difference in rates of fruit and seed predation was observed between *A. anfractuosa* and *A. sciophanes* indicating that reproduction in *A. sciophanes* is not inhibited by predation of seed or fruit (Buist 2003).

It is not known if *Acacia sciophanes* is restricted by climatic tolerances, but it was found to occupy a habitat envelope in which rainfall is more predictable than that of its closest relative *A. anfractuosa*. *A. sciophanes* does not appear to be restricted by landform characteristics such as soil chemistry, composition and water balance. However, a slight preference for flat habitats was observed for *A. sciophanes* in comparison to *A. anfractuosa*, which prefers gently sloping environments (Buist 2003).

Buist (2003) concluded that *Acacia sciophanes* seed was dispersed over short distances by ants. The persistence of *A. sciophanes* may therefore be dependant on meeting the ecological requirements of the ant guilds associated with the species. No single species of ant taxon has been identified as having a symbiotic relationship with *A. sciophanes*.

As for most other *Acacia* species it is thought that *A. sciophanes* is insect pollinated, but there are currently no supportive field observations. Pollination is quite successful with plants producing prolific viable fruit and seed (Buist 2003).

Initial testing on ten *Acacia sciophanes* seedlings by staff from DEC's Science Division indicates the species is moderately susceptible to dieback (*Phytophthora cinnamomi)* disease.

The evolutionary affiliations of *Acacia sciophanes* using Restriction Fragment Length Polymorphisms (RFLP) in chloroplast DNA has been investigated and concluded that both *Acacia anfractuosa* and *A. sciophanes* show similar degrees of recent evolutionary divergence from *A. heteroneura* (Byrne *et al*. 2001). *A. anfractuosa* has a widespread distribution within central and south-eastern parts of the South West land division, while *A. sciophanes* has a localized distribution on the north-western edge of the more widely distributed *A. anfractuosa*. The distributions of the two species do not overlap and are separated by approximately 50 km (Maslin 1977; Byrne *et al.* 2001).

Yates *et al.* (2000), using four polymorphic allozyme loci to estimate mating system and pollination biology of *Acacia sciophanes* and *A. anfractuosa*, concluded that both species exhibit significant levels of inbreeding in both single and multiple loci out-crossing rate estimations.

When measured using thirteen enzyme systems on fifteen allozyme loci, *Acacia sciophanes* exhibited lower genetic diversity than its closest relative *A. anfractuosa* [expected panmictic heterozygosity (He) for *A. sciophanes* = 0.340, He for *A. anfractuosa* = 0.421]. Low levels of genetic diversity may have a long-term effect on the species persistence (Yates *et al.* 2000) but *A. sciophanes* currently does not exhibit the effects of small population size such as reduced seed set and reduced seed viability (Buist 2003). However, comparisons of gene diversity estimates between *A. sciophanes* and a range of other Australian endemics suggest that this level of genetic diversity is comparable or higher than in many other species including widespread species with similar mating systems such as *Daviesia suaveolens* (He=0.32) and *A. anomala* (He=0.209) (Yates *et al.* 2000).

Threats

Acacia sciophanes was declared as Rare Flora in 1995 under the Western Australian *Wildlife Conservation Act 1950* and currently meets ranking criteria for Critically Endangered (CR) under World Conservation Union (IUCN 2001) Red List criterion B1ab(iii,v)+2ab(iii,v), due to its area of occupancy being less than 10 km^2,

severe fragmentation and a continuing decline in the number of mature individuals. *A. sciophanes* is listed as Endangered (EN) under the *Environment Protection Biodiversity Conservation Act, 1999* (EPBC Act). The main threats are road, rail and firebreak maintenance, grazing, gravel extraction, weeds, inappropriate fire regimes and poor recruitment.

- **Road, rail and firebreak maintenance** threatens both populations. Threats include grading, drain construction and maintenance, and mowing roadside vegetation. Apart from causing direct damage to plants, such activities also encourage weed invasion. Relevant authorities have been informed of population locations so that appropriate protective measures can be implemented.
- **Grazing** by rabbits, kangaroos and livestock is a minor problem. Grazing can potentially be damaging during seedling development. Trampling and weed invasion are secondary effects of animal movement in areas inhabited by the species.
- **Future gravel extraction** is a threat to Subpopulation 2a as the removal of topsoil prevents natural regeneration. Gravel extraction has been a threat to the population in previous years. The Shire has been formally notified of the presence of *Acacia sciophanes* in case of further gravel extraction.
- **Weed invasion,** particularly on road and rail reserves, threatens both populations. Weeds suppress early plant growth through competition for resources and increased grazing pressure. Weeds also generate high fuel loads that increase the frequency and intensity of fire.
- **Inappropriate fire regimes** would affect the long-term viability of both populations. Adult plants of *Acacia sciophanes* are killed by fire, with regeneration relying on the germination of soil-stored seed. The soil seed bank would be rapidly depleted if fires recurred before plants reached maturity. An appropriate fire regime (every 10 to 20 years) is required for populations to successfully recruit from soil-stored seed. Low intensity burns of 80 to 100ºC are recommended due to *A. sciophanes* having a narrow tolerance to fire temperature and exposure time, resulting in low germination rates outside these tolerance limits (Buist 2003).
- **Poor recruitment** is believed to be due to a lack of disturbance (e.g. fire). It threatens both populations of *Acacia sciophanes* with very few young healthy plants being observed.

The intent of this plan is to provide actions that will deal with immediate threats to *Acacia sciophanes*. Although climate change may have a long-term effect on the species, actions taken directly to prevent the impact of climate change are beyond the scope of this plan.

Table 2. Summary of population information and threats

Pop. No. & Location	Land Status	Year/No. plants		Condition	Threats
1a. NE of Bencubbin	Rail Reserve	1990	14*	Moderate	Inappropriate fire, weeds, railway maintenance, poor recruitment
		1994	7		
		1996	150		
		1998	150 [5]*		
		1999	150		
		2000	98		
		2003	113		
1b. NE of Bencubbin	Road Reserve	1990	14*	Healthy	Inappropriate fire, road maintenance and, spoon drain maintenance, poor recruitment
		1991	10		
		1994	3 (3)		
		2004	3		
		2006	3		
1c. NE of Bencubbin	Nature Reserve	1994	50	Moderate	Inappropriate fire, weeds, firebreak maintenance, poor recruitment
		1998	150 [5]*		
		1999	402		
		2003	106 (2) [12]		
1d. NE of Bencubbin	Road Reserve	1994	50	Moderate	Inappropriate fire, weeds, road maintenance, poor recruitment
		2000	123 [1]		
		2003	52 (1) [9]		
2a. W of Mukinbudin	Pump Station	1998	30	Disturbed and modified	Inappropriate fire, weeds, firebreak maintenance, poor recruitment
		1999	180 [30]*		
2b. W of Mukinbudin	Private Property	1999	180 [30]*	Moderate	Poor recruitment, weeds, inappropriate fire, firebreak maintenance, grazing
		2000	65		
2c. W of Mukinbudin	Private Property	1999	180 [30]*	Moderate	Poor recruitment, weeds, inappropriate fire, firebreak maintenance, grazing
		1999	115		

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

Guide for decision-makers

Section 1 provides details of current and possible future threats. Developments and/or land clearing in the immediate vicinity of *Acacia sciophanes* populations require assessment. Developments or clearing should not be approved unless the proponents can demonstrate that their actions will have no significant impact on the species, its habitat or potential habitat or on the local surface hydrology, such that drainage in the habitat of the species would be altered.

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

Given that *Acacia sciophanes* is ranked as CR, it is considered that all known habitat for wild populations is critical to the survival of the species, and that all wild populations are important populations. Habitat critical to the survival of *A. sciophanes* includes the area of occupancy of the populations, areas of similar habitat (i.e. deep, gravelly yellow sands overlying laterite) surrounding and linking populations (these providing potential habitat for pollinators and ant guilds that disperse seed) additional occurrences of similar habitat that may contain undiscovered populations of the species or be suitable for future translocations and the local catchment for the surface and/or groundwater that maintains the habitat of the species.

Benefits to other species or ecological communities

Recovery actions implemented to improve the quality or security of the habitat of *Acacia sciophanes* will also improve the status of associated native vegetation dominated by *Allocasuarina campestris*, *A. corniculata*, *Acacia neurophylla* and hummock grassland associations (Buist 2003). A Priority species that is located within the vicinity of *A. sciophanes* populations is listed in the table below:

Conservation-listed flora species occurring in habitat of *Acacia sciophanes*

Species name	Conservation Status (Western Australia)	Conservation Status (EPBC Act, 1999)
Acacia merrickiae	Priority 4	Not listed

For a description of the Priority categories see Atkins (2006).

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. *Acacia sciophanes* is not listed under any specific international treaty and this IRP does not affect Australia's obligations under any other international agreements.

Indigenous consultation

According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register, no known Aboriginal sites of significance occur within or in close proximity to known populations of *Acacia sciophanes*. The involvement of the Indigenous community is currently being sought to determine if there are any indigenous issues identified in the Plan. If no role is identified for indigenous communities in the recovery of this species, opportunities may exist through cultural interpretation and awareness of the species.

The advice of the South West Aboriginal Land and Sea Council (SWALSC) and Department of Indigenous Affairs is being sought to assist in the identification of potential indigenous management responsibilities for land occupied by threatened species, or groups with a cultural connection to land that is important for the species' conservation.

Continued liaison between DEC and the indigenous community will identify areas in which collaboration will assist implementation of recovery actions.

Social and economic impacts

The implementation of this recovery plan is unlikely to cause significant adverse social and economic impact. However, as *Acacia sciophanes* Subpopulations 2b and 2c occur on private property the protection of the species at these sites may potentially affect development and asset protection measures. Recovery actions refer to continued liaison between stakeholders with regard to populations located on private property.

Affected interests

The implementation of this plan has some implications for land managers, particularly where populations occur on lands not specifically managed for conservation. The occurrence of *Acacia sciophanes* populations on private property will have implications for the property owners. Where it occurs on road reserves under the care, control and management of Main Roads Western Australia (MRWA) and the Shire of Muckinbudin, the authoritys' will be required to ensure protection of those populations. Where a population occurs on a rail reserve under the care, control and management of the Public Transport Authority, the Authority will be required to ensure protection of that population. Where a population occurs at a pump station the Water Corporation will be required to ensure protection of that population. Where populations occur in Conservation Estate, DEC, as the managing authority will be required to protect populations from threatening processes and potential damage from management practices such as prescribed burning and track maintenance. Recovery actions refer to continued liaison between stakeholders with regard to all of these areas.

Evaluation of the Plan's Performance

DEC, in conjunction with the Yilgarn District Threatened Flora Recovery Team (YDTFRT), will evaluate the performance of this IRP. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following four years of implementation.

2. RECOVERY OBJECTIVE AND CRITERIA

Objective

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

Criteria for success: The number of populations have increased and/or the number of individuals within populations have increased by ten percent or more over the term of the plan.
Criteria for failure: The number of populations have decreased and/or the number of individuals within populations have decreased by ten percent or more over the term of the plan.

3. RECOVERY ACTIONS

Completed recovery actions

Land managers, including private landowners, the Shire of Mukinbudin, WestNet Rail, Water Corporation and MainRoads WA have been made aware of the threatened nature of the species, its location and their legal obligations to protect it.

Declared Rare Flora (DRF) markers have been installed at Subpopulations 1a, 1b and 1d.

In 2000, fencing was extended along a rail reserve to include additional plants in Population 1a that were discovered during routine monitoring.

Dashboard stickers and an A4 sized poster that provides a description of the species and information about threats and recovery actions, have been produced and distributed. It is hoped that the poster will result in the discovery of new populations.

A reply paid postal drop, illustrating *Acacia sciophanes* and describing its distinctive features and habitat has been distributed by DEC Yilgarn District staff to local farmers and other residents in the Shires of Mukinbudin,

Beacon and Bencubbin. Postal drops aim to provide information about threatened species and a contact name and number if new populations are found.

Some 2,610 seeds that were collected in January 1996 are stored in DEC's Threatened Flora Seed Centre (TFSC). The Botanic Gardens and Parks Authority (BGPA) has 3.3g of seed from *Acacia sciophanes* collected in 1999/2000.

In 1999 staff from DEC's, Science Division, funded through the Natural Heritage Trust (NHT), conducted research on the conservation biology of six *Acacia* species, one of which was *A. sciophanes*. A report on this research was produced in 2000 (Yates *et al.* 2000). Specific aspects covered in the report include soil seed bank dynamics and the role of disturbance, competition and rainfall on recruitment and seedling survival, reproductive strategies, phenology and seasonal growth, pollination biology, population genetic structure, levels of genetic diversity and minimum viable population size, impact and control of diseases and invasive weeds and *ex-situ* conservation strategies such as propagation protocols and germplasm storage techniques.

DEC's Science Division provided academic support for Marcelle Buist to complete her PhD titled: "*Comparative ecology and conservation biology of two critically endangered Acacias (Acacia lobulata and A. sciophanes) and two common, widespread relatives (Acacia verricula and A. anfractuosa) from the south-west of Western Australia*." Preliminary conclusions were published in 2002 (Buist *et al.* 2002). This research has improved the biological and ecological understanding of *A. sciophanes.*

Subpopulation 1a and adjacent subpopulations are threatened by ongoing rail maintenance. CALM staff began negotiations with WestNet Rail in 1996 and has fenced groups of plants that have the potential to be damaged by WestNet Rail activities.

Ongoing and future recovery actions

The YDTFRT will oversee the implementation of this IRP and will include information on progress in their annual report to DEC's Corporate Executive and funding bodies.

Staff from DEC's Yilgarn District Office regularly monitor both known populations.

Where populations occur on lands other than those managed by DEC, permission has been or will be sought from appropriate owners/land managers prior to recovery actions being undertaken. The following recovery actions are generally in order of descending priority, influenced by their timing over the life of the plan. However this should not constrain addressing any of the actions if funding is available and other opportunities arise.

1. Coordinate recovery actions

The YDTFRT will coordinate recovery actions for *Acacia sciophanes* and other DRF in the Yilgarn District. They will include information on progress in their annual report to DEC's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: DEC (Yilgarn District) through the YDTFRT
Cost: $1,400 per year

2. Liaise with relevant land managers and Indigenous groups

As a number of subpopulations occur on lands that are not managed by DEC, close liaison with land managers is essential. Input and involvement will also be sought from any Noongar groups that have an active interest in areas that are habitat for the species.

Action: Liaise with relevant land managers and Indigenous groups
Responsibility: DEC (Yilgarn District) through the YDTFRT
Cost: $800 per year

3. Monitor populations

The status of the populations will be checked through regular monitoring of threats and counting the number of mature individuals. Factors such as weed densities, habitat degradation, fence integrity, population stability (expansion or decline), pollination activity, seed production, recruitment and longevity will need to be monitored. The visibility of the DRF markers will also be monitored and maintenance will be conducted when required.

Action: Monitor populations
Responsibility: DEC (Yilgarn District) through the YDTFRT
Cost: $800 per year

4. Develop and implement fire and disturbance trials

DEC Yilgarn District will, in consultation with private landowners, the Shire of Mukinbudin, Water Corporation, MainRoads WA and Public Transport Authority, will develop and implement burn and disturbance trials to stimulate the germination of soil stored seed and induce population recruitment. Care will be taken to avoid competition with existing *Acacia sciophanes* plants. The results of trials will be monitored and, if successful, a larger scale operation undertaken. Attention will be given to the following to ensure maximum recruitment but at the same time maintaining the integrity of the extant population:

- burn several discrete dead plants
- rake the soil below and near dead plants

Action: Develop and implement fire and disturbance trials
Responsibility: DEC (Science Division, Yilgarn District) through the YDTFRT and relevant authorities
Cost: $3,400 in years 1, 3 and 5

5. Develop and implement a fire management strategy

Since 2000 the number of mature *Acacia sciophanes* plants has decreased by 44 percent due to a lack of recruitment. As *A. sciophanes* is believed to be a disturbance opportunist that is killed by fire but regenerates from soil stored seed, an inappropriate fire regime (lack of fire or too frequent fire) may result in a further reduction of plants and little or no recruitment. A fire management strategy will therefore be developed for the species, including recommendations on fire frequency, intensity and season, precautions to prevent and react to uncontrolled wildfire, and the method of construction and maintenance of firebreaks.

Action: Develop and implement a fire management strategy
Responsibility: DEC (Yilgarn District) through the YDTFRT and relevant authorities
Cost: $2,500 in year 1 and $900 in subsequent years

6. Undertake weed control

Weeds are a major threat to both known populations, especially where they extend onto rail and road reserves. The following actions will be implemented:

1. Select appropriate herbicides after determining which weeds are present.
2. Control invasive weeds by hand removal or spot spraying around *Acacia sciophanes* plants when weeds first emerge.
3. Schedule weed control to include spraying other threatened flora populations within the district.

The tolerance of associated native plant species to herbicides at the site of *Acacia sciophanes* is not known and weed control programs will be undertaken in conjunction with appropriate research.

Action: Undertake weed control

Responsibility: DEC (Yilgarn District, DEC's Science Division) through the YDTFRT
Cost: $1,200 per year

7. Collect seed and other material to preserve genetic diversity

Seed has been collected from Population 1 by staff from DEC's TFSC and the BGPA, with additional collections needing to be made from Population 2. Collections need to give consideration to holding material in a variety of forms, including seed storage, living collections and tissue culture. These collections should aim to sample and preserve the maximum range of genetic diversity possible (which should be determined by an appropriate molecular technique such as genetic fingerprinting if feasible). The "Germplasm Conservation Guidelines for Australia", as produced by the Australian Network for Plant Conservation (ANPC), should be used to guide this process (ANPC 1997).

Actions: Collect seed and other material to preserve genetic diversity
Responsibility: DEC (Yilgarn District, TFSC), and BGPA through the YDTFRT
Cost: $3,800 in years 1, 3 and 5

8. Install DRF markers

Declared Rare Flora (DRF) markers are required at Subpopulation 2a.

Action: Install DRF Markers
Responsibility: DEC (Yilgarn District) through the YDTFRT
Cost: $200 in year 1

9. Fence populations

Although it appears unlikely that plants at Subpopulations 2b and 2c are currently being grazed, the area should be fenced to exclude stock and, in the case of Subpopulation 2c, the area of occupancy should be marked to prevent damage from possible future gravel extraction.

Action: Fence populations
Responsibility: DEC (Yilgarn District) through the YDTFRT
Cost: $1,400 in year 1

10. Seek security of tenure for Subpopulations

The conservation status of land that supports Subpopulations 2b and c will be reviewed and the possibility of purchase and/or a change of land tenure investigated. Protecting important populations on private land through conservation covenants or registration with the Land for Wildlife or Bush Forever schemes will also be investigated. This action will secure habitat on which *Acacia sciophanes* can be managed and promote conditions that will result in an increase in the size and health of subpopulations.

Action: Seek security of tenure for Subpopulations
Responsibility: DEC (Yilgarn District) through the YDTFRT
Cost: $1,900 in year 1, $400 in subsequent years

11. Undertake and monitor translocations, if required

The distribution and number of populations of *Acacia sciophanes* is limited. In addition, most populations are located on land not managed for conservation. Translocations will need to be considered for the conservation of this species. This approach will require the development of a translocation proposal and selection of suitable translocation sites. Normal protocols involve the propagation of material prior to planting out in accordance with an approved Translocation Proposal. Information on the translocation of threatened plants and animals in the wild is provided in the Department's Policy Statement No. 29 *Translocation of Threatened Flora and Fauna*. All translocation proposals require endorsement by the Department's Director of Nature Conservation.

Monitoring of the translocation is essential and will be undertaken according to the timetable developed for the Translocation Proposal.

Action: Undertake and monitor translocation, if required
Responsibility: DEC (Science Division, Yilgarn District) through the YDTFRT
Cost: $36,000 in the fourth year and $2,000 in the fifth year

12. Promote awareness

An A4 sized information sheet, that provides a description of the species and information about threats and recovery actions, has been developed for *Acacia sciophanes*. It is hoped that the poster will result in discovery of new populations. In conjunction with this, a publicity campaign has also been run to increase local community awareness of the species. Formal links with local naturalist groups and interested individuals should also be encouraged. DEC's Yilgarn District will deliver an A1 and five A4 sized maps containing the road names and approximate locations of Declared Rare Flora (including *Acacia sciophanes*) to the Shire of Mukinbudin's Chief Executive Officer and Road Works Supervisor.

It is recommended that the exact location of *Acacia sciophanes* be kept from the general public. Such information should, however, be given to relevant landowners, Shire staff and government authorities.

Action: Promote awareness
Responsibility: DEC (Yilgarn District, Species and Communities Branch (SCB) and Strategic Development and Corporate Affairs Division) through the YDTFRT
Cost: $1,600 in year 1, $1,000 in years 3 and 5

13. Map habitat critical to the survival of *Acacia sciophanes*

It is a requirement of the EPBC Act that spatial data relating to habitat that is critical to the survival of threatened species be determined. Although habitat critical to the survival of the species is alluded to in Section 1, the areas described have not been fully mapped and this 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 *Acacia sciophanes*
Responsibility: DEC (Yilgarn District) through the YDTFRT
Cost: $2,500 in year 1

14. Conduct further surveys

Populations of *Acacia sciophanes* will be resurveyed to ascertain accurate boundaries and ensure that no plants have been missed during previous surveys. This will be done during the species main flowering period between August and November, with assistance from local naturalists and volunteers. A survey of Subpopulations 2a and c were last conducted in 1999 and Subpopulation 2b in 2000. Follow up surveys of these subpopulations are required.

It is suggested that surveys of existing populations be done in conjunction with surveying other possible areas of suitable habitat within the shire and should include appropriate habitat on private land.

Action: Conduct further surveys
Responsibility: DEC (Yilgarn District) through the YDTFRT
Cost: $2,400 in years 1, 3 and 5

15. Rehabilitate habitat

The gravel pit at Subpopulation 2c should be rehabilitated in order to provide a buffer area, habitat for pollinators and seed dispersing ant guilds and habitat in which a translocation of *Acacia sciophanes* and other locally threatened flora may take place.

Action: Rehabilitate habitat
Responsibility: DEC (Yilgarn District) through the YDTFRT
Cost: $13,400 in year 2, $6,700 in year 3

16. Review this plan and assess the need for further recovery actions

If *Acacia sciophanes* is still ranked Critically Endangered at the end of the five-year term of this IRP, a review will be undertaken and a revised plan prepared if necessary.

Action: Review this plan and assess the need for further recovery actions
Responsibility: DEC (SCB, Yilgarn District) through the YDTFRT
Cost: $1,500 in year 4

Summary of recovery actions

Recovery Actions	Priority	Responsibility	Completion date
Coordinate recovery actions	High	YDTFRT	Ongoing
Liaise with relevant land managers and Indigenous groups	High	DEC (Yilgarn Districts), through the YDTFRT	Ongoing
Monitor populations	High	DEC (Yilgarn District) through the YDTFRT	Ongoing
Develop and implement fire and disturbance trials	High	DEC (Science Division, Yilgarn District) through the YDTFRT and relevant authorities	2013
Develop and implement a fire management strategy	High	DEC (Yilgarn District) through the YDTFRT and relevant authorities	Develop by 2009 with implementation ongoing
Undertake weed control	Medium	DEC (Yilgarn District, Science Division) through the YDTFRT	Ongoing
Collect seed and other material to preserve genetic diversity	Medium	DEC (Yilgarn District, TFSC), and BGPA through the YDTFRT	2013
Install DRF markers	Medium	DEC (Yilgarn District) through the YDTFRT	2009
Fence populations	Medium	DEC (Yilgarn District) through the YDTFRT	2009
Seek security of tenure for subpopulations	Medium	DEC (Science Division, Yilgarn District) through the YDTFRT	2013
Undertake and monitor translocations, if required	Medium	DEC (Science Division, Yilgarn District) through the YDTFRT	2013
Promote awareness	Medium	DEC (Yilgarn District, Species and Communities Branch (SCB) and Strategic Development and Corporate Affairs Division) through the YDTFRT	Ongoing
Map habitat critical to the survival of *Acacia sciophanes*	Medium	DEC (Yilgarn District) through the YDTFRT	2009
Conduct further surveys	Medium	DEC (Yilgarn District) through the YDTFRT	Ongoing
Rehabilitate habitat	Medium	DEC (Yilgarn District) through the YDTFRT	Ongoing
Review this plan and assess the need for further recovery actions	Medium	DEC (SCB, Yilgarn District) through the YDTFRT	2013

4. TERM OF PLAN

Western Australia

This IRP will operate from April 2008 to March 2013 but will remain in force until withdrawn or replaced. If *Acacia sciophanes* is still ranked CR after five years, this IRP will be reviewed and, if necessary, further recovery actions put in place.

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.

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6. TAXONOMIC DESCRIPTION

Excerpt from: Maslin, B. R. (1977) Studies in the genus Acacia (Mimosaceae) No. 6 - Miscellany. *Nuytsia* **2(3)**: 145-161.

Shrub diffuse, openly branched, wispy to 2.3 m tall, dividing near ground level (or to 0.6 m above) into a number of main trunks; *bark* light grey, smooth but finely fissured at extreme base of trunk; *branches* mostly pendulous, flexuous, terete (but ribbed towards apex), slightly resinous, glabrous to strigillose, light brown towards apex but red-brown with a light grey peeling epidermis with age. *Stipules* caducous. *Phyllodes* coarsely filiform, 90-150 mm long, 1-2 mm wide, ± curved, spreading, very slightly resinous, slightly laterally compressed, prominently 4-ribbed (ribs alternating with 4 equally prominent grooves), ribs yellowish and glabrous, grooves concave subglaucous and glabrous or strigillose; *apex* straight or uncinate, not pungent, brown; *pulvinus* 1-2 mm long, obscurely wrinkled, glabrescent. *Gland* situated on upper rib of phyllode 1-2 mm above pulvinus, lamina tissue slightly swollen around gland, orifice distinct (oblong, ± 0.5 mm long), lip indistinct. *Inflorescences* simple, normally arising from near base of new shoot, 1-2 per axil; *peduncles* 5-6 mm long, slightly longitudinally sulcate (when dry), glabrous, or strigose at base, resinous; *basal peduncular bracts* caducous, solitary, ± triangular, ± 1 mm long; *receptacles* slightly obloid, glabrous; *flower heads* bright yellow, globular, with 25-31 ± loosely arranged flowers. *Bracteoles* ca. 0.5 mm long (= calyx in length); *claws* linear; *laminae* ovate, puberulous, slightly keeled. *Flower heads* 5-merous, slightly resinous; calyx 1/4 length of corolla, very shallowly divided (for ca. 1/6 its length) into broadly triangular ciliolate lobes, tube sparsely puberulous and nerveless; *petals* 2-2.5 mm long, connate for ± 2/3 their length, not reflexed at anthesis, glabrous, very obscurely 1-nerved; *ovary* very shortly stipitate, densely tomentose. *Legumes* linear, to 100 mm long, 1-2 mm wide, ± terete, sometimes twisted, firmly chartaceous, silvery-strigillose; *margins* slightly contracted between seeds (indentations shallowly concave); *marginal nerves* scarcely thickened, broad, glabrous, yellowish. *Seeds* longitudinal in legume, obloid to ellipsoid, 3-3.5 x 1.5 mm, slightly compressed, mottled, a dark brown line extending around periphery, slightly shiny; *pleurogram* ‘u’- to ‘v’-shaped, open towards the hilum, obscure; *areole* 0.3- 0.4 mm long; *funicle* convoluted, expanded into a pileiform white *aril*.