INTERIM RECOVERY PLAN NO. 107

Plant assemblages of the Inering System

Interim Recovery Plan

2002-2007

Sheila Hamilton-Brown

Photograph: Sheila Hamilton-Brown

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Western Australian Threatened Species and Communities Unit
Department of Conservation and Land Management
PO Box 51. Wanneroo 6946.

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) 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.

The Department is committed to ensuring that Critically Endangered, and where appropriate and feasible, other threatened ecological communities are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans. The Department will also ensure that conservation action commences as soon as possible and always within three years of endorsement of Vulnerable rank by the Minister for the Environment.

This IRP will operate from May 2002 to May 2007 but will remain in force until withdrawn or replaced.

The provision of funds identified in this IRP is dependent on budgetary and other constraints affecting the Department, as well as the need to address other priorities.

Information in this IRP was accurate at 7 September 2001.

SUMMARY

Name: Plant assemblages of the Inering System.

Description: Plant assemblages of the Inering System (Beard 1976): *Allocasuarina campestris* scrub over chert and granite hills; *Allocasuarina campestris* thicket with scattered *Acacia acuminata* and *Allocasuarina huegeliana* over brown sandy loam over stoney and lateritic summits and slopes; *Acacia* sp. mixed low woodland on red/brown sandy loam over granite on summits and slopes; *Melaleuca cardiophylla* thicket with scattered *Eucalyptus loxophleba* and *Eucalyptus salmonophloia* over granite on the lower slopes and foothills; and *Eucalyptus loxophleba* woodland over clay loam on the foothills.

IBRA Bioregion: Geraldton Sandplains

Region: Midwest Region

District: Moora

Shire(s): Carnamah and Three Springs

Recovery Team: Moora District Threatened Flora Recovery Team

Current status: Assessed by the Western Australian Threatened Ecological Communities' Scientific Committee on 18 September 2000 as Vulnerable. The ranking was endorsed by the Minister for the Environment on 6 November 2001.

Critical Habitat: The area of occupancy of the occurrences corresponding to the Archaean-granite complex of hills as expressed in the hill ranges 2.5 km south west of Carnamah north to Three Springs.

IRP Objective(s): To maintain the overall health of the community and reduce the level of threat to ensure the community does not move to the Endangered category.

Criteria for success: Maintenance of the diversity and composition of the native species in the community and of the full range of the remaining occurrences.

Criteria for failure: An increased level of modification of the occurrences of the community as measured by a further decline in the diversity and composition of the native species.

Summary of Recovery Actions

1. Map the components of each plant assemblage	6. Design and implement weed control strategy
2. Liaise with current owners and managers to fence occurrences	7. Design and apply appropriate fire management plans
3. Monitor the extent and boundaries of the community	8. Obtain biological and ecological information on the community
4. Design and implement a program for flora monitoring	9. Seek to acquire the larger occurrences for the conservation estate when available
5. Implement replanting and rehabilitation, and link remnants	

1 BACKGROUND

History, defining characteristics of ecological community, and conservation significance

The Inering System comprises a group of hills – stretching from Carnamah to Three Springs - with a particular series of plant assemblages recurring in a catenary sequence linked to topographic, pedological and/or geological features. The plant community on these hills is different from other plant communities found on other Systems (eg. Billeranga and Koolanooka Systems); and comprise *Allocasuarina campestris* scrub over chert and granite hills; *Allocasuarina campestris* thicket with scattered *Acacia acuminata* and *Allocasuarina huegeliana* over brown sandy loam over stoney and lateritic summits and slopes; *Acacia* spp. (*A. acuminata, A. tetragonophylla* and *A. neurophylla*) mixed low woodland on red/brown sandy loam over granite on summits and slopes; *Melaleuca cardiophylla* thicket with scattered *Eucalyptus loxophleba* and *Eucalyptus salmonophloia* over granite on the lower slopes and foothills; and *Eucalyptus loxophleba* woodland over clay loam on the foothills (Beard 1976).

There is very little information on the plant community itself, let alone the species associated with each plant assemblage. Most Botanists tended only to record information from Woondadying hill – the southern-most occurrence. More recently, Orsini and Lewis (1992) recorded the vegetation of many hills of the Inering hill range (now highly fragmented); and mapped most of the occurrences as *Allocasuarina campestris, Hakea recurva, Grevillea paniculata, Acacia acuminata* and *Acacia tetragonophylla* low woodland/scrub; these species are the least palatable to sheep. Neither they nor the author found the *Melaleuca filifolia – Allocasuarina campestris* assemblage on Proterozoic Noondine chert as reported by Beard (1976).

The Inering System is known to contain taxa that are listed as Priority (Department of Conservation and Land Management 2000): *Scholtzia* sp. Prowaka Springs (P1) which is in need of urgent survey to clarify its status and taxonomy (L. Polomka, personal communication[1]), *Epitriche demissus* (P2) and *Acacia nodiflora* (P3) which are very restricted in distribution and not under immediate threat, and *Wurmbea drummondii* (P4) which is secure but requires monitoring.

Description of occurrences

Beard's Inering System originally comprised 4 occurrences: Inering hills, a 10 km long range approximately 12 km north of Carnamah; Woondadying Hill, 5 km immediately south west of Carnamah; and two other hill ranges (~2-4 km long) just north of Woondadying Hill. All are fragmented into numerous smaller occurrences (Table 1).

All the occurrences are privately owned, most are not fenced and are immediately surrounded by agricultural land or border sealed or unsealed roads. Current or potential threatening processes include fragmentation, grazing, weed invasion and/or inappropriate fire regimes. Threats to the *Eucalyptus loxophleba* woodland assemblage over clay loam on the foothills of occurrences 1 and 11 also include waterlogging and salinisation.

Critical Habitat

Critical habitat is habitat identified as being critical to the survival of a listed threatened species or listed threatened ecological community. Habitat is defined as the biophysical medium or media (a) occupied (continuously, periodically or occasionally) by an organism or group of organisms; or (b) once occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind that the potential to be reintroduced (sections 207A and 528 of Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)).

[1] Lesley Polomka – Priority Flora Project Officer, Department of Conservation and Land Management.

Table 1: Summary of occurrence information and threats

Original range (and area)	Occ.	Area (ha)	Modification	Threats
Inering (1331 ha)	1	185.7	Slight to moderate	Grazing, weed invasion, inappropriate fire regimes, salinisation and water-logging
	2	15.7	Moderate	Clearing, grazing, weed invasion and/or inappropriate fire regimes
	3	31	High	Grazing, weed invasion, inappropriate fire regimes
	4	14.5	High	Grazing, weed invasion
	5	5.3	High	Grazing, weed invasion, inappropriate fire regimes
	6	10.2	High	Grazing, weed invasion, inappropriate fire regimes
	7	5.6	High	Fragmentation, grazing, weed invasion
	8	8.2	Moderate	Grazing, weed invasion, inappropriate fire regimes
	9	14	High	Grazing, weed invasion, inappropriate fire regimes
	10	9	Moderate to High	Grazing, weed invasion, inappropriate fire regimes
	11	52	Slight to moderate	Grazing, weed invasion, inappropriate fire regimes, salinisation and waterlogging
	12	7.9	High	Grazing, weed invasion, inappropriate fire regimes
	13	51.3	Insignificant to Slight	Grazing, weed invasion, inappropriate fire regimes
	14	2.7	High	Fragmentation, grazing, weed invasion, inappropriate fire regimes
	15	51.7	Moderate	Grazing, weed invasion, inappropriate fire regimes
	16	13.7	-	Fragmentation
	17	9.6	-	Fragmentation
	18	4.4	Moderate	Fragmentation, grazing, weed invasion
	19	0.8	-	Fragmentation
	20	2.5	Slight	Fragmentation, grazing, weed invasion
	21	1.7	-	Fragmentation
	22	5.7	Slight	Grazing
		Total = 503.2 ha		
Range 2 (244.7 ha)	23	4.3	Moderate	Fragmentation, grazing, weed invasion, inappropriate fire regimes
	24	49.7	High	Fragmentation, grazing, weed invasion, inappropriate fire regimes
	25	5.8	-	Fragmentation
		Total = 59.8 ha		
Range 3 (253 ha)	26	5.5	-	Fragmentation, grazing, weed invasion
Woondadying (346.8 ha)	27	85	-	Weed invasion

The critical habitat for the plant assemblage of the Inering System comprises the area of occupancy of the occurrences corresponding to the Archaean-granite complex of hills as expressed in the hill range 2.5 km south west of Carnamah northwards to Three Springs and encompasses:

- Proterozoic chert and granite hills
- brown sandy loam over stoney and lateritic summits and slopes
- red/brown sandy loam over granite on summits and slopes
- granite on lower slopes and foothills
- clay loam on foothills.

Biological and ecological characteristics

Important factors affecting community composition and structure are aspect, soil/substrate types and depths, fire history and moisture regimes. There has been no study of any of these aspects of the community's ecological needs.

Threatening processes

It is estimated that thirty per cent of the Inering System remains and that most of the remaining remnants have been modified. It is presumed that a number of species have disappeared from the community. Threatening processes include:

Fragmentation

Remnants with large edge to area ratios coupled with high levels of degradation and large distances between remnants are unlikely to remain viable in the future (Odum 1971) as intact representations of the TEC. Some occurrences are in danger of fragmentation; whereas others are already fragmented. For the latter, management must address issues such as linking these remnants or maintaining them as modified versions of the original assemblages.

Grazing

On current information, only part of occurrence 1 is fenced; and most of the rest are grazed by sheep, which has caused alterations to the species composition by the selective grazing of edible species, the introduction of weeds and nutrients, trampling and general disturbance.

Weed invasion

Weeds can have significant impacts on a community through competition with the native species, prevention of regeneration and alteration of fire regimes (Hobbs and Mooney 1993). Combined disturbances such as fires and grazing can predispose areas to weed invasion if weed propagules are present. All occurrences of this community are adjacent to agricultural areas that act as weed sources, and are vulnerable to weed invasion following any disturbance.

Altered fire regimes

Fire can cause alterations to the species composition by increasing the number of weeds. As well, an increase in the frequency of fire can prevent species from completing growth and reproductive cycles.

Salinisation and waterlogging/inundation

Increase in salinity levels and inundation is occurring over many of the low lying areas of the WA wheatbelt and is a major threat to remnant biological diversity. These processes are likely to destroy many of the key elements of the *Eucalyptus loxophleba* woodland over clay loam assemblage.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Developments in the immediate vicinity of the occurrences require assessment. No developments should be approved unless the proponents can demonstrate that they will have no significant impact on the ecological community.

Current status

The 'Plant assemblages of the Inering System' community meets the following criteria for Vulnerable (VU):

> *(C) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.*

Recovery strategy

In close liaison with landowners, devise recovery actions for all occurrences, and promote and assist their conservation.

To conduct appropriate research into the ecology of the community to develop further understanding about the management actions required to maintain or improve its condition.

2 RECOVERY AIM AND CRITERIA

Aim

- To improve the long term security of the plant community by protecting and maintaining the known occurrences, and reducing the level of threat so that the community will not move into a higher category of threat.

Criteria for success

- Improvement in the condition of known occurrences of the community measured by a reduction in grazing pressure, weed invasion and inappropriate fire regime by encouraging landholders to fence occurrences, reduce grazing where necessary, and implement weed control strategies and fire management plans.

Criterion for failure

- Significant sustained and/or increased level of modification of the occurrences of the community as measured by a decline in the diversity and composition of the native species and increase in weed diversity or extent.

3 RECOVERY ACTIONS

All land managers and the Yarra Yarra Catchment Group have been notified of the importance of the TEC. Their cooperation will be sought to ensure that on-farm activities do not affect the occurrences. As well, permission and cooperation will be sought from land managers prior to any recovery actions being taken.

3.1 Existing Recovery Actions

The Moora District Threatened Flora Recovery Team (MTFRT) is the recovery team for this ecological community and is responsible for overseeing Recovery Actions. The Recovery Team will continue to report annually to the Department's Corporate Executive.

3.2 Required Recovery Actions

The following recovery actions are roughly in order of descending priority. However this should not constrain addressing any of the 'lower' priorities if the opportunity arises.

3.2.1 Map the components of each plant assemblage

A vegetation map (with comprehensive species lists) of all the plant assemblages associated with the Inering System should be produced using aerial photography and ground survey. The outcome may be used to identify assemblages and prioritise actions. This information will be added to the Department's Threatened Ecological Communities (TEC) database as recommended in English and Blyth (1999).

Responsibility: WATSCU and Moora District through the MTFRT
Estimated cost: $10,000
Completion date: Year 2.

3.2.2 Liaise with current owners and managers to fence occurrences

Liaise with landowners and seek to fence occurrences to ensure stock is excluded and vehicle access can be limited to management needs, but also take into account any recreational needs. This may include seeking funds on behalf of the landowners. At the same time, landowners should be encouraged to seek long-term protection of the community through covenants or management agreements.

Responsibility: WATSCU and Moora District through the MTFRT
Estimated cost: $1,000
Completion date: Year 5.

3.2.3 Monitor the extent and boundaries of the community

The extent and condition of known occurrences should be determined and monitored. The boundary of the occurrences should be monitored regularly (approximately every 2 years or immediately after a disturbance event such as fire) and can be defined from aerial photographs and annual ground-truthing. This information will be added to the TEC database.

Responsibility: WATSCU and Moora District through the MTFRT
Estimated cost: $3,000 for the establishment of baseline information, $1,000 for subsequent monitoring
Completion date: On-going.

3.2.4 Design and implement a program for flora monitoring

Data collected will include plant species diversity and weed levels. Occurrences will be monitored yearly to provide information on condition, with emphasis on the fragmented occurrences. The program should include baseline data from erecting quadrats, and taking photopoints and photoplots annually (Elzinga *et al*. 2001). This information will be added to the TEC database.

Responsibility: WATSCU and Moora District through the MTFRT

Estimated cost: $1000 per year
Completion date: On-going.

3.2.5 Implement replanting and rehabilitation, and link remnants

Seek to replant and rehabilitate the occurrences for areas already devoid of species (eg. edges, heavily stocked areas, and areas subjected to weed control). At the same time, encourage landowners (via the catchment group) to replant areas beyond the current TEC boundaries to link up smaller remnants. This may include seeking funds on behalf of the landowners. The appropriate species can be identified from proposed quadrat data (recovery action 3.2.4). These should then be propagated from seed collections taken from the community. If there is a significant risk of depleting seed bank reserves within the community, seed should be sought from nearby areas.

Responsibility: WATSCU and Moora District through the MTFRT in liaison with landowners and Yarra Yarra Catchment
Estimated cost: All parties to determine costs
Completion date: On-going.

3.2.6 Design and implement weed control strategy

A weed control strategy is required that takes into account the nature of the community and the need for continuing maintenance. The weed control program should include:

1. Determining which weeds and native species are present (recovery action 3.2.4).
2. The selection of the appropriate herbicide and establishing priorities for treatment
3. The control of invasive weeds by hand or spot spraying as soon as the weeds emerge.

Responsibility: WATSCU and Moora District through the MTFRT
Estimated cost: WATSCU and Moora District to determine costs
Completion date: On-going.

3.2.7 Design and apply appropriate fire management plans

A fire management plan should be developed with landowners and the relevant authorities. The plan should deal with issues such as knowledge of the recovery of the community and its component species from fire (derived from information in recovery action 3.2.8); minimising wildfires; the need for, design and position of firebreaks/fire-fighting access tracks; and fire management including the need for and design of prescribed fire and fire suppression. The plan should include an annual fire monitoring and reporting schedule.

Responsibility: Moora District through the MTFRT in conjunction with landowners
Estimated cost: Moora District to determine costs
Completion date: Ongoing.

3.2.8 Obtain biological and ecological information on the community

Research designed to increase an understanding of the biology of the community will provide a scientific base for management. Research will include:

1. Fire ecology
2. Soil seed bank dynamics and the role of various factors (disturbance, competition, rainfall and grazing) in recruitment and seedling survival.
3. Seed germination requirements.
4. Response to herbicide treatments.

5. Response to trampling.

Responsibility: WATSCU and Moora District through the MTFRT in liaison with Science Division
Estimated cost: All parties to determine costs
Completion date: On-going.

3.2.9 Seek to acquire the larger occurrences for the conservation estate when available

To secure the long-term recovery of this community, the Department should seek funds for the purchase, and negotiate with the landowners to acquire the larger occurrences, in particular occurrence 1, if and when it becomes available. It should then be declared a Class A reserve for the purpose of 'Conservation of Flora and Fauna' and vested in the Conservation Commission.

Responsibility: WATSCU, Moora District and Land Administration Section
Estimated cost: Negotiate costs on a market/valuation basis.

4 TERM OF PLAN

This Interim Recovery Plan (IRP) will operate from May 2002 for five years but will remain in force until withdrawn or replaced.

5 ACKNOWLEDGMENTS

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

John Blyth	Acting Manager, WATSCU, Department of Conservation and Land Management
Ross Bowman	Pruaka Springs Pty Ltd, Carnamah
Andrew Brown	Botanist, WATSCU, Department of Conservation and Land Management
Fiona Falconer	Land for Wildlife Officer, Coorow
Jim Lane	Landowner, Three Springs
Max and Fiona Levett	Landowners, Carnamah
Alfred Niven	Landowner, Carnamah

6 REFERENCES

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Appendix 1: List of species found on occurrences of the Inering System (NB: List is not exhaustive)

Species	**Occurrences**																										
	1	**2***	**3***	**4**	**5***	**6***	**7***	**8***	**9***	**10***	**11**	**12**	**13**	**14**	**15**	**16**	**17***	**18***	**19***	**20***	**21***	**22***	**23**	**24**	**~~25~~**	**~~26~~**	**27***
Acacia acuminata subsp. *acuminata*	√	√	√	√	√	√	√	√	√	√	√	√			√	√		√	√	√	√		√	√			√
Acacia anthochaera	√																										
Acacia assimilis subsp. *assimilis*	√																						√				
Acacia erinacea	√										√												√	√			
Acacia latipes subsp. *latipes*	√																										
Acacia ligustrina											√																
Acacia nigripilosa subsp. *nigripilosa*	√																										
Acacia nodiflora	√					√							√				√			√		√					
Acacia restiacea	√																						√				
Acacia stereophylla var. *stereophylla*																							√				
Acacia tetragonophylla	√	√	√	√	√	√	√	√	√	√	√	√	√			√			√				√	√			√
Allocasuarina campestris	√							√	√	√	√		√		√	√	√	√	√	√		√	√	√			
Allocasuarina huegeliana													√														
Astroloma serratifolium	√												√														
Borya sphaerocephala	√										√		√														√
Burchardia umbellata	√																										
Caladenia hirta subsp. rosea																											√
Calytrix depressa				√																							
Cephalipterum drummondii																							√				
Comesperma scoparium	√																										
Cryptandra arbutiflora var. *borealis*													√										√				
Cyanicula gemmata																											√
Dianella revoluta													√														
Diuris laxiflora																											√
Dodonaea inaequifolia	√										√																

Dryandra fraseri																											
Epitriche demissus	√																										
Eremophila decipiens subsp. *decipiens*																						√					
Eremophila oldfieldii subsp. *oldfieldii*											√																
Eucalyptus eudesmioides subsp. *eudesmioides*																						√					
Eucalyptus ewartiana																						√					
Eucalyptus loxophleba	√										√		√			√		√	√	√				√			
Eucalyptus salmonophloia																	√										
Eucalyptus salubris																	√										
Glycine canescens													√														
Grevillea hakeoides subsp. *stenophylla*	√																										
Grevillea paniculata	√	√	√		√			√	√	√	√		√	√		√		√			√	√					
Hakea invaginata	√																										
Hakea lissocarpha																											√
Hakea recurva		√	√		√	√	√	√	√	√	√	√	√	√		√							√	√			
Hakea scoparia																						√					
Hybanthus floribundus subsp. *floribundus*													√														
Kennedia coccinea	√																										
Lawrencella rosea	√																										
Melaleuca cardiophylla																√	√	√		√		√					
Melaleuca cordata																						√					
Melaleuca coronicarpa											√																
Melaleuca eleuterostachya											√											√					
Melaleuca fulgens subsp. *steedmanii*	√																	√									
Melaleuca longistaminea subsp. *longistaminea*													√														
Melaleuca radula											√					√											
Melaleuca uncinata		√									√			√	√	√	√	√			√	√					
Pityrodia dilatata	√																										
Podolepis capillaris	√																										

Ptilotus obovatus var. *obovatus*											√																
Santalum acuminatum																						√					
Santalum spicatum													√														
Scaevola spinescens	√										√		√														
Scholtzia leptantha	√																										
Senna artemisioides											√		√														
Stylobasium australe	√																										
Thelymitra antennifera																											√
Trymalium daphnifolium	√																										
Wurmbea drummondii																											√

* from Orsini and Lewis (1992) or roadside survey

Summary of costs for each Recovery Action

Recovery action	Year 1	2	3	4	5
Map the components of each plant assemblage	$10000		-	-	-
Liaise with current owners and managers to fence occurrences					$1000
Monitor the extent and boundaries of the community	$3000	-	$1000	-	$1000
Design and implement a program for flora monitoring	$1000	$1000	$1000	$1000	$1000
Implement replanting and rehabilitation, and link remnants	*	*	*	*	*
Design and implement weed control strategy	*	*	*	*	*
Design and apply appropriate fire management plans	*	*	*	*	*
Obtain biological and ecological information on the community	*	*	*	*	*
Seek to acquire the larger occurrences for the conservation estate when available	Market/valuation basis				

* Moora District Threatened Flora Recovery Team to calculate costs and obtain funding