INTERIM RECOVERY PLAN NO. 61

SHRUBLANDS AND WOODLANDS ON PERTH TO GINGIN IRONSTONE

INTERIM RECOVERY PLAN 2000 2003

by

Val English and John Blyth

Photo: Val English

January 2000

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

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

Natural Heritage Trust
Helping Communities Helping Australia

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 Critically Endangered ecological communities are conserved through the preparation and implementation of Recovery Plans or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible and always within one year of endorsement of that rank by CALM's Director of Nature Conservation.

This Interim Recovery Plan will operate from 31 January 2000 but will remain in force until withdrawn or replaced. It is intended that, if the ecological community is still ranked Critically Endangered, this IRP will be replaced by a full Recovery Plan after three years.

The 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 January 2000.

SUMMARY

Name: Shrublands and woodlands on Perth to Gingin ironstone

Description: Plant community located on seasonally inundated ironstone and heavy clay soils. The community occurs on the eastern side of the Swan Coastal Plain. Typical and common native species are the shrubs *Melaleuca viminea*, *Dryandra sessilis, Acacia saligna, Grevillea curviloba* subsp. *incurva, Kunzea* aff. *recurva, Jacksonia furcellata* and the herbs *Rhodanthe manglesii, Tribonanthes australis* and *Isotropis cuneifolia* subsp. *glabra*. The following exotic species are also currently common: *Romulea rosea, Briza maxima, Trifolium dubium, Spergula arvensis* and *Hesperanthura falcata*.

CALM Region: Swan

CALM District: Perth

Shire: Gingin

Recovery Team: To be established jointly with that for the Critically Endangered Muchea Limestone community. Proposed membership: landholder, CALM Perth District (chair), CALMScience, WATSCU, planning officer - Shire of Gingin, Fire and Rescue Service. The Recovery Team will report annually to CALM's Corporate Executive.

Current status: Assessed 21 November 1995 as Critically Endangered.

Habitat requirements: The community is located on skeletal soils developed over massive ironstones and undergoes seasonal inundation with fresh water. Many of the plant species present are specifically adapted to this shallow seasonal inundation. Specifically, the herb layer, which is a major distinguishing characteristic of this community, probably would not occur in late winter and early spring without inundation in winter. This daisy dominated herb layer would probably not occur in deeper soils either, as species that reproduce by means other than annual seed production may have a competitive advantage.

IRP Objective: To maintain or improve the overall condition of the wetlands and the associated plant community in the known locations and reduce the level of threat, with the aim of reclassifying it from Critically Endangered to Endangered.

Criteria for success:

- An increase in the area and number of occurrences of this community under conservation management.
- Maintenance in terms of diversity and basic composition of native species as well as hydrological and biological processes, taking account of natural change of the community over time.
- Improvement in terms of reduction of numbers of exotic species and of other threatening processes as defined in this document.

Criterion for failure: Significant loss of area or further modification of occurrences of the threatened ecological community.

Recovery Actions:

1. Establish Recovery Team	9. Install markers
2. Clarify and monitor boundaries	10. Implement weed control
3. Liaise with landholder	11. Monitor flora
4. Fence occurrences	12. Monitor weed populations
5. Access funding incentives for conservation	13. Replant / rehabilitate
6. Seek to purchase community and buffer	14. Assess hydrological information
7. Develop Fire Management Plan	15. Conduct research
8. Implement Fire Management Plans, implement dieback hygiene	16. Inspect for dieback
	17. Report on management strategies

1. BACKGROUND

1.1 History, defining characteristics of ecological community, conservation significance and status

Ironstone soils are extremely restricted in distribution on the Swan Coastal Plain. These soils may have been historically associated with bogs - the iron being deposited by water percolating through the soil (H. Smolinsky[1],personal communication). Restricted areas of ironstone soils associated with unusual plant communities occur in a number of areas in the southwest of Western Australia; near Kalbarri (A.P. Brown[2], personal communication.), near Eneabba (Griffin *et al.* 1983), at Gingin and Busselton (DEP 1996; Gibson *et al.* 1994) and in the Scott River area (N. Gibson and M. Lyons[3], personal communication.). Each of these areas contain plant communities that are characterised by different taxa.

The Perth to Gingin ironstone soil type occurs on the eastern side of the Swan Coastal Plain. This area contains heavy soils that are particularly useful for agricultural purposes and are around 97% cleared (Department of Conservation and Land Management (CALM) 1990; Keighery and Trudgen 1992). Churchward and McArthur (1980) mapped the Yanga fluviatile landform that contains these ironstone soils. The unit is described as "poorly drained plain with grey sandy benches and intervening swamps; also areas of bog iron ore, marl or solonetzic soils" (Churchward and McArthur 1980). The scale of mapping was 1:250,000, which is not sufficiently detailed to indicate the individual small areas of bog-ironstone on the Swan Coastal Plain.

On the 1:50,000 scale Urban/Environmental Geology series (Anon. 1976, 1977; Gozzard 1982) ironstone areas are noted as "bog-iron or iron-rich laterite" within the Guildford Formation, which consists mainly of alluvial clays. The original extent of the community is not known as boundaries of the soil type are not specified on these maps, but symbols occur where patches of the type occur. It is evident however, that the soil type is extremely restricted and that most of the original community has been cleared (B. Keighery and G. Keighery[4], personal communication; Gibson *et al.* 1994). Agriculture WA is completing additional geological mapping of the soils of the Gingin area (H. Smolinsky, personal communication). This may provide more information about the likely original extent of the community.

The Perth to Gingin ironstone soils are associated with shallow seasonal inundation with fresh water. This inundation could be by surface water that accumulates due to the impermeable nature of the ironstone and the associated heavy soils. In addition, groundwater may come very close to or reach the surface in the wetter months.

The plant community on these ironstone soils is the only one in the Perth area that is characterised by massed everlastings (*Rhodanthe* spp.) in the understorey (English *et al.* 1996). Floristic analyses of plots on this soil type link to 'herb rich shrublands in clay pans' (community type 8) as described by Gibson *et al*. (1994) - reflecting the clays in the soil (DEP 1996). Typical and common native species in the community are the shrubs *Kunzea* aff. *recurva, Grevillea curviloba* subsp. *incurva, Melaleuca viminea, Acacia saligna, Jacksonia furcellata, Grevillea obtusifolia* and *Dryandra sessilis* and the herbs *Rhodanthe manglesii, Tribonanthes australis* and *Isotropis cuneifolia* subsp. *glabra* ms. A full list of plant taxa from plots in Occurrence 1 is provided at Appendix 1.

One plant that occurs in this community (DEP 1996), *Grevillea curviloba* subsp. *incurva*, is listed as threatened (i.e. declared as rare flora under the *Wildlife Conservation Act 1950*) and one, *Isotropis cuneifolia* subsp. *glabra* ms) is a Priority 2 taxon (refer to the Glossary for definitions of Priority status). The

[1] Henry Smolinsky, Agriculture Western Australia, Locked Bag 4 Bentley Delivery Centre, WA 6983
[2] Andrew Brown, WA Threatened Species and Communities Unit, Department of Conservation and Land Management, PO Box 51, Wanneroo, WA 6065
[3] Neil Gibson and Mike Lyons, CALM**Science** Division, Department of Conservation and Land Management, PO Box 51, Wanneroo, WA 6065
[4] Bronwen Keighery, Department of Environmental Protection, 141 St Georges Terrace, Perth, WA 6000 and
Greg Keighery, CALM**Science** Division, Department of Conservation and Land Management, PO Box 51, Wanneroo, WA 6065

community contains the largest known population of the threatened *Grevillea* taxon (B. Keighery personal communication).

The species composition of the community is likely to have been altered by grazing, as the occurrences have been grazed by stock intermittently. It is not known to what extent fire has influenced the present structure or composition of the community. The grazing would almost certainly have increased the invasion of exotic species such as *Romulea rosea* and *Briza major* into the community.

The only occurrences of the community found were on private land adjacent to Airfield Road in the Shire of Gingin. The largest of these has been acquired with funding from the Commonwealth National Reserve System Program and the Western Australian Government and is now a nature reserve. Very small, degraded areas of the community occur on road verges in the Gingin area. All of the road side occurrences except the road side portion of Occurrence 1 (refer Table 1) are considered totally destroyed as few of the taxa that were likely to have inhabited the community remain, and occurrences have been severely invaded by weeds (Gibson *et al.* 1994; DEP 1996).

The major threats to the community are weed invasion, grazing, inappropriate fire regime, clearing, and possibly changes to hydrology such as salinisation and altered patterns of inundation. Dieback, caused by *Phytophthora* species, is not recorded from occurrences of the community, but may be present.

Table 1: Extent and location of occurrences

Occurrence Number	Location	Estimated area
Occurrence 1a	Nature reserve, Shire of Gingin	55 ha
Occurrence 1b	Road verge (contiguous with 1a)	Approximately 0.25 ha
Occurrence 2	Private property, Shire of Gingin	3 ha
Occurrence 3	Private property, Shire of Gingin	2 ha

1.2 Description of Occurrences

The ironstone community type as described by Gibson *et al.* (1994) and DEP (1996) was found on only one privately owned property, and adjoining road verge, in the Shire of Gingin. Three occurrences of the community occurred on this property, and much the largest, Occurrence 1a, has now been purchased by CALM and is gazetted as a nature reserve. Ironstone soils occur elsewhere in the vicinity of this occurrence, but are either totally cleared or support a community that has been so modified as to be considered totally destroyed (Gibson *et al.* 1994; DEP 1996).

Occurrence 1a consists of a shrubland dominated by *Kunzea* aff. *recurva* (swamp kunzea) and *Melaleuca viminea* over mixed herbs and low sedges (DEP 1996 - see Appendix 1 for species list). The herbs *Rhodanthe manglesii* (pink sunray) and *Tribonanthes australis* are noticeable in the herb layer in spring. Areas of *Banksia* woodland occur on sandy soils immediately adjacent to the western side of the occurrence. A creek line with pasture under remnant trees occurs in the north east, and pasture under remnant trees also occurs to the south. Occurrence 1a is now fenced on all sides. This occurrence appears to be located on the shallowest soils of all the known occurrences and is associated with the greatest dominance of daisies in the understorey.

Occurrence 1b is the extension of the same occurrence onto an adjacent road reserve. This road verge portion of Occurrence 1 has been slashed in recent years. Pasture-land occurs on the opposite side of the road.

Occurrence 2 is about a kilometre north of Occurrence 1. The shrub layer in both Occurrences 2 and 3 consists of a thicket dominated by *Kunzea* aff *recurva* and *Melaleuca viminea*. The herb layer in these two areas contains a similar suite of species as those in Occurrence 1. Occurrence 2 covers about two hectares of a 12 ha remnant. The remainder of the area is *Banksia* woodland and a densely wooded wetland. An electric fence surrounds the perimeter of the entire remnant, as the vegetation was recognised as significant by the owner. Some portions of this fence are in disrepair, however, and the area is apparently lightly grazed. Another sizeable remnant occurs to the south east. Pasture surrounds the remainder of the perimeter of the remnant.

Occurrence 3 is within a larger remnant that is surrounded by an electric fence and utilised as a bull paddock. The surrounding area consists of remnant trees over pasture. This occurrence is about 750 m south of the northern edge of Occurrence 1, and about 500 m east of that occurrence.

Data on all known occurrences of threatened ecological communities are held in the threatened ecological community database at CALM, kept at the Wildlife Research Centre, Woodvale.

1.3 Biological and ecological characteristics

The ironstone soils near Gingin are seasonally inundated (surface water in wetter months). Many of the plant species present are specifically adapted to this shallow seasonal inundation, eg., *Kunzea* aff. *recurva* (swamp kunzea). In particular, the herb layer, which is a major distinguishing characteristic of this community, probably would not occur in late winter and early spring, without the incidence of inundation in winter.

It is also likely that the daisy-dominated herb layer that occurs in spring would not occur in deeper soils, as species that reproduce by means other than annual seed production may have a competitive advantage (G. Keighery, personal communication). Indeed, the herb assemblages on the ironstone soils where the topsoil is deepest are not dominated by daisies, although daisies still occur (Occurrences 2 and 3; V. English, J. Blyth, L. Mutter,[5] personal observation).

1.4 Hydrology

Occurrences of the community are all located on the north Gnangara Mound, an unconfined groundwater aquifer. The height of the groundwater table is 60-70 metres above sea level (m AHD) where the community occurs. Occurrences are also located in a low point adjacent to a peak in the water mound (a 'col') and adjacent to a flow channel in the groundwater mound (Davidson 1995). Local hydrogeology is therefore likely to be very important in maintaining the community.

Long term observations (G. Keighery and B. Keighery; landholder, personal communication) indicate that seasonal inundation is limited to very shallow surface water during the winter months. Inundation usually persists for a period of around three months, with the soils drying out at the surface in summer. The surface waters may be linked to the water table as the groundwater is close to the surface in September - October (Davidson 1995). Surface water would also originate from rainfall runoff in the wetter months of the year and be retained by the impervious substrata of heavy soils and rock. If there are connections between the surface and groundwater through the ironstone, then both these sources would effect the quantity and quality of water on the surface of the site.

A trend of falling water tables in the general area is evident since around 1976 (Greay 1993). As there is a corresponding decline in annual rainfall this general fall in the water table may be presumed to be at least partly as a result of this decline. It is possible that draw-down of the superficial aquifer - the Gnangara Mound - could also have had an effect. The hydrology of specific areas of the eastern side of the Swan Coastal Plain has also been altered through the construction of drains to lower the water table (Keighery and Trudgen 1992). Conversely, the area is characterised by much valued heavy soils, which were historically highly cleared for agriculture, and for the Gingin Airfield immediately to the west. Clearing is likely to have

[5] V. English and J. Blyth, WA Threatened Species and Communities Unit, Department of Conservation and Land Management, PO Box 51, Wanneroo, WA 6065 and L. Mutter, Perth District, CALM, 5 Dundebar Road, Wanneroo, WA 6065

increased surface runoff and recharge of the groundwater in the local area. Despite a likely increase in recharge due to clearing, drainage has probably resulted in an overall lowering of the water table in localised areas (B. Keighery pers. comm.). Altered surface flow and/or alteration of the height of the local water table may change the length of the period or the depth of ponding.

The shallow groundwater in the vicinity has a salinity of around 250-500 milligrams per litre total dissolved solids (mg/L TDS) (Davidson 1995), which is quite fresh. Areas of fresh groundwater are generally associated with relatively low risk of salinisation on the Swan Coastal Plain (Davidson 1995). However, samphire, which is vegetation associated with saline areas, was recorded very close to Occurrence 2 (J. Blyth, N. Gibson, V. English, personal observation).

The Central Coast Regional Strategy (WA Planning Commission 1996) indicates there is unlikely to be significant urbanisation in the area due to the proximity to the airfield. Additional water table rise in the superficial aquifer or increased surface flows due to further clearing in the catchment therefore seem unlikely. This issue is discussed further under threatening processes.

1.5 Historical and current threatening processes

Clearing

Clearing for agriculture has been extensive on the heavy soils on the eastern side of the Swan Coastal Plain, with some 97% of all vegetation in the area cleared historically (Keighery and Trudgen 1992; CALM 1990). The vegetation on the ironstone soils near Perth occur on this portion of the plain and has suffered almost total destruction.

The largest remnant of the community (Occurrence 1), adjacent to Airfield Road, was apparently rolled and fertilised in 1969. However, the attempt to convert the area to more useable pasture was not successful as the soils were too shallow (landowner, personal communication).

Grazing

Grazing of the community is likely to have caused alterations to the species composition, by the selective grazing of edible species, the introduction of weeds and nutrients, trampling and general disturbance.

Occurrence 1 is currently grazed, but the shallow soils are not very productive. This has resulted in the area being only lightly grazed. Attempts have been made to fence the most northerly remnant (Occurrence 2) from stock. However, fencing was apparently difficult in the shallow soils, and the fencing was not replaced once penetrated by stock. Occurrence 3 is fenced within a larger area that is used as pasture and is currently lightly grazed as a bull-paddock (landowner, personal communication).

Altered fire regimes

Fire regimes are likely to have a significant effect on the vegetation composition in Mediterranean ecosystems (Gill *et al.* 1981). It is likely that the fire regime in the area has been modified since the introduction of grazing.

Mediterranean ecosystems are usually adapted to fire and indeed may require a particular fire regime to assist regeneration. If an appropriate fire frequency is exceeded, however, species that are obligate seeders may not have sufficient time to flower and produce seed. If the time between fires is too long, obligate seeders may senesce and be unable to regenerate. Therefore, fires must occur at appropriate intervals, and possibly at the appropriate season and intensity, to sustain the integrity of plant communities. As this community is not well studied, little is known of its requirements in terms of fire regime to maintain species composition.

The risk of frequent fire is generally increased by the presence of grassy weeds in the understorey, as they are likely to be more flammable than many of the original native species in the herb layer.

Weed invasion

Grazing alters species composition through increased nutrient levels and weed invasion. Other disturbances, such as fire and rolling of the vegetation also result in increased weed invasion. The pollution of the surface waters with droppings from stock is likely to cause increased nutrient levels and, hence to favour weed species, which are generally adapted to higher levels of nutrients than local species.

A weed control program would be necessary to maintain or improve the current condition of occurrences of the community in the long term. Panetta and Hopkins (1991) state that the aims of weed control are to maintain the pre-invasion condition of the habitat (prevention); control or arrest ongoing weed invasion (intervention); and reverse the degraded condition of the habitat where applicable (rehabilitation). A weed control program would involve the following steps (adapted from Panetta and Hopkins 1991):

1. Accurately mapping the boundaries of weed populations.
2. Selecting an appropriate herbicide or other method of weed control after determining which weeds are present.
3. Controlling weeds that pose the greatest threat to the community in the early stages of invasion where possible, eg, invasive perennial grasses, *Watsonia.*
4. Rehabilitation through reintroduction of local native species where areas are no longer capable of regenerating following weed control.

Hydrological changes

Increased clearing would be expected to result in increased runoff and an increase in recharge to the groundwater table, while on the other hand drainage of the area, and uncontrolled extraction from irrigation bores may lower groundwater levels, especially in summer. Altered periods or depths of ponding may impact the timing of growth of herbs in the understorey, and may also affect the species composition of the community by favouring different plant species.

Salinisation

Salinisation may pose a threat to this ironstone community as it occurs on very low-lying, seasonally inundated sites. Samphire, which is vegetation associated with saline areas, was recorded very close to Occurrence 2 (J. Blyth, N. Gibson, V. English, personal observation). It is not known if this is a result of natural salinity resulting from the annual drying out and concentration of small amounts of salt in rain water, or secondary salinity as a consequence of clearing in the catchment.

The levels of salinity in the community should be monitored to determine if salinisation poses a major threat to the community. Remedial actions such as replanting with deep rooted vegetation in strategic parts of the catchment may be necessary if monitoring indicates secondary salinisation is a problem.

Erosion by wind and water

Erosion by wind and water may also occur following removal of vegetation by clearing, grazing or fire, although it may not be significant for this community, which is located on heavy soils.

Disease introduction

It is not known if the community type is susceptible to dieback from *Phytophthora cinnamomi*, or other diseases. Another plant community that occurs on ironstone soils in the Busselton area (community 10b as identified by Gibson *et al*. 1994) is extremely susceptible to dieback, but the species composition of the two ironstone communities is very different. Risk of introduction of disease in this community should be minimised by ensuring good hygiene procedures. This would involve wash-down of any equipment used adjacent to the community, and restricting access by vehicles and machinery to dry soil conditions.

1.6 Conservation status

The community meets the criteria for Critically Endangered (CR) as follows (from English and Blyth 1997):

a (ii) the estimated total area and/or number of discrete occurrences have been reduced by at least 90% since European settlement and modification is continuing throughout its range such that in the immediate future the community is unlikely to be capable of being substantially rehabilitated (within approximately 5 years),

b (ii) current distribution is limited and there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes, and

c the ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 5 years).

1.7 Strategy for recovery

To identify, and influence the management of, the areas in which the community occurs, so maintaining natural biological and non-biological attributes of the sites and the current area covered by the community.

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

2. RECOVERY OBJECTIVE AND CRITERIA

2.1 Objective

To maintain or improve the overall condition of the wetlands and the associated plant community in the known locations and reduce the level of threat, with the aim of reclassifying it from Critically Endangered to Endangered.

2.2 Criteria for success

1. An increase in the area, and number of occurrences, of this community under conservation management.
2. Maintenance in terms of diversity and basic composition of native species (as described in DEP 1996) as well as hydrological and biological processes, taking account of natural change of the community over time.
3. Improvement in terms of reduction of numbers of exotic species and of other threatening processes as defined above.

2.2.2 Criterion for failure

Significant loss of area or further modification of occurrences of the threatened ecological community.

3. RECOVERY ACTIONS

Note: The responsible authority is frequently listed as the relevant CALM District. This refers largely to initiating and guiding actions. However, in general the relevant CALM District, the Western Australian Threatened Species and Communities Unit (WATSCU) and the Recovery Team share the primary responsibility for securing funds for recovery actions.

3.1 Establish a Recovery Team

To be established jointly with that for the Critically Endangered Muchea Limestone community. Proposed membership: landholder, CALM Perth District (chair), CALMScience, WATSCU, planning officer - Shire of Gingin, Fire and Rescue Service. The Recovery Team will report annually to CALM's Corporate Executive.

Responsibility: WATSCU
Cost: Nil

Completion date: Year 1

3.2 Clarify boundaries and condition of occurrences

Clarify the extent, and determine and compare the condition of the three known occurrences, as described in Table 1 above, and any other identified occurrences. The boundary of occurrences should be monitored every two years.

Responsibility: CALM (CALMScience Division, WATSCU, Perth District)
Cost: $200 every second year
Completion date: Initial survey completed August 1997 (N. Gibson, V. English and J. Blyth); monitoring ongoing

3.3 Liaise with landholder to determine appropriate ownership and management arrangements in the light of the results of survey under Action 3.2

Strategy includes liaison with the landholder to determine the next management actions. The most important action to arise from the liaison, the purchase of Occurrence 1 (see 3.4, 3.5 below), has been completed. Other matters still to be negotiated include upgrading the fence around the remnant that contains Occurrence 2, fencing the perimeter of Occurrence 3 and other actions as listed below (3.4 - 3.16).

Responsibility: CALM (Perth District; WATSCU)
Cost: Costs of all liaison $1,500 (vehicle costs not included)
Completion date: Liaison largely completed; see 3.5 to 3.16 for ensuing actions

3.4 CALM seek funds and seek to negotiate purchase of Occurrence 1

CALM to negotiate purchase of Occurrence 1 of the community (and appropriate buffer areas) and declare the area Class A reserve for the purpose of 'Conservation of Flora and Fauna' vested in the National Parks and Nature Conservation Authority (NPNCA).

Funding for two thirds of the purchase cost of Occurrence 1 was approved by Environment Australia's National Reserve System Program of the Natural Heritage Trust in November 1997. CALM provided the balance of the funds required.

Responsibility: CALM (Land Acquisitions Section; Perth District; WATSCU); Environment Australia
Cost: Market price of land at time of purchase
Completion date: Acquisition completed, February 1999

3.5 Upgrade fencing around occurrences and appropriate buffer areas, and exclude stock from remnants that contain the community

The existing fence around the entire (~12 ha) remnant that contains Occurrence 2 should be upgraded to exclude stock. Stock should also be excluded from the remnant that contains Occurrence 3 (~2 ha). Fencing around the boundary of Occurrence 1 and its buffer area should be completed and stock excluded.

Responsibility: CALM (Perth District) in liaison with adjacent landowner
Cost: Costs of all liaison included in 3.2; fencing costs $4,500 for Occurrence 1; $2,000 for Occurrence 2
Completion date: Occurrence 1 Completed, Occurrences 2 and 3 ongoing.

3.6 Access available incentives and mechanisms for conserving the threatened ecological community

Access incentives for protection, including the Remnant Vegetation Protection Scheme and other sources, to ensure long term protection of the community.

Responsibility: CALM (Perth District; WATSCU)
Cost: Costs of liaison included in 3.3
Completion date: Ongoing.

3.7 Develop a Fire Management Strategy

3.7.1 Develop and implement fire management plans that encompass the following (3.7.1-3.7.4) and include an annual fire monitoring and reporting schedule

There is a need for research into recovery of the community from fire (to be completed under Action 3.10 - flora monitoring); and determining the implications of findings for management. This would also include developing a fire history map of the occurrences, which is updated annually. As little is known of the response of the community to fire, no planned burn should be implemented for the life of this IRP, unless results of future studies suggest it is necessary and urgent.

A Fire Management Plan has been developed for Talbot Road bushland by the Fire and Rescue Service, Shire of Swan and CALM. It specifies no planned burns without consultation with CALM, no construction of new fire breaks, a fire-fighting strategy, implementation of dieback hygiene for all vehicles, routine fuel and weed monitoring, and maintenance of fire breaks. A similar plan should be developed for occurrences of this community, using the plan for Talbot Road bushland as a guide.

Responsibility: CALM (Perth District; WATSCU); liaison with all stakeholders
Cost: $850 for preparation of plan
Completion date: Year 1

3.7.2 Ensure maintenance of strategic firebreaks to help prevent fire spreading to community

Maintenance of existing firebreaks is appropriate where firebreaks are already constructed, unless maintenance is likely to cause spread or intensification of dieback or otherwise degrade the community. Local CALM staff should be involved in planning the construction and maintenance of firebreak for all occurrences of the community.

No new firebreaks should be constructed or existing breaks upgraded around occurrences of this community on CALM-managed lands unless they are provided for in an authorised fire management plan.

Responsibility: CALM (Perth District)
Cost: Firebreak maintenance $300 pa; costs of liaison included in Action 3.3
Completion date: Ongoing

3.7.3 Ensure fire suppression strategy does not impact the community

Use of heavy machinery to create new fire breaks within the community should be avoided as additional disturbance would encourage further weed invasion, and chemicals that may be toxic to the community should not be used. Ensure fire fighting authorities recognise the importance of not constructing new tracks during their operations, including during wildfires.

A local CALM staff member should be present during wildfires and controlled burns in remnants that contain occurrences of the community, to advise on protecting the conservation values of the community.

Responsibility: CALM (Perth District and CALMfire); liaison with local Bush Fire Brigades and Fire and Rescue Service
Cost: Costs of preparation of guidelines included in 3.7.1; costs of liaison included in 3.3; additional funds for CALM district staff to attend fires in the community ($200 pa)
Completion date: Ongoing

3.7.4 Liaise with surrounding landholders to ensure strategies for fuel reduction on their lands do not impact the community

For example, burning at inappropriate times when fires are likely to spread to adjacent lands should be avoided.

Responsibility: CALM (Perth District)
Cost: Costs of liaison included in 3.3
Completion date: Ongoing.

3.8 Install markers to indicate the location of the community alongside the occurrence on a road reserve

CALM will mark, or encourage the appropriate authorities to mark the roadside occurrence with the same pegs as used to mark threatened flora, to reduce the likelihood of accidental destruction. This action is recommended in English and Blyth (1997) and will be included in a future policy on Threatened Ecological Communities being prepared by CALM.

Responsibility: CALM (Perth District; WATSCU)
Cost: $200
Completion date: Year 1

3.9 Ensure hygiene conditions

Occurrences have not been tested for presence of dieback, and the susceptibility of the community to the disease is not known. Risk of introduction of disease should therefore be minimised by ensuring good hygiene procedures. This would involve wash-down of any equipment used adjacent to the community, and restricting access by vehicles and machinery to dry soil conditions.

No vehicle access should be allowed onto bushland areas.

Responsibility: CALM (Perth District); all personnel operating machinery on site, including during fire control operations
Cost: to be underwritten by user of machinery; costs of liaison included in 3.3
Completion date: Ongoing

3.10 Design and implement a program for monitoring flora

Data collected should include weed levels, plant species diversity and species composition of flora.

Occurrences should be monitored two-yearly to provide information on condition. This information should be added to the threatened ecological community database, as recommended in English and Blyth (1997).

Two floristic plots occur in Occurrence 1 (DEP 1996). All native and weed species were recorded, however, density or cover values for each species were not included in these data and would be essential for determining changes over time (eg as a result of too frequent fire). One plot should also be put into each of Occurrences 2 and 3 (total of four plots).

Line intercept and photographic methods as described in Hopkins *et al.* (1987) could be utilised to monitor floristic composition, using permanent plots already in place from other surveys (DEP 1996).

Data should be entered on a database program such as that used by Gibson *et al.* (1994) and unknown plant species should be collected, identified and lodged in the WA Herbarium (except identified Declared Rare Flora).

Responsibility: CALM (Perth District; WATSCU)
Cost: $2,000 every second year (for two permanent plots already in the community, and additional plots in Occurrences 2 and 3) for field survey, specimen identification, and databasing for 1 monitoring period
Completion date: Ongoing

3.11 Assess and monitor weed populations

Floristic data in DEP (1996) may help determine weeds that pose the greatest threat in Occurrence 1 as all weed species that occur in plots have been recorded. Data included detailed species lists, but cover or density data were not reported for weeds. Some significant weeds in occurrences also may not occur in plots. Weed populations should be accurately mapped and appropriate herbicides or other method of weed control determined.

The actual monitoring of weeds can be incorporated in Action 3.10

Responsibility: CALM (Perth District)
Cost: Weed monitoring could be incorporated into other flora monitoring (refer 3.10); $250 every second year for mapping of the boundaries of weed species that are high priority for control
Completion date: Ongoing

3.12 Implement weed control, and replanting where necessary

Initial stages of rehabilitation should involve control of perennial weeds and their replacement with local species, where appropriate. Local species suitable for replanting should be identified from plot data in DEP (1996) and from the results of Action 3.10.

The highest priority should be controlling weeds that pose the greatest threat to the community in the early stages of invasion where possible, eg, invasive perennial grasses and *Watsonia*. Rehabilitation through reintroduction of local native species may be necessary if areas are no longer capable of regenerating following weed control.

Only seed from the same occurrence should be used for rehabilitation. No seed from other areas should be introduced into occurrences.

Responsibility: CALM (Perth District)
Cost: $1,500 for weed control; costs of replanting and rehabilitation to be determined
Completion date: Ongoing

3.13 Assess hydrological information

Occurrences of the community may be at risk from salinisation and increased inundation.

Groundwater levels and quality are routinely monitored by the Water and Rivers Commission (WRC), and in specific areas by Agriculture Western Australia and local Landcare District Committees (LCDCs). These data for areas close to the ironstone community should be assessed as they may indicate that remedial measures should be undertaken.

Responsibility: CALM (Perth District); liaison with Agriculture Western Australia, the LCDCs and the WRC
Cost: $500 pa
Completion date: Ongoing

3.14 Design and conduct research

Research should be designed to increase the understanding of the biological and ecological characteristics of the community to assist future management decisions. Such research could include:

1. The impact of weeds on the community.

2. The role of disturbance such as fire and grazing in regeneration or maintenance of the community.

3. The development of a monitoring system. Protocols will be developed as part of a future policy on threatened ecological communities based on recommendations held in English and Blyth (1997).

4. Investigation of significant biological processes in the community, eg, pollination biology, germination requirements, longevity and time taken to reach maturity of important plant taxa in the community.

5. Monitoring of water depth, timing and depth of inundation, and water quality in ironstone occurrences.

6. Research on hydrogeology of the community.

Responsibility: CALM (CALM**Science**; Perth District; WATSCU)
Cost: Recovery Team to determine costs and likely funds available through other sources and to recommend a research program and sources of funds to CALM
Completion date: To be determined

3.15 Determine if dieback represents a threat to the community, and if so, determine priority areas for *treatment*

Survey for *Phytophthora* dieback in the community. Undertake baseline and ongoing monitoring of the extent, impact and boundaries of dieback in all occurrences of the community and determine if there are priority areas for dieback treatment.

Priority areas for dieback treatment in the community should be determined from the Dieback Protocol that is currently used by CALM. Data on dieback presence and impact, and future biodiversity implications (eg, loss or decline of DRF or Priority taxa, or structurally or functionally important taxa) are likely to be important determinants of the priority of treatment of individual occurrences.

Dieback has not been recorded in this community, but has been recorded in other plant communities on ironstone soils. If dieback is detected, the dieback front should be monitored at least every five years in summer and flagging marking the front replaced regularly. Spraying with phosphite should be considered. Additional plot information (refer 3.10) would provide useful monitoring data.

Responsibility: CALM (Perth District)
Cost: $1,000
Completion date: Year 1.

3.16 Report on success of management strategies for this ironstone community

Reporting should be part of annual reports prepared by the Recovery Team for CALM's Corporate Executive. A final report would be presented as part of or complementary to the full recovery plan for community, if a full recovery plan is necessary.

Responsibility: CALM (Perth District; WATSCU)
Cost: Nil
Completion date: Year 3 (final report)

4. TERM OF PLAN

This Interim Recovery Plan will operate from February 2000 to January 2003 but will remain in force until withdrawn or replaced. It is intended that, if the community is still ranked Critically Endangered, this IRP will be replaced by a full Recovery Plan after three years.

Table 2: Summary of recovery actions

Recovery Action	Occurrences	Responsibility	Completion date
Establish Recovery Team	All	CALM (WATSCU)	Year 1
Clarify and monitor boundaries	All	CALM (CALM**Science**, Perth District, WATSCU)	Survey completed; monitoring ongoing
Liaise with landholder	All	CALM (Perth District, WATSCU)	Ongoing
Fencing	1 and 2	CALM (Perth District)	Completed Occurrence 1, ongoing occurrence 2
Access funding incentives for conservation	All	CALM (Perth District; WATSCU)	Ongoing
Seek to acquire community and buffer	1	CALM (Perth District, Land Acquisitions Section, WATSCU), Environment Australia	Completed
Develop Fire Management Plan	All	CALM (Perth, District, WATSCU) in consultation with all stakeholders	Development of Fire Management Plan has begun. To be completed Year 1.
Implement Fire Management Plans, implement dieback hygiene	All	CALM (Perth District); liaison with Bush Fire Brigades and Fire and Rescue Service	Ongoing
Install markers	1	CALM (Perth District, WATSCU)	Year 1
Implement weed control	All	CALM (Perth District)	Ongoing
Monitor Flora	All	CALM (Perth District, WATSCU)	Ongoing
Assess and monitor weed populations	All	CALM (Perth, District)	Ongoing
Replanting / rehabilitation	Costs to be determined	CALM (Perth District)	Ongoing
Assess hydrological information	1	CALM (Perth District); liaison with WRC, LCDCs and Agriculture Western Australia	Ongoing
Conduct research	All	CALM (CALM**Science**, Perth District, WATSCU)	No date set
Monitor for dieback	All	CALM (Perth District)	Year 1
Report on management strategies	All	CALM (Perth District; WATSCU); Recovery Team	Year 3

Table 3: Summary of costs for each recovery action

Recovery Action	Year 1	Year 2	Year 3
Establish Recovery Team	-		
Clarify and monitor boundaries		200	
Liaise with landholder	500	500	500
Fence occurrences	6,500		
Access funding incentives for conservation	Completed		
Seek to purchase Occurrence 1 and buffer	Acquisition completed		
Develop Fire Management Plan	850		
Implement Fire Management Plans, implement dieback hygiene	500	500	500
Install markers	200		
Implement weed control	500	500	500
Monitor flora	2,000		2,000
Assess and monitor weed populations	250		250
Replant / rehabilitate	To be determined		
Assess hydrological information	500	500	500
Conduct research	To be determined		
Inspect for dieback	1,000		
Report on management strategies	-		
Total	**12,800**	**2,200**	**4,250**

Total cost over three years $19 250 (costs of rehabilitation and research not included)

ACKNOWLEDGMENTS

The National Reserve System Program of Environment Australia funded the project entitled "Identifying and conserving threatened ecological communities in the south west botanical province". The project confirmed the threatened status of this plant community.

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

Neil Gibson, Greg Keighery and John Blyth	CALM, Wildlife Research Centre, Woodvale
Landowner	Shire of Gingin
Bronwen Keighery and Natalie Thorning	Department of Environmental Protection, Perth
David Mitchell	CALM Swan Region, Kelmscott
Lyndon Mutter and Ken Borland	CALM Perth District, Wanneroo
Henry Smolinsky	Agriculture Western Australia

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APPENDIX 1

Vascular Plants in Occurrence 1 (From DEP 1996)

	Taxon	Status
	Asphodelaceae	
	Bulbine semibarbata	
	Asteraceae	
	Cotula australis	
	Cotula coronopifolia	
	Helipterum manglesii	
	Myriocephalus helichrysoides	
	Callitrichaceae	
*	*Callitriche stagnalis*	
	Caryophyllaceae	
*	*Spergula arvensis*	
	Centrolepidaceae	
	Centrolepis aristata	
	Centrolepis glabra	
	Crassulaceae	
*	*Crassula ?decumbens*	
*	*Crassula natans*	
	Cyperaceae	
*	*Cyperus tenellus*	
	Isolepis marginata	
	Schoenus odontocarpus	
	Droseraceae	
	Drosera rosulata	
	Haemodoraceae	
	Tribonantes australis	
	Haloragaceae	
	Haloragis tenuifolia	
	Hydatellaceae	
	Trithuria bibracteata	
	Iridaceae	
*	*Hesperantha falcata*	
*	*Romulea rosea*	
	Lentibulariaceae	
	Polypompholyx multifida	
	Lobeliaceae	
	Monopsis ?debilis	
	Juncaceae	
	Juncus bufonis	
	Juncus holoschoenus	
	Juncaginaceae	

Triglochin centrocarpa	
Marsileaceae	
Pilularia novae-hollandiae	
Menyanthaceae	
Villarsia capitata	
Mimosaceae	
Acacia saligna	
Myrtaceae	
Kunzea aff. recurva	
Melaleuca viminea	
Orchidaceae	
Thelymitra antennifera	
Papilionaceae	
Isotropis cuneifolia subsp. *glabra* ms	R
Jacksonia furcellata	
Ornithopsis sp.	
Trifolium dubium	
Poaceae	
Amphibromus neesii	
Briza maxima	
Proteaceae	
Dryandra sessilis	
Grevillea curviloba ssp. incurva	P1
Grevillea obtusifolia	
Scrophulariaceae	
Glossostigma drummondii	
Stylidiaceae	
Stylidium ecorne	

***** **Introduced**

GLOSSARY

Alluvial: made up of sediments deposited by flowing water
Fluviatile: found in or near rivers
Marl: compact impure limestone
Solonchak: pale saline soils typical of certain poorly drained semi-arid regions
Solonetzic: dark alkaline soils formed from solonchak by leaching

STATUS OF FLORA TAXA (FROM DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT 1999)

Declared Rare Flora (DRF)	'taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such pursuant to the Wildlife Conservation Act 1950.'
Priority 1 (P1)	'taxa which are known from one or a few populations which are under threat.'
Priority 2 (P2)	'taxa which are known from one or a few populations, at least some of which are not believed to be under immediate threat.'
Priority 3 (P3)	'taxa which are known from several populations, at least some of which are not believed to be under immediate threat.'