INTERIM RECOVERY PLAN NO. 127

UNDERGROUND ORCHID (*RHIZANTHELLA GARDNERI*)

INTERIM RECOVERY PLAN

2003-2008

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Photo: Bert Wells

February 2003

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

Natural Heritage Trust
Helping Communities Helping Australia

Kings Park & Botanic Garden
Botanic Gardens & Parks Authority

The University of Western Australia

Government of Western Australia

Department of Conservation and Land Management
Conserving the nature of WA

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (the Department) 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 taxa 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 the Minister.

This Interim Recovery Plan will operate from February 2003 to January 2008 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked Critically Endangered, this IRP will be reviewed after five years and the need for a full Recovery Plan assessed.

This IRP was approved by the Director of Nature Conservation 20 June, 2003. The provision of funds identified in this Interim Recovery Plan are 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 February 2003.

SUMMARY

Scientific Name:	***Rhizanthella gardneri***	**Common Name:**	Underground orchid
Family:	Orchidaceae	**Flowering Period:**	May to July
Dept Region:	Wheatbelt	**Dept District:**	Narrogin
Shire:	Corrigin	**Recovery Team:**	Narrogin District Threatened Flora Recovery Team

Illustrations and/or further information: Brown, A., Thomson-Dans, C. and Marchant, N. (Eds). (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia; Dixon, K. W., J. S. Pate, et al. (1990). The Western Australian fully subterranean orchid *Rhizanthella gardneri*. Orchid Biology, Reviews and Perspectives, V. J. Arditti. Portland, Oregon, Timber Press. 5: 37-62; Warcup, J. H. (1985). *Rhizanthella gardneri* (Orchidaceae), its Rhizoctonia endophyte and close association with *Melaleuca uncinata* (Myrtaceae) in Western Australia. *New Phytologist* 99: 273-280; Warcup, J. H. (1991). The Rhizoctonia endophytes of *Rhizanthella* (Orchidaceae). *Mycological Research* 95: 656-659.

Current status: *Rhizanthella gardneri* was declared as Rare Flora in November 1980 and currently (2002) meets World Conservation Union (IUCN, 2000) Red List Category 'CR' under criteria B2ab(ii,iii,v); C2a(i); D due to the extreme fragmentation of populations, a continuing decline in area of occupancy, area, extent, quality of habitat and the number of mature individuals and a total population size of less than 50 mature individuals. The main threats are the death of adult plants, poor recruitment, loss of habitat (due to the death of the associated *Melaleuca uncinata*), human damage when searching for plants, drought and weeds.

Critical habitat: The critical habitat for *Rhizanthella gardneri* comprises the area of occupancy of the known populations; similar habitat within 200 metres of known populations; and additional nearby occurrences of similar habitat that do not currently contain the taxon but may have done so in the past and may be suitable for future translocations.

Habitat critical to the survival of the species, and important populations: Given that this species is listed as Critically Endangered it is considered that all known habitat for wild and translocated populations is habitat critical.

Benefits to other species/ecological communities: There are no ecological communities or other threatened species in the immediate vicinity of *Rhizanthella gardneri*. However, recovery actions implemented to improve the quality or security of the habitat of the species, such as weed control and rehabilitation, will benefit the habitat in which it occurs.

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

Role and interests of indigenous people: There are no known indigenous communities interested or involved in the management of areas affected by this plan. Therefore no role has been identified for indigenous communities in the recovery of this species.

Social and economic impacts: The implementation of this recovery plan is unlikely to cause significant adverse social and economic impacts. One population of *Rhizanthella gardneri* occurs on private property. However, negotiations between relevant parties have ensured that the area directly supporting the species will be left uncleared.

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

Habitat requirements: *Rhizanthella gardneri* is currently known from two disjunct areas some 260 km apart (The Munglinup – Oldfield River area in the south-eastern Wheatbelt and the Corrigin – Babakin area in the Central Wheatbelt (Brown *et al*. 1998)). In both areas it grows in association with *Melaleuca uncinata* and specific micorrhizal fungi forming a three-way relationship. Habitat is mallee heath.

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

1. All relevant land owners and managers have been made aware of the location and threatened status of the taxon.
2. Staff from the Botanic Garden and Parks Authority (BGPA), and the Department's Narrogin and Esperance Districts and Threatened Species and Communities Unit regularly monitor populations of the taxon.

3. The Narrogin and Esperance District Threatened Flora Recovery Teams are overseeing the recovery of this species and will include information on progress in annual reports to the Department's Corporate Executive and funding bodies.
4. Two reserves at Babakin have now been vested in the Conservation Commission as Class A Nature reserves for the Conservation of Flora and Fauna.
5. A masters student from the University of Western Australia has commenced DNA extraction from floral bracts and fungal isolates collected during 2001 season by staff from the BGPA.
6. The BGPA currently have limited seed collections of *Rhizanthella gardneri* and the associated *Melaleuca uncinata*. Mycorrhizal fungi have been isolated from a section of rhizome from the Babakin population. Germination tests were commenced in May 2002. However, results on fungal efficacy are unknown at this point.
7. The BGPA have developed methods for the production of mycorrhizal inoculum suitable for glasshouse and field studies.
8. Surveys of all known populations were undertaken by departmental and BGPA staff in 2002.

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

Recovery criteria

Criteria for success: The number of individuals within populations and/or the number of populations have increased by 10% or more.

Criteria for failure: The number of individuals within populations and/or the number of populations have decreased by 10% or more.

Recovery actions

1. Coordinate recovery actions
2. Liase with land managers and achieve long-term protection of habitat.
3. Monitor populations.
4. Collect seed and mycorrhizal fungi from all populations and develop suitable long-term storage protocols.
5. Obtain biological and ecological information.
6. Population genetics
7. In situ seed germination.
8. Conduct further surveys.
9. Develop and implement a translocation proposal.
10. Conduct research into the reasons for habitat degradation.
11. Develop and implement a fire management strategy.
12. Undertake weed control.
13. Rehabilitate habitat.
14. Promote awareness.
15. Review the need for a full Recovery Plan and prepare if necessary.

1. BACKGROUND

History

John Trott discovered the first specimen of the underground orchid on his farm near Corrigin on the 23rd of May 1928 and Richard Rogers described it in August the same year, naming it in honour of the then Premier of Western Australia Charles Gardner. Between 1928 and 1959 it was found six more times, each time by chance during plowing of recently rolled and burnt bushland. All discoveries up until this time were made between the Corrigin and Dowerin areas. There was then a gap of 20 years before it was again seen (1979) by a private landowner near the town of Munglinup, some 300 kilometers south of previous known locations. During surveys of thickets of broom honey-myrtle (*Melaleuca uncinata*) in the Munglinup area by Dr Kingsley Dixon and members of the WA Native Orchid Study and Conservation Group (WANOSCG) 24 plants were found in three separate populations. Following these southern sightings Dr Dixon and members of WANOSCG searched areas near the original sighting at Corrigin and in 1981 and 1982 located two more populations together containing over 114 flowering plants. In 1985 a further population was discovered west of Corrigin and some 36 flowering plants were located at the site during surveys in 1989. Since that time no new populations have been located.

Natural Heritage Trust funding has been obtained by the Botanic Gardens and Parks Authority (BGPA) who are providing the research, seed collection, propagation and translocation components of this Interim Recovery Plan.

Description

Until recently, *Rhizanthella* was thought to be a monotypic genus confined to the south-west of Western Australia. However, in 1984, a second underground orchid, formerly known as *Cryptanthemis slateri*, was placed in *Rhizanthella*. This second species is known only from south-eastern Queensland and central-eastern New South Wales and, like the western Underground Orchid, lives out its entire life cycle under the surface of the soil.

Both species are leafless and lack chlorophyll. The flowers are positioned in inward-facing rows surrounded by fleshy, overlapping bracts.

The name *Rhizanthella* was coined by Richard Rogers in 1928 and refers to the rhizome-like tubers of the two orchids.

Flowering of *Rhizanthella gardneri* begins in late May, early June when each plant produces up to 100 small, inward facing, cream to reddish coloured flowers, surrounded by 6 to 12 large, cream or pinkish-cream bracts. These bracts form a tulip-like head that curves over the flowers forming a small opening at the soil surface. A layer of leaf and bark litter covers this opening. The plants have a horizontal rhizome 6 to 12 cm below the ground level, which, like the rest of the plant, is succulent and produces a formalin-like odour when cut. Once pollinated each flower produces a berry-like indehiscent fleshy fruit containing 20 to 150 seeds. This type of fruit is unique amongst the Western Australian orchids as species in all other orchid genera produce a dehiscing pod from which thousands of minute seeds are dispersed by the wind.

Distribution and habitat

Rhizanthella gardneri is known from two disjunct areas some 300 km apart - between Corrigin and Babakin and northwest of Munglinup. Plants occur under leaf and bark litter in thickets of broom honey-myrtle with scattered emergent *Eucalyptus* and *Acacia* species. Soil is either sandy-clay or sandy-loam.

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 occupied (continuously, periodically or occasionally) by an organism or group of organisms or once occupied (continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms

of that kind have the potential to be reintroduced. (*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)).

The critical habitat for *Rhizanthella gardneri* comprises:

- the area of occupancy of known populations;
- areas of similar habitat within 200 metres of known populations i.e. thickets of *Melaleuca uncinata* (these provide potential habitat for natural range extension);
- additional occurrences of similar habitat on nearby areas of remnant bushland that are not currently known to contain the taxon but may have done so in the past (these represent possible translocation sites).

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

Given that this species is listed as Critically Endangered it is considered that all known habitat for wild and any translocated populations is habitat critical.

Benefits to other species/ecological communities

There are no threatened ecological communities or other threatened species in the immediate vicinity of *Rhizanthella gardneri*. However, recovery actions implemented to improve the quality or security of the habitat of the species, such as weed control and rehabilitation, will benefit the remnant bushland habitat in which it occurs.

International Obligations

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

Role and interests of indigenous people

There are no known indigenous communities interested or involved in the management of areas affected by this plan. Therefore no role has been identified for indigenous communities in the recovery of this species.

Social and economic impacts

The implementation of this recovery plan is unlikely to cause significant adverse social and economic impacts. One population of *Rhizanthella gardneri* occurs on private property. However, negotiations between relevant parties have ensured that the area directly supporting this species will be left uncleared.

Evaluation of the Plans Performance

The Department of Conservation and Land Management, in conjunction with the Recovery Team will evaluate the performance of this IRP. In addition to annual reporting on progress with listed actions and comparison against the criteria for success and failure, the plan is to be reviewed within five years of its implementation.

Biology and ecology

Although *Rhizanthella* is like other orchids in that it relies on an association with mycorrhizal fungi for its survival, due to its subterranean habit and lack of photosynthetic capacity, its dependence is likely to be greater than most. The relationship with broom honey-myrtle is unique in the orchid world with a symbiotic micorrhizal fungus forming a link between the orchid and the *Melaleuca*.

It is currently unknown why the orchid occurs under some thickets of *Melaleuca uncinata* and apparently not under others. It is also not known why the orchid appears in two disjunct areas some 300 km apart. Distribution

of essential mycorrhizal fungi may be a determining factor for its distribution. However, research using seed baiting methods for detection of suitable mycorrhizal fungi, developed by BGPA, may provide further information.

It is known that small fungal gnats pollinate flowers of the underground orchid. These are small enough to get through the gaps in the leaf and bark litter that covers the tulip-like inflorescence of the orchid. The gnats crawl through the litter into the tiny opening at the top of the floral bracts and down to the flowers that encircle the inside of the capitulum. Other insects such as termites and mosquitoes have been seen on flowers of an exposed capitulum and may also be incidental pollinators.

It is currently unknown how seed is dispersed but it is thought that small marsupials may eat the succulent fruits produced by the plant and deposit seed in their faeces.

Threats

Rhizanthella gardneri currently meets World Conservation Union (IUCN, 2000) Red List Category 'CR' under criteria B2ab(ii,iii,v); C2a(i); D due to its extreme fragmentation, a continuing decline in area of occupancy, area, extent, quality of habitat and the number of mature individuals and a total population size of less than 50 mature individuals.

Its specialized habitat survives as disjunct remnants in the central and southern Wheatbelt. A combination of drought and senescence resulting in the death of mature *Melaleuca uncinata* (Broom honey-myrtle) plants threatens much of its habitat in the central wheatbelt where little recruitment of broom honey-myrtle is evident and the once large thickets are becoming smaller and more open. This has resulted in vastly increased light levels and a significant drop in the level of leaf and bark litter held at the base of plants, causing the soil to become hard baked and dry. Habitat is in better condition in the area of southern populations.

Just 23 flowering plants were found during intensive surveys of three populations in the Corrigin area in May-June 2001 and a further 4 plants found in two populations near Munglinup in July 2002.

The main threats are lack of suitable habitat, degraded habitat, drought, soil compaction, road and firebreak maintenance, rising saline water tables (Meston 2001), weeds, inappropriate fire regimes, human damage during searches for the orchid and poor recruitment.

- **Lack of suitable habitat** is a barrier to more populations being found. This also limits the number of areas suitable for translocation.
- **Degraded habitat** is a current and continuing threat as the thickets of *Melaleuca uncinata* on which the orchid depends for its fungal nutrient link are dying back from the edges due to drought and possibly rising saline water tables.
- **Drought** appears to be a major threat to the habitat of *Rhizanthella gardneri* in the central Wheatbelt.
- **Soil compaction** due to poor levels of leaf and bark litter and human disturbance has resulted in poor flowering and possible deaths of *Rhizanthella gardneri* plants.
- **Road and firebreak maintenance** threatens several southern populations.
- **Rising saline water tables** are possibly already causing deaths amongst the associated *Melaleuca uncinata* and are likely to become an increasing future threat.
- **Weed invasion** is a minor threat to all populations. The effect of weeds is uncertain but they are likely to compete for soil moisture and nutrients needed by the orchid and associated fungi. Weeds also increase the fire hazard due to the easy ignition of high fuel loads produced annually by many grass weed species.
- **Inappropriate fire** may threaten populations if it occurs during the flowering period of the orchid and overly frequent fires are likely to alter its habitat. One southern population was burnt some years ago and despite several searches since then no *Rhizanthella gardneri* plants have been located.
- **Human damage** during searches for the orchid is a continuing threat. The method used to locate plants is quite destructive requiring the removal of leaf litter beneath *Melaleuca uncinata*. This litter is often not replaced and when it is, is usually mixed with soil resulting in soil compaction and the drying out of the area where the orchid occurs.

- **Poor recruitment and declining populations** are a major threat to the orchid. In areas where many flowering plants were located during surveys in the 1980s few plants were found during surveys in 2001 and 2002.
- **A lack of a seed dispersal agent and severe habitat fragmentation** may prevent recruitment into new habitats**.**

Summary of population information and threats

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
1. Babakin	Nature Reserve	1982 110 2001 15 2002 10	Poor	Drought, soil compaction, future rising saline water tables, degraded habitat, habitat damage during searches
2. W of Babakin	Nature Reserve	1982 4 2001 6 2002 2	Good	Drought, soil compaction, future rising saline water tables, lack of habitat, habitat damage during searches
3. Oldfield River	Unvested Crown Land	1982 4 2002 2	Good	Drought, road and firebreak maintenance, habitat damage during searches
4. NW of Munglinup	Nature Reserve	1982 4 2002 0	None seen	Drought, inappropriate fire, firebreak maintenance
5. NW of Munglinup	Private	1981 10 2002 2	Good	Drought, weeds, clearing, firebreak maintenance
6. Kunjin	Townsite Reserve	1989 38 2001 2 2002 3	Poor	Drought, soil compaction, degraded habitat, future rising saline water tables, habitat damage during searches

Guide for decision-makers

Section 1 provides details of current and possible future threats. Any on-ground works (firebreaks, roadworks etc) in the immediate vicinity of *Rhizanthella gardneri* will require assessment. On ground works should not be approved unless the proponents can demonstrate that they will not have an 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.

2. RECOVERY OBJECTIVE AND CRITERIA

Objectives

The objective of this Interim Recovery Plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term preservation of the species in the wild. Also to understand in more detail the relationships between orchid, fungi and shrub to improve management decisions and conservation of the species.

Criteria for success: The number of individuals within populations and/or the number of populations have increased by 10% or more.
Criteria for failure: The number of individuals within populations and/or the number of populations have decreased by 10% or more.

3. RECOVERY ACTIONS

Existing recovery actions

The majority of land managers and adjacent landowners have been notified of the location and threatened status of *Rhizanthella gardneri*. The notification details the Declared Threatened status of the taxon and legal responsibilities to protect it.

Surveys of all known populations were undertaken in 2002.

Staff from the BGPA Orchid Research Unit, the Department's Narrogin and Esperance Districts and the Department's Threatened Species and Communities Unit are monitoring populations of the taxon.

The Narrogin and Esperance District Threatened Flora Recovery Teams (N & EDTRTs) are overseeing the recovery of this species and will include information on progress in an annual report to the Department's Corporate Executive and funding bodies.

Two reserves near Babakin, both of which have populations of *Rhizanthella*, have now been vested in the Conservation Commission as Class A Nature reserves for the Conservation of Flora and Fauna.

Approximately 500 seeds were collected from one Babakin population in November 2001 and in 2002 a further 1000 seeds were collected from the same reserve and 1000 seeds from a second nearby reserve. However, seed failed to develop on plants at a third Wheatbelt reserve and on plants in southern populations, possibly due to drought. Seed used for research into propagation methods and *ex-situ* seedling establishment is stored at the BGPA seed store. Germination tests were commenced in May 2002. However, results on fungal efficacy are unknown at this point.

Mycorrhizal fungi have been isolated from section of rhizomes from four populations. However, to date efficacy of isolates has not been established.

DNA extraction from floral bracts and fungal isolates collected during the 2001 season have commenced at the BGPA to examine genetic variation in *R. gardneri.*

BGPA staff have commenced genetic studies which will provide invaluable information for the implementation of appropriate conservation and management practices. Preliminary results suggest that *R. gardneri* has a large genome which may cause problems with AFLP (a DNA fingerprinting technique) analysis. Techniques such as micro satellites may need to be developed.

A preliminary *in situ* seed baiting trial was conducted by BGPA staff. Results appeared promising with early signs of seed germination. However, seedlings failed to develop due to extreme drought conditions.

A two sided poster containing photographs of the species, description and threat information, and outlining current recovery actions has been produced by the Department and distributed.

Future recovery actions

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

1. Coordinate recovery actions

The Narrogin and Esperance Districts Threatened Flora Recovery Teams (N & EDTFRTs) will oversee the implementation of recovery actions for *Rhizanthella gardneri* and will include information on progress in their annual report to the Department's Corporate Executive and funding bodies.

Action:	Coordinate recovery actions
Responsibility:	The Department (WATSCU, Narrogin and Esperance Districts) through the N & EDTFRTs
Cost:	$3500 per year

2. Liaise with land managers and achieve long-term protection of habitat

Staff from the Department's Narrogin and Esperance Districts will continue liaison with land landowners and managers to ensure that populations are not accidentally damaged or destroyed. In addition, ways and means of improving the security of populations and their habitat will be investigated. This may include land purchase, conservation covenants or utilizing the Land for Wildlife scheme. Populations at Kunjin and Oldfield River are currently on unallocated Crown land and it is desirable for the long-term conservation of the species that these

areas be vested in the Conservation Commission as Class A Nature Reserves for the purpose of Conservation of Flora and Fauna.

Action: Achieve long-term protection of habitat
Responsibility: The Department (Narrogin and Esperance Districts) through the N & EDTFRTs
Cost: $1000 in the first year, $200 per year thereafter. Note: if land is purchased the cost will be considerably higher.

3. Monitor populations

Annual monitoring of factors such as population stability (expansion or decline), habitat degradation, pollinator activity, seed production, recruitment, longevity and predation is essential. Particular attention should be paid to the level of threat posed by the deaths of *Melaleuca uncinata*.

Action: Monitor populations
Responsibility: The Department (WATSCU, Narrogin and Esperance Districts) through the N & EDTFRTs
Cost: $4,750 per year

4. Collect seed and associated mycorrhizal fungi from all populations and develop suitable long-term storage protocols

Preservation of germplasm is essential to guard against extinction if wild populations are lost. Such collections are also needed to propagate plants for translocations. A small quantity of seed has been collected from 2 populations but further collections are required from these and the other 4 populations. The collection of specific mycorrhizal fungi is also necessary as the seed requires it to germinate. Development of suitable long-term storage protocols for propagation material (seed and mycorrhizal fungi) is required.

Action: Collect seed and associated mycorrhizal fungi from all populations and develop long-term storage protocols.
Responsibility: BGPA through the N & EDTFRTs
Cost: $5,500 for the first two years and $2,000 in subsequent years

5. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Rhizanthella gardneri* will provide a better scientific basis for its management in the wild and will include:

1. Studying the role of disturbance, competition, rainfall and grazing on flowering, seed production, recruitment and seedling survival.
2. Investigating the interactions and levels of dependence of the three-way relationship between *Rhizanthella gardneri*, associated mycorrhizal fungi and *Melaleuca uncinata*.
3. Determining the pollination biology and reproductive methodology of the species.
4. Studying the impact of salinity and habitat degradation on *Rhizanthella gardneri*.
5. Investigating seedling establishment and survival in field sites.
6. Investigating mycorrhizal distribution and persistence in the field.

Action: Obtain biological and ecological information
Responsibility: BGPA and the Department (Narrogin and Esperance Districts) through the N & EDTFRTs
Cost: $12,500 per year

6. Population genetics

Determine genetic diversity between known populations, especially southern and northern populations. This will be important for future translocation and establishment of possible new populations. Information gained will be valuable when planing translocations. The use of micro satellites may be needed to overcome problems

with AFLP's and the apparent large genome size of *R. gardneri* increasing the time and resources required for genetic analysis.

Action: Genetic analysis of *Rhizanthella gardneri* plants and populations
Responsibility: BGPA through the N & EDTFRTs
Cost: $6,000 in the first two years.

7. In situ seed germination

Seed collected in retrievable pouches from known *Rhizanthella gardneri* locations will be trialed to assess viability under field conditions. If successful this method may be suitable for establishing new individuals of *Rhizanthella gardneri* at field sites. These trials will be conducted at known *Rhizanthella gardneri* populations in accordance with necessary regulations and permits.

Action: Trial in situ seed germination of *Rhizanthella gardneri*
Responsibility: BGPA through the N & EDTFRTs
Cost: $3,500 per year

8. Conduct further surveys

Further surveys by BGPA, Departmental staff and community volunteers will be conducted during the flowering period of the species (May to July).

Action: Conduct further surveys
Responsibility: The Department (WATSCU, Narrogin and Esperance Districts) and BGPA through the N & EDTFRTs
Cost: $8,000

9. Develop and implement a translocation proposal

As the number of extant adult plants is low and populations are not secure from threats, a translocation proposal will be developed and suitable translocation sites selected. This will be coordinated by Threatened Flora Recovery teams and the Esperance and Narrogin Districts in conjunction with the BGPA. 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. Translocation is dependent on the development of suitable propagation protocols and the availability of appropriate translocation sites.

Action: Develop and implement a translocation proposal
Responsibility: BGPA and the Department (WATSCU, Narrogin and Esperance Districts) through the N & EDTFRTs
Cost: $7,000 in the second and $3,500 in the third and fourth years

10. Conduct research into the reasons for habitat degradation

The habitat of *Rhizanthella gardneri* in the areas of populations 1 and 2 is under severe threat as the *Melaleuca uncinata* thickets under which it grows, and on which it relies for its mycorrhizal nutrient link, is showing signs of severe stress with many mature plants dead or dying. The reasons for these deaths is unknown but may be due to either senescence, drought or rising saline water tables or a combination of all three. Research is needed to ascertain the causes so that management decisions can be made to reverse the trend.

Action: Conduct research into the reasons for habitat degradation
Responsibility: The Department (Science Division, Narrogin and Esperance Districts) through the N & EDTFRTs
Cost: $8,000 for the first two years

11. Develop and implement a fire management strategy

The effect of fire on plants of *Rhizanthella gardneri* and associated native species is unknown, however, one southern population has not reappeared following fire and fire should, if possible, be prevented from occurring in the area of populations until more is known about its affect. A fire management strategy will be developed to determine fire control measures and fire frequency.

Action: Develop and implement a fire management strategy
Responsibility: The Department (Narrogin and Esperance Districts) through the N & EDTFRTs
Cost: $2,400 in the first year and $1,000 in subsequent years (if required)

12. Undertake weed control

Weeds are a minor threat in all populations. The following actions will be implemented:

1. Appropriate herbicides will be selected after determining which weeds are present.
2. Weed control will be scheduled to include spraying of other threatened flora populations within the district.

Action: Undertake weed control
Responsibility: The Department (Narrogin and Esperance Districts) through the N & EDTFRTs
Cost: $1500 per year (if required)

13. Rehabilitate habitat

If identified as a need during monitoring the Department will undertake habitat restoration including the re-introduction of endemic plant species to the site.

Action: Rehabilitate habitat
Responsibility: The Department (Narrogin and Esperance Districts) through the N & EDTFRTs
Cost: $6000 per year (if required)

14. Promote awareness

The importance of biodiversity conservation and the need for the long-term protection of wild populations of this taxon will be promoted to the community through poster displays and the local print and electronic media. Formal links with local naturalist groups and interested individuals will also be encouraged. An information sheet, which includes a description of the plant, its habitat, threats, recovery actions has been produced and distributed.

A reply paid postal drop illustrating *Rhizanthella gardneri* and describing its distinctive features and habitat will be produced and distributed by the Department's Narrogin and Esperance District offices to local farmers and other residents in Shires containing possible habitat of the taxon. The identification of any populations found through this action will be confirmed by staff from Narrogin and Esperance Districts. Postal drops aim to stimulate interest, provide information about threatened species and provide a name and number to contact if new populations are found by members of the community.

Action: Promote awareness
Responsibility: The Department (WATSCU, Narrogin and Esperance Districts) through the N & EDTFRT
Cost: $1,300 in first year and $1,000 in subsequent years

14. Review the need for a full Recovery Plan and prepare if necessary

At the end of the fourth year of the five-year term of this Interim Recovery Plan, if the taxon is still ranked as Critically Endangered, the need for a full Recovery Plan or a review of this IRP will be assessed and a plan prepared if necessary.

Action: Review the need for a full Recovery Plan and prepare if necessary

Responsibility: The Department (WATSCU, Narrogin and Esperance Districts) through the N & EDTFRT
Cost: $21,300 in the fifth year (if required)

4. TERM OF PLAN

This Interim Recovery Plan will operate from February 2003 to January 2008 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked as Critically Endangered after four years, Action 14 above will be implemented.

5. ACKNOWLEDGMENTS

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

Ryan Butler	Conservation Officer, the Department's Esperance District
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Greg Durell	Operation officer, the Department's Narrogin District
Bret Beecham	Regional Ecologist, the Department's Wheatbelt Region

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6. REFERENCES

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

Brown, A. (2002) Endangered, Underground Orchid. *Landscope* - WA's Conservation, Parks and Wildlife Magazene 17(3): 42.

Dixon, K. W., *et al.* (1990). The Western Australian fully subterranean orchid Rhizanthella gardneri. *Orchid Biology*, Reviews and Perspectives. V. J. Arditti. Portland, Oregon, Timber Press. 5: 37-62.

Dixon, K. W. and Pate, J. S. (1984). Biology and Distributional Status of *Rhizanthella gardneri* Rogers. *Kings Park Research Notes* 9.

George, A. S. (1981). *Rhizanthella*-The Underground Orchid of Western Australia. *Proceedings of the Orchid Symposium, 13th International Botanical Congress* 77-78.

George, A. S. (1980). *Rhizanthella gardneri* R.S. Rogers-The Underground Orchid of Western Australia. *American Orchid Society Bulletin* 49: 631-646.

Meston, J. (2001). Mapping and monitoring salinity: The Ravensthorpe Landsat TM scene (109-083). CSIRO Mathematical and Information Sciences. CMIS report number: 01/111.

The Department (1992) Policy Statement No. 44 *Wildlife Management Programs*. Department of Conservation and Land Management, Western Australia.

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

The Department (1995) Policy Statement No. 29 *Translocation of Threatened Flora and Fauna*. Department of Conservation and Land Management, Western Australia.

The Department (1998) Western Australian Herbarium FloraBase – Information on the Western Australian Flora. Department of Conservation and Land Management, Western Australia. http://www.calm.wa.gov.au/science/

Warcup, J. H. (1985). *Rhizanthella gardneri* (Orchidaceae), its Rhizoctonia endophyte and close association with *Melaleuca uncinata* (Myrtaceae) in Western Australia. *New Phytologist* 99: 273-280.

Warcup, J. H. (1991). The Rhizoctonia endophytes of *Rhizanthella* (Orchidaceae). *Mycological Research* 95: 656-659.

World Conservation Union (2000) *IUCN red list categories prepared by the IUCN Species Survival Commission*, as approved by the 51st meeting of the IUCN Council. Gland, Switzerland.

7. TAXONOMIC DESCRIPTION

Rhizanthella gardneri is a small subterranean epi-parasitic herb. Rhizomes short, thickened, without roots, branching. Inflorescences erect, subsessile, solitary, terminal; those on the smaller lateral rhizomes with well developed bracteate stems. Capitula up to 5 cm in diameter; bracts rather large, ovate or oblong-lanceolate, imbricate, up to 5 cm long, slightly spreading at the apices, in my specimens about 12 in number. Flowers numerous, small, sessile, dark purple, crowded, facing the center, arranged in 4 or 5 whorls. Sepals and petals erect, about 4 mm long, connate in a split tube 3-lobed at the apex. Dorsal sepal cucullate, adnate in its lower half with the petals and back of the column, triangular-ovate, rather wide, concave, abruptly incurved at the apex, ending in a short recurved apiculum; lateral sepals very fleshy, connate in their lower half, widely triangular, their apices short acute enclosing a sinus. Petals oblong-falcate, acute. Membranous, slightly shorter and much narrower than the sepals and hidden by the latter, adnate in the lower half by the posterior margins to the dorsal sepal and column, forming a galea with the former. Labellum reddish, attached to the apex of the column-foot by a delicate movable claw, linguiform, conspicuous, very large in comparison with the size of the flower, the apex subacute, glandular, undivided, very fleshy, erect against the column then recurved; lamina longitudinally concave, the tip slightly protruding from the galea. Column erect, almost equal in length to the sepals, not winged, terete, adnate to the petals and dorsal sepal, produced into a short foot at the base. Anther persistent, terminal, erect, without a point, rather obtuse, compressed laterally at the apex, rather widely attached to the posterior margin of the clinandrium, valvate, 2-celled. Clinandrium slightly concave. Pollinia 4, granular, almost sessile on the minute viscidium of the rostellum. Stigma prominent vertical, ovate, rather large. Rostellum erect, emarginate at the apex, much shorter than the anther. Ovary white, terete, up to 7mm long, the subtending bract lanceolate, equal to or sometimes longer than the ovary.