INTERIM RECOVERY PLAN NO. 138

RECURVED-LEAVED SWORDFISH DRYANDRA

(*DRYANDRA MUCRONULATA* SUBSP. *RETRORSA*)

INTERIM RECOVERY PLAN

2003-2008

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Photograph: Bethea Loudon

May 2003

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

Natural Heritage Trust
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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This Interim Recovery Plan will operate from May 2003 to April 2008 but will remain in force until withdrawn or replaced.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 11 July, 2003. The provision of funds identified in this Interim Recovery Plan 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 May 2003.

SUMMARY

Scientific Name: *Dryandra mucronulata* subsp. *retrorsa*
Common Name: Recurved-leaved Swordfish Dryandra
Family: Proteaceae
Flowering Period: July to August
The Department's Region: Wheatbelt
The Department's District: Katanning
Shires: Broomehill, Tambellup, Cranbrook
Recovery Team: Katanning District Threatened Flora Recovery Team (KDTFRT)

Illustrations and/or further information: George, A.S. (1996) New taxa and a new infrageneric classification in *Dryandra* R. Br. (Proteaceae: Grevilleoideae). *Nuytsia* 10(3), 313-408; Western Australian Herbarium (1998) FloraBase - Information on the Western Australian Flora. Department of Conservation and Land Management, Western Australia. http://www.calm.wa.gov.au/science/.

Current status: *Dryandra mucronulata* subsp. *retrorsa* was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in March 1999. It currently (2003) meets World Conservation Union (IUCN 2000) Red List Category Critically Endangered (CR) under criteria B1ab(iii)+B2ab(iii) due to the extent of occurrence being less than 100 km^2, the area of occupancy estimated to be less than 10 km^2, a severe fragmentation of populations and a continuing decline in the area, extent and quality of habitat. The main threats are poor regeneration, road maintenance activities, weed invasion, inappropriate fire regimes, grazing, salinity and disease.

Distribution and habitat: *Dryandra mucronulata* subsp. *retrorsa* is endemic to Western Australia where it is apparently confined to the Cranbrook and Broomehill areas. The species grows in grey sandy loam on laterite in *Eucalyptus wandoo* and *E. decipiens* woodland and tall scrub (George 1996).

Critical habitat: The critical habitat for *Dryandra mucronulata* subsp. *retrorsa* 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 subspecies is listed as threatened it is considered that all known habitat for wild and translocated populations is habitat critical.

Benefits to other species/ecological communities: The subspecies is not located with other threatened flora or within a Threatened Ecological Community (TEC). 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 *Dryandra mucronulata* subsp. *retrorsa* 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 subspecies.

Social and economic impacts: The implementation of this recovery plan has the potential to have some minimal social and economic impact, as some populations are located on private property. Where populations occur on lands other than those managed by DCLM, permission is sought from the appropriate land managers prior to recovery actions being undertaken.

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.

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

1. Private property owners, Main Roads WA and Shires have been formally notified of the presence and threatened nature of populations of *Dryandra mucronulata* subsp. *retrorsa* on or adjacent to their land.
2. Declared Rare Flora (DRF) markers have been installed at Population 1. These alert workers to the presence of threatened flora and help prevent accidental damage during maintenance operations.
3. Dashboard stickers and posters, including an illustration, information on their purpose and a contact telephone number, have been produced and distributed.
4. Germinants of *Dryandra mucronulata* subsp. *retrorsa* were sent to the Department's Science Division for dieback testing. All 49 germinants that were inoculated with *Phytophthora cinnamomi* died suggesting that the species is very susceptible to dieback disease.

5. In March 1997 approximately 662 seeds were collected from Population 1. In April 2000 228 seeds were collected from Population 2 and in September 2000 964 seeds were collected from Population 5, 302 seeds from Population 3 and 1441 seeds from Population 4. All are stored at the Department's Threatened Flora Seed Centre (TFSC) at –18°C.
6. The Botanic Garden and Parks Authority (BGPA) currently have no *Dryandra mucronulata* subsp. *retrorsa* in stock.
7. An article about the discovery of Population 3 was placed in the Albany Advertiser in August 2000.
8. A fence is currently being erected around Population 3 to prevent disturbance by stock.
9. The Katanning District Threatened Flora Recovery Team (KDTFRT) is overseeing the implementation of this IRP and will include information on progress in its annual report to the Department's Corporate Executive and funding bodies.
10. Staff from the Department's Katanning District office regularly monitor populations.

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

Recovery criteria

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

Criterion 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. Install Declared Rare Flora markers.
3. Install fencing.
4. Stimulate and monitor germination.
5. Conduct further surveys.
6. Undertake weed control using proven, best practice methods.
7. Rehabilitate habitat.
8. Develop and implement a fire management strategy.
9. Land protection.
10. Collect seed.
11. Confirm presence of Aerial Canker.
12. Liaise with relevant land managers.
13. Monitor populations.
14. Promote awareness.
15. Start the translocation process.
16. Obtain biological and ecological information.
17. Review the need for a full Recovery Plan and prepare if necessary.

1. BACKGROUND

History

Dryandra mucronulata subsp. *retrorsa* was first collected southwest of Broomehill (Population 1) by K. Newbey in 1963 and later by A. George from the same area. Further sightings of the species were made by local wildflower enthusiasts many years later. The first of these was by a local property owner who grew the species from seed he had collected from somewhere north of Tambellup and later a specimen that had been collected from northwest of Cranbrook was confirmed as this taxon. However, it is likely that both these collections were from the area of Population 1. In 1992 M. Pieroni discovered further plants in the same general area as Population 1.

Surveys in 2000 and 2001 by Wendy Bradshaw (Bushcare Officer) and Departmental district staff resulted in the discovery of four new *Dryandra mucronulata* subsp. *retrorsa* populations on private property and road reserves. A possible new population has also been found in the Stirling Range National Park but has yet to be confirmed. The taxon is currently known from 6 populations consisting of around 3893 mature plants.

Description

Dryandra mucronulata R. Br. Subsp. *retrorsa* has 4 to 7 mm wide leaves, with subtending marginal teeth. The inflorescence is often retrorse, sinuses ± U-shaped and 2 to 5 mm across. The perianth is 27 to 30 mm long, the limb 3.5 to 4 mm long. The pistil is 34 to 38 mm long and pollen presenter 2 mm long (George 1996).

Dryandra mucronulata subsp. *retrorsa* differs from *D. mucronulata* subsp. *mucronulata* in having larger flowers and narrower leaves with scalloped margins (George 1996).

Biology and ecology

The subspecific name of *Dryandra mucronulata* subsp. *retrorsa* is derived from the latin *retrorsus* which means turned backwards and refers to the teeth and lobes of the floral leaves (George 1996).

A high level of avian and insect predation on fruit and seed has been observed. At Populations 2, 3 and 7, birds have damaged plants.

Dryandra mucronulata subsp. *retrorsa* may require occasional fire for recruitment. Populations that have not been burnt for many years contain many senescing mature plants and very little regeneration is evident. On the other hand, Population 3 which was burnt in 1984 has two distinct age classes, suggesting that occasional fire may be required for recruitment. The timing of burning however is crucial. A study of three other threatened *Dryandra* species showed that they release the bulk of their seed once ripe. None of these stored a significant seed bank in their crown beyond one year and, as the seed is not hard coated, it was not retained in the soil. Therefore any fires that occur before seed maturation would result in the elimination of the seed bank and adult plants (Monks 1999).

Distribution and habitat

Dryandra mucronulata subsp. *retrorsa* is endemic to Western Australia where it appears to be confined to the Cranbrook and Broomehill areas. The taxon grows in grey sandy loam on laterite in *Eucalyptus wandoo* and *E. decipiens* woodland and tall scrub (George 1996). Associated species include *Allocasuarina humilis*, *Hakea trifurcata*, *Hakea undulata*, *Banksia grandis*, *Gastrolobium spinosum*, *Eucalyptus falcata*, *Dryandra sessilis*, *Xanthorrhoea platyphylla*, *Hakea cucullata*, *Beaufortia cyrtodonta*, *Adenanthos cygnorum*, *Acacia pulchella*, *Kunzea recurva*, *Bossiaea eriocarpa*, *Calothamnus quadrifidus* and *Lechenaultia formosa*.

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

The critical habitat for *Dryandra mucronulata* subsp. *retrorsa* comprises:

- the area of occupancy of known populations,
- areas of similar habitat ie. grey sandy loam on laterite in *Eucalyptus wandoo* and *E. decipiens* woodland and tall scrub, within 200 metres of known populations (these provide potential habitat for natural range extension),
- corridors of remnant vegetation that link populations (these are necessary to allow pollinators to move between populations and are usually road and rail verges),
- the local catchment for the groundwater that provides the habitat of the species,
- additional occurrences of similar habitat that do not currently contain the species (this represents possible translocation sites).

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

Given that this subspecies is listed as threatened it is considered that all known habitat is habitat critical. In addition all populations, including translocated populations, are considered important to the survival of the species. Recovery actions include survey for further populations that would lead to the identification of additional habitat critical.

Threats

Dryandra mucronulata subsp. *retrorsa* was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in March 1999. It currently (2003) meets World Conservation Union (IUCN 2000) Red List Category 'CR' under criteria B1ab(iii)+B2ab(iii) due to the extent of occurrence being less than 100 km^2, the area of occupancy estimated to be less than 10 km^2, a severe fragmentation of populations and a continuing decline in the area, extent and quality of habitat. The main threats are poor regeneration, road maintenance activities, weed invasion, inappropriate fire regimes, grazing, salinity and disease.

- **Poor regeneration**, due to lack of appropriate disturbance, threatens most populations with very few young plants of *Dryandra mucronulata* subsp. *retrorsa* observed in any of them. It appears that once plants reach a certain size they fall over and die.
- **Road maintenance** may threaten Populations 1, 5 and 6. Construction of drainage channels, grading activities, soil and gravel extraction and road widening may impact on road reserve populations. At Population 5 soil from nearby road maintenance activities has been dumped in the road reserve. Removing the mounds would create more disturbance to the site. Some native vegetation has already germinated on top of the mounds but additional planting of endemic species is needed.
- **Weed invasion** is a minor threat to most populations. Weeds suppress early plant growth by competing for soil moisture, nutrients and light. They also exacerbate grazing pressure and increase the fire hazard due to the easy ignition of high fuel loads, which are produced annually by many grass weed species.
- **Inappropriate fire regimes** would affect the viability of populations. It is thought that the species requires occasional fire for recruitment but the seed bank would be depleted if fires were overly frequent and occurred before juvenile plants reached maturity. Further investigation is required and will be addressed in Recovery Action 16.
- **Grazing by rabbits** (*Oryctolagus cuniculus*) has had a minor impact on Population 4 with stems and leaves bitten off on several seedlings. Other threats include digging, increased nutrient levels from droppings and the introduction of weeds. Grazing may have an impact on the establishment of *Dryandra mucronulata* subsp. *retrorsa* seedlings thus limiting the natural recruitment of the species.

- **Grazing and trampling by stock** is a potential risk. Although there is currently no stock accessing the private property remnant containing Subpopulation 7B, this subpopulation may be at risk from future grazing. Grazing threatens plants by removing plant material and damaging surrounding habitat and also has the potential to exacerbate weed encroachment and compact the soil.
- **Rising saline water tables** due to agricultural clearing may be a threat to populations. Within 300 m of Population 1 there is evidence of rising water levels and increasing salinity. Although the area is naturally wet in winter this combination of conditions may be caused by a higher than usual water table. If this trend continues, the long-term survival of the population is doubtful. Assessment and monitoring of the population is required.
- **Disease** is a minor threat to all populations. Aerial canker (*Cryptodiaporthe* sp., *Diplodina* sp.) is thought to be present at several populations with some limb death evident.

Summary of population information and threats

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
1. WSW of Cranbrook	Main Roads WA Road Reserve	1998 21 [5] 2000 50 [21]	Moderate/ Poor	Road maintenance, weeds, poor regeneration, inappropriate fire regimes, salinity, disease
2. NW of Cranbrook	Private Property	2000 80 [10+]	Moderate	Poor regeneration, weeds, inappropriate fire regimes, disease
3. W of Tambellup	Private Property	2000 2000 [2]	Moderate	Inappropriate fire regimes, disease
4. SW of Broomehill	Private Property	2000 1500 (24)[112]	Healthy	Grazing, weeds, inappropriate fire regimes, disease
5. WSW of Tambellup	Shire Road Reserve	2000 14 [5]	Moderate	Road maintenance, weeds, poor regeneration, inappropriate fire regimes, disease
*6				
7A. W of Tunney	Private Property	2001 200+	Healthy	Weeds, inappropriate fire regimes, disease
7B. W of Tunney	Private Property	2001 45	Healthy	Inappropriate fire regimes, senescence, grazing

Numbers in ( ) = number of seedlings. Numbers in [ ] = number dead. *Population 6 is now known to be *Dryandra mucronulata* subsp. *mucronulata.*

Benefits to other species/ecological communities

The subspecies is not located with other threatened flora or within a Threatened Ecological Community (TEC). 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 *Dryandra mucronulata* subsp. *retrorsa* is not listed under any international agreement, the implementation of Australia's 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 subspecies.

Social and economic impacts

The implementation of this recovery plan has the potential to have some minimal social and economic impact, as some populations are located on private property. Areas on private land that are considered to be 'habitat critical' may be regarded as having potential for uses other than conservation by landholders. Approaches that may minimise this potential impact could include land acquisition, covenants or management agreements.

Evaluation of the Plans Performance

The Department of Conservation and Land Management, in conjunction with the Katanning District Threatened Flora Recovery Team will evaluate the performance of this Interim Recovery Plan. The plan is to be reviewed within five years of its implementation. Any changes to management / recovery actions will be documented accordingly.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Developments in the immediate vicinity of any of the populations or within the defined critical habitat of *Dryandra mucronulata* subsp. *retrorsa* require assessment. No developments should be approved unless the proponents can demonstrate that they will have no significant impact on the species, its habitat or potential habitat, the local surface and ground water hydrology, or have the potential to spread or amplify any disease such as *Phytophthora cinnamomi* or aerial canker.

2. RECOVERY OBJECTIVE AND CRITERIA

Objectives

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

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

Private property owners, Main Roads WA and Shires have been formally notified of the location and threatened status of *Dryandra mucronulata* subsp. *retrorsa*. The notification details the Declared Threatened status of the taxon and the legal responsibilities to protect it.

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

Germinants of *Dryandra mucronulata* subsp. *retrorsa* have been sent to the Department's Science Division for dieback testing. All 49 germinants that were inoculated with *Phytophthora cinnamomi* died suggesting that the species is very susceptible to dieback disease (pers comm. C. Crane[1]).

[1] Colin Crane, Senior Technical Officer, the Department's Science Division

Approximately 662 seeds were collected from Population 1 in March 1997 and stored in the Department's TFSC at –18°C. The TFSC test the viability of the seed initially and after one year in storage. The initial germination rate of *Dryandra mucronulata* subsp. *retrorsa* seed was found to range between 94 and 96% and after one year in storage was 76%. Other collections consisted of 228 seeds from Population 2 in April 2000 and 964 seeds from Population 5, 302 seeds from Population 3 and 1441 seeds from Population 4 in September 2000. The initial germination rates were 100%, 93%, 53% and 97% respectively (unpublished data, A. Cochrane).

The Botanic Garden and Parks Authority (BGPA) currently have no *Dryandra mucronulata* subsp. *retrorsa* in stock (pers comm. A. Shade[2]).

An article about the discovery of Population 3 of *Dryandra mucronulata* subsp. *retrorsa* was placed in the Albany Advertiser in August 2000.

A fence is currently being erected around Population 3 of *Dryandra mucronulata* subsp. *retrorsa* to prevent disturbance by stock.

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

Staff from the Department's Katanning District office regularly monitor all populations.

Future recovery actions

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

1. Coordination

The Katanning District Threatened Flora Recovery Team (KDTFRT) will oversee the implementation of recovery actions for *Dryandra mucronulata* subsp. *retrorsa* and will include information on progress in its annual report to the Department's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: The Department (Katanning District) through the KDTFRT
Estimated Cost: $1200 per year.

2. Declared Rare Flora markers

Declared Rare Flora (DRF) markers are required for Population 5 which is on a road reserve. The purpose of DRF markers is to alert road and other workers to the presence of threatened flora and the need to take care when carrying out works in the area.

Action: Install DRF markers
Responsibility: The Department (Katanning District) through the KDTFRT
Estimated Cost: $500 in first year.

3. Fencing

In cooperation with the landowner, a fence will be erected around Population 7B including a buffer of surrounding habitat to protect *Dryandra mucronulata* subsp. *retrorsa* from possible future stock damage.

Action: Install fencing
Responsibility: The Department (Katanning District) through the KDTFRT

[2] Amanda Shade, Horticulturalist, Botanic Garden and Parks Authority

Estimated Cost: $1,700 in the first year.

4. Recruitment

Fire, smokewater and soil disturbance may be effective in stimulating the germination of *Dryandra mucronulata* subsp. *retrorsa* seed and will be trialled around some dead plants. However, as *Dryandra* seed is generally soft coated it is not stored in the soil for long periods and any disturbance trials would need to be undertaken immediately after the seed has matured or as soon after plant death as possible. Yearly monitoring should continue to record the time when flowering first occurs, seed is produced and the plant reaches senescence. This will enable the best interval time between disturbances to be estimated. Soil seed bank monitoring will be addressed under Recovery Action 16.

Action: Stimulate and monitor germination
Responsibility: The Department (Katanning District) through the KDTFRT
Estimated Cost: $3,600 in first and second years and $900 in subsequent years.

5. Surveys

Further surveys, supervised by the Department's staff and with assistance of local volunteers and wildflower society members, will be conducted during the flowering period of *Dryandra mucronulata* subsp. *retrorsa.*

Action: Conduct further surveys
Responsibility: The Department (Katanning District) through the KDTFRT
Estimated Cost: $2,000 per year.

6. Weed control

Weeds are a minor threat to most *Dryandra mucronulata* subsp. *retrorsa* populations. If control is implemented the following will need to be considered.

1. Experience and research to date in similar situations has shown that the use of selective herbicides to control grasses may on occasions result in infestation by broad leaf weeds. There are currently no herbicides available for broad leaf weeds that can be non-selectively sprayed without killing or severely affecting the critically endangered flora. Therefore, care must be taken when implementing control.
2. Broad spectrum, non-residual herbicides, e.g. glyphosate, can be used for spot control of weeds utilising techniques such as direct application or the use of temporary spray shields around native plants. Generally these techniques have been under-utilised in respect to threatened flora and practical methods of application in the field require further development.
3. Hand removal of weeds will be undertaken around *Dryandra mucronulata* subsp. *retrorsa* plants. Care must be taken, as hand weeding is an ongoing option that has the potential to increase weed levels (at least temporarily) as a result of soil disturbance.
4. Within the five-year scope of an IRP weed control will be a short-term protective measure. Long term conservation of populations of CR flora will require further habitat rehabilitation including the replacement of weeds with appropriate native species, including the threatened taxon.

Action: Undertake weed control using proven, best practice methods
Responsibility: The Department (Katanning District, Science Division) through the KDTFRT
Estimated Cost: $600 per year.

7. Rehabilitate habitat

Restoration of habitat by the re-introduction of endemic plant species will be undertaken along the road reserve where Population 5 occurs.

Action: Rehabilitate habitat
Responsibility: The Department (Katanning District) through the KDTFRT
Estimated Cost: $2,800 in first and second years and $600 in subsequent years.

8. Fire management strategy

It is not known what the fire response of *Dryandra mucronulata* subsp. *retrorsa* is. Frequent fire may prevent the accumulation of sufficient soil stored seed for the effective regeneration of populations and is likely to promote the germination of introduced weedy species. On the other hand, *Dryandra mucronulata* subsp. *retrorsa* may require occasional fire for recruitment. If possible, fire other than that for experimental purposes, should be prevented from occurring at least in the short term. 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 (Katanning District) through the KDTFRT
Estimated Cost: $2,500 in first year and $1,000 in subsequent years.

9. Land protection

Formal protection of the land on which Populations 3, 4 and 7 of *Dryandra mucronulata* subsp. *retrorsa* occurs is desirable and will be investigated. Possible methods of achieving future protection include covenanting and land purchase.

Action: Land protection
Responsibility: The Department (Katanning District) through the KDTFRT
Estimated Cost: To be determined

10. Seed collections

Preservation of germplasm is essential to guard against the possible extinction of wild populations and can be used to propagate plants for future translocations. Some seed has already been collected and stored but additional collections are required.

Action: Collect seed
Responsibility: The Department (Katanning District, TFSC) through the KDTFRT
Estimated Cost: $3,300 in first and second years.

11. Aerial Canker

Aerial Canker is thought to be present in most populations with some limb death evident. Samples will be collected and analysed at the Department's Vegetation Health Service for confirmation.

Action: Confirm the presence of Aerial Canker
Responsibility: The Department (Katanning District, Science Division) through the KDTFRT
Estimated Cost: $1,600 in the first year.

12. Liaison

Owners and managers of land containing populations of *Dryandra mucronulata* subsp. *retrorsa* have been officially notified of the occurrence of the species. Staff from the Department's Katanning District will continue to liaise with owners and land managers to ensure the populations are not damaged or destroyed accidentally.

Action: Liaise with relevant owners and land managers
Responsibility: The Department (Katanning District) through the KDTFRT
Estimated Cost: $700 per year.

13. Monitoring

Monitoring of factors such as weed invasion, habitat degradation (including the impact of dieback), salinity levels and population stability (expansion or decline), pollinator activity, seed production, recruitment, and longevity is essential. All populations will be inspected annually with special attention given to salinity levels and its impact. Soil salinity and pH readings will be taken annually.

Action: Monitor populations
Responsibility: The Department (Katanning District) through the KDTFRT
Estimated Cost: $1,500 per year.

14. Community awareness

The importance of biodiversity conservation and the need for the long-term protection of *Dryandra mucronulata* subsp. *retrorsa* populations in the wild will be promoted to the public through the local print, electronic media and poster displays. An information sheet, which includes a description of the plant, its habitat type, threats, management actions and photos will be produced. Formal links with local naturalist groups and interested individuals will also be encouraged.

Due to the potential susceptibility of this subspecies to dieback caused by *Phytophthora* spp., the need for dieback hygiene procedures will be included in information provided to visitors and workers when they are at the site of populations. This will stress the need to restrict the movement of soil into the habitat of the populations.

Action: Increase community awareness
Responsibility: The Department (Katanning District, Corporate Relations) through the KDTFRT
Estimated Cost: $1,900 in first year, $1,200 in the second year and $900 in subsequent years.

15. Translocations

Because *Dryandra mucronulata* subsp. *retrorsa* is not known to occur on land managed for conservation its translocation to a secure area is of high priority. Although translocations are generally undertaken under full Recovery Plans, it is possible to develop a translocation proposal and start propagating plants within the time frame of an Interim Recovery Plan. Information on the translocation of threatened animals and plants 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 Director of Nature Conservation.

Action: Start the translocation process
Responsibility: The Department (Katanning District) through the KDTFRT
Estimated Cost: $5,100 in third year

16. Biology and ecology

Better knowledge of the biology and ecology of *Dryandra mucronulata* subsp. *retrorsa* will provide a scientific basis for management of the wild populations. An understanding of the following is necessary for effective management:

1. The pollination biology of *Dryandra mucronulata* subsp. *retrorsa*
2. The soil seed bank dynamics, seed life and the effect of disturbance, competition, rainfall and grazing on germination and seedling survival.
3. Reproductive strategies, phenology and seasonal growth.
4. Population genetic structures, levels of genetic diversity and minimum viable population size.
5. The impact of water logging and/or salinity on the subspecies and its habitat.
6. The impact of dieback disease and control techniques on the subspecies and its habitat.

Action: Obtain biological and ecological information
Responsibility: The Department (Science Division, Katanning District) through the KDTFRT

Estimated Cost: $18,500 per year.

17. Full Recovery Plan

If *Dryandra mucronulata* subsp. *retrorsa* is still ranked as Critically Endangered at the end of the fourth year of the five-year term of this Interim Recovery Plan, 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, Katanning District) through the KDTFRT
Cost:	$20,600 in the fifth year (if required).

4. TERM OF PLAN

This Interim Recovery Plan will operate from May 2003 to April 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 17 above will be implemented.

5. ACKNOWLEDGMENTS

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

Brett Beecham	Regional Ecologist, the Department's Wheatbelt Region, Narrogin
Sarah Barrett	Conservation Officer, the Department's Albany District
Wendy Bradshaw	Bushcare Officer
Anne Cochrane	Manager, the Department's Threatened Flora Seed Centre
Colin Crane	Senior Technical Officer, the Department's Science Division
Mal Graham	Former District Operations Officer, the Department's Katanning District
Amanda Shade	Horticulturalist, Botanic Garden and Parks Authority

We would like to thank the staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information, and the Department's Wildlife Branch for their extensive assistance.

6. REFERENCES

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

Department of Conservation and Land Management (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.

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

George, A.S. (1996) New taxa and a new infrageneric classification in *Dryandra* R. Br. (Proteaceae: Grevilleoideae). *Nuytsia* 10(3), 313-408.

Monks L. (1999) Conservation biology of the rare and threatened *Dryandra ionthocarpa*, *D. mimica* and *D. serra*. Master of Science (Natural Resources) Thesis. School of Environmental Biology, Curtin University of Technology. Bentley, Western Australia.

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

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

George, A.S. (1996) New taxa and a new infrageneric classification in *Dryandra* R. Br. (Proteaceae: Grevilleoideae). *Nuytsia* 10(3), 313-408.

Dryandra mucronulata R. Br. Subsp. *retrorsa* A.S. George has *leaves* 4-7 mm wide; teeth of leaves subtending inflorescence often retrorse; sinuses ± U-shaped, 2-5 mm across. *Perianth* 27-30 mm long; limb 3.5-4 mm long. *Pistil* 34-38 mm long; pollen presenter 2 mm long.