

INTERIM RECOVERY PLAN NO. 200

MANYPEAKS RUSH

(Chordifex abortivus)

RECOVERY PLAN

Renée Hartley, Sandra Gilfillan and Sarah Barrett



FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in WA Department of Conservation and Land Management (CALM) Policy Statements Nos. 44 and 50. Note: the Department of CALM formally became the Department of Environment and Conservation (DEC) in July 2006. DEC will continue to adhere to these Policy Statements until they are revised and reissued.

IRPs outline the recovery actions that are required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process.

DEC is committed to ensuring that Threatened taxa are conserved through the preparation and implementation of Recovery Plans (RPs) or IRPs and by ensuring that conservation action commences as soon as possible.

This IRP will operate from October 2005 to September 2010 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked Vulnerable (WA), this IRP will be reviewed after five years and the need further recovery actions assessed.

This IRP was given regional approval on 26 October, 2005 and was approved by the Director of Nature Conservation on 26 October, 2005. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting DEC, as well as the need to address other priorities.

This IRP has been updated with information contained herein accurate as at January 2008.

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

ACKNOWLEDGMENTS

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

Anne Cochrane	Manager, DEC Threatened Flora Seed Centre
Andrew Brown	Threatened Flora Coordinator, DEC Species and Communities Branch
Kathy Meney	Director and Principal Environmental Consultant, Syrinx Environmental Pty Ltd

Thanks also to staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information, and DEC Wildlife Branch for their assistance.

SUMMARY

Scientific Name:	<i>Chordifex abortivus</i>	Common Name:	Manypeaks Rush
Family:	Restionaceae	Flowering Period:	August to October
DEC Regions:	South Coast	DEC District:	Albany Work Centre
Shires:	City of Albany	Recovery Team:	Albany 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; Western Australian Herbarium (2007) FloraBase - Information on the Western Australian Flora. Department of Conservation and Land Management, Western Australia. <http://www.calm.wa.gov.au/science/>. Meney, K.A. and Pate, J.S. (Eds) (1999) *Australian Rushes. Biology, Identification and Conservation of Restionaceae and Allied Families* University of Western Australia Press, Australian Biological Resources Study.

Current status: *Chordifex abortivus* was declared as Rare Flora under the *Western Australian Wildlife Conservation Act 1950* in May 1991 and is currently ranked Vulnerable (VU) under World Conservation Union (IUCN 2001) Red List Criterion D2 due to its restricted area of occupancy and the small number of populations. Three populations (five subpopulations) are currently known and together total around 2.17 million plants. Two populations approximately 40 kilometres apart, together total around 2,000,000 plants over an area of 194 hectares. The species is listed as Endangered under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*.

Description: *Chordifex abortivus* is an erect, slightly spreading perennial herb to 60cm high. It has separate male and female plants. The hollow jointed culms are 1.5 to 2.5 mm in diameter and olive green. The culm sheaths are flared and the lamina is absent. They have numerous branches, with each branch divided again into branchlets and terminating in spikelets. Egg-shaped bracts with hairy tips surround the base of each stem. Male plants have egg-shaped spikelets, 4 to 5 mm long, while those of females are slightly longer, with sickle-shaped tips. Both old and new, rust red spikelets are present. The rhizomes are horizontal to erect, on the surface or buried to 1 cm deep, pale brown with prominent tufts of ginger hairs.

Habitat requirements: *Chordifex abortivus* is currently known from three populations approximately 40 kilometres apart in the Waychinicup area east of Albany. The species grows in sand over gravelly clay in heath or scrub with a sedge understorey. Associated species include *Hakea cucullata*, *Banksia brownii*, *B. baxteri*, *B. coccinea*, *Melaleuca striata*, *Pericalymma ellipticum* and *Dasypogon bromeliifolius*.

Habitat critical to the survival of the species, and important populations: The habitat critical to the survival of *Chordifex abortivus* comprises the area of occupancy of important populations; areas of similar habitat surrounding important populations (these areas provide potential habitat for natural range extension and for allowing pollinators or biota essential to the continued existence of the species to move between populations); and additional occurrences of similar habitat that may contain important populations of the species or be suitable for future translocations or other recovery actions intended to create important populations. Given that this taxon is listed as Endangered it is considered that all populations are important populations.

Benefits to other species/ecological communities: *Chordifex abortivus* occurs in the same location as a population of the Critically Endangered (WA) *Banksia brownii*. The population is also within the known range of four threatened bird species and could potentially contain the Endangered Dribbler (*Parantechinus apicalis*). Recovery actions put in place for *C. abortivus* will benefit the above threatened species and reciprocally, recovery actions for these species will benefit *C. abortivus*.

International obligations: This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity and will assist in implementing Australia's responsibilities under that convention. The taxon is not listed under any specific international treaty, however and therefore this IRP does not affect Australia's obligations under any other international agreements.

Role and interests of Indigenous people: Involvement of the Indigenous community is being sought through the advice of the Department of Indigenous Affairs to determine whether there are any issues or interests identified in the plan. A search of the Department of Indigenous Affairs Aboriginal Heritage Sites Register has identified that there are no sites of Aboriginal significance at or near populations of the species covered by this IRP. Where no role is identified for the Indigenous community associated with this species in the development of the recovery plan, opportunities may exist through cultural interpretation and awareness of the species. Indigenous involvement in the implementation of recovery actions will be encouraged.

Affected interests: All populations are on Crown land.

Social and economic impacts: The implementation of this Interim Recovery Plan has the potential to have some minimal social and economic impact, as parts of Population 1 are located within an Unvested Crown Reserve and proposed National Park and Population 2 is in a City of Albany Reserve. Recovery actions include continued liaison between all stakeholders with regard to the conservation of this species.

Evaluation of the Plan's Performance: The Department of Environment and Conservation (DEC), in conjunction with the Albany District Threatened Flora Recovery Team (ADTFRT) will evaluate the performance of this IRP.

Completed Recovery Actions: The following recovery actions have been implemented:

1. All land managers have been notified of the location and threatened status of the species.
2. Rare flora markers have been installed at both populations.
3. Staff from the DEC's Albany Work Centre and volunteers have regularly monitored populations.
4. Seed collections have been made by staff at DEC's Threatened Flora Seed Centre (TFSC).
5. Fire management strategies are in place.

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 species in the wild.

Recovery criteria

Criterion for success: The number of populations and individuals within populations remains stable or increases over the five years of the plan.

Criterion for failure: The number of populations or the number of individuals within populations decreases over the five years of the plan.

Recovery actions

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| 1. Coordinate recovery actions. | 6. Obtain biological and ecological information. |
| 2. Monitor populations. | 7. Implement weed control |
| 3. Implement a fire management strategy. | 8. Promote awareness and encourage involvement |
| 4. Conduct further surveys. | 9. Map habitat critical to the survival of the species |
| 5. Undertake seed collection and <i>ex situ</i> propagation. | 10. Review the IRP and assess the need for further recovery actions |

1. BACKGROUND

History

Chordifex abortivus, commonly called Manypeaks rush, was collected by Ludovich Preiss at Cape Riche in 1840 and described by Esenbech von Nees from this collection. It was thought to be an aberrant form of another *Restio* (now *Chordifex*) species but it was later considered by Dr. B. Briggs and Dr. L.A.S. Johnson to be a good taxon.

This early collection remained the only one for over 100 years (Meney and Pate 1999), until it was rediscovered by E.J. Croxford in 1986. In 1996, E.J. Croxford collected the species from a Reserve in Lower King, where it was relocated in 2004 and in 2005 a third population was located on Private property.

It is currently known from three locations. Population 1, consisting of three subpopulations, approximately 40 kilometres east of Albany; Population 2 in Lower King approximately 10 kilometres from Albany's centre and Population 3 on Private property near the location of Population 1. The species has not been relocated at the type location at Cape Riche or along Waychinicup Road where located by E.J. Croxford in 1986. The reason for its apparent disappearance from these sites is unclear. The total number of plants is currently estimated to be around 2,000,000, occupying approximately 194 hectares.

Description

Chordifex abortivus was previously known as *Restio abortivus*, however, *Restio* is now considered an African genus. Most Western Australian species previously referred to as *Restio* are now placed in the genus *Chordifex* (Meney and Pate 1999). The genus is named from the Latin word meaning 'rope maker' and the species name reflects its very high level of aborted seed (Meney and Pate 1999). *Chordifex abortivus* is related to crinkled rush (*Chordifex crispatus*), which occurs from east of Albany to Esperance.

Chordifex abortivus is an erect, slightly spreading perennial herb, up to 60 cm high. It has separate male and female plants, although they are not easily distinguished. The hollow jointed culms are 1.5 to 2.5 mm in diameter and olive green. The culm sheaths are flared and the lamina is absent. They have numerous branches, with each branch divided again into branchlets and terminating in spikelets. Egg-shaped bracts with hairy tips surround the base of each stem. Male plants have egg-shaped spikelets, 4 to 5 mm long, while those of females are slightly longer, with sickle-shaped tips. Both old and new, rust red spikelets are present. The rhizomes are horizontal to erect, on the surface or buried to 1 cm deep, pale brown with prominent tufts of ginger hairs. *Chordifex abortivus* is readily distinguished from all other *Chordifex* species by the characteristic spikelet shape and profuse upper branching of the culms (Brown *et al.* 1998; Meney and Pate 1999).

Distribution and habitat

Chordifex abortivus is currently known from just three locations. Population 1 (approximately 193 ha) is approximately 40 kilometres east of Albany in Waychinicup National Park and adjoining Unvested Crown Reserve. Population 2 (approximately 1 ha) occurs in Lower King, in a City of Albany Reserve. Population three, located during surveys in 2005, contains approximately 500 plants. The species grows in sand over gravelly clay in heath or scrub with a sedge understorey. Associated species include *Hakea cucullata*, *Banksia brownii*, *B. baxteri*, *B. coccinea*, *Melaleuca striata*, *Pericalymma ellipticum* and *Dasypogon bromeliifolius*.

Population 1 consists of three sub-populations, separated by Cheyne Rd and Waychinicup Rd. The majority of this population occurs within Waychinicup National Park. However, Sub-population 1A and a small part of Sub-population 1B occur within an Unvested Crown Reserve (proposed National Park).

A detailed biogeography of *Chordifex abortivus* has not been properly established to date (¹K. Meney, personal communication), therefore the reason for the species restricted range is unclear. The species distribution may have been reduced as a result of land clearing. It is also suspected to be relatively drought sensitive and it may have contracted south to its existing area in response to the long-term climate change (K. Meney, personal

¹ Kathy Meney Director and Principal Environmental Consultant, Syrinx Environmental Pty Ltd

communication). The species intrinsic rarity is possibly related to its reproductive failure (Meney and Pate 1999).

Biology and ecology

Chordifex abortivus is a seeder, with a seed maturation period of 10 to 12 months (Meney and Pate 1999). It is wind pollinated and is therefore not dependent on specific pollinating agents. The fruit is a capsule dehiscent, that is the capsule breaks open to release the seeds whilst the whole capsule is still attached to the parent plant. The capsule contains two compartments (locules), each bearing an ovule, however usually only one ovule is developed and fertile (Meney and Pate 1999). The species has an exceptionally low seed:ovule ratio, typically aborting 89% of its flowers (Meney and Pate 1999). In a trial at Kings Park and Botanic Garden, only 11% of flowers set seed and only 3% of seed were germinable (Meney and Pate 1999, Meney *et al.* 1997). It is likely that genetic lethals, possibly as a result of inbreeding, are the cause of successfully fertilised ovules being aborted (Meney *et al.* 1997).

Chordifex abortivus germinates predominantly after fire. The species recruited an average of 300 seedlings per square metre after the 1996 summer fire, which partially burnt Population 1 (K. Meney, unpubl.). The high post-fire recruitment reflects a high seed output per plant, due to the large numbers of culms and individual spikelets produced (K. Meney, personal communication). Current densities in all sub-populations of Population 1 of various fire ages are approximately 5 plants per square metre. *C. abortivus* also displays extensive recruitment after human induced soil disturbance. This would suggest that the species is a general disturbance opportunist rather than just a fire-obligate recruiting species (Meney and Pate 1999).

Large persistent seed banks are not characteristic of Restionaceae species studied to date. Seeds of tested species decline in germinability to less than 5% after only 12 to 21 months storage (Meney and Pate 1999). The time between disturbance events and the timing of disturbance events is absolutely critical for a seeder species given that the seedlings must at least attain a semblance of reproductive activity to contribute appreciably towards replenishment of short-lived seed banks (Meney and Pate 1999).

The reproductive potential of *Chordifex abortivus* has been determined in a study by Meney *et al.* (1997). The species was found to have a poor pre-dispersal success rate, primarily due to high incidences of fruit failure (carpel:flower ratio of 0.23). Pre-dispersal reproductive potential (seed:ovule ratio x carpel:flower ratio) was 0.11, which is low for a seeder species. In an isolated embryo test, *C. abortivus* yielded only 3% germination. The species extremely low seed:ovule ratio combined with poor germinability to give inordinately low values for post-dispersal reproductive potential (0.003). A relatively high mean ovule number per culm offsets this, however. The number of germinable seeds per female *C. abortivus* plant per year was calculated to be 16.3, given that females make up around 48.5% of the population. This output can only be met by large adult plants, suggesting that long periods between successive fires and other disturbances would be required to maintain the population (Meney *et al.* 1997).

Phytophthora cinnamomi is an introduced soil-borne plant pathogen. Infection results in plant death in susceptible species through the destruction of root systems. The impact of the disease on plant communities is variable between sites as it is dependent on temperature, soil type, nutrient status, water and species susceptibility. The greatest impact usually occurs where soils are infertile and drainage is poor (Weste and Marks 1987; Shearer and Tippett 1989; Wilson *et al.* 1994).

Restionaceae species in general show high resistance to *Phytophthora cinnamomi*. This lead to an apparent dominance of these species in *P. cinnamomi* infested sites due to the loss of susceptible species. However, positive impacts on the long-term survival of Restiads remain to be seen (Meney and Pate 1999).

Chordifex abortivus plants exposed to *Phytophthora cinnamomi* in pot trials have been observed to form root lesions. A new root was produced above the infection and no signs of gross symptoms were evident (Brown *et al.* 1998). The species does therefore not appear to be susceptible to *P. cinnamomi*. The habitat of all *C. abortivus* populations in the Waychinicup area is largely infested with *P. cinnamomi*.

In June 2004, approximately 15% culm death was observed in Population 1, in both *Phytophthora cinnamomi* free and *P. cinnamomi* infested habitat (S. Gilfillan, personal observation.). A sample was taken which tested

negative for *P. cinnamomi* infection. The same level of culm death was observed in habitat burnt in 1996 and 1989. It therefore seems unlikely that the deaths are due to either *P. cinnamomi* or fire age. The reason for these deaths is yet to be determined. The possibility of drought stress has not been ruled out.

Smuts are the most debilitating pathogens of rushes and sedges (Websdane *et al.* 1994). Smuts are a group of fungi that can fully replace the reproductive structures of a host and render the plant sterile (Meney and Pate 1999). In many seeder species, smut infection causes total loss of reproductive capacity. Incidence appears to increase with disturbance. Twenty to fifty percent smutting of rushes has been recorded in populations experiencing frequent fires, mining activities or road works (Websdane *et al.* 1994).

The susceptibility of *Chordifex abortivus* to smut disease has not been tested to our knowledge; however, other species of *Chordifex* are known to be susceptible. In a number of species, infection of inflorescences can only be diagnosed after careful examination (Websdane *et al.* 1994). It is therefore possible that the disease is present within *C. abortivus* populations and has not yet been identified.

Threats

Chordifex abortivus was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in May 1991 and is currently ranked Vulnerable (VU) under World Conservation Union (IUCN 2001) Red List criterion D2 due to its restricted area of occupancy and its small number of locations. Three populations approximately 40 kilometres apart are currently known and together total around 2,000,000 plants over an area of 194 hectares. The species is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

All areas occupied by this taxon are affected or potentially affected by one or more threats identified in this IRP. Threats include:

- **Inappropriate fire regime:** Population 1A and the most part of Population 1C were last burnt in 1987. The southern section of Population 1C was burnt in a 1992 fire. The eastern section of Population 1B was last burnt in 1989 and the western section was burnt more recently in 1996. Population 2 was last burnt in a controlled burn in April 1995.

Chordifex abortivus germinates predominantly after fire, however, poorly timed fires can be particularly damaging to obligate seeders that do not maintain large, persistent seed banks. Such species rely heavily on the last major seed production event to regenerate (Meney and Pate 1999). The species flowers from August to October, so a fire in early spring for example, before seeds have ripened, can be devastating. Long periods between times of disturbance are necessary for individuals to produce high culm numbers to compensate for poor germinability.

- **Weed invasion:** *Chordifex abortivus* habitat in Population 2 is heavily infested with weeds, including *Psoralea pinnata*, *Acacia longifolia* and various grasses. Weeds suppress early plant growth by competing for soil moisture, nutrients and light, and are blown in from adjoining pasture. 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 weed species.
- **Small isolated populations (intrinsic rareness):** Small geographic range and limited distribution increases the vulnerability of species to local extinction through stochastic events. The restricted area of occupancy of *Chordifex abortivus* increases the chances of extinction by demographic stochasticity (e.g. lack of recruitment in one year) or environmental stochasticity (random variation in environmental factors such as rainfall or fire).

In the study by Meney *et al.* (1997), only a small percentage of ovules of *Chordifex abortivus* were non-developed, indicating that most are likely to have been successfully fertilized but were subsequently aborted. It is possible that genetic lethals may be operating within the population as a result of inbreeding (Meney *et al.* 1997).

- **Edge effects:** Population 2 is subjected to influences from adjacent cleared farmland, or edge effects, as it is only five metres from the reserve's boundary fence. Effects may include increased fertiliser runoff, modified hydrology and altered disturbance and fire regimes.
- **Roadworks:** Road maintenance poses a minor threat to Population 1 and firebreak maintenance poses a threat to Population 2.
- **Climate change:** Long-term climate change is likely to stress the *Chordifex abortivus* populations given the predicted increases in temperature, evaporation and sea level and decrease in rainfall. It has been speculated that those groups likely to be most affected by climate change include geographically localised taxa, peripheral or disjunct populations, specialised species, poor dispersers, genetically impoverished species, and coastal communities (Peters & Darling 1985).

Summary of population land vesting, purpose and tenure

Population	Vesting	Purpose	Tenure
1A Waychinicup	Unvested	Waychinicup River Catchment Area	Non DEC Act - General
1B Waychinicup	WA Conservation Commission	National Park	National Park
1C Waychinicup	WA Conservation Commission	National Park	National Park
2 Lower King	City of Albany	Use & Requirements of Shire of Albany	Non DEC Act - General
3 South of Green Range	-	Private property	Private property

Summary of population information and threats

Pop. No. & Location	Year/No. plants	Condition	Threats
1A Crown Reserve	1990 100 1996 10,000+ 1999 100,000+/- (all sub-populations) 2002 partial survey 2004 10,000+/-	Unknown Healthy Healthy Healthy Moderate	Fire Roadworks
1B Waychinicup National Park	1996 100+ 2002 50,000+/- 2004 2,000,000+/-	Poor Healthy Moderate	Fire Roadworks
1C Waychinicup National Park	1996 800+ 2002 50,000+/- 2004 160,000+/-	Moderate Healthy Moderate	Fire Roadworks
2 Shire Reserve Lower King	1996 Herbarium specimen 2004 100+/-	Healthy Healthy	Fire Weeds
3 Private property south of Green range	2005 500+	Healthy	Weeds, grazing

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

The habitat critical to the survival of *Chordifex abortivus* comprises the area of occupancy of important populations; areas of similar habitat surrounding important populations (these areas provide potential habitat for natural range extension and for allowing pollinators or biota essential to the continued existence of the species to move between populations); and additional occurrences of similar habitat that may contain important populations of the species or be suitable for future translocations or other recovery actions intended to create

important populations. Given that this taxon is listed as Endangered it is considered that all populations are important populations.

Benefits to other species/ecological communities

Chordifex abortivus occurs in the same location as a population of the Critically Endangered *Banksia brownii*. The population is also within the known range of four threatened bird species: the Endangered Western Ground Parrot (*Pezoporus wallicus flaviventris*), Endangered Western Whipbird (western heath subsp. *Psophodes nigrogularis nigrogularis*), Vulnerable Western Bristlebird (*Dasyornis longirostris*) and Vulnerable Noisy Scrub-bird (*Atrichornis clamosus*). This area could potentially contain the Endangered Dibbler (*Parantechinus apicalis*), as records of this species occur within five kilometres and are from vegetation dominated by *Banksia* spp. with continuous remnant vegetation in between. Recovery actions put in place for *C. abortivus* will benefit the above threatened species and reciprocally, any recovery actions in place for these species will benefit *C. abortivus*.

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. *Chordifex abortivus* is not specifically listed under any international treaty and therefore this plan does not affect Australia's obligations under any other international agreements.

Role and interests of Indigenous people

Involvement of the Indigenous community is being sought through the advice of the Department of Indigenous Affairs to determine whether there are any issues or interests identified in the plan. A search of the Department of Indigenous Affairs Aboriginal Heritage Sites Register has identified that there are no sites of Aboriginal significance at or near populations of the species covered by this IRP. Where no role is identified for the Indigenous community associated with this species in the development of the recovery plan, opportunities may exist through cultural interpretation and awareness of the species. Indigenous involvement in the implementation of recovery actions will be encouraged.

Affected interests

All populations are on Crown Land.

Social and economic impacts

The implementation of this IRP has the potential to have some minimal social and economic impact, as parts of Population 1 are located within Unvested Crown Reserve (proposed National Park) and Population 2 is located in the City of Albany Reserve. However, recovery actions refer to continued negotiations between stakeholders with regard to these areas.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Developments in the immediate vicinity of the population or within the defined habitat critical to the survival of *Chordifex abortivus* require assessment. No developments should be approved unless the proponents can demonstrate that they will not have a detrimental impact on the species, or its habitat or potential habitat, or the local surface and ground water hydrology.

Evaluation of the Plan's Performance

DEC, in conjunction with the Albany District Threatened Flora Recovery Team, will evaluate the performance of this recovery plan. In addition to annual reporting on progress against the criteria for success and failure, the

plan is to be reviewed within five years of its implementation. Any changes to management or recovery actions made in response to monitoring results will be documented accordingly.

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.

Criteria for success: The number of populations and individuals within populations remains stable or increases over the five years of the plan.

Criteria for failure: The number of populations or the number of individuals within populations decreases over the five years of the plan.

3. RECOVERY ACTIONS

Completed recovery actions

All land managers have been notified of the location and threatened status of *Chordifex abortivus*. The notification details the Declared Rare status of the species and the legal responsibility to protect it.

Declared Rare Flora (DRF) markers have been installed at both populations. The markers alert road workers of the presence of threatened flora and help prevent accidental damage during maintenance operations.

Seed collections were made, however it was found that none was viable. Some was immature but the majority of fruits had aborted seed (²A. Cochrane, personal communication).

A fire management strategy has been developed for the area (Comer *et al.* 2003).

Ongoing and future recovery actions

Regular population monitoring is being conducted, with population numbers and condition recorded.

Firebreaks in the vicinity of *Chordifex abortivus* are currently maintained by DEC.

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

The following recovery actions are roughly in order of descending priority; however, this should not constrain addressing any of the priorities if funding is available for 'lower' priorities and other opportunities arise.

1. Coordinate recovery actions

The Albany District Threatened Flora Recovery Team (ADTFRT) is coordinating recovery actions for *Chordifex abortivus* and include information on progress in their annual reports to DEC's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: DEC (Albany Work Centre) through the ADTFRT
Cost: \$3,000 per year.

2. Monitor populations

² Anne Cochrane Manager, DEC Threatened Flora Seed Centre

Regular (annual) monitoring of *Chordifex abortivus* abundance, extent and health is ongoing. Monitoring of Population 2 last occurred in 2007, with Population 3 monitored in 2006 and Subpopulations 1a, 1b and 1c monitored in 2004.

Action: Monitor populations
Responsibility: DEC (Albany Work Centre)
Cost: \$1,365 per year.

3. Implement a fire management strategy

Fire management for Population 1 for the term of this Interim Recovery Plan (five years) is in the form of fire exclusion to allow plants to reach maturity. A fire management strategy for Population 2 is being developed in cooperation with the City of Albany. The primary fire management focus for the species is control from burns.

Action: Implement a fire management strategy
Responsibility: DEC (Albany Work Centre)
Cost: \$3,050 every second year.

4. Conduct further surveys

Surveys supervised by DEC staff, with assistance from local naturalists and wildflower society members, are being conducted during the species' flowering period (August to October). Similar habitat has not been extensively surveyed. Information on soil and vegetation types will be used to identify similar habitat to target for further survey.

Action: Conduct further surveys
Responsibility: DEC (Albany Work Centre)
Cost: \$4,550 per year.

5. Seed collection and *ex situ* propagation

Propagation protocols have been developed for *Chordifex abortivus* (Meney and Pate 1999), however there is currently no seed in storage due to previous collection attempts proving unsuccessful. Further attempts will be made to establish an *ex situ* collection.

Action: Seed Collection
Responsibility: DEC (Threatened Flora Seed Centre and Albany Work Centre)
Cost: \$11,000 in the first year and \$1,365 each year thereafter.

6. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Chordifex abortivus* will provide a better scientific basis for management of the wild populations. An understanding of the following is particularly necessary for effective management:

1. Population dynamics over time and the effects of frequent and seasonal fire.
2. Soil moisture, depth to groundwater and drought stress effects.
3. The presence, extent and effect of smut disease within the *in situ* populations.

Action: Obtain biological and ecological information
Responsibility: DEC (Science Division and Albany Work Centre)
Cost: \$20,800 per year for the final three years.

7. Implement weed control

Weed control is paramount in Population 2 where the weeds appear to be out-competing and overcrowding the native species. Various methods may be required for their removal and control. Weed control has been undertaken by City of Albany with subsequent follow up control. These actions have proved successful with little re-growth of introduced weed species evident.

The following weed management actions have been identified:

1. Prioritise areas and weed species to target for weed control based on invasiveness, size of infestation, and impact of disturbance.
2. Choose and implement appropriate weed control method/s.
3. Control invasive weeds by hand removal and/or spot spraying around *Chordifex abortivus* plants.
4. Monitor the success of the treatment on weed death and the tolerance of *Chordifex abortivus* and adjacent native plant species to the treatment.
5. Report on the method, timing, and success of the treatment, and effect on *Chordifex abortivus* and associated native plants species.

Action: Implement weed control
Responsibility: DEC (Science Division and Albany Work Centre)
Cost: \$5,200 per year.

8. Promote awareness and encourage involvement

The importance of biodiversity conservation and the need for the long-term protection of wild populations of this species will be promoted to the community through poster displays and the local print and electronic media. The City of Albany has been informed of the presence of the species. Formal links with local naturalist groups and interested individuals is also being encouraged. Particularly, input and involvement is being sought from any Noongar groups that have an active interest in the areas that are habitat for *Chordifex abortivus*.

Action: Promote awareness and encourage involvement
Responsibility: DEC (Albany Work Centre) through the ADTFRT
Cost: \$900 per year.

9. Map habitat critical to the survival of the species

The areas of occupancy of currently known *Chordifex abortivus* populations have been mapped; however, other parts of the habitat critical to the survival of the species have not. The process will clearly identify potential habitats which may be currently unoccupied yet present opportunities for reintroduction or reinvasion and which need to be protected and/or rehabilitated to ensure the long-term future of the species. If additional populations are located, habitat critical to survival will also be determined and mapped for them.

Action: Map habitat critical to the survival of the species
Responsibility: DEC (Albany Work Centre)
Cost: \$600 in the first year.

10. Review IRP and assess the need for further recovery actions

If *Chordifex abortivus* is still ranked as Vulnerable at the end of the five-year term of this IRP, the plan will be reviewed and the need for further recovery actions assessed.

Action: Review the IRP and assess the need for further recovery actions
Responsibility: DEC (WATSCU and Albany Work Centre) through the ADTFRT
Cost: \$4,000 in the fifth year (if required).

4. TERM OF PLAN

Western Australia

This Interim Recovery Plan will operate from October 2005 to September 2010 but will remain in force until withdrawn or replaced. If the species is still ranked Vulnerable (WA) after five years, this plan will be reviewed and the need for further recovery actions determined.

Commonwealth

In accordance with the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) this adopted recovery plan will remain in force until revoked.

The recovery plan must be reviewed at intervals of not longer than 5 years.

5. REFERENCES

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6. TAXONOMIC DESCRIPTION

Chordifex abortivus is an erect, slightly spreading perennial herb, up to 60 cm high. It has separate male and female plants, but they are not easily distinguished. The hollow, jointed stems, up to 1 mm in diameter, are olive green. They have numerous branches, with each branch divided again into branchlets, terminating in spikelets. The base of each stem is surrounded by egg-shaped bracts with hairy tips. Male plants have egg-shaped spikelets, 4 to 5 mm long, while those of females are slightly longer, with sickle-shaped tips. Both old and new, rust-coloured spikelets are present.