Government of **Western Australia**
Department of **Environment and Conservation**

INTERIM RECOVERY PLAN NO. 322

WEBB'S MOSS

(*Rhacocarpus rehmannianus* var. *webbianus*)

INTERIM RECOVERY PLAN

2012–2017

March 2012
Department of Environment and Conservation
Warren Region

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (CALM) Policy Statements Nos. 44 and 50. 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.

These plans 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 and, in the case of Critically Endangered taxa, always within one year of endorsement of that rank by the Minister.

This plan will operate from March 2012 to February 2017 but will remain in force until withdrawn or replaced. It is intended that, if the variety is still ranked as Critically Endangered in WA, this plan will be reviewed after five years and the need for further recovery actions assessed.

This plan was given regional approval on 30th March 2012 and was approved by the Director of Nature Conservation on 19th April 2012. The provision of funds identified in this plan is dependent on budgetary and other constraints affecting DEC, as well as the need to address other priorities.

Information in this plan was accurate at March 2017.

IRP PREPARATION

This plan was prepared by Cassidy Newland[1], Andrew Brown[2], Dr Niels Klazenga[3] and Robyn Luu[4].

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ACKNOWLEDGMENTS

The following people provided assistance and advice in the preparation of this plan:

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Ray Cranfield	Senior Technical Officer, DEC Science Division
Roger Hearn	Regional Ecologist, DEC Warren Region
Edward Middleton	Volunteer, DEC Frankland District
Nikki Rouse	Former Flora Conservation Officer, DEC Frankland District
Amanda Shade	Assistant Curator (Nursery), Botanic Gardens and Parks Authority
Jo Smith	Flora Conservation Officer, DEC Donnelly District
Ian Wilson	Nature Conservation Coordinator, DEC Warren Region

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Cover photograph taken at Population 2 by Cassidy Newland.

CITATION

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SUMMARY

Scientific Name:	***Rhacocarpus rehmannianus* var. *webbianus***	**Common Name:**	Webb's Moss
Family:	HEDWIGIACEAE	**Flowering Period:**	NA
DEC Region:	Warren	**DEC Districts:**	Donnelly, Frankland
Shires:	Manjimup	**NRM Regions:**	South West Catchment Council
Recovery Team:	Warren Region Threatened Flora Recovery Team (WRTFRT)	**IBRA Region:**	Warren

Illustrations and/or further information: Frahm, J.P. (1996) Revision der gattung *Rhacocarpus LINDB. Cryptog.Bryol.Lichenol*. 17(1), pp.39-65; Scott, G.A.M., Stone, I.G., Rosser, C. (1976) The Mosses of Southern Australia. Academic Press, London; Hearn R.W., Meissner R., Brown A.P., Macfarlane T.D. and Annels T.R. (2006) *Declared Rare and Poorly Known Flora in the Warren Region*. Department of Environment and Conservation, Perth, Western Australia; Western Australian Herbarium (1998−) *FloraBase − The Western Australian Flora*. Department of Environment and Conservation. http://florabase.dec.wa.gov.au/.

Current status: *Rhacocarpus webbianus* is declared as rare flora (DRF) in WA under the Western Australian *Wildlife Conservation Act 1950* and is ranked Critically Endangered (CR) under International Union for Conservation of Nature (IUCN 2001) criteria B1+ 2bc due to the extent of occurrence being less than 100 km^2 and there being a continuing decline in the area of occupancy of mature individuals. The variety is not currently listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The main threats to the variety are fire and a drying climate.

Description: *Rhacocarpus rehmannianus* var. *webbianus* is an aquatic moss; stems are red, up to 10 cm long, irregularly branched, generally growing towards the flow of water, older parts of stems are often bare; leaves are deep green, spirally arranged, procumbent, 1.5 mm long and 0.5 mm wide, margins entire in lower 2/3 of leaf, bordered and inrolled, with a serrate margin towards the apiculate apex, alar cells nearly colourless, porose cells are absent.

Habitat requirements: *Rhacocarpus rehmannianus* var. *webbianus* inhabits granite areas where there is surface water. In one occurrence it grows in a drainage line while in a second occurrence it inhabits water filled gnamma holes. While it actively grows in water it is capable of surviving dry periods as has been observed in one population where the gnamma hole dries out over summer.

Habitat critical to the survival of the variety, and important populations: Given that *Rhacocarpus rehmannianus* var. *webbianus* is ranked as CR, it is considered that all known habitat for wild populations is critical to the survival of the variety, and that all wild populations are important populations. Habitat critical to the survival of *R. rehmannianus* var. *webbianus* includes the area of occupancy of the important populations; areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion); additional occurrences of similar habitat that may contain undiscovered populations or be suitable for future translocations; and the local catchment for the surface and/or groundwater that maintains the habitat of the variety.

Benefits to other species/ecological communities: *Warnstorfia fluitans* (P1) occurs within the critical habitat of *Rhacocarpus rehmannianus* var. *webbianus* at Mt Chudalup and Roe Forest Block. It has similar habitat requirements and actions implemented to improve the quality or security of the habitat of *R. rehmannianus* var. *webbianus* can be expected to benefit *Warnstorfia fluitans* also. Two declared rare flora and five other priority flora also occur in the general vicinity of the variety and will benefit from many of the recovery actions.

International obligations: This plan is fully consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in 1993, and will assist in implementing Australia's responsibilities under that convention. This variety is not specifically listed under any international treaty, however, and this plan does not affect Australia's obligations under any other international agreements.

Indigenous consultation: According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register no populations occur in or near a currently registered Aboriginal Heritage site. However, the variety occurs on granite outcrops which are known to be culturally significant sites, and in gnammas which are recognised as being highly significant to indigenous people. Input and involvement is being sought through the South West Aboriginal Land and Sea Council (SWALSC) to determine if there are any issues or interests. As this is not expected to be completed before the approval of

the plan, further consultation has been included as a recovery action to ensure there has been Indigenous engagement in relation to the recovery actions posed in this plan.

Social and economic impacts: The implementation of this recovery plan may cause some economic impact to DEC through the cost of implementing recovery actions.

Affected interests: All known populations are on Crown land, vested with the Conservation Commission of WA, and managed by DEC.

Evaluation of the plan's performance: DEC, with assistance from the Warren Region Threatened Flora Recovery Team (WRTFRT), will evaluate the performance of this plan. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following four years of implementation.

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

1. The walk trail up Mt Chudalup has been realigned and a boardwalk has been installed in the vicinity of the population to prevent trampling.
2. Searches for further populations have been carried out in the Warren Region.
3. A weed eradication program is underway at Mt Chudalup.
4. Propagating material has been collected from Mt Chudalup and has been sent to the Australian National Botanic Gardens for propagation trials.
5. Staff from DEC's Donnelly and Frankland Districts regularly monitor populations of the taxon. All known populations were monitored in 2010 and 2011.

Recovery Objective

The objective of this plan is to abate identified threats and maintain or enhance viable *in situ* populations to ensure the long-term preservation of the variety in the wild.

Criteria for success: The number of populations have increased or the area occupied within populations have increased by 20 per cent or more over the term of the plan.

Criteria for failure: The number of populations have decreased or the area occupied within populations have decreased by 20 per cent or more over the term of the plan.

Recovery actions:

1. Coordinate recovery actions
2. Monitor populations
3. Monitor hydrological conditions
4. Develop a monitoring protocol
5. Develop and implement a fire management strategy and monitor its success
6. Complete taxonomic review
7. Install fencing and signage at Mt Chudalup
8. Conduct molecular genotype analysis
9. Search type location
10. Conduct further surveys
11. Monitor and control pig activity
12. Collect and propagate material and develop *ex-situ* living collections
13. Map habitat critical to survival of *Rhacocarpus rehmannianus* var. *webbianus*
14. Develop and implement translocation proposal
15. Conduct weed control
16. Obtain biological and ecological information
17. Liaise with Indigenous groups
18. Promote awareness
19. Review this plan and assess the need for further recovery actions

1. BACKGROUND

History

Rhacocarpus rehmannianus var. *webbianus* is one of only four Western Australian mosses presumed to be endemic (Hearn *et al*. 2006). The variety was first collected from Mt Lindesay by William Webb in 1882 and was initially described in 1897 under the name *Harrisonia webbiana* by C. Müll (Frahm 1996). Müller placed the moss in the genus *Rhacocarpus* in 1900 and provided it the amended name *webbianus*. This name remained current until 1996 when Frahm carried out a taxonomic review of the genus *Rhacocarpus* and renamed the moss as a variant of *Rhacocarpus rehmannianus.*

Since its initial collection *Rhacocarpus rehmannianus* var. *webbianus* had not been relocated at Mt Lindesay, but a new population was located at Mt Chudalup in 1974 by David Catcheside (Professor of Biological Sciences, Flinders University, Adelaide). In 1998 another small population was located on a granite outcrop to the south of Mt Roe by local amateur botanists Edward Middleton and Bill Jackson (a former DEC volunteer, Walpole). In this location the moss was growing in a gnamma hole on a large granite outcrop. In 2007 it was thought that *Rhacocarpus rehmannianus* var. *webbianus* was rediscovered in the vicinity of the type location at Mt Lindesay, however, this collection was later identified as another species.

Description

Rhacocarpus rehmannianus var. *webbianus* is an aquatic moss; stems red, up to 10cm long, irregularly branched, generally growing towards the flow of water, older parts of stems are often bare; leaves are deep green, spirally arranged, procumbent, 1.5 mm long and 0.5 mm wide, margins entire in lower 2/3 of leaf, bordered and inrolled, with a serrate margin towards the apiculate apex, alar cells nearly colourless, porose cells absent (Frahm 1996).

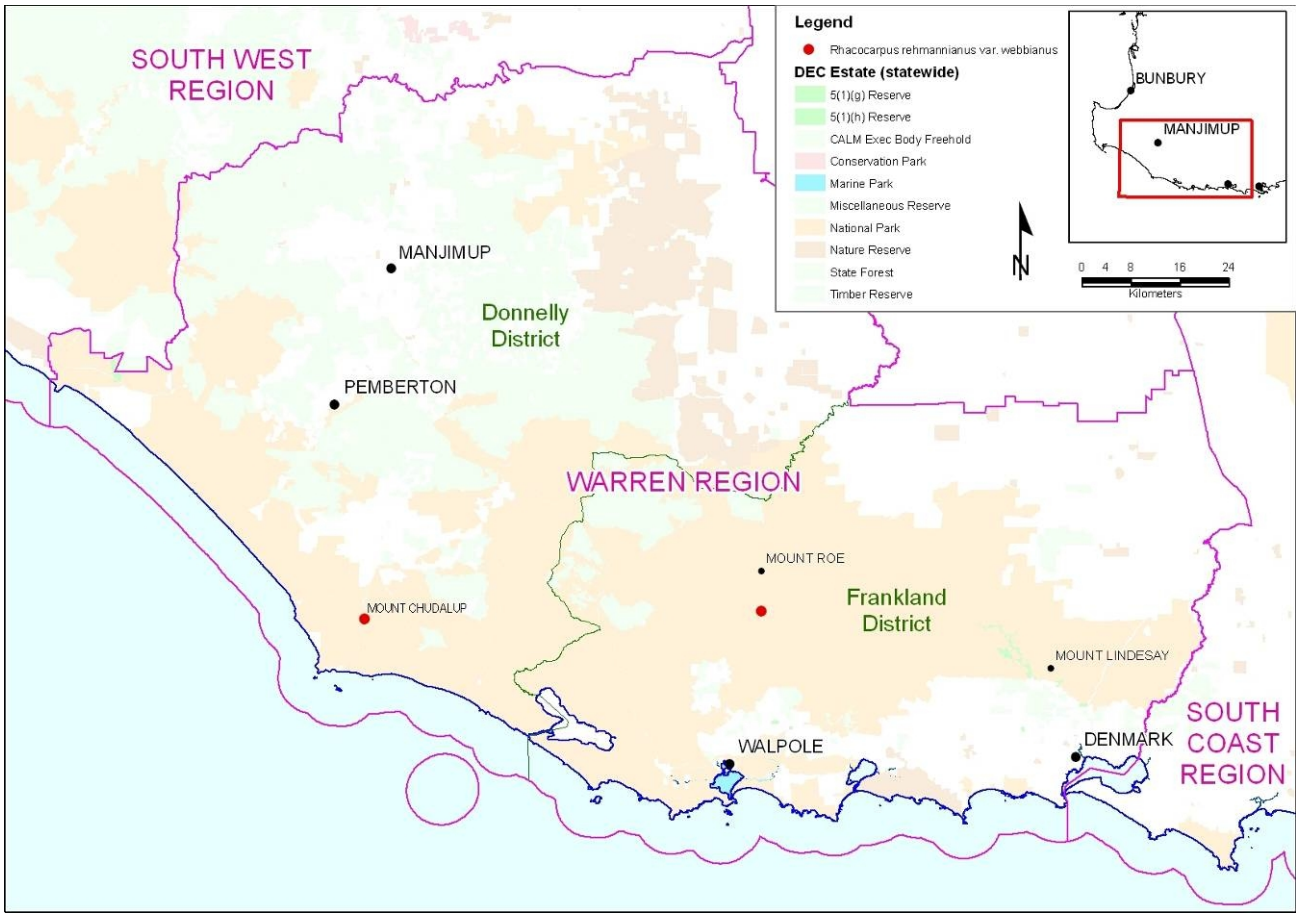
Distribution and habitat

Rhacocarpus rehmannianus var. *webbianus* is restricted to the Warren Region, occurring on granite in locations which remain wet for much of the year. The moss is currently known from two locations, at the granite dome known as Mt Chudalup and on a sheet granite in the south west corner of Mt Roe. Associated species include *Rhacocarpus purpurascens*, *Campylopus bicolor* var. *bicolor* and *Warnstorfia fluitans*. Both populations are water related with one occurring in drainage lines fed by runoff from granite and the second in gnamma holes on a granite sheet. The drainage lines appear to remain wet for a longer period through the year than the gnamma holes, however further investigation is required to quantify this.

Table 1: Summary of population land vesting, purpose and tenure

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Management
1. Mt Chudalup	Donnelly	Manjimup	Conservation Commission of WA	National Park	DEC
2. Mt Roe	Frankland	Manjimup	Conservation Commission of WA	National Park	DEC

Map 1: Distribution of *Rhacocarpus rehmannianus* var. *webbianus*



Biology and ecology

Rhacocarpus rehmannianus var. *webbianus* is a semi aquatic moss which requires seasonal immersion in water to survive, but is able to withstand periods of summer drought in a dormant dehydrated state. Observations suggest *R. rehmannianus* var. *webbianus* takes much longer to recover from summer drought than species such as *R. purpurascens* with which it occurs. The variety appears not to resume significant growth until its water supply is re-established through sufficient rainfall.

Fire appears to kill *Rhacocarpus rehmannianus* var. *webbianus*, particularly if it occurs when the gamma holes and drainage lines containing the variety are dry and the material able to ignite. In December 2009 an intense wildfire burnt the majority of Population 1, with less than 5% of material remaining alive. Monitoring so far has revealed the variety has not recovered well.

Threats

Rhacocarpus webbianus is declared as rare flora (DRF) in WA under the Western Australian *Wildlife Conservation Act 1950* and is ranked Critically Endangered (CR) under International Union for Conservation of Nature (IUCN 2001) criteria B1+ 2bc due to the extent of occurrence being less than 100 km^2 and there being a continuing decline in the area of occupancy of mature individuals. The variety is not currently listed as threatened under the Commonwealth *Environment Protection and Biodiversity Conservation* Act 1999 (EPBC Act). DEC has provided advice to the Commonwealth for its listing, and the variety is awaiting assessment. The main threats to the variety are:

- **Fire** is known to kill *Rhacocarpus rehmannianus* var. *webbianus* with a wildfire in December 2009 destroying most of Population 1. It is not known whether the variety recovers purely from surviving plant material or from spore germination. The semi aquatic moss is protected from fire whilst its habitat is wet but will burn readily if exposed to fire whilst dry. Exposure to fire is expected to occur in moderate to high

intensity fire where ember attacks may overcome the often fragmented nature of the habitat. Carrying out prescribed burning with mild to moderate fire behaviour while the variety is inundated, should avoid threatening populations.

- **Drought** is a serious threat to the variety as it is reliant on partial immersion in water, either as seasonal streamline water flow or rock pools. It is expected that an extended dry season is likely to result in the decline of plants and a reduction in the annual growth of the plant.
- **Competition** with other naturally occurring bryophytes is a potential threat to *Rhacocarpus rehmannianus* var. *webbianus.* This is of particularly concern in Population 2 where there is extremely limited habitat and, following fire, *Warnstorfia fluitans*, has colonised some gnammas it was not previously present in.
- **Limited habitat:** *Rhacocarpus rehmannianus* var. *webbianus* has specific habitat which requires both granite and semi-permanent water, and very little suitable habitat has been identified outside the known populations.
- **Weeds** are present in the habitat of Population 1, i.e. *Impatiens sodenii,* and require continued management to eradicate them without disturbing moss mats. At Population 2 weeds do not appear to be present but should be monitored given the highly limited availability of habitat.
- **Recreational damage** through trampling and disturbance is a potential threat at present to the populations, and has previously caused significant decline of the variety. In particular, Population 1 is situated close to the Mt Chudalup walk trail which provides recreational access to the summit. At present a boardwalk and fencing is deterring people from wandering off the trail, however, the fencing may need to be extended down the trail where it appears there has been occasional access below the main portion of the population. Access to Population 2 is less of an issue as it is within the bounds of a core wilderness area and access is restricted. However, it should still be considered a potential threat to this population.

The intent of this plan is to provide actions that will deal with immediate threats to *Rhacocarpus rehmannianus* var. *webbianus*. Although climate change and drought may have a long-term effect on the variety, actions taken directly to prevent the impact of climate change and drought are beyond the scope of this plan.

Table 2. Summary of population information and threats

Pop. No. & Location	Land status	Year / No. of plants		Condition	Threats
1. Mt Chudalup	National Park	1994 1997 2004 2011	10m² 2m² 5m²	Moderate Poor Moderate Healthy	Recreational access, drought, fire, weeds
2. Mt Roe	National Park	2007 2010 2011	0.12m² (3) 0.01m² (1) 0.01m² (1)	Healthy Healthy Poor	Fire, drought, competition, recreational access (disturbance).

Populations in **bold text** are considered to be Important Populations. Note: due to the difficulty in determining individual plants and the small size of populations it has been difficult to quantify individual populations. However it is estimated that the total area of occupancy would be less than 6m². It should also be noted that the condition of all populations would appear to have been impacted by a recent dry period.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Actions for development and/or land clearing in the immediate vicinity of *Rhacocarpus rehmannianus* var. *webbianus* will require assessment.

Actions that could result in any of the following may potentially result in a significant impact on the variety:

- Damage or destruction of occupied or potential habitat.
- Alteration of the local surface hydrology or drainage.
- Reduction in population size.
- A major increase in disturbance in the vicinity of a population.

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

Rhacocarpus rehmannianus var. *webbianus* is ranked as CR, in WA and as such it is considered that all the known habitat of wild populations is habitat critical to their survival and that all wild populations are important populations. Habitat critical to the survival of *R. rehmannianus* var. *webbianus* includes the area of occupancy of populations (both extant and previously known populations), areas of similar habitat surrounding the populations (these providing potential habitat for population expansion and for pollinators), additional occurrences of similar habitat that may contain undiscovered populations of the variety or be suitable for future translocations, and the local catchment for the surface and/or groundwater that maintains the habitat of the variety.

Benefits to other species or ecological communities

Recovery actions implemented to improve the quality or security of the habitat of *Rhacocarpus rehmannianus* var. *webbianus* will also improve the status of associated native vegetation including several threatened and priority species. *Warnstorfia fluitans* (P1) occurs within the critical habitat of *R. rehmannianus* var. *webbianus* at Mt Chudalup and Roe Forest Block. It has similar habitat requirements and actions implemented to improve the quality or security of the habitat of *R. rehmannianus* var. *webbianus* can be expected to benefit *Warnstorfia fluitans* also. Two declared rare flora and five other priority flora also occur in the general vicinity of the variety and will benefit from many of the recovery actions. These species are listed in the table below.

Table 3: Conservation-listed flora species occurring in the vicinity of *Rhacocarpus rehmannianus* var. *webbianus*

Species name	Conservation Status (WA)	Conservation Status (EPBC Act)
Kennedia glabrata	DRF (Vulnerable)	Vulnerable
Reedia spathacea	DRF (Endangered)	Critically Endangered
Warnstorfia fluitans	Priority 1	-
Calymperastrum latifolium	Priority 2	-
Degelia flabellata	Priority 2	-
Pertusaria trachyspora	Priority 2	
Xanthoparmelia louisii	Priority 2	-
Chamelaucium sp. Mt Frankland (A.S. George 11117)	Priority 3	-

For a description of the Priority categories see Smith (2011)

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. The variety is not listed under Appendix II in the United Nations Environment Program World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES), and this plan does not affect Australia's obligations under any other international agreements.

Indigenous consultation

According to the Department of Indigenous Affairs Aboriginal Heritage Sites Register no populations occur in or near a currently registered Aboriginal Heritage site. However, the variety occurs on granite outcrops which are known to be culturally significant sites and in gnammas which are recognised as being highly significant to indigenous people. Input and involvement is being sought through the South West Aboriginal Land and Sea Council (SWALSC) to determine if there are any issues or interests. As this is not expected to be completed before the approval of the plan, further consultation has been included as a recovery action to ensure there has been Indigenous engagement in relation to the recovery actions posed in this plan.

Social and economic impacts

The implementation of this recovery plan may cause some economic impact to DEC through the cost of implementing recovery actions.

Affected interests

The known population is on Crown land vested in the Conservation Commission and managed by DEC.

Evaluation of the plan's performance

DEC, with assistance from the Warren Region Threatened Flora Recovery Team (WRTFRT), will evaluate the performance of this plan. In addition to annual reporting on progress and evaluation against the criteria for success and failure, the plan will be reviewed following four years of implementation.

2. RECOVERY OBJECTIVE AND CRITERIA

Objective

The objective of this plan is to abate identified threats and maintain or enhance populations to ensure the long-term preservation of the variety in the wild.

Criteria for success: The number of populations has increased and/or the number of mature individuals has increased by 20 per cent or more over the term of the plan.

Criteria for failure: The number of populations has decreased and/or the number of mature individuals has decreased by 20 per cent or more over the term of the plan.

3. RECOVERY ACTIONS

Existing recovery actions

The walk trail up Mt Chudalup has been realigned and a boardwalk has been installed near a population of *Rhacocarpus rehmannianus* var. *webbianus* to prevent trampling.

Searches for further populations have been carried out across many areas of suitable habitat in the Warren Region.

A weed eradication program is underway in habitat at Mt Chudalup.

Propagating material collected from the Mt Chudalup population has been sent to the Australian National Botanic Gardens.

Staff from DEC's Frankland and Donnelly Districts regularly monitor populations of the variety.

The WRTFRT is assisting DEC to coordinate recovery actions for *Rhacocarpus rehmannianus* var. *webbianus* along with other threatened species in the Region. Information on progress in implementing recovery actions will be reported through annual reports to DEC's Corporate Executive and funding bodies.

Future recovery actions

Where *Rhacocarpus rehmannianus* var. *webbianus* occurs on lands other than those managed by DEC, permission has been or will be sought from appropriate owners/land managers prior to recovery actions being undertaken. The following recovery actions are generally in order of descending priority, influenced by their timing over the life of the plan. However this should not constrain addressing any of the actions if funding is available and other opportunities arise.

1. Coordinate recovery actions

The WRTFRT will assist DEC in coordinating recovery actions for *Rhacocarpus rehmannianus* var. *webbianus* along with other threatened species. Information on progress in implementing recovery actions will be reported through annual reports to DEC's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: DEC (Donnelly and Frankland Districts) with assistance from the WRTFRT
Cost: $4,000 per year

2. Monitor populations

Monitoring of factors such as hydrology, access, sedimentation, competition with other bryophytes, weed encroachment, habitat degradation, sub-population stability (expanding or declining), recruitment and longevity is required. The populations will be inspected annually.

Action: Monitor populations
Responsibility: DEC (Frankland and Donnelly Districts)
Cost: $4,000 per year

3. Monitor hydrological conditions

While the variety is able to survive periods of desiccation it is expected that drying conditions could lead to a reduction in annual growth, greater susceptibility to fire, and resultant population decline. Monitoring of the hydrological conditions, including yearly rainfall, the dry season period and month of break of the dry season through the establishment of local automated rainfall gauges is recommended.

Action: Monitor hydrological conditions
Responsibility: DEC (Frankland and Donnelly Districts)
Cost: $3,000 in first year then $1500 per year

4. Develop a monitoring protocol

Accurate monitoring of this moss is difficult and inaccuracies in previous monitoring are likely to have skewed fluctuations in population size and moss abundance. To enable the success of this plan and its actions to be determined, clear methods of monitoring need to be defined. Following preliminary consideration of the issues it is expected that monitoring methods will need to be tailored to individual populations.

Action: Develop a monitoring protocol
Responsibility: DEC (Frankland and Donnelly Districts)
Cost: $3,000 in year 1

5. Develop and implement a fire management strategy and monitor its success

It is not thought desirable to introduce fire into habitat critical to the survival of *Rhacocarpus rehmannianus* var. *webbianus*, however, prescribed burning around habitat can be expected to help minimise the threat from wildfire and constitutes an important part of management of the surrounding landscape. A fire management strategy needs to be developed to protect habitat critical to the survival of *Rhacocarpus rehmannianus* var. *webbianus* from fire and during prescribed burning operations. Following the development of the strategy its implementation should be monitored to assess success.

Action: Develop and implement a fire management strategy and monitor its success
Responsibility: DEC (Frankland and Donnelly Districts), relevant authorities
Cost: $4000 in first year plus $1500 to monitor implementation at each population following prescribed burns.

6. Complete taxonomic review

In a review of the genus *Rhacocarpus* by Frahm in 1996, a brief treatment saw *R. webbianus* re-described as a variety. However, in a recent treatment contained in the Flora of South Africa *R. rehmannianus* was synonymised with *R. purpurascens* (Magill et al. 1998) and it is expected that *R. rehmannianus* var. *webbianus* may be more appropriately named as a species. If it is not possible to taxonomically resolve if this taxon is a species or a variety, then analysis of its genetics will be carried out through Action 8.

Action: Complete taxonomic review
Responsibility: DEC (Warren Region, Science Division)
Cost: $10,000 in year 2

7. Install fencing and signage at Mt Chudalup

Several tracks that run off from the main walk trail and from the picnic site at Mt Chudalup pass into the population. These need to be closed to prevent accidental damage to the population and includes extending the fencing along the boardwalks and between the boardwalks to create a continuous barrier within the vicinity of *Rhacocarpus rehmannianus* var. *webbianus*. Installation of signage explaining the diversity of cryptogams found at Mt Chudalup and their sensitivity and slow recovery from physical disturbance is also recommended.

Action: Install fencing at Mt Chudalup
Responsibility: DEC (Donnelly District) through the WRTFRT
Cost: $5,000 to be completed by year 2

8. Conduct molecular genotype analysis

Analysis of the genetics of populations is required to determine if there is more then one genotype present or they are clones. If required, this analysis will also include an examination of the relationship between *Rhacocarpus rehmannianus* var. *webbianus*, *R. purpurascens* and *R. rehmannianus* var. *rehmannianus*.

Action: Conduct molecular genotype analysis
Responsibility: DEC (Warren Region, Science Division)
Cost: $10,000 in year 3

9. Search type location

Historic records indicate the type specimen of *Rhacocarpus rehmannianus* var. *webbianus* was collected within the vicinity of Mt Lindesay. As no additional information on the whereabouts of the location is available no comprehensive search has been undertaken within the area, and it is considered that further potential habitat exists.

Action: Search type location
Responsibility: DEC (Frankland District) through the WRTFRT
Cost: $2,500 within the first year

10. Conduct further surveys

Rhacocarpus rehmannianus var. *webbianus* is relatively poorly known. While parts of the Warren Region have been searched for the variety as part of other survey work there are still many granite outcrops which may contain potential habitat which have not been searched. Further coordinated survey is required on granites in the Warren and South Coast Regions. Surveys supervised by qualified staff trained in the identification of this variety, with assistance of volunteers, should be conducted while the habitat is moist.

Action: Conduct further surveys
Responsibility: DEC (Frankland and Donnelly Districts, South Coast Region) through the WRTFRT
Cost: $6,000 in years 1 and 3

11. Monitor and control pig activity

Pigs are present in the vicinity of Population 2 and possibly Population 1. Monitoring is required to determine the level of threat and control required.

Action: Monitor and control pig activity
Responsibility: DEC (Frankland District) through the WRTFRT
Cost: $5,000 per year

12. Collect and propagate plant material and develop ex-situ living collections

Trials will be undertaken to propagate material collected from both populations of *Rhacocarpus rehmannianus* var. *webbianus* so as to develop ex-situ populations. These will provide material for restocking, reintroduction and translocation in the wild.

Action: Collect and propagate plant material and develop ex-situ living collections
Responsibility: DEC (Warren Region, Australian National Botanic Gardens) through the WRTFRT
Cost: $5,000 per year

13. Map habitat critical to the survival of *Rhacocarpus rehmannianus* var. *webbianus*

Although habitat critical to the survival of the variety is alluded to in Section 1, it has not yet been mapped and this will be addressed under this action. If additional populations are located, then habitat critical to their survival will also be determined and mapped.

Action: Map habitat critical to the survival of *Rhacocarpus rehmannianus* var. *webbianus*
Responsibility: DEC (SCB, Frankland and Donnelly Districts)
Cost: $5,000 in year 2

14. Develop and implement a translocation proposal

Translocation is essential for the conservation of this variety. A translocation proposal will be developed, suitable translocation sites selected and the translocation implemented. Information on the translocation of threatened plants and animals in the wild is provided in DEC's Policy Statement No. 29 *Translocation of Threatened Flora and Fauna* (CALM 1995), and the Australian Network for Plant Conservation translocation guidelines (Vallee *et al*. 2004). All translocation proposals require endorsement by DEC's Director of Nature Conservation. Monitoring of translocations is essential and will be included in the timetable developed for the Translocation Proposal.

Action: Develop and implement a translocation proposal
Responsibility: DEC (Science Division, Frankland and Donnelly Districts) through the WRTFRT
Cost: $4,000 in year 2, $6,000 in year 3 and $1,500 in year 4-5

15. Conduct weed control

Weeds, in particular *Impatiens sodenii*, are a threat to Population 1 and control is required. The following actions will be implemented:

1. Determine which weeds are present and map them.
2. Select appropriate technique; herbicide or hand weeding.
3. Control invasive weeds by hand removal and/or spot spraying around *Rhacocarpus rehmannianus* var. *webbianus* populations when weeds first emerge.
4. Revegetation with site-specific species is required (in Autumn) to maintain low weed levels.
5. Monitor the success of the treatment on weed death, and the tolerance of *Rhacocarpus rehmannianus* var. *webbianus* and associated native plant species to the treatment.
6. Report on the method and success of the threatment, and effect on *Rhacocarpus rehmannianus* var. *webbianus* plants and associated species.

Action: Conduct weed control
Responsibility: DEC (Donnelly District)
Cost: $2,000 per year, as required

16. Obtain biological and ecological information

Increased knowledge of the biology and ecology of *Rhacocarpus rehmannianus* var. *webbianus* will provide a scientific basis for its management in the wild. Investigations will ideally include:

- Defining the habitat requirements of the variety including the chemistry of the substrate and water flows.
- Determination of reproductive strategies, phenology and seasonal growth.
- Investigation of reproductive success and pollination biology.
- Investigation of minimum viable population size.
- Investigate the variety's response to disturbance, including fire.

Action: Obtain biological and ecological information
Responsibility: DEC (Warren Region, Science Division)
Cost: $6,000 per year

17. Liaise with Indigenous groups

Rhacocarpus rehmannianus var. *webbianus* occurs on granite outcrops and in gnammas both of which are considered to be culturally sensitive. Indigenous consultation should be obtained for guidance in recovery activities.

Action: Liaise with Indigenous groups
Responsibility: DEC (Frankland and Donnelly Districts)
Cost: $2,000 per year

18. Promote awareness

The importance of biodiversity conservation and the protection of the critical habitat of *Rhacocarpus rehmannianus* var. *webbianus* will be promoted to the public. An information sheet, which includes a description of the variety, its habitat type, threats, management actions and photos will be produced. These will be distributed to the public through DEC's Frankland and Donnelly District offices and at the libraries of the Shire of Manjimup and Denmark.

Specific interest groups should be targeted who have the skills to recognise the variety as it is very difficult to accurately identify in the field. Such groups may include the Australasian Bryophyte Workshop, Australasian Bryological Newsletter, WA Naturalists Club and other groups interested in bryology and cryptogams. Such information distribution may lead to the discovery of new populations or potential habitat.

Action: Promote awareness
Responsibility: DEC (Frankland and Donnelly Districts, SCB and Corporate Relations) with assistance from the WRTFRT
Cost: $4,000 in year 1 and $2,000 in years 2-5

19. Review this plan and assess the need for further recovery actions

If *Rhacocarpus rehmannianus* var. *webbianus* is still ranked CR at the end of the five-year term of this plan, the need for further recovery actions, or a review of this plan will be assessed and a revised plan prepared if necessary.

Action: Review this plan and assess the need for further recovery actions
Responsibility: DEC (SCB, Frankland and Donnelly Districts) with assistance from the WRTFRT

Cost: $3,000 in year 5

Table 4. Summary of recovery actions

Recovery Actions	Priority	Responsibility	Completion date
Coordinate recovery actions	High	DEC (Warren Region) through WRTRFT	Ongoing
Monitor populations	High	DEC (Frankland and Donnelly Districts) through WRTFRT	Ongoing
Monitor hydrological conditions	High	DEC (Frankland and Donnelly Districts) through the WRTFRT	Ongoing
Develop a monitoring protocol	Medium	DEC (Frankland and Donnelly Districts) through the WRTFRT	2013
Develop and implement a fire management strategy and monitor its success	High	DEC (Frankland and Donnelly Districts) through the WRTFRT	2013/Ongoing
Complete taxonomic review	High	DEC (Warren Region, Science Division)	2014
Install fencing and signage at Mt Chudalup	Medium	DEC (Donnelly District) through WRTFRT	2014
Conduct molecular genotype analysis	High	DEC (Warren Region, Science Division)	2015
Search type location	Medium	DEC (Frankland District) through WRTFRT	2013
Conduct further surveys	Medium	DEC (Frankland and Donnelly Districts and South Coast Region) through the WRTFRT	2015
Monitor and control pig activity	Medium	DEC (Frankland and Donnelly Districts) through the WRTFRT	Ongoing
Collect and propagate material and develop ex-situ living collections	High	DEC (Frankland and Donnelly Districts) through the WRTFRT	Ongoing
Map habitat critical to survival of *Rhacocarpus rehmannianus* var. *webbianus*	Medium	DEC (Frankland and Donnelly Districts) through the WRTFRT	2014
Develop and implement a translocation proposal	Medium	DEC (Warren Region, Science Division) through the WRTFRT	2014
Conduct weed control	Low	DEC (Donnelly District) through WRTFRT	Ongoing
Increase biological and ecological information	Medium	DEC (Warren Region, Science Division) through the WRTFRT	2017
Liaise with Indigenous groups	Medium	DEC (Frankland and Donnelly Districts) through WRTRFT	Ongoing
Promote awareness	Low	DEC (Frankland and Donnelly Districts) through the WRTFRT	Ongoing
Review this plan and assess the need for further recovery actions	Low	DEC (Frankland and Donnelly Districts, Species and Communities Branch) through the WRTFRT	2017

4. TERM OF PLAN

This plan will operate from March 2012 to February 2017 but will remain in force until withdrawn or replaced. If the variety is still ranked CR after five years, the need for further recovery actions will be determined.

5. REFERENCES

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

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6. TAXONOMIC DESCRIPTION

Excerpt from: Frahm, J.P. (1996) Revision der gattung *Rhacocarpus LINDB. Cryptog.Bryol.Lichenol*. 17(1), pp.39-65.

Rhacocarpus rehmannianus var. *webbianus* is an aquatic moss; stems red, up to 10cm long, irregularly branched, generally growing towards the flow of water, older parts of stems are often bare; leaves are deep green, spirally arranged, procumbent, 1.5 mm long and 0.5 mm wide, margins entire in lower 2/3 of leaf, bordered and inrolled, with a serrate margin towards the apiculate apex, alar cells nearly colourless, porose cells absent.