



Department of
Parks and Wildlife



Interim Recovery Plan No. 350

Shell-fruited Grevillea (*Grevillea murex*)

Interim Recovery Plan
2014–2019



Department of Parks and Wildlife, Western Australia

June 2014

List of Acronyms

The following acronyms are used in this plan:

BGPA	Botanic Gardens and Parks Authority
CALM	Department of Conservation and Land Management
CITES	Convention on International Trade in Endangered Species
CR	Critically Endangered
DEC	Department of Environment and Conservation
DAA	Department of Aboriginal Affairs
DPaW	Department of Parks and Wildlife (also shown as Parks and Wildlife)
DRF	Declared Rare Flora
EN	Endangered
EPBC	Environment Protection and Biodiversity Conservation
GDTFRT	Geraldton District Threatened Flora Recovery Team
IBRA	Interim Biogeographic Regionalisation for Australia
IRP	Interim Recovery Plan
IUCN	International Union for Conservation of Nature
LGA	Local Government Authority
MDTFRT	Moora District Threatened Flora and Recovery Team
NRM	Natural Resource Management
PEC	Priority Ecological Community
PICA	Public Information and Corporate Affairs
RP	Recovery Plan
SCB	Species and Communities Branch (Parks and Wildlife)
SCD	Science and Conservation Division
SWALSC	South West Aboriginal Land and Sea Council
TEC	Threatened Ecological Community
TFSC	Threatened Flora Seed Centre
UNEP-WCMC	United Nations Environment Program World Conservation Monitoring Centre
WA	Western Australia

Foreword

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Parks and Wildlife Policy Statements Nos. 44 and 50 (CALM 1992; CALM 1994). Note: The Department of Conservation and Land Management (CALM) formally became the Department of Environment and Conservation (DEC) in July 2006 and the Department of Parks and Wildlife in July 2013 (Parks and Wildlife). 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.

Parks and Wildlife 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 (CR) taxa, always within one year of endorsement of that rank by the Minister.

This plan will operate from June 2014 to May 2019 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked as Endangered (EN), this plan will be reviewed after five years and the need for further recovery actions assessed.

This plan was given regional approval on 16 June 2014 and was approved by the Director of Science and Conservation on 27 June 2014. The provision of funds identified in this plan is dependent on budgetary and other constraints affecting Parks and Wildlife, as well as the need to address other priorities.

Information in this plan was accurate at June 2014.

Plan preparation: This plan was prepared by:

Robyn Luu	Project Officer, Parks and Wildlife Species and Communities Branch, Locked Bag 104, Bentley Delivery Centre, Western Australia, 6983.
Andrew Brown	Threatened Flora Coordinator, Parks and Wildlife Species and Communities Branch, Locked Bag 104, Bentley Delivery Centre, Western Australia, 6983.

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

Alanna Chant	Flora Conservation Officer, Parks and Wildlife Geraldton District
Anne Cochrane	Senior Research Scientist, Threatened Flora Seed Centre, Parks and Wildlife Science and Conservation Division
Anthony Desmond	Regional Leader Nature Conservation, Parks and Wildlife Midwest Region
Amanda Shade	Assistant Curator (Nursery), Botanic Gardens and Parks Authority
Niall Sheehy	Flora Conservation Officer, Parks and Wildlife Moora District
Benson Todd	Nature Conservation Coordinator, Parks and Wildlife Moora District

Thanks also to the staff of the Western Australian Herbarium for providing access to Herbarium databases and specimen information.

Cover photograph by Gemma Phelan.

Citation: This plan should be cited as: Department of Parks and Wildlife (2014) Shell-fruited *Grevillea*, *Grevillea murex* McGill. Interim Recovery Plan 2014–2019. Interim Recovery Plan No. 350. Department of Parks and Wildlife, Western Australia.

Summary

Scientific name:	<i>Grevillea murex</i> McGill.	Common name:	Shell-fruited Grevillea
Family:	Proteaceae	Flowering period:	August–September
DPaW region:	Midwest	DPaW districts:	Geraldton, Moora
Shires:	Three Springs, Mingenew, Morawa	NRM region:	Northern Agricultural
IBRA region:	Avon Wheatbelt	Recovery teams:	GDTFRT, MDTFRT
IBRA subregion:	Avon Wheatbelt AVW01		

Distribution and habitat: *Grevillea murex* is endemic to the northern Wheatbelt area of Western Australia, growing in lateritic-gravel, brown clay-loam or red clayey-sand soil on gentle lower valley slopes or flat areas. Habitat is open York gum (*Eucalyptus loxophleba*) woodland over open low scrub, grasses and herbs.

Habitat critical to the survival of the species, and important populations: Given that *Grevillea murex* is ranked as Endangered (EN), it is considered that all known habitat for wild populations is critical to the survival of the species, and that all wild populations are important populations. Habitat critical to the survival of *G. murex* includes the area of occupancy of populations, areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion and for pollinators), additional occurrences of similar habitat that may contain undiscovered populations of the species or be suitable for future translocations, and the local catchment for the surface and/or groundwater that maintains the habitat of the species.

Conservation status: *Grevillea murex* is specially protected under the Western Australian *Wildlife Conservation Act 1950* and is ranked as EN in Western Australia under International Union for Nature Conservation (IUCN 1994) criteria C2a due to less than 2,500 mature individuals being known in the wild, a continuing decline in the number of mature individuals and severe fragmentation of populations. The species is listed as EN under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Threats: The main threats to the species are road, track and firebreak maintenance, insect infestation, altered fire regimes, a reduction of factors positively influencing reproduction, weed invasion and rabbits.

Existing recovery actions: The following recovery actions have been or are currently being implemented and have been considered in the preparation of this plan:

1. Relevant land managers have been made aware of the species and its locations.
2. Departmental staff conducted surveys for *Grevillea murex* between 1990 and 1994, and again in 1996.
3. Declared Rare Flora (DRF) markers have been installed at all road reserve populations.
4. Remnant vegetation containing Population 1c on private property has been fenced and a protective covenant placed over the area.
5. The Botanic Gardens and Parks Authority (BGPA) currently have 12 plants growing in their gardens.
6. 1,242 seeds collected from Populations 5, 6 and 7 are stored in Parks and Wildlife's TFSC at –18°C.

Plan objective: The objective of this plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term conservation of the species in the wild.

Recovery criteria

Criteria for recovery success:

- The number of extant populations has increased from 10 to 11 or more over the term of the plan and/or
- The number of mature plants has increased by 20% or more over the term of the plan from 314 to 377 or more.

Criteria for recovery failure:

- The number of populations has decreased from 10 to nine or less over the term of the plan and/or
- The number of mature plants has decreased by 20% or more over the term of the plan from 314 to 251 or less.

Recovery actions

- | | |
|---|---|
| 1. Coordinate recovery actions | 10. Collect and store seed |
| 2. Monitor populations | 11. Obtain biological and ecological information |
| 3. Identify and control a defoliating insect | 12. Develop and implement a translocation proposal |
| 4. Undertake weed control | 13. Liaise with land managers and Aboriginal communities |
| 5. Undertake regeneration trials | 14. Map habitat critical to the survival of <i>Grevillea murex</i> |
| 6. Install and reposition DRF markers | 15. Promote awareness |
| 7. Protect plants from herbivory | 16. Review this plan and assess the need for further recovery actions |
| 8. Undertake surveys | |
| 9. Develop and implement a fire management strategy | |

1. Background

History

Grevillea murex was first collected north of Three Springs by C. Chapman in 1975, with subsequent collections made between there and the Mingenew-Morawa Road. McGillivray and Makinson described the species in 1993.

Grevillea murex is currently known from 10 populations comprising 314 mature plants. All but one population are located on narrow road reserves which are under threat from road maintenance activities.

Description

Grevillea murex is an upright shrub 1 to 2m tall with many somewhat hairy branches. The leaves are on stalks up to 1.5mm long and have four or five blunt tipped lobes. The dome-shaped flower heads are at the ends of the branchlets and contain cream to yellow flowers about 3cm long. The fruits, 9 to 13mm long, are oblong to ellipsoid in shape and are covered with irregular shiny protuberances to 2.5mm high. The species is related to *G. crithmifolia* but has hairy branchlets, smaller leaves and hard-coated seed pods with irregular projections (Brown *et al.* 1998). The name *murex* refers to the similarity of the fruit surface to that of the shellfish *Murex*, which has pointy projections on its surface.

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; McGillivray, D.J., Makinson, R.O. (1993) *Grevillea, Proteaceae: a taxonomic revision*. Melbourne University Press, Victoria; Western Australian Herbarium (1998-) *FloraBase – the Western Australian Flora*. Department of Parks and Wildlife. <http://florabase.dpaw.wa.gov.au/>.

Distribution and habitat

Grevillea murex is endemic to Western Australia where it is restricted to the northern Wheatbelt between Three Springs and the Mingenew-Morawa Road, growing in lateritic-gravel, brown clay-loam or red clayey-sand on gentle lower valley slopes or flat areas. Habitat is open York gum (*Eucalyptus loxophleba*) woodland over open low scrub, grasses and herbs. Associated species include *E. loxophleba*, *E. baudiniana*, *Acacia spathulifolia*, *Allocasuarina campestris*, *Calothamnus* and *Melaleuca* species.

Table 1. Summary of population land vesting, purpose and manager

Population number & location	Parks and Wildlife district	Shire	Vesting	Purpose	Manager
1b. N of Three Springs	Moora	Three Springs	LGA	Road reserve	Shire of Three Springs
1c. N of Three Springs	Moora	Three Springs	Private property		Landowners
2a. N of Three Springs	Moora	Three Springs	LGA	Road reserve	Shire of Three Springs
2b. N of Three Springs	Moora	Three Springs	LGA	Road reserve	Shire of Three Springs
2c. N of Three Springs	Moora	Three Springs	LGA	Road reserve	Shire of Three Springs
2d. N of Three Springs	Moora	Three Springs	LGA	Road reserve	Shire of Three Springs
3. WSW of Morawa	Geraldton	Mingenew	LGA	Road reserve	Shire of Mingenev
4. NE of Three Springs	Moora	Three Springs	LGA	Road reserve	Shire of Three Springs
5a. WSW of Morawa	Geraldton	Morawa	LGA	Road reserve	Shire of Morawa
5b. WSW of Morawa	Geraldton	Morawa	LGA	Road reserve	Shire of Morawa
5c. WSW of Morawa	Geraldton	Morawa	LGA	Road reserve	Shire of Morawa
6. WSW of Morawa	Geraldton	Morawa	LGA	Road reserve	Shire of Morawa
7a. W of Morawa	Geraldton	Morawa	LGA	Road reserve	Shire of Morawa
7b. W of Morawa	Geraldton	Morawa	LGA	Road reserve	Shire of Morawa
9. W of Morawa	Geraldton	Mingenew	LGA	Road reserve	Shire of Mingenev
10. W of Morawa	Geraldton	Morawa	LGA	Road reserve	Shire of Morawa

Biology and ecology

The biology and ecology of the species is poorly known, and recovery actions refer to a need for research.

Natural germination of *Grevillea murex* seed is likely to be triggered by disturbance events (physical or fire), hence its affinity for growing in disturbed areas along road verges.

Conservation status

Grevillea murex is specially protected under the WA *Wildlife Conservation Act 1950* and is ranked as Endangered (EN) in Western Australia under International Union for Nature Conservation (IUCN 1994) criteria C2a due to less than 2,500 mature individuals being known from the wild, a continuing decline in the number of mature individuals and severe fragmentation of populations. The species is listed as EN under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Threats

- **Road, track and firebreak maintenance** including grading, chemical spraying, the construction of drainage channels and the mowing of roadside vegetation is a threat to most populations.
- **Insect infestation** is a threat to Populations 1, 2, 3, 4 and 7. The insects (possibly mealy bugs?) suck the sap from the leaves of *Grevillea murex* causing defoliation. Infestations appear to stop over the summer months and then reoccur in wetter months.
- **Altered fire regimes:** Fire may be detrimental if it is too frequent and occurs before plants have replenished the soil seed store.
- A **reduction of factors positively influencing reproduction** such as appropriate fire regimes is a threat to the species.
- Habitat degradation by **weed invasion** is a potential threat to populations of *Grevillea murex*.
- **Grazing** by rabbits (*Oryctolagus cuniculus*) is a threat to Populations 5 and 7.

The intent of this plan is to provide actions that will mitigate immediate threats to *Grevillea murex*. Although climate change and drought may have a long-term effect on the species, actions taken directly to prevent their impact are beyond the scope of this plan.

Table 2. Summary of population information and threats

Population number & location	Land status	Year / No. of plants	Current condition	Threats
1b. N of Three Springs	Road reserve	1989 11 2008 16	Healthy	Road maintenance, insects, altered fire regimes, weeds
1c. N of Three Springs	Private property	1990 4 1996 20 2003 9+	Healthy	Altered fire regimes, weeds
2a. N of Three Springs	Road reserve	1990 150 (includes 2a-c) 2003 72 (includes 2a-c) 2008 10	Healthy	Road maintenance, insects, altered fire regimes
2b. N of Three Springs	Road reserve	2008 6	Healthy	Road maintenance, insects, altered fire regimes
2c. N of Three Springs	Road reserve	2008 21	Healthy	Road maintenance, insects, altered fire regimes, weeds
2d. N of Three Springs	Road reserve	2008 21	Healthy	Road maintenance, insects, altered fire regimes, weeds
3. WSW of Morawa	Road reserve	1994 50+ 2000 50 2007 77	Moderate	Insects, road maintenance, altered fire regimes, weeds
4. NE of Three Springs	Road reserve	1996 1 2008 2	Healthy	Road maintenance, insects, altered fire regimes
5a. WSW of Morawa	Road reserve	1996 3 2000 2 2008 0	Disturbed	Road maintenance, gravel extraction, altered fire regimes, weeds
5b. WSW of Morawa	Road reserve	1996 76 (20) 2006 *40 2008 55	Healthy	Road maintenance, gravel extraction, recreational activities, altered fire regimes, weeds, grazing (rabbits)
5c. WSW of Morawa	Road reserve	1996 4 2003 *50+ 2006 *40	Healthy	Road maintenance, altered fire regimes, weeds, grazing (rabbits)
6. WSW of Morawa	Road reserve	1996 26 2006 26 2008 31	Healthy	Road maintenance, altered fire regimes
7a. W of Morawa	Road reserve	1996 42 2003 *29 2007 *19	Healthy	Road maintenance, insects, altered fire regimes, weeds, grazing (rabbits)
7b. W of Morawa	Road reserve	1996 5 2006 *27 2007 *19	Healthy	Road maintenance, insects, altered fire regimes, weeds, grazing (rabbits)
9. W of Morawa	Road reserve	1996 3 2003 10 2006 8 2007 3	Healthy	Road maintenance, altered fire regimes
10. W of Morawa	Road reserve	2000 4 2004 4 2006 4	Moderate	Road maintenance, altered fire regimes, weeds

Note: Populations in **bold text** are considered to be important populations; Populations 7 and 8 were found to be continuous and are now regarded as two subpopulations (Subpopulation 7a and 7b); Subpopulations 1a and 1b were also found to be continuous and are now regarded as a single subpopulation (1b); and * = total for subpopulations combined.

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 *Grevillea murex* may require assessment.

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

- 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 species, and important populations

Grevillea murex is ranked as EN in Western Australia and it is considered that all known habitat for wild populations is critical to the survival of the species and that the wild populations are important populations. Habitat critical to the survival of *G. murex* includes the area of occupancy of populations, areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion and for pollinators), additional occurrences of similar habitat that may contain undiscovered populations of the species or be suitable for future translocations, and the local catchment for the surface and/or groundwater that maintains the habitat of the species.

Benefits to other species or ecological communities

Recovery actions implemented to improve the quality or security of the habitat of *Grevillea murex* will also improve the status of associated native vegetation. One Declared Rare Flora (DRF) species and one Priority flora species occur within 500m of *G. murex* (see table below).

Table 3. Conservation-listed flora species occurring within 500m of *Grevillea murex*

Species name	Conservation status (WA)	Conservation status (EPBC Act)
<i>Verticordia spicata</i> subsp. <i>squamosa</i>	DRF (CR)	EN
<i>Baeckea</i> sp. Morawa (M.A. Langley MAL4177)	Priority 1	

For a description of conservation codes for Western Australian flora see http://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/Listings/Conservation_code_definitions_18092013.pdf

Grevillea murex does not occur within or adjacent to any Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs).

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 species 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.

Aboriginal consultation

A search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Sites Register revealed two sites of Aboriginal significance adjacent to populations of *Grevillea murex*. These include site #24382 (Yarra Yarra Lakes; mythological site; closed site) and #24379 (Simpson Road Quarry; artefacts, open site). Input and involvement has been sought through the South West Aboriginal Land and Sea Council (SWALSC) and DAA to determine if there are any issues or interests with respect to management for this species in the vicinity of these sites. Indigenous opportunity for future involvement in the implementation of the plan is included as an action in the plan. Aboriginal involvement in management of land covered by an agreement under the *Conservation and Land Management Act 1984* is also provided for under the joint management arrangements in that Act, and will apply if an agreement is established over any reserved lands on which this species occurs.

Social and economic impacts

For plants on private property (Population 1c) some impacts may be through the loss of land available for development and the cost of implementing recovery actions (controlling weeds). For populations on land under the management of the Shires of Three Springs, Mingenew and Morawa impacts may be through the implementation of recovery actions (controlling weeds) and restrictions imposed on the management of these lands, including maintenance of the road infrastructure.

Affected interests

Affected interests include private landholders and the Shires of Three Springs, Mingenew and Morawa.

Evaluation of the plan's performance

Parks and Wildlife, with assistance from the Moora District Threatened Flora Recovery Team (MDTFRT) and Geraldton District Threatened Flora Recovery Team (GDTFRT) 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 five years of implementation.

2. Recovery objective and criteria

Plan objective

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

Recovery criteria

Criteria for recovery success:

- The number of extant populations has increased from 10 populations to 11 or more over the term of the plan and/or
- The number of mature individuals has increased by 20% or more over the term of the plan from 314 to 377 or more.

Criteria for recovery failure:

- The number of populations has decreased from 10 populations to nine or less over the term of the plan and/or
- The number of mature individuals has decreased by 20% or more over the term of the plan from 314 to 251 or less.

3. Recovery actions

Existing recovery actions

Relevant land managers have been made aware of this species and its locations. These notifications detail the current status of the species as DRF and the associated legal obligations in regards to their protection.

Departmental staff surveyed for *Grevillea murex* between 1990 and 1994 during preparation of the Moora District Threatened Flora Management Program (Patrick and Brown 2001), with two new populations located. Further survey in 1996 located an additional three new populations. Two local wildflower enthusiasts undertook surveys in the Yandanooka and Arrino areas but did not locate any new populations.

DRF markers have been installed at all road verge populations. These alert people working in the vicinity to the presence of DRF and the need to avoid work that may damage the species or its habitat. Dashboard stickers and posters describing the significance of DRF markers have been produced and distributed to relevant Shires and other organisations.

Remnant vegetation on private property containing Population 1c was fenced and a protective covenant placed over the area.

BGPA currently have 12 plants growing in their gardens. Ten of these plants are grown from seed collected in 1996. The other two are from cuttings taken in 1995 and 1998. Strike rate was varied with 13%, 21% and 19% success from cuttings taken from the 1997 seedlings, and 19% and 60% success from cuttings collected in 1998.

Some 1,242 seeds were collected from *Grevillea murex* Populations 5, 6 and 7 and are stored in Parks and Wildlife's Threatened Flora Seed Centre (TFSC) at -18°C (see table 4). Some seed has been processed and the germination rates were 72, 85 and 100%.

Table 4. Threatened Flora Seed Centre collection details for *Grevillea murex*

Accession number	Date collected	Population number	Collection type	Seeds/follicles in storage	Germination rate (%)
00373	21/11/1996	5	B/50	330 seeds, 120 seeds	85
00374	21/11/1996	6	B/15	117 seeds	72
01504	1/12/2004, 12/11/2005	6	B/14,B/17	490 seeds	100
01591	1/12/2004	7	B/3	16 seeds	n/a
02492	9/11/2007	5	B/16	80 seeds	n/a
02505	9/11/2007	6	B/14,B/17	79 seeds, 10 seeds	n/a

Note: 'B' = a bulked collection and the number of plants sampled

Future recovery actions

Parks and Wildlife, with the assistance of the MDTFRT and GDTFRT, is overseeing the implementation of this plan and will include information on progress in annual reports to Parks and Wildlife's Corporate Executive and funding bodies. Where recovery actions are implemented on lands other than those managed by Parks and Wildlife, permission has been or will be sought from the appropriate land managers prior to actions being undertaken. The following recovery actions are roughly in order of descending priority, influenced by their timing over the term of the plan. However this should not constrain addressing any recovery action if funding is available and other opportunities arise.

1. Coordinate recovery actions

Parks and Wildlife, with assistance from the MDTFRT and GDTFRT will coordinate recovery actions for *Grevillea murex* and will include information on progress in annual reports to Parks and Wildlife's Corporate Executive and funding bodies.

Action:	Coordinate recovery actions
Responsibility:	Parks and Wildlife (Moora and Geraldton Districts), with assistance from the MDTFRT and GDTFRT
Cost:	\$8,000 per year

2. Monitor populations

Populations will be inspected with accurate counts undertaken and locational information recorded. Monitoring of factors such as insect infestations, grazing, weed invasion, habitat degradation, hydrology (including salinity), population stability (expansion or decline), pollinator activity, seed production, recruitment, and longevity will also be undertaken.

Action:	Monitor populations
Responsibility:	Parks and Wildlife (Moora and Geraldton Districts), with assistance from the MDTFRT and GDTFRT
Cost:	\$8,000 per year

3. Identify and control a defoliating insect

The insect responsible for causing the defoliation of *Grevillea murex* plants will be identified and its impact investigated. Insect control will be undertaken where required.

Action:	Identify and control a defoliating insect
Responsibility:	Parks and Wildlife (Science and Conservation Division (SCD), Moora and Geraldton Districts)
Cost:	\$10,000 per year

4. Undertake weed control

Weeds are a potential threat to all populations and the following actions will be implemented:

1. Determine which weeds are present and map them.
2. Control invasive weeds by hand removal and/or spot spraying when they first emerge.
3. Monitor the success of the treatment on weed death, and the tolerance of *Grevillea murex* and associated native plant species to the weed control treatment.
4. Report on the method and success of the treatment.
5. Revegetate with site-specific species if required to maintain low weed levels.

Action:	Undertake weed control
Responsibility:	Parks and Wildlife (Moora and Geraldton Districts), Shires of Three Springs, Mingenew and Morawa
Cost:	\$10,000 per year, as required

5. Undertake regeneration trials

Disturbance events (physical or fire) may be the most effective means of germinating *Grevillea murex* seed in the wild. Different disturbance techniques should be investigated (i.e. soil disturbance and fire), or smoke water, to determine the most successful and appropriate method. Regeneration trials will need to be undertaken in conjunction with weed control.

Action:	Undertake regeneration trials
Responsibility:	Parks and Wildlife (SCD, Moora and Geraldton Districts)
Cost:	\$10,000 in years 1 and 3, \$4,000 in years 2, 4 and 5

6. Install and reposition DRF markers

DRF markers are required at Populations 3 and 7.

Action:	Install and reposition DRF markers
Responsibility:	Parks and Wildlife (Geraldton District)
Cost:	\$4,00 in year 1

7. Protect plants from herbivory

When monitoring ascertains the threat of rabbits is high, baiting using 1080 oats should be undertaken. Protective cages or fencing should also be considered if rabbit baiting is not sufficient protection for individual plants or grazing increases.

Action:	Protect plants from herbivory at Populations 5 and 7
Responsibility:	Parks and Wildlife (Geraldton District), Shire of Morawa
Cost:	\$15,000 in years 1, 3 and 5

8. Undertake surveys

Additional surveys of potential habitat should be conducted during the species' flowering period. Plants on private property adjacent to Populations 2 and 7, observed from the roadside, need to be confirmed. A potential population on private property east of Populations 5, 6 and 7 (west of the Billeranga Hills) may have been located by the landowner and will also need to be confirmed. All surveyed areas will be recorded and the presence or absence of the species documented to increase survey efficiency and reduce unnecessary duplicate surveys. Where possible, volunteers from the local community, Landcare groups, wildflower societies and naturalists' clubs will be encouraged to become involved.

Action:	Undertake surveys
Responsibility:	Parks and Wildlife (Moora and Geraldton Districts), with assistance from the MDTFRT, GDTFRT and volunteers
Cost:	\$10,000 per year

9. Develop and implement a fire management strategy

Fire will be prevented from occurring in the habitat of the populations, except where it is being used experimentally as a recovery tool. A fire management strategy will be developed that recommends fire frequency, intensity, season and control measures.

Action:	Develop and implement a fire management strategy
Responsibility:	Parks and Wildlife (Moora and Geraldton Districts)
Cost:	\$10,000 in year 1, and \$6,000 in years 2–5

10. Collect and store seed

Preservation of genetic material is essential to guard against extinction of the species if the wild populations are lost. It is recommended that seed be collected and stored in the TFSC and BGPA.

Action:	Collect and store seed
Responsibility:	Parks and Wildlife (Moora and Geraldton Districts, TFSC), BGPA
Cost:	\$10,000 per year

11. Obtain biological and ecological information

Improved knowledge of the biology and ecology of the species will provide a scientific basis for its management in the wild and will ideally include:

1. Soil seed bank dynamics and the role of various factors including disturbance, competition, drought, inundation and grazing in recruitment and seedling survival;
2. Reproductive strategies, phenology and seasonal growth;
3. Reproductive success and pollination biology;
4. Minimum viable population size; and
5. The impact of changes in hydrology in the habitat.

Action:	Obtain biological and ecological information
Responsibility:	Parks and Wildlife (SCD, Moora and Geraldton Districts)
Cost:	\$50,000 in years 1–3

12. Develop and implement a translocation proposal

If required, a translocation proposal will be developed and suitable translocation sites selected. Information on the translocation of threatened plants and animals in the wild is provided in Parks and Wildlife'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 Parks and Wildlife's Director of Science and 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:	Parks and Wildlife (SCD, Moora and Geraldton Districts), BGPA
Cost:	\$42,000 in years 1 and 2; and \$26,500 in years 3–5 as required

13. Liaise with land managers and Aboriginal communities

Staff from Parks and Wildlife's Moora and Geraldton Districts will liaise with appropriate land managers to ensure that populations of *Grevillea murex* are not accidentally damaged or destroyed and the habitat is maintained in a suitable condition for the conservation of the species. Aboriginal consultation will take place to determine if there are any issues or interests in areas that are habitat for the species.

Action:	Liaise with land managers and Aboriginal communities
Responsibility:	Parks and Wildlife (Moora and Geraldton Districts)
Cost:	\$4,000 per year

14. Map habitat critical to the survival of *Grevillea murex*

Although habitat critical to the survival of the species is alluded to in Section 1, it has not been mapped. If additional populations are located, habitat critical to their survival will also be determined and mapped.

Action:	Map habitat critical to the survival of <i>Grevillea murex</i>
Responsibility:	Parks and Wildlife (Species and Communities Branch (SCB), Moora and Geraldton Districts)
Cost:	\$6,000 in year 2

15. Promote awareness

The importance of biodiversity conservation and the protection of *Grevillea murex* will be promoted by setting up poster displays and the development of an information sheet. Formal links with local naturalist groups and interested individuals will also be encouraged.

Action:	Promote awareness
Responsibility:	Parks and Wildlife (Moora and Geraldton Districts, SCB and Public Information and Corporate Affairs (PICA), with assistance from the MDTFRT and GDTFRT)
Cost:	\$7,000 in years 1 and 2; \$5,000 in years 3–5

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

If *Grevillea murex* is still ranked as EN 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:	Parks and Wildlife (SCB, Moora and Geraldton Districts)
Cost:	\$6,000 in year 5

Table 5. Summary of recovery actions

Recovery action	Priority	Responsibility	Completion date
Coordinate recovery actions	High	Parks and Wildlife (Moora and Geraldton Districts) with assistance from the MDTFRT and GDTFRT	Ongoing
Monitor populations	High	Parks and Wildlife (Moora and Geraldton Districts) with assistance from the MDTFRT and GDTFRT	Ongoing
Identify and control a defoliating insect	High	Parks and Wildlife (SCD, Moora and Geraldton Districts)	Ongoing
Undertake weed control	High	Parks and Wildlife (Moora and Geraldton Districts), Shires of Three Springs, Mingenew and Morawa	Ongoing
Undertake regeneration trials	High	Parks and Wildlife (SCD, Moora and Geraldton Districts)	2019
Install and reposition DRF markers	High	Parks and Wildlife (Geraldton District)	2015
Protect plants from herbivory	High	Parks and Wildlife (Geraldton District), Shire of Morawa	2019
Undertake surveys	High	Parks and Wildlife (Moora and Geraldton Districts) with assistance from the MDTFRT, GDTFRT and volunteers	Ongoing
Develop and implement a fire management strategy	High	Parks and Wildlife (Moora and Geraldton Districts)	Developed by 2015 with implementation ongoing
Collect and store seed	High	Parks and Wildlife (Moora and Geraldton Districts, TFSC), BGPA	2019
Obtain additional biological and ecological information	High	Parks and Wildlife (SCD, Moora and Geraldton Districts)	2017
Develop and implement a translocation proposal	High	Parks and Wildlife (SCD, Moora and Geraldton Districts), BGPA	2019
Liaise with land managers and Aboriginal communities	High	Parks and Wildlife (Moora and Geraldton Districts)	Ongoing
Map habitat critical to the survival of <i>Grevillea murex</i>	Medium	Parks and Wildlife (SCB, Moora and Geraldton Districts)	2016
Promote awareness	Medium	Parks and Wildlife (Moora and Geraldton Districts, SCB and PICA) with assistance from the MDTFRT and GDTFRT	Ongoing
Review this plan and assess the need for further recovery actions	Medium	Parks and Wildlife (SCB, Moora and Geraldton Districts)	2019

4. Term of plan

This plan will operate from June 2014 to May 2019 but will remain in force until withdrawn or replaced. If the species is still ranked EN after five years, the need for further recovery actions will be determined.

5. References

- Brown, A., Thomson-Dans, C. and Marchant, N. (eds) (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia.
- 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, Western Australia.
- Government of Australia (1999) Environment Protection and Biodiversity Conservation Act.
- International Union for Conservation of Nature (1994) *IUCN Red List Categories: Version 2.3*. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
- McGillivray, D.J. and Makinson, R.O. (1993) *Grevillea, Proteaceae: a taxonomic revision*. Melbourne University Press, Victoria.
- Patrick, S.J., and Brown, A.P. (2001) Declared Rare and Poorly Known Flora in the Moora District. Department of Conservation and Land Management, Perth, Western Australia.
- Vallee, L., Hogbin, T., Monks, L., Makinson, B., Matthes, M. and Rossetto, M. (2004) Guidelines for the Translocation of Threatened Australian Plants. Second Edition. *The Australian Network for Plant Conservation*. Canberra, Australia.
- Western Australian Herbarium (1998–) *FloraBase – the Western Australian Flora*. Department of Parks and Wildlife. <http://florabase.dpaw.wa.gov.au/>.

6. Taxonomic description

***Grevillea murex* McGill.**

McGillivray, D.J. and Makinson, R.O. (1993) *Grevillea, Proteaceae: a taxonomic revision*. Melbourne University Press, Victoria.

Much-branched shrub c. 1m high; branchlets angular, subsericeous; leaf bases decurrent. **Leaves** ascending, petiolate, pinnatipartite with 4–5 (–6) lobes or occasionally tripartite, c. 4–10mm long, c. 3–8mm wide; lobes linear to oblong, 1–8mm long, 0.7–0.9mm wide; base attenuate, petioles c. 1–1.5mm long; apex and apices of lobes obtuse with a down-turned tip; margin revolute, enclosing the lower surface except for the midvein; upper surface glabrous; lower surface inconspicuous, covered with closely packed straight hairs; venation obscure except for the midveins of the rachis and lobes on the lower surface; texture firmly chartaceous but brittle. **Inflorescences** terminal, or occasionally subterminal-axillary, simple, erect, pedunculate, dome-shaped, centripetal, c. 1–2cm long, c. 2cm across; peduncles 1–5mm long, peduncles and rachises tomentose-subsericeous; bracts angular-ovate, c. 0.5mm long, c. 0.4mm wide, loosely subvillous outside, glabrous inside, bracts deciduous when the buds are c. 0.3mm long; floral orientation parallel with the sutures adaxial; **pedicels** 2–3mm long with an inconspicuous indumentum of scattered appressed hairs; torus almost

square, slightly oblique (to c. 10°), 0.6–0.7mm across; perianth oblong below the curve, c. 0.8mm across, glabrous outside, on the inside with a dense patch of hairs c. 0.3mm long at c. 1.5mm from the base and loosely villous to the limb; limb obliquely depressed-angular-ovate, 0.6–0.7mm long, 0.8mm across; dorsal tepals broadest slightly above the base, 5–6mm long, 0.5–0.7mm wide; nectar relatively conspicuous, superposed on the torus, sublunate, 0.2–0.3mm high, c. 0.15mm thick at the level of the torus, margin entire to slightly sinuate; pistil 9–10mm long, glabrous; stipe 1.2–1.5mm long; ovary obliquely and broadly ovoid, tuberculate, 0.7–0.8mm long, ovules medially attached; pollen-presenter oblique at c. 45°, oblong, almost flat, 0.7–0.8mm long, 0.6–0.7mm wide, stigma distally off-centre. **Fruits** erect to slightly oblique on the pedicels, oblong to narrowly ellipsoid, 9–13mm long, 5–6mm wide, 5–7mm thick; styles variably persistent on this collection; surface hairless, covered with very conspicuous, more or less erect, sublaminar, irregular, somewhat spiny protuberances up to 2.5mm high; pericarp c. 0.6–1.5mm across at the suture, c. 0.5–2.5mm thick at centre-face, c. 0.6–0.7mm thick at the dorsal side, texture crustaceous. **Seeds** not seen. **Flower colour** cream to white.