Department of Parks and Wildlife

Interim Recovery Plan No. **380**

Serpentine Synaphea (*Synaphea* sp. Serpentine (G.R. Brand 103))

Interim Recovery Plan

2017–2022

Department of Parks and Wildlife, Western Australia

May 2017

List of Acronyms

The following acronyms are used in this plan:

AFLP	Amplified fragment length polymorphism
BGPA	Botanic Gardens and Parks Authority
CALM	Department of Conservation and Land Management
CFF	Conservation of Flora and Fauna
CITES	Convention on International Trade in Endangered Species
CPC	Conservation and Parks Commission
CR	Critically Endangered
DEC	Department of Environment and Conservation
DAA	Department of Aboriginal Affairs
DPaW	Department of Parks and Wildlife
DRF	Declared Rare Flora (also known as Threatened Flora)
EN	Endangered
EPBC	Environment Protection and Biodiversity Conservation
IBRA	Interim Biogeographic Regionalisation for Australia
IRP	Interim Recovery Plan
IUCN	International Union for the Conservation of Nature
LGA	Local Government Authority
NRM	Natural Resource Management
PICA	Public Information and Corporate Affairs
PTA	Public Transport Authority
SCB	Species and Communities Branch
SRTFCRT	Swan Region Threatened Flora and Communities Recovery Team
SWALSC	South West Aboriginal Land and Sea Council
TEC	Threatened Ecological Community
TFSC	Threatened Flora Seed Centre
UCL	Unallocated Crown Land
UNEP-WCMC	United Nations Environment Program World Conservation Monitoring Centre
VU	Vulnerable
WA	Western Australia
WAPC	Western Australian Planning Commission

Foreword

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Parks and Wildlife Corporate Policy Statement No. 35 (DPaW 2015*a*) and Department of Parks and Wildlife Corporate Guideline No. 35 (DPaW 2015*b*). 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 are committed to ensuring that threatened flora (also known as Declared Rare Flora (DRF)) 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) flora, always within one year of endorsement of that rank by the Minister.

This plan will operate from May 2017 to April 2022 but will remain in force until withdrawn or replaced. It is intended that, if the species is still listed as threatened in Western Australia following five years of implementation, this plan will be reviewed, the need for further recovery actions assessed and a revised plan prepared if necessary.

This plan was given regional approval on 24 March 2017 and was approved by the Director of Science and Conservation on 22 May 2017. The provision of funds identified in this plan is dependent on budgetary and other constraints affecting the Department of Parks and Wildlife, as well as the need to address other priorities.

Information in this plan was accurate at May 2017.

Plan preparation: This plan was prepared by:

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Cover photograph by Ryonen Butcher.

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Summary

Scientific name:	*Synaphea* sp. Serpentine (G.R. Brand 103).	**DPaW district:**	Swan Coastal
		Shire:	Serpentine-Jarrahdale
Common name:	Serpentine Synaphea	**NRM region:**	South West
Family:	Proteaceae	**IBRA region:**	Swan Coastal Plain
Flowering period:	late August–November	**IBRA subregion:**	Perth SWA02
DPaW region:	Swan	**Recovery team:**	SRTFCRT

Distribution and habitat: *Synaphea* sp. Serpentine (G.R. Brand 103) occurs over a narrow geographic range from west of Byford to south of Serpentine, growing predominantly in grey-brown sandy-loam or clay in seasonally wet areas.

Habitat critical to the survival of the species, and important populations: It is considered that all known habitat for natural populations is critical to the survival of *Synaphea* sp. Serpentine (G.R. Brand 103) and that natural populations are important populations. Habitat critical to the survival of the species includes the area of occupancy of populations and areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion and for pollinators). It may also include 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: *Synaphea* sp. Serpentine (G.R. Brand 103) was listed as specially protected under the Western Australian *Wildlife Conservation Act 1950* on 17 September 2013. It is ranked as Critically Endangered (CR) in Western Australia under IUCN (2001) criteria B1ab(ii,iii,v) due to its extent of occurrence estimated to be less than 100km^2; severe fragmentation of populations and a continuing decline in area of occupancy, area, extent and quality of habitat and number of mature individuals. The species is not listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Threats: The main threats to the species are weeds, road, rail, track and firebreak maintenance, fragmentation of habitat, clearing, inappropriate fire regimes, insecure land tenure, poor recruitment, limited seed production, recreational activities, infrastructure maintenance, insect infestation, rabbits and dieback disease.

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. Declared Rare Flora (DRF) markers have been installed at Subpopulations 1k and 2b.
2. The Parks and Wildlife Threatened Flora Seed Centre (TFSC) has one collection of seed made from Subpopulation 1a in January 2009. The seed has not yet been processed.
3. Surveys and monitoring has been undertaken.

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

Recovery will be considered successful if one or more of the following take place over the term of the plan.

- There is no reduction in the extent of occurrence and the number of mature plants within the known populations has remained within a 10% range or has increased by >10% from 1331 to 1464 or more or
- New populations have been found, increasing the number of known populations from six to seven or more with no net loss of mature plants or
- The area of occupancy has increased by >10% with no net loss of mature plants.

Recovery will be considered unsuccessful if one or more of the following take place over the term of the plan.

- Populations have been lost which result in a reduction in the extent of occurrence or
- The number of mature plants has decreased by >10% from 1331 to 1198 or less or
- The area of occupancy has decreased by >10%, with a net loss of mature plants.

Recovery actions

1. Coordinate recovery actions
2. Monitor populations
3. Install DRF markers
4. Confirm taxonomic status through genetic studies
5. Undertake weed control
6. Collect and store seed
7. Install signage at Population 1
8. Undertake surveys
9. Remove rubbish from Population 1
10. Develop and implement a fire management strategy
11. Undertake regeneration trials
12. Identify and control insects
13. Determine susceptibility to *Phytophthora cinnamomi*
14. Maintain hygiene
15. Ensure long-term protection of habitat
16. Develop and implement translocations
17. Implement rabbit control
18. Liaise with land managers and Aboriginal communities
19. Promote awareness
20. Obtain biological and ecological information
21. Map habitat critical to the survival of *Synaphea* sp. Serpentine (G.R. Brand 103)
22. Review this plan and assess the need for further recovery actions

1. Background

History

Alex George included *Synaphea* sp. Serpentine (G.R. Brand 103) as a form of *S. odocoileops* in his 1995 review of the genus. However, *S. odocoileops* was subsequently segregated into two species – *S. odocoileops* and *S.* sp. Serpentine (G.R. Brand 103) – with the majority of specimens previously included under *S. odocoileops* re-determined as *S.* sp. Serpentine (G.R. Brand 103). The diagnostic characters of *S. odocoileops* discussed by George (1995) refer mainly to *S.* sp. Serpentine (G.R. Brand 103) and his statement that *S. odocoileops* was distinguishable from *S. stenoloba* by its "less-divided leaves with longer, flatter terminal lobes and a long-pilose petiole, and slightly smaller flowers" actually refers to *S.* sp. Serpentine (G.R. Brand 103). Plants of *S. odocoileops* are more similar to *S. stenoloba* than has been previously documented but the two taxa are still distinguishable in the field and from herbarium specimens. *Synaphea* sp. Serpentine (G.R. Brand 103) is currently in the process of being formally described (Butcher in prep.).

Currently, there are 36 collections of *Synaphea* sp. Serpentine (G.R. Brand 103) held in the Western Australian Herbarium. Of these, two outlying populations – one east of Byford (Keighery 7047) and one north of Elgin (Keighery 6781) – have not been relocated and are not included in the current extent of occurrence. A population north of Yarloop (Papenfus 2016) is also excluded as it is represented by a poor quality specimen, not confidently identified and the species has not been seen at this site since that collection.

The species is currently known from six highly fragmented populations comprising 1331 mature individuals. The majority of plants are found on weedy road and rail reserves that are threatened by further habitat degradation and ongoing maintenance activities.

Description

Synaphea sp. Serpentine (G.R. Brand 103) is a perennial, erect, clumped shrub to 60cm high by 50cm wide with yellow flowers borne on long spikes well above the leaves. Flowering is between late August and November.

Key distinguishing features of *Synaphea* sp. Serpentine (G.R. Brand 103) (Butcher in prep.) are:

- Plants clumped, with or without elongate stem internodes.
- Leaves 2–4 x tripartite, terminal lobes linear with acute to acuminate apices, some asymmetry in terminal lobing; lowest lobes often falcate. Mid- to dark green.
- Petioles pilose (i.e. with long hairs) at base or along length.
- Spikes long, undulating, axis frequently dark red (or green heavily infused with red).
- Flowers small, openly spaced, +/- horizontal and opening narrowly, glabrous or sparsely pubescent. Tepal apices scarcely reflexed.
- Stigma with erect, narrow, apical lobes.
- Fruit cylindrical to narrowly obovate with a small apical rim, the base of the fruit tapering into a relatively long (*c.* 1/3 total fruit length), slender neck. Sparsely hairy to hairless in upper 1/3 of fruit body.

Synaphea sp. Serpentine (G.R. Brand 103) is not known to hybridise despite co-occurring with up to four other *Synaphea* species (*S. gracillima*, *S. petiolaris*, *S.* sp. Fairbridge Farm (D.Papenfus 696) and *S.* sp. Pinjarra Plain (R. Davis 6578)) at one location.

Illustrations and/or further information

Butcher, R. (2004) A Survey of Gazetted and Proposed Declared Rare species of *Synaphea* (Proteaceae) occurring on the Pinjarra Plain. Unpublished report prepared for the Western Australian Threatened Species and Communities Unit, Department of Conservation and Land Management; George, A.S. (1995) *Synaphea*. *Flora of Australia* 16: 271–316; Western Australian Herbarium (1998–) *FloraBase– the Western Australian Flora*. Department of Parks and Wildlife. https://florabase.dpaw.wa.gov.au/.

Distribution and habitat

Synaphea sp. Serpentine (G.R. Brand 103) occurs over a narrow geographic range from west of Byford to south of Serpentine with an extent of occurrence of about 60km^2. It grows predominantly on grey-brown sandy loams or clay in seasonally wet areas. Associated species include *Adenanthos meisneri*, *Corymbia calophylla, Kingia australis*, *Kunzea micrantha*, *Mesomelaena tetragona*, *Pericalymma ellipticum*, *Tetraria octandra*, *Tricoryne elatior* and *Xanthorrhoea preissii*.

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

TPFL population number & location	Parks and Wildlife District	Shire	Vesting	Purpose	Manager
1a. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	CPC	CFF	Parks and Wildlife
1b. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	LGA	Road reserve	Shire of Serpentine-Jarrahdale
1c. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	LGA	Road reserve	Shire of Serpentine-Jarrahdale
1d. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	LGA	Road reserve	Shire of Serpentine-Jarrahdale
1e. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	LGA	Road reserve	Shire of Serpentine-Jarrahdale
1f. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	UCL		Shire of Serpentine-Jarrahdale
1g. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	PTA	Rail reserve	Brookfield Rail
1h. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	LGA	Road reserve	Shire of Serpentine-Jarrahdale
1i. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	PTA	Rail reserve	Brookfield Rail
1j. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	LGA	Road reserve	Shire of Serpentine-Jarrahdale
1k. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	PTA	Rail reserve	Brookfield Rail
2a. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	WAPC	Unknown	WAPC
2b. Serpentine	Swan Coastal	Shire of Serpentine-Jarrahdale	UCL		Shire of Serpentine-Jarrahdale
3. Byford	Swan Coastal	Shire of Serpentine-	Private		WAPC

		Jarrahdale	property		
4. Mundijong	Swan Coastal	Shire of Serpentine-Jarrahdale	PTA	Rail reserve	Brookfield Rail
5. Mundijong	Swan Coastal	Shire of Serpentine-Jarrahdale	PTA	Government requirements	Shire of Serpentine-Jarrahdale
6. Mundijong	Swan Coastal	Shire of Serpentine-Jarrahdale	PTA	Government requirements	Shire of Serpentine-Jarrahdale

Biology and ecology

Segregation of *Synaphea* sp. Serpentine (G.R. Brand 103) from *S. odocoileops* has clarified the taxonomic boundaries of these species. A morphometric analysis of conservation-listed *Synaphea* taxa from the Swan Coastal Plain has shown that *S.* sp. Serpentine (G.R. Brand 103) can be readily distinguished from other taxa and is therefore a distinct species (Butcher and Thiele in prep.).

Pollinators are unknown and despite producing a large number of flowers per plant only a small proportion develop fruit. Levels of seed abortion and parasitism, as well as fruit galling, are high. Each fully-formed fruit contains a single seed which is dispersed a short distance from the parent plant, leading to localised clusters of plants in the environment. The conditions for seed germination are unknown. The life expectancy of the species has not been researched; however, mature individuals have been relocated five years after previous surveys.

The natural habitat of *Synaphea* sp. Serpentine (G.R. Brand 103) has been extensively cleared and remaining bushland remnants are small and highly fragmented.

Conservation status

Synaphea sp. Serpentine (G.R. Brand 103) was listed as specially protected under the Western Australian *Wildlife Conservation Act 1950* on 17 September 2013. It is ranked as Critically Endangered (CR) in Western Australia under IUCN (2001) criteria B1ab(ii,iii,v) due to its extent of occurrence estimated to be less than 100km^2; severe fragmentation of populations and a continuing decline in area of occupancy, area, extent and quality of habitat and number of mature individuals. The species is not listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Threats

- **Weeds.** Main threats are introduced grasses, in particular *Eragrostis curvula* (African Lovegrass) and *Watsonia*. Weeds suppress early plant growth by competing for soil moisture, nutrients and light. They also increase the fire hazard due to the high fuel loads produced annually by many weed species.
- **Road, rail, track and firebreak maintenance.** Threats include grading, spraying of chemicals, construction and maintenance of drainage channels and mowing roadside vegetation.
- **Fragmentation of habitat.** Most populations occur in small, narrow, linear remnants separated by roads, rail-lines, maintenance tracks, firebreaks and cleared areas.
- **Clearing.** New road construction and widening of existing roads is a threat to the species.

- **Altered fire regimes.** It is thought the species resprouts from rootstock following fire, however, negative post-fire effects of habitat modification and weed invasion has been noted as a cause of past decline.
- **Insecure land tenure.** All but one population occur on land tenure that is not consistent with conservation and, as they are of poor and deteriorating quality, are not conducive to the long-term conservation of flora.
- **Poor recruitment.** In most populations there has been very poor recruitment.
- **Limited seed production.** The fruits are single-seeded and high levels of seed abortion and predation have been observed.
- **Recreational activities.** Horse riding and BMX bike riding are common in the area of populations.
- **Rubbish dumping.** This has occurred in the area of some populations.
- **Infrastructure maintenance.** Maintenance of telephone wires and powerlines at Subpopulations 1d, 1e and 1h is a direct potential threat to the species. Disturbance during maintenance may also encourage weed invasion.
- **Armoured scale insects** and to a lesser extent mealy bugs are present on plants at Subpopulations 1a, 1h and Population 5. The scale insect observed needs to be identified to determine the best treatment method.
- **Rabbits (*Oryctolagus cuniculus*).** Grazing of plants by rabbits in Subpopulations 2a and 2b is likely to inhibit recruitment. Weed invasion may occur following soil disturbance (e.g. digging and subsequent erosion), nutrient addition and the introduction of weed seeds.
- **Dieback disease (*Phytophthora cinnamomi*).** It is not known if *Synaphea* sp. Serpentine (G.R. Brand 103) is susceptible to *P. cinnamomi*, and testing of the species' susceptibility is required.

The intent of this plan is to provide actions that will mitigate immediate threats to *Synaphea* sp. Serpentine (G.R. Brand 103). Although climate change and drought may have a long-term effect on the species, direct actions to prevent the impact of climate change and drought are beyond the scope of this plan.

Table 2. Summary of population information and threats

Population no & location	Land status	Year / no. of plants	Current condition		Threats
			Population	Habitat	
1a. Serpentine	Nature reserve	2010 90 [64*]	Healthy	Poor	Mealy bug, weeds
1b. Serpentine	Road reserve	2010 17 [64*]	Healthy	Poor	Road and fence maintenance, weeds
1c. Serpentine	Road reserve	2010 80 2012 87 [6]	Healthy	Very good	Road and fence maintenance, weeds, recreational users
1d. Serpentine	Road reserve	2010 79	Healthy	Very good	Road maintenance, weeds, recreational users, utilities maintenance
1e. Serpentine	Road reserve	2010 26	Healthy	Very good	Road and utilities maintenance, weeds, recreational users,
1f. Serpentine	UCL	2010 153	Healthy	Very good	Track and firebreak maintenance, weeds, recreational users
1g. Serpentine	Rail reserve	2010 6 2012 426 [233]	Burnt Spring 2012	Very good	Rail maintenance, weeds, recreational users
1h. Serpentine	Road reserve	2011 22 [16]	Poor	Very good	Road and utility maintenance, scale infestation, weeds, recreational users
1i. Serpentine	Rail reserve	2011 282 (19) [67]	Burnt Dec 2011		Rail maintenance, weeds, recreational users

1j. Serpentine	Road reserve	2011 3 2012 0	Burnt Dec 2011		Road maintenance, weeds, recreational users
1k. Serpentine	Rail reserve	2010 29 [3] 2012 63 [4]	Moderate	Degraded	Rail maintenance, weeds, recreational users
2a. Serpentine	WAPC	2010 4	Moderate	Very good	Track, firebreak and fence maintenance, rabbits
2b. Serpentine	UCL	2010 18 [2]	Healthy	Excellent	Road and fence maintenance, rabbits
3. Byford	Private property (WAPC)	2012 2 [3]	Moderate	Degraded	Firebreak maintenance, weeds
4. Mundijong	Rail reserve	2011 10 [3]	Moderate	Very good	Rail maintenance, weeds
5. Mundijong	Crown reserve (rail)	2012 48 (53) [3]	Healthy	Very good	Clearing (Tonkin Highway extension), weeds, scale infestation
6. Mundijong	Crown reserve (rail)	2011 4 (4) [2]	Moderate	Very good	Clearing (Tonkin Highway extension), weeds

Note: Populations over 20 mature individuals (**bold text)** are considered to be important populations; * total estimated count for subpopulations 1a and 1b; () = number of seedlings; [ ] = number of dead.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Actions that result in any of the following may potentially have 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

It is considered that all known habitat for natural populations is critical to the survival of *Synaphea* sp. Serpentine (G.R. Brand 103) and that natural populations are important populations. Habitat critical to the survival of the species includes the area of occupancy of populations and areas of similar habitat surrounding and linking populations (these providing potential habitat for population expansion and for pollinators). It may also include 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 *Synaphea* sp. Serpentine (G.R. Brand 103) will also improve the status of associated native vegetation. Four Threatened and nine Priority taxa that occur within 500m of the species are listed in the table below:

Table 3. Conservation-listed flora species occurring within 500m of *Synaphea* sp. Serpentine (G.R. Brand 103)

Species name	Conservation status (WA)	Conservation status (EPBC Act 1999)
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	Threatened (CR)	CR
Synaphea sp. Pinjarra Plain (A.S. George 17182)	Threatened (CR)	-
Verticordia plumosa var. *ananeotes*	Threatened (CR)	EN
Tetraria australiensis	Threatened (VU)	VU
Synaphea odocoileops	Priority 1	-
Johnsonia pubescens subsp. *cygnorum*	Priority 2	-
Acacia oncinophylla subsp. *patulifolia*	Priority 3	-
Baeckea sp. Perth Region (R.J. Cranfield 444)	Priority 3	-
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459)	Priority 3	-
Isopogon drummondii	Priority 3	-
Jacksonia gracillima	Priority 3	-
Drosera occidentalis subsp. *occidentalis*	Priority 4	-
Verticordia lindleyi subsp. *lindleyi*	Priority 4	-

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

Synaphea sp. Serpentine (G.R. Brand 103) occurs in association with the three Threatened Ecological Communities (TECs) listed in the table below.

Table 4. TECs in the area of *Synaphea* sp. Serpentine (G.R. Brand 103)

TEC name	Conservation status (WA)	Conservation status (EPBC Act)
Corymbia calophylla-Kingia australis woodlands on heavy soils, Swan Coastal Plain (type SCP3a)	CR	EN
Banksia attenuata and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain (type SCP20b)	EN	-
Shrublands on dry clay flats (type SCP10a)	EN	CR

For a description of the TEC categories see DEC (2010).

Two rare and one Priority fauna species, (Baudin's Cockatoo (*Calyptorhynchus baudinii*) (EN), Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (EN) and Quenda (*Isoodon obesulus* subsp. *fusciventer*) (P5)), that occur within the range of *Synaphea* sp. Serpentine (G.R. Brand 103) are likely to benefit from the management of the species.

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. *Synaphea* sp. Serpentine (G.R. Brand 103) 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 one site of Aboriginal significance (# 3582, Serpentine River) which co-occurs with Subpopulations 1a–1k of *Synaphea* sp. Serpentine (G.R. Brand 103) and input and involvement has been sought through the DAA to determine if there are any issues or interests with respect to management for this species. Opportunity for future Aboriginal 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

Where populations occur on land under the management of the Shire of Serpentine-Jarrahdale (Subpopulations 1b–f, 1h, 1j and 2b and Populations 5 and 6), Western Australian Planning Commission (WAPC) (Subpopulation 2a and Population 3) and Brookfield Rail (Subpopulations 1g, 1i and 1k and Population 4) some social and economic impacts may occur through the implementation of recovery actions (controlling weeds and rabbits) and restrictions imposed on the management of the land, including maintenance of road and rail infrastructure.

Affected interests

The implementation of this plan has some implications for private landholders, WAPC, the Shire of Serpentine-Jarrahdale and Brookfield Rail, particularly as these populations occur on lands not specifically managed for conservation.

Evaluation of the plan's performance

Parks and Wildlife, with assistance from the Swan Region Threatened Flora and Communities Recovery Team (SRTFCRT) 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

Recovery will be considered successful if one or more of the following take place over the term of the plan.

- There is no reduction in the extent of occurrence and the number of mature plants within the known populations has remained within a 10% range or has increased by >10% from 1331 to 1464 or more or
- New populations have been found, increasing the number of known populations from six to seven or more with no net loss of mature plants or
- The area of occupancy has increased by >10% with no net loss of mature plants.

Recovery will be considered unsuccessful if one or more of the following take place over the term of the plan.

- Populations have been lost which result in a reduction in the extent of occurrence or
- The number of mature plants has decreased by >10% from 1331 to 1198 or less or
- The area of occupancy has decreased by >10%, with a net loss of mature plants.

3. Recovery actions

Existing recovery actions

Parks and Wildlife, with the assistance of the SRTFCRT, is overseeing the implementation of recovery actions for *Synaphea* sp. Serpentine (G.R. Brand 103).

Notifications to land owners/managers detail the current Declared Rare Flora (DRF) status of the species and the associated legal obligations in regards to its protection.

DRF markers have been installed at Subpopulations 1k and 2b. These alert people working in the vicinity to the presence of the species and the need to avoid work that may damage it or its habitat. Dashboard stickers and posters describing the significance of DRF markers have been produced and distributed to relevant Shires and other organisations.

Parks and Wildlife's Threatened Flora Seed Centre (TFSC) has a collection of seed made from Subpopulation 1a in January 2009.

Surveys undertaken for the species include:

- Opportunistic searches were made by Departmental staff in 1997 and 1998 while undertaking surveys for other *Synaphea* species, concentrating on areas around Pinjarra, Serpentine and Mundijong and extending southwards to include rail reserves associated with the South West railway to Elgin (Butcher 2004).
- Ryonen Butcher searched for the species while surveying for other rare *Synaphea* species in 2003. The area surveyed comprised a large proportion of the Pinjarra Plain between Byford and Capel, extending to Yoongarillup in the southwest as well as inland to the lower slopes of the Darling Scarp (Butcher 2004).
- Swan Coastal District Flora Conservation Officers undertook targeted surveys between 2010 and 2012. Habitat between populations was also searched.
- Areas of potential habitat were searched while undertaking surveys for other conservation listed species during 2009 and 2012.

Future recovery actions

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. Where these 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.

1. Coordinate recovery actions

Parks and Wildlife with assistance from the SRTFCRT will oversee the implementation of recovery actions for *Synaphea* sp. Serpentine (G.R. Brand 103) and will include information on progress in annual reports.

Action:	Coordinate recovery actions
Responsibility:	Parks and Wildlife (Swan Region), with assistance from the SRTFCRT
Cost:	$8,000 per year

2. Monitor populations

Monitoring of populations and their habitat should be undertaken to identify trends or potential management requirements. Population monitoring should record the health and expansion or decline in populations, and other observations such as pollinator activity or seed production. Site monitoring should include observations of grazing, habitat degradation including weed invasion, and hydrological status (drought). Specific monitoring of hydrology and activities relating to research into the biology and ecology of *Synaphea* sp. Serpentine (G.R. Brand 103) are included in other recovery actions detailed below.

Action:	Monitor populations
Responsibility:	Parks and Wildlife (Swan Coastal District), with assistance from the SRTFCRT
Cost:	$10,000 per year

3. Install DRF markers

DRF markers are required at Subpopulations 1d, 1e, 1f, 1g, 1h, 1i, 1j and 2a, and Populations 3, 4 and 6. If not already present, markers will also need to be installed along tracks where infrastructure (powerline and telephone cables) maintenance is undertaken.

Action:	Install DRF markers
Responsibility:	Parks and Wildlife (Swan Coastal District)
Cost:	$4,000 in year 1

4. Confirm species status through genetic studies

Multivariate morphometric analysis of *Synaphea* taxa occurring on the Pinjarra Plain supports the recognition of *S.* sp. Serpentine (G.R. Brand 103) as a discrete taxon (Butcher & Thiele in prep.), and preliminary molecular analysis, based on AFLPs, shows that this taxon has a unique genetic signature. However, as only five plants from a single population were genetically analysed, further research including a larger number of plants from across the species' range is needed to assess the genetic cohesion of the species, and to determine patterns of genetic variation within and between the populations for effective conservation.

Action:	Confirm species status through genetic studies
Responsibility:	Parks and Wildlife (Science and Conservation Division, Swan Coastal District)
Cost:	$20,000 in years 1 and 2

5. Undertake weed control

Weeds are a threat to all populations and the following actions will be implemented as resources become available:

1. Determine which weeds are present.
2. Select appropriate technique; herbicide, mowing or hand weeding.
3. Control invasive weeds they first emerge.
4. Monitor the success of the treatment on weed death, and the tolerance of *Synaphea* sp. Serpentine (G.R. Brand 103) and associated native plant species to the weed control treatment.
5. Report on the method and success of the treatment.

Action:	Undertake weed control
Responsibility:	Parks and Wildlife (Swan Coastal District), WAPC, Shire of Serpentine-Jarrahdale, Brookfield Rail
Cost:	$10,000 per year, as required

6. Collect and store seed

To guard against the extinction of natural populations of *Synaphea* sp. Serpentine (G.R. Brand 103) it is recommended that seed be collected and stored at the TFSC. Collections should aim to sample the maximum range of genetic diversity possible by collecting from the widest range of reproductive plants.

Action:	Collect and store seed
Responsibility:	Parks and Wildlife (Swan Coastal District, TFSC)
Cost:	$10,000 per year

7. Install signage at Population 1

Signs advising people of the significance of the habitat will be installed at Population 1 to prevent trampling of plants by recreational users.

Action:	Install signage at Population 1
Responsibility:	Parks and Wildlife (Swan Coastal District)
Cost:	$3,000 in year 1

8. Undertake surveys

Surveys should be undertaken from mid-September through October with all surveyed areas recorded and the presence or absence of *Synaphea* sp. Serpentine (G.R. Brand 103) documented to improve survey efficiency and prevent duplication of effort. Where feasible, volunteers will be encouraged to participate

Action:	Undertake surveys
Responsibility:	Parks and Wildlife (Swan Coastal District), with assistance from the SRTFCRT
Cost:	$10,000 per year

9. Remove rubbish from Population 1

Rubbish has been dumped at Population 1 and requires removal.

Action:	Remove rubbish from Population 1
Responsibility:	Parks and Wildlife (Swan Coastal District)
Cost:	$10,000 in year 1

10. Develop and implement a fire management strategy

A fire management strategy will be developed in consultation with land owners/managers, that recommends fire frequency, intensity and seasonality, precautions to prevent bushfire and strategies for reacting to bushfire, and the need, method of construction and maintenance of firebreaks. The risk of fire occurring in the habitat of populations should be minimised, except where it is being used to assist recovery. All data relating to fire response of the species will be entered into the Threatened Priority Flora (TPFL) fire response data base.

Action:	Develop and implement a fire management strategy
Responsibility:	Parks and Wildlife (Swan Coastal District)
Cost:	$10,000 in years 1 and 2, and $6,000 in years 3–5

11. Undertake regeneration trials

Observational evidence suggests that disturbance events (physical or fire) may be an effective means of germinating soil-stored seed of *Synaphea* sp. Serpentine (G.R. Brand 103) in the wild. Different disturbance techniques should be investigated to determine the most successful and appropriate method.

Action:	Undertake regeneration trials
Responsibility:	Parks and Wildlife (Science and Conservation Division, Swan Coastal District)
Cost:	$10,000 in years 1 and 3, $4,000 in years 2, 4 and 5

12. Identify and control insect infestations

The scale insect on plants at Subpopulations 1h and Population 5 will be identified and appropriate control undertaken. Control of mealy bug, building on the short-term trial undertaken in 2009, will be undertaken at Subpopulation 1a.

Action:	Identify and control insect infestations
Responsibility:	Parks and Wildlife (Swan Coastal District)
Cost:	$3,000 per year when required

13. Determine the susceptibility of *Synaphea* sp. Serpentine (G.R. Brand 103) to *Phytophthora cinnamomi*

The level of susceptibility of *Synaphea* sp. Serpentine (G.R. Brand 103) to *Phytophthora cinnamoni* is not known. Plants grown from seed will be forwarded to Forest and Ecosystem Management Division for testing.

Action:	Determine the susceptibility of *Synaphea* sp. Serpentine (G.R. Brand 103) to *Phytophthora cinnamomi*
Responsibility:	Parks and Wildlife (Swan Coastal District, Forest and Ecosystem Management Division)
Cost:	$3,000 in years 1 and 2

14. Maintain hygiene

Disease hygiene measures are required for all populations. Dieback hygiene (outlined in CALM 2003) will be followed during installation and maintenance of firebreaks and when walking into populations in wet soil conditions. Purpose built signs advising of the dieback risk and high conservation values of the sites will be installed if required.

Action:	Maintain hygiene
Responsibility:	Parks and Wildlife (Swan Coastal District)
Cost:	$4,000 per year

15. Achieve long-term protection of habitat

Parks and Wildlife will investigate the possibility of land outside reserves that contains populations of *Synaphea* sp. Serpentine (G.R. Brand 103) being placed in the reserve system or be otherwise protected such as through a conservation covenant.

Action:	Achieve long-term protection of habitat
Responsibility:	Parks and Wildlife (Swan Region, SCB Nature Conservation Covenant Program and Land Unit)
Cost:	$4,000 per year

16. Develop and implement translocations

Translocations may be required for the long term conservation of *Synaphea* sp. Serpentine (G.R. Brand 103), with the first priority being augmentation of the populations.

Information on the translocation of threatened plants and animals in the wild is provided in Parks and Wildlife Corporate Policy Statement No. 35 (DPaW 2015*a*), Parks and Wildlife Corporate Guideline No. 36 (DPaW 2015*c*) and the Australian Network for Plant Conservation translocation guidelines (Vallee *et al*. 2004). The 2004 guidelines state that a translocation may be needed when a species is represented by few populations and the creation of additional self-sustaining, secure populations may decrease its susceptibility to catastrophic events and environmental stochasticity. For small populations which may be declining in size or subject to high levels of inbreeding, successful population enhancement may increase population stability and hence long-term viability.

Depending on the characteristics of the species, Vallee *et al*. (2004) suggest a minimum viable population size estimated between 50 and 2,500 individuals will be required. Suitable translocation sites may include where the taxon occurs, where it was known to have occurred historically and other areas that have similar habitat (soil, associated vegetation type and structure, aspect etc.), within the known range of the taxon (Vallee *et al*. 2004).

All translocation proposals require endorsement by the department'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 translocations
Responsibility:	Parks and Wildlife (Science and Conservation Division, Swan Coastal District), Botanic Gardens and Parks Authority (BGPA)
Cost:	$42,000 in years 1 and 2; and $26,500 in years 3–5 as required

17. Implement rabbit control

When monitoring ascertains the threat of rabbits is high, baiting using 1080 oats should be undertaken.

Action:	Implement rabbit control
Responsibility:	Parks and Wildlife (Swan Coastal District), relevant land managers
Cost:	$4,000 in years 1, 3 and 5

18. Liaise with land managers and Aboriginal communities

Staff from Parks and Wildlife's Swan Coastal District will liaise with appropriate land managers to ensure that populations of *Synaphea* sp. Serpentine (G.R. Brand 103) are not accidentaly damaged or destroyed, and the habitat is maintained in a suitable condition for the conservation of the species. Consultation with the Aboriginal community 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 (Swan Coastal District)
Cost:	$4,000 per year

19. Promote awareness

The importance of biodiversity conservation and the protection of *Synaphea* sp. Serpentine (G.R. Brand 103) will be promoted through direct contact with the affected land owner/manager, and more broadly through the print and electronic media and by setting up poster displays. Formal links with local naturalist groups and interested individuals will also be encouraged.

Action:	Promote awareness
Responsibility:	Parks and Wildlife (Swan Region, SCB and Public Information and Corporate Affairs (PICA)), with assistance from the SRTFCRT
Cost:	$7,000 in years 1 and 2; $5,000 in years 3–5

20. Obtain biological and ecological information

It is recommended that research on biology and ecology of *Synaphea* sp. Serpentine (G.R. Brand 103) include:

1. Identification of pollinators and their habitat requirements.
2. Soil seed bank dynamics and seed viability.
3. Conditions necessary for natural germination.
4. Response to disturbance, competition, drought, inundation and grazing.

5. Longevity of plants, time taken to reach maturity, and minimum viable population size.
6. The impact of changes in hydrology.
7. The impact of *Phytophthora* dieback and the effectiveness of control techniques.

Action:	Obtain biological and ecological information
Responsibility:	Parks and Wildlife (Science and Conservation Division, Swan Coastal District)
Cost:	$50,000 in years 1–3

21. Map habitat critical to the survival of *Synaphea* sp. Serpentine (G.R. Brand 103)

Although spatial data relating to habitat critical to the survival of the species has been identified 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 *Synaphea* sp. Serpentine (G.R. Brand 103)
Responsibility:	Parks and Wildlife (SCB, Swan Region)
Cost:	$6,000 in year 2

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

If *Synaphea* sp. Serpentine (G.R. Brand 103) is still listed as threatened in Western Australia following five years of implementation, this plan will be reviewed, the need for further recovery actions 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, Swan Region)
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 (Swan Region), with assistance from the SRTFCRT	Ongoing
Monitor populations	High	Parks and Wildlife (Swan Coastal District), with assistance from the SRTFCRT	Ongoing
Install DRF markers	High	Parks and Wildlife (Swan Coastal District)	2015
Confirm species status through genetic studies	High	Parks and Wildlife (Science and Conservation Division, Swan Coastal District)	2016
Undertake weed control	High	Parks and Wildlife (Swan Coastal District), WAPC, Shire of Serpentine-Jarrahdale, Brookfield Rail	Ongoing
Collect and store seed	High	Parks and Wildlife (Swan Coastal District, TFSC)	Ongoing
Install signage at Population 1	High	Parks and Wildlife (Swan Coastal District)	2015
Undertake surveys	High	Parks and Wildlife (Swan Coastal District), with assistance from the SRTFCRT	2019
Remove rubbish from Population 1	High	Parks and Wildlife (Swan Coastal District)	2015
Develop and implement a fire management strategy	High	Parks and Wildlife (Swan Coastal District)	Developed by 2016 with implementation ongoing
Undertake regeneration trials	High	Parks and Wildlife (Science and Conservation Division, Swan Coastal District)	2019
Identify and control insect infestations	High	Parks and Wildlife (Swan Coastal District)	Ongoing
Determine susceptibility to *Phytophthora cinnamomi*	High	Parks and Wildlife (Swan Coastal District, Forest and Ecosystem Management Division)	2016
Maintain disease hygiene	High	Parks and Wildlife (Swan Coastal District)	Ongoing
Ensure long-term protection of habitat	High	Parks and Wildlife (Swan Region, SCB Nature Conservation Covenant Program and Land Unit)	Ongoing
Develop and implement translocations	High	Parks and Wildlife (Science and Conservation Division, Swan Coastal District), BGPA	2019
Implement rabbit control	High	Parks and Wildlife (Swan Coastal District), relevant land managers	Ongoing
Liaise with land managers and Aboriginal communities	Medium	Parks and Wildlife (Swan Coastal District)	Ongoing
Promote awareness	Medium	Parks and Wildlife (Swan Region, SCB and PICA), with assistance from the SRTFCRT	Ongoing
Obtain biological and ecological information	Medium	Parks and Wildlife (Science and Conservation Division, Swan Coastal District)	2017
Map habitat critical to the survival of *Synaphea* sp. Serpentine (G.R. Brand 103)	Medium	Parks and Wildlife (SCB, Swan Region)	2016
Review this plan and assess the need for further recovery actions	Medium	Parks and Wildlife (SCB, Swan Region)	2019

4. Term of plan

This plan will operate from May 2017 to April 2022 but will remain in force until withdrawn or replaced.

5. References

Butcher, R. (2004) A Survey of Gazetted and Proposed Declared Rare species of *Synaphea* (Proteaceae) occurring on the Pinjarra Plain. Unpublished report prepared for the Western Australian Threatened Species and Communities Unit, Department of Conservation and Land Management.

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Department of Parks and Wildlife (2015*a*) Corporate Policy Statement No. 35 *Conserving Threatened Species and Ecological Communities*. Perth, Western Australia.

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Department of Parks and Wildlife (2015*c*) Corporate Guideline No. 36 *Recovery of Threatened Species through Translocation and Captive Breeding or Propagation*. Perth, Western Australia.

Department of Conservation and Land Management (2003) *Phytophthora cinnamomi* and disease caused by it. Volume 1 – Management Guidelines. Department of Conservation and Land Management, Perth, Western Australia.

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Government of Australia (1999) Environment Protection and Biodiversity Conservation Act.

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.

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World Conservation Union (2001) *IUCN Red List Categories: Version 3.1*. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

6. Taxonomic description

Shortened draft taxonomic description of *Synaphea* sp. Serpentine (G.R. Brand 103) (G.R. Brand 103) from Butcher (in prep.):

Clumped *subshrubs*, 0.3–0.6m tall, 0.2–0.5m wide, with or without elongate stem internodes. *Leaves* 2–4 x tripartite, 45–150mm long, 30–165mm wide, mid- to dark green; terminal lobes linear with acute to acuminate apices, some asymmetry in terminal lobing; lowest lobes often falcate. *Petiole* 30–175mm long, pilose (i.e. with long hairs) at base to *c.* 3/4 of length. *Flowering spikes* very long, 0.5–3 × longer than leaves, axis sinuous, frequently dark red (or green heavily infused with red), sparsely appressed-puberulous to pubescent. *Flowers* yellow, *c.* 3.5–4.5mm long, openly spaced, held +/- horizontally, opening narrowly, glabrous or sparsely appressed-puberulous; tepal apices only gently reflexed. *Stigma* transversely oblong to transversely lunate with short, erect horns, 0.7–1.2mm long, 0.9–1.5mm wide, including horns 0.25–0.6mm long. *Fruit* cylindrical to narrowly obovate with a small apical rim, the base of the fruit tapering into a relatively long (*c.* 1/3 total fruit length) and slender neck, 5.5–6.8mm long, 2.2–2.5mm wide, lightly puberulous in lower 2/3, sparsely hairy to glabrous above.