Department of Parks and Wildlife

Interim Recovery Plan No. **351**

Foote's Grevillea (*Grevillea calliantha*)

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
CCWA	Conservation Commission of Western Australia
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 DPaW and Parks and Wildlife)
DRF	Declared Rare Flora
EN	Endangered
EPBC	Environment Protection and Biodiversity Conservation
GPS	Global Positioning System
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 Recovery Team
NRM	Natural Resource Management
PEC	Priority Ecological Community
PICA	Public Information and Corporate Affairs
PVA	Population viability analysis
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 or IRPs, and by ensuring that conservation action commences as soon as possible and, in the case of Critically Endangered (CR) taxa, within one year of endorsement of that rank by the Minister.

This plan, which replaces plan No. 102 Foote's Grevillea, *Grevillea calliantha* (Phillimore *et al*. 2001), will operate from June 2014 to May 2019 but will remain in force until withdrawn or replaced. It is intended that, if the species is still ranked as CR in Western Australia, 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:

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Niall Sheehy	Flora Conservation Officer, 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 Andrew Crawford.

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Summary

Scientific name:	***Grevillea calliantha***	**Common name:**	Foote's Grevillea
Family:	Proteaceae	**Flowering period:**	Sept–Feb; peaking Sept–Nov
DPaW region:	Midwest	**DPaW district:**	Moora
Shire:	Dandaragan	**NRM region:**	Northern Agricultural
IBRA region:	Geraldton Sandplains	**Recovery team:**	MDTFRT
IBRA subregion:	Lesueur Sandplain GES02		

Distribution and habitat: *Grevillea calliantha* is endemic to the Dandaragan area of Western Australia where it occurs over a range of about eight kilometres. The species grows in sandy or sandy-clay soil in open low woodland of *Eucalyptus todtiana* and *Corymbia calophylla* (Brown *et al*. 1998), on lower to mid level slopes to low hills.

Habitat critical to the survival of the species, and important populations: Given that *Grevillea calliantha* is ranked as Critically Endangered (CR), 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. calliantha* 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 calliantha* is specially protected under the Western Australian *Wildlife Conservation Act 1950* and is ranked as CR in Western Australia under International Union for Conservation of Nature (IUCN 1994) criteria B1+2ce due to severe fragmentation and a continuing decline in quality of habitat and number of mature individuals. The species is listed as Endangered (EN) under the Commonwealth EPBC Act.

Threats: The main threats to the species are road and firebreak maintenance, weeds, poor recruitment, grazing, altered fire regimes and 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. Land managers have been informed of the existence of this species and its locations.
2. Declared Rare Flora (DRF) markers have been installed at Populations 2, 5 and 6.
3. Dashboard stickers and posters describing the significance of DRF markers have been produced and distributed to relevant Shires and other organisations.
4. Population 1 was fenced by Parks and Wildlife in 1997.
5. Cages have been placed around emerging seedlings by Parks and Wildlife's District staff to prevent grazing by kangaroos and rabbits.
6. In February 2000, in response to a request from the Shire of Dandaragan, staff from Parks and Wildlife trimmed *Grevillea calliantha* plants that were encroaching onto the road at Populations 2 and 5.
7. One hundred hectares containing Population 4b on private property was fenced in 1995.
8. Population 4a was fenced in 1990 by Parks and Wildlife and the private property owner.
9. Research on population dynamics of selected rare *Grevillea* species, including *G. calliantha*, was undertaken by Parks and Wildlife Science and Conservation Division and Murdoch University between 1993 and 1994.
10. A PhD project entitled 'Population dynamics with life history modelling of rare and common *Grevillea* species in Western Australia' was completed in 2001.

11. In 1998, 106 seedlings of *Grevillea calliantha* were planted into a Shire Reserve in Dandaragan, in accordance with an approved Translocation Proposal. Further plantings occurred in 1999, 2001, 2002 and 2005.
12. In June 2010, a further 177 seedlings were planted into a new site in a nature reserve north of the existing populations.
13. An A4 sized poster, which provides a description of the species, and information about threats and recovery actions, was developed for *Grevillea calliantha*.
14. Some 1,378 seeds collected from *Grevillea calliantha* are currently stored in the TFSC at –18°C.
15. The Botanic Gardens and Parks Authority (BGPA) have 88 plants of *Grevillea calliantha* in their gardens and nursery.
16. All plants at Populations 4 and 7 were marked with a fence dropper, numbered and had their coordinates recorded by Parks and Wildlife in October 2012.

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 six to seven or more over the term of the plan and/or
- The number of mature individuals has increased by 10% or more over the term of the plan from 168 to 185 or more.

Criteria for recovery failure:
- The number of populations has decreased from six to five or less over the term of the plan and/or
- The number of mature individuals has decreased by 10% or more over the term of the plan from 168 to 151 or less.

Recovery actions

1. Coordinate recovery actions
2. Monitor populations
3. Undertake weed control
4. Protect plants from herbivory
5. Undertake regeneration trials
6. Determine susceptibility to *Phytophthora* dieback
7. Confirm the presence of *Phytophthora* dieback
8. Continue the translocation program
9. Maintain disease hygiene
10. Develop and implement a fire management strategy
11. Undertake surveys
12. Collect and store seed
13. Ensure long-term protection of habitat
14. Liaise with land managers and Aboriginal communities
15. Promote awareness
16. Map habitat critical to the survival of *Grevillea calliantha*
17. Review this plan and assess the need for further recovery actions

1. Background

Analysis of outputs and effectiveness of Interim Recovery Plan (IRP) No. 102 (2001-2004) by Phillimore, Papenfus and English.

The criteria for success in the previous plan (the number of individuals within populations and/or the number of populations have increased) has been partly met. At the time the plan was written in 2001, the taxon was known from five populations, including two subpopulations, comprising 159 plants. There are currently six populations (not taking into account translocated populations) and two subpopulations, two of which (1a and 4a) no longer have any plants *in situ*. Although the number of naturally occurring plants has increased slightly from 159 individuals to 168 (5.7% increase), many of the plants are old and senescing. A new translocated population and subpopulation have been established at both a new site and an existing site, although they are not yet self-sustaining.

Although most recovery actions in the previous plan have now been fully or partially implemented, others are still to be implemented. In addition, the taxon's restricted extent of occurrence and occupancy, a continuing decline in the area, extent and its quality of habitat and plant numbers, and its current critical ranking, warrant further recovery. *Action 16* Write a full Recovery Plan is now redundant as Parks and Wildlife no longer produces full recovery plans for flora. Current plans now run for a five year term after which they are to be reviewed and updated if required. The status of recovery actions is listed in table 1. This plan replaces plan No. 102.

Table 1: Status of recovery actions included in previous plan

Recovery action	Status	Result
Coordinate recovery actions	Ongoing	Recovery actions have been conducted by the Moora District Flora Conservation Officer with assistance from the MDTFRT. The team has met biannually over the term of the plan.
Undertake weed control	Not completed	
Stimulate and monitor germination	Smokewater treatment tested	A PhD project by Armstrong (2001) used smokewater to effectively stimulate germination in *Grevillea calliantha*. Moderate numbers of plants were produced, but few survived to maturity. The survival rate of smoke induced seedlings was lower than for a natural fire.
Propagate plants for translocation	Plants propagated	Plants have been propagated by BGPA for use in two translocations.
Continue translocation process	Translocation undertaken, monitoring ongoing	Two translocations have occurred for this species. In 1998, 106 seedlings were planted into a Shire Reserve in Dandaragan (Coates and Monks 1998). In June 2010, a further 177 seedlings were planted into a new site in a nature reserve north of the existing populations (Dillon *et al.* 2010).
Implement disease hygiene measures	Measures implemented	Departmental staff routinely clean vehicles and footwear on entry and exit of sites.
Undertake rabbit control	Not completed	
Monitor populations	Ongoing	Populations were monitored during the term of the plan. Information collected is stored at Parks and Wildlife's district office and SCB.
Develop and implement a fire management strategy	Not completed	
Develop and implement a drainage strategy	Not currently required	

Seek measures to achieve conservation management	Not completed	No action has been taken to achieve conservation management at Populations 1 and 4, either by placing a conservation covenant on or by purchasing the land.
Collect seed and cutting material	Collections made, ongoing	Some 1,378 seeds collected from *Grevillea calliantha* are currently stored in the TFSC at –18°C. Some seed has been processed and the germination ranged from 90 to 100%. BGPA currently have 88 plants of *Grevillea calliantha* in their gardens and nursery.
Conduct further surveys	Surveys conducted, ongoing	The species has been surveyed for in areas of suitable habitat by departmental staff.
Notify and liaise with relevant land managers	Completed	Stakeholders have been made aware of the existence of this species and its locations. Liaison with landowners has been ongoing.
Promote awareness	Ongoing	Information on the species has been included in the WATSNU Newsletter and The West Australian Newspaper. An A4 sized poster, which provides a description of the species, and information about threats and recovery actions, was developed for the species.
Write a full Recovery Plan	No longer a requirement	As Parks and Wildlife no longer produces full recovery plans for flora, this plan will be reviewed and, if necessary, a new plan prepared.

Ongoing recovery actions included in the previous plan are included in this revised plan. *Action 10* (develop and implement a drainage strategy) has not been included in this plan as monitoring has indicated that this is no longer a threat. New recovery actions included in this plan are to determine the susceptibility to *Phytophthora* dieback, monitor and map critical habitat, and review this plan and assess the need for further recovery actions.

History

Grevillea calliantha was discovered in 1981 by Nick Foote who provided material to Zanthorrea Nursery. The nursery introduced the species to the *Grevillea* Study Group, which in turn notified Parks and Wildlife in 1988. The type specimen, which was collected near Cataby by B.J. Conn in 1989, is lodged in the New South Wales Herbarium. Subsequent searching by Parks and Wildlife resulted in the discovery of five additional populations.

Grevillea calliantha was named by Makinson and Olde in 1991, its name derived from the Greek *callos* meaning 'beauty' and *anthos* meaning 'a flower', referring to the spectacular and prolific floral display (Olde and Marriott 1995).

Grevillea calliantha is known from six *in situ* populations, comprising 168 mature plants. In 1998 and 2010, translocations were carried out in an attempt to increase the number of extant plants. However, the survival rate has been low mainly due to heavy grazing and drought.

Description

Grevillea calliantha has spreading branches that are ridged and covered with felty hairs. The leaves are rigid, greyish-yellow, green, up to 7.5cm long and have up to seven stiff, linear lobes. The flower heads are mainly on the edges and lower sides of the branches. Each head has 15 to 30 pouched flowers, about 8mm long, which are hairy and greenish-yellow outside, ageing to apricot orange. The maroon to blackish style is 30 to 40mm long. Fruits are up to 18mm long and 9mm wide, and are densely hairy with a persistent style. *G. calliantha* is closely related to *G. hookeriana* but has longer pistils and decurved inflorescences (Brown *et al*. 1998; Olde and Marriott 1995).

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; Olde, P. and Marriott, N. (1995) *The Grevillea Book*. Vol. 2. Kangaroo Press, Kenthurst; Western Australian Herbarium (1998–) *FloraBase- the Western Australian Flora*. Department of Parks and Wildlife. http://florabase.dpaw.wa.gov.au/.

Distribution and habitat

Grevillea calliantha is endemic to the Dandaragan area of Western Australia where it occurs over a range of about eight kilometres. The species grows in sand or sandy-clay soil in open low woodland of *Eucalyptus todtiana* and *Corymbia calophylla* (Brown *et al*. 1998).

Associated species include *Acacia saligna*, *A. pulchella*, *Adenanthos cygnorum*, *Allocasuarina humilis*, *Anigozanthos humilis*, *Banksia attenuata*, *Calothamnus sanguineus*, *C. quadrifidus*, *Conostephium pendulum*, *Conostylis teretifolia*, *Dianella revoluta*, *Elythranthera brunonis*, *Eremaea asterocarpa*, *Gastrolobium spinosum*, *Hakea incrassata*, *H. prostrata*, *H. trifurcata*, *Hibbertia hypericoides*, *Hypocalymma angustifolium*, *Stirlingia latifolia*, *Synaphea spinulosa*, *Thryptomene mucronulata* and *Xanthorrhoea preissii*.

Table 2. Summary of population land vesting, purpose and manager

Population number & location	Parks and Wildlife district	Shire	Vesting	Purpose	Manager
1a. WSW of Dandaragan	Moora	Dandaragan	LGA	Water reserve	Shire of Dandaragan
1b (T). WSW of Dandaragan	Moora	Dandaragan	LGA	Water reserve	Shire of Dandaragan/Parks and Wildlife
2. WSW of Dandaragan	Moora	Dandaragan	LGA	Road reserve	Shire of Dandaragan
4a. WSW of Dandaragan	Moora	Dandaragan	Private property		Landowners
4b. WSW of Dandaragan	Moora	Dandaragan	Private property		Landowners
5. WSW of Dandaragan	Moora	Dandaragan	LGA	Road reserve	Shire of Dandaragan
6. WSW of Dandaragan	Moora	Dandaragan	LGA	Road reserve	Shire of Dandaragan
7. WSW of Dandaragan	Moora	Dandaragan	Private property		Landowners
8T. W of Dandaragan	Moora	Dandaragan	CCWA	Nature reserve	Parks and Wildlife

Note: Populations 1b and 8 are translocated.

Biology and ecology

Research undertaken by Armstrong (2001) provides information on the biology of *Grevillea calliantha*. The species has large numbers of flowers in spring to summer (>70,000 per plant) but produces limited amounts of seed, usually 120 seeds per plant. The seed-set is influenced by pollinator activity, and plants in more disturbed sites produce fewer seeds. Seed is released between mid-October and February.

Germination of *Grevillea calliantha* seed is stimulated by fire or other disturbance but few seedlings survive to maturity (note: survival rate of smoke induced seedlings was lower than for a natural fire). *Grevillea calliantha* also sprouts from lower stems following fire and these plants set seed within three years. Daughter plants also appear from the roots of mature plants after fire. Plants that germinate from seed following fire do not flower for at least five years (Armstrong 2001). Plants at the translocation site began to flower and set seed at three to four years of age (Dillon *et al*. 2010).

Population viability analysis (PVA) based on the model produced by Armstrong (2001) for *Grevillea calliantha* indicated populations were in decline and possibly not viable long-term. Adult deaths exceeded the recruitment rate due to few germinates between fires. The model determined that an optimal fire regime of seven to 15 years, in autumn, would produce a stable population with a low extinction probability.

Testing of one plant under laboratory conditions indicates that *Grevillea calliantha* may be susceptible to *Phytophthora* dieback caused by *Phytophthora cinnamomi*. However, further testing is required to provide a more conclusive result.

Conservation status

Grevillea calliantha is specially protected under the Western Australian *Wildlife Conservation Act 1950* and is ranked as Critically Endangered (CR) in Western Australia under International Union for Conservation of Nature (IUCN 1994) criteria B1+2ce due to severe fragmentation and a continuing decline in quality of habitat and number of mature individuals. The species is listed as Endangered (EN) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Threats

- **Road and firebreak maintenance**. Threats to Populations 2, 5 and 6 include grading, chemical spraying, construction of drainage channels and mowing of roadside vegetation.
- Habitat degradation from **weeds** is a threat to all populations of *Grevillea calliantha*.
- **Poor recruitment and declining populations**. Many *Grevillea calliantha* plants are old and reaching senescence.
- **Grazing** by rabbits (*Oryctolagus cuniculus*) and kangaroos (*Macropus fuliginosus*) is a threat to most populations.
- **Altered fire regimes.** Frequent fire could result in the depletion of soil-stored seed and exacerbate the impact of disease on the habitat. Fire may also facilitate weed invasion and when it occurs should be followed up with appropriate weed control.
- **Disease** caused by *Phytophthora cinnamomi* is a potential threat to all populations.

The intent of this plan is to provide actions that will mitigate immediate threats to *Grevillea calliantha*. 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 3. Summary of population information and threats

Population number & location	Land status	Year/no. mature plants	Condition		Threats
			Plants	Habitat	
1a. WSW of Dandaragan	Shire water reserve	1988 4 (4) 1993 6 (16) 1994 1 (10) 1998 6 1999 7 (1) [1] 2002 7 [1] 2007 5 2011 0		Good/ degraded	Poor recruitment, weeds, disease, fire, grazing
1b (T). WSW of Dandaragan	Shire water reserve	1998 (106) 1999 73 (115) 2001 140 (114) 2002 196 (106) 2003 302 2005 109 (25) 2006 99 2008 85 2012 13			
2. WSW of Dandaragan	Shire road reserve	1988 14 1995 17 [3 1998 5 2000 18 (1) [3] 2002 34 (9) [2] 2010 10 (1) 2012 10	Moderate	Good	Road maintenance, weeds, fire, disease
4a. WSW of Dandaragan	Private property	1990 14 1993 4 1994 2			Population extinct
4b. WSW of Dandaragan	Private property	1993 100+ 2007 27 (2) [4] 2012 30 [17]	Moderate	Good	Grazing, weeds, fire, poor recruitment
5. WSW of Dandaragan	Shire road reserve	1988 7 1995 5 1998 3 2002 6 2010 3	Poor	Degraded	Road maintenance, weeds, grazing, fire, disease, poor recruitment
6. WSW of Dandaragan	Shire road reserve	1990 14 1996 14 [2] 1998 6 (1) 2000 12 [1] 2007 14 [1] 2010 14	Moderate	Good	Road maintenance, grazing, weeds, fire, poor recruitment
7. WSW of Dandaragan	Private property	2003 20+ 2008 13 (1) [15] 2011 23 [2] 2012 24 [4]	Moderate	Good	Weeds, fire, disease, grazing, poor recruitment
8T. W of Dandaragan	Nature reserve	2010 (177) 2012 74			

Note: Populations in **bold text** are considered to be important populations; Subpopulation 1b and Population 8 are translocated populations; Population 3 has been incorporated into Population 2 given the proximity of the two sites; () = number of juveniles; and [] = number of dead plants.

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 calliantha* 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
- Spread of *Phytophthora* dieback
- A major increase in disturbance in the vicinity of a population.

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

Given that *Grevillea calliantha* is ranked as CR, 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. calliantha* 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 calliantha* will also improve the status of associated native vegetation. Four Priority flora taxa also occur within 500m of the species (see Table 4).

Table 4. Conservation-listed flora species occurring within 500m of *Grevillea calliantha*

Species name	Conservation status (WA)	Conservation status (EPBC Act)
Grevillea synapheae subsp. *minyulo*	Priority 1	-
Anigozanthos humilis subsp. Badgingarra (S.D. Hopper 7114)	Priority 2	-
Hypocalymma tetrapterum	Priority 3	-
Anigozanthos humilis subsp. *chrysanthus*	Priority 4	-

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

One threatened fauna species Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Endangered) which occurs within the range of populations, will benefit from management of *Grevillea calliantha*.

Grevillea calliantha does not occur in association with 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 one site (#28326, Minyulo Brook) of Aboriginal significance adjacent to *Grevillea calliantha* Populations 1 and 2. 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

The implementation of this plan is unlikely to cause significant adverse social and economic impact. For the populations occurring on private property (Populations 4 and 7) some impacts may occur through the loss of land available for development and the cost of implementing recovery actions (maintaining fencing, controlling weeds and rabbit control). For populations occurring on land under the management of the Shire of Dandaragan (Populations 1, 2, 5 and 6), impacts are likely to be similar to above but would also include maintenance of the road infrastructure.

Affected interests

Affected interests include private landholders and the Shire of Dandaragan.

Evaluation of the plan's performance

Parks and Wildlife, with assistance from the Moora District Threatened Flora Recovery Team (MDTFRT), 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 six populations to seven or more over the term of the plan and/or
- The number of mature individuals has increased by 10% or more over the term of the plan from 168 to 185 or more.

Criteria for recovery failure:

- The number of populations has decreased from six populations to five or less over the term of the plan and/or
- The number of mature individuals has decreased by 10% or more over the term of the plan from 168 to 151 or less.

3. Recovery actions

Existing recovery actions

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

DRF markers have been installed at Populations 2, 5 and 6. 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 Shires and other organisations.

Population 1 was fenced by Parks and Wildlife in 1997. Cages have also been placed around emerging seedlings to prevent grazing by kangaroos and rabbits.

In February 2000, in response to a request from the Shire of Dandaragan, staff from Parks and Wildlife trimmed *Grevillea calliantha* plants that were encroaching onto the road at Populations 2 and 5. These cuttings were provided to the Botanic Gardens and Parks Authority (BGPA) to grow plants for future translocations.

One hundred hectares of private property containing Subpopulation 4b was fenced in 1995 using funding provided through the Remnant Vegetation Protection Scheme.

Subpopulation 4a was fenced in 1990 by Parks and Wildlife and the private property owner.

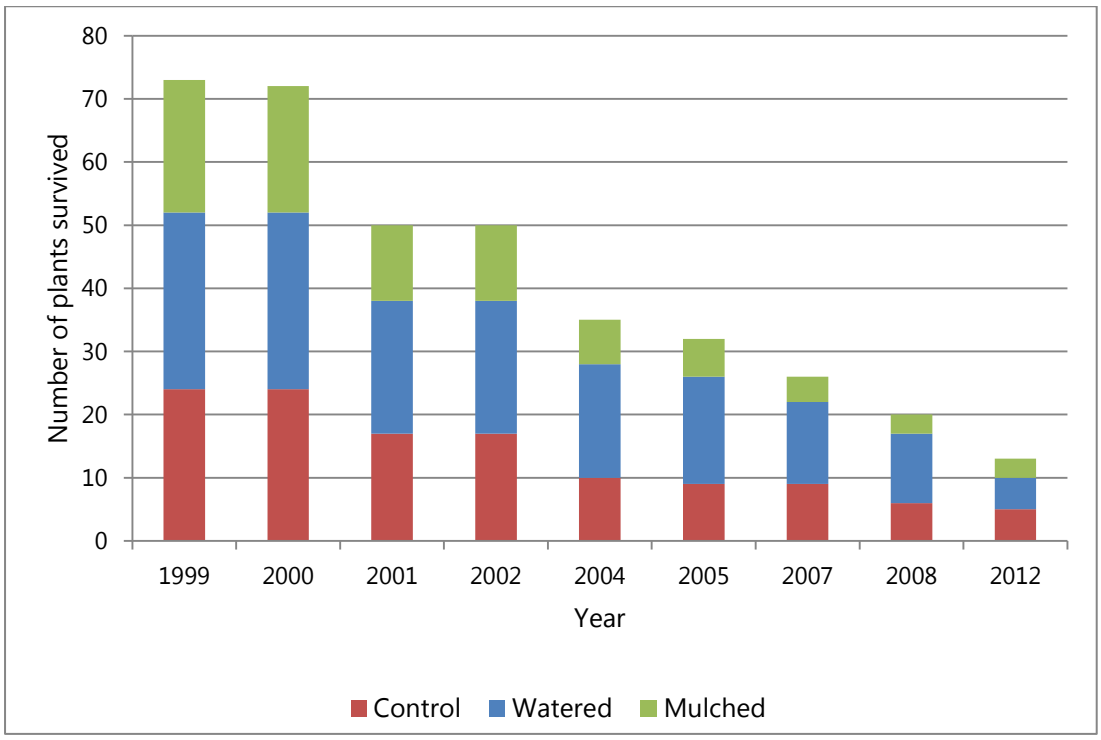
Research on the population dynamics of *Grevillea calliantha* was undertaken between 1993 and 1994 by Parks and Wildlife's Science Division (now Science and Conservation Division (SCD)) and Murdoch University. The aims of the project were to:

1. Prepare life history records.
2. Examine patterns in the habitat of the species to seek generalisations about traits that correlate with rarity or commonness.
3. Design models of population behaviour.
4. Examine the genetic structure of populations.

A PhD project entitled 'Population dynamics with life history modelling of rare and common *Grevillea* species in Western Australia' was completed in 2001 (Armstrong 2001). *Grevillea calliantha* was included in this study.

In 1998, 106 seedlings of *Grevillea calliantha* were planted into a Shire Reserve in Dandaragan (Coates and Monks 1998). Three treatments were tested – water, mulch and control (no watering or mulching). The number of surviving germinates, height, crown width, reproductive state, number of inflorescences and follicles, presence of second generation plants and general health is being monitored. Further plantings took place in 1999, 2001, 2002 and 2005. Additional treatments were applied including comparing early plantings (early in winter months) and late plantings (late in winter months), as well as caged versus uncaged treatments. Preliminary monitoring data from those planted in 1998 suggests that watering of seedlings resulted in a higher survival (Monks and Coates 2000) (see figure 1). However, survival has been generally low due to heavy grazing and drought.

Figure 1. Yearly survival rate for treatments applied for 106 translocated *Grevillea calliantha* seedlings planted in 1998.



In June 2010, a further 177 seedlings were planted into a new site in a nature reserve north of the existing populations (Dillon *et al.* 2010). As at May 2012, 41.8% of translocated plants had survived.

An A4 sized poster, which provides a description of the species, and information about threats and recovery actions, was produced for *Grevillea calliantha*. It is hoped that the poster will result in the discovery of new populations.

Some 1,378 seeds collected from *Grevillea callianthaare* currently stored in the Threatened Flora Seed Centre (TFSC) at –18°C (see table 5). Some seed has been processed and the germination rate ranged from 90 to 100%.

Table 5. TFSC collection details for *Grevillea calliantha*

Accession number	Date collected	Population number	Collection type	Seeds/follicles in storage	Germination rate (%)
00258	6/11/1995	6	B/14	369	90
00259	6/11/1995	3	B/5	80	100
00260	6/11/1995	2	B/10	449	92
00265	6/11/1995	5	B/4	49	-
01556	4/12/2004	1	I/4, I/1	48	-
01557	4/12/2004	1	I/4	45	-
01807	1/12/2005	1	I/3	20	-
01810	1/12/2005	2	I/1, I/2	10	-
02564	3/12/2007	2	I/3	25	-
03598	19/10/2011	2	I/1, I/8	147	not yet conducted
03599	25/10/2011	7	I/1, I6, I/1	32	-
03630	29/11/2011	4	I/3	11	-
03633	28/11/2011	6	I/4	93	not yet conducted

Note: 'I' = a collection of individuals and the number of plants collected; 'B' = a bulked collection and the number of plants sampled.

BGPA have 88 *Grevillea calliantha* plants in their gardens and nursery.

All plants at Populations 4 and 7 were marked with a fence dropper, numbered and had coordinates recorded by Parks and Wildlife in October 2012.

Future recovery actions

Parks and Wildlife, with the assistance of the MDTFRT, 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 the assistance of the MDTFRT, will coordinate recovery actions for *Grevillea calliantha* 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 District), with assistance from the MDTFRT
Cost:	$8,000 per year

2. Monitor populations

Monitoring of grazing, habitat degradation, disease impact (*Phytophthora* sp.), population stability (expansion or decline), pollinator activity, seed production, recruitment, and longevity will be undertaken.

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

3. Undertake weed control

Weeds are a threat to all populations and control is required. The following actions will be implemented:

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

Action:	Undertake weed control
Responsibility:	Parks and Wildlife (Moora District)
Cost:	$10,000 per year, as required

4. Protect plants from herbivores

When monitoring ascertains the threat is high, baiting for rabbits using 1080 oats should be undertaken in summer months when less green feed is available as an alternative food source. Protective cages or fencing should also be considered if rabbit baiting is not sufficient protection for individual plants, or grazing by kangaroos increases.

Action:	Protect plants from herbivores
Responsibility:	Parks and Wildlife (Moora District)
Cost:	$15,000 in years 1, 3 and 5

5. Undertake regeneration trials

Natural disturbance events (physical or fire) may be the most effective means of germinating *Grevillea calliantha* in the wild. Different disturbance techniques should be investigated (i.e. soil disturbance and fire), to determine the most successful and appropriate method. Records will need to be maintained for future research. Any disturbance trials will need to be undertaken in conjunction with weed control.

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

6. Determine susceptibility to *Phytophthora* dieback

Testing is required to determine the susceptibility of the species to *Phytophthora cinnamomi*.

Action:	Determine susceptibility to *Phytophthora* dieback
Responsibility:	Parks and Wildlife (Moora District, Forest and Ecosystem Management Division)
Cost:	$3,000 in year 1

7. Confirm the presence of *Phytophthora* dieback

The presence of *Phytophthora* will be confirmed through mapping and the collection and testing of plant samples. Priority areas for dieback treatment in the community will be determined using Parks and Wildlife's Dieback Management Guidelines (CALM 1999). If present, dieback fronts within, or very close to, *Grevillea calliantha* will be mapped using differential global positioning system, and a photo monitoring point set up. The dieback front will be monitored at least every two years in summer.

Action:	Confirm the presence of *Phytophthora* dieback
Responsibility:	Parks and Wildlife (Moora District)
Cost:	$10,000 in years 1, 3 and 5

8. Continue the translocation program

If required, additional translocation proposals will be developed and suitable disease-free 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:	Continue the translocation program
Responsibility:	Parks and Wildlife (SCD, Moora District), BGPA
Cost:	$42,000 in years 1 and 2; and $26,500 in subsequent years as required

9. Maintain disease hygiene

As *Phytophthora* is suspected to be present in the area of populations, disease hygiene measures are required. Dieback hygiene (outlined in Department of Parks and Wildlife 2014) 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 disease hygiene
Responsibility:	Parks and Wildlife (Moora District)
Cost:	$4,000 per year

10. Develop and implement a fire management strategy

A fire management strategy will be developed in consultation with land managers which recommends fire frequency, intensity, season, and control measures. Armstrong (2001) suggested an optimal fire regime of seven to 15 years.

Action:	Develop and implement a fire management strategy
Responsibility:	Parks and Wildlife (Moora District)
Cost:	$10,000 in year 1 and $6,000 in subsequent years

11. Undertake surveys

It is recommended that areas of potential suitable habitat be surveyed for the presence of *Grevillea calliantha* during its flowering period. 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 District), with assistance from the MDTFRTand volunteers
Cost:	$10,000 per year

12. Collect and store seed

Preservation of genetic material is essential to guard against extinction of the species if the wild population is 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 District, TFSC), BGPA
Cost:	$10,000 per year

13. Ensure long-term protection of habitat

Ways and means of achieving protection of the land on which Populations 1 and 4 of *Grevillea calliantha* occur will be investigated. Possible methods of achieving future conservation management include developing a Management Plan in consultation with the land manager, covenanting, and acquiring the land.

Action:	Ensure long-term protection of habitat
Responsibility:	Parks and Wildlife (Moora District, Species and Communities Branch (SCB))
Cost:	$4,000 per year

14. Liaise with land managers and Aboriginal communities

Staff from Parks and Wildlife's Moora District will liaise with appropriate land managers to ensure that populations of *Grevillea calliantha* are not accidentaly 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 District)
Cost:	$4,000 per year

15. Promote awareness

The importance of biodiversity conservation and the protection of *Grevillea calliantha* will be promoted to the public through poster displays and the development of an information sheet which includes a description of the plant, its habitat type, threats, management actions and photos. This has already been produced but may need to be updated, reprinted and redistributed. Formal links with local naturalist groups and interested individuals will also be encouraged.

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

16. Map habitat critical to the survival of *Grevillea calliantha*

Although habitat critical to the survival of the species is alluded to in Section 1, it has not yet been mapped and 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 *Grevillea calliantha*
Responsibility:	Parks and Wildlife (SCB, Moora District)
Cost:	$6,000 in year 2

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

If *Grevillea calliantha* is still ranked as 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:	Parks and Wildlife (SCB, Moora District)
Cost:	$6,000 at the end of year 5

Table 6. Summary of recovery actions

Recovery action	Priority	Responsibility	Completion date
Coordinate recovery actions	High	Parks and Wildlife (Moora District), with assistance from the MDTFRT	Ongoing
Monitor populations	High	Parks and Wildlife (Moora District), with assistance from the MDTFRT	Ongoing
Undertake weed control	High	Parks and Wildlife (Moora District)	Ongoing
Protect plants from herbivores	High	Parks and Wildlife (Moora District)	Ongoing
Undertake regeneration trials	High	Parks and Wildlife (SCD, Moora District)	2019
Determine susceptibility to *Phytophthora* dieback	High	Parks and Wildlife (Moora District, Forest and Ecosystem Management Division)	2015
Confirm presence of *Phytophthora* dieback	High	Parks and Wildlife (Moora District)	Ongoing
Continue the translocation program	High	Parks and Wildlife (SCD, Moora District), BGPA	2019
Maintain disease hygiene	High	Parks and Wildlife (Moora District)	Ongoing
Develop and implement a fire management strategy	High	Parks and Wildlife (Moora District)	Developed by 2015, ongoing
Undertake surveys	High	Parks and Wildlife (Moora District), with assistance from the MDTFRT and volunteers	Ongoing
Collect and store seed	High	Parks and Wildlife (Moora District, TFSC), BGPA	2019
Ensure long-term protection of habitat	High	Parks and Wildlife (Moora District, SCB)	2019
Liaise with land managers and Aboriginal communities	High	Parks and Wildlife (Moora District)	Ongoing
Promote awareness	Medium	Parks and Wildlife (Moora District, SCB, PICA), with assistance from the MDTFRT	2019
Map habitat critical to the survival of *Grevillea calliantha*	Medium	Parks and Wildlife (SCB, Moora District)	2016
Review this plan and assess the need for further recovery actions	Medium	Parks and Wildlife (SCB, Moora District)	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 CR after five years, the need for further recovery actions will be determined, and a review of this plan will be assessed and a revised plan prepared if necessary.

5. References

Armstrong, P.A (2001) Population dynamics with life history modelling of rare and common *Grevillea* species in Western Australia. Unpublished PhD Thesis submitted to Murdoch University.

Brown, A., Thomson-Dans, C. and Marchant, N. (eds) (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia.

Coates D. and Monks L. (1998) Translocation Proposal – Foote's Grevillea, *Grevillea calliantha* R.O. Makinson & P.M. Olde (PROTEACEAE). Unpublished report. Department of Conservation and Land Management.

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.

Department of Conservation and Land Management (1999) *Phytophthora cinnamomi* and disease caused by it Volume III – Phosphite Operations Guidelines. Perth, Western Australia.

Department of Parks and Wildlife (2014) Policy Statement No. 3 Management of *Phytophthora* disease. Department of Parks and Wildlife, Western Australia.

Dillon, R., Todd, B. and Monks, L. (2010) Translocation Proposal – *Grevillea calliantha* (PROTEACEAE). Unpublished report. Department of Environment and Conservation.

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.

Makinson, R.O. and Olde, P.M. (1991) A new species of *Grevillea* (Proteaceae: Grevilleoideae) from south-west Western Australia. *Telopea* 4(2): 351−355.

Monks, L. and Coates, D. (2000) Critically Endangered WA Plants- Translocation and Re-establishment Trials. Department of Conservation and Land Management, Western Australia.

Olde, P. and Marriott, N. (1995) *The Grevillea Book*. Vol. 2. Kangaroo Press, Kenthurst.

Phillimore, R., Papenfus, D. and English, V. (2001) Foote's Grevillea *Grevillea calliantha* Interim Recovery Plan No. 102, 2001–2004. Department of Conservation and Land Management, Perth.

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 calliantha* Makinson & Olde**

Makinson, R.O. and Olde, P.M. (1991) A new species of *Grevillea* (Proteaceae: Grevilleoideae) from south-west Western Australia. *Telopea* 4(2): 351−355.

Grevillea calliantha is a spreading flat-topped shrub *c*. 1m tall, 2−3m wide; branches spreading or slightly ascending, somewhat secund on older plants; bark rough, grey over red-brown; branchlets (younger) flattened, strongly ridged, and tomentose with wavy hairs; when older the branchlets more terete, ridged, sublanate with curled hairs; branchlets indumentum whitish with reddish brown stripes corresponding to ridges and decurrent from the leaf-bases. *Leaves* greyish yellow-green, ascending, subsessile (appearing petiolate) or with petioloes up to *c*. 3mm long, pinnatipartite (almost pinnatisect), 4.0−7.5cm long with (3−) 5−7 (−11, cultivated) entire ascending linear lobes, lobes 1−4.5cm long, 1.0−1.1mm wide, basal lobes longest; apex and apices of lobes acute with a sometimes pungent point; margin smoothly revolute, enclosing the lower surface except for the midvein(s) of leaf and lobes; upper surface of leaves and lobes with an inconspicuous midvein; young leaves with an open to dense indumentum of wavy to curly hairs on upper surface and the exposed veins of the lower surface, older leaves becoming glabrous and faintly granulate on these parts; texture chartaceous. *Inflorescences* on older plants largely confined to a zone beneath and at the edge of the layered foliage, terminal and simple but sometimes on short lateral branchlets arising from successive nodes and appearing branched, decurved to sigmoid from near the base of the peduncle, conspicuous, many (15−30) flowered, secund, centripetal (?20−) 50−70mm long; peduncles bracteate, densely tomentose, 5−15mm long; rachises densely tomentose to sublanate with whitish hairs only, ridged beneath the indumentum, up to *c*. 60mm long; bracts spreading (spreading to recurved, and conspicuous, on very young bud-bearing rhachises), ovate-acuminate, 2.2−2.9mm long, 1.3−1.8mm wide, outer and inner surfaces tomentose with straight to wavy hairs, bracts persistent at anthesis; pedicels 1.0−2.5 (−3.5 cultivated)mm long, tomentose; torus oblique at 15°−30°, 1.3−2.1mm across, projecting strongly at the ventral side where it is adnate to the prominent nectary; perianth obliquely ovate to rather saccate below the curve, 2.2−3.0 (−4.0 cultivated)mm across, outer surface tomentose with white and reddish two-armed hairs (and rarely, cultivated NSW 228067), some simple erect multicellular glandular hairs), the indumentum longer (to villous) on the limb; inner surface of perianth glabrous; limb of bud spheroidal, 1.7−2.2mm long 2.4mm wide; dorsal tepals (10.5−) 11.3−12.8mm long, 1.8−2.6mm wide; nectary conspicuous, prominent, spreading, linguiform, sometimes decurved at tip, usually partly enclosed with the torus, 0.7−1.9mm long, projecting 0.3−0.6 (−0.8 cultivated)mm beyond the rim, margin entire; pistil (28.5−) 30−40mm long, stipe absent or obscure, up to *c*. 0.5mm long ovary subsessile, 1.3−1.6mm long, subvillous with two-armed hairs only. Some reddish blotching evident in the indumentum; ovules attached about the medial position; style appearing glabrous but occasionally with two-armed hairs extending for about 2−3mm above the ovary, and sometimes with few to many short (*c*. 0.1mm) inconspicuous erect multicellular ?glandular hairs, especially on the ventral side, or glabrous throughout; apical *c*. 2mm of style dilating smoothly into the back in the style-end; pollen-presenter ovate, oblique at *c*. 45°, strongly and obliquely convex, 1.1−1.5mm long, 1.0−1.2mm wide, 0.3−0.5mm high, stigma distally off-centre. *Fruits* 2-seeded, more or less spreading from the rachis, erect to somewhat reflexed at the apex of the decurved pedicel, obliquely oblong-ellipsoid, somewhat laterally compressed, 13−18mm long, 8−9mm wide, *c*. 6mm thick; styles persistent; surface with a dense matted tomentose indumentum of multicellular glandular hairs,

sometimes interspersed with a few two-armed hairs (most or all of the two-armed hairs of the ovary shed as the fruit matures); on young fruits up to *c*. 8mm long two-armed hairs still predominate, with longitudinal reddish striping of the indumentum; mature fruits with surface beneath the indumentum unevenly pitted; pericarp 0.3–0.4 (0.7, Conn 3278)mm across at the suture, 0.4–0.8mm thick at centre-face, 0.5–0.8mm thick at the dorsal side, texture weakly crustaceous. *Seeds* slightly curved, obliquely elliptical, 12.5mm long, 5.0mm wide, 2.0–2.5mm thick; outer face convex, with a slight submarginal ridge, tissue outside the ridge paler than the central elliptical area; inner face with a central more or less flat elliptical area *c*. 60mm long and 1.0mm wide, surrounded by an outer ring of radially-oriented upright lamellae of papery or waxy tissue.