INTERIM RECOVERY PLAN NO. 274

MATCHSTICK BANKSIA

(*Banksia cuneata*)

INTERIM RECOVERY PLAN

2008-2013

April 2008

Department of Environment and Conservation
Kensington

Australian Government

Government of Western Australia

Department of Environment and Conservation
Our environment, our future

FOREWORD

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

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

DEC is committed to ensuring that threatened taxa are conserved through the preparation and implementation of Recovery Plans (RPs) or IRPs, and by ensuring that conservation action commences as soon as possible and, in the case of Critically Endangered (CR) taxa, always within one year of endorsement of that rank by the Minister.

This IRP will operate from April 2008 to March 2013 but will remain in force until withdrawn or replaced. It is intended that, if the species is still ranked as Endangered (EN) this IRP will be reviewed after five years and the need for further recovery actions assessed.

This IRP was approved by the Director of Nature Conservation on the 30 April 2008. The allocation of staff time and provision of funds identified in this IRP is dependent on budgetary and other constraints affecting DEC, as well as the need to address other priorities.

Information in this IRP was accurate at April 2008.

This IRP was prepared with financial support from the Australian Government to be adopted as a National Recovery Plan under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

IRP PREPARATION

This IRP was prepared by Craig Douglas[1], Marie Strelein[2], Greg Durell[3] and Kym Pryor[4].

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ACKNOWLEDGMENTS

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

Andrew Brown	Threatened Flora Coordinator, Species and Communities Branch, DEC
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Andrew Crawford	Technical Officer, Threatened Flora Seed Centre, DEC
Bob Elkins	Technical Assistant, Botanic Gardens and Parks Authority
Kelly Poultney	Officer, Threatened Flora Database, DEC

Thanks also to the staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information. Thanks also to DEC's Species and Communities Branch and the private land holders who provided information and assistance in locating populations in the field.

Cover photographs by Babs and Bert Wells (top), M. Blackwell and Steve Hopper (bottom left and right). Images used with the permission of the Western Australian Herbarium.

CITATION

This IRP should be cited as:

Department of Environment and Conservation (2008) Matchstick Banksia (*Banksia cuneata*) Interim Recovery Plan 2008-2013. Interim Recovery Plan 274. Department of Environment and Conservation, Perth, Western Australia.

SUMMARY

Scientific Name:	***Banksia cuneata***	**Common Name:**	Matchstick Banksia, Quairading Banksia
Family:	PROTEACEAE	**Flowering Period:**	September - December
DEC Region:	Wheatbelt	**DEC Districts:**	Great Southern and Avon-Mortlock
Shires:	Quairading, Brookton and Cuballing	**Recovery Teams:**	Great Southern and Avon-Mortlock District Threatened Flora Recovery Teams
NRM Regions:	Avon, South West		

Illustrations and/or further information: Brown, A., Thomson-Dans, C. and Marchant, N. (1998) *Western Australia's Threatened Flora*. Department of Conservation and Land Management, Western Australia pp 70; Department of Environment and Conservation (2008) *Western Australian Herbarium FloraBase 2 – Information on the Western Australian Flora* (Accessed 2008) Department of Environment and Conservation, Western Australia. http://www.calm.wa.gov.au/science/; George, A.S. (1981) The Genus Banksia L.f. (Proteaceae). *Nuytsia*. **3(3)**: 457-460.

Current status: *Banksia cuneata* was declared as Rare Flora in 1982 under the Western Australian *Wildlife Conservation Act 1950* and is currently ranked as Endangered (EN) under World Conservation Union (IUCN 1994) Red List criterion C2a due to there being less than 2500 mature individuals in the wild and severe fragmentation of populations which are showing a continuing decline. The main threats are weed invasion, rabbit activity, road maintenance, farming activities (including chemical drift, application of herbicides and fence maintenance), parrot damage, disease, lack of natural recruitment, salinity, rising water tables, exposure to wind, habitat degradation and inappropriate fire regimes. *Banksia cuneata* is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Description: *Banksia cuneata* is a smooth barked shrub or small tree to 4 m high with one or more woody stems, each of which has many branches. The erect branches form an irregular, bushy crown. The species name refers to the wedge-shaped leaves that are 1 to 4 cm long and 0.5 to 1.5 cm wide and generally flat with prominent marginal teeth. Flower heads are 3 to 4 cm wide. The style is cream, turning red, with a green pollen presenter. Each fruiting cone usually has one to five follicles 17 to 21 mm long and 9 to 12 mm wide and densely covered with short, soft, matted hairs (Brown *et al.* 1998).

Banksia cuneata differs from the closely related *B. ilicifolia* in that it has smaller leaves and fruit and occurs more than 50 km further inland. The smooth bark and flowers are also a distinctive feature of *B. cuneata* (Brown *et al.* 1998).

Habitat requirements: *Banksia cuneata* occurs in small, localised stands of tall sclerophyllous scrub-heath or low open woodland on undulating deep yellow sands (Lamont *et al.* 1991; cited Burgman and Lamont 1992).

Habitat critical to the survival of the species, and important populations: Given that *Banksia cuneata* is ranked as EN, it is considered that all wild and translocated populations are important populations. Habitat critical to the survival of *B. cuneata* 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: Several *Banksia cuneata* populations occur within the Priority Ecological Community '*Banksia prionotes* and *Xylomelum angustifolium* low woodlands on transported yellow sands' (Priority 1). Five threatened and priority flora species - *Jacksonia quairading* ms (EN), *Calectasia pignattiana* (VU), *Hemiandra coccinea* (Priority 3), *Conospermum eatoniae* (Priority 3) and *Acacia lirellata* subsp. *compressa* (Priority 2) - will benefit from recovery actions put in place for *B. cuneata*.

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. *Banksia cuneata* is not listed under any specific international treaty however, and this IRP does not affect Australia's obligations under any other international agreements.

Indigenous Consultation: Involvement of the Indigenous community is being sought through the South West Aboriginal Land and Sea Council and the Badjaling Wanderers Aboriginal group to assist in the identification of cultural values for land occupied by *Banksia cuneata*, or groups with a cultural connection to land that is important for the species' conservation, and to determine whether there are any issues or interests identified in the plan. A search of the Department of Indigenous Affairs Aboriginal Heritage Sites Register has revealed that several plants from *B. cuneata* Population 2 are located on land vested with the Aboriginal Lands Trust (ALT). Where no role is identified for the indigenous community associated with this species in the development of the recovery plan, opportunities may exist through cultural interpretation and awareness of the species. Indigenous involvement in the implementation of recovery actions will be encouraged.

Continued liaison between DEC and the indigenous community will identify areas in which collaboration will assist implementation of recovery actions.

Social and economic impact: As some populations of *Banksia cuneata* occur on, or adjacent to, private land, recovery actions could potentially affect farming activities. Where populations are located on private property, recovery actions refer to continued liaison between stakeholders with regards to these areas.

Affected interests: Stakeholders potentially affected by the implementation of this plan include the Shires of Brookton, Quairading and Cuballing, Main Roads WA, owners of private land and the Badjaling Wanderers Aboriginal group. Recovery actions refer to continued liaison between stakeholders.

Evaluation of the plan's performance: DEC, in conjunction with the Great Southern and Avon-Mortlock District Threatened Flora Recovery Teams will evaluate the performance of this IRP. 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.

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

Recovery criteria
Criteria for success: The number of populations have increased and/or the number of mature individuals have increased by ten percent or more over the term of the plan.
Criteria for failure: The number of populations have decreased and/or the number of mature individuals have decreased by ten percent or more over the term of the plan.

Completed recovery actions
1. Land owners and managers have been made aware of the threatened nature of this species, its location and their legal obligations to protect it.
2. DRF markers have been installed at Populations 1, 4, 5 and 9.
3. Populations 4 and 11 and Subpopulations 8a & b, and part of Population 10 have been fenced to exclude rabbits and livestock.
4. A groundwater pump has been installed and a *Eucalyptus* plantation established at Population 8 to lower the rising water table.
5. A translocation site for *Banksia cuneata* has been established to protect the type population.
6. Re-vegetation of the translocation site (Population 13t) with local natives has been undertaken.
7. Cultivated plants have been planted at the translocation site and at Populations 1, 4, 7, 8 and 10.
8. *Banksia cuneata* has been planted on road verges within the Quairading townsite.
9. Live *Banksia cuneata* plants are held in the Botanic Gardens and Parks Authority (BGPA) Rare and Endangered Garden.
10. Between 1996 and 2005, recruitment and seedling survival following fire was investigated at Population 6.
11. Seed collections are stored with DEC's Threatened Flora Seed Centre (TFSC) and Botanic Gardens and Parks Authority (BGPA).

Ongoing and future recovery actions
1. Rabbit baiting is being undertaken at Populations 1, 8, 10, 12 and 13t.
2. A series of bore monitoring stations have been installed at Population 7 to monitor rising groundwater levels.
3. Sixty five hectares of land on a Private Property adjacent to Population 1 has been offered to DEC for the re-establishment of *Banksia cuneata*.
4. DEC's Great Southern and Avon-Mortlock District Recovery Teams are overseeing the implementation of this IRP and will include it in their annual report to DEC's Corporate Executive and funding bodies.
5. Staff from DEC's Great Southern and Avon-Mortlock District offices are monitoring all known populations.

Recovery actions

1. Coordinate recovery actions
2. Monitor populations
3. Liaise with relevant land managers and Indigenous groups
4. Install DRF markers
5. Implement rabbit control
6. Undertake weed control
7. Monitor groundwater levels and salinity
8. Develop and implement fire and disturbance trials
9. Develop and implement a fire management strategy
10. Enhance habitat
11. Collect seed
12. Control dieback
13. Report on the post fire study
14. Enhance populations
15. Investigate security of tenure
16. Promote awareness
17. Conduct further surveys
18. Obtain biological and ecological information
19. Map habitat critical to the survival of *Banksia cuneata*
20. Review this plan and assess the need for further recovery actions

1. BACKGROUND

History

Alex George described *Banksia cuneata* in 1981 from specimens collected east of Quairading in 1971 (George 1981). The earliest collection housed at the WA Herbarium was made in 1937 by William Blackall.

It is thought that land clearing in Western Australia's Wheatbelt has reduced *Banksia cuneata* to about seven per cent of its original distribution (Maguire and Sedgley 1997).

There are currently 12 known natural populations of *Banksia cuneata* and one translocated population (Population 13t). It is likely that many existing populations are small residual parts of what were once much larger populations. Populations 3, 4, 5 and 11 are presumed to have once been joined as a single large population. Population 9 occurs in close proximity to Subpopulations 8a-c, and these are also likely to have been joined at one time (Stace and Coates 2001).

The most recent comprehensive monitoring of the species was conducted in December 2004 (Populations 1, 6, 8, 9, 12 and 13t), February 2005 (Populations 2, 7 and 10), December 2005 (Population 11) and August 2006 (Populations 3, 4 and 5). From data obtained it is estimated that around 690 mature individual individuals occur across the 12 known natural populations.

Description

Brown *et al.* (1998) describe *Banksia cuneata* as "a smooth barked shrub or small tree reaching up to 4 m tall with one or more woody stems, each of which has many branches. The erect branches form an irregular, bushy crown. The species name refers to the wedge-shaped leaves. They are 1 to 4 cm long and 0.5 to 1.5 cm wide and are generally flat, with prominent teeth. Flower heads are 3 to 4 cm wide. The style is cream turning red, with a green pollen presenter. Each fruiting cone usually has one to five follicles. Follicles are 17 to 21 mm long and 9 to 12 mm wide and densely covered with short, soft, matted hairs."

Banksia cuneata differs from *B. ilicifolia* (a closely related species) in that it has smaller leaves and fruit and occurs more than 50 km further inland. The smooth bark and flowers are also a distinctive feature of *B. cuneata* (Brown *et al.* 1998).

Distribution and habitat

Banksia cuneata is located in the central Wheatbelt of Western Australia in the Shires of Quairading, Brookton, and Cuballing.

The habitat in which *Banksia cuneata* occurs consists of deep yellow sands supporting tall sclerophyllous scrub-heath or low open woodland. Species associated with *Banksia cuneata* include *B. prionotes*, *Xylomelum angustifolium*, *Leptospermum erubescens* and *Eremaea pauciflora*.

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

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager
1. E of Quairading	Avon-Mortlock	Quairading	Main Roads	Road Reserve	Main Roads WA
2. E of Quairading	Avon-Mortlock	Quairading	Conservation Commission and Aboriginal Lands Trust	Conservation of Flora and Fauna	DEC
3. NE of Brookton	Great Southern	Brookton	Shire of Brookton	Road Reserve	Shire of Brookton
4. NE of Brookton	Great Southern	Brookton	Conservation Commission	Conservation of Flora and Fauna	DEC
5. NE of Brookton	Great Southern	Brookton	Shire of Brookton	Road Reserve	Shire of Brookton
6. Quairading	Avon-Mortlock	Quairading	Unallocated Crown Land		Department for Planning and Infrastructure
7. SE of Quairading	Avon-Mortlock	Quairading	Freehold	Private Property	Landholders

8a. SE of Popanyinning	Great Southern	Cuballing	Freehold	Private Property	Landholders
8b. SE of Popanyinning	Great Southern	Cuballing	Freehold	Private Property	Landholders
8c. SE of Popanyinning	Great Southern	Cuballing	Freehold	Private Property	Landholders
9. SE of Popanyinning	Great Southern	Cuballing	Shire of Cuballing	Road Reserve	Shire of Cuballing
10. SE of Dangin	Avon-Mortlock	Quairading	Freehold	Private Property	Landholders
11. N of Aldersyde	Great Southern	Brookton	Freehold	Private Property	Landholders
12a. N of Popanyinning	Great Southern	Cuballing	Freehold	Private Property	Landholders
12b. N of Popanyinning	Great Southern	Cuballing	Freehold	Private Property	Landholders
12c. N of Popanyinning	Great Southern	Cuballing	Freehold	Private Property	Landholders
13t. E of Quairading (Translocation Site)	Avon-Mortlock	Quairading	Freehold	Private Property	Landholders

Populations in **bold text** are considered to be Important Populations

Biology and ecology

Banksia cuneata builds up a large seed reserve in its fruit follicles, with seed viability lasting up to 10 years and seed reserves increasing exponentially with tree age. No seed is produced before plants reach reproductive maturity at around 5 years of age. By the time plants reach 25 years of age over 17,000 seeds may be stored in the canopy (Burgman and Lamont 1992).

The seeds of *Banksia cuneata* are rarely damaged by insects (Burgman and Lamont 1992). However, rabbits are known to eat or ringbark seedlings and often burrow in the sandy soil beneath plants, disturbing the root systems. Parrots are known to damage branches.

It appears that *Banksia cuneata* seed release has two pathways, the first being a gradual release that allows for some annual recruitment, and the other being a rapid, fire induced release (Stace and Coates 2001).

The main limitation to recruitment is water availability following seed release. Providing water to seedlings in dry years, especially following fire, increases *Banksia cuneata* seedling survival from 60 to 85.5% (Lamont *et al*. 1991). Hydrology is also potentially a key factor in sustaining *B. cuneata* populations. Populations with access to subterranean aquifers have higher recruitment rates (Stace and Coates 2001).

Mature plants begin to show signs of senescence at around 20 years of age. Burgman and Lamont (1992) suggest that it is unlikely that *Banksia cuneata* reaches more than 45 years of age.

While *Banksia cuneata* generally requires some habitat disturbance to stimulate germination, it is susceptible to inappropriate fire regimes. Stace and Coates (2001) conclude that fire events less than seven years apart lead to a decline in population size as very little seed accrues on plants over this short interval. Fire cycles in the order of fifteen to twenty five years are likely to be necessary to raise population numbers, provided fires are not followed by drought (Burgman and Lamont 1992).

Honeyeaters are the most efficient pollinators of *Banksia cuneata* but other known pollinators include bees, beetles and wasps. Flowering of nearby nectar producing species such as *Banksia prionotes* and *Grevillea bipinnatifida* prior to and overlapping that of *B. cuneata* increases the abundance of honeyeaters and other pollinators (McNee 2002).

Studies of *Banksia cuneata* reproduction have shown that the species is self-compatible, and that inbreeding occurs in highly disturbed populations. Inbreeding can result in smaller and weaker seed, slower germination rates and low seedling survival in summer (Broadhurst and Coates 2004).

Threats

Banksia cuneata was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in 1982 and is currently ranked as Endangered (EN) under World Conservation Union (IUCN 1994) Red List criterion C2a due to their being less than 2500 mature individuals in the wild, severe fragmentation of populations and populations showing a continuing decline. The main threats are weed invasion, rabbit activity, road maintenance, farming activities (including chemical drift, application of herbicides and fence maintenance), parrot damage, disease, lack of natural recruitment, salinity, rising water tables, exposure to wind,

habitat degradation and inappropriate fire regimes. *Banksia cuneata* is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

- **Weed invasion** is a threat to Populations 1-4, 6, 7, 9, 10 and 13t and Subpopulation 12b, c. Weeds compete with *Banksia cuneata* for space and resources resulting in reduced seedling survival. Fuel loads built up by annual grasses increase the frequency and severity of fire and can potentially lead to a decline in population size.
- **Rabbit activity.** All populations of *Banksia cuneata* have rabbits present. Rabbit warrens under trees are likely to damage roots. Rabbits are also likely to eat seedlings and are a vector for weed introduction.
- **Road maintenance** threatens *Banksia cuneata* Populations 1, 3-5 and 9 through grading and herbicide spraying. Grading may directly damage plants and also encourage weed invasion.
- **Farming activities,** including fence maintenance and chemical spraying, potentially threatens Populations 3, 5, 9, 11 and Subpopulation 12c.
- **Parrot damage** has been noted at Populations 3 and 5 however all populations are potentially affected by this threat.
- **Disease.** *Banksia cuneata* Populations 8, 9 and Subpopulations 12b and c are located in Dieback (*Phytophthora* sp.) disease risk areas and observations indicate that *B. cuneata* is susceptible.
- **Lack of natural recruitment** affects several populations of *Banksia cuneata*. This is the result of dry conditions, lack of appropriate disturbance regimes such as fire, absence of effective pollinators (e.g. honeyeaters), inbreeding, predation of seedlings by rabbits and accumulation of non-wetting soils from farming properties.
- **Salinity.** *Banksia cuneata* populations are known to occupy areas of internal drainage where access to underground water is possible. This exacerbates the threat of salinity to this species as low lying areas are most affected by rising saline groundwater.
- **Rising water tables** and water logging of soils threatens low-lying populations. Protective measures have been taken at Populations 7 and 8 to abate this threat. Hydrological assessment of all populations is required to determine the level of threat.
- **Exposure to wind.** Wind damage to adult plants is exacerbated by exposed conditions along road verges and leads to the breakage of branches.
- **Habitat degradation** threatens Populations 1, 3-5, 7-9, 11 and 12.
- **Inappropriate fire regimes.** A lack of fire at *Banksia cuneata* populations has resulted in plant senescence and poor recruitment rates.

The intent of this plan is to provide actions that will deal with immediate threats to *Banksia cuneata*. Threats such as drought and climate change may impact on the species over time however actions taken to prevent such threats are beyond the scope of this plan.

Table 2: Summary of population information and threats

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
1. E of Quairading	Road Reserve	1982 56 1993 50 (35) 1996 50 (35) 1999 64 (5) 2001 71 2005 40	Moderate	Weeds, rabbit activity, road and firebreak maintenance, habitat degradation
2. E of Quairading	Nature Reserve and ALT Reserve	1982 300 1988 13 1996 28 2001 32 2005 9 [8]	Poor	Lack of recruitment, rabbit activity, weeds, inappropriate fire regime
3. NE of Brookton	Road Reserve	1982 15(3) 1993 6 2001 2 2006 1	Poor	Weeds, wind, habitat degradation, lack of natural recruitment, chemical drift, parrot damage, road maintenance
4. NE of Brookton	Nature Reserve	1982 70(5) 1991 80(4)[7] 1994 87 1999 100 2005 62 2006 49	Healthy	Weeds, rabbit activity, road maintenance

5. NE of Brookton	Road Reserve	1982 15 1994 9 1997 8 [3] 1999 6 [1] 2005 6 2006 2	Poor	Wind, habitat degradation, rabbit activity, road maintenance, parrot damage, chemical drift
6. Quairading	Unallocated Crown Land	1988 87 [10] 1999 618 2001 699 2004 150	Healthy	Weeds, rabbit activity
7. SE of Quairading	Private Property	1988 50 1992 112(6)[28] 1994 57 2001 18 2005 22	Poor	Salinity, rising water table, weeds, rabbit activity, lack of natural recruitment
8a. SE of Popanyinning	Private Property	1990 97(25)[24] 1992 100(25)[20] 1999 118* 2001 99[25]* 2005 57[32]*	Moderate	Rabbit activity
8b. SE of Popanyinning	Private Property	1990 [12] 1999 118* 2001 99[25]* 2005 57[32]*	Moderate	Rabbit activity, salinity, rising water table
8c. SE of Popanyinning	Private Property	1990 2 1994 106* 1996 106* 1999 118* 2001 99[25]* 2005 57[32]*	Moderate	Disease
9. SE of Popanyinning	Road Reserve	1993 1 1994 2 1996 2 [1] 2001 3 2005 2	Moderate	Weeds, rabbit activity, lack of natural recruitment, road maintenance, chemical drift, disease, habitat degradation
10. SE of Dangin	Private Property	1993 8 (2) [1] 1992 10 [1] 1996 8 1999 12 (2) [1] 2001 8 2005 4	Poor	Rabbit activity, weeds, lack of natural recruitment
11. N of Aldersyde	Private Property	1995 3 [1] 1996 3 2005 2	Poor	Weeds, wind exposure, habitat degradation, chemical drift
12a. N of Popanyinning	Private Property	2002 127 2005 115	Moderate	Lack of natural recruitment, rabbit activity
12b. N of Popanyinning	Private Property	2002 97 2004 182 [103]	Moderate	Rabbit activity, weeds, disease
12c. N of Popanyinning	Private Property	2002 6 2005 6	Healthy	Lack of natural recruitment, rabbit activity, weeds, farming activities, disease
13t. E of Quairading (Translocation site)	Private Property	1995 53 1999 123 2005 120	Healthy	Weeds, rabbit activity

Census information taken from: MacWilliams (2005) and Department of Environment and Conservation (2008); Populations in **bold text** are considered to be Important Populations; Note: * = summed total for subpopulations, ( ) = number of seedlings, [ ] = number dead.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Developments and/or land clearing in the immediate vicinity of *Banksia cuneata* populations require assessment. Developments or clearing should not be approved unless the proponents can demonstrate that their actions will have no significant impact on the species, its habitat or potential habitat or on the local surface hydrology, such that drainage in the habitat of the species would be altered.

Habitat critical to the survival of *Banksia cuneata*, and important populations

Given that *Banksia cuneata* is ranked as EN, it is considered that all known habitat for wild and translocated populations is critical to the survival of the species, and that all wild and translocated populations are important populations. Habitat critical to the survival of *B. cuneata* 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

Several of *Banksia cuneata* populations occur within a Threatened Ecological Community (TEC) '*Banksia prionotes* and *Xylomelum angustifolium* low woodlands on transported yellow sands' (Priority 1). This community type contains an assemblage of plants that are restricted in area and only found in a few locations. Five threatened and priority flora species occur in association with *Banksia cuneata* and are listed in the table below. Recovery actions implemented to improve the quality or security of the habitat of *B. cuneata* will improve the status of associated native vegetation, associated threatened species and the TEC.

Table 3: Conservation-listed flora species occurring in habitat of *Banksia cuneata*

Species name	Conservation Status (Western Australia)	Conservation Status (EPBC Act 1999)
Jacksonia quairading ms	DRF (EN)	EN
Calectasia pignattiana	DRF (VU)	
Hemiandra coccinea	Priority 3	
Conospermum eatoniae	Priority 3	
Acacia lirellata subsp. *compressa*	Priority 2	

DRF – Declared Rare Flora; for a description of Priority categories see Atkins (2008)
For a description of the TEC categories see Department of Environment and Conservation (2007)

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. *Banksia cuneata* is not listed under any specific international treaty however, and this IRP does not affect Australia's obligations under any other international agreements.

Indigenous Consultation

Involvement of the Indigenous community is being sought through the South West Aboriginal Land and Sea Council and the Badjaling Wanderers Aboriginal group. This is to assist in the identification of cultural values for land occupied by *Banksia cuneata*, or groups with a cultural connection to land that is important for the species' conservation, and to determine whether there are any issues or interests identified in the plan. A search of the Department of Indigenous Affairs Aboriginal Heritage Sites Register has revealed that several plants from *B. cuneata* Population 2 are located on lands vested with the Aboriginal Lands Trust (ALT). Where no role is identified for the indigenous community associated with this species in the development of the recovery plan, opportunities may exist through cultural interpretation and awareness of the species. Indigenous involvement in the implementation of recovery actions will be encouraged.

Continued liaison between DEC and the indigenous community will identify areas in which collaboration will assist implementation of recovery actions.

Social and economic impacts

As some populations of *Banksia cuneata* occur on, or adjacent to, private land, recovery actions could potentially affect farming activities. Where populations are located on private property, recovery actions refer to continued liaison between stakeholders with regards to these areas.

Affected interests

Stakeholders potentially affected by the implementation of this plan include the Shires of Quairading, Brookton and Cuballing, Main Roads WA, owners of private land and the Badjaling Wanderers Aboriginal group. Recovery actions refer to continued liaison between stakeholders.

Evaluation of the plan's performance

DEC, in conjunction with the Great Southern and Avon-Mortlock District Threatened Flora Recovery teams, will evaluate the performance of this IRP. 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

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

Criteria for success: The number of populations have increased and/or the number of mature individuals have increased by ten percent or more over the term of the plan.
Criteria for failure: The number of populations have decreased and/or the number of mature individuals have decreased by ten percent or more over the term of the plan.

3. RECOVERY ACTIONS

Completed recovery actions

Land managers, including private landowners, the Shires of Brookton and Cuballing, MainRoads WA and the Badjaling Wanderers Aboriginal group have been made aware of the threatened nature of the species, its location and their legal obligations to protect it.

DRF markers have been installed at Populations 1, 4, 5 and 9.

Rabbit exclusion fencing has been installed at Population 4 and 11 and Subpopulations 8a and b. Part of Population 10 was fenced in 1991.

Rabbit baiting was undertaken at Populations 1, 10 and 13t, and Subpopulations 8a-c and 12a-c in 2005 using Phostoxin and 1080 oats.

A series of bore monitoring stations have been installed at Population 7 and a solar groundwater pump was installed at Population 8 in 1994 to monitor and combat rising water tables. A *Eucalyptus* plantation was established near Population 8 in 1994 to assist in lowering the groundwater table. Currently, the bores are not monitored and the pump has been temporarily removed due to consistently low water levels and the need for replacement.

Several populations of *Banksia cuneata* have had numbers augmented by the translocation of seedlings. These include Populations 1, 4, 7, 8 and 10. Population 1 had seedlings planted in 1989 and 1995. Cuneata park in the Quairading townsite had 90 seedlings planted in 1987 followed by a further 30 seedlings in 1991 sourced from DEC's Narrogin nursery. Of the 90 seedlings planted in 1987, 10 were still alive in 2001 (McNee 2002).

The Botanic Gardens and Parks Authority (BGPA) has nine *Banksia cuneata* plants in their Rare and Endangered Garden (Amanda Shade pers. comm.) and have distributed the species to other Botanic Gardens in Australia (Stace and Coates 2001).

Private land owners adjacent to *Banksia cuneata* Population 1 offered 65 ha of their land for the establishment of translocated Population 13t. This strip of land occupies approximately 2 ha along Bruce Rock Road. The soil is deep yellow sand and may have contained *B. cuneata* prior to clearing. Seedlings were planted at this site in 1995, 1997 and 1999. Re-vegetation of the translocation site has been undertaken using local woody perennials.

Cultivated *Banksia cuneata* plants have been translocated into Populations 4, 7, 8 and 10.

Following a wildfire in 1996, in which the whole of Population 6 was burnt, three 10 m x 10 m monitoring plots were established to research recruitment levels. This research continued from 1996 to 2005.

Staff from DEC's Threatened Flora Seed Centre (TFSC) made 23 seed collections totalling 307 extracted seeds and 3921 follicles (each containing up to two seeds) from Populations 1-8, 10 and 11 between 1988 and 1997. All seed is stored at -18ºC and all follicles at 4ºC. The average *ex-situ* germination rate for stored *B. cuneata* seed is around 70% (Andrew Crawford pers. comm.). The most recent collection was made from Population 8 in 1997, making all stored seed over 10 years old.

The BGPA has 86.6g of seed collected from four plants near Quairading in 1981, 1988, 1990 and 1994. Germination trials on the 1990 and 1994 collections were both successful, although unquantified.

Ongoing and future recovery actions

The Great Southern District Threatened Flora and Avon-Mortlock District Threatened Flora and Communities Recovery Teams (GSDTFRT and AMDTFCRT) are overseeing the implementation of this IRP and will include information on progress in their annual reports to DEC's Corporate Executive and funding bodies.

Staff from DEC's Great Southern and Avon-Mortlock District offices are monitoring all populations.

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

1. Coordinate recovery actions

The GSDTFRT and AMDTFCRT coordinate recovery actions for *Banksia cuneata* and other DRF in their Districts and include information on progress in their annual reports to DEC's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT
Cost: $1,400 per year.

2. Monitor populations

Monitoring of factors such as weed invasion, habitat degradation, population stability (expansion or decline), pollinator activity, seed production, recruitment, longevity, predation and variation in seasonal conditions is essential. All populations will be inspected annually and Rare Flora Report Forms completed.

Action: Monitor populations
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT
Cost: $2,200 per year.

3. Liaise with relevant land managers and Indigenous groups

Staff from DEC's Great Southern and Avon-Mortlock Districts will liaise with appropriate private land owners, MainRoads WA and local Shires to ensure that populations are not accidentaly damaged or destroyed and that relevant land managers are informed of population locations, the conservation status of the species and their legal reponsability to protect it. Input and involvement will also be sought from the Badjaling Wanderers Group, and other Aboriginal groups who have an active interest in areas that are habitat for *Banksia cuneata*.

Action: Liaise with relevant land managers and Indigenous groups
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT
Cost: $3,400 per year.

4. Install DRF markers

Declared Rare Flora (DRF) markers are required at Populations 1, 3, 5 and 9.

Action: Install DRF Markers
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT
Cost: $1,000 in the first year.

5. Implement rabbit control

All populations of *Banksia cuneata* have rabbits present. However, only Populations 1 and 10, and Subpopulations 8a-c, 12a-c and 13t have a regular baiting program. Baiting will be continued at these populations and, with the exception of Population 2 which overlaps an Aboriginal Reserve, commence at other populations.

Actions: Implement rabbit control
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT
Cost: $4,000 in the first year and $2,100 in years 2-5.

6. Undertake weed control

Weeds are a threat at most *Banksia cuneata* populations. The following actions will be implemented.
1. Select appropriate herbicides after determining which weeds are present.
2. Control invasive weeds by hand removal or spot spraying when weeds first emerge.
3. Schedule weed control to include spraying at other threatened flora populations within the district.
4. Regularly monitor weeds and implement additional weed control if required.

Action: Undertake weed control
Responsibility: DEC (Great Southern and Avon-Mortlock Districts, Science Division) through the GSDTFRT and AMDTFCRT
Cost: $3,200 per year

7. Monitor groundwater levels and salinity

The bore monitoring station at Population 8 will be checked regularly and a series of observation bores established at Population 7 will be monitored every six months to assess water levels. Research will be undertaken into the hydrology of all populations.

Action: Monitor groundwater levels and salinity
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT
Cost: $1,000 in years 1, 3-5, $13,200 in the second year for research.

8. Develop and implement fire and disturbance trials

DEC's Great Southern and Avon-Mortlock Districts will, in consultation with private landowners and the Shires of Quairading, Brookton and Cuballing, MainRoads WA and the Badjaling Wanderers Aboriginal group, develop and implement fire and disturbance trials to stimulate the germination of *Banksia cuneata* seed at selected populations. Weed and rabbit control will be undertaken at burn sites to increase germinant survival.

Care will be taken to avoid competition with existing *B. cuneata* plants. The results of trials will be monitored and, if successful, implemented under a larger scale operation.

Action: Develop and implement fire and disturbance trials
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT and authorities
Cost: $6,300 in years 1 and 3 for burns, $1,700 in years 2, 4 and 5 for watering and monitoring

9. Develop and implement a fire management strategy

A fire management strategy will be developed to help ensure fire occurs at a frequency, intensity and season that maximises the size and health of *Banksia cuneata* populations. The Indigenous custodians of Badjaling Nature Reserve and the Aboriginal Lands Trust will be consulted in the development of the strategy.

Action: Develop and implement a fire management strategy
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT and authorities
Cost: $3,600 in the first year to write the plan, $1,000 in years 2-5 for liaison.

10. Enhance habitat

A vegetation corridor to join Populations 1, 2 and translocated Population 13t will be established using a range of native species found in the area. The corridor will extend habitat for *Banksia cuneata* and create habitat for honeyeaters and other pollinators. Local volunteers and community groups will be involved with the planting program, supervised by DEC officers.

Action: Enhance habitat
Responsibility: DEC (Avon-Mortlock District) through the AMDTFCRT and volunteer groups
Cost: $15,000 per year.

11. Collect seed

Seed will be collected from natural *Banksia cuneata* populations and will aim to sample and preserve the maximum range of genetic diversity possible. The "Germplasm Conservation Guidelines for Australia" produced by the Australian Network for Plant Conservation (ANPC) will be used to guide this process. If it is not possible to harvest seed from all populations, samples from Populations 1 to 8 will be collected to maximise genetic diversity (Stace and Coates 2001).

Actions: Collect seed
Responsibility: DEC (Great Southern and Avon Mortlock Districts, TFSC) and BGPA, through the GSDTFRT and AMDTFCRT
Cost: $3,800 in years 1, 3 and 5.

12. Control dieback

Control of *Phytophthora* will be implemented at Population 8 using an annual application of Phosphite. Regular monitoring of the population will be undertaken to assess the success of control measures.

Action: Control dieback
Responsibility: DEC (Great Southern District) through the GSDTFRT
Cost: $1,800 in years 1, 3 and 5 for control, $1,000 in years 2 and 4 for monitoring.

13. Report on the post fire study

Following a wildfire that burnt Population 6 in 1996, plots were established to monitor germination and seedling survival. Monitoring finished in 2005 and the results of the study will be formally collated and presented in a report.

Action: Report on the post fire study
Responsibility: DEC (Avon-Mortlock District) through AMDTFCRT
Cost: $1,300 in the first year.

14. Enhance populations

Banksia cuneata Populations 1, 4, 7, 8 and 10 and 13t, will be augmented with the translocation of cultivated seedlings to counteract poor recruitment. Recruitment through natural stimulus, such as burning, is not practical at these populations due to heavy weed infestation. Seed will be collected, germinated *ex situ* and raised in a nursery until ready for planting. Local volunteers and community groups will be involved with the planting program, supervised by DEC staff. Information on the translocation of threatened animals and plants in the wild is provided in CALM Policy Statement No 29 *Translocation of Threatened Flora and Fauna*. All translocation proposals require approval by the Director of Nature Conservation.

Action: Enhance populations
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) and BGPA, through the GSDTFRT and AMDTFCRT
Cost: $15,000 in years 1-3, $5,000 in years 4-5.

15. Investigate security of tenure

The possibility of purchase and/or protection through the reservation system for land that supports Subpopulation 12b and a strip of farmland that borders Populations 3, 5 and 9 will be investigated.

Action: Investigate security of tenure
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT
Cost: $3,000 in the first year, $200 in years 2-5.

16. Promote awareness

The importance of biodiversity conservation and the protection of *Banksia cuneata* will be promoted to the public through an educational program. The program will be delivered through an information campaign using the local print and electronic media, and by setting up poster displays.

An A4 sized information sheet, which includes a description of the plant, its habitat type, status, threats, management actions and photos, will be developed for *Banksia cuneata* and distributed to local land owners, relevant authorities, volunteer organisations, libraries and schools. Increased awareness may result in the discovery of more populations which will assist in the conservation of this species.

Action: Promote awareness
Responsibility: DEC (Great Southern and Avon-Mortlock Districts, Species and Communities Branch (SCB), Strategic Development and Corporate Affairs Division) through the GSDTFRT and AMDTFCRT
Cost: $2,000 in the first year, $1,000 in years 3 and 5.

17. Conduct further surveys

Banksia cuneata will be surveyed during the species flowering period between September and December with assistance from local naturalist clubs and volunteers. Surveys will also be done on an opportunistic basis while surveying for other threatened flora, particularly on private property. Volunteers from the local community, wildflower societies, naturalist clubs and the Badjaling Wanderers Aboriginal group may be involved in surveys, supervised by DEC staff.

Action: Conduct further surveys

Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT
Cost: $1,500 per year.

18. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Banksia cuneata* will provide a better scientific basis for management of the wild populations. The following will be researched in an effort to better understand the biology and ecology of the species.

1. Research into the hydrology of *B. cuneata* habitat and water-plant relations.
2. Research to determine the age of plants when viable seeds are produced.
3. Examination of the genetic relatedness of Populations 8, 9, 10 and 12 and their levels of outcrossing.
4. Research into the phylogenetic affiliations of *Banksia cuneata* Population 8 with *Banksia oligantha*.
5. Effectiveness of planting *B. cuneata* seedlings in early winter as opposed to other times of the year.
6. Effectiveness of using a water retention agent and other practicable water supplying aids for young plants.

Action: Obtain biological and ecological information
Responsibility: DEC (Science Division, Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT
Cost: $16,500 in years 2 and 3, $31,500 in year 4

19. Map habitat critical to the survival of *Banksia cuneata*

It is a requirement of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that spatial data relating to habitat critical to the survival of threatened species be determined. Although this is alluded to in Section 1, all areas described have not been accurately mapped and this will be addressed under this action. If additional populations are located, habitat critical to their survival will also be determined and mapped.

Action: Map habitat critical to the survival of *Banksia cuneata*
Responsibility: DEC (Great Southern and Avon-Mortlock Districts) through the GSDTFRT and AMDTFCRT
Cost: $3,000 in the first year.

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

If *Banksia cuneata* is still ranked Endangered at the end of the five-year term of this IRP, the need for further recovery actions will be assessed and a revised plan prepared if necessary.

Action: Review this plan and assess the need for further recovery actions
Responsibility: DEC (Great Southern and Avon-Mortlock Districts, SCB) through the GSDTFRT and AMDTFCRT
Cost: $1,500 in the fifth year.

Table 4: Summary of recovery actions

Recovery Actions	Priority	Responsibility	Completion date
Coordinate recovery actions	High	GSTFRT and AMTFCRT	Ongoing
Monitor populations	High	DEC (Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT	Ongoing
Liaise with relevant land managers and Indigenous groups	High	DEC (Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT	Ongoing
Install DRF Markers	High	DEC (Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT	2009
Implement rabbit control	High	DEC (Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT	Develop by 2009 with implementation ongoing
Undertake weed control	High	DEC (Great Southern and Avon-Mortlock Districts, Science Division) through the GSTFRT and	Ongoing

		AMTFCRT	
Monitor groundwater levels and salinity	High	DEC (Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT	Ongoing
Develop and implement fire and disturbance trials	High	DEC (Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT and authorities	Ongoing
Develop and implement a fire management strategy	High	DEC (Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT and authorities	Develop by 2009 with implementation ongoing
Enhance habitat	High	DEC (Avon-Mortlock District) through the AMTFCRT and volunteer groups	2013
Collect seed	Moderate	DEC (Great Southern and Avon-Mortlock Districts, TFSC) and BGPA, through the GSTFRT and AMTFCRT	2013
Control dieback	Moderate	DEC (Great Southern District) through the GSTFRT	Ongoing
Report on post fire study	Moderate	DEC (Avon-Mortlock District) through the AMTFCRT	2009
Enhance populations	Moderate	DEC (Great Southern and Avon-Mortlock Districts) and BGPA, through the GSTFRT and AMTFCRT	2013
Investigate security of tenure	Moderate	DEC (Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT	2013
Promote awareness	Moderate	DEC (Great Southern and Avon-Mortlock Districts, SCB, Strategic Development and Corporate Affairs Division) through the GSTFRT and AMTFCRT	Ongoing
Conduct further surveys	Moderate	DEC (Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT	Ongoing
Obtain biological and ecological information	Moderate	DEC (Science Division, Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT	2012
Map habitat critical to the survival of *Banksia cuneata*	Moderate	DEC (Great Southern and Avon-Mortlock Districts) through the GSTFRT and AMTFCRT	2009
Review this plan and assess the need for further recovery actions	Moderate	DEC (Great Southern and Avon-Mortlock Districts, SCB) through the GSTFRT and AMTFCRT	2013

4. TERM OF PLAN

This IRP will operate from April 2008 to March 2013 but will remain in force until withdrawn or replaced. If *Banksia cuneata* is still ranked EN after five years, this IRP will be reviewed and, if necessary, further recovery actions put in place.

Commonwealth

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

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

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6. TAXONOMIC DESCRIPTION

Excerpt from: George, A.S. (1981) The Genus Banksia L.f. (Proteaceae). *Nuytsia*. **3(3)**: 457-460.

Shrub or small tree to 5 m with 1-several woody stems, without lignotuber. Bark smooth, grey. Main branches ± straight, erect; lateral branches numerous; crown becoming bushy and irregular. Branchlets when young hirsute with spreading hairs and pubescent with short curled hairs, becoming glabrous after 2-3 years; epidermis then deciduous to reveal brown or grey-brown bark beneath. Leaves cuneate to angular-obovate, obtuse or acute but mucronate, 1-4 cm long, 0.5-1.5 cm wide, sometimes smaller, usually concave; margins flat, serrate with 1-5 teeth on each side, rarely entire; teeth triangular, 1-4 mm long, mucronate; sinuses shallow and broadly V-shaped; lamina hirsute above especially on midrib with pale ferruginous spreading hairs and pubescent with short curled hairs, becoming glabrous; lower surface similar but with fine white wool persisting in lacunae; petiole tomentose. Inflorescence terminal, 3-4 cm diameter. Receptacle ovoid. Involucral bracts ovate, acuminate, thick, 4-7 mm long, tomentose outside with grey-white curled hairs, silky-hirsute inside. Common bracts narrowly linear, 3-4 mm long, silky-hirsute with long ferruginous hairs; exserted apex conical, somewhat upturned, tomentose, pale brown. Floral bracts similar. Flowers cream, pink towards base, limb sometimes green; becoming pink throughout, finally pale brown; style cream becoming red; pollen-presenter green. Perianth 24-25 mm long including limb of 3-4 mm; claws narrowly linear to filiform, on upper side splitting to within 5-6 mm of base, otherwise cohering for most of their length, appressed-pubescent outside except base, glabrous inside; limb narrowly obovate to oblong, obtuse, glabrous. Anthers ± 2 mm long, shortly apiculate. Hypogynous scales oblong, obtuse, ± 1.5 mm long. Pistil as long as perianth, exserted when perianth relaxes at anthesis, swollen above ovary then tapering, ± straight, glabrous; pollen-presenter ovoid, ± wrinkled, ± 1 mm long, the apex compressed, obtuse; stigmatic groove terminal; ovary narrow, 1 mm long, with a few hairs at apex. Follicles usually 1-5 per inflorescence; perianth and styles early deciduous; follicles obliquely ovoid, 17-21 mm long, 10-13 mm high, 9-12 mm wide, obtuse, ± smooth, densely and closely tomentose with spreading and curled hairs, the former wearing off, mottled pale and dark grey; suture fine; follicle dehiscing along whole of lower side and ½-$^{2}/_{3}$ way along upper side; 2 lateral splits 5-7 mm long from stylar point, leaving beak below; lips ± 1 mm wide, dark brown. Seed obliquely ovate, 17-20 mm long; seed body obtusely and unevenly triangular, 7-8 mm wide, 4-5 mm high, very thick, black along upper inner surface with a prominent ridge, elsewhere with irregular short plate-like projections; outer surface irregularly wrinkled; wing 8-10 mm wide, ± wrinkled, with a broad, irregular sinus and stylar side. Separator obliquely ovate, deeply excavated next to seed body with the upper margin of cavity overhanging, much thickened above then becoming thinner on wings.