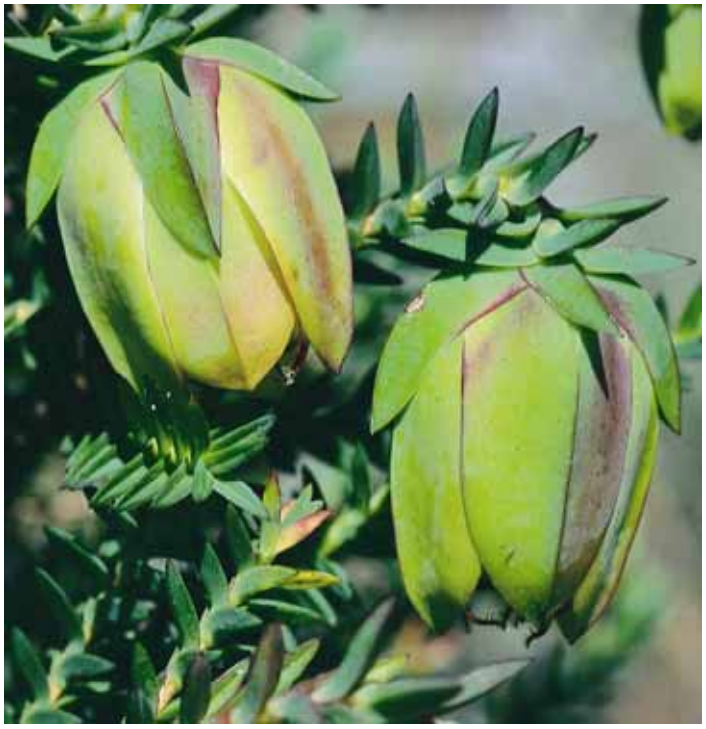
MOGUMBER and NARROGIN BELL (*Darwinia carnea*)

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 and threatened ecological communities 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This IRP will operate from March 2008 to February 2013 but will remain in force until withdrawn or replaced. It is intended that, if the species is still ranked as CR at the end of the five-year term, this IRP will be reviewed and the need for further recovery actions assessed.

This IRP was approved by the Director of Nature Conservation on 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 Amanda Fairs [1], Craig Douglas[2], Marie Strelein[3], Benson Todd[4] and Rebecca Hayes[5]
[1] Project Officer, Species and Communities Branch, DEC, Locked Bag 104, Bentley DC, 6983.
[2]Former Project Officer, Species and Communities Branch, DEC, Locked Bag 104, Bentley DC, 6983.
[3] Flora Conservation Officer, Great Southern District, DEC, PO Box 100, Narrogin, WA, 6312.
[4] Flora Conservation Officer, Moora District, DEC, PO Box 638, Jurien Bay WA 6516.
[5] Project Officer, Species and Communities Branch, DEC, Locked Bag 104, Bentley DC, 6983.

ACKNOWLEDGMENTS

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

Jessica Allen	Nature Conservation Officer, Perth Hills District, DEC
Andrew Brown	Threatened Flora Coordinator, Species and Communities Branch, DEC
Anne Cochrane	Senior Research Scientist, Albany Research Station, DEC
Andrew Crawford	Principal Technical Officer, Threatened Flora Seed Centre, DEC
Victoria Cunningham	Technical Officer, Threatened Flora Seed Centre, DEC
Greg Durell	District Manager, Great Southern District, DEC
Bob Elkins	Technical Assistant, Botanic Gardens and Parks Authority
Bethea Louden	Flora Conservation Officer, Great Southern District, DEC
Dr Neville Marchant	Senior Principal Research Scientist, WA Herbarium, DEC
Leonie Monks	Research Scientist, WA Herbarium, DEC
Amanda Shade	Assistant curator of displays and development, Botanic Gardens and Parks Authority
Gillian Stack	Conservation Officer (Flora), Species and Communities Branch, DEC

Thanks also to the staff of the W.A. Herbarium for providing access to Herbarium databases and specimen information, and DEC's Species and Communities Branch for assistance.

Cover photograph by Andrew Brown (DEC)

CITATION

This IRP should be cited as:

Department of Environment and Conservation (2008). Mogumber and Narrogin Bell (*Darwinia carnea*) Interim Recovery Plan 2008-2013. Interim Recovery Plan No. 268. Department of Environment and Conservation, Western Australia.

SUMMARY

Scientific Name:	***Darwinia carnea***	**Common Name:**	Mogumber Bell and Narrogin Bell
Family:	Myrtaceae	**Flowering Period:**	October - November
DEC Region:	Wheatbelt, Swan	**DEC District:**	Great Southern, Avon Mortlock, Perth Hills
Shire:	Narrogin,Victoria Plains, Cuballing, Chittering	**Recovery Team:**	Great Southern District, Avon Mortlock District and Swan Region Threatened Flora and Communities Recovery Teams
NRM Region:	South West, Northern Agriculture, Swan		

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 78; Durell, G.S and Buehrig, R.M. (2001) *Declared Rare and Poorly Known Flora in the Narrogin District*. Western Australian Wildlife Management Program No. 30. Department of Conservation and Land Management, Western Australia. pp 35-6; Patrick, S. and Brown, A. (2001) *Declared Rare and Poorly Known Flora in the Moora District: Wildlife Program No 28.* Department of Conservation and Land Management, Western Australia. pp 42-3; Leigh, J., Boden, R. and Briggs, J. (1984) *Extinct and Endangered Plants of Australia*. South Melbourne, The Macmillan Company of Australia Pty Ltd. pp 338; Hopper, S., Van Leeuwen, S., Brown, A. and Patrick, S. (1990). *Western Australia's Endangered Flora*. Department of Conservation and Land Management, Western Australia; DEC (2007) *Western Australian Herbarium FloraBase 2 – Information on the Western Australian Flora* (Accessed 2007). Department of Environment and Conservation, Western Australia. http://www.calm.wa.gov.au/science/.

Analysis of outputs and effectiveness of Interim Recovery Plan (IRP) 10 (1996-1999) prepared by E. Holland, K. Kershaw and A. Brown

The criteria for success in the previous IRP (threatening processes identified within the IRP have been reduced or removed within the three year period) has been met.

Grazing by sheep is no longer considered a threat to subpopulations 3a and 3c as they have now been fenced, however, grazing by other animals has been recorded and recovery actions included within this IRP aim to address this threat.

Inappropriate fire regimes are considered to be an ongoing threat to this species and its habitat. Firebreaks have been constructed in bushland containing populations of *Darwinia carnea* and land managers have been informed of the need to protect the plants. Recovery actions listed within this IRP aim to further address this issue.

Rabbit control has reduced the level of threat on Population 1, although ongoing control is required. Recovery actions in this IRP further address this issue.

Weeds are a minor issue for *Darwinia carnea*. Population 1 is threatened by weed invasion, but weed control is being conducted at this site. Recovery actions involving weed control are ongoing and included within this IRP.

The number of known subpopulations has increased from six to nine and the number of known plants in populations has increased from 269 to 515. The significant increase in mature plants is due to three translocations which account for 437 (85%) of plants.

Recovery actions carried out in the previous plan include:

ESSENTIAL

Action 1 Fence subpopulation 5b (now subpopulation 3c)
Action 3 Preserve genetic diversity of the species
Action 4 Implement rabbit control
Action 5 Monitor populations

DESIRABLE

Action 1 Conduct further surveys
Action 2 Implement weed control
Action 3 Information dissemination
Action 4 Conduct research
Action 6 Translocation

Essential recovery actions 2, 3, 4 and 5 and desirable recovery actions 1, 2, 3, 4, 5 and 6 included in the previous plan are ongoing and are included in this revised plan.

New recovery actions included in this plan are:

Action 1 Coordinate recovery actions
Action 2 Liaise with relevant land managers and indigenous groups
Action 4 Continue to monitor and supplement translocation projects
Action 9 Develop and implement fire and soil disturbance trials
Action 10 Develop and implement an insect pest control strategy and follow-up with regular monitoring and additional control if required
Action 16 Map habitat critical to the survival of *Darwinia carnea*
Action 18 Review the plan and the need for further recovery actions

Current status: *Darwinia carnea* was listed as Declared Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in 1980 and is currently ranked as Critically Endangered (CR) under the World Conservation Union (IUCN 1994) Red List criteria B1+2c, based on the area of occupancy estimated to be less that 10km², populations being severely fragmented and a continuing decline in area of occupancy and quality of habitat. The main threats include grazing, drought, fragmentation of habitat, inappropriate fire regimes, weeds, trampling and small population size. The Narrogin and Mogumber plants are considered to be two different taxonomic forms. The Mogumber *Darwinia carnea* is the type form. It is possible that the two forms are separate subspecies however this has not yet been confirmed by genetic studies. The species is listed as Endangered (EN) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Darwinia carnea is known from two wild populations and three translocated populations, totaling approximately 515 mature individuals.

Description: *Darwinia carnea* is a small shrub reaching 20 to 30 cm tall. Leaves are narrow, keeled, 6 to 10 mm long and are arranged in opposite pairs along the stem. Flower head is surrounded by broad, yellowish-green to pinkish-red bracts, up to 3 cm long. Bracts conceal about eight tubular flowers with short, blunt lobes, about 1.5 mm long, and five white petals, 4 mm long (Brown *et al* 1998). The Mogumber form is taller with larger inflorescences and different colored bracts compared to the Narrogin form (Brown *et al* 1998).

Habitat requirements: *Darwinia carnea* occurs on lateritic gravel and sandy red/brown loams, on hilltops near Narrogin and amongst massive laterite on breakaways near Mogumber, in open *Eucalyptus* woodland over *Dryandra* heath.

Habitat critical to the survival of the species, and important populations: Given that *Darwinia carnea* is ranked as CR, it is considered that all known habitat for wild and translocated populations is critical to its survival, and that all wild and translocated populations are important populations. Habitat critical to the survival of *Darwinia carnea* includes the area of occupancy, 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 for *Darwinia carnea* will also improve the status of associated native vegetation. No threatened species or ecological communities are known to occur within the same habitat as *D. carnea*, although *Lasiopetalum rotundifolium* (Endangered) is known to occur near Population 5T and *Asterolasia nivea* (Vulnerable) is known to occur near population 7T.

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. *Darwinia carnea* is not listed under any specific international treaty 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 (SWALSC) and the Department of Indigenous Affairs to assist in the identification of cultural values for land occupied by *Darwinia carnea*, 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 identified no sites of Aboriginal significance at or near populations of the species. 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: The implementation of this recovery plan is unlikely to cause significant adverse social and economic impacts but, as two populations and three subpopulations are located on private property, their protection has the potential to affect private activities, development and asset protection measures on the sites.

Affected interests: Stakeholders potentially affected by the implementation of this plan include owners of private property and the Shire of Narrogin.

Evaluation of the plan's performance: DEC in conjunction with the Great Southern District, Swan Region and Avon Mortlock District Threatened Flora Recovery Teams (GSDTFRT, SRTFCRT and AMDTFRT) 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.

Completed Recovery Actions

1. Relevant land managers have been formally notified of the presence of the species, its location on land under their management and their legal obligations to protect it.
2. Clonal lines from vegetative material collected prior to 1970 from a presumed extinct Mogumber population of *D. carnea* have been grown by the Wildflower Society and Lullfitz Nurseries.
3. Fencing of all extant populations except 3b has been undertaken.
4. A rabbit baiting program is in place for Population 1 in Narrogin.
5. DEC's Threatened Flora Seed Centre (TFSC) holds eleven collections of seed from Narrogin and Mogumber, including seeds from translocated populations (5T and 6T).
6. The Botanic Gardens and Parks Authority (BGPA) have cultivated considerable numbers of clones in their nursery for translocation.
7. Initial testing of three seedlings by DEC Science Division indicates the species is resistant to the Dieback water mould *Phytophthora cinnamoni*.
8. Two translocations of the Narrogin Bell form, using cloned material from Population 1 have been conducted (Populations 5T and 6T). A progress report on the outcomes and results from the translocation was produced in 2004.
9. A translocation of the Mogumber Bell form, using cloned material from Population 3, was conducted in September 2006 (Population 7T).
10. The species has received considerable coverage through print and electronic media. DEC produced and circulated an information poster in 1999 and 2000. Articles have been published in local and State newspapers, LANDSCOPE and interviews with DEC staff have featured on local radio.
11. DEC staff and community members have searched for *Darwinia carnea* in areas of similar remnant vegetation and soil type and no new populations have been located, however, suitable translocation sites have been identified.

Ongoing and future recovery actions

1. DEC's AMDTFRT, SRTFCRT and GSDTFRT continue to monitor all known populations.
2. DEC's AMDTFRT, SRTFCRT and GSDTFRT staff members are overseeing the implementation of this IRP and will include it in their annual report to DEC's Corporate Executive and funding bodies

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
Criterion for success: The number of populations have increased and/or the number of individuals in populations have increased by ten per cent or more over the term of the plan.
Criterion for failure: The number of populations have decreased and/or the number of individuals in populations have decreased by ten per cent or more over the term of the plan.

Recovery actions

1. Coordinate recovery actions	10. Maintain a rabbit control program
2. Liaise with relevant land managers and indigenous groups	11. Develop and implement an insect pest control strategy and follow-up with regular monitoring and additional control when required
3. Monitor populations	12. Achieve long-term protection of habitat
4. Continue to monitor and supplement the translocation projects	13. Conduct further surveys
5. Collect seed and other material to preserve genetic diversity	14. Obtain biological and ecological information
6. Fence subpopulation 3b and carry out routine maintenance when required	15. Undertake weed control and follow-up with regular monitoring
7. Investigate genetic diversity and confirm taxonomic status	16. Map habitat critical to the survival of *Darwinia carnea*
8. Develop and implement a fire management strategy	17. Promote awareness
9. Develop and implement fire and soil disturbance trials	18. Review the plan and need for further recovery actions

1. BACKGROUND

History

Darwinia carnea was first collected by C. Gardner from an area near Mogumber in 1922. Gardner named and described the species in 1928 (DEC 2007; Gardner 1928).

Darwinia carnea is presumed extinct in the type locality at Mogumber where it has not been relocated since 1970. In 1990 it was rediscovered by E. Griffin close to the original Mogumber locality (Subpopulation 3a). Subpopulation 3b was found on private property at Mogumber approximately 2 km from Subpopulation 3a. by consultant botanist J. Gathe in 1990. Subpopulation 3c was found by M. Warnock in 1995.

Darwinia carnea was found south-east of Narrogin on private property in the 1950s by R. Durell. When the area was proposed to be cleared in the mid 1970s R. Durell negotiated with the landowner and was successful in conserving a small area of remnant bush comprising most of the population. The existing fenced area represents the total area that was saved from clearing. The population was brought to the attention of [the former] Department of Fisheries and Wildlife in 1978 when a site inspection was undertaken by Dr N. Marchant, P. Lambert, F. Lullfitz and R. Durell during which cutting material was collected (Greg Durell[1], pers. comm., 2007).

In 1985, B. Jacks (local horticulturalist) and member of the Wildflower Society attempted to reintroduce 50 *Darwinia carnea* seedlings (form unknown) to a 0.5ha site on a breakaway north of Mogumber (type locality Population 2T). In 1990, J. Gathe surveyed the translocation site and no plants were found. It is believed that drought contributed to the failure of the translocated seedlings.

In September 1992 an unconfirmed sighting of a single plant of *Darwinia carnea* (Population 4) was made by Mrs Barratt-Lennard and Mrs Scott in State Forest south west of Narrogin. The locality was described as a forest area 8 km west of Highbury and 3 km south down a road. Searching for this population was undertaken by L. Silvester in 1993 and 1994, by P. Hussey and P. Murray in October 1993 and by E. Holland, J. Gathe and R. Hindmarsh in October 1995. No plants were found on any of these occasions.

Three translocations of *Darwinia carnea* have been successfully established by DEC in conjunction with BGPA. In order to ensure the long-term survival of the Narrogin form, two translocation sites were established in 1999 (Population 5T and 6T; Durell 1997). Plantings of propagated clones took place at these sites in 1999, 2000 and 2002 with a total of 431 plants from 20 clonal types. The translocated plants have been monitored annually.

Translocation into Udamung Nature Reserve in the Shire of Chittering (Population 7T) was established in 2006. Plants were propagated from cuttings sourced from Subpopulations 3a and b (Mogumber form). Monitoring of this population occurs biannually.

Darwinia carnea is currently known from two wild populations and three translocated populations, totaling approximately 515 mature individuals.

Description

Darwinia carnea is a small shrub 20 to 30 cm tall. Leaves are narrow, keeled, 6 to 10 mm long and are arranged in opposite pairs along the stem. Flower head is surrounded by broad, yellowish-green to pinkish-red bracts, up to 3 cm long. Bracts conceal about eight tubular flowers with short, blunt lobes, about 1.5 mm long, and five white petals, 4 mm long (Brown *et al* 1998). The Mogumber form is taller with larger inflorescences and different colored bracts compared to the Narrogin form (Brown *et al* 1998).

[1] Greg Durell, District Manager, Great Southern District, DEC

Distribution and habitat

The *Darwinia carnea* populations are geographically isolated, being separated by approximately 250 km. The species is known from two distinct morphological forms, the Narrogin and Mogumber forms.

The species was collected and named from a specimen found in the Mogumber area, making this the type form. It is possible that the Mogumber and Narrogin forms are different subspecies, however this has not yet been confirmed by genetic studies.

At Mogumber, *Darwinia carnea* is known from three subpopulations on private property, each covering an area approximately 1 ha in size (Subpopulations 3a, b and c). The populations are situated on the tops of lateritic breakaways, growing in gravelly brown loamy soils, in open *Eucalyptus wandoo* woodland over heath. Associated species include *Xanthorrhoea preissii, Dryandra polycephala*, *Eucalyptus accedens*, *Corymbia calophylla, Petrophile heterophylla, Adenanthos cygnorum, Banksia sphaerocarpa* and *Dryandra nobilis.* There is also a translocated population (Population 7T) which is situated on similar soil of gravelly, orange-brown, loamy clay, with some coarse white sand. It is near a laterite hill with boulders in open *Eucalyptus wandoo* woodland over a sparse shrub layer. Associated species include *Corymbia calophylla*, *Xanthorrhoea preissii*, *Dodonaea*, *Calothamnus*, *Dryandra* and *Hibbertia* species (Stack *et al* 2006). The Mogumber form is considered extinct in the type locality, including a trial translocation conducted in 1985 (Population 2T).

At Narrogin, *Darwinia carnea* is known from a single population (Population 1) on private property, covering an area of approximately 0.5 ha. The population grows on an exposed lateritic gravel hilltop in dark yellow brown sandy loam soil with gravel over the lateritic duri-crust. There are also two translocated populations in the Narrogin area (Population 5T and 6T). Vegetation of the Narrogin populations consists of very low open woodland of *Allocasuarina huegeliana*, *Eucalyptus wandoo* and *Banksia sphaerocarpa* over heath of *Dryandra nobilis*, *Adenanthos cygnorum*, *Beaufortia incana*, *Hibbertia rupicola* and *Grevillea leptobotrys*.

Summary of population land vesting, purpose and management

Pop. No. & Location	DEC District	Shire	Vesting	Purpose	Manager
1. Narrogin	Great Southern	Narrogin	Freehold	Private Property	Landholders
2T Mogumber (extinct)	Avon Mortlock	Victoria Plains	Freehold	Private Property	Landholders
3a. Mogumber	Avon Mortlock	Victoria Plains	Freehold	Private Property	Landholders
3b. Norcia	Avon Mortlock	Victoria Plains	Freehold	Private Property	Landholders
3c. Mogumber	Avon Mortlock	Victoria Plains	Freehold	Private Property	Landholders
4.* Highbury (not found)					
5T. Narrogin	Great Southern	Narrogin	Shire of Narrogin	Gravel Pit	Shire of Narrogin
6T. Narrogin	Great Southern	Cuballing	Lands and Forests Commission	State Forest	DEC
7T. Udumung	Perth Hills	Chittering	Conservation Commission	Nature Reserve	DEC

Populations in **bold text** are considered to be Important Populations. *Unconfirmed sighting 19/9/92 by Mrs Barratt-Lennard and Mrs Scott; further surveys have failed to locate the plant.

Biology and ecology

The genus *Darwinia*, which is endemic to south-western and south-eastern Australia, is closely related to *Chamelaucium* (wax plants) and *Verticordia* (feather flowers) (Keighery 1985). Many south-western *Darwinia* species are characterized by their flowers being surrounded by large coloured bracts and the common name "bells" is derived from this feature. A taxonomic study by Marchant and Keighery in 1992 recognised 48 named *Darwinia* species and an additional 15-20 unnamed species. *Darwinia carnea* is the only member of the mountain bell group to occur outside of the Stirling Range.

It is believed that *Darwinia carnea* is pollinated by nectar feeding birds. The flowers are pendulous (to keep rain from the nectar) and positioned so that a bird can perch on them or probe up from the ground (Keighery and Marchant 1993).

Darwinia seeds have no specialised means of dispersal and remain stored in the soil below adult plants (Keighery and Marchant 1993). Plants are believed to be killed by fire and to later regenerate from soil-stored

seed (Keighery 1985). *Darwinia carnea* appears to respond to disturbance as G. Durell noted in 1994 when 72 seedlings germinated in disturbed rabbit warrens. W. Silvester also noted in 1988 that despite several attempts to germinate *Darwinia carnea* seed by broadcasting it amongst extant plants there was no response (Greg Durell pers. comm. 2007).

Darwinia carnea flowers between October and November, with flower buds being recorded as early as July. Both immature and mature fruit have been recorded in November with dehisced fruit recorded between February and April. Many species of *Darwinia* flower two to five years after germination but reproductive maturity is not reached until seven to ten years. Population health and numbers are thought to decline after a period of around twenty years as the surrounding vegetation becomes too dense for *Darwinia* individuals to survive (Keighery and Marchant 1993). This 'crowding' by associated vegetation has been noted at Population 1 (Narrogin), where several associated species (e.g. *Dryandra nobilis* and *Adenanthos cygnorum*) compete with *D. carnea*. Without intervention these larger associated plants could displace the *D. carnea* (Holland *et al* 1996).

Darwinia species appear resistant to Dieback (*Phytophthora* spp.) in the wild and the testing of three *Darwinia carnea* seedlings by DEC's Science Division showed that the taxon appears to be resistant but, as the testing lacked statistical replication, the threat is considered moderate.

Threats

Darwinia carnea was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in 1980 and is currently ranked as Critically Endangered (CR) under the World Conservation Union (IUCN 1994) Red List criteria B1+2c, based on its area of occupancy estimated to be less than 10km², populations being severely fragmented and a continuing decline in the area of occupancy and quality of habitat. The main threats include grazing, drought fragmentation of habitat, inappropriate fire regimes, weeds, trampling and small population size. The species is listed as Endangered (EN) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999).

- **Grazing.** All populations are threatened by grazing from rabbits, livestock, insects, birds and kangaroos. Spotted vegetable weevils (*Steriphus diversipes*) have been observed in plants in Population 1. Weevils bore through flower head and bracts, entering the seed capsule consuming the seeds. Looper caterpillars have been observed eating flowers and immature fruit at Population 5T. Parrots have also been noted to remove the flower head and consume the immature seeds within. A secondary concern of rabbit grazing is the impact of the disturbance caused by digging and warren construction and increased nutrient levels from faeces.
- **Drought.** Drought threatens all populations and may have serious effects on the survival of both mature and juvenile plants and the fecundity of the species. Drought may also alter the habitat structure, killing associated species and opening up the canopy and ground cover layer, exposing the DRF to intense sunlight which scorches plants and reduces soil moisture.
- **Fragmentation of habitat.** Land clearing for broad scale agriculture has removed large areas of natural suitable habitat, fragmenting populations of *Darwinia carnea.* Remaining populations are likely to have reduced genetic diversity. Population 1 in particular is restricted to a small area of remnant vegetation making it subject to severe edge effects.
- **Inappropriate fire regimes.** *Darwinia carnea* is believed to be killed by fire and regenerate from soil-stored seed. Frequent fire is likely to deplete soil stored seed reserves and can cause general degradation of habitat by increasing weed invasion. Fire can also alter habitat structure by favouring native species that are obligate resprouters. Alternatively, too great an interval between fires may threaten populations of the species through senescence of mature plants and lack of recruitment.
- **Weed invasion.** Weeds are present in Population 1. Weeds compete for space, nutrients, water and light. Competition is likely to reduce recruitment of *Darwinia carnea*. Heavy weed infestations also generate high fuel loads which increase the frequency and intensity of wildfire events and contribute to increased grazing pressure around plants.
- **Trampling.** As many *Darwinia carnea* plants occur under larger native species such as *Adenanthos cygnorum* and *Dryandra* species where kangaroos seek shade and places to rest, they are prone to being smothered. Fencing has abated this threat in most populations however fences need regular monitoring and maintenance. Subpopulation 3b needs to be fenced.

- **Small population size.** As the total population size of *Darwinia carnea* is small and populations are severely fragmented, the likelihood of the species being adversely impacted by chance demographic or environmental events is increased. Small populations are also at a greater risk of loss of genetic diversity and inbreeding depression.

The intent of this plan is to provide actions that will deal with immediate threats to *Darwinia carnea*. Although climate change may have a long-term effect on the species, actions taken directly to prevent the impact of climate change are beyond the scope of this plan.

Summary of population information and threats

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
1. Narrogin	Private Property	1978 6 1983 67 1984 85 1989 30 1990 36 {41} [2] 1995 26 {43} [4] 1996 20 {5} 2006 20 {52} [5] 2007 16 {37} [12]	Moderate	Weeds, rabbit grazing, drought/exposure, insect damage to reproductive shoots, birds nibbling buds and flowers.
2. Mogumber	Private Property	1985 44 [6] 1990 0 [50+]	Failed translocation	Parrot grazing, drought / exposure, trampling
3a. Mogumber	Private Property	1990 200 1995 80 {30} 1997 120 1999 127 {31} 2005 34 [3] 2007 22 {1} [5]	Moderate	Grazing (rabbits, kangaroos, birds), trampling, insect damage to reproductive shoots drought/exposure, inappropriate fire regimes
3b. Norcia	Private Property	1990 50 1994 25 {45} 1995 10 {30} 2007 1**	Poor	Weeds, inappropriate fire regimes, drought / exposure, grazing, habitat deterioration
3c. Mogumber	Private Property	1995 100 1996 70 1997 70 1998 65 {31} 2007 39 {6}	Moderate	Weeds, grazing (kangaroos), inappropriate fire regimes
4.* Highbury	State Forest	1992 1 1995 0	Not relocated.	
5T. Narrogin	Shire Reserve	2001 48 [36] 2002 124 (89) [9] 2006 66 (22) [1] 2007 54 (16) [17]	Moderate	Drought, poor recruitment, grazing, looper caterpillar eating flowers of immature fruit.
6T. Narrogin: Dryandra	State Forest	2001 127 [30] 2001 113 [14] 2002 189 (98) [12] 2006 103 (1) [3] 2007 90 (10) [13]	Healthy	Drought, poor recruitment, grazing, looper caterpillar eating flowers of immature fruit.
7T. Udamung	Nature Reserve	2007 396 2007 293	Healthy	Inappropriate fire

Populations in **bold text** are considered to be Important Populations; *Unconfirmed sighting 19/9/92 by Mrs Barratt-Lennard and Mrs Scott; further surveys have failed to locate this single plant, **incomplete survey () = planted seedlings, [ ] = dead, {} = seedlings

Guide for decision-makers

Section 1 provides details of current and possible future threats. Developments and/or land clearing in the immediate vicinity of *Darwinia carnea* 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 the species, and important populations

Given that *Darwinia carnea* is ranked as CR, 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 *Darwinia carnea* includes the area of occupancy, 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 for *Darwinia carnea* will also improve the status of associated native vegetation. No threatened species or ecological communities are known to occur within the same habitat as *D. carnea*, although *Lasiopetalum rotundifolium* (Endangered) is known to occur near Population 5T and *Asterolasia nivea* (Vulnerable) is known to occur near population 7T.

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. *Darwinia carnea* 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 (SWALSC) and the Department of Indigenous Affairs to assist in the identification of cultural values for land occupied by *Darwinia carnea*, 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 identified no sites of Aboriginal significance at or near populations of the species. 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

The implementation of this IRP is unlikely to cause significant adverse social and economic impacts but, as two populations and three subpopulations are located on private property, their protection has the potential to affect farming activities. Where populations or subpopulations 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 owners of private property and the Shire of Narrogin.

Evaluation of the plan's performance

DEC in conjunction with the Swan Region, Great Southern and Avon Mortlock District Threatened Flora Recovery Teams (SRTFCRT, GSDTFRT and AMDTFRT) 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 four years of implementation.

2. RECOVERY OBJECTIVE AND CRITERIA

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

Criterion for success: The number of populations have increased and/or the number of individuals in populations have increased by ten per cent or more over the term of the plan.
Criterion for failure: The number of populations have decreased and/or the number of individuals in populations have decreased by ten per cent or more over the term of the plan.

3. RECOVERY ACTIONS

Completed recovery actions

Relevant land managers have been formally notified of the presence of the DRF species, its location on land under their management and their legal obligations to protect the species.

Vegetative material was collected prior to 1970 from a presumed extinct Mogumber population of *Darwinia carnea*. This material formed the basis of clonal lines multiplied by the Wildflower Society and Lullfitz Nurseries.

Fencing of all extant wild and translocated populations except subpopulation 3b has been undertaken. Both translocated populations were fenced with funds from World Wide Fund for Nature and Native Heritage Trust in 1999.

A rabbit control program has been undertaken by DEC's Narrogin District at Population 1 since 1978. Currently, DEC staff control rabbit numbers by using targeted Phostoxin fumigation in the remnant bush where Population 1 is located. The landowner continues to control rabbits by shooting them in the surrounding paddocks (Greg Durell pers. comm., 2007).

DEC's Threatened Flora Seed Centre (TFSC) holds eleven collections of seed from Populations 1, 3, 5T and 6T. A total of 856 fruits and 314 seeds were collected from Populations 1, 5T and 6T (Narrogin form), and 528 fruits and 177 seeds were collected from Population 3 (Mogumber form). Two collections from Populations 5T and 6T have not yet been processed. Germination for the Narrogin form was 20% (one test), and for the Mogumber form was 26.5% (two tests) (V. Cunningham[2] pers. comm., 2008)

The Botanic Gardens and Parks Authority (BGPA) have cultivated considerable numbers of plants in their nursery for translocation. Currently the BGPA have 99 plants representing 23 different clones, 21 of the Narrogin form and one of the Mogumber form. Of these plants, 64 are long term container stock (11 Narrogin, 1 Mogumber, 1 unknown), 5 will be planted in the Botanic Garden (2 Narrogin clones, 1 unknown) and 30 (all Narrogin form) are for translocation. (Amanda Shade, pers. comm., 2008[3]).

Initial testing of three *Darwinia carnea* seedlings by DEC's Science Division indicates the species is resistant to *Phytophthora cinnamomi*.

Translocations of both the Narrogin Bell and Mogumber Bell form have been conducted. Two sites were chosen for the Narrogin Bell form, a Shire Reserve (Population 5T) and State Forest block (Population 6T). Using cloned material from Population 1, plantings began in 1999, with follow-up plantings occurring in 2000 and 2002 by DEC staff and volunteers from the Central South Naturalists Club. Clones in both populations descend from vegetative material collected from 20 plants in Population 1 (collected in 1997 and 1998). The translocated plants have been regularly watered and monitored. A further translocation proposal for Population

[2] Victoria Cunningham, Technical Officer, TFSC
[3] Amanda Shade, Assistant Curator, BGPA Nursery

3 (Mogumber form) was approved in August 2006 and 400 plants were planted into the Udamung Nature Reserve in September 2006. Monitoring is ongoing at this population (7T). A summary of the number of plants planted and plant survival rates are included in the table below.

Narrogin and Mogumber Bell translocation planting and survival summary

Species	Population number	Year 1st planted	Total no. planted	No. surviving at last monitoring
Darwinia carnea	5T (Narrogin form)	1999	224	51 plus 25 natural recruits in 2007
Darwinia carnea	6T (Narrogin form)	1999	282	88 plus 1 natural recruit in 2007
Darwinia carnea	7T (Mogumber form)	2006	400	293* in 2007

* incomplete survey only, 78 plants were not monitored

A progress report on the outcomes and results from the translocations was produced by Leonie Monks[4] in 2004. The report concluded that inbreeding depression and the potential for a few clonal lines to dominate the gene pool of the second generation was likely due to the death of several clonal lines and the disproportionate survival of other lines. The criterion for success for the transloction was to achieve the establishment of a maximum of 50 plants in each population; this number was deemed too small for long-term population viability. To prevent inbreeding depression and to increase long-term viability of populations vegetative material was collected from Population 1 in 2005 and propagated by BGPA to replace those clonal lines lost, to increase the representation of other lines in the translocated populations and increase the size of the populations. Further cuttings were taken from Population 1 in 2006 to improve nursery stock at BGPA and produce more plants for planting. Currently these plants are in the BGPA nursery awaiting planting.

An A4 information poster was produced and circulated in 1999 and 2000 which provided information on the biology and ecology of *Darwinia carnea.* An earlier poster was prepared and circulated by the former Department of Fisheries and Wildlife in 1982 (Rye 1982).

Darwinia carnea has received considerable coverage through the print and electronic media with articles in local and State newspapers, the DEC publication LANDSCOPE (Keighery 1985) and interviews with DEC staff on local radio.

DEC staff and community members have searched for *Darwinia carnea* in areas of similar remnant vegetation and soil type, however no new populations have been located. In 1990, Dr. N. Marchant and G. Keighery conducted extensive surveys of suitable habitat on foot south-east and south-west of Narrogin, east of Cuballing, north-west and south-west of Highbury, south and east of Gillingarra, and north of North Road on the eastern side of the Great Northern Highway.

Ongoing and future recovery actions

Staff members from DEC's Swan Region, Avon Mortlock District and Great Southern District continue to monitor all populations.

The SRTFCRT, AMDTFRT and GSDTFRT continue to oversee the implementation of the IRP in their respective districts and include information on progress in their annual report to DEC's Corporate Executive and funding bodies.

Where recovery actions are implemented on lands other than those managed by DEC, permission has been or will be sought from the appropriate land managers prior to actions being undertaken. The following recovery actions are ranked 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

[4] Leonie Monks, Research Scientist, WA Herbarium

The GSDTFRT, SRTFCRT and AMDTFRT will coordinate the implementation of recovery actions for *Darwinia carnea* and will 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, Swan Region) through the GSDTFRT, AMDTFRT and SRTFCRT
Cost: $1,500 annually.

2. Liaise with relevant land managers and indigenous groups

Staff from DEC's Great Southern and Avon Mortlock Districts, and Swan Region will liaise with relevant land managers to ensure populations of *Darwinia carnea* are not accidentally damaged or destroyed. Input and involvement will also be sought from indigenous groups that have an active interest in areas that are habitat for *Darwinia carnea*.

Action: Liaise with relevant land managers and indigenous groups
Responsibility: DEC (Great Southern and Avon Mortlock Districts, Swan Region) through the GSDTFRT, AMDTFRT and SRTFCRT
Cost: $1,500 annually.

3. Monitor populations

Annual monitoring of factors such as habitat degradation (including the effects of weed invasion and grazing), population stability (expansion or decline), pollination activity, seed production, recruitment, longevity and predation is essential and will be met under this action. Subpopulation 3b has not been thoroughly surveyed since 1995 and should be a priority for further survey and monitoring activities. Populations will be inspected annually and Rare Flora Report Forms completed.

Action: Monitor populations
Responsibility: DEC (Great Southern and Avon Mortlock Districts, Swan Region) through GSDTFRT, AMDTFRT and SRTFCRT
Cost: $1,000 annually.

4. Continue to monitor and supplement translocation projects

In order to ensure the genetic viability of the three extant translocated populations (5T, 6T and 7T) and prevent inbreeding depression, it is recommended that cutting material continued to be collected and propagated, with the aim to replace any clonal lines lost since translocation. This will increase genetic diversity in the translocated populations and also increase the size of these populations. For future translocations further cutting material will be required from a range of mature plants occurring in natural populations.

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* (CALM 1995).

Action: Continue to monitor and supplement the translocation projects
Responsibility: DEC (Science Division, Great Southern and Avon Mortlock Districts, Swan Region), BGPA and relevant authorities through GSDTFRT, AMDTFRT and SRTFCRT
Cost: $8,500 in year 1; $4,500 in years 2-5.

5. Collect seed and other material to preserve genetic diversity

DEC's TFSC currently holds collections of fruit and seed from *Darwinia carnea*. The BGPA holds no seed from *D. carnea* however it does hold live collections from both natural populations. Preservation of genetic

material is essential to guard against extinction of the species if the wild populations are lost. It is recommended that seed and/or cuttings be collected and stored by DEC's TFSC and BGPA.

Consideration should be given to holding material in a variety of forms, including seed storage, living collections and tissue collections. Seed collections need to be replaced within the shelf life of the species. Collections should aim to sample and preserve the maximum range of genetic diversity possible (which should be determined by an appropriate molecular technique such as genetic fingerprinting if feasible), and thus collection of seed and cuttings from all populations should be a priority. The *Germplasm Conservation Guidelines for Australia* produced by the Australian Network for Plant Conservation (ANPC 1997) should be used as a minimum standard to guide this process.

Action: Collect seed and other material to preserve genetic diversity
Responsibility: DEC (Great Southern and Avon Mortlock Districts, Swan Region), and BGPA through the GSDTFRT, AMDTFRT and SRTFCRT
Cost: $4,500 annually in years 1-4.

6. Fence subpopulation 3b and carry out routine maintenance when required

It is essential that subpopulation 3b (Mogumber) be fenced from stock. This is the only subpopulation remaining unfenced, and is at risk of grazing and trampling by livestock and native animals. All fences need to be routinely monitored and maintained. Liaison with land owners is essential.

Action: Fence subpopulation 3b and carry out routine maintenance where required
Responsibility: DEC (Great Southern and Avon Mortlock Districts) through the GSDTFRT and AMDTFRT, and relevant landowners
Cost: $3000 in year 1, $500 annually in years 1-4.

7. Investigate genetic diversity and confirm taxonomic status

Considering the large distance (245km) between the Mogumber and the Narrogin populations, it is recommended that genetic testing be conducted to determine if they represent two subspecies.

Action: Investigate genetic diversity and confirm taxonomic status
Responsibility: DEC (Avon Mortlock and Great Southern Districts, WA Herbarium) through AMDTFRT and GSDTFRT
Cost: $11,000 in year 1.

8. Develop and implement a fire management strategy

Fire is likely to stimulate the germination of soil-stored *Darwinia carnea* seed. However, frequent fires may kill seedlings and exhaust the seed bank. A fire management strategy will be developed by DEC's Great Southern and Avon Mortlock Districts and Swan Region in consultation with the respective Threatened Flora Recovery Teams and relevant land managers. This will include the maintenance of firebreaks, fire exclusion and actions to reduce the impact of frequent wildfires on populations.

Action: Develop and implement a fire management strategy
Responsibility: DEC (Great Southern and Avon Mortlock Districts, Swan Region and) through the GSDTFRT, AMDTFRT and SRTFCRT and relevant authorities.
Cost: $4,500 in year 1 and $1,200 annually in years 1-4.

9. Develop and implement fire and soil disturbance trials

Darwinia carnea is believed to be an obligate re-seeder, killed by fire and germinating post fire from soil-stored seed. Natural populations show continuing decline in the number of mature individuals with poor seedling survival and recruitment.

Fire and soil disturbance trials will be conducted to research the effectiveness of application of fire, smoke water and mechanical disturbance of soil stored seed as methods to induce recruitment to ensure ongoing survival and genetic diversity *in situ.* Care will be taken to avoid stimulating competition with existing *Darwinia carnea* plants. The results of all trials will be monitored regularly

Action: Develop and implement fire and soil disturbance trials
Responsibility: DEC (Science Division, Great Southern and Avon Mortlock Districts) through the GSDTFRT, AMDTFRT and relevant authorities.
Cost: $2,500 in year 1; $4,000 in years 2-4; $3,000 in year 5.

10. Maintain a rabbit control program

In the past, grazing by rabbits has been a major threat to Population 1 and Subpopulations 3a-c. Rabbits graze on mature plants and also reduce or prevent recruitment by grazing on young seedlings. In addition to grazing, rabbits also impact on populations by encouraging the invasion of weeds through soil disturbance (digging and warren construction), erosion, addition of nutrients and the introduction of weed seeds.

It is recommended that rabbit control strategies continue particularly at Population 1, in consultation with relevant land managers.

Action: Maintain a rabbit control program
Responsibility: DEC (Great Southern and Avon Mortlock Districts) through GSDTFRT and AMDTFRT
Cost: $4,000 annually.

11. Develop and implement an insect pest control strategy and follow-up with regular monitoring and additional control when required

Currently an unknown species of insect or insect larvae is attacking the flowering and fruiting tips of *Darwinia carnea* resulting in some loss of reproductive potential.

Application of a systemic insecticide is recommended to abate this threat and improve reproductive output in *Darwinia carnea*. The species flowers from October to November, with buds present in early July onwards so spraying is recommended in June to eradicate the insect or its larvae from plants before they can cause damage to developing reproductive shoots.

It is recommended that spraying be preempted by survey and followed up with survey, the former to make sure plants are not in flower, the latter to make sure infestation does not reoccur before seed is set. Spraying of plants while in flower may be detrimental to pollination thus spraying at this time should be avoided.

Action: Develop and implement an insect pest control strategy and follow-up with regular monitoring and additional control if required
Responsibility: DEC (Great Southern and Avon Mortlock Districts) through the GSDTFRT and AMDTFRT
Cost: $3,500 in year 1; $7,000 annually in years 2-5.

12. Achieve long-term protection of habitat

The conservation status of remnant vegetation supporting Population 1 and Subpopulations 3a-c will be reviewed and the possibility of additional protection through the conservation reserve system investigated. Protection of populations through various other schemes will also be investigated.

Action: Achieve long-term protection of habitat
Responsibility: DEC (Avon Mortlock and Great Southern Districts) through AMDTFRT and GSDTFRT
Cost: $3,500 in the first year; $1,000 in years 2-4.

13. Conduct further surveys

All known populations of *Darwinia carnea* will be resurveyed to ascertain accurate boundaries and ensure that no plants have been missed during previous surveys. It is recommended that surveys also be carried out in other areas of suitable habitat during the species' flowering period, between October and November.

Action: Conduct further surveys
Responsibility: DEC (Great Southern and Avon Mortlock Districts, Swan Region) through GSDTFRT, AMDTFRT and SRTFCRT
Cost: $3,500 annually.

14. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Darwinia carnea* will provide a better scientific basis for management of the wild populations. Research designed to increase understanding of the following is particularly necessary for effective management:

1. Investigate soil seed bank dynamics (e.g. size, longevity and viability) and develop techniques for stimulating germination of soil stored seed.
2. Investigate factors affecting germination rate and survival.
3. Longevity of plants and time taken to reach maturity.
4. The reproductive strategies, phenology and seasonal growth of the species.
5. Investigating the pollination biology of the species, including the identification of pollinators.
6. Investigate the factors determining the level of flower and fruit abortion.
7. Investigate which species of insect is causing damage to reproductive shoots and what methods of control are available.
8. Investigate the population genetic structure, levels of genetic diversity and minimum viable population size.
9. Response of *Darwinia carnea* to fire and soil disturbance.

Action: Obtain biological and ecological information
Responsibility: DEC (Avon Mortlock and Great Southern Districts, Swan Region and Science Division) through AMDTFRT, SRTFCRT and GSDTFRT
Cost: $12,500 in years 1-3; $18,000 in year 4.

15. Undertake weed control and follow up with regular monitoring

Weeds are a potential threat to all natural populations and weed control is recommended. The tolerance of native species to herbicides at *Darwinia carnea* sites is unknown and it is recommended that a weed control program be implemented once appropriate research has been undertaken.

The weed control program should include:
1. Monitor all populations for weed intrusions.
2. Select appropriate herbicides after determining which weeds are present.
3. Control invasive weeds by hand removal or spot spraying around *Darwinia carnea* plants when weeds first emerge.
4. Schedule weed control to include spraying at other threatened flora populations within the District.
5. Regularly monitor weeds and implement additional weed control if required.

Action: Undertake weed control and follow-up with regular monitoring
Responsibility: DEC (Science Division, Avon Mortlock and Great Southern Districts) through AMDTFRT and GSDTFRT
Cost: $5,000 annually.

16. Map habitat critical to the survival of *Darwinia carnea*

It is a requirement of the EPBC Act that spatial data relating to critical habitat be determined. Although critical habitat is described in Section 1, the areas described have not yet been mapped and that will be redressed under

this action. If any additional populations are located, then critical habitat will also be determined and mapped for these locations.

Action: Map habitat critical to the survival of *Darwinia carnea*
Responsibility: DEC (Great Southern and Avon Mortlock Districts) through the GSDTFRT and AMDTFRT
Cost: $3,000 in year 2.

17. Promote awareness

The importance of biodiversity conservation and the protection of *Darwinia carnea* will continue to be promoted to the public. This will be achieved through an information campaign using local print and electronic media and by setting up poster displays. An A4 sized information sheet that provides a description of the species and information about threats and recovery actions has been developed and will continue to be distributed to local land owners, relevant authorities and organisations. It is hoped that the poster will result in the discovery of new populations. Formal links with local naturalist groups and interested individuals should also be encouraged. Such activities may lead to the discovery of new populations of the species.

Action: Promote awareness
Responsibility: DEC (Avon Mortlock and Great Southern Districts, Species and Communities Branch, Strategic Development and Corporate Affairs Division) through the AMDTFRT and GSDTFRT
Cost: $1,500 in year 1, $1000 in years 3 and 5.

18. Review the plan and need for further recovery actions

At the end of the five-year term this IRP, the plan will be reviewed and the need for further recovery actions assessed.

Action: Review the plan and the need for further recovery actions
Responsibility: DEC (SCB, Great Southern and Avon Mortlock Districts) through the GSDTFRT and AMDTFRT
Cost: $2,000 in year 5.

Summary of recovery actions

Recovery Actions	Priority	Responsibility	Completion date
Coordinate recovery actions	High	DEC (Swan Region, Great Southern and Avon Mortlock Districts) through SRTFCRT, GSDTFRT and AMDTFRT	Ongoing
Liaise with relevant land managers and indigenous groups	High	DEC (Great Southern and Avon Mortlock Districts) through GSDTFRT and AMDTFRT	Ongoing
Monitor populations	High	DEC (Swan Region, Great Southern and Avon Mortlock Districts) through SRTFCRT, GSDTFRT and AMDTFRT	Ongoing
Continue to monitor and supplement the translocation projects	High	DEC (Science Division, Swan Region, Great Southern and Avon Mortlock Districts) and BGPA through SRTFCRT, GSDTFRT and AMDTFRT	Ongoing
Collect seed and other material to preserve genetic diversity	High	DEC (Swan Region, Great Southern and Avon Mortlock Districts), and BGPA through the SRTFCRT, GSDTFRT and AMDTFRT	Ongoing
Fence subpopulation 3b and carry out routine maintenance when required	High	DEC (Great Southern and Avon Mortlock Districts) through the GSDTFRT and AMDTFRT, and relevant landowners	Fencing in by 2009, maintenance ongoing
Investigate genetic diversity and confirm taxonomic status	High	DEC (Avon Mortlock and Great Southern Districts, WA Herbarium) through AMDTFRT and GSDTFRT	2009
Develop and implement a fire management strategy	High	DEC (Swan Region, Great Southern and Avon Mortlock Districts) through the SRTFCRT, GSDTFRT and AMDTFRT, and relevant authorities	Developed by 2009 with implementation ongoing.
Develop and implement fire and soil disturbance trials	High	DEC (Science Division, Great Southern and Avon Mortlock Districts) through the GSDTFRT and AMDTFRT, and relevant authorities	Developed by 2009 with implementation ongoing
Maintain a rabbit control program	High	DEC (Great Southern and Avon Mortlock Districts) through GSDTFRT and AMDTFRT	Ongoing
Develop and implement an insect pest control strategy and follow-up with regular monitoring and additional control when required	High	DEC (Great Southern and Avon Mortlock District) through the GSDTFRT and AMDTFRT	Developed by 2009 with implementation ongoing
Achieve long-term protection of habitat	Medium	DEC (Avon Mortlock and Great Southern Districts) through AMDTFRT and GSDTFRT	2012
Conduct further surveys	Medium	DEC (Swan Region, Avon Mortlock and Great Southern Districts) through SRTFCRT, AMDTFRT and GSDTFRT	Ongoing
Obtain biological and ecological information	Medium	DEC (Swan Region, Avon Mortlock and Great Southern Districts, DEC Science Division) through SRTFCRT, AMDTFRT and GSDTFRT	2012
Undertake weed control and follow-up with regular monitoring	Low	DEC (Science Division, Avon Mortlock and Great Southern Districts) through AMDTFRT and GSDTFRT	Ongoing
Map habitat critical to the survival of *Darwinia carnea*	Low	DEC (Avon Mortlock and Great Southern Districts) through the AMDTFRT and GSDTFRT	2012
Promote awareness	Low	DEC (Avon Mortlock and Great Southern Districts, Species and Communities Branch (SCB) and Strategic Development and Corporate Affairs Division) through the AMDTFRT and GSDTFRT	Ongoing
Review the plan and need for further recovery actions	Low	DEC (SCB, Great Southern and Avon Mortlock Districts) through the GSDTFRT and AMDTFRT	2013

4. TERM OF PLAN

Western Australia

This IRP will operate from March 2008 to February 2013 but will remain in force until withdrawn or replaced. If the taxon is still ranked CR after five years, the need for further recovery actions and an update of this IRP will be assessed.

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 Leigh, J. Boden, R. and Briggs, J. (1984). *Extinct and Endangered Plants of Australia*. Pp 338. The Macmillan Company of Australia Pty Ltd. Crows Nest, South Melbourne.

Open spreading shrub to 40 cm high. *Leaves* are crowded, opposite with alternate pairs at right angles to each other, linear-lanceolate and pointed at the tip, keeled, 1-15 mm long and about 1 mm wide, hairless, leathery in texture. *Flowers* are small, pale pink, arranged 10-14 together at the ends of the branches in large, globular bell-shaped nodding heads 3 cm long which are enclosed by several ovate, hairless greenish-pink persistent bracts. Individual flowers have ovate-lanceolate blunt-tipped petals 4 mm long and about 2 mm wide and a shortly lobed cylindrical calyx 4 mm long and 2 mm wide. *Fruit* is a small nut but not described in detail.