DUNSBOROUGH SPIDER ORCHID
(*Caladenia viridescens*)

RECOVERY PLAN

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Australian Government

Government of Western Australia

Department of Environment and Conservation

FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in WA 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 or Interim Recovery Plans and by ensuring that conservation action commences as soon as possible.

This Interim Recovery Plan results from a review of, and replaces, IRP No.121 *Caladenia busselliana* and *Caladenia viridescens* (Stack *et al.* 2002).

This Interim Recovery Plan will operate from December 2005 to November 2010 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked Critically Endangered (WA) after five years, this IRP will be reviewed and the need for a revised recovery plan assessed.

This IRP was given regional approval on 21 November 2005 and was approved by the Director of Nature Conservation on 13 December 2005. The allocation of staff time and provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting DEC, as well as the need to address other priorities.

This IRP has been updated with information contained herein and is accurate as at January 2008.

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

ACKNOWLEDGMENTS

The following people have provided assistance and advice in the preparation of this Interim Recovery Plan:

Mark Brundrett	Orchid Research Unit, Botanic Garden and Parks Authority
Leonie Monks	Research Scientist, DEC's Science Division

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

SUMMARY

Scientific Name:	*Caladenia viridescens*	**Common Name:**	Dunsborough spider orchid
Family:	Orchidaceae	**Flowering Period:**	September – October
DEC Region:	South West	**DEC District:**	Blackwood
Shire:	Busselton	**Recovery Team:**	South West Region Threatened Flora and Communities Recovery Team

Illustrations and/or further information: Brown, A., Thomson-Dans, C. and Marchant, N. (Eds) (1998) *Western Australia's Threatened Flora.* Department of Conservation and Land Management, Perth; Hoffman, N. and Brown, A. (1992) *Orchids of South-west Australia.* University of Western Australia Press. Perth; Hopper, S.D. and Brown, A.P. (2001) Contributions to Western Australian Orchidology:2. New taxa and circumscriptions in *Caladenia* (Spider, Fairy and Dragon orchids of Western Australia). *Nuytsia* 14(1/2), 27-308.

Current status: *Caladenia viridescens* was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in September 1992 and is currently ranked Critically Endangered (CR) in Western Australia under World Conservation Union (IUCN 2001) Red List criteria B1ab(iii,v)+2ab(iii,v); C2a(i) and D due to its limited distribution, severe fragmentation of populations and continuing decline in the quality of habitat and number of mature individuals. The main ongoing threats are further habitat degradation and inappropriate fire regimes. The species is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Description: *Caladenia viridescens* stands from 25 to 40cm high, and has a single leaf, 15-20cm long and 5-8mm wide. It displays one to three flowers, which are pale green, stiffly held, and which have a narrow labellum. The flowers are similar in size and shape to those of *C. busselliana* and also the common *C. paludosa* (Swamp Spider Orchid). *C. viridescens* differs from *C. busselliana*, its nearest relative, in its green colouration, its dark maroon fringe and apex, and shorter, wider clubs on the sepals (Hoffman and Brown 1992). Although the plants are perennial herbs, they are reduced to a below-ground storage organ (tuber) in summer, re-emerging in autumn and flowering from mid-September to late October.

Habitat requirements: *Caladenia viridescens* occurs over a linear range of 12km near the northern end of the Leeuwin-Naturaliste Ridge. It grows on well-drained lateritic sandy loam soils in marri and peppermint woodlands with *C. brownii* or coastal heath with *Calothamnus graniticus* subsp. *graniticus*, *Hakea trifurcata* and many other *Caladenia* species, and occasionally occurs in the same swampy areas that *C. busselliana* favours.

Guide for decision-makers: Section 1 provides details of current and possible future threats. Developments in the immediate vicinity of populations or within the area defined as habitat critical for survival require assessment. Any on-ground works (clearing, firebreaks, roadworks, spraying of herbicides, burning, drainage etc) in the immediate vicinity of *Caladenia viridescens* will require assessment. Proponents should demonstrate that on-ground works will not have an impact on the species, or on its habitat or potential habitat.

Habitat critical to the survival of the species, and important populations: Habitat critical to the survival of the species includes the area of occupancy of important populations; areas of similar habitat surrounding important populations i.e. well-drained lateritic sandy loam soils or winter-wet swamps in jarrah, marri and peppermint woodlands or coastal heath (these provide potential habitat for natural expansion); and additional occurrences of similar habitat that may contain important populations of the species or be suitable for future translocations or other recovery actions intended to create important populations. All population are considered important for the long-term recovery and survival of the species.

Benefits to other species/ecological communities: Recovery actions implemented to improve the quality or security of the habitat of *Caladenia viridescens* will also improve the status of the threatened giant spider orchid (*C. excelsa*) and Bussell's spider orchid (*C. busselliana*), which occurs in the habitat of *C. viridescens* at Population 4.

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. Although the taxon is listed under the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES) this IRP does not affect Australia's obligations under international agreements.

Role and interests of Indigenous people: Involvement of the Indigenous community is being sought through the advice of the Department of Indigenous Affairs 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 that there are no sites of Aboriginal significance at or near populations of the species covered by this IRP. 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.

Social and economic impacts: The implementation of this recovery plan has the potential to have some social and economic impact, as some populations are located on Shire and unvested reserves, and State Forest, and this is discussed under recovery actions.

Evaluation of the Plans Performance: DEC, in conjunction with the Recovery Team will evaluate the performance of this IRP. The plan is to be reviewed within five years.

Completed Recovery Actions: The following recovery actions have been implemented:

1. Relevant land managers have been made aware of the location and threatened status of the species.
2. Declared Rare Fauna (DRF) markers have been installed at all roadside populations.
3. Habitat restoration measures including deep-ripping, rubbish removal and weed control have been undertaken at Population 4. A track at Population 4 has also been closed to help prevent illegal rubbish dumping.
4. Spot spraying of weeds has been carried out as appropriate.
5. The habitat of Population 4 has been fenced to exclude grazing.
6. Staff from Botanic Garden and Parks Authority (BGPA) collected seed from Population 1 in 2001. They also collected seed and fungi in 2002. This is stored in the BGPA's plant science lab at –196°C.
7. BGPA staff have assessed material from *Caladenia viridescens* to determine the genetic distinctiveness of the species.
8. Germination trials of *Caladenia viridescens* have been carried out by BGPA staff and germination rates of around 60% have been achieved.
9. A research burn was undertaken in December 1999 to investigate how the species responds to fire. Monitoring of this trial is ongoing. Population 3b was burnt in Autumn 2002 and the area around Population 1b was burnt in May 2004.
10. An information sheet that describes and illustrates the species has been produced and distributed.
11. A new population (Population 6) was located during surveys for additional populations undertaken in 1999-2000.
12. The species was promoted through threatened flora displays at local wildflower shows and threatened flora field days.
13. A review of historical rainfall data was undertaken in 2001 to identify any correlation between rainfall patterns and orchid flowering.

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

Recovery criteria

Criteria for success: The number of individuals within populations and/or the number of populations have increased by 10 percent or more over the five years of the plan.

Criteria for failure: The number of individuals within populations and/or the number of populations have decreased by 10 percent or more over the five years of the plan.

Recovery actions

1. Coordinate recovery actions
2. Stimulate seed set
3. Collect seed and fungal material
4. Monitor populations
5. Conduct further surveys
6. Complete and implement the fire management strategy
7. Obtain biological and ecological information
8. Undertake translocation
9. Stimulate flowering
10. Map habitat critical to survival
11. Continue weed control
12. Control rabbits
13. Liaise with land managers
14. Seek to increase security of Population 4
15. Promote awareness
16. Rehabilitate habitat as required
17. Review this Plan

1. BACKGROUND

History

There are 340 orchid taxa in the south west of Western Australia of which 300 are endemic to this corner of the State. Of these 34 are Critically Endangered and 34 others are only known from a few locations and require urgent investigation.

Caladenia viridescens was first collected in 1985 in a road reserve near Dunsborough by Steve Hopper and Andrew Brown (Population 1). They located more than 20 plants at this time. Eight plants were located in the population in 2001. There are now six populations (a possible new population of 20 to 30 plants (yet to be verified) was located in 2007 during a survey by the West Australian Native Orchid Study and Conservation Group), and monitoring indicates that the numbers fluctuate and are generally in decline. Several plants were reported from Leeuwin Naturaliste National Park in 1986 (Population 5), but have not been relocated since to confirm the identification. There was a summer fire at the site in 1993/94 that would have been expected to stimulate flowering and further recruitment. However, repeated surveys (1994, 1997, 1999, 2000 and 2001) have not located any plants of *C. viridescens* at that location. Surveys in 1999 located one new population near Population 2 (Population 6), but this was not relocated in 2000 or 2001.

Description

Caladenia viridescens stands from 25 to 40cm high, and has a single leaf, 15-20cm long and 5-8mm wide. It displays one to three flowers, which are pale green, stiffly held and which have a narrow labellum. The flowers are similar in size and shape to those of *C. busselliana* and also the common *C. paludosa* (swamp spider orchid). *C. viridescens* differs from *C. busselliana*, its nearest relative, in its green colouration, its dark maroon fringe and apex, and shorter, wider clubs on the sepals (Hoffman and Brown 1992). Although the plants are perennial herbs, they are reduced to a below-ground storage organ (tuber) in summer, re-emerging in autumn and flowering from mid-September to late October.

Distribution and habitat

Caladenia viridescens grows in well-drained, lateritic sandy loam soils in marri (*Eucalyptus calophylla*) and peppermint (*Agonis flexuosa*) woodlands or coastal heath over a range of only 12 linear kilometres in the Dunsborough area. It also occasionally occurs in the same swampy habitat that *C. busselliana* favours (Hoffman and Brown 1992; Brown *et al*. 1998).

Associated species include *Calothamnus graniticus* subsp. *graniticus*, *C. brownii*, *Hakea trifurcata* and many other *Caladenia* species.

Biology and ecology

Caladenia species such as *C. viridescens* typically have a growing phase from March through to late November. Early in the growing season the orchid remains below ground as a newly sprouted shoot from the dormant tuber. Following the first seasonal rains a single leaf appears above ground and mycorrhizal associations with soil fungi are active. Orchid seedlings are dependent on one specific, or range of, specific mycorrhizal fungi for seed germination and nutrition. During winter the replacement tuber, which is essential for survival until the following year, is initiated and continues to develop until late in the growing season. The survival of the plant to the following growing season is dependent on the presence of this tuber at the end of the growing season and for the tuber to survive the period of summer dormancy. Further research is needed into understanding what stimulates tuber production, and the interactions between leaves and tubers as ‘sinks’ for resources. It seems likely that tubers must reach a critical size to sustain dormancy throughout the summer (Batty *et al*. In prep A, B).

Not all plants in a population will produce flowers in any one year. Generally, for every plant in flower, a number of vegetative plants will be present. The proportion of flowering to non-flowering individuals is influenced by environmental conditions including the presence or absence of summer fire and the amount of rainfall received during winter and spring (Batty *et al*. In prep A, B).

Flowering individuals will produce a bud mid way through the growing season that continues to grow until flowering. Plants flower for approximately two weeks or until pollination occurs, after which flowers collapse and if pollination was successful a seed capsule develops. The capsule swells as seed matures, and this can take from six to eight weeks to develop depending on climatic conditions. If temperatures are higher than average seeds may mature faster. Prior to seeds being released the green capsule turns yellow and then brown. Small slits develop in the capsule from which the seed is dispersed. Up to 30,000 seeds can be produced in the one capsule (Batty *et al*. In prep A, B).

Seeds will remain dormant in the soil over summer until the break of the season the following year. Once wet, the seeds imbibe water and the seed coat splits. At this point infection by a suitable fungus is required for germination to occur, and this will result in a protocorm and subsequent seedling. Not all of these seedlings will mature, as those that fail to produce a tuber will not survive dry summer conditions. If no fungus is present, seed remains in the soil throughout the growing season, and those that are not predated are killed by dry summer conditions (Batty *et al.* 2000, 2001).

Orchid seedlings are very small for the first growing season and are difficult to locate. Leaves are typically less than 20mm long and only a few millimetres wide. It appears that leaf and tuber size will then increase over the next four to five years until adult plants capable of flowering are present.

Threats

Caladenia viridescens was declared as Rare Flora under the Western Australian *Wildlife Conservation Act 1950* in September 1992 and is currently ranked as Critically Endangered (CR) in Western Australia under World Conservation Union (IUCN 2001) Red List criteria B1ab(iii,v)+2ab(iii,v); C2a(i); and D due to the severe fragmentation of populations and continuing decline in the quality of habitat and the number of mature individuals. The main ongoing threats are further habitat degradation, and weed infestation in particular. A number of plants occur next to roadsides and these are threatened by accidental destruction. The species is listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

- **Weed invasion** is a potential threat to all populations. Weeds suppress early plant growth by competing with the orchids and associated species in their habitat for soil moisture, nutrients and light. They also exacerbate grazing pressure and increase the fire hazard due to the easy ignition of high fuel loads, which are produced annually by many grass weed species.

- **Grazing** by rabbits, kangaroos or stock has impacted on all *Caladenia viridescens* populations. Grazing by insects has also been observed at some populations. The high level of palatable weeds near these populations and in adjacent farming properties attract herbivorous animals, which are often unselective in their grazing.

- **Digging** by small mammals including rabbits and Quendas (Southern Brown Bandicoots; *Isoodon obesulus*), are a potential threat to all populations as they dig burrows or seek orchid tubers as a food source.

- **Inappropriate fire regimes** may affect the viability of populations. Undergrowth can get excessively dense and orchids can be out-competed if an area is unburnt too long. However, fire that occurs when the orchid has above-ground growth will prevent seed set and possibly kill the tuber through a lack of opportunity to build up starch reserves. Most orchid species emerge from the soil by mid April and dehisce their seed by late November. The optimum time for fire in orchid populations is therefore from December to March. The orchids become dormant at this time because climatic conditions are typically hot and dry. However there is a risk of fires at this time becoming uncontrolled and risking lives and property. People conducting any approved controlled burn in orchid populations need to consider the timing of summer rainfall or other conditions that reduce those risks. In addition to the detrimental effects of inappropriate fire on the vegetative stages of the species, a proliferation of weeds often follows burning, partly due to a temporary increase in the availability of nutrients (Panetta and Hopkins 1991).

- **Recreational impacts** such as trampling, picking of orchid flowers, soil compaction and habitat fragmentation by establishment of paths by visitors may exert further pressure on populations of the orchids.

- **Road maintenance** has impacted on Population 3 in the past, where *Caladenia viridescens* grows within 2m of the road edge. Threats to roadside populations include grading, chemical spraying, construction of drainage channels and the mowing of roadside vegetation. Several of these actions also encourage weed invasion.

- **Poor recruitment** threatens all populations with few plants developing seed without artificial assistance. It is suspected that low orchid recruitment rates from seed dispersed in their natural environment may in part be due to the patchy distribution of mycorrhiza in soils (Scade *et al*. In prep). It is also possible that natural recruitment of terrestrial orchids may only occur in years when a longer growing season results from above average spring rainfall prior to the onset of summer dormancy. Climatic conditions during this time are more conducive to the formation of tubers.

- **Rubbish dumping** has occurred in the past in the habitat of Population 4. Track closure was completed in 1999 and this has restricted vehicle access and hence, further rubbish dumping.

Summary of population information and threats

Pop. No. & Location	Land Status	Year/No. plants	Habitat Condition	Threats
1a. N of Dunsborough	Shire Road Reserve	1985 20+ 1988 0	Moderate to good	Road maintenance, weed invasion, grazing, trampling, inappropriate fire, poor recruitment
1b. N of Dunsborough	Shire Road Reserve	1988 20+* 1993 0* 1994 20* 1996 20* 1997 6* 1998 9* 1999 6* 2000 3* 2001 8* 2002 10(7) 2003 32*	Moderate to good	Road maintenance, weed invasion, grazing, trampling, inappropriate fire, poor recruitment
1c. N of Dunsborough	Shire Reserve	See above	Moderate to good	Trampling, weed invasion, grazing, inappropriate fire, poor recruitment
2a. Dunsborough	Shire Reserve	1986 1 1997 0 1999 16 2000 3 2001 4	Healthy	Weed invasion, grazing, trampling, inappropriate fire, poor recruitment
2b. Dunsborough	Shire Reserve	2001 3	Healthy	Weed invasion, grazing, trampling, inappropriate fire, poor recruitment
3a. W of Dunsborough	Shire Reserve	1985 6* 1988 10* 1993 1* 1994 20* 1996 3* 1997 1* 1998 2* 1999 2*	Moderate	Weed invasion, grazing, rubbish dumping, inappropriate fire, poor recruitment
3b. W of Dunsborough	Shire Road Reserve	2001 1* 2002 2*	Moderate	Road maintenance, weed invasion, grazing, rubbish dumping, inappropriate fire, poor recruitment

Pop. No. & Location	Land Status	Year/No. plants	Habitat **Condition**	**Threats**
4. SE of Dunsborough	Unvested Reserve	1986 10 1994 15 1997 2 1998 2 1999 1 2000 5 2001 4 2002 4 2003 7	Moderate	Weed invasion, grazing, trampling, inappropriate fire, poor recruitment, rubbish dumping (historically)
5. Leeuwin Naturaliste National Park	National Park	1986 several 1994 0 1997 0 1999 0 2000 0 2002 0	Moderate	Weed invasion, grazing, trampling, inappropriate fire, poor recruitment
6. Dunsborough	Shire Reserve	1999 1 2000 0 2001 0 2002 1	Healthy	Weed invasion, grazing, trampling, rubbish dumping, inappropriate fire, poor recruitment

* = total for subpopulations combined.
Numbers in brackets = leaves with no flower.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Developments in the immediate vicinity of the population or within the defined habitat critical to the survival of *Caladenia viridescens* require assessment for the potential for a significant level of impact.

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

Habitat critical to the survival of the species includes the area of occupancy of important populations; areas of similar habitat surrounding important populations i.e. well-drained lateritic sandy loam soils or winter-wet swamps in jarrah, marri and peppermint woodlands or coastal heath (these provide potential habitat for natural expansion); and additional occurrences of similar habitat that may contain important populations of the species or be suitable for future translocations or other recovery actions intended to create important populations. All population are considered important for the long-term recovery and survival of the species.

Benefits to other species or ecological communities

Recovery actions implemented to improve the quality or security of the habitat of *Caladenia viridescens* will also improve the status of the Endangered giant spider orchid (*C. excelsa*) as well as the Critically Endangered Bussell's spider orchid (*C. busselliana*) which occur in the habitat of *C. viridescens* at Population 4.

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. Although the taxon is listed under the United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) Convention on International Trade in Endangered Species (CITES) this IRP does not affect Australia's obligations under international agreements.

Role and interests of Indigenous people

Involvement of the Indigenous community is being sought through the advice of the Department of Indigenous Affairs 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 that there are no sites of Aboriginal significance at or near populations of the species covered by this IRP. 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.

Social and economic impacts

The implementation of this recovery plan may cause some social and economic impacts as some of the populations occur in Shire and unvested reserves, and State Forest and this is discussed under recovery actions.

Evaluation of the Plan's Performance

DEC, in conjunction with the South West Region Threatened Flora and Communities Recovery Team 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 Interim Recovery Plan is to abate identified threats and maintain or enhance *in situ* populations to ensure the long-term preservation of the species in the wild.

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

3. RECOVERY ACTIONS

Completed recovery actions

All relevant land managers have been notified of the location and threatened status of the species. The notification details the Declared Rare status of *Caladenia viridescens* and the legal responsibility to protect it.

Declared Rare Flora (DRF) markers have been installed to mark the locations of all road reserve populations of the species to help prevent future damage from road maintenance activities. These markers alert people working in the area to the presence of rare flora and help avoid damage to the habitat.

Habitat restoration measures including restriction of vehicle access, deep-ripping, rubbish removal and weed control were instigated in 1996 and 1997 at Population 4. The site was fenced in 2000 to reduce grazing pressure and will now be allowed to regenerate naturally. Tracks were closed near Population 4 in 1999 to restrict access. This was required, in particular, to help prevent illegal dumping of rubbish.

In 1999, spot spraying of watsonia and other weeds (mainly flat weed) was carried out at Populations 1a, 1b and 4. Some subsequent hand weeding has taken place around individual plants. Many of the weeds still in close association with the orchids are small grassy weeds. These do not require very labour intensive hand weeding to remove, but the negative effects of disturbance to soil (disturbance to fine root systems of orchids, increased weed invasion) would probably outweigh the benefits of weed removal.

Botanic Garden and Parks Authority (BGPA) staff artificially pollinated flowers and collected seed for storage from *Caladenia viridescens* in 1999. They also collected material to evaluate genetic distinctiveness and for isolation of endophytic material (the orchid's associated fungi). This was successfully isolated, and seed and fungi are now stored in liquid nitrogen at the BGPA facility. Evaluation of genetic distinctiveness of this species is also in progress. BGPA staff collected additional seed from Population 1 in 2001. Eight seed capsules were also collected by BGPA from Population 1c in 2002. Germination trials have been carried out by BGPA and germination rates of around 60% were achieved.

A research burn was undertaken at Population 4 on 12 December 1999 to investigate the response of the orchids to summer fire. This occurred. The last known previous burn was in Spring/Summer 1989. A 20m x 20m plot was burnt under mild conditions in an area in which both *Caladenia viridescens* and *C. busselliana* (also a

Critically Endangered taxon) were previously recorded but had not been recorded in flower for several years. Surface moisture was between 14-16%, the maximum temperature recorded at 5cm depth in the soil was 35°C and at 10cm depth was 27.8°C, during the burn. The burn plot was monitored in 2000, 2001 and 2003 but no orchids were located. However, the area has been fenced and regrowth of other native species is good with little weed invasion. Monitoring of this site will continue. Population 3b was burnt in a fuel reduction burn carried out on 3rd March 2003. This was a fairly warm burn. The area in the vicinity of Population 1b was burnt during a fuel reduction burn in May 2004. A 30m radius around the loading ramp was excluded from the burn area, however some plants outside this area may have been burnt. Monitoring of these sites was carried out in 2004.

A fire response plan for each population of the species has been produced and incorporated into the Fire Control Working Plan. This is to ensure appropriate actions are undertaken during wildfire suppression to protect the orchid habitat. The response plan includes production of maps and information detailing seasonally specific responses, and the marking of Fire Management Services Co-ordination Boards to highlight population locations. Information sessions with personnel involved with wildfire suppression were also undertaken in 2000, 2001 and 2002. Current recommended management practices are to restrict prescribed burns to at least 10-15 year intervals and not burning during the growing phase of March to November each year.

Extensive surveys were carried out for *Caladenia viridescens* in 1999 and 2000. A new population of one plant was located in 1999 (Population 6), but no additional populations were located in 2000.

Threatened flora displays were presented at the Busselton Wildflower Show in 1999 and 2000. Two threatened flora field days were held in 1999. One of these was for DEC staff and one was for the Bunbury Naturalists Club. DEC Blackwood District field workers have been provided with scanned colour photographs of the species to assist with recognition of new populations. An information sheet, which includes a description of the plant, its habitat, threats, recovery actions and photos has been produced and distributed for the species. These information sheets are also available on the internet.

A review of historical rainfall data was undertaken in 2001 to identify any correlation between rainfall patterns and orchid flowering. Initial results indicate that in years where the rainfall is more than 150mm during April and/or May rather than June or later, are years of greater orchid flowering (personal communication M. Spencer[1]). These data have not been statistically analysed, however.

Ongoing and future recovery actions

Negotiations have been initiated to transfer the reserve that contains Population 4 to the care, control and management of the Conservation Commission as A Class for Conservation of Flora and Fauna. It is further proposed to amalgamate a location that adjoins the reserve to provide a vegetated buffer to the population and possible future translocation site. This proposal is supported by Department of Mineral and Petroleum Resources and the Shire of Busselton. The Department of Land Information (DLS) is seeking clarification of the Native Title Act before making a final determination on the vesting and amalgamation of this reserve.

Plant numbers and threats are monitored annually during the flowering season. Global Positioning System (GPS) locations of all populations have been recorded in DEC's Blackwood District Geographic Information System database. Further, the differential GPS locations of all individual *Caladenia viridescens* plants in Population 2 were recorded in 1999 and 2001.

Funding was received to carry out preliminary research into seed baiting for fungi for translocation work for *Caladenia viridescens* and *C. busselliana*. This work will be carried out by an Honours student. Once this preliminary research is complete then a translocation proposal will be written. This translocation will aim to enhance population numbers of the two species by planting them back into the existing site, and possibly introducing them into new sites.

The South West Region Threatened Flora and Communities Recovery Team (SWRTFCRT) is overseeing the implementation of this IRP and will include information on progress in its annual report to DEC's Corporate Executive and funding bodies.

[1] Meredith Spencer, Former Project Officer, DEC's Blackwood District

Where populations occur on lands other than those managed by DEC, permission has been or will be sought from appropriate land managers prior to recovery actions being undertaken.

The following recovery actions are roughly in order of descending priority, however this should not constrain addressing any of the priorities if funding is available for 'lower' priorities and other opportunities arise.

1. Coordinate recovery actions

The SWRTFCRT will continue to oversee the implementation of the recovery actions for *Caladenia viridescens* and will include information on progress in its annual report to DEC's Corporate Executive and funding bodies.

Action: Coordinate recovery actions
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $700 per year

2. Stimulate seed set

Flowers of the species will continue to be artificially hand pollinated to stimulate seed set. This is necessary to allow for *in-situ* germination and to produce enough seed for collections. Less than half of the flowers in any given population will be pollinated this way, and records kept as to which plants have been treated. In particular, this process will indicate whether low recruitment is due to low pollen viability, or to the natural rate of pollination for this species. Trials into seed set and fungus associations are being undertaken by researchers at Kings Park Botanic Gardens and include artificial pollination of flowers.

Action: Artificially pollinate flowers to increase seed set
Responsibility: BGPA and DEC (Blackwood District) through the SWRTFCRT
Cost: $800 per year

3. Collect seed and fungal material

Preservation of germplasm is essential to guard against extinction if wild populations are lost. Such collections are also needed to propagate plants for translocations. Some seed and endophytic material has been collected from *Caladenia viridescens* at Population 1 and further collections will be undertaken as required from all other populations.

In addition, seed and fungal material collection is necessary to enable DNA studies of the fungal diversity present at each population.

Action: Collect seed and fungal material
Responsibility: BGPA and DEC (Blackwood District) through the SWRTFCRT
Cost: $2,000 per year for the first two years

4. Monitor populations

Plant numbers and threats are monitored annually during the flowering season. Annual monitoring of factors such as habitat degradation (including weed invasion, plant diseases such as *Phytophthora cinnamomi* and salinity), population stability (expansion or decline), pollination activity, seed production, recruitment, longevity and predation is essential. Where possible, the position of each individual plant will be mapped using a differential GPS when in flower. This is to give a truer indication of the size of the population even though a small proportion of the plants in the population are likely to flower in any one season.

The effects of the research burn undertaken in 1999 will also be closely monitored, particularly for any evidence of recruitment. Although no flowers have been recorded yet, the seedlings are very small and indistinct for the first few years.

Action: Monitor populations
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $2,500 per year

5. Conduct further surveys

Community volunteers will be encouraged to participate in further surveys supervised by DEC staff that will be conducted during the flowering period of the species (September-October). A possible new population of 20 to 30 plants (yet to be verified) was located in 2007 during a survey by the West Australian Native Orchid Study and Conservation Group.

Action: Conduct further surveys
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $1,000 per year

6. Complete and implement the fire management strategy

A coordinated fire response plan has been developed for the South West Region and incorporated into the Fire Control Working Plan. It includes strategies for fire control for the habitat of each population of this species. The information will also be communicated to other fire response organisations.

It is thought that fire in autumn-to-spring kills terrestrial orchids, but summer fire is unlikely to affect adult plants in their dormant phase as underground tubers. Little is known about the effects of fire on orchid fungi. Fire also encourages weed invasion, so monitoring of burnt areas and undertaking any necessary weed control is important. The habitat of the species is generally programmed for summer or early autumn burns (December – March) on a 10 to 15 year rotation.

Action: Complete and implement the fire management strategy
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $2,600 in first year and $1,000 in subsequent years

7. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Caladenia viridescens* will provide a better scientific basis for its management in the wild. Some studies have been carried out by the Botanic Gardens and Parks Authority and this research will continue. An understanding of the following is particularly necessary for effective management:

1. The diversity of fungi present in the soil at each site, and their ecological specificity (some fungi serve as appropriate symbionts in laboratory conditions, but not in the field situation).
2. Ecological requirements of *C. viridescens* and associated fungi, e.g. pollinators, association between leaf litter depth and flowering.
3. Effects of fire, competition, rainfall and grazing in recruitment and survival of orchids and associated fungi.
4. The pollination biology of the species.
5. The requirements of pollinators.
6. The population genetic structure, levels of genetic diversity and minimum viable population size.

Action: Obtain biological and ecological information
Responsibility: DEC (Blackwood District), BGPA through the SWRTFCRT
Cost: $20,000 per year for the first three years

8. Undertake translocation

As the number of extant plants is very low and populations are not secure from threats, a translocation proposal is currently being developed. Suitable translocation sites have been selected and orchid seed baiting has also commenced at these suitable translocation sites in preparation for the translocation. Information on the translocation of threatened animals and plants in the wild is provided in DEC's Policy Statement No. 29 *Translocation of Threatened Flora and Fauna*. All translocation proposals require endorsement by DEC's Director of Nature Conservation.

Action: Undertake translocation
Responsibility: DEC (Blackwood District), BGPA through the SWRTFCRT
Cost: $3,000 in the first year (proposal development, germination trials); $5,000 in second year (planting, monitoring); $2,000 per year thereafter (monitoring)

9. Stimulate flowering

Numbers of flowering specimens in most populations have been declining recently. Where the species occurs in habitat that has not been subject to recent disturbance, such as fire, and numbers of flowering individuals have declined, selected areas will continue to be subject to small trial recovery burns or to other disturbance such as raking. This will be undertaken between mid November and mid April to ensure that above ground parts of the orchids are not damaged.

Action: Carry out trial burns to stimulate flowering
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $2,000 for the first two years

10. Map habitat critical to survival

Although habitat critical to survival is described in Section 1, the areas as described have not yet been fully mapped and that will be redressed under this action. If any additional populations are located, then habitat critical to survival will also be determined and mapped for these locations.

Action: Map habitat critical to survival
Responsibility: DEC (Blackwood District, SCB) through the SWRTFCRT
Cost: $500 in the first year

11. Continue weed control

As a consequence of weed control undertaken in previous years, the current level of threat from weeds is low. If monitoring indicates that the threat from weeds has increased, weed control will be undertaken in consultation with the relevant landholders. This will be through hand weeding or spot spraying during the appropriate season to minimise the effect of herbicide on the orchids and the surrounding native vegetation. All weed control will be followed by a report on the method, timing and success of the treatment against weeds, and the effect on *Caladenia viridescens* and associated native plant species.

Action: Continue weed control
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $700 per year

12. Control rabbits

Population 4 was fenced to prevent grazing by rabbits. If monitoring indicates that the rabbits are impacting on other populations through grazing and digging, rabbits will be controlled using appropriate control methods, in consultation with the landholders.

Action: Control rabbits
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $600 per year

13. Liaise with land managers

Staff from DEC's Blackwood District will continue to liaise with land managers and landowners to ensure that populations are not accidentally damaged or destroyed. Input and involvement will also be sought from any Indigenous groups that have an active interest in areas that are habitat for *Caladenia viridescens*.

Action: Liaise with land managers
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $1,200 per year

14. Seek to improve the security of Population 4

Population 4 was previously located in a Shire reserve. Vesting changes have now been finalised to have the reserve transferred to the care, control and management of the Conservation Commission to be managed by DEC as an 'A' class Nature Reserve. DEC will also seek the amalgamation of the adjoining location to this Reserve. Staff from the DEC's Blackwood District will continue to liaise with DLI and relevant parties to facilitate this change.

Action: Seek to improve the security of Population 4
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $200 per year

15. Promote awareness

The importance of biodiversity conservation and the need for the long-term protection of wild populations of this species will be promoted to the community through field day poster displays and the local print and electronic media. Formal links with local naturalist groups and interested individuals will also be encouraged.

An information sheets has been produced for the species. This will be reprinted and will continue to be distributed in an effort to identify new populations.

Action: Promote awareness
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $1,500 in first two years and $900 in subsequent years

16. Rehabilitate habitat as required

DEC will undertake habitat restoration if it is identified as being required during monitoring. This may include modifying the distribution of leaf litter and possibly the re-introduction of locally provenanced material from species native to the site, particularly if species can be identified that provide other needs of pollinators (for example, habitat). Where required weed control has occurred through activities such as spot spraying and hand weeding.

Action: Rehabilitate habitat as required
Responsibility: DEC (Blackwood District) through the SWRTFCRT
Cost: $2,900 in first two years and $1,000 in subsequent years

17. Review this Plan

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

Action: Review the need for a revised Recovery Plan
Responsibility: DEC (SCB, Blackwood District) through the SWRTFCRT
Cost: $20,300 in the fifth year (if required)

4. TERM OF PLAN

Western Australia
This Interim Recovery Plan will operate from December 2005 to November 2010 but will remain in force until withdrawn or replaced. If the species is still ranked Critically Endangered (WA) after five years, this plan will be reviewed and the need for further recovery actions determined.

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

Hopper, S.D. and Brown, A.P. (2001) Contributions to Western Australian Orchidology: 2. New taxa and circumscriptions in *Caladenia* (Spider, Fairy and Dragon orchids of Western Australia). *Nuytsia* 14(1/2), 27-308.

Caladenia viridescens

Typus: Cape Naturaliste, Western Australia, 26 September 1985, *S.D. Hopper* 4657 (*holo*: PERTH 01099620; *iso*: AD!, CBG!, MEL!).

Plant solitary or in loose clumps. *Leaf* erect, linear, 15-20cm x 5-8mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25-40cm tall. *Flowers* 1 to 3(4), *c.* 5-7cm across, predominantly pale greenish yellow with variable suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/4-1/3, then abruptly narrowing to a long-acuminate apex; osmophore prominently tumescent, 5-14mm long on sepals, absent from petals, light to dark brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 4-5cm x 2.5-3mm. *Lateral sepals* horizontal obliquely spreading with downcurved apex, 4.5-5cm x 3-7mm. *Petals* horizontal to obliquely descending, 3.5-4cm x 2.5-3mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, greenish-yellow to pink with dull maroon to red radiating stripes, terminating in a shiny uniformly dark maroon recurved apex, stiffly articulate on a claw *c.* 2mm wide; lamina narrowly cordate in outline when flattened, 17-22 x 10-14mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by vertically ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender clubbed linear dark maroon (sometimes white-tipped) calli to 4mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 4/5 the length of the labellum, dark maroon, sometimes white at base, golf stick-shaped, the longest *c.* 1.5mm tall, decrescent towards apex and becoming sessile. *Column* 15-18 x 6-9mm, broadly winged, creamy to greenish yellow with red-pink blotches. *Anther c.* 2.5 x 2.5mm, dark maroon. *Pollinia c.* 2.5mm long, yellow. *Stigma c.* 2.5mm wide, dark yellow-green. *Capsule* not seen.

Selected specimens examined. WESTERN AUSTRALIA: Cape Naturaliste, 9 Sep. 1985 *S.D. Hopper* 4515 (PERTH 01198238); Cape Naturaliste, 25 Sep. 1985 *S.D. Hopper* 4650 (PERTH 01198211).

Distribution and habitat. Confined to a small area on Cape Naturaliste over a 12 km range, favouring Marri, Jarrah and Peppermint woodlands on lateritic loam, sand or sandy clay.

Flowering period. September to October.

Etymology. Named from the Latin *viridi-* (green), and the suffix *–escens* (becoming), alluding to the pale greenish-yellow colour of the sepals, petals and rear labellum lamina.

Notes. A rare species of very restricted distribution, currently declared as Rare Flora (Hopper *et al.* 1990, Brown *et al.* 1998). *Caladenia viridescens* is allied to *C. paludosa*, from which it differs in its somewhat smaller flowers, its paler petals and sepals, its lateral sepals often splayed out horizontally, and its narrower less cordate labellum. The two species grow together near Dunsborough. *C. brownii* also grows nearby and has greenish flowers with dark maroon markings, but flowers later (October to December) and is readily distinguished by its clubbed petals.