BUSSELL'S SPIDER ORCHID (*CALADENIA BUSSELLIANA*) AND DUNSBOROUGH SPIDER ORCHID (*CALADENIA VIRIDESCENS*)

INTERIM RECOVERY PLAN 2002-2007

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Caladenia viridescens

Caladenia busselliana

Photographs: Andrew Brown

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Government of Western Australia

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

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FOREWORD

Interim Recovery Plans (IRPs) are developed within the framework laid down in Department of Conservation and Land Management (the Department) Policy Statements Nos. 44 and 50.

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.

The Department is committed to ensuring that Critically Endangered 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 and always within one year of endorsement of that rank by the Minister.

This Interim Recovery Plan will operate from December 2002 to January 2008 but will remain in force until withdrawn or replaced. It is intended that, if the taxon is still ranked Critically Endangered, this IRP will be reviewed after five years and the need for a full Recovery Plan assessed.

This IRP was approved by the Director of Nature Conservation on 11 July 2003. The provision of funds identified in this Interim Recovery Plan is dependent on budgetary and other constraints affecting the Department, as well as the need to address other priorities.

Information in this IRP was accurate at December 2002.

SUMMARY

Scientific Name:	*Caladenia busselliana*	**Common Name:**	Bussell's spider orchid
Scientific Name:	*Caladenia viridescens*	**Common Name:**	Dunsborough spider orchid
Family:	Orchidaceae	**Flowering Period:**	September – October
Dept Region:	South West	**Dept District:**	Blackwood
Shire:	Busselton	**Recovery Team:**	South West Region Threatened Flora Recovery Team

Illustrations and/or further information: A. Brown, C. Thomson-Dans and N. Marchant (Eds) (1998) *Western Australia's Threatened Flora.* Department of Conservation and Land Management, Perth; N. Hoffman and A. Brown (1992) *Orchids of South-west Australia.* University of Western Australia Press. Perth; S.D. Hopper and A.P. Brown (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; S. Elscot (2001) *Carbunup Reserve Management Plan* Shire of Busselton. Western Australia.

Current status: *Caladenia busselliana* and *Caladenia viridescens* were declared as Rare Flora in September 1992 and ranked as Critically Endangered (CR) in September 1995. Both species currently meet World Conservation Union (IUCN, 2000) Red List Category 'CR' under criteria B1ab(iii,v)+2ab(iii,v) and D due to the limited distribution and severe fragmentation of populations and continuing decline in the quality of the habitat and number of mature individuals. The main ongoing threats are further habitat degradation and inappropriate fire regimes. A number of plants of both species occur adjacent to roadsides or walk trails and these are threatened by accidental destruction.

Critical habitat: The critical habitat for *Caladenia busselliana* and *C. viridescens* is comprised of the area of occupancy of the known populations; similar habitat within 200 metres of known populations; corridors of remnant vegetation that link populations, additional nearby occurrences of similar habitat that do not currently contain the species but may have done so and may be used for translocations, and the local catchment for the surface water that provides the wetland habitat of the species.

Habitat requirements: *Caladenia busselliana* is currently known from a narrow range of less than 40 linear km in the Vasse-Yallingup area. It grows in winter-wet swamps on sandy loam over clay soils in jarrah and marri woodland, with *Anigozanthos viridis* and *C. paludosa*. *C. viridescens* occurs over a linear range of 12 km 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* ssp. *graniticus*, *Hakea trifurcata* and many other *Caladenia* species, and occasionally in the same swampy areas that *C. busselliana* favours.

Existing Recovery Actions: The following recovery actions have been or are currently being implemented –

1. Relevant land managers have been made aware of the location and threatened status of each species.
2. 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 *Caladenia busselliana* Population 1 and *C. viridescens* Populations 1 and 4.
4. A track at *Caladenia busselliana* Population 1 and *C. viridescens* Population 4 has been closed.
5. Spot spraying of weeds has been carried out as appropriate for both species.
6. The habitat of *Caladania busselliana* Populations 1 and 2a and *C. viridescens* Population 4 have been fenced to exclude grazing.
7. Staff from Botanic Garden and Parks Authority (BGPA) collected seed from *Caladenia busselliana* Population 2 and *C. viridescens* Population 1 in 2001. This is stored in the BGPA's plant science lab at –196°C.
8. BGPA staff are assessing material from *Caladenia busselliana* and *C. viridescens* to determine the genetic distinctiveness of each of the species.
9. Germination trials of *Caladenia busselliana* and *C. viridescens* are currently being carried out by BGPA staff.
10. A research burn was undertaken in December 1999 to investigate how these species respond to fire. Monitoring of this trial is ongoing.
11. A fire management plan is being developed, and will be modified as appropriate when results of fire research are known.
12. The process of changing the care, control and management of the Shire Reserve, on which *Caladenia busselliana* Population 1 and *C. viridescens* Population 4 occur, to A Class Nature Reserve vested with the Conservation Commission has commenced.
13. Staff from the Department's Blackwood District regularly monitor populations of these species. The exact location of individual plants is recorded by differential GPS when possible.
14. A new population of each species has been discovered during recent surveys.
15. Information sheets describing and illustrating each species have been produced and distributed.

16. These species were both promoted through threatened flora displays at local wildflower shows and Threatened Flora Field Days. Field workers from the Blackwood District have received scanned colour photographs of both species.
17. A review of historic rainfall data was undertaken in 2001 to identify any correlation between rainfall patterns and orchid flowering.
18. The South West Region Threatened Flora Recovery Team is overseeing the implementation of this IRP and will include information on progress in an annual report to the Department's Corporate Executive and funding bodies.

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.
Criteria for failure: The number of individuals within populations and/or the number of populations have decreased.

Recovery actions
1. Coordinate recovery actions
2. Continue weed control
3. Continue control of grazing
4. Conduct further surveys
5. Stimulate seed set
6. Collect seed and fungal material
7. Stimulate flowering
8. Undertake translocation
9. Monitor populations
10. Finalise the fire management plan
11. Liaise with land managers
12. Seek to transfer care, control and management of habitat
13. Obtain biological and ecological information
14. Promote awareness
15. Rehabilitate habitat as required
16. Review the need for a full Recovery Plan

1. BACKGROUND

History

The first collection of *Caladenia busselliana* housed at the WA Herbarium was made in 1954 from an unknown location and exhibited in a flower show. The species then escaped detection until 1990 when it was rediscovered by Busselton orchid enthusiast Mr Greg Bussell.

During surveys in 1990 more than 100 plants were recorded south east of Dunsborough (Population 1). Since then the number of plants in all populations has fluctuated but shown a general decline, with only 6 plants located in Population 1 in 2001.

Caladenia viridescens was first collected in 1985 in a road reserve near Dunsborough by S.D. Hopper and A.P. Brown (Population 1). They located more than 20 plants at this time. Eight plants were located in the population in 2001. There are now 6 populations, and all show a fluctuation and general decline in numbers similar to that noted for *C. busselliana*. 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 1 plant near Population 2, but this was not relocated in 2000 or 2001(Population 6).

Due to small and generally declining population sizes, the restricted range of these orchids and their vulnerability to accidental destruction and weed invasion, both *C. busselliana* and *C. viridescens* were declared as Rare Flora in 1992 and ranked as Critically Endangered in September 1995.

Description

Caladenia busselliana is between 20 to 30 cm high and has a single hairy leaf, 10-20 cm long and 5-10 mm wide. Each plant displays one to three pale yellow flowers that are similar in size and shape to those of *C. viridescens* and also the common *C. paludosa* (Swamp Spider Orchid). *C. busselliana* differs from *C. viridescens*, its nearest relative, in its paler yellow colouration, more ovate labellum lacking a dark maroon apex and longer, narrower clubs on the sepals (Hoffman and Brown 1992). Although they 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.

Caladenia viridescens stands from 25 to 40 cm high, and also has a single leaf, 15-20 cm long and 5-8 mm wide. It also displays one to three flowers, but these are pale green, stiffly held and with a narrow labellum. The labellum has a dark maroon fringe and apex.

Distribution and habitat

Caladenia busselliana is currently known from a narrow geographic range of less than 40 linear km near the northern end of the Leeuwin-Naturaliste Ridge between Vasse and Yallingup. It occurs in winter-wet swamps of marri (*Corymbia calophylla*) and jarrah (*Eucalyptus marginata*) woodland with *Anigozanthos viridis* and *C. paludosa*. (Hoffman and Brown 1992; Brown *et al*. 1998).

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

Critical habitat

Critical habitat is habitat identified as being critical to the survival of a listed threatened species or listed threatened ecological community. Habitat is defined as the biophysical medium or media occupied (continuously, periodically or occasionally) by an organism or group of organisms or once occupied

(continuously, periodically or occasionally) by an organism, or group of organisms, and into which organisms of that kind have the potential to be reintroduced (Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*).

The critical habitat for *Caladenia busselliana* and *C. viridescens* comprises:

- the area of occupancy of known populations;
- areas of similar habitat within 200 metres of known 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 range extension);
- corridors of remnant vegetation that link populations (these are necessary to allow pollinators to move between populations and are usually road and rail verges);
- additional occurrences of similar habitat that do not currently contain the species but may have done so in the past (these represent possible translocation sites); and
- the local catchment for the surface water that provides the wetland habitat of the species (the species occurs in winter wet areas and is dependent on maintenance of local surface hydrology).

Biology and ecology

Caladenia species such as *C. busselliana* and *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 are active. 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. 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.

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.

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, which 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).

Orchid seedlings are very small for the first growing season and are difficult to locate. Leaves are typically less than 20 mm long and only a few mm wide. It appears that leaf and tuber size increase over the next 4 to 5 years until adult plants capable of flowering are present.

Threats

Caladenia busselliana and *C. viridescens* were both declared as Rare Flora in September 1992 and ranked as Critically Endangered (CR) in September 1995. Both species currently meet World Conservation Union (IUCN) Red List Category 'CR' under criteria B1ab(iii,v)+2ab(iii,v) and D (IUCN 2000) due to the severe fragmentation of populations and continuing decline in the quality of habitat and the number of mature individuals. The main cause of the species' critically endangered status is previous habitat destruction, and the main ongoing threats are further habitat degradation, and weed infestation in particular. A number of plants of both species occur next to roadsides and these are threatened by accidental destruction.

- **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 busselliana* and *C. viridescens* populations. Grazing by insects has also been observed at some populations. The only bud found at *C. busselliana* Population 2 in October 2001 was grazed before flowering. The high level of palatable weeds near these populations and in adjacent farming properties attract herbivorous animals, which are often unselective in their grazing.

- **Diggings** 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. *Caladenia busselliana* Population 2 has been particularly affected.

- **Inappropriate fire regimes** may affect the viability of populations. Undergrowth can get excessively dense and orchids can be out-competed if an area is too long unburnt. 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. However, the orchids become dormant at this time because climatic conditions are typically hot and dry, with associated risks of fire 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 by visitors, 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 *Caladenia viridescens* Population 3 in the past, where it grows within 2 m 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.

Summary of population information and threats – *Caladenia busselliana*

Pop. No. & Location	Land Status	Year / No. plants	Condition	Threats
1a. SE of Dunsborough	Unvested Reserve	1990 100+* 1991 30* 1993 63* 1994 15* 1997 1* 1998 5* 1999 16* 2000 6* 2001 6*	Healthy	Weed invasion, grazing, trampling, inappropriate fire, poor recruitment
1b. SE of Dunsborough	Shire Road Reserve	(See above)	Healthy	Road maintenance, weed invasion, grazing, inappropriate fire, poor recruitment
2a. Carbunup	Shire of Busselton Parks and Recreation Reserve	1991 2 1993 0 1997 1 1998 0 1999 0 2000 0 2001 1	Healthy	Weed invasion, grazing, quenda diggings, inappropriate fire, poor recruitment

Summary of population information and threats – *Caladenia busselliana (Cont)*

2b. Carbunup	Shire of Busselton Parks and Recreation Reserve	2000 2 2001 2	Healthy	Firebreak maintenance, weed invasion, grazing, quenda diggings, inappropriate fire, poor recruitment
3. Capel	State Forest	1991 1	Disturbed	Clearing, weed invasion, grazing, inappropriate fire, poor recruitment

* = total for both subpopulations combined.

Summary of population information and threats – *Caladenia viridescens*

Pop. No. & Location	Land Status	Year/No. plants	Condition	Threats
1a. N of Dunsborough	Shire Road Reserve	1985 20+* 1988 20+* 1993 0* 1994 20* 1996 20* 1997 6* 1998 9* 1999 6* 2000 3* 2001 8*	Moderate to good	Road maintenance, weed invasion, grazing, trampling, inappropriate fire, poor recruitment
1b. N of Dunsborough	Shire Road Reserve	See above	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*	Moderate	Road maintenance, weed invasion, grazing, rubbish dumping, inappropriate fire, poor recruitment
4. SE of Dunsborough	Unvested Reserve	1986 10 1994 15 1997 2 1998 2 1999 1 2000 5 2001 4	Moderate	Weed invasion, grazing, trampling, inappropriate fire, poor recruitment
5. Leeuwin Naturaliste National Park	National Park	1986 several 1994 0 1997 0 1999 0 2000 0 2001 0	Moderate	Weed invasion, grazing, trampling, inappropriate fire, poor recruitment
6. Dunsborough	Shire Reserve	1999 1 2000 0 2001 0	Healthy	Weed invasion, grazing, trampling, rubbish dumping, inappropriate fire, poor recruitment

* = total for two or three subpopulations combined.

Guide for decision-makers

Section 1 provides details of current and possible future threats. Any development that requires clearing or disturbance of vegetation, soil disturbance (firebreaks, roadworks etc), or may alter surface hydrology, in the

immediate vicinity of *Caladenia. busselliana* and *C. viridescens* will require assessment. Development proposals should not be approved unless the proponents can demonstrate that they will not have an impact on the species, its habitat or potential habitat, or the local surface hydrology.

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.
Criteria for failure: The number of individuals within populations and/or the number of populations have decreased.

3. RECOVERY ACTIONS

Existing recovery actions
(N.B. Many actions refer to *Caladenia busselliana* Population 1 and *C. viridescens* Population 4. These populations occur at the same site.)

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

Declared Rare Flora (DRF) markers have been installed to mark the locations of all road reserve populations of both species to help prevent future damage from road maintenance activities. Pegs have also been placed at an internal firebreak within the reserve habitat of *Caladenia busselliana* Population 2b. 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 *Caladania busselliana* Population 1 and *C. viridescens* Population 4. The site has been fenced to reduce grazing pressure and will now be allowed to regenerate naturally. Track closure at the site of *C. busselliana* Population 1 and *C. viridescens* Population 4 was completed in 1999 to restrict access, particularly to help prevent illegal dumping of rubbish.

In 1999, spot spraying of Watsonia was carried out at the site of *Caladenia busselliana* Population 1 and *C. viridescens* Population 4, and at *C. viridescens* Population 1a and 1b. Weeds (mainly flat weed) were also spot sprayed. Some subsequent hand weeding has taken place around individual plants. Many of the weeds still in close association with the orchids are very small grassy weeds that would 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.

Grazing was noticed during monitoring in 2000 at *Caladenia busselliana* Population 1 and *C. viridescens* Population 4 and the site has now been fenced to reduce this pressure. Some digging was also observed at *C. busselliana* Population 2a in 2000, and a fence was erected in the immediate vicinity of the last known plant location before the flowering season. No flowering plant was seen there in 2000, but one was found in 2001. One plant at *C. busselliana* Population 2b was grazed in 2001 shortly after flowering and will be caged in 2002.

Botanic Garden and Parks Authority (BGPA) staff artificially pollinated flowers and collected seed for storage from *Caladenia busselliana* and *C. 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 these species is also in progress. BGPA staff collected additional seed from *C. busselliana* Population 2 and *C. viridescens* Population 1 in 2001. Germination trials are being carried out in preparation for

a possible translocation in 2003, pending production of dormant tubers and approval of a Translocation Proposal.

A research burn was undertaken on 12 December 1999 to investigate the response of these orchids to summer fire. This occurred at the site of *C. busselliana* Population 1 and *C. viridescens* Population 4. 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 orchids were previously recorded but had not been recorded in flower for several years. (Surface moisture was between 14-16%; the maximum temperature recorded at 5 cm depth in the soil was 35°C and at 10 cm depth was 27.8°C). The burn plot was monitored in 2000 and 2001, 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.

A fire response plan for each population of both species has been produced and incorporated into the Fire Control Working Plan, to ensure appropriate actions are undertaken during wildfire suppression to protect the orchid habitat. This 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 have also been undertaken in 2000, 2001 and 2002. Current 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.

Caladenia busselliana Population 1 and *C. viridescens* Population 4 occur within a Shire Reserve. Negotiations have been initiated to transfer the care, control and management of the reserve to the Conservation Commission as A Class for Conservation of Flora and Fauna. It is further proposed to amalgamate the location adjoining the reserve to provide a vegetated buffer to the populations 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 Administration 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 the Department's Blackwood District Geographic Information System database. Further, the Differential GPS locations of all individual *Caladenia busselliana* plants at both confirmed populations, and *C. viridescens* plants in Population 2 were recorded in 1999 and 2001. Plants at *C. busselliana* Population 1 appear to be occurring further west than previously recorded.

Surveying for new populations was undertaken near *Caladenia busselliana* Population 2 in 1999 and 2000, and two new plants were located (Population 2b). Extensive surveys were carried out for *C. viridescens* in 1999 and 2000. A new population of 1 plant was located in 1999 (Population 6), but no additional populations were located in 2000.

Public awareness of these species has been raised through threatened flora displays at the Busselton Wildflower Show in 1999 and 2000. Two Threatened Flora Field Days were held in 1999; one for Departmental staff and one for the Bunbury Naturalists Club. Blackwood District field workers have been provided with scanned colour photographs of both these species to enable 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 each species. These posters are also available on the internet.

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

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

[1] Meredith Spencer, Project Officer, the Department's Blackwood District

Future recovery actions

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

1. Coordinate recovery actions

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

Action: Coordinate recovery actions
Responsibility: The Department (Blackwood District) through the SWRTFRT
Cost: $800 per year

2. Continue weed control

As a consequence of weed control 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 busselliana* and *C. viridescens* and associated native plant species.

Action: Continue weed control
Responsibility: The Department (Blackwood District) through the SWRTFRT
Cost: $700 per year

3. Continue control of grazing

A number of populations have been fenced after grazing was recorded (*Caladenia busselliana* Populations 1 and 2a and *C. viridescens* Population 4). However, if monitoring indicates that the rabbits are impacting on other populations, they will be controlled using appropriate control methods, in consultation with the landholders.

Action: Continue control of grazing
Responsibility: The Department (Blackwood District) through the SWRTFRT
Cost: $200 per year

4. Conduct further surveys

Community volunteers will be encouraged to participate in further surveys supervised by Departmental staff that will be conducted during the flowering period of each species (September-October).

Action: Conduct further surveys
Responsibility: The Department (Blackwood District) through the SWRTFRT
Cost: $1,000 per year

5. Stimulate seed set

Flowers of both species will 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 these species.

Action: Stimulate seed set
Responsibility: BGPA and the Department (Blackwood District) through the SWRTFRT
Cost: $ 800 per year

6. 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 busselliana* and *C. viridescens* but further collections are required from all populations.

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

Action: Collect seed and fungal material
Responsibility: BGPA and the Department (Blackwood District) through the SWRTFRT
Cost: $2,000 per year the first two years**.**

7. Stimulate flowering

Numbers of flowering specimens in most populations has been declining recently. Where the species occur in habitat that has not been subject to recent disturbance, such as fire, and numbers of flowering individuals has declined, selected areas will 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: Stimulate flowering
Responsibility: The Department (Blackwood District) through the SWRTFRT
Cost: $2,000 for the first two years**.**

8. Undertake translocation

As the number of extant plants of both species is very low and populations are not secure from threats, a translocation proposal will be developed and suitable translocation sites selected. This will coordinated by the SWRTFRT. Information on the translocation of threatened animals and plants in the wild is provided in the Department's Policy Statement No. 29 *Translocation of Threatened Flora and Fauna*. All translocation proposals require endorsement by the Department's Director of Nature Conservation.

If dormant tubers are successfully formed during germination trials, it is anticipated that these will be planted out early in 2003 as part of an approved translocation proposal.

Action: Undertake translocation
Responsibility: The Department (Blackwood District), BGPA through the SWRTFRT
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. Monitor populations

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, 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: The Department (Blackwood District) through the SWRTFRT
Cost: $2,500 per year

10. Finalise 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 these 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 may also encourage weed invasion, so monitoring of burnt areas and undertaking any necessary weed control is important. The habitat of these species is generally programmed for summer or early autumn burns (December – March) on a 10 to 15 year rotation.

Action: Finalise the fire management strategy
Responsibility: The Department (Blackwood District) through the SWRTFRT
Cost: $2,600 in first year and $1,000 in subsequent years

11. Liaise with land managers

Staff from the Department's Blackwood District will continue to liaise with land managers and landowners to ensure that populations are not accidentally damaged or destroyed.

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

12. Seek to transfer care, control and management of habitat to Conservation Commission

Caladenia busselliana Population 1 and *C. viridescens* Population 4 are currently located in a Shire reserve. The Department will continue to seek to have the care, control and management of the reserve transferred to the Conservation Commission to be managed by the Department as an A class Nature Reserve. The Department will also seek the amalgamation of the adjoining location to this Reserve. This action has been endorsed by the Department of Minerals and Energy and the Shire of Busselton. The Department of Lands Administration (DOLA) are currently seeking clarification of the Native Title Act before making a final determination. Staff from the Department's Blackwood District will continue to liaise with DOLA and relevant parties to facilitate this change.

Action: Seek to transfer care, control and management of habitat to Conservation Commission
Responsibility: The Department (Blackwood District) through the SWRTFRT
Cost: $200 per year

13. Obtain biological and ecological information

Improved knowledge of the biology and ecology of *Caladenia. busselliana* and *C. viridescens* will provide a better scientific basis for their management in the wild. 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. busselliana* and *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: The Department (Blackwood District), BGPA through the SWRTFRT
Cost: $ 20,000 per year for the first three years

14. Promote awareness

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

Information sheets have been produced for both of these species. These will be reprinted and will continue to be distributed in an effort to identify new populations.

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

15. Rehabilitate habitat as required

The Department will undertake habitat restoration in populations of these species if this is identified as being required during monitoring. This may include modifying the distribution of leaf litter and possibly the re-introduction of local provenance plants of species native to the site, particularly if species can be identified that provide other needs of pollinators (for example, habitat).

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

16. Review the need for a full Recovery Plan

At the end of the fourth year of the five-year term of this Interim Recovery Plan, the need for further recovery will be assessed. If the taxon is still ranked as Critically Endangered at that time the need for a full Recovery Plan or to update this IRP will be assessed.

Action: Review the need for a full Recovery Plan
Responsibility: The Department (WATSCU, Blackwood District) through the SWRTFRT
Cost: $20,300 in the fifth year (if required)

4. TERM OF PLAN

This Interim Recovery Plan will operate from December 2002 to November 2007 but will remain in force until withdrawn or replaced. If the taxon is still ranked Critically Endangered after five years, the need to update this IRP or to replace it with a full Recovery Plan will be determined.

5. ACKNOWLEDGMENTS

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7. 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 busselliana

Typus: near Quindalup, Western Australia, 20 October 1990, *G.Bussell s.n.* (*holo*: PERTH 02648733; *iso*: AD!, CBG!, K!).

Plant solitary or in loose clumps. *Leaf* 10-20 cm x 5-10 mm, linear, erect, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20-30 cm tall. *Flowers* 1 or 2(3), *c.* 5-8 cm across, creamy-yellow with occasional suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a long-acuminate apex; osmophore narrowly tumescent, 10-20 mm long on sepals, absent from petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 3-4.5 cm x 3-4 mm. *Lateral sepals* spreading and downcurved, 5-5.5 cm x 4-5 mm. *Petals* horizontal to somewhat downcurved, 3-4.5 cm x 3-4 mm. *Labellum* 3-lobed (sometimes obscurely), uniformly coloured or occasionally suffused pink, with pink to red radiating stripes, stiffly articulate on a claw *c.* 2 mm wide; lamina cordate in outline when flattened, 15-20 x 10-12 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point curved upwards and terminated by obliquely ascending calli; lateral lobes erect with entire margins within 2 mm of the claw, becoming fimbriate with slender clubbed narrowly fusiform dark maroon to pink (sometimes white-tipped) calli to 6 mm long which are abruptly decrescent near midlobe; midlobe margins with short narrow forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 2/3 the length of the labellum, pink, sometimes white at base, golf stick-shaped, the longest *c.* 1.5 mm tall, decrescent towards apex and becoming sessile. *Column* 15-18 x 6-8 mm, broadly winged, creamy yellow with pink blotches. *Anther c.* 2.5 x 2.5 mm, pale yellowish pink. *Pollinia c.* 2 mm long, flat, yellow. *Stigma c.* 3 mm wide, yellow-green. *Capsule* not seen.

Selected specimens examined. WESTERN AUSTRALIA: W of Capel, 10 Oct. 91 *S.D. Hopper* 8210 (PERTH 1829351); Vasse/Yallingup area, 11 Oct.91, *S.D. Hopper* 8213 (PERTH); Flower Show, Sep.1954, *R.D. Royce* 4849 (CBG, PERTH 00260959).

Distribution and habitat. Poorly known. Apparently confined to two sites at the northern end of Leeuwin-Naturaliste Ridge and another location further north near Capel. Southern populations grow in winter-wet swamps and acidic grey sandy loam beneath Marri with *Anigozanthos viridis* and *Caladenia paludosa*. Near Capel, the single plant seen was with dense weedy herbs and *C. lorea*, *C. flava*, *C. latifolia* and *Diuris* aff. *Amplissima* in Tuart woodland with a Peppermint understorey. Soils there were calcareous grey sandy loam with scattered limestone rock. Flowers best after summer fire.

Flowering period. Late September to October.

Etymology. Named after Mr Greg Bussell (1945-), a descendent of the pioneering family after whom Busselton was named, and a keen orchid enthusiast who discovered and made the first collections of this rare species. Greg and his wife Mary have greatly assisted our research, particularly on orchids of the Leeuwin-Naturaliste Ridge where they have farmed and more recently become chalet owners.

Notes. *Caladenia busselliana* is a recently recognised and very rare orchid (Declared Rare) first collected from an unknown location for a flower show in 1954. The species subsequently escaped detection by orchid enthusiasts until 1990. It is one of only three members of the *C. huegelii* complex in Western Australia known to us that lack a red apex to the labellum. Of the other two, *C. busselliana* differs from *C. interjacens* in having smaller less robust flowers that are creamy-yellow, and shorter narrower osmophores. From *C. lodgeana*, *C. busselliana* differs in its petals lacking osmophores, its smaller creamy-yellow flowers, and earlier (September to October) flowering season.

Caladenia busselliana has flowers also similar to *C. viridescens*, but differs in its paler yellow colouration, the labellum more ovate with a yellow, not dark maroon, apex, its longer osmophores on the sepals, and its preference for winter-wet swamps rather than the dry slopes and woodlands occupied by *C. viridescens*. However, the two species do occur in close sympatry at the type locality of *C. busselliana*, together with *C. paludosa*, *C. chapmanii*, and *C. ferruginea*.

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, 15-20 cm x 5-8 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25-40 cm tall. *Flowers* 1 to 3(4), *c.* 5-7 cm 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 ¼-1/3, then abruptly narrowing to a long-acuminate apex; osmophore prominently tumescent, 5-14 mm 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, 4-5 cm x 2.5-3 mm. *Lateral sepals* horizontal obliquely spreading with downcurved apex, 4.5-5 cm x 3-7 mm. *Petals* horizontal to obliquely descending, 3.5-4 cm x 2.5-3 mm. *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.* 2 mm wide; lamina narrowly cordate in outline when flattened, 17-22 x 10-14 mm, 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 4 mm 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.* 1.5 mm tall, decrescent towards apex and becoming sessile. *Column* 15-18 x 6-9 mm, broadly winged, creamy to greenish yellow with red-pink blotches. *Anther c.* 2.5 x 2.5 mm, dark maroon. *Pollinia c.* 2.5 mm long, yellow. *Stigma c.* 2.5 mm 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 10 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.