

**Wheatbelt Orchid Rescue Project**  
**Final Report 2**  
**Population Size and Vital Statistics Data for the**  
**Granite Spider Orchid (*Caladenia graniticola*)**

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## Wheatbelt Orchid Rescue Project Final Reports

Brundrett M. 2011a. Wheatbelt Orchid Rescue Project. Final Report 1. Objectives, Outcomes and Overall Conclusions. Wheatbelt Orchid Rescue Project, University of Western Australia. [Link 1](#)

Brundrett M. 2011b. Wheatbelt Orchid Rescue Project Final Report 2. Population Size and Vital Statistics Data for the Granite Spider Orchid (*Caladenia graniticola*). Wheatbelt Orchid Rescue Project, University of Western Australia. **This Report**

Brundrett M. 2011c. Wheatbelt Orchid Rescue Project Final Report 3. Population Size and Vital Statistics Data for the Ballerina Orchid (*Caladenia melanema*). Wheatbelt Orchid Rescue Project, University of Western Australia. [Link 3](#)

Brundrett M. 2011d. Wheatbelt Orchid Rescue Project Final Report 4. Population Size and Vital Statistics Data for the William's Spider Orchid (*Caladenia williamsiae*). Wheatbelt Orchid Rescue Project, University of Western Australia. [Link 4](#)

Brundrett M. 2011e. Wheatbelt Orchid Rescue Project Final Report 5. Population Size and Vital Statistics Data for the Lonely Hammer Orchid (*Drakaea isolata*). Wheatbelt Orchid Rescue Project, University of Western Australia. [Link 5](#)

Brundrett M. 2011f. Wheatbelt Orchid Rescue Project Final Report 6. Population Size and Vital Statistics Data for Southern Populations of the Western Underground Orchid (*Rhizanthella gardneri*). Wheatbelt Orchid Rescue Project, University of Western Australia. [Link 6](#)

Brundrett M and Ager E. 2011. Wheatbelt Orchid Rescue Project Final Report 7. Seed Collecting, Soil Baiting and Propagation of Orchids. Wheatbelt Orchid Rescue Project, University of Western Australia. [Link 7](#)

Brundrett M. 2011g. Wheatbelt Orchid Rescue Project Final Report 8. Translocation of Orchids in Wheatbelt Nature Reserves. Wheatbelt Orchid Rescue Project, University of Western Australia. [Link 8](#)

### Citation of 2 or more Project Reports

Brundrett M. 2011. *Wheatbelt Orchid Rescue Project: Case Studies of Collaborative Orchid Conservation in Western Australia*. University of Western Australia, Crawley, Western Australia.

**Note:** Appendix 1 contains location data for Declared Rare Flora that is not included in publicly available versions of this report.

## 1. Introduction and Objectives

The Wheatbelt Orchid Rescue (WOR) project is a Lotterywest funded collaboration between the Western Australian Native Orchid Study and Conservation Group (WANOSCG), the School of Plant Biology at the University of Western Australia (UWA), the Friends of Kings Park and the Department of Environment and Conservation (DEC). This project aims to help conserve the rarest orchids in the Western Australian wheatbelt by obtaining knowledge required for sustainable management and directly contributing to recovery actions. Please refer to the first WOR report for further information.

The granite spider orchid (also known as the Pingaring spider orchid) was described as *Caladenia hoffmanii* subsp. *graniticola* by Hopper and Brown (2001) and redefined as the separate species *Caladenia graniticola* by Hopper and Brown (2004). Mrs K. White of Pingaring made the first collection in 1984. Following this, small populations of the subspecies were located on granite outcrops southwest of Karlgarin and in Dragon Rocks Nature Reserve south of Hyden (Kershaw et al. 2003). This species has a very small area of distribution on granite rock outcrops in the south-eastern wheatbelt of WA with six populations in three nature reserves over a range of about 50 square km.

*Caladenia graniticola* is listed as Declared Rare Flora and ranked as Critically Endangered in Western Australia. This species is also ranked as Critically Endangered under the Commonwealth Environment Protection Biodiversity Conservation Act 1999. An Interim Recovery Plan (IRP) has been prepared by DEC (Kershaw et al. 2003). The location and status of all populations is described in Table 1 below, with locations for populations 3 to 5 provided in Appendix 1.

**Table 1.** Population size estimates for *Caladenia graniticola* from the Interim Recovery Plan (Kershaw et al. 2003). Population 3b was discovered in the 2008 WOR survey.

Pop. No. & Location	Land Status	Located	No. plants	Last survey	Current Condition
1a. E of Pingaring	Water Reserve	1984	8	2007	Disturbed
1b. E of Pingaring	Shire Reserve	1999	29	2007	Disturbed
1c. E of Pingaring	Water Reserve	1994	27	2008	Disturbed
1d. E of Pingaring	Shire Reserve	1999	4	2007	Disturbed
2. SW of Karlgarin	Water Reserve	1994	51	2007	Disturbed
3a. Dragon Rocks Nature Reserve	Nature Reserve	1986	40	2008	Healthy*
3b. Dragon Rocks Nature Reserve	Nature Reserve	2008	(8)	2008	Healthy*
4. Dragon Rocks Nature Reserve	Nature Reserve	1985	30	2008	Healthy*
5. Dragon Rocks Nature Reserve	Nature Reserve	1991	10	2008	Healthy*

\*Habitat condition differs from that stated in the IRP.

**Table 2.** Soil Properties from 2 sites in Dragon Rocks Nature Reserve where *Caladenia graniticola* grows (Populations 3 and 4).

	Site1	Site 2
pH	5.35	5
pH (CaCl <sub>2</sub> )	4.53	4.41
Salinity (ds/m)	39.6	141.5
clay %	6.6	3.3
silt %	1	1.8
Sand%	92	95
Classification	sand	sand



**Figure 1.** Granite spider orchid flower and plant. **A.** Habit of *Caladenia graniticola*. **B.** Flower. **C.** Long dense hairs on leaf and stem. **D-F.** Close-up details of flower showing long fringe and rows of boot shaped calli (arrow) on lip.

## 2. Orchid and Habitat Characteristics

*Caladenia graniticola* is a tuberous, perennial spider orchid 10 to 30 cm high with a single hairy leaf 8-15 cm long and 5-10 mm wide (Hopper and Brown 2001). Each plant has 1-2 (3) creamy or greenish-yellow, red marked flowers that are 3-7 cm long and 3-5 cm wide. The shortened petals and sepals are up to 3 cm long and have somewhat swollen glandular tips (Fig. 1). The distinctive tapering labellum (lip) has long reddish fringes, 2-4 rows of dark red central calli and a long red tip that is curled under at the apex (Fig. 1). Flowers of this orchid are characteristic of *Caladenia* species pollinated by male thynnid wasps lured to flowers by sexual attraction (Stoutamire 1983). A specific pollinator has not been identified for this species.

In most cases the granite spider orchid typically occurs in thick leaf litter under or near sheoak trees *Allocasuarina huegeliana* or *A. campestris* (Fig. 2), but is also found in more open areas. In some cases the sheoaks form an almost pure stand, or there is an understorey of other associated native plants including the grass *Spartochloa scirpoidea* and sedges (*Lepidosperma* spp.). The most commonly associated orchids include *Ericksonella saccharata*, *Caladenia dimidia*, *C. roei* and *C. hirta* subsp. *rosea*. Soils are sandy with < 10% clay but set hard, with a pH of about 5 (Table 2).



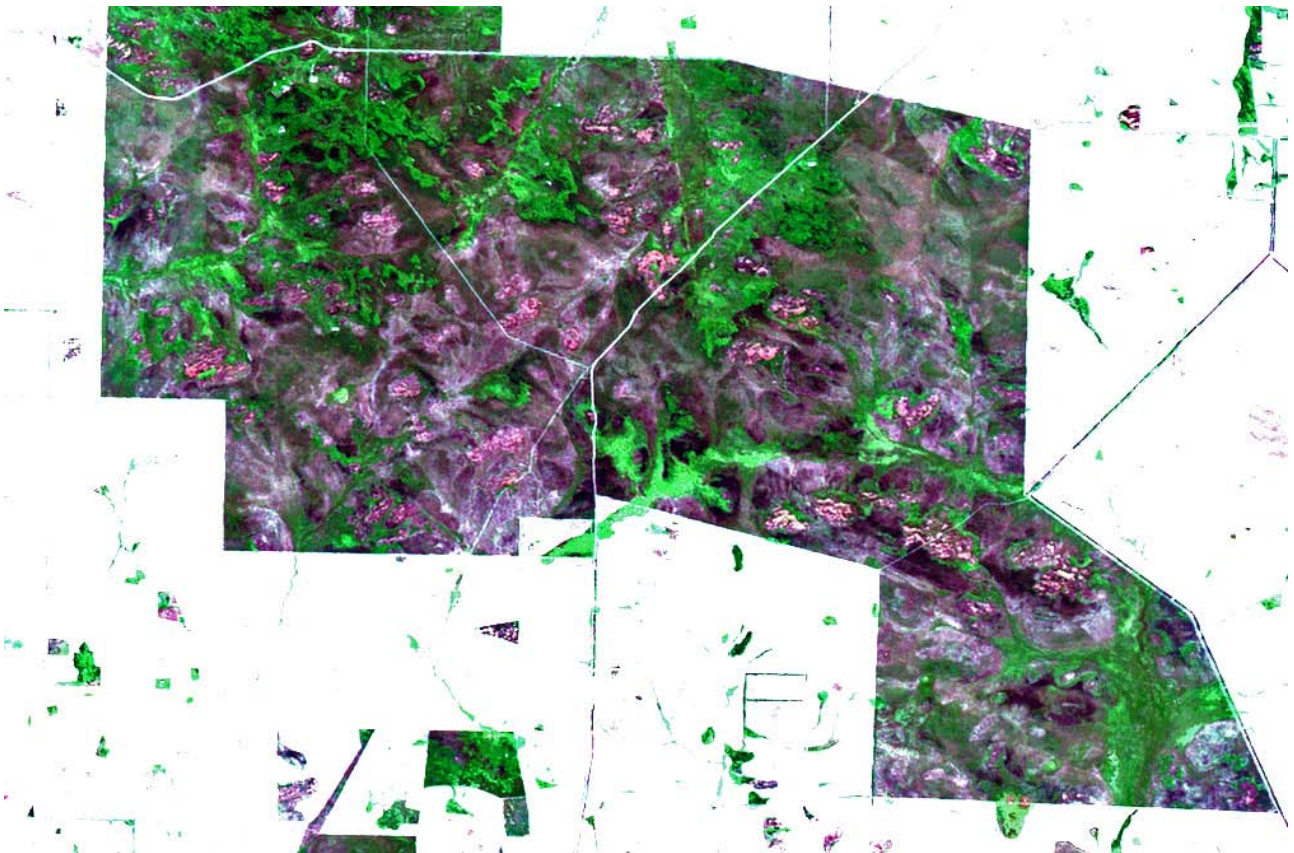
**Figure 2. AB.** Typical habitat of *Caladenia graniticola* under sheoaks in runoff areas near granite. **C.** It often grows in relatively deep leaf litter.

### 3. Survey of Dragon Rocks Nature Reserve

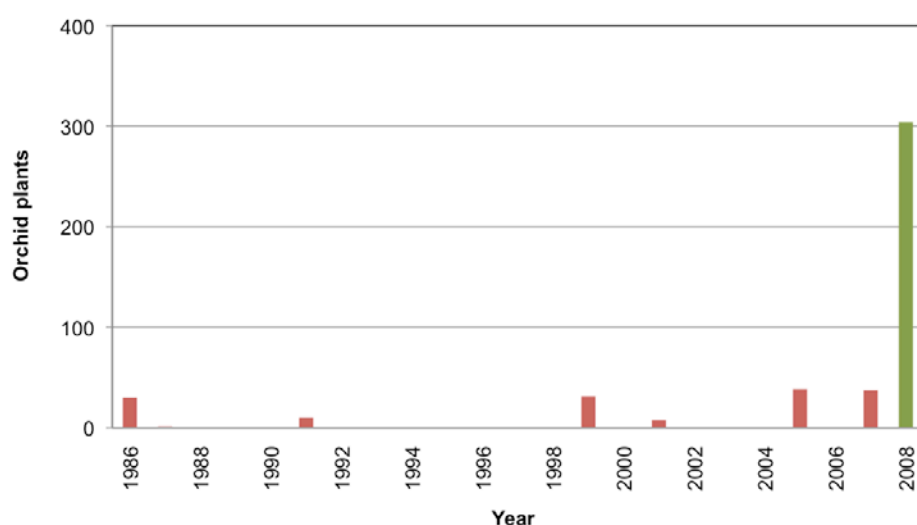
On Sept 18 - 20 2008 WANOSCG volunteers participated in a *Caladenia graniticola* survey at known and likely habitats in Dragon Rocks Nature Reserve (DRNR) coordinated by the WOR project. This nature reserve is one of the largest in south-western WA (32,000 ha) and there are many areas of potential suitable habitat. However, earlier survey work has established that this orchid primarily occurs next to relatively large granite rocks where runoff provides increased water availability. Survey target areas were selected using detailed aerial photographs and Landsat satellite imagery showing areas of granite (Fig. 3).

The objectives of this survey were to (i) to provide an accurate estimate of the size of known populations of the granite spider orchid at DRNR, (ii) identify the size of known habitats, (iii) investigate potential new habitats, (iv) accurately record information about the position and numbers of orchids using GPS coordinates and photographs and (v) provide updated information on population viability and potential threats.

Despite relatively dry weather in May, June and August 2008 was an exceptionally good year for *C. graniticola* (Fig. 4). There were fewer plants observed at these locations in a preliminary survey of the same habitats in 2007 by Andrew Brown and Mark Brundrett. It is probable that differences in weather contributed to the abundance of plants observed in 2008. However, the assistance of experienced and enthusiastic volunteers resulted in a very substantial improvement in survey effort, leading to a much understanding of this critically endangered orchid. We counted 300 flowering individuals in total (see Table 3).



**Figure 3.** False colour Landsat satellite image of the southern part of Dragon Rocks Nature Reserve showing locations of granite rocks (pink) that were survey targets (image provided by Grahm Behn, DEC).



**Figure 4.** Orchid sightings graph for Dragon Rocks Nature Reserve including data from the 2008 survey (green bar) and earlier data summarised in the recovery plan (Kershaw et al. 2003).

**Table 3.** Summary of 2008 survey data for 3 populations of *Caladenia graniticola* in Dragon Rocks Nature Reserve with estimated habitat area and number of GPS points covering plants within 5 m of each other (GPS points are defined in Appendix 1).

Population	Date	Leaves	Flowers	GPS points	Habitat area
3a	20/9/08	39	28	15	800 x 200 m
3b#	20/9/08	8	2	3	15 x 5 m
4	18/9/08	36	28	4	15 x 5 m
5	19/9/08	217	115	30	100 x 100 m
5 (recounted in 2009)	22/9/09	236			
<b>Total (2008)</b>		<b>300</b>	<b>173</b>	<b>50</b>	<b>~18 ha</b>

# Population 3b was discovered during this survey and is approximately 1 km from 3a.

### 3.1. Population 4 in Dragon Rocks Nature Reserve

On Thursday 18 of September, despite persistent rain the author (MB) and 9 WANOSCG volunteers, surveyed 3 large areas, including several that were relatively inaccessible. We were eventually able to relocate population 4 and conduct a thorough survey of the surrounding area. Thirty-six plants were located and mapped (Table 3, Appendix 1).

The total area of occupation at population 4 is very small (15 x 5 m) and is defined by 3 GPS points encompassing plants within 5 m (Appendix 1). This habitat consists of open mallee woodland with scattered sheoaks in shallow soil over granite. Populations 3 and 4 differ from the largest population (5) where orchids occur in typical habitat (dense stands of sheoak close to granite rocks).

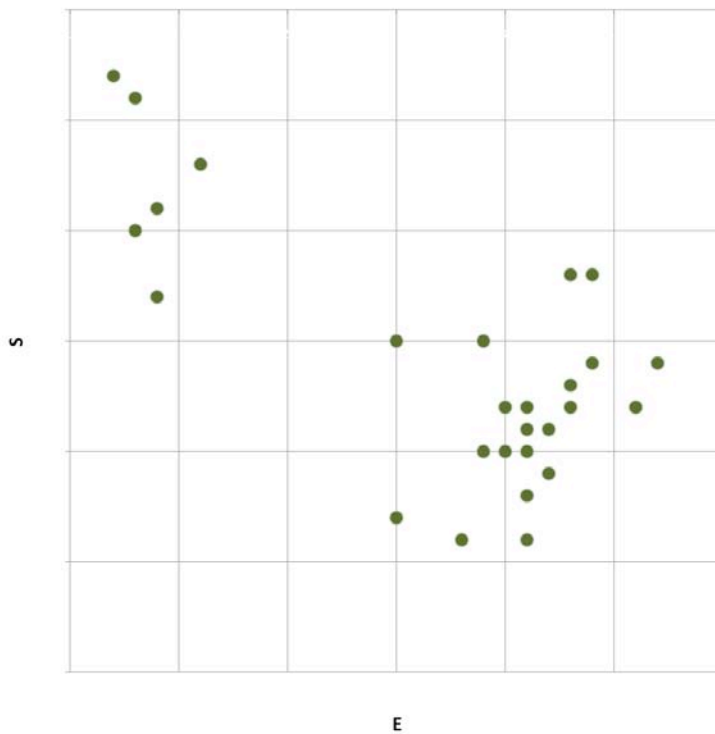
Population 4 was extremely difficult to locate due to the small area of occupied habitat relative to the large expanse of surrounding granite vegetation and is also relatively inaccessible so had not been surveyed for some time. This population was discovered in 1985 and most subsequent surveys found few if any plants in this location (Kershaw et al. 2003).

**3.2. Population 5 in Dragon Rocks Nature Reserve**

A detailed survey of a second DRNR rock outcrop with a known population of *C. graniticola* was conducted with the help of 12 WANOSCG volunteers. This survey revealed over 200 plants within approximately 1 ha of habitat (Table 3, Appendix 1). Many of these were found in a new area 100 m southeast of the patch of sheoak where first discovered by Ann Coates (Rick) and Ann McDonald in 1991 (Coates et al. 1992). Comparatively few of these orchids had been located at this site in previous years (Table 1). Both subpopulations occur under the canopy of a stand of sheoak (*Allocasuarina huegeliana*) with a fairly dense canopy (see Figs. 5, 6). No other occupied habitat was found nearby. This habitat is in exceptionally good condition with few issues with grazing or weeds, etc. There are some signs of canopy decline where old sheoaks have fallen over, but this actually seems to favour the orchids, which may respond to increased light levels and are protected from grazing by fallen branches.



**Figure 5.** The largest population of granite spider orchids (Population 5) occurs within a small patch of sheoak woodland surrounded by granite. Over 200 plants were observed here in 2008, considerably more than occur in any other population of this very rare orchid combined.



**Figure 6.** Relative locations of 2 patches of plants in the 200 x 200 m habitat area for Population 5. Points are GPS coordinates for all orchids within a 5 m radius. This area is extremely important for conservation of this species, as it contains about 50% of known plants for the species.



### 3.3. Population 3 in Dragon Rocks Nature Reserve

On September 20, 2008 we surveyed suitable habitat areas near Population 3 (Fig. 7). Two groups were sent in different directions, each with a recording sheets and GPS. They eventually met on the north side of the granite rock, where most of the orchids were located. We noted that many of these orchids occurred outside of what was previously believed to be prime habitat (some over 1 km from expected habitat in close proximity to massive granite).

Population 3 was discovered by Steve van Leeuwen in 1986, who originally found 30 plants, but few individuals were observed in subsequent surveys over the next 3 decades (Kershaw et al. 2003). An intensive survey of the area by 30 WANOSCG volunteers in 2008 located 47 individuals including 8 plants at a new sub-population 1 km northeast near a track (Fig. 7). Many *C. graniticola* orchids were located in open shrubland further from the granite than expected, so were likely to have been overlooked in earlier surveys.



**Figure 7.** Volunteers from the WA Native Orchid Study and Conservation group helped conduct surveys at Dragon Rocks Nature Reserve in September 2008. This photo is at the location of a new sub-population (3b) they discovered approx. 1 km from previously known plants (right photo).

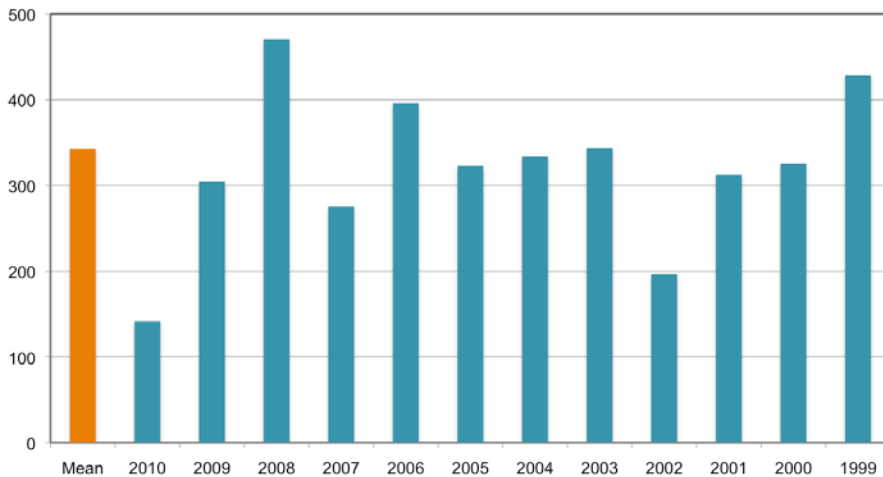
Areas targeted in 2008 have now been thoroughly surveyed, but there are other areas of potential habitat in DRNR that are worth investigating in the future (granite areas visible in Fig. 2). Most of these areas are inaccessible due to the infrequent tracks and dense vegetation in many parts of this very large nature reserve. In total, there are still about 5 sites with substantial areas of granite rock-associated vegetation that are worthy of future survey efforts (see Fig. 2). However, even if these gaps in survey effort can be addressed, it is unlikely that many new plants will be discovered, since most of the apparently suitable habitat investigated over 3 days in 2008, a good flowering year, was unoccupied.

### 3.4. Overall orchid diversity in Dragon Rocks Nature Reserve

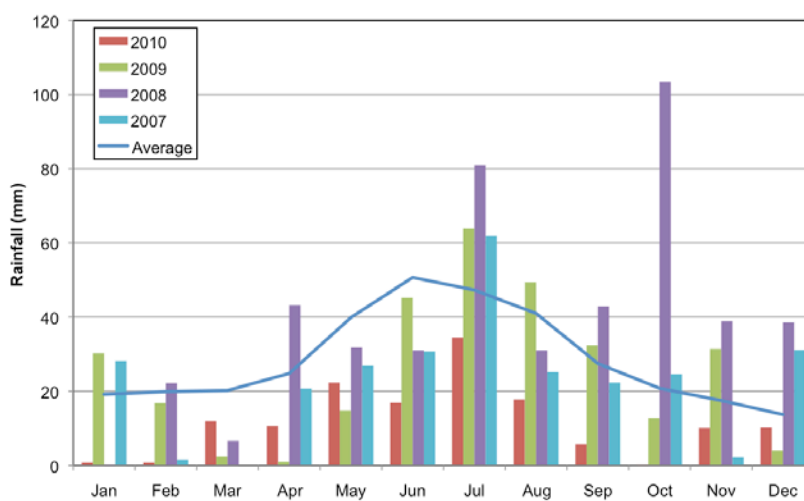
In total 40 orchid species were observed over three days. An orchid list is provided in Table 4 as an update for the flora list for DRNR (Coates 1992). About 50 *Thelymitra maculata* plants were observed in full bloom.

**Table 4.** Dragon Rocks Nature Reserve orchid list (Margaret Petrides, Andrew Brown, Mark Brundrett).

Genus	Species	Notes
<i>Caladenia</i>	<i>dimidia</i>	
<i>Caladenia</i>	<i>falcata</i>	
<i>Caladenia</i>	<i>flava</i> subsp. <i>flava</i>	
<i>Caladenia</i>	<i>graniticola</i>	DRF Survey target
<i>Caladenia</i>	<i>hirta</i> subsp. <i>rosea</i>	
<i>Caladenia</i>	<i>longicauda</i> ssp. <i>eminens</i>	
<i>Caladenia</i>	<i>mesocera</i>	
<i>Caladenia</i>	<i>nana</i> subsp. <i>nana</i>	well outside normal range
<i>Caladenia</i>	<i>pachychila</i>	
<i>Caladenia</i>	<i>radialis</i>	
<i>Caladenia</i>	<i>roei</i>	
<i>Cyanicula</i>	<i>nikulinskyae</i>	pale blue
<i>Cyanicula</i>	<i>aperata</i>	range extension?
<i>Cyanicula</i>	<i>gemmata</i>	
<i>Cyrtostylis</i>	<i>huegelii</i>	
<i>Diuris</i>	aff. <i>corymbosa</i>	
<i>Diuris</i>	aff. <i>corymbosa</i>	long sepals
<i>Diuris</i>	sp. Granite	
<i>Elythranthera</i>	<i>brunonis</i>	
<i>Ericksonella</i>	<i>saccharata</i>	
<i>Eriochilus</i>	<i>dilatatus</i>	leaf
<i>Leporella</i>	<i>fimbria</i>	leaves
<i>Microtis</i>	<i>media</i> subsp. <i>media</i>	leaves
<i>Prasophyllum</i>	<i>macrotys</i>	
<i>Prasophyllum</i>	<i>gracile</i>	
<i>Prasophyllum</i>	<i>sargentii</i>	
<i>Pterostylis</i>	aff. <i>barbata</i>	dwarf bird
<i>Pterostylis</i>	<i>mutica</i>	
<i>Pterostylis</i>	aff. <i>nana</i>	seed
<i>Pterostylis</i>	<i>recurva</i>	
<i>Pterostylis</i>	<i>sargentii</i>	
<i>Pterostylis</i>	<i>spathulata</i>	
<i>Pterostylis</i>	<i>vittata</i>	seed
<i>Pyrorchis</i>	<i>nigricans</i>	leaves
<i>Spiculaea</i>	<i>ciliata</i>	
<i>Thelymitra</i>	<i>antennifera</i>	closed
<i>Thelymitra</i>	<i>flexuosa</i>	
<i>Thelymitra</i>	<i>macrophylla</i>	large leaf early bud
<i>Thelymitra</i>	<i>maculata</i> ( <i>spiralis</i> )	common near Dragon Rocks
<i>Thelymitra</i>	<i>maculata</i> x <i>flexuosa</i> ?	unusual hybrid



**Figure 8A.** Rainfall at Hyden the closest station to Dragon Rocks Nature Reserve from the Bureau of Meteorology ([www.bom.gov.au](http://www.bom.gov.au)). Rainfall in 2010 was only 40 % of the long-term average.



**Figure 8B.** Annual variations in monthly rainfall patterns over the past 4 years. There was severe late winter and spring drought in 2010. Rainfall data is for Hyden about 40 km North of Dragon Rocks Nature Reserve.

#### 4. Vital Statistics Data

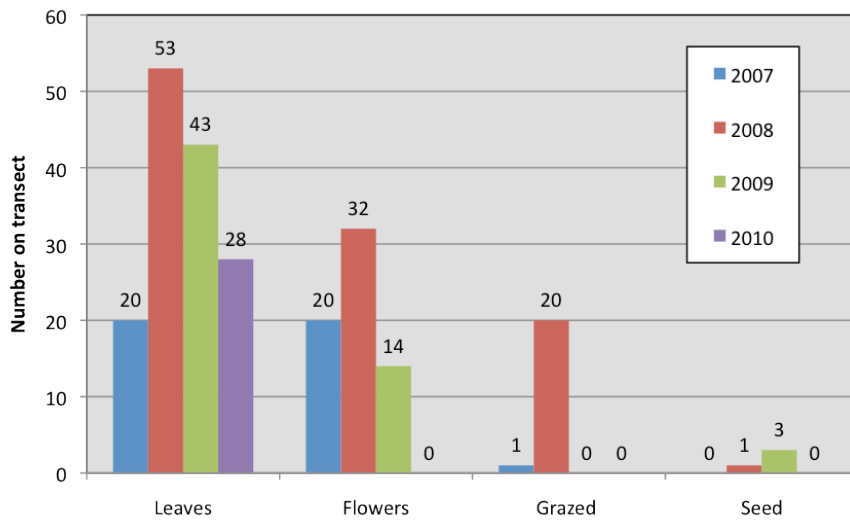
A 20 x 4 m permanent transect was established across the densest area of population 5 in 2007 in order to collect data on rates of flowering, seed-set, grazing, recruitment and survival of individual plants, (Fig. 9). This transect included most of the individuals present in 2007, but only about 1/4 of those present in the population in 2008.

*Caladenia graniticola* emerges in early winter and flowers in late September to early October (Hopper and Brown 2001). Like other *Caladenia* species it is a geophyte that survives the dry, hot conditions of summer as a dormant tuber, so plants can remain dormant on a given year, to reappear in a subsequent year.

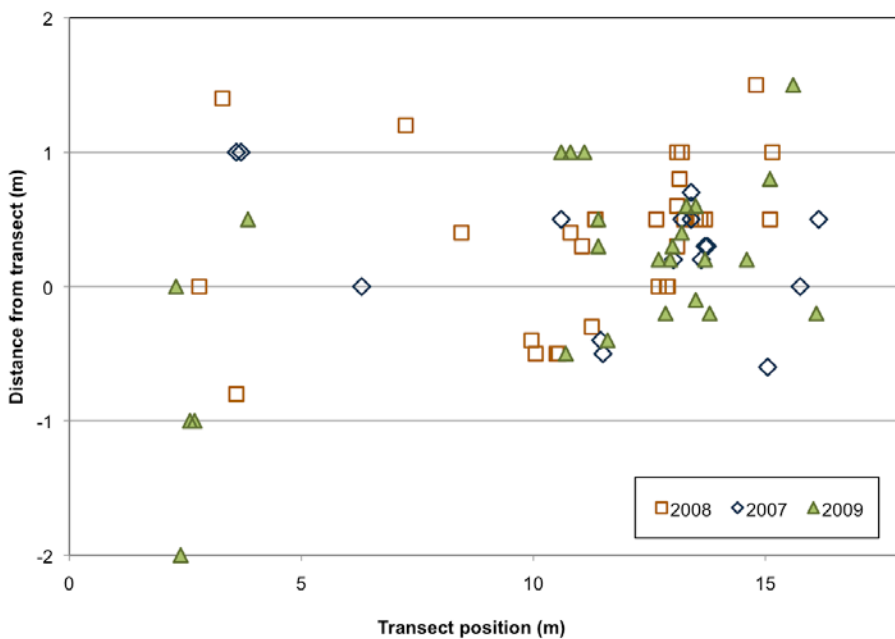
The first four years of data was sufficient to identify low seed production as a potential threat and there was substantial grazing in 2008, but not in other years (Fig. 10). A single plant formed seed in 2008, 3 plants in 2009 and there was no seed set in 2007 or 2010. Plants became dormant before the flowering period in 2010 due to severe drought. Only one plant had 2 flowers out of 31 flowering plants in 2008 and a substantial proportion of plants did not flower in 2009 and 2010 (Fig. 10).



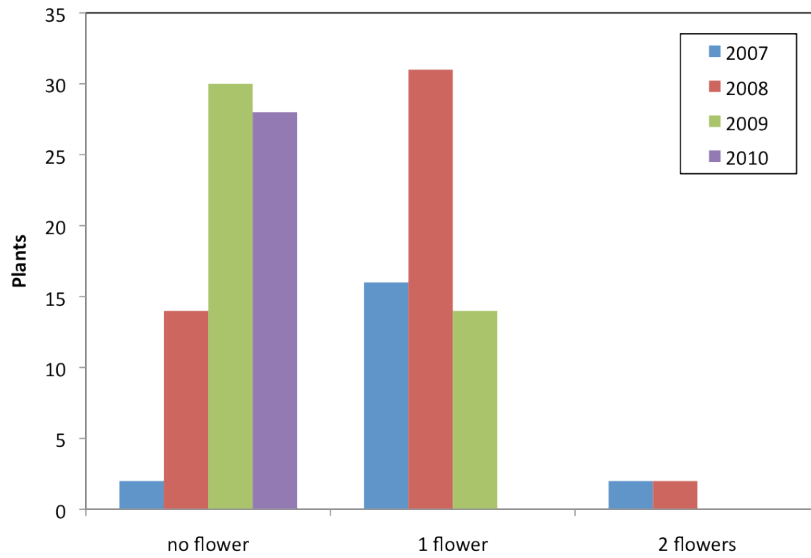
**Figure 9AB.** The *Caladenia graniticola* transect was located under a dense stand of *Allocasuarina huegeliana* in shallow soil over granite in population 5.



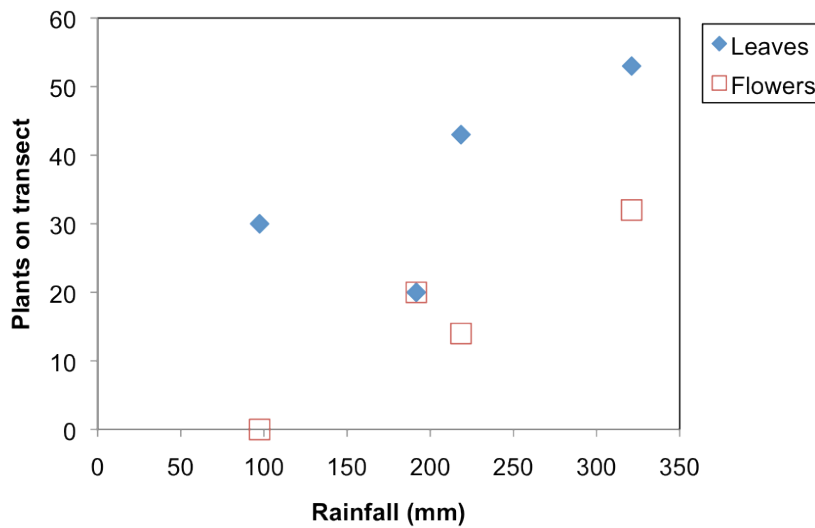
**Figure 10.** Seasonal variation in emergent plants, flowering, grazing and seed set for plants along a 20 x 4 m transect. This transect is located in the heart of Population 5.



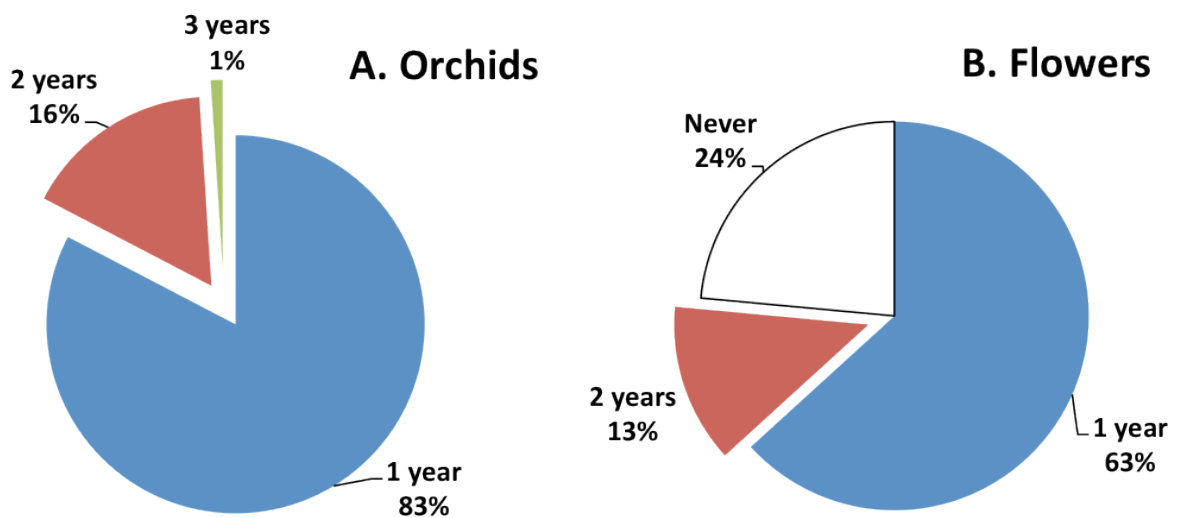
**Figure 11.** The relative position of plants of *Caladenia graniticola* along the transect over 3 years. Data was not collected in 2010 due to severe drought. Note that the vertical scale is much finer than the x-axis scale.



**Figure 12.** The number of flowers per plant of *Caladenia graniticola* on the transect over 4 years.



**Figure 13.** Relationship between winter plus spring rainfall and emergent plants or flowers. Data are for *Caladenia graniticola* on the population 5 transect over 4 years. Rainfall data for Hyden from [www.bom.gov.au/climate](http://www.bom.gov.au/climate).



**Figure 14AB.** The proportion of *Caladenia graniticola* plants that emerge (A) or flower (B) on one or more years as determined by their position in a 15 x 4 m area over 3 years.

## 5. Population Size and Dynamics

Long-term trends show that Population 5 in DRNR has increased in size substantially since its discovery by Ann Rick in 1991 and seems to be the only population of the granite spider orchid to be substantially increasing in size (Tables 1, 3). There was a strong correlation between rainfall and orchid emergence and flowering (Fig. 13). Severe winter drought had a substantial impact on flowering, especially in 2010 when rainfall was less than half the average annual total (Fig. 8) and plants failed to flower (Fig. 12).

Precise data on plant locations relative to the transect axis allowed individual plants to be identified (see Fig. 11). These data were then used to determine how many plants emerged more than once over the 4-year period of observation (Fig. 14). Estimates of the total transect population size and the proportion of plants that emerge, flower, set seed, or are grazed each year are provided in Table 5. On average 37% of plants emerged each year and 17% flowered, while seed set was a very low 1% of all plants (emergent plus dormant). It seems that about 1/2 of the orchids which exist as dormant tubers along the transect emerged in 2008, which was a wet year, while only 1/3 or 1/4 of these plants emerged in dry years such as 2007 or 2010.

This orchid has a relatively low frequency of annual emergence from dormant tubers. The proportion of plants which emerge, but fail to flower (Fig. 14) is also greater than for other species studied in the WOR project and none flowered more than twice over 4 years. Population size estimates require assumptions, in particular that newly observed plants were not seedlings, but this is unlikely as most were of flowering size. These assumptions are discussed further in WOR Report 3.

Annual orchid emergence trend data from the permanent transect (Table 5) can be used to provide an overall estimate for all orchids in DRNR. Since just over 1/2 of the estimated total of plants on the transect emerged in 2008, it would suggest there are about 600 plants in total in populations 3, 4 and 5, of which 300 emerged on the year of the survey, which was the wettest rainfall in the 4-year study (Fig. 8). It is likely that fewer plants would have been counted if the survey had occurred on a drier year.

The dramatic increase in population size estimates for the granite spider orchid in DRNR (Table 3), in part results from relatively high rates emergence and flowering in 2008, but many new plants were discovered by expanding the size of areas known to contain the granite spider orchid as a result of careful searching with the assistance of volunteers.

**Table 5.** Vital statistics summary for *Caladenia graniticola* from the Dragon Rocks Nature Reserve transect. The estimated transect total is the sum of individuals that emerged at different positions on one or more years and the average annual % is based on this estimated total population.

	Year	Leaves	Flowers	Seed set %	Grazed %
	2007	20	20	0.0	5.0
	2008	53	32	3.0	37.7
	2009	43	14	21.0	0.0
	2010	28	0	0.0	0.0
	<i>Average</i>	36	16.5	6	10.675
	Estimated transect total	98			
	<b>Average annual % of total</b>	<b>36.7</b>	<b>16.8</b>	<b>1</b>	<b>5.3</b>

## 6. Conclusions and Recommendations

1. The 2008 survey, which included teams of 9 to 30 experienced volunteers from WANOSCG over 3 days, resulted in the discovery of many more granite spider orchids in DRNR than were expected. The majority of these were flowering, but it was also possible to reliably identify non-flowering individuals, by distinguishing their leaves from those of other orchids. This revealed over 300 plants, an order of magnitude increase in the size of populations from earlier surveys.
2. Areas occupied by *C. graniticola* are very small areas in a vast nature reserve, resulting in a very large survey effort to find new plants. There are a few remaining unsurveyed large granite areas in DRNR, but some are very inaccessible (e.g. 4 km from a track or road).
3. The vegetation where *C. graniticola* occurs was found to more diverse and open than expected. Future surveys should target all vegetation types that occur within 200 m of granite rocks.
4. WOR project surveys with DEC and WANOSCG have substantially increased the number of plants known (300) but their habitat areas were very small and the granite spider orchid still must still be considered a threatened species.
5. Some existing location information on collections of *Caladenia graniticola* from Dragon Rocks Nature Reserve in the WA Herbarium was very inaccurate. More accurate coordinates for 2 historic collections were provided to DEC and redefined for the IRP (Appendix 1).
6. Vital statistics gathered for the granite spider orchid over 4 years allowed population size and flowering capacity along the transect to be estimated. The number of *C. graniticola* plants that appear above ground and flower were highly correlated with rainfall. It was estimated that about 1/2 of the orchids which exist as dormant tubers along the transect emerged in a wet year, while only 1/3 to 1/4 of these plants emerged in dry years.
7. Only 1/2 of the emergent plants on the transect flowered and very few set seed. Overall, there were very low rates of pollination at DRNR (populations 3-5), but seed set was observed to be higher at the 2 other sites where this orchid occurs (populations 1 and 2).
8. The use of small permanent tags that identify individual plants should be investigated, as this may benefit future monitoring efforts.
9. Due to the fact that only a fraction of orchids emerge each year, long term monitoring of the same areas is required to allow population size estimates to be obtained and changes to be observed.
10. All *C. graniticola* habitats in DRNR are in excellent condition without any major problems with weeds or disturbance (contrary to status given in the IRP).
11. Weed management recommended in the IRP is only required for populations 1 and 2 which are elsewhere.
12. Grazing management, as recommended in the IRP (Table 4), is also not required at DRNR (populations 3-5) at present.
13. Perhaps of greatest concern should be the long-term viability of this species if climate change continues to alter rainfall patterns in this area, which is already close to the limit of orchid distribution in WA (orchids are most abundant and diverse in higher rainfall areas). The impacts of severe drought on *C. graniticola* should be evaluated by long-term monitoring. Changes in rainfall patterns may affect orchids indirectly if canopy decline opens up the habitat and results in increased competition with other species.
14. Data on orchid emergence rates from a permanent transect was used in combination with survey data to provide a revised estimate for orchid populations size. Since approx. 1/2 of plants on the transect emerged in 2008 when 300 emergent plants were counted during surveys, it would suggest there are about 600 plants in total in all 3 populations in DRNR.
15. Additional research is required to develop an understanding of habitat specificity and to explain why the majority of apparently suitable habitat at DRNR and elsewhere is unoccupied. The role of mycorrhizal fungi in determining habitat preferences should also be investigated. This

requires additional seed baiting experiments and comparison of mycorrhizal fungi that associate with co-occurring orchids (Brundrett et al. 2003, Bonnardeaux et al. 2007).

16. A preliminary seed baiting trial confirmed that seed collected from 3 populations of this orchid was viable and some soils harboured compatible fungi so were suitable for translocation of this orchid species (WOR Report 7).
17. As recommended in the IRP (Kershaw et al. 2003), a translocation plan for *Caladenia graniticola* was developed and approved by the WOR project and DEC in 2009 (Brundrett and Edgley 2009). In addition to augmenting population sizes, a translocation trial was considered to be an appropriate means of investigating plant growth in areas of unoccupied habitat that appear suitable. One translocation site was located in a relatively accessible area in an attempt to create a new population for visitors to see and thus reduce disturbance impacts on existing populations. The propagation and translocation outcomes from the WOR project are presented in separate reports in this series (WOR reports 7 and 8).
18. The translocation trials initiated in 2009 and 2010 should continue to be monitored and future translocations may be required to maintain populations.
19. This report identifies Core Habitat and Critical Habitat areas, as defined below, for this species that should be included in a fire management plan and any other relevant management plans.
20. *In particular, population 5 is the most important Core Habitat area as it contains about 50% of all known plants for this species within a very small area (1 ha).*
21. The second highest priority area in Dragon Rocks Nature Reserve is Population 3a (about 16 ha), followed by population 4 (< 1 ha), which is smaller and not readily accessible.
22. All areas of granite associated vegetation, especially with an *Allocasuarina* sp. overstory, and buffer areas within 500 m of granite rocks within the reserves where it occurs are Critical Habitat areas for *Caladenia graniticola*. These can be identified using aerial imagery (Fig. 3) and an existing vegetation map (Coates 1992).
23. Core Habit areas shown in Appendix 1 should be protected from fire. *Caladenia graniticola* seems to be most abundant in areas where trees are mature or declining due to old age (where more light is available). Fallen branches are a key component of the habitat of this species as they provide protection from grazing. This species grows best in areas with deep leaf litter.
24. The WOR project, in collaboration with DEC and WANOSCG, has successfully addressed 12 out of 13 of the actions in the IRP (DEC 2007), but some are ongoing (Table 6).
25. This report includes data and management recommendations that should be included in future versions of the IRP.

### **Definitions**

**Critical habitat** is identified as being habitat essential for the survival of a listed threatened species or community. Habitat means the biophysical medium or media: (a) occupied (continuously, periodically or occasionally) by an organism or group of organisms; or (b) 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. (*Environment Protection and Biodiversity Conservation Act 1999*).

**Core Habitat**, as defined in this report, is the most essential area (s) for survival of the species as it contains the highest concentrations of and/or the majority of currently known individuals. This is the area where the species is most vulnerable to threats such as disturbance causing changes to associated vegetation. This area is the highest priority for protective or remedial actions in the case of fire, weed outbreaks, animal grazing etc. Multiple separate areas, if defined, should be ranked in order of importance.



**Table 6.** Recovery actions proposed in the Interim Recovery Plan for *Caladenia graniticola* (Kershaw et al. 2003) with their original priority relative to outcomes of the WOR project.

<b>Recovery Action</b>	<b>Priority</b>	<b>WOR Outcomes</b>	<b>Future Objectives</b>
Coordinate recovery actions	High	Attendance of recovery team meetings to coordination of recovery actions with DEC	Transfer new objectives to IRP
Liaise with relevant land managers	High	Permits and permissions obtained	
Undertake weed control	High	Not identified as major threat for populations 3 - 5	Weed control recommended for populations 1 and 2
Control rabbits	High	Minor impacts only detected at populations 3 - 5	Investigate value of fencing for populations 1 and 2
Monitor populations and establish monitoring plots	High	Monitoring plot established and data collected	Monitoring should continue if possible
Fence sections of population 1	High		Has not yet occurred
Conduct further surveys	High	Major surveys of Dragon Rocks Nature Reserve in 2008	Additional potential habitat areas may require further surveys
Develop and implement a fire management strategy	High	Core Habitat identified and mapped	Create or amend fire plans
Collect and preserve genetic material	High	Seeds and fungi collected	
Assess the need for translocation or restocking and if deemed necessary develop a translocation proposal	High	Background data for proposal is summarised here. Seed baiting trails confirmed soil compatibility for seedlings. Proposal prepared and approved in 2009. Translocations occurred in 2009 and 2010	Further translocations may be advisable following assessment of results
Obtain biological and ecological information	High	Permanent transect established in 2007 and substantial new datasets obtained and evaluated (this report)	Monitoring should continue
Promote awareness	High	Presentations and displays to community groups	Additional articles and website (in development)
Review the need for further recovery actions	Moderate	Major issues that require action have been identified in this report	

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