Wheatbelt Orchid Rescue Project

Final Report 4

Population Size and Vital Statistics Data for the William's Spider Orchid *(Caladenia williamsiae)*

Mark Brundrett

Wheatbelt Orchid Rescue

lotterywest supported

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W.A. Native Orchid Study & Conservation Group

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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. *Link 2*

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. **This Report**

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 Survey 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 William's spider orchid *(Caladenia williamsiae)* was discovered by Judy Williams in 1999 near Brookton. It was described by Hopper and Brown in 2001 and named after Judy Williams. *Caladenia williamsiae* is listed as Declared Rare Flora and ranked as Critically Endangered in Western Australia. This species is also ranked as Endangered under the Commonwealth Environment Protection Biodiversity Conservation Act 1999 (www.environment.gov.au). An Interim Recovery Plan (IRP) has been prepared by DEC (DEC 2007). Threats listed in the IRP include grazing, firebreak maintenance, grazing, small population size and poor recruitment.

The William's spider orchid is endemic to Western Australia and known from a single nature reserve near Brookton approximately 135 km south-east from Perth (DEC 2007). All 5 populations of the William's spider orchid are in close proximity to each other in a nature reserve (Table 1). All populations are located within a few km in the same nature reserve and the total extent of occurrence is estimated to be approximately 4 ha (Table 1). The total population size of the Williams Spider Orchid was estimated to be about 150 mature individuals (Table 1), but this estimate has now been considerably revised, as explained below. Surveys of suitable habitats in other reserves nearby have failed to find additional populations and in some similar habitats in nearby reserves had been severely impacted by gravel extraction for road building.

Table 1. Population size and area estimates for *Caladenia williamsiae* from the Interim Recovery Plan (DEC 2007).

Pop. No.	Land Status	Located	Last survey	No. plants	Habitat area	Current Condition
1	Nature Reserve	1999	2006	14	3 x 3 m	Healthy
2	Nature Reserve	2003	2006	102	100 x 300 m	Healthy
3	Nature Reserve	2003	2006	27	40 x 20 m	Moderate
4	Nature Reserve	2005	2006	7	2 x 2 m	Healthy

Table 2. Properties of sieved soil from *Caladenia williamsiae* habitats.

Site	1	2
pH	4.9	5
pH (CaCl2)	4.18	4.78
Salinity (ds/m)	115.5	82.9
clay %	8.2	5.8
silt %	1.2	0
Sand%	91	95
Classification	Laterite (sand)	Laterite (sand)

Figure 1. Flowers and plants of the William's spider orchid (*Caladenia williamsiae*). **A.** Habit. **B.** Flower showing clubs on 3 sepals. **C.** Close-up of flower showing glandular hairs on club (arrow) and lip with 4 rows of cali. **D.** The leaf and stem are densely covered with long hairs.

2. Orchid and Habitat Characteristics

The William's spider orchid is a small spider orchid with distinctive looking flowers that does not have any close relatives (Hopper and Brown 2001). It is distinguished from other spider orchids by a relatively short and broad leaf, small greenish-yellow flowers, with four rows of labellum calli. The relatively broad and short sepals abruptly narrow into elongated tips with clubs that are densely covered with dark trichomes (Fig. 1). The flowering period for this orchid is from August to

September and most produce a single flower. It is most likely that this species is pollinated by thynnid wasps because of the clubs (osmophores) on sepals, which are considered to be the source of pheromones that attract male wasps (Fig. 1C).

Most individuals of the Williams spider orchid occur in dense heathland over laterite, but some are associated with woodland nearby (Fig. 2). The associated vegetation is dominated by member of the Proteaceae, especially dryandras and includes species of *Banksia, Jacksonia, Calothamnus*, etc. Soil is laterite with a high gravel content, with finer components that consists mostly of sand with 5-10% clay content (Table 2).

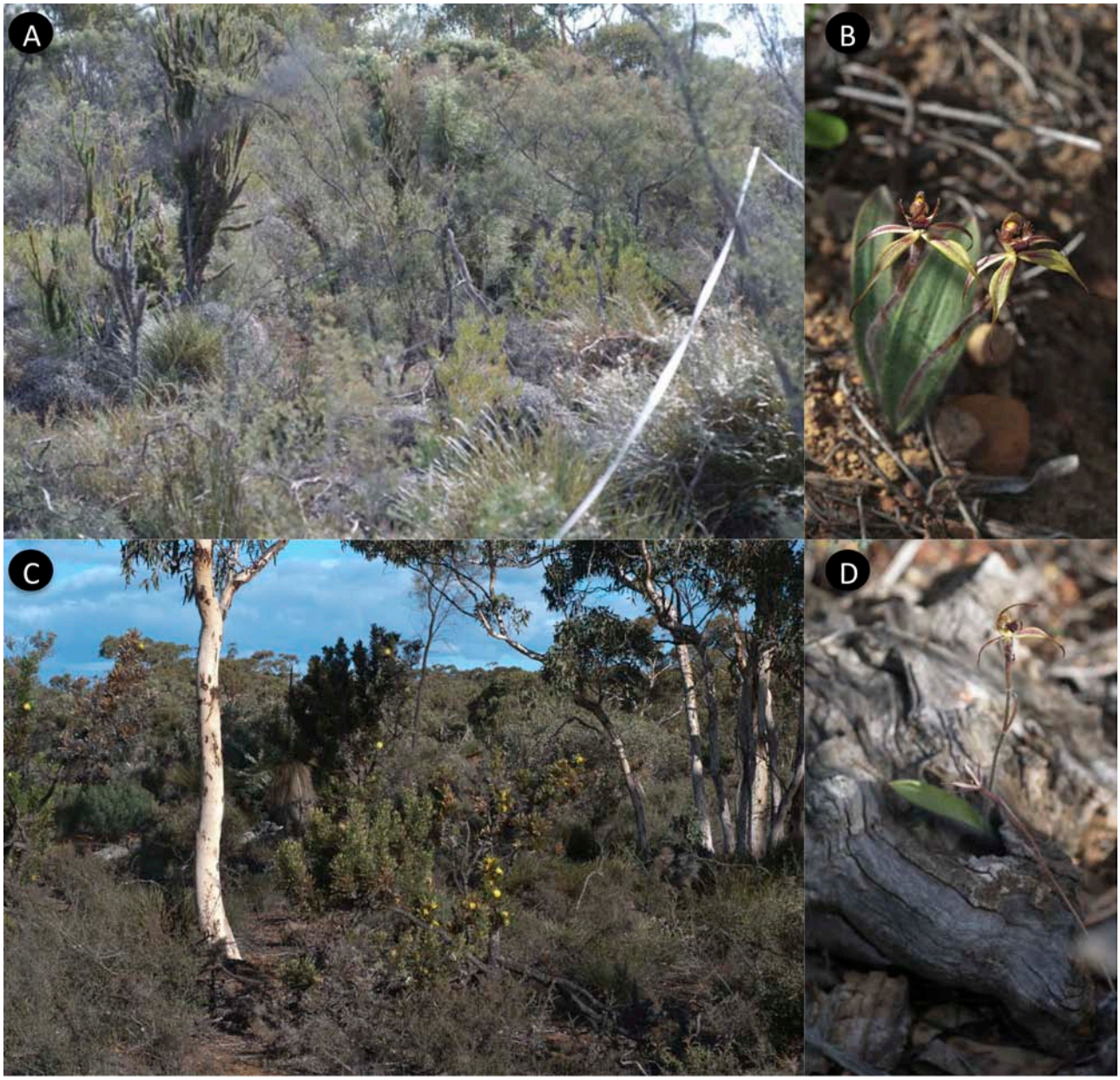

Figure 2A-C. Typical lateritic heathland habitat where the largest population of *Caladenia williamsiae* occurs in a nature reserve near Brookton. **D.** A small population consisting of a few plants in atypical habitat in wandoo woodland.

3. Population Surveys

There was a comprehensive survey of the William's spider orchid in 2010 by the author, Kris Brooks (DEC Flora Conservation Officer) and Judy Williams from Brookton. This survey resulted in updated counts of individuals and location data that can be used to map habitat areas to allow more effective management and monitoring of these rare orchids in the future (Appendix 1). This survey revealed considerably more plants, especially within Population 2, but these were concentrated in a very narrow area, as shown in Figure 3. In 2008 Judy Williams and MB surveyed Population 3 and a new population (5). Plants in Population 1 occurred in atypical habitat within woodland and have not been surveyed recently. This orchid flowered well despite severe late winter and spring drought in 2010.

Figure 3. The distribution of plants in the largest population (2) which occur within a narrow 400 x 50 m zone of lateritic heathland vegetation near the edge of a breakaway. The relative position of the 50 m transect (red line) is also shown.

Table 2. Revised Population size and area estimates for *Caladenia williamsiae* from the 2010 survey (Data by Kris Brooks, Judy Williams and MB).

Pop. No.	Land Status	Located	Last survey	No. plants	Habitat area	Current Condition
1	Nature Reserve	1999			3 x 3 m	Healthy
2	Nature Reserve	2003	2010	426	50 x 400 m	Healthy
3	Nature Reserve	2003	2008	8	40 x 20 m	Moderate
4	Nature Reserve	2005	2010	2	2 x 2 m	Healthy
5	Nature Reserve	2008	2008	8	2 x 5 m	Healthy

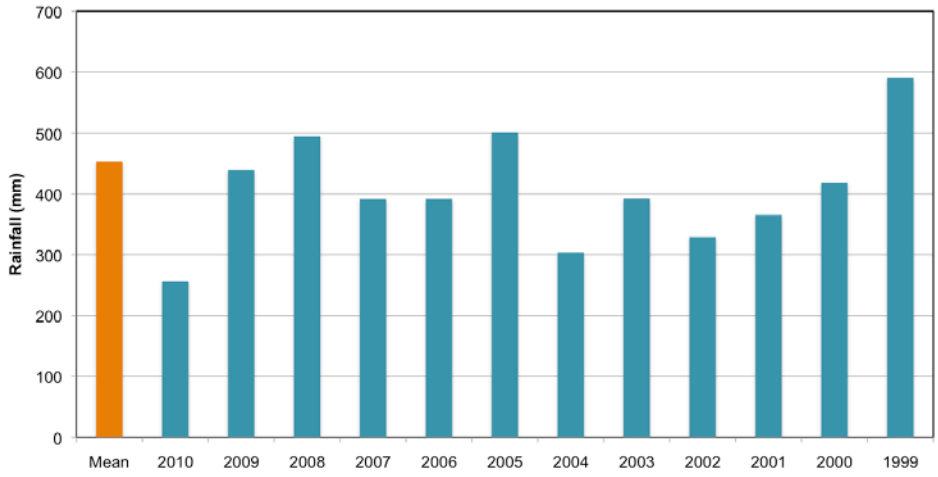

Figure 4A. Rainfall at Brookton the closest station to locations where *Caladenia williamsiae* occurs (Bureau of Meteorology, www.bom.gov.au).

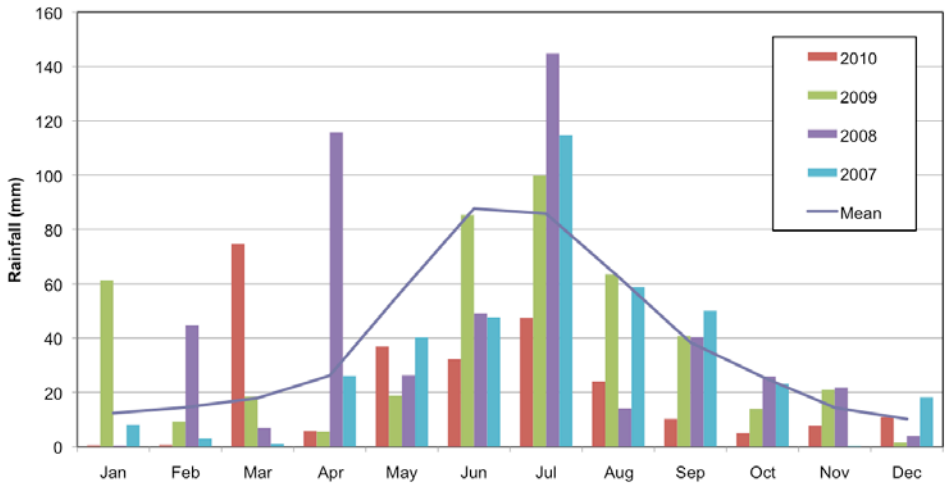

Figure 4B. Annual variations in monthly rainfall patterns over the past 4 years (Bureau of Meteorology, www.bom.gov.au).

Figure 5. A (left). *Caladenia williamsiae* produces up to 2 flowers per leaf, but most are single. **B.** (right) The transect passes through very dense low shrubland over massive laterite which is typical habitat for this species.

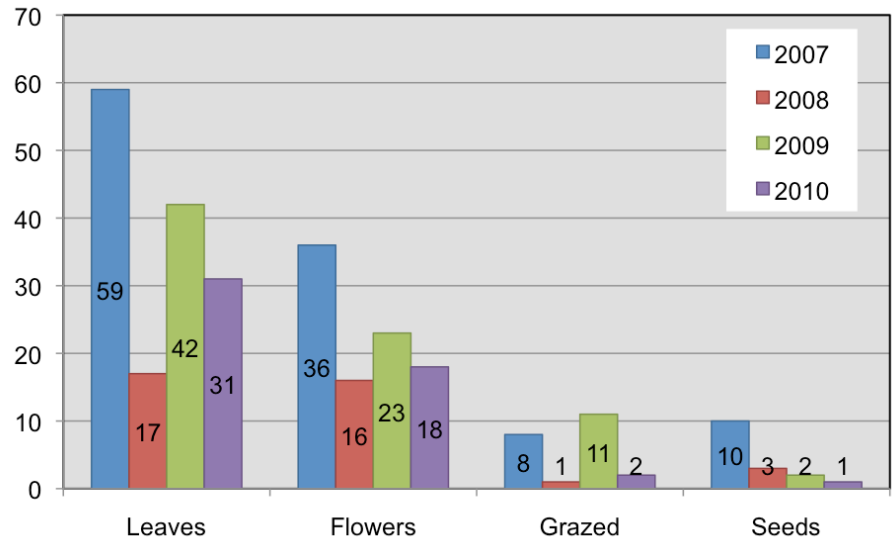

Figure 6. Seasonal variation in emergent plants, flowering, grazing and seed set for plants along a 50 x 4 m transect. This transect is located in the heart of population 2.

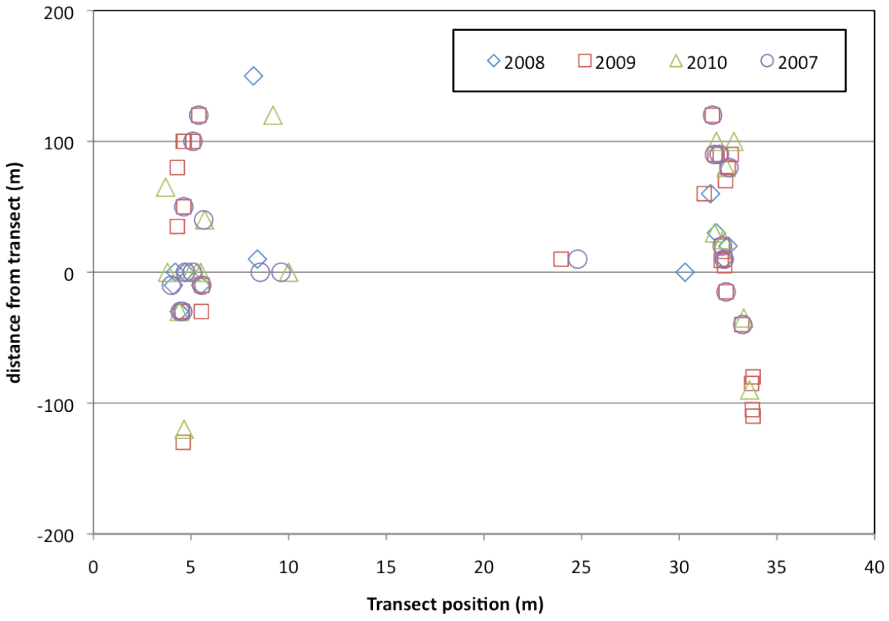

Figure 7. The relative position of leaves and flowers in clumps of *C. willliamsiae* on a transect over 4 years. The distribution of these orchids was aggregated into zones where competition for resources may occur. Note that the vertical scale is much finer than the x-axis scale.

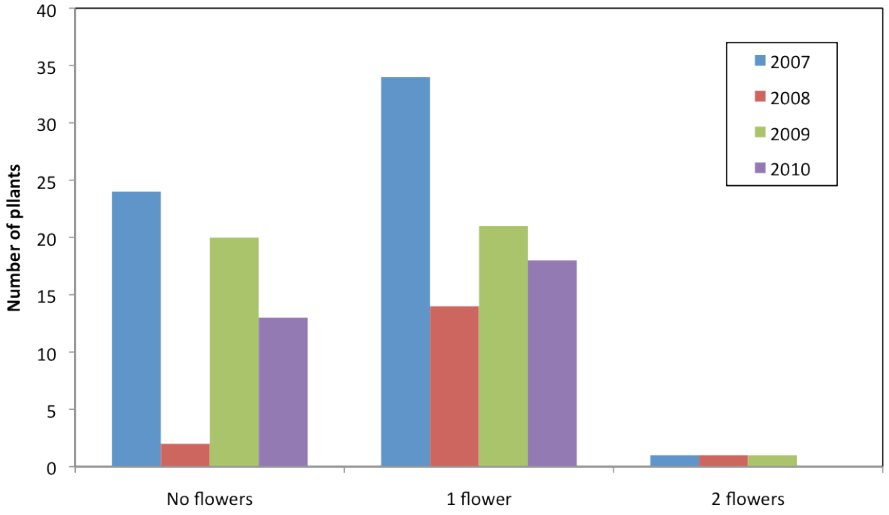

Figure 8. The number of flowers per emerging leaf for *C. williamsiae* over 4 years.

4. Vital Statistics Data

Most leaves of William's spider orchid are solitary, so reproduction is probably only by seed. Monitoring plants on a 50 x 4 m transect showed that 2007 and 2009 had higher rates of emergence for *Caladenia williamsiae* than 2008 (Fig. 6). Different plants emerged each year and some plants that were dormant in 2007 appeared and flowered in 2008, despite lower rainfall (Fig. 7). There is no evidence that the population within the transect area is increasing in number. Seed production along the transect was very low in all years but 2007 and grazing impacts were substantial in 2007 and 2009 (Fig. 6).

As shown in Figure 8, flowering varied from 60-90% of plants and most of these produced a single flower (5% had 2). Relatively few plants set seed except in 2007 where 28% had capsules. Overall, rates of seed set rates are probably adequate, but the volume of seed in capsules is low compared to most other *Caladenia* species. Seed set was very low for the whole population in 2010, presumably due to severe spring drought.

Plants suffer from substantial grazing impacts, especially of the flowers, but this did not occur every year. Grazing varied from 6% of plants in 2008 and 2010 to 22-26 % in 2007 and 2009. It was observed that grazed plants are often relatively exposed while those protected under the canopy of shrubs were less likely to be grazed. There is visibly evidence of high kangaroo population levels at the site (tracks, scats and sleeping areas).

5. Population Size, Dynamics and Viability

The number of plants of William's spider orchid that emerge and flower varies considerably from year to year, presumably due to seasonal variations in rainfall. Transect data over 4 years revealed that the same plants did not emerge each year with the majority only appearing once in 4 years. Only 32% of the plants emerged more than once at the same position (Fig. 9A). Only 29% of plants flowered more than once and 16 % did not flower at all in 4 years (Fig. 9B).

It was relatively difficult to measure positions accurately along the *C. williamsiae* transect due to dense shrub cover that caused some vertical deflections in the measuring tape. Consequently plants emerging within 20 cm of the same position were considered to be the same individual. Despite these potential errors, which may have resulted in a few plants being miss-assigned, the overall population size estimate in Table 2 is more likely to be an underestimate than an over estimate. This results because more than 4 years of data may be required to locate all dormant plants and multiple dormant tubers could be co-located. The William's spider orchid occurs in a relatively dry and exposed habitat but plant emergence and flowering was not well correlated with winter rainfall (Fig. 10).

A preliminary estimate of the number of individuals within the transect was 108, of which 34% emerged and 22% flowered on average each year (Table 3). The emergence rate data from the transect can be used in combination with survey data to provide a revised estimate for orchid populations size. Since approx. 30 % of plants emerged in 2010, it would suggest there are about 1400 plants in total in all populations of the William's spider orchid.

In the past, land clearing and gravel extraction would have been the main threats to the survival of the William's spider orchid. Currently, fire is a potential threat to the known populations since the species response to fire is unknown (DEC 2007). The populations may also need to be protected from unauthorised visitors / collectors due to the small area of habitat occupied.

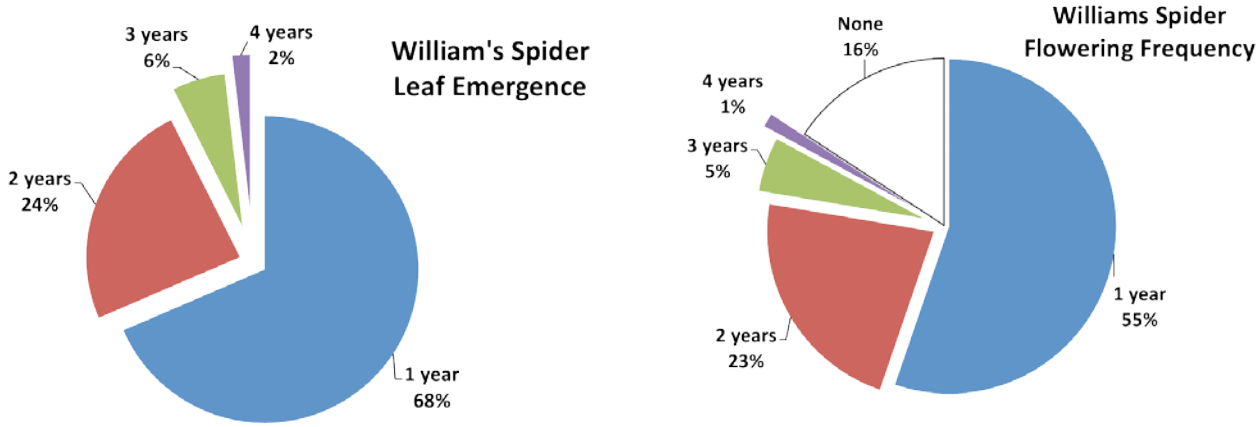

Figure 9AB. The proportion of *Caladenia williamsiae* plants that emerge (left) and the number of emergent plants that flower (right) on one or more years over a 4 year period, as determined by their position in a 50 x 4 m area.

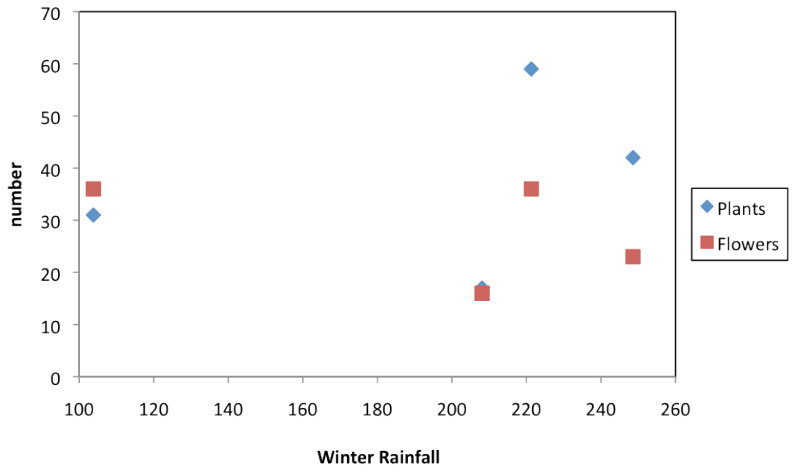

Figure 10. There does not seem to be a substantial relationship between rainfall and emergent plant numbers for *C. williamsiae* in population 2 over the past 4 years. Plant numbers are from the transect and rainfall data are from the Bureau of Meteorology, www.bom.gov.au.

Table 3. Assessment of population viability for *Caladenia williamsiae* from a 50 x 4 m 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	Flower %	Seed set %	Grazed %
2007	59	61	28	22
2008	17	94	19	6
2009	42	54	9	26
2010	31	58	6	6
Average	*37*	*67.0*	*15.2*	*13.0*
Estimated transect total	108			
Average annual % of total	**34.3**	**21.6**	**3.7**	**5.1**

6. Conclusions

1. Data collected using permanent transects allowed flowering, seed-set and survival rates to be determined for the same plants each year (Tables 2-3). Four years of data shows that grazing and infrequent seed production are significant threats to the William's spider orchid.
2. The majority of plants remain dormant each year so long-term monitoring of a fixed area over a number of years was required to provide an estimate of population size.
3. The numbers of plants emerging or flowering varied considerably from year to year and was not strongly linked to rainfall. The fact that many plants remain dormant each year limits reproductive potential and may be due to the relatively exposed habitat of this orchid, which grows on upland ridges within very well drained lateritic gravel.
4. The use of small permanent tags that identify individual plants should be investigated, as this may benefit future monitoring efforts.
5. 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. 30 % of plants on the transect emerged in 2010, it would suggest there are about 1400 plants in total in all populations, of which about 450 emerged in 2010.
6. Additional research is required to develop an understanding of habitat specificity and to explain why the majority of apparently suitable habitat in the nature reserve is unoccupied.
7. Seed baiting trials confirmed that seed collected was viable and one soil sample had compatible fungi so may be suitable for translocation of this endangered orchid species. However, the majority of soil samples did not induce germination, so fungal inoculum compatible with *C. williamsiae* seems to be very patchy and at low levels compared to all of the other orchids included in these trials (see WOR Report 7).
8. The role of mycorrhizal fungi in determining habitat preferences should be investigated further. 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).
9. The impact of grazing on emergence, flowering, seed production and recruitment should be investigated using one or more small fenced areas in population 1 and perhaps elsewhere.
10. The IRP lists firebreak maintenance, grazing, fire and small population sizes as significant threats to existing populations of this orchid and the WOR project also identified low seed set as a significant threat. Of these threats the most serious is likely to be its small population size coupled with a small area of occupation and a low capacity for reproduction.
11. The majority of individuals of *C. williamsiae* occurred in one population within a narrow band of low shrubland about 2 ha in size and plants are often grouped together in small patches within this area. This orchid may already occupy most patches of suitable habitat in its Critical Habitat area.
12. The concentrated distribution of plants also suggests that competition for resources in patches where plants grow together may be a major factor limiting the size of populations. Intense competition for resources such as nutrients provided by mycorrhizal fungi or pollinator visitations is likely to occur in these patches. Such competition may be less severe in non-productive years when more plants remain dormant.
13. The low number of *C. williamsiae* plants known to exist and the very small areas of Core Habitat in a single nature reserve provide ample evidence that this species should be ranked as Critically Endangered under commonwealth legislation (it already is in WA).
14. As recommended in the IRP (DEC 2007), a translocation plan for *Caladenia williamsiae* 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 currently unoccupied habitat that appear suitable, perhaps due to low rates of pollination and seed set. The propagation and

translocation outcomes from the WOR project are presented in separate reports (WOR Reports 7 and 8).

15. Suitable areas for translocation outside of the single nature reserve where this orchid occurs should be identified as translocation sites. Further translocation trials and full translocation should be conducted.
16. This report identifies Core Habitat and Critical Habitat areas, as defined below, for this species that should be included in fire management plan and other relevant management plans.
17. *In particular, population 2 is the most important Core Habitat area for Caladenia williamsiae as it contains about 95 % of all known plants of this species within a very small area (2 ha).*
18. All of the remaining Core Habitat areas are relatively small and of lesser significance to survival of the species.
19. Critical Habitat areas for *Caladenia williamsiae* can be defined as all areas of lateritic heathland vegetation and buffer areas within 500 m within the reserve where it occurs. This would encompass a large part of the reserve and some adjacent private land.
20. Core Habit areas, as identified in Appendix 1, should be protected from fire as the fire response of the species and its habitat are unknown.
21. A revised table with more accurate population locations has been provided for the IRP (Appendix 1).
22. The WOR project, in collaboration with DEC and community groups, has successfully addressed all 11 of the actions recommended in the IRP (DEC 2007), but a recovery action should be added to the IRP and others are recommended to continue in Table 4.
23. This report includes data and management recommendations that should be included in future revisions 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 4. Recovery actions proposed in the Interim Recovery Plan for *Caladenia williamsiae* (DEC 2007) with relevant and planned outcomes of the WOR project.

Recovery Actions	Priority	WOR Outcomes	Future Objectives
Coordinate recovery actions	High	Attendance of recovery team meetings	
Propose ranking criteria change	High	Relevant data provided in this report	Meets criteria for Critically Endangered
Monitor populations	High	Monitoring with DEC and Judy Williams	Monitoring should continue
Conduct further surveys	High	Extended areas within reserve surveyed in 2010	Some suitable areas remain as future survey targets
Collect seed and other material to preserve genetic diversity	High	Seeds and fungi collected and viability tested	Propagate more plants for future translocation
Obtain biological and ecological information	High	Permanent transect established in 2007 and substantial new datasets obtained and evaluated (this report)	Monitoring of transect should continue
Promote awareness	High	Displays and presentations to community groups	Additional articles and website (in development)
Develop and implement a fire management strategy	High	Core Habitat areas identified in this report	Create or amend fire plans
*Grazing control trial by fencing sections of population 2**	*High*	*Threat identified*	*The value of a small enclosure should be tested*
Prepare a translocation proposal	High	Background data for proposal is summarised here. Seed baiting trails show limited soil compatibility for seedlings. Proposal prepared, approved and implemented in 2009 and 1010	Further translocations are advisable following assessment of results. Establishment of a new population outside the original reserve is highly desirable.
Map habitat critical to the survival of *Caladenia williamsiae*	Moderate	Core Habitat areas identified with DEC	Revise areas after future surveys if required
Review the Plan and the need for further recovery actions	High	Major issues that require action are identified in this report	

*New objectives for the IRP.

7. Acknowledgements

The Wheatbelt Orchid Rescue Project was funded primarily by Lotterywest. Judy Williams, Kris Brooks (DEC) conducted the 2010 surveys with MB. Judy Williams, Andrew Brown (DEC) and Mayne Merritt were major contributors to earlier surveys and provided considerably expertise about populations of this orchid. The WOR project would especially like to acknowledge the assistance of Judy Williams for field trip assistance and knowledge of habitats. Phylis Robertson, Nur Koshkuson and Emily Ager also assisted with fieldwork.

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