



Vascular flora of Credo Station and adjacent reserves.

A Report to the Bush Blitz Program, Australian Biological Resources Study

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February 2012

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Contents

List of contributors	2
Abstract	3
1. Introduction	3
2. Methods	5
2.1 Site selection	5
2.2 Collection methods	5
2.3 Identifying the collections	5
3. Results and Discussion	5
3.1 Overview of collecting	5
3.2 Named taxa newly recorded for the reserve	9
3.3 Un-named taxa	12
3.4 New species to be described	13
3.5 Weed species	13
3.6 Vulnerable, threatened or endangered species	14
4. General comment on species lists	14
5. Conclusions	15
Acknowledgements	15
References	16
Appendix 1. List of vascular flora occurring on Credo Station	18

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Cover photo: Regenerating Salmon gum woodlands following clear felling for fuel and mine timbers ca. 100 years ago. View from Coolgardie North Road toward Turkey Flat Dam.

Abstract

The two week Bush Blitz survey of Credo and adjacent conservation reserves more than doubled the known vascular flora from 158 taxa (including 10 introduced species) to 427 taxa which includes 11 new weed records. No threatened taxa were encountered and only five taxa listed on WA Department of Environment and Conservation Priority Flora were found. Major range extensions were recorded for three taxa, one of which was an unusual *Goodenia* that possessed an aquatic stage and requires further study. A large number of taxa reach their range limits on Credo consistent with the major biogeographic boundary in the northern section of the station where the eucalypt woodlands are replaced by the more arid *Acacia* shrublands. Credo also contains some extensive undisturbed salmon gum woodlands which are regionally rare following extensive clearing of these woodlands to provide timber to the mining centres of Coolgardie and Kalgoorlie in the 19th century.

1. Introduction

Credo Station covers an area of some 202,000 ha approximately 70 km NW of Coolgardie (Figure 1). It is currently Unallocated Crown Land (UCL) proposed for conservation and is managed by the Western Australian Department of Environment and Conservation (DEC). It has been incorporated into the National Reserves System and prior to 2007 was run as a pastoral station.

Within the boundary of Credo are Clear and Muddy Lakes Nature Reserve (R7634 – 1926 ha), Rowles Lagoon Conservation Park (R4274 – 405 ha) and several areas of UCL, and some small miscellaneous reserves (Figure 1). The two conservation reserves are important habitat for waterbirds and most of their catchment is covered by Credo Station. For the purpose of this report reference to Credo Station is taken to include these two conservation reserves and other miscellaneous reserves and UCL within the boundary of Credo Station (Figure 1).

Credo is roughly rectangular 90 km long and 25 km wide. The vegetation is a mosaic of acacia and eucalypt woodlands, chenopod shrublands, granite outcrop and sandplain. A major biogeographic boundary runs though the northern part of the station where the temperate eucalypt woodlands give way to more arid *Acacia* shrubland. These eucalypt woodlands are part of the Great Western Woodlands (GWW) which represents the largest intact area of temperate woodland left on the planet (Prober et al., 2011). Most of Credo lies within the GWW (Figure 1). These woodlands were heavily cutover in the 19th century to supply wood for fuel and mine supports for the mining centres of Kalgoorlie and Coolgardie. Both cutover and undisturbed eucalypt woodlands occur on Credo.

Previous botanical collecting on Credo Station has been limited, with collections of only 159 taxa being lodged in the Western Australian Herbarium (PERTH). Of these 137 taxa were collected by D.J. Endinger between 8th – 17th June 2008.

The current survey was run over two weeks in early September 2011 and was assisted in the first week by five EarthWatch volunteers from BHP Billiton and EarthWatch staff.

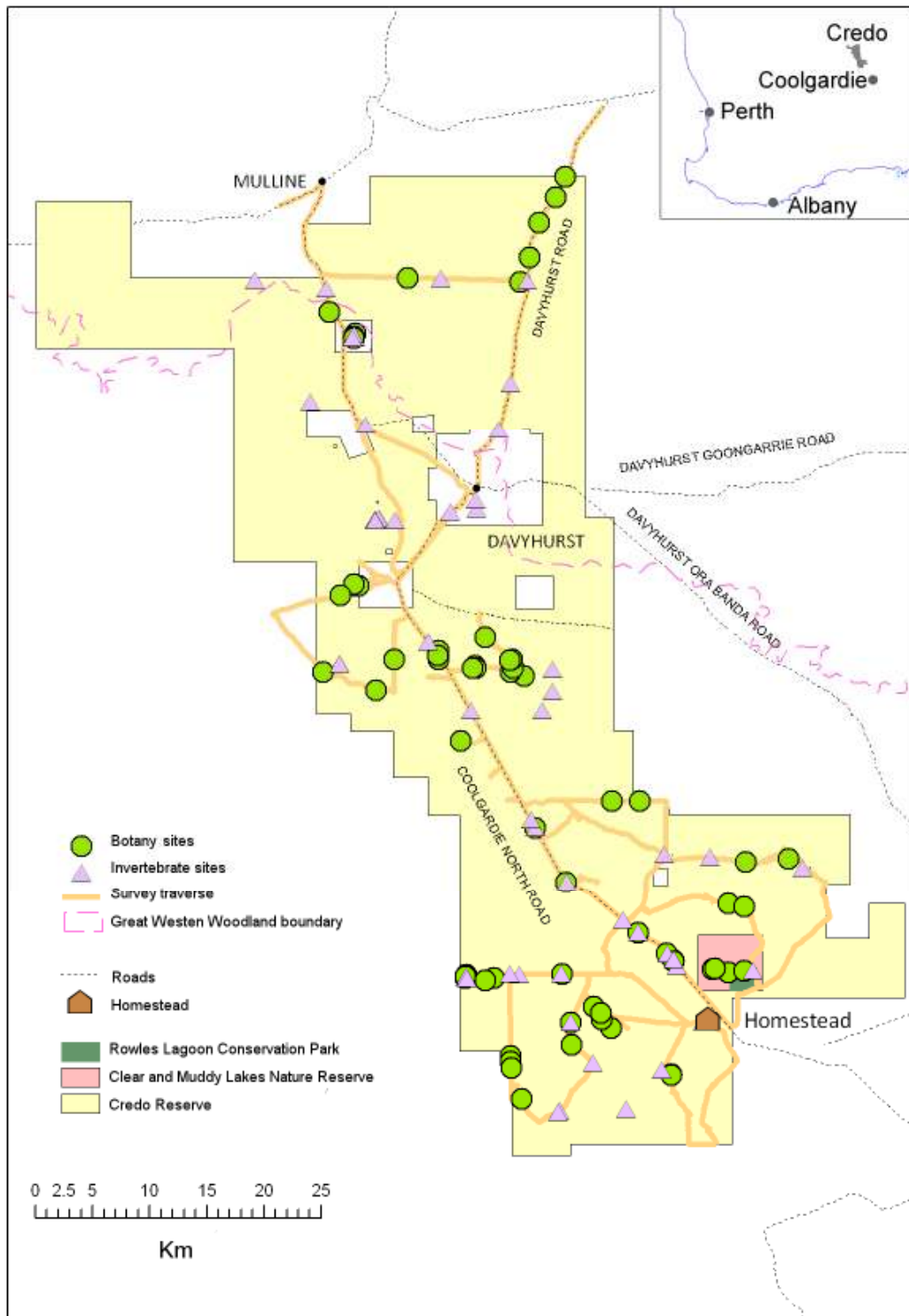


Figure 1. Map showing the three conservation reserves, the location of the plant collection sites of the botany and invertebrate survey teams and the route traversed by the botany team over the course of the survey.

2. Methods

2.1 Site selection

Two survey teams collected vascular plants. The botany team stratified their sampling by geology, geomorphology, and topography across the station as far as practicable in the time available; in order to sample all major habitat types (Figures 2–4). As the survey was based at the homestead near the southern boundary, the northern area was not as well sampled as those areas closer to the homestead. Herbarium quality collections were made of the vascular flora with most effort directed to taxa not previously encountered in the survey.

The invertebrate team collected herbarium quality collections to act as vouchers of the host plants of the invertebrate groups being collected. Insect collection numbers appear on the plant voucher label in the notes field.

2.2 Collection methods

The survey was undertaken in spring 2011 from the 29th August to 9th September. Collecting followed standard methods with flowering and fruiting material being allocated collection numbers and pressed after each days collecting. Where sufficient material was available efforts were made to collect duplicate material. At the completion of the survey the plant presses were dried and frozen before processing. Minor loss of some *Senna* material occurred due to insect damage. Future trips planned to collect this group should consider the use of field driers.

Nomenclature follows current usage at PERTH (Western Australian Herbarium 1998–).

2.3 Identifying the collections

Collections were identified using a diverse range of taxonomic literature given the breadth of families collected during the survey. Identifications generally required the use of binocular microscopes and identifications were confirmed where necessary using the reference and main collections in PERTH. The main collections was only available for a limited time due to the move of the collection to a new herbarium building.

The core resources used for identifications were the Flora of Australia series and the electronic keys to the grasses (Sharp & Simon 2002), acacias (Maslin 2001), eucalypts (Slee et al. 2006), the peas (de Kok & Boffin 2007), Proteaceae (Hollis & Thiele 2011) and Goodeniaceae (Hollis 2011).

3. Results and Discussion

3.1 Overview of collecting

Some 650 collections representing 348 taxa were made during the survey. The botany team made 547 collections while the invertebrate team made 103 collections. Of the 348 taxa encountered in the survey, 269 had not been previously recorded for Credo. The current flora of Credo is now 427 taxa. Individual taxa were represented by between 1 and 8 collections.



Figure 2. Some of the major habitat types covered in the survey. a) Salmon gum woodland (undisturbed), b) Banded Iron Formation ridges, c) Granite inselbergs, d) ephemeral wetlands associated with granites, e) Mulga woodlands, f) Chenopod shrublands with a vertebrate trapping line in the foreground.



Figure 3. a) View across eucalypt woodlands which is one of the dominant vegetation types encountered on Credo, b) *Drosera moorei* and c) *Calandrinia granulifera* – both found in herblands on granite outwash areas, d) *Gunniopsis saxicola* and e) *Eucalyptus oleosa* (tree mallee) both found on lateritic ridges.



Figure 4. a) *Wurmbea murchisoniana* dominated the vegetation of an ephemeral wetland at Ularring Rock, b) *Grevillea georgeana* common on Banded Iron Formation ridges, c) *Balaustion pulcherrimum* common on the extensive yellow sandplains.

3.2 Named taxa newly recorded for the reserve

Asteraceae (54 taxa), Fabaceae (25), Myrtaceae (21) and Poaceae (17) contributed most of the taxa not previously recorded. The very high number of Asteraceae added to the list were largely annuals and reflected the limited previous spring collecting that had been undertaken on Credo. Similarly the excellent spring season of 2011 allowed many more shrubs and trees in the Fabaceae and Myrtaceae to be identified as well as a considerable number of grasses. The survey more than doubled the known weed flora for the reserve (11 new records, Table 1).

Table 1. Taxa newly recorded from Credo.

Family	Name	Naturalised
Aizoaceae	<i>Cleretum papulosum</i> subsp. <i>papulosum</i>	*
Amaranthaceae	<i>Ptilotus carlsonii</i>	
	<i>Ptilotus chamaecladus</i>	
	<i>Ptilotus exaltatus</i>	
	<i>Ptilotus holosericeus</i>	
Apiaceae	<i>Daucus glochidiatus</i>	
Araliaceae	<i>Trachymene cyanopetala</i>	
	<i>Trachymene ornata</i>	
Asparagaceae	<i>Arthropodium curvipes</i>	
	<i>Thysanotus manglesianus</i>	
	<i>Thysanotus speckii</i>	
Asteraceae	<i>Actinobole uliginosum</i>	
	<i>Angianthus tomentosus</i>	
	<i>Asteridea athrixoides</i>	
	<i>Brachyscome ciliaris</i>	
	<i>Brachyscome iberidifolia</i>	
	<i>Brachyscome perpusilla</i>	
	<i>Calocephalus francisii</i>	
	<i>Calotis hispidula</i>	
	<i>Cephalipterum drummondii</i>	
	<i>Ceratogyne obionoides</i>	
	<i>Chthonocephalus pseudevax</i>	
	<i>Gilberta tenuifolia</i>	
	<i>Gnephosis brevifolia</i>	
	<i>Gnephosis intonsa</i>	
	<i>Gnephosis tenuissima</i>	
	<i>Hyalosperma demissum</i>	
	<i>Hyalosperma glutinosum</i>	
	<i>Hypochaeris glabra</i>	*
	<i>Isoetopsis graminifolia</i>	
	<i>Lawrencella davenportii</i>	
	<i>Lawrencella rosea</i>	
	<i>Leiocarpa semicalva</i>	
	<i>Lemooria burkittii</i>	
	<i>Millotia myosotidifolia</i>	
	<i>Millotia tenuifolia</i>	
	<i>Myriocephalus guerinae</i>	
	<i>Myriocephalus pygmaeus</i>	
	<i>Olearia humilis</i>	
	<i>Olearia muelleri</i>	
	<i>Olearia muricata</i>	
	<i>Olearia pimeleoides</i>	
	<i>Podolepis lessonii</i>	
	<i>Podolepis rugata</i>	
	<i>Rhodanthe battii</i>	
	<i>Rhodanthe charsleyae</i>	
	<i>Rhodanthe floribunda</i>	
	<i>Rhodanthe haigii</i>	
	<i>Rhodanthe laevis</i>	
	<i>Rhodanthe maryonii</i>	
	<i>Rhodanthe oppositifolia</i>	
	<i>Rhodanthe pollackii</i>	
	<i>Rhodanthe stricta</i>	
	<i>Schoenia cassiniana</i>	
	<i>Senecio glossanthus</i>	
	<i>Senecio lacustrinus</i>	
	<i>Senecio quadridentatus</i>	
	<i>Siloxerus multiflorus</i>	
	<i>Sonchus oleraceus</i>	*

	Streptoglossa cylindriceps	
	Trichanthodium skirrophorum	
	Triptilodiscus pygmaeus	
	Vittadinia dissecta var. hirta	
	Vittadinia eremaea	
	Waitzia acuminata	
Boraginaceae	Halgania integerrima	
Brassicaceae	Arabidella chrysodema	
	Lepidium fasciculatum	
	Menkea australis	
	Sisymbrium irio	*
	Stenopetalum filifolium	
Campanulaceae	Isotoma petraea	
	Lobelia rarifolia	
	Wahlenbergia gracilentia	
	Wahlenbergia tumidifruca	
Caryophyllaceae	Stellaria filiformis	
Casuarinaceae	Allocasuarina acutivalvis	
	Allocasuarina campestris	
	Allocasuarina corniculata	
	Allocasuarina eriochlamys subsp. eriochlamys	
	Casuarina pauper	
Celastraceae	Stackhousia muricata	
	Stackhousia sp. Mt Keith (G. Cockerton & G. O'Keefe 11017)	
Centrolepidaceae	Centrolepis strigosa	
Chenopodiaceae	Atriplex codonocarpa	
	Atriplex lindleyi subsp. inflata	
	Dissocarpus paradoxus	
	Maireana carnosia	
	Maireana georgei	
	Maireana pyramidata	
	Maireana trichoptera	
	Rhagodia preissii	
	Sclerolaena fusiformis	
	Tecticornia disarticulata	
Convolvulaceae	Cuscuta planiflora	*
Crassulaceae	Crassula colorata var. acuminata	
	Crassula tetramera	
Cupressaceae	Callitris canescens	
	Callitris columellaris	
Cyperaceae	Chrysitrix distigmatosa	
	Isolepis congrua	
	Lepidosperma sp. (NG & MAL 4907)	
	Schoenus nanus	
Dilleniaceae	Hibbertia exasperata complex (NG & MAL 4966)	
	Hibbertia exasperata complex (NG & MAL 5206)	
Droseraceae	Drosera macrantha subsp. macrantha	
	Drosera moorei	
Euphorbiaceae	Beyeria sulcata var. sulcata	
	Monotaxis luteiflora	
Fabaceae	Acacia aneura	
	Acacia hemiteles	
	Acacia longispinea	
	Acacia prainii	
	Acacia quadrimarginea	
	Acacia ramulosa var. linophylla	
	Acacia resinimarginea	
	Acacia steedmanii subsp. steedmanii	
	Acacia tetragonophylla	
	Acacia uncinella	
	Bossiaea walkeri	
	Daviesia benthamii subsp. acanthoclona	
	Dillwynia sp. Coolgardie (V.E. Sands 637.3. 1)	
	Jacksonia nematoclada	
	Leptosema aculeatum	
	Mirbelia ramulosa	
	Mirbelia seorsifolia	
	Mirbelia trichocalyx	
	Petalostylis cassioides	
	Senna cardiosperma	
	Senna pleurocarpa var. pleurocarpa	
	Swainsona affinis	
	Swainsona beasleyana	
	Swainsona kingii	
	Trigonella suavissima	

Bush Blitz – Credo Reserve, August – September 2011

Geraniaceae	<i>Erodium aureum</i>	*
	<i>Erodium cicutarium</i>	*
	<i>Erodium cygnorum</i>	
Goodeniaceae	<i>Brunonia australis</i>	
	<i>Dampiera stenostachya</i>	
	<i>Dampiera tenuicaulis</i> var. <i>tenuicaulis</i>	
	<i>Goodenia ?berringbinensis</i>	
	<i>Goodenia mimuloides</i>	
	<i>Goodenia mueckeana</i>	
	<i>Goodenia occidentalis</i>	
	<i>Velleia rosea</i>	
Haloragaceae	<i>Glischrocaryon aureum</i>	
	<i>Haloragis gossei</i> / <i>trigonocarpa</i>	
	<i>Haloragis ?maierae</i>	
Hemerocallidaceae	<i>Dianella revoluta</i> var. <i>divaricata</i>	
Isoetaceae	<i>Isoetes muelleri</i>	
Juncaceae	<i>Juncus aridicola</i>	
Juncaginaceae	<i>Triglochin ?singiana</i>	
Lamiaceae	<i>Lachnostachys coolgardiensis</i>	
	<i>Physopsis viscida</i>	
	<i>Pityrodia lepidota</i>	
	<i>Prostanthera grylloana</i>	
Lauraceae	<i>Cassytha melantha</i>	
Loganiaceae	<i>Phyllangium sulcatum</i>	
Malvaceae	<i>Keraudrenia cacaobrunnea</i>	
	<i>Lawrencia repens</i>	
	<i>Rulingia luteiflora</i>	
	<i>Sida calyxhymania</i>	
	<i>Sida phaeotricha</i>	
	<i>Sida</i> sp. dark green fruits (S. van Leeuwen 2260)	
	<i>Sida</i> sp. <i>Excedentifolia</i> (J.L. Egan 1925)	
Marsileaceae	<i>Marsilea</i> sp. (NG & MAL 5080)	
Myrtaceae	<i>Aluta aspera</i> subsp. <i>aspera</i>	
	<i>Balaustion pulcherrimum</i>	
	<i>Calothamnus gilesii</i>	
	<i>Calytrix depressa</i>	
	<i>Chamelaucium ciliatum</i>	
	<i>Eucalyptus clelandii</i>	
	<i>Eucalyptus ewartiana</i>	
	<i>Eucalyptus griffithsii</i>	
	<i>Eucalyptus horistes</i>	
	<i>Eucalyptus moderata</i>	
	<i>Eucalyptus oleosa</i>	
	<i>Eucalyptus ravidia</i>	
	<i>Eucalyptus rigidula</i>	
	<i>Eucalyptus sheathiana</i>	
	<i>Eucalyptus transcontinentalis</i>	
	<i>Eucalyptus yilgarnensis</i>	
	<i>Euryomyrtus maidenii</i>	
	<i>Homalocalyx thryptomenoides</i>	
	<i>Kunzea pulchella</i>	
	<i>Melaleuca leiocarpa</i>	
	<i>Micromyrtus monotaxis</i>	
Ophioglossaceae	<i>Ophioglossum lusitanicum</i>	
Orchidaceae	<i>Prasophyllum gracile</i>	
Orobanchaceae	<i>Parentucellia latifolia</i>	*
Phrymaceae	<i>Glossostigma drummondii</i>	
Plantaginaceae	<i>Plantago debilis</i>	
	<i>Plantago turrifera</i>	
Poaceae	<i>Austrodanthonia caespitosa</i>	
	<i>Austrostipa elegantissima</i>	
	<i>Austrostipa eremophila</i>	
	<i>Austrostipa nitida</i>	
	<i>Austrostipa scabra</i>	
	<i>Enneapogon caerulescens</i>	
	<i>Eragrostis ?xerophila</i>	
	<i>Eriachne flaccida</i>	
	<i>Monachather paradoxus</i>	
	<i>Paspalidium ?clementii</i>	
	<i>Pentaschistis airoides</i>	*
	<i>Rostraria pumila</i>	*
	<i>Schismus barbatus</i>	*
	<i>Themeda triandra</i>	
	<i>Triodia rigidissima</i>	
	<i>Triodia scariosa</i>	

Polygalaceae	Triodia tomentosa Comesperma spinosum Muehlenbeckia florulenta Polygonum plebeium
Portulacaceae	Calandrinia calyprata Calandrinia eremaea Calandrinia granulifera Calandrinia porifera Calandrinia sp. Bullardoo (F. Obbens & F. Hort FO 57/04)
Proteaceae	Banksia elderiana Conospermum stoechadis subsp. stoechadis Grevillea didymobotrya subsp. didymobotrya Grevillea excelsior Grevillea georgeana Grevillea hookeriana Grevillea juncifolia Grevillea paradoxa Grevillea teretifolia Hakea minyma Hakea preissii Persoonia coriacea Persoonia ?helix
Pteridaceae	Cheilanthes lasiophylla Cheilanthes sieberi subsp. sieberi
Restionaceae	Lepidobolus preissianus subsp. volubilis
Rhamnaceae	Stenanthemum stipulosum
Rubiaceae	Synaptantha tillaeacea var. tillaeacea
Rutaceae	Boronia ternata var. ternata Phebalium filifolium Phebalium tuberculosum x megaphyllum Philotheca brucei subsp. brucei Philotheca tomentella
Santalaceae	Santalum acuminatum
Sapindaceae	Dodonaea amblyophylla Dodonaea rigida Dodonaea viscosa subsp. angustissima
Scrophulariaceae	Eremophila clarkei Eremophila clavata Eremophila decipiens subsp. decipiens Eremophila deserti Eremophila eriocalyx Eremophila interstans subsp. interstans Eremophila ionantha Eremophila latrobei subsp. latrobei Eremophila oppositifolia subsp. angustifolia Eremophila scoparia Eremophila serrulata
Solanaceae	Duboisia hopwoodii Nicotiana goodspeedii Solanum ellipticum Solanum orbiculatum subsp. orbiculatum
Stylidiaceae	Levenhookia dubia Levenhookia leptantha Stylidium arenicola Stylidium dielsianum
Thymelaeaceae	Pimelea aeruginosa
Urticaceae	Parietaria cardiostegia
Zygophyllaceae	Zygophyllum aurantiacum Zygophyllum tetrapterum

3.3 Un-named taxa

Nine taxa newly recorded for the reserve could not be identified to specific level. Five of these taxa have recognised phrase names in PERTH and are likely to represent unnamed taxa. Of the other four taxa a *Lepidosperma* sp. was collected but the taxonomy of this group is in a state of flux and it will be some years before names can be accurately assigned. The two *Hibbertia* collections appear to belong to distinct taxa within the “exasperata group”. This group is taxonomically complex and would require considerable work to resolve good species. The *Marsilea* sp. was not collected in fruit so assignment to species is difficult.

Table 2. Putatively un-named or not formalised taxa recorded from Credo.

Family	Name
Celastraceae	Stackhousia sp. Mt Keith (G. Cockerton & G. O'Keefe 11017)
Cyperaceae	Lepidosperma sp. (NG & MAL 4907)
Dilleniaceae	Hibbertia exasperata complex (NG & MAL 4966)
	Hibbertia exasperata complex (NG & MAL 5206)
Fabaceae	Dillwynia sp. Coolgardie (V.E. Sands 637.3. 1)
Malvaceae	Sida sp. dark green fruits (S. van Leeuwen 2260)
	Sida sp. Excedentifolia (J.L. Egan 1925)
Marsileaceae	Marsilea sp. (NG & MAL 5080)
Portulacaceae	Calandrinia sp. Bullardoo (F. Obbens & F. Hort FO 57/04)

3.4 New species to be described

No new species are to be described from collections made during this survey at this time. Collections made will assist in resolution of some taxonomically complex groups (e.g. *Lepidosperma*, *Hibbertia exasperata* complex). An unusual aquatic *Goodenia* sp. was collected during the survey and has been tentatively identified as *Goodenia ?berringbinensis*, however further collections are needed later in the season to get flowering and fruiting material. Given the very different aquatic leaves of this collection compared to typical *G. berringbinensis* and its disjunct distribution further study further study is clearly warranted when more material becomes available.

Table 3. New species to be described from Credo.

None proposed for description at this stage.

3.5 Weed species

Twenty one weed taxa have been recorded for Credo Station, an increase of 11 taxa over the previous collections. All are described as environmental weeds by Keighery & Longman (2004) except for *Marrubium vulgare*. However, more recent assessments suggest that this species is also a significant environmental weed and this species is now a declared weed in Western Australia under the AGRICULTURE AND RELATED RESOURCES PROTECTION ACT 1976.

In the Shire of Menzies (northern section of Credo) it is listed as a:

- P1 - Introduction of the plant into, or movement of the plant within, an area is prohibited;
- P2 - Plant to be eradicated in the area.

In the Shire of Coolgardie and the City of Kalgoorlie (southern parts of Credo) it is listed as:

- P1 - Introduction of the plant into, or movement of the plant within, an area is prohibited;
- P4 – Spread of plant beyond where it currently occurs to be prevented.

This species was not encountered in the current survey. The other serious environmental weeds encountered were *Emex australis* and *Carrichtera annua*. *Emex australis* is a declared weed in Western Australia in most wheatbelt shires, a single plant was recorded near a dam in uncut salmon gum woodland in the current survey. Recent modelling by Cooke et al. (2011) also suggests that *Carrichtera annua* could become widespread across much of the GWW, two collections were made of this taxon from dissimilar habitats, one in a creekline and the other near a saline wetland.

Table 4. Environmental and declared weeds recorded in Credo in current and previous surveys.

Family	Name	Current	Previous	Declared in WA
Aizoaceae	Cleretum papulosum subsp. papulosum	+		
Asteraceae	Dittrichia graveolens			
	Hypochaeris glabra	+		
	Sonchus oleraceus	+		
Brassicaceae	Carrichtera annua	+	+	
	Sisymbrium irio	+		
	Sisymbrium orientale		+	
Convolvulaceae	Cuscuta epithymum		+	
	Cuscuta planiflora	+		
Fabaceae	Medicago minima	+	+	
Geraniaceae	Erodium aureum	+		
	Erodium cicutarium	+		
Lamiaceae	Marrubium vulgare		+	X
	Salvia verbenaca	+	+	
Orobanchaceae	Parentucellia latifolia	+		
Poaceae	Pentaschistis airoides	+		
	Rostraria pumila	+		
	Schismus barbatus	+		
Polygonaceae	Emex australis	+	+	
Primulaceae	Lysimachia arvensis	+	+	
Solanaceae	Solanum nigrum	+	+	

3.6 Vulnerable, threatened or endangered species

No threatened taxa were encountered during the survey. Two taxa on DEC's Priority Flora List (Smith 2010) had previously been recorded for the reserve, a further four were added by the current survey.

The Priority Flora List is a state based list of taxa under consideration for listing as threatened flora. Taxa that have not yet been adequately surveyed may be added to the Priority Flora List under Priorities 1, 2 or 3. Taxa that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4 (Smith 2010).

Table 5. Priority flora recorded in Credo in current and previous surveys.

Family	Name	Current	Previous	Priority code
Asteraceae	Gnephosis intonsa	1		1
Brassicaceae	Lepidium fasciculatum	1		3
Chenopodiaceae	Atriplex lindleyi subsp. conduplicata		1	3
Colchicaceae	Wurmbea murchisoniana	1	1	4
Goodeniaceae	Goodenia ?berringbinensis	1		4
Proteaceae	Grevillea georgeana	1		3

4. General comment on species lists

Most of the previous collections of vascular plant on Credo Station and adjacent reserves had been undertaken in winter. As a result spring flowering annuals graminoids and shrubs have been badly under sampled. The spring of 2011 was an excellent year following good winter rains for both plants and insects (Figure 5). As a result the species list for Credo was increased by more than 2.5 times and now totals some 427 taxa.

More than 60 of the taxa encountered in the survey were at their range limits (41 at their inland limit and 19 at their southern limit). This is consistent with the existence of a major biogeographic boundary in the north of the station; representing the change

from mosaics of eucalypt woodland in the south to the more arid acacia shrublands of the interior.



Figure 5. a) Bee fly (Family Bombyliidae) searching for nectar on *Phebalium canaliculatum*, b) *Phebalium canaliculatum* and *Grevillea oligomera* growing on yellow sandplain.

In addition to species at their range limits, major range extensions were recorded for three taxa:

- *Calandrinia* sp. Bullardoo (F. Obbens & F. Hort FO 57/04). This taxon was previously known from the area inland of Geraldton (Midwest region) and represents a range extension of some 350 km. On Credo it was found on a lateritised Banded Iron Formation ridge south of the old Callion mine.
- *Goodenia ?berringbinensis* is an unusual *Goodenia* in possessing an aquatic stage. It was found in the ephemeral wetland at the base of Ularring Rock, where material had been collected the previous year but not identified (NG & EMS 4681). This may represent a 380 km range extension from the Midwest region but as stated previously good flowering and fruiting material is needed to confirm its identity. This needs to be collected in early summer as the wetland dries.
- *Sida phaeotricha* is widespread but poorly collected in the arid zone of the Yilgarn. The Credo collection represents a range extension of the southern boundary of this taxon by some 250 km. This taxon was also collected at Ularring Rock.

The northern section of the reserve remains under sampled due to logistic constraints and would reward further collections in that area. An area of yellow sandplain east of Davyhurst in particular appears to be quite different to other sandplains sampled and warrants further collections.

5. Conclusions

The two week survey was extremely productive in increasing the species list known for the reserve. It could be expected that further collecting, especially in the north of the reserve will result in further significant increases to species richness. The reserve was geologically complex and thus contained many different habitats which showed a high turn over in species composition. This was particularly noticeable on the different sandplains.

Credo also contains some significant areas of undisturbed Salmon gum woodlands. These areas were not cut by the woodline to supply timber to Kalgoorlie and Coolgardie in the 1800s and little of this type of woodland is believed to remain but detailed mapping has yet to be undertaken. The areas of Salmon gum cut in the woodline are generally obvious from the multiple stem regeneration (see front cover) while uncut stands show large diameter single stems (Figure 2a).

No threatened taxa were found on the reserve, and only a few taxa showing narrow distributions (e.g. *Baeckea* sp. Comet Vale (A.S. George 8078)).

Collections in the Ularring Rock area added significantly to the species list, particularly the large ephemeral wetland at on the northwest side of the rock. This area is currently a water reserve (R4574) and should continue to be managed in primarily for its conservation values.

Acknowledgements

We would like to thank Katie Syme and the Earthwatch crew for their able assistance in the field and their persistence in pressing plants late into the night. Our invertebrate colleagues made valuable plant collections which helped detail the flora values of the reserve. Logistic support provided by Bush Blitz staff and DEC regional staff is gratefully acknowledged as is the excellent catering supplied by Robbie Bayliss. Frank Obbens kindly identified the *Calandrinia* collections.

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Appendix 1.

List of vascular flora occurring on Credo Station.

Number of taxa: 427.

Appendix 1, Table 1. Full species list for Credo Station, no new taxa were recorded nor were any EPBC listed taxa encountered.

Family	Name	New record	State Listed	Weed
Algae	Chara sp. (NG & EMS 4675)			
Aizoaceae	Cleretum papulosum subsp. papulosum	✓		✓
	Disphyma crassifolium subsp. clavellatum			
	Gunniopsis septifraga	✓		
	Tetragonia eremaea	✓		
Amaranthaceae	Hemichroa diandra			
	Ptilotus aervoides	✓		
	Ptilotus carlsonii	✓		
	Ptilotus chamaecladus	✓		
	Ptilotus ?drummondii	✓		
	Ptilotus exaltatus	✓		
	Ptilotus holosericeus	✓		
	Ptilotus obovatus	✓		
Apiaceae	Daucus glochidiatus	✓		
Apocynaceae	Alyxia buxifolia	✓		
	Marsdenia australis	✓		
	Rhyncharrhena linearis			
Araliaceae	Trachymene cyanopetala	✓		
	Trachymene ornata	✓		
Asparagaceae	Arthropodium curvipes	✓		
	Chamaexeros macranthera	✓		
	Thysanotus manglesianus	✓		
	Thysanotus speckii	✓		
Asteraceae	Actinobole uliginosum	✓		
	Angianthus tomentosus	✓		
	Asteridea athrixioides	✓		

Asteraceae	Brachyscome ciliaris	✓	
	Brachyscome iberidifolia	✓	
	Brachyscome perpusilla	✓	
	Calocephalus francisii	✓	
	Calotis hispidula	✓	
	Calotis multicaulis	✓	
	Cephalopterum drummondii	✓	
	Ceratogyne obionoides	✓	
	Chthonocephalus pseudevax	✓	
	Dittrichia graveolens		✓
	Gilberta tenuifolia	✓	
	Gnephosis brevifolia	✓	
	Gnephosis intonsa	✓	✓
	Gnephosis tenuissima	✓	
	Helichrysum luteoalbum	✓	
	Hyalosperma demissum	✓	
	Hyalosperma glutinosum	✓	
	Hypochaeris glabra	✓	✓
	Isoetopsis graminifolia	✓	
	Lawrencella davenportii	✓	
	Lawrencella rosea	✓	
	Leiocarpa semicalva	✓	
	Lemooria burkittii	✓	
	Millotia myosotidifolia	✓	
	Millotia tenuifolia	✓	
	Myriocephalus guerinae	✓	
	Myriocephalus pygmaeus	✓	
	Olearia exiguifolia		
	Olearia humilis	✓	
	Olearia muelleri	✓	
	Olearia muricata	✓	
	Olearia pimeleoides	✓	
	Podolepis capillaris	✓	
	Podolepis lessonii	✓	
	Podolepis rugata	✓	
	Rhodanthe battii	✓	

Asteraceae	Rhodanthe charsleyae	✓	
	Rhodanthe floribunda	✓	
	Rhodanthe haigii	✓	
	Rhodanthe laevis	✓	
	Rhodanthe maryonii	✓	
	Rhodanthe oppositifolia	✓	
	Rhodanthe pollackii	✓	
	Rhodanthe stricta	✓	
	Schoenia cassiniana	✓	
	Senecio glossanthus	✓	
	Senecio lacustrinus	✓	
	Senecio pinnatifolius var. pinnatifolius		
	Senecio quadridentatus	✓	
	Siloxerus multiflorus	✓	
	Sonchus oleraceus	✓	✓
	Streptoglossa cylindriceps	✓	
	Streptoglossa liatroides	✓	
	Trichanthodium skirroporum	✓	
	Triptilodiscus pygmaeus	✓	
	Vittadinia dissecta var. hirta	✓	
	Vittadinia eremaea	✓	
	Waitzia acuminata	✓	
	Boraginaceae	Halgania integerrima	✓
Brassicaceae	Arabidella chrysodema	✓	
	Carrichtera annua	✓	✓
	Lepidium fasciculatum	✓	✓
	Menkea australis	✓	
	Sisymbrium irio	✓	✓
	Sisymbrium orientale		✓
	Stenopetalum filifolium	✓	
Campanulaceae	Isotoma petraea	✓	
	Lobelia rarifolia	✓	
	Wahlenbergia gracilentia	✓	
	Wahlenbergia tumidifructa	✓	
Caryophyllaceae	Stellaria filiformis	✓	
Casuarinaceae	Allocasuarina acutivalvis	✓	

Casuarinaceae	<i>Allocasuarina campestris</i>	✓	
	<i>Allocasuarina corniculata</i>	✓	
	<i>Allocasuarina eriochlamys</i>		
	<i>Allocasuarina eriochlamys</i> subsp. <i>eriochlamys</i>	✓	
Celastraceae	<i>Casuarina pauper</i>	✓	
	<i>Stackhousia muricata</i>	✓	
	<i>Stackhousia</i> sp. Mt Keith (G. Cockerton & G. O'Keefe 11017)	✓	
Centrolepidaceae	<i>Centrolepis polygyna</i>	✓	
	<i>Centrolepis strigosa</i>	✓	
Chenopodiaceae	<i>Atriplex codonocarpa</i>	✓	
	<i>Atriplex lindleyi</i> subsp. <i>conduplicata</i>		✓
	<i>Atriplex lindleyi</i> subsp. <i>inflata</i>	✓	
	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>	✓	
	<i>Atriplex semibaccata</i>		
	<i>Atriplex</i> ? <i>vesicaria</i>	✓	
	<i>Chenopodium curvispicatum</i>		
	<i>Didymanthus roei</i>		
	<i>Dissocarpus paradoxus</i>	✓	
	<i>Dysphania kalpari</i>		
	<i>Enchylaena tomentosa</i>	✓	
	<i>Maireana amoena</i>		
	<i>Maireana carnosa</i>	✓	
	<i>Maireana georgei</i>	✓	
	<i>Maireana pyramidata</i>	✓	
	<i>Maireana sedifolia</i>		
	<i>Maireana trichoptera</i>	✓	
	<i>Maireana triptera</i>	✓	
	<i>Rhagodia drummondii</i>	✓	
	<i>Rhagodia preissii</i>	✓	
<i>Sclerolaena cuneata</i>			
<i>Sclerolaena eurotioides</i>			
<i>Sclerolaena fimbriolata</i>			
<i>Sclerolaena fusiformis</i>	✓		
<i>Tecticornia disarticulata</i>	✓		

Chenopodiaceae	Tecticornia sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)			
Colchicaceae	Wurmbea murchisoniana	✓	✓	
Convolvulaceae	Convolvulus clementii	✓		
	Cuscuta epithymum			✓
	Cuscuta planiflora	✓		✓
Crassulaceae	Crassula colorata var. acuminata	✓		
	Crassula tetramera	✓		
Cupressaceae	Callitris canescens	✓		
	Callitris columellaris	✓		
	Callitris preissii	✓		
Cyperaceae	Chrysitrix distigmata	✓		
	Genus sp. indet - Cyperaceae			
	Isolepis congrua	✓		
	Lepidosperma sp. (NG & MAL 4907)	✓		
	Schoenus nanus	✓		
Dilleniaceae	Hibbertia exasperata	✓		
	Hibbertia sp. (NG & MAL 5206)	✓		
Droseraceae	Drosera macrantha subsp. macrantha	✓		
	Drosera moorei	✓		
Euphorbiaceae	Beyeria sulcata var. sulcata	✓		
	Euphorbia drummondii			
	Monotaxis luteiflora	✓		
Fabaceae	Acacia ancistrophylla var. ancistrophylla	✓		
	Acacia aneura	✓		
	Acacia burkittii	✓		
	Acacia coolgardiensis			
	Acacia effusifolia	✓		
	Acacia hemiteles	✓		
	Acacia leptopetala			
	Acacia ligulata			
	Acacia longispinea	✓		
	Acacia murrayana	✓		
	Acacia prainii	✓		
	Acacia quadrimarginea	✓		
	Acacia ramulosa var. linophylla	✓		

Fabaceae	Acacia ramulosa var. ramulosa	✓		
	Acacia resinimarginea	✓		
	Acacia sp. narrow phyllode (B.R. Maslin 7831)			
	Acacia steedmanii subsp. steedmanii	✓		
	Acacia tetragonophylla	✓		
	Acacia uncinella	✓		
	Acacia yorkrakinensis subsp. acrita	✓		
	Bossiaea walkeri	✓		
	Daviesia benthamii subsp. acanthoclona	✓		
	Dillwynia sp. Coolgardie (V.E. Sands 637.3. 1)	✓		
	Jacksonia nematoclada	✓		
	Leptosema aculeatum	✓		
	Medicago minima	✓	✓	
	Mirbelia microphylla	✓		
	Mirbelia ramulosa	✓		
	Mirbelia seorsifolia	✓		
	Mirbelia trichocalyx	✓		
	Petalostylis cassioides	✓		
	Senna artemisioides subsp. filifolia	✓		
	Senna cardiosperma	✓		
	Senna charlesiana			
	Senna pleurocarpa var. angustifolia			
	Senna pleurocarpa var. pleurocarpa	✓		
	Swainsona affinis	✓		
	Swainsona beasleyana	✓		
	Swainsona canescens			
	Swainsona kingii	✓		
	Trigonella suavissima	✓		
	Frankeniaceae	Frankenia irregularis		
		Frankenia setosa		
Geraniaceae	Erodium aureum	✓	✓	
	Erodium cicutarium	✓	✓	
	Erodium cygnorum	✓		
Goodeniaceae	Brunonia australis	✓		
	Dampiera stenostachya	✓		
	Dampiera tenuicaulis var. tenuicaulis	✓		

Goodeniaceae	Goodenia ?berringbinensis	✓	✓
	Goodenia havilandii		
	Goodenia mimuloides	✓	
	Goodenia mueckeana	✓	
	Goodenia occidentalis	✓	
	Scaevola spinescens	✓	
	Velleia rosea	✓	
Gyrostemonaceae	Codonocarpus cotinifolius		
Haloragaceae	Glischrocaryon aureum	✓	
	Haloragis gossei / trigonocarpa	✓	
	Haloragis ?maierae	✓	
	Haloragis trigonocarpa		
Hemerocallidaceae	Dianella revoluta var. divaricata	✓	
Isoetaceae	Isoetes muelleri	✓	
Juncaceae	Juncus aridicola	✓	
Juncaginaceae	Triglochin ?isingiana	✓	
Lamiaceae	Hemigenia brachyphylla		
	Lachnostachys coolgardiensis	✓	
	Marrubium vulgare		✓
	Physopsis viscida	✓	
	Pityrodia lepidota	✓	
	Prostanthera althoferi subsp. althoferi	✓	
	Prostanthera campbellii	✓	
	Prostanthera grylloana	✓	
	Salvia verbenaca	✓	✓
	Westringia cephalantha		
	Westringia rigida	✓	
Lauraceae	Cassytha melantha	✓	
Loganiaceae	Phyllangium sulcatum	✓	
Loranthaceae	Amyema benthamii		
	Amyema gibberula var. gibberula		
	Amyema nestor	✓	
	Amyema preissii		
	Lysiana casuarinae		
Malvaceae	Abutilon cryptopetalum	✓	

	Brachychiton gregorii	
	Keraudrenia cacaobrunnea	✓
	Lawrencia repens	✓
	Radyera farragei	
	Rulingia luteiflora	✓
	Sida calyxhymenia	✓
	Sida fibulifera	
	Sida phaeotricha	✓
	Sida sp. dark green fruits (S. van Leeuwen 2260)	✓
	Sida sp. Excedentifolia (J.L. Egan 1925)	✓
Marsileaceae	Marsilea hirsuta	
	Marsilea sp. (NG & MAL 5080)	✓
Myrtaceae	Aluta aspera subsp. aspera	✓
	Baekkea sp. Comet Vale (A.S. George 8078)	✓
	Balaustion pulcherrimum	✓
	Calothamnus gilesii	✓
	Calytrix depressa	✓
	Chamelaucium ciliatum	✓
	Eucalyptus celastroides subsp. celastroides	✓
	Eucalyptus ceratocorys	
	Eucalyptus clelandii	✓
	Eucalyptus concinna	✓
	Eucalyptus cylindrocarpa	✓
	Eucalyptus dundasii	
	Eucalyptus ebbanoensis subsp. ebbanoensis	
	Eucalyptus eremophila	
	Eucalyptus ewartiana	✓
	Eucalyptus griffithsii	✓
	Eucalyptus horistes	✓
	Eucalyptus leptopoda subsp. subluta	✓
	Eucalyptus longicornis	
	Eucalyptus longissima	
	Eucalyptus loxophleba subsp. lissophloia	✓
	Eucalyptus moderata	✓
	Eucalyptus oleosa	✓
	Eucalyptus orbifolia	✓

Myrtaceae	<i>Eucalyptus ravida</i>	✓	
	<i>Eucalyptus rigidula</i>	✓	
	<i>Eucalyptus salmonophloia</i>	✓	
	<i>Eucalyptus salubris</i>	✓	
	<i>Eucalyptus sheathiana</i>	✓	
	<i>Eucalyptus transcontinentalis</i>	✓	
	<i>Eucalyptus trichopoda</i>		
	<i>Eucalyptus yilgarnensis</i>	✓	
	<i>Eucalyptus youngiana</i>		
	<i>Euryomyrtus maidenii</i>	✓	
	<i>Euryomyrtus patrickiae</i>		
	<i>Homalocalyx thryptomenoides</i>	✓	
	<i>Kunzea pulchella</i>	✓	
	<i>Malleostemon roseus</i>	✓	
	<i>Melaleuca halmaturorum</i>		
	<i>Melaleuca hamata</i>	✓	
	<i>Melaleuca leiocarpa</i>	✓	
	<i>Melaleuca phoidophylla</i>	✓	
	<i>Micromyrtus monotaxis</i>	✓	
	<i>Thryptomene urceolaris</i>		
<i>Verticordia helmsii</i>			
Ophioglossaceae	<i>Ophioglossum lusitanicum</i>	✓	
Orchidaceae	<i>Prasophyllum gracile</i>	✓	
Orobanchaceae	<i>Parentucellia latifolia</i>	✓	✓
Oxalidaceae	<i>Oxalis perennans</i>		
Phrymaceae	<i>Glossostigma diandrum</i>		
	<i>Glossostigma drummondii</i>	✓	
Pittosporaceae	<i>Bursaria occidentalis</i>		
	<i>Pittosporum angustifolium</i>	✓	
Plantaginaceae	<i>Plantago debilis</i>	✓	
	<i>Plantago turrifera</i>	✓	
	<i>Plantago turrifera</i>	✓	
Poaceae	<i>Aristida contorta</i>	✓	
	<i>Austrodanthonia caespitosa</i>	✓	
	<i>Austrostipa elegantissima</i>	✓	
	<i>Austrostipa eremophila</i>	✓	
	<i>Austrostipa nitida</i>	✓	

Poaceae	<i>Austrostipa platychaeta</i>	✓	
	<i>Austrostipa scabra</i>	✓	
	<i>Austrostipa tuckeri</i>	✓	
	<i>Chloris truncata</i>		
	<i>Enneapogon avenaceus</i>		
	<i>Enneapogon caeruleus</i>	✓	
	<i>Eragrostis dielsii</i>	✓	
	<i>Eragrostis falcata</i>	✓	
	<i>Eragrostis lacunaria</i>		
	<i>Eragrostis ?xerophila</i>	✓	
	<i>Eriachne flaccida</i>	✓	
	<i>Eriachne ovata</i>		
	<i>Eriachne pulchella</i>	✓	
	<i>Monachather paradoxus</i>	✓	
	<i>Paspalidium ?clementii</i>	✓	
	<i>Paspalidium constrictum</i>		
	<i>Pentaschistis airoides</i>	✓	*
	<i>Rostraria pumila</i>	✓	*
	<i>Schismus barbatus</i>	✓	*
	<i>Themeda triandra</i>	✓	
	<i>Triodia desertorum</i>		
	<i>Triodia rigidissima</i>	✓	
	<i>Triodia scariosa</i>	✓	
<i>Triodia tomentosa</i>	✓		
Polygalaceae	<i>Comesperma spinosum</i>	✓	
Polygonaceae	<i>Emex australis</i>	✓	✓
	<i>Muehlenbeckia florulenta</i>	✓	
Portulacaceae	<i>Polygonum plebeium</i>	✓	
	<i>Calandrinia calyptrata</i>	✓	
	<i>Calandrinia eremaea</i>	✓	
	<i>Calandrinia granulifera</i>	✓	
	<i>Calandrinia porifera</i>	✓	
	<i>Calandrinia pumila</i>		
	<i>Calandrinia</i> sp. Bullardoo (F. Obbens & F. Hort FO 57/04)	✓	

Potamogetonaceae	Lepilaena australis	✓	
Primulaceae	Lysimachia arvensis	✓	✓
Proteaceae	Banksia elderiana	✓	
	Conospermum stoechadis subsp. stoechadis	✓	
	Grevillea acacioides	4	
	Grevillea acuaria		
	Grevillea didymobotrya subsp. didymobotrya	✓	
	Grevillea excelsior	✓	
	Grevillea georgeana	✓	✓
	Grevillea hookeriana	✓	
	Grevillea juncifolia	✓	
	Grevillea nematophylla subsp. nematophylla		
	Grevillea oligomera	✓	
	Grevillea paradoxa	✓	
	Grevillea teretifolia	✓	
	Hakea francisiana	✓	
	Hakea minyma	✓	
	Hakea preissii	✓	
	Hakea recurva		
	Hakea recurva subsp. recurva	✓	
	Persoonia coriacea	✓	
	Persoonia ?helix	✓	
Pteridaceae	Cheilanthes lasiophylla	✓	
Pteridaceae	Cheilanthes sieberi subsp. sieberi	✓	
Restionaceae	Lepidobolus preissianus subsp. volubilis	✓	
Rhamnaceae	Cryptandra aridicola	✓	
	Granitites intangendus		
	Stenanthemum stipulosum	✓	
Rubiaceae	Synaptantha tillaeacea var. tillaeacea	✓	
Rutaceae	Boronia ternata var. ternata	✓	
	Phebalium canaliculatum	✓	
	Phebalium filifolium	✓	
	Phebalium megaphyllum		
	Phebalium tuberculosum x megaphyllum	✓	
	Philotheca brucei subsp. brucei	✓	

Santalaceae	<i>Philothea tomentella</i>	✓
	<i>Exocarpos aphyllus</i>	✓
	<i>Santalum acuminatum</i>	✓
	<i>Santalum spicatum</i>	✓
Sapindaceae	<i>Dodonaea adenophora</i>	
	<i>Dodonaea amblyophylla</i>	✓
	<i>Dodonaea lobulata</i>	✓
	<i>Dodonaea rigida</i>	✓
Scrophulariaceae	<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>	✓
	<i>Eremophila alternifolia</i>	✓
	<i>Eremophila clarkei</i>	✓
	<i>Eremophila clavata</i>	✓
	<i>Eremophila decipiens</i> subsp. <i>decipiens</i>	✓
	<i>Eremophila deserti</i>	✓
	<i>Eremophila eriocalyx</i>	✓
	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	✓
	<i>Eremophila gibbosa</i>	
	<i>Eremophila glabra</i> subsp. <i>glabra</i>	✓
	<i>Eremophila granitica</i>	✓
	<i>Eremophila interstans</i> subsp. <i>interstans</i>	✓
	<i>Eremophila interstans</i> subsp. <i>virgata</i>	✓
	<i>Eremophila ionantha</i>	✓
	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	✓
	<i>Eremophila longifolia</i>	✓
	<i>Eremophila maculata</i> subsp. <i>brevifolia</i>	
	<i>Eremophila metallicorum</i>	
	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>	✓
	<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>	✓
<i>Eremophila scoparia</i>	✓	
<i>Eremophila serrulata</i>	✓	
<i>Eremophila</i> sp. Mt Jackson (G.J. Keighery 4372)		
Solanaceae	<i>Duboisia hopwoodii</i>	✓
	<i>Nicotiana goodspeedii</i>	✓
	<i>Solanum ellipticum</i>	✓
	<i>Solanum hoplopetalum</i>	✓
	<i>Solanum lasiophyllum</i>	✓

Solanaceae	Solanum nigrum	✓	✓
	Solanum nummularium		
	Solanum orbiculatum subsp. orbiculatum	✓	
Stylidiaceae	Levenhookia dubia	✓	
	Levenhookia leptantha	✓	
	Stylidium arenicola	✓	
	Stylidium dielsianum	✓	
Thymelaeaceae	Pimelea aeruginosa	✓	
	Pimelea microcephala subsp. microcephala		
Urticaceae	Parietaria cardiostegia	✓	
Zygophyllaceae	Zygophyllum aurantiacum	✓	
	Zygophyllum tetrapterum	✓	