SUMMARY OF FINDINGS FROM

VEGETATION

MONITORING SITES AT

CARABAN

Prepared for:

Department of Environment and Conservation

Prepared by:

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MATTISKE CONSULTING PTY LTD

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1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned by Department of Environment and Conservation to establish and monitor vegetation monitoring quadrats to assist in assessing the effects of grazing after fire. A total of Twelve - 10m x 10m vegetation monitoring quadrats were established and recorded over two seasons. The initial assessment was undertaken in the winter months of 2008 and the second assessment was undertaken in the summer months of 2008/2009.

The six quadrats established in the unburnt areas are effectively control quadrats where the effect of grazing without being burnt can be monitored. This report compares the fenced and unfenced quadrats in burnt and unburnt areas to determine the difference in species regrowth with and without grazing.

Mean alive species density in the burnt quadrats was significantly higher in the fenced quadrats compared to the unfenced quadrats indicating an increase in the number of species when animal grazing was excluded. The Summer 08/09 monitoring showed higher species richness in the burnt fenced quadrats compared to the burnt unfenced quadrats however the difference was not significant. This indicates that eliminating grazing and trampling allows for more young species to establish. More seedlings were recorded of species such as *Adenanthos cygnorum* and *Banksia menziesii*. This is to be expected as many native Australian species have reproductive cycles that are cued to post-fire conditions.

The Summer 08/09 monitoring showed significant difference in foliage cover between unburnt fenced and unburnt unfenced quadrats. This indicates that grazing does significantly reduce foliage cover however may not necessarily affect species density. The monitoring in Winter 2008 and Summer 08/09 of the unburnt quadrats showed dead species density in the unburnt quadrats were higher in the unfenced quadrats compared to the fenced quadrats. Although not significantly lower over time this could become more prominent as grazing will continue in unfenced quadrats and more plants will get eaten or trampled.

In both the burnt and unburnt quadrats the fenced quadrats showed a higher species richness and density. This indicates that the fencing does prevent grazing and trampling in both burnt and unburnt quadrats. Species such as *Calytrix fraseri, Conostephium pendulum* and, *Conostylis setigera* had increased in density in the fenced areas in both burnt and unburnt quadrats indicating better species establishment when not under pressure from grazing.

This study is very limited by sample size since it is a preliminary study into the effect of grazing after fire. It is recommended the sample size be increased in a larger study area. Future monitoring should continue to show accurate trends over time.

2. INTRODUCTION

Mattiske Consulting Pty Ltd was commissioned by the Department of Environment and Conservation to establish vegetation monitoring quadrats in order to quantify the effect of grazing after fire. This project was located in unallocated crown land east of Military Road at Caraban, about 65 km north of Perth.

2.1 Climate

Beard (1990) described the climate as warm Mediterranean with up to six dry months per year. Mean maximum temperatures range from 17.8ºC in July to 33.3ºC in January, while mean minimum temperatures reach 17.4ºC in February and fall to 8.2ºC in August. Mean rainfall is approximately 696mm (Bureau of Meteorology 2009).

2.2 Regional Vegetation

Caraban is located in the Swan Coastal Plain subregion (Drummond Botanical Subdistrict) (Beard 1990). The region is characterised mainly by low *Banksia* woodlands on leached sands with Melaleuca swamps in poorly drained areas (Beard 1990). Tuart (*Eucalyptus gomphocephala*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*) woodlands occur where soils are less leached, while laterite pavement and gravelly sandplains support scrub heath (Beard 1990, Desmond 2001).

2.3 Topography and Soils

The region is a low-lying, swampy coastal plain with sandhills. Soils are chiefly recent sands or swamp deposits (Beard 1990). Vegetation type is a good indicator of the soil type found in the area. Siliceous sands support low *Banksia* and *Eucalyptus marginata* woodlands while *Corymbia calophylla* and *Eucalyptus wandoo* woodlands can be found on lateritic podzolic soils and soloths. *Eucalyptus gomphocephala* is an indicator of coastal limestone overlain by yellow sands (Beard 1975).

3. OBJECTIVES

The objective of this project was to determine the effect of grazing after fire. More specifically, the following were required;

- Installation of Twelve - 10m x 10m vegetation quadrats (Figure 1)
- Re-monitoring of quadrats to provide two sets of data
- Statistical analysis to determine the quantitative effects of grazing after fire
- Report summarising the work completed and the results of this work.

4. METHODS

4.1 Data Collection

Twelve vegetation monitoring quadrats were established by Mattiske Consulting Pty Ltd on the 6th to 9th May and the 12th and 13th June 2008. These twelve - 10 m x 10 m quadrats were located within the four - 75 m x 75m plots established by the Department of Environment and Conservation. The twelve quadrats were re-monitored in the summer months of 2008/2009.

Each of the 75 m plots reflected one of the following treatments;

- Burnt and Excluded from grazing animals
- Burnt and not excluded from grazing animals
- Unburnt and Excluded from grazing animals
- Unburnt and not excluded from grazing animals

Inside each of the 75 m by 75 m plots, three 10 m x 10 m vegetation monitoring quadrats were established. These were established in regular pattern and numbered as described in Figure 1.

At each 10m x 10m quadrat the following site factors were recorded; GPS location of the corners of each quadrat (Table 1), topography, percentage litter cover, soil type and colour, percentage of bare ground, outcropping rocks and their type, gravel type and size, and, time since fire. Each 10 m x 10 m quadrat was divided into 2 m x 2 m sub-quadrats, inside which the following was recorded for each vascular plant species; maximum height (cm), number of individuals alive and dead, percentage cover of individuals alive and dead. Plant species that were not recognisable in the field were collected from outside the 10 m x 10 m quadrat.

Table 1: GPS locations for each quadrat (GDA94 Zone 50J)

	NorthWest Corner		NorthEast Corner		SouthWest Corner		SouthEast Corner	
Quadrat	**mE**	**mN**	**mE**	**mN**	**mE**	**mN**	**mE**	**mN**
1	373615	6528591	373638	6528588	373619	6528591	373631	6528584
2	373644	6528569	373648	6528567	373645	6528565	373640	6528561
3	373661	6528556	373674	6528550	373665	6528542	373673	6528539
4	373699	6528589	373708	6528587	373701	6528577	373703	6528576
5	373720	6528568	373731	6528567	373722	6528556	373731	6528556
6	373739	6528552	373749	6528554	373739	6528547	373744	6528547
7	373820	6528592	373831	6528593	373822	6528586	373832	6528583
8	373842	6528574	373849	6528563	373843	6528563	373849	6528559
9	373865	6528552	373880	6528543	373864	6528539	373874	6528539
10	373897	6528590	373914	6528588	373898	6528583	373910	6528580
11	373923	6528573	373932	6528575	373930	6528569	373952	6528572
12	373944	6528539	373947	6528559	373943	6528538	373949	6528553

All plant specimens collected during the field surveys were dried and fumigated in accordance with the requirements of the Western Australian Herbarium. The plant species were identified through comparisons with pressed specimens housed at the Western Australian Herbarium. Nomenclature of the species recorded was in accordance with the Department of Environment and Conservation (2009c; 2009d).

4.2 Photographic monitoring

Digital photographs were taken at each quadrat as a visual record of condition. Photographs were taken at the NW corner of each 10 m x 10 m quadrat.

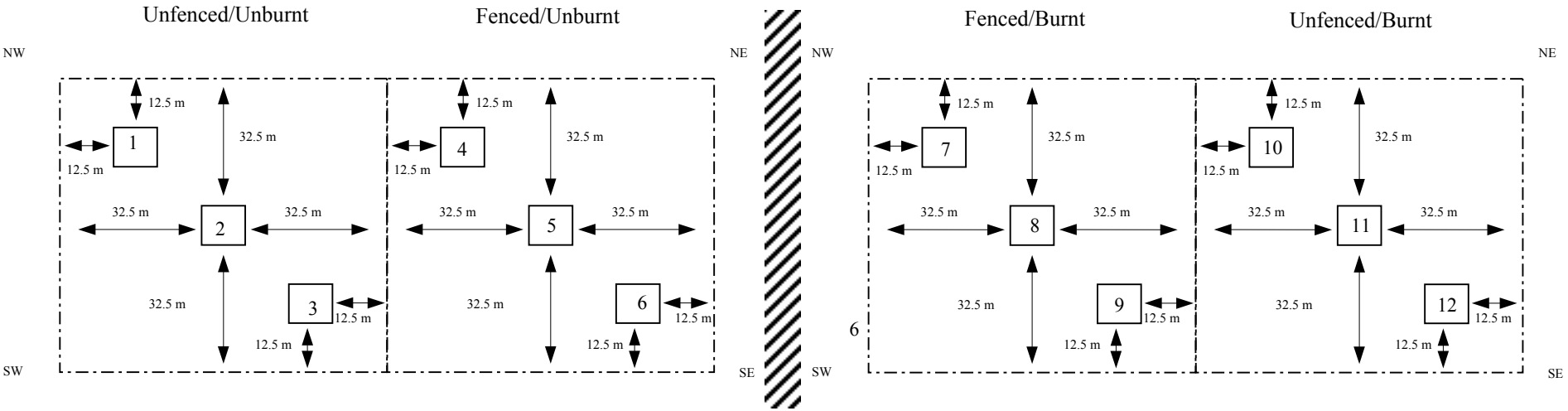

Figure 1: Layout out of 10 m x10 m Vegetation Quadrats Inside the 75m x 75 m Treatment Plots at Caraban

5. RESULTS

5.1. Flora

Overall 136 taxa were recorded incorporating 70 different genera and 29 families. The most common families recorded were the Myrtaceae (20 species), Proteaceae (13 species), and Haemodoraceae (12 species). In 2008 the most common species recorded across all monitoring quadrats were *Mesomelaena pseudostygia, Patersonia occidentalis, Scholtzia involucrata* and *Lomandra hermaphrodita.* In 2009 the most common species recorded across all monitoring quadrats were *Mesomelaena pseudostygia, Patersonia occidentalis, Drosera erythrorhiza* and *Scholtzia involucrata*.

5.2 Burnt Quadrats

The results, including alive and dead species density, alive and dead foliage cover, and species richness for the 2008 and 2009 burnt quadrats are illustrated in Figure 2 to 8.

Mean alive species density per quadrat recorded in all burnt Quadrats (Q) both fenced and unfenced in Winter 2008 was highest in Q8 with 13.9 ± 1.40 plants per m^2 (Figure 2). Mean alive species density in Summer 08/09 was the highest in Q7 with 15.31 ± 1.23 plants per m^2. Mean alive species density overall was significantly higher in the fenced quadrats in Winter 2008 and Summer 08/09 than unfenced in ($P \leq 0.05$) (Figure 3).

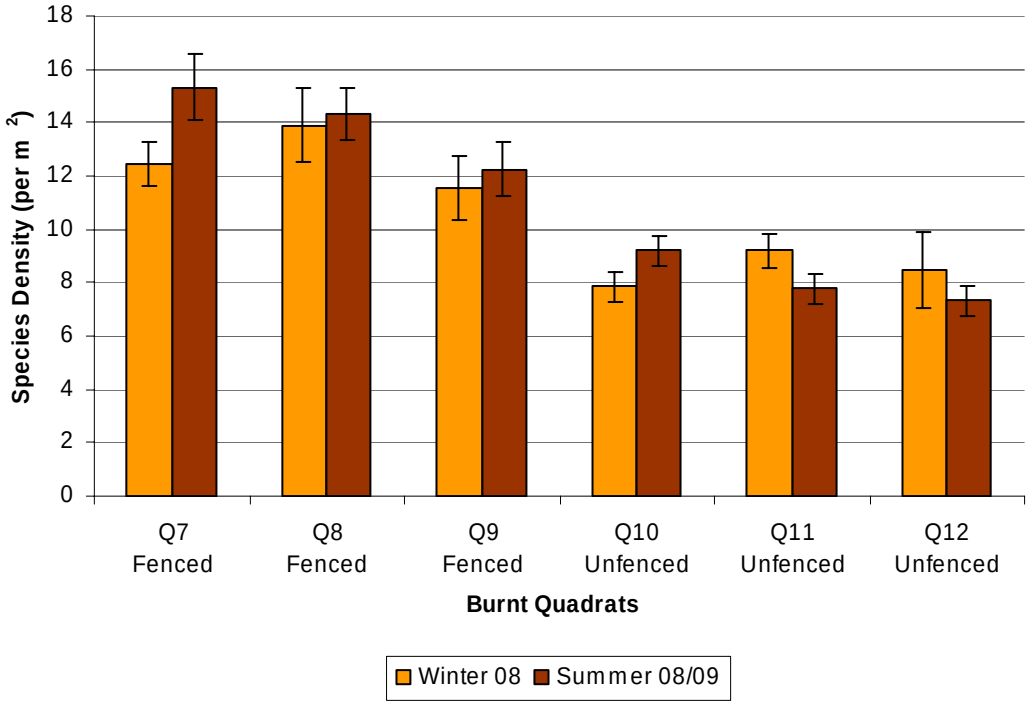

Figure 2: Mean Alive Species Density of Burnt Quadrats, both Fenced and Unfenced at Caraban

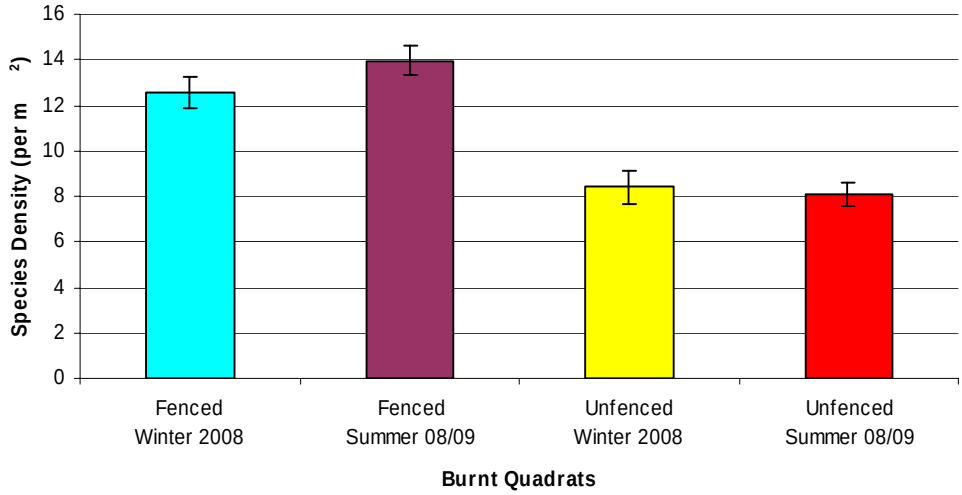

Figure 3: Mean Alive Species Density overall, both Fenced and Unfenced at Caraban

Mean alive species foliage cover in the burnt quadrats in Winter 2008 was the highest in Q7 at 15.79 ± 1.29 % per m^2 followed by a decrease in Summer 08/09 recording 9.94 ± 1.18 % per m^2 (Figure 4). Mean alive foliage cover in Summer 08/09 was the highest in Q9 at 11.29 ± 1.27 % per m^2. Foliage cover has decreased in every quadrat from Winter 2008 to Summer 08/09.

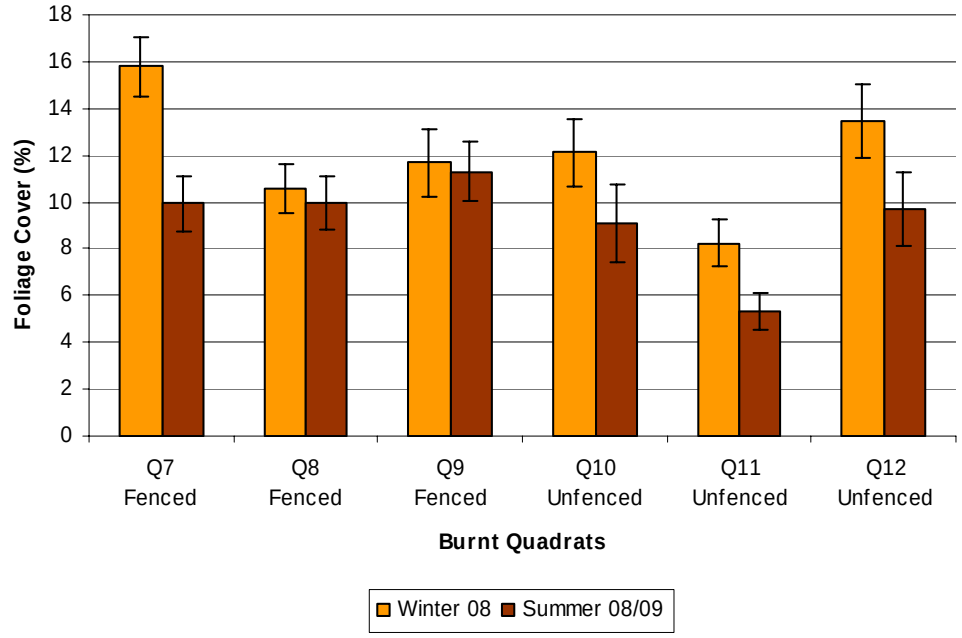

Figure 4: Mean Alive Species Foliage of Burnt Quadrats, both Fenced and Unfenced at Caraban

Species richness in burnt quadrats in Winter 2008 and Summer 08/09 was the highest in Q9 recording 53 and 54 species per 10 m^2 (Figure 5). Mean species richness in Winter 2008 was very similar in fenced and unfenced quadrats. Mean species richness was not significantly different (P ≥0.05) between unfenced or fenced quadrats in Winter 2008 and Summer 08/09 (Figure 6).

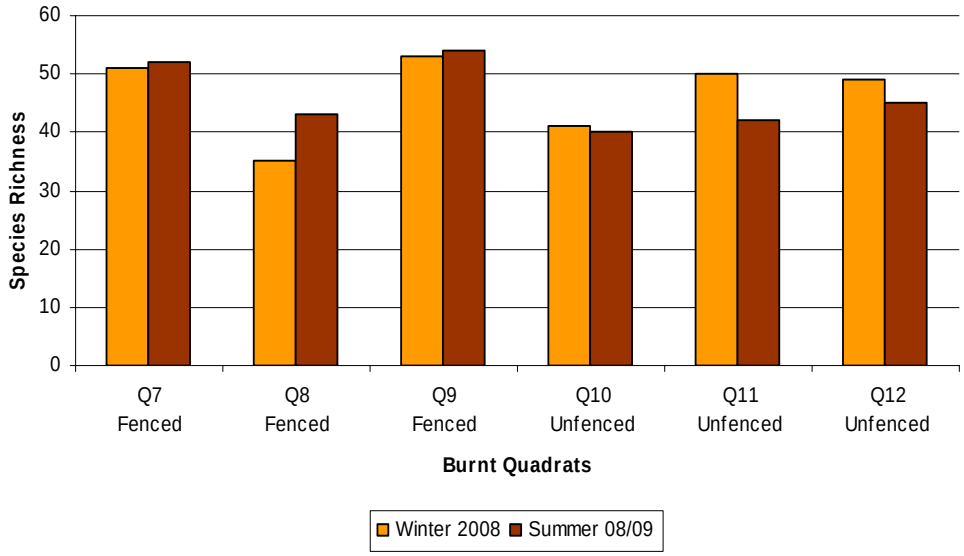

Figure 5: Species Richness of Burnt Quadrats, both Fenced and Unfenced, at Caraban

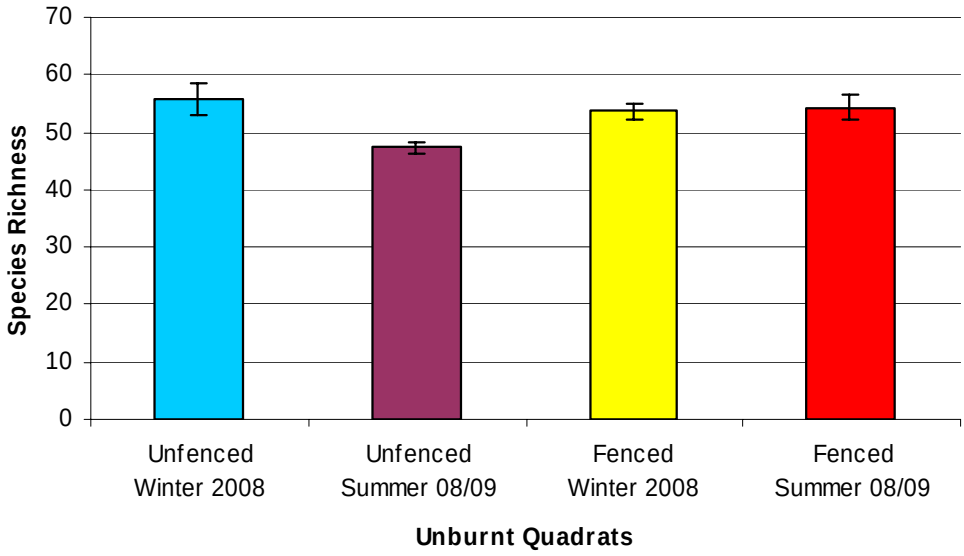

Figure 6: Mean Species Richness of Burnt Quadrats, both Fenced and Unfenced, at Caraban

Mean dead species density per quadrat in Winter 2008 was the highest in Q8 at 0.81 ± 0.25 plants per m^2. In Summer 08/09 it was Q8 that had the lowest species density of 0.08 ± 0.03 plants per m^2 (Figure 7). Mean dead species density overall decreased in both fenced and unfenced quadrats from Winter 2008 to Summer 08/09 (Figure 8).

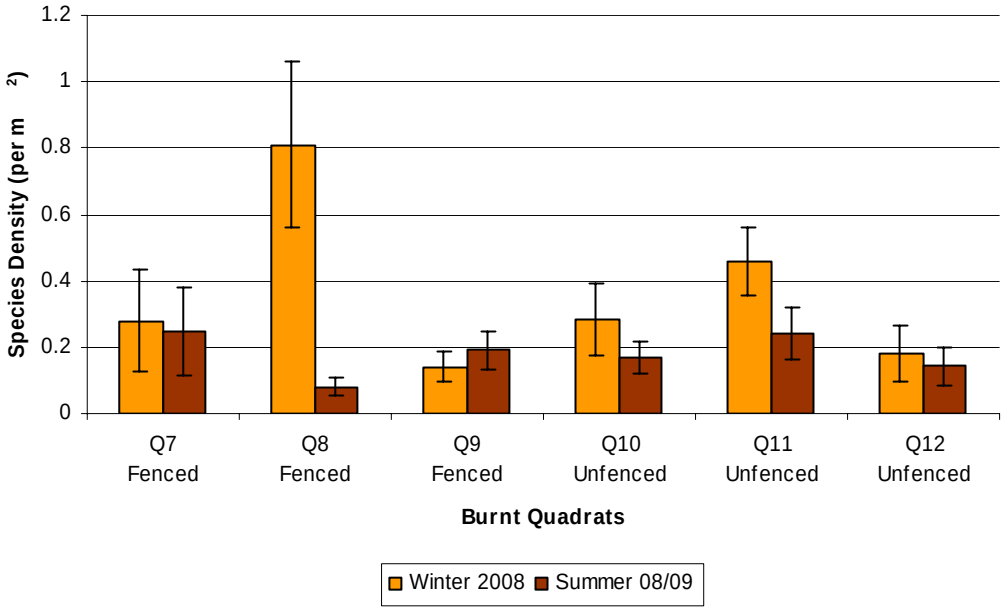

Figure 7: Mean Dead Species Density per Burnt Quadrat, both Fenced and Unfenced at Caraban

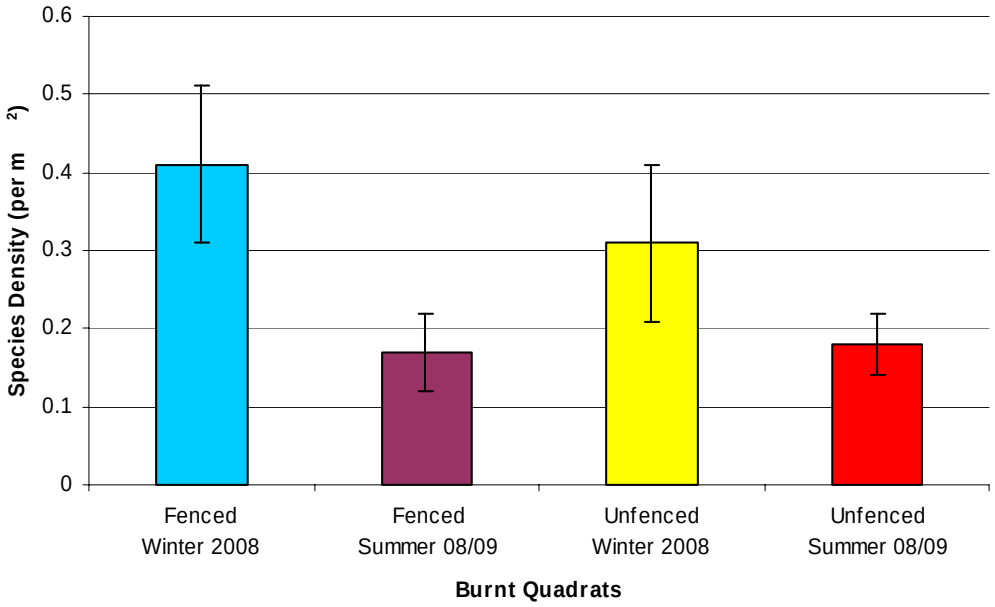

Figure 8: Mean Dead Species Density Overall in Burnt Quadrats both Fenced and Unfenced at Caraban

5.3 Unburnt Quadrats

The highest mean alive species density per quadrat recorded in Winter 2008 and Summer 08/09 was in Q5 with 12.89 ± 0.56 and 10.58 ± 0.56 plants per m^2 respectively (Figure 9). Mean density has decreased overall in the unfenced from Winter 2008 to Summer 08/09 (Figure 10), although not significantly ($P \geq 0.05$).

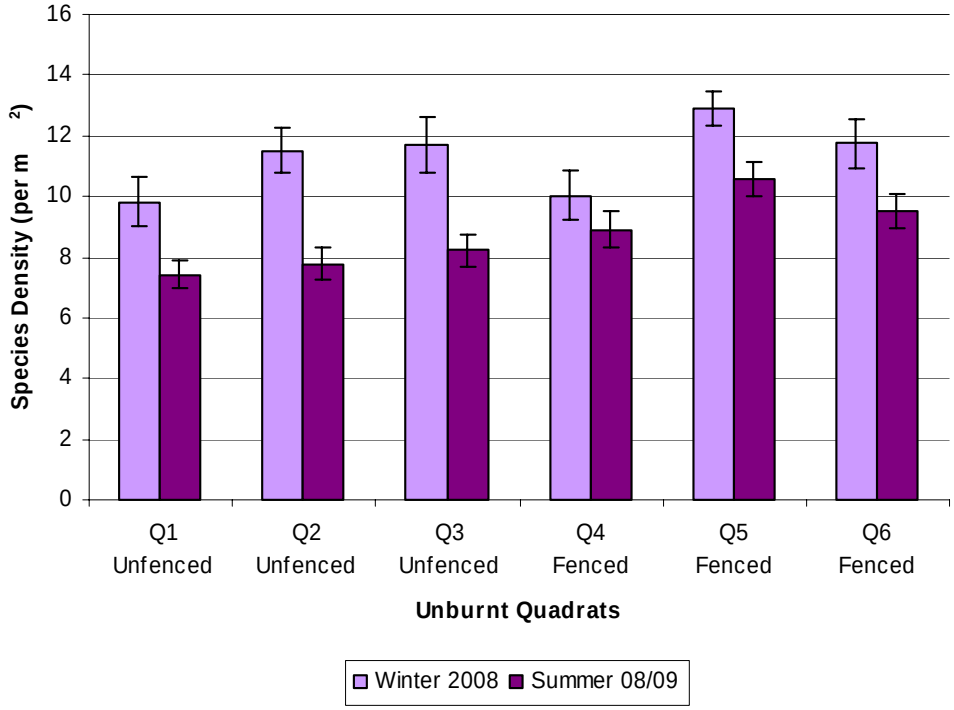

Figure 9: Mean Alive Species Density per Unburnt Quadrats, both Fenced and Unfenced, at Caraban

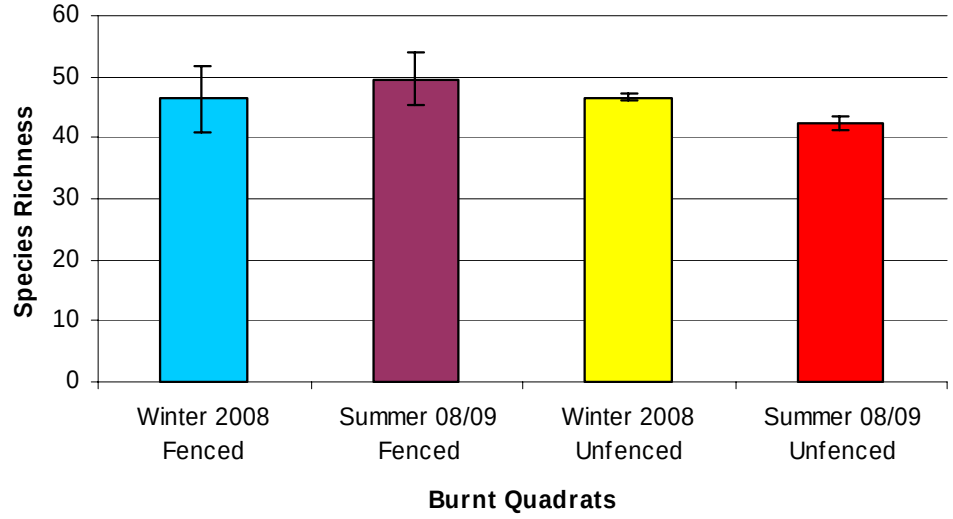

Figure 10: Mean Alive Species Density Overall in Unburnt Quadrats, both Fenced and Unfenced, at Caraban

The highest mean alive foliage cover per quadrat in Winter 2008 was recorded in Q3 with 13.55 ± 0.94 % per m^2. The highest mean alive foliage cover in Summer 08/09 was recorded in Q1 with 14.64 ± 1.64 % per m^2. The alive foliage cover in the fenced monitoring quadrats increased in Summer 08/09, whilst the cover decreased in two of the 3 unfenced quadrats (Figure 11).

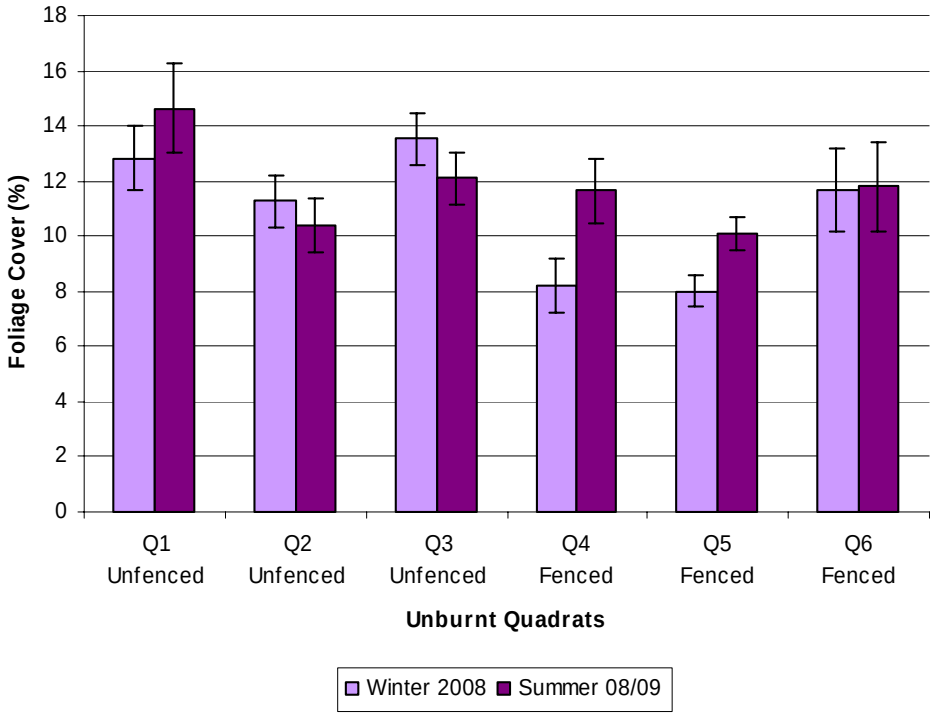

Figure 11: Mean Alive Foliage Cover per Unburnt Quadrats, both Fenced and Unfenced, at Caraban

The highest species richness in Winter 2008 in unburnt quadrats was recorded in Q3 with 61 species per 10 m^2. The highest species richness in Summer 08/09 was in Q4 with 58 species per 10 m^2 (Figure 12). Mean species richness is not significantly different between fenced and unfenced ($P \geq 0.05$) (Figure 13).

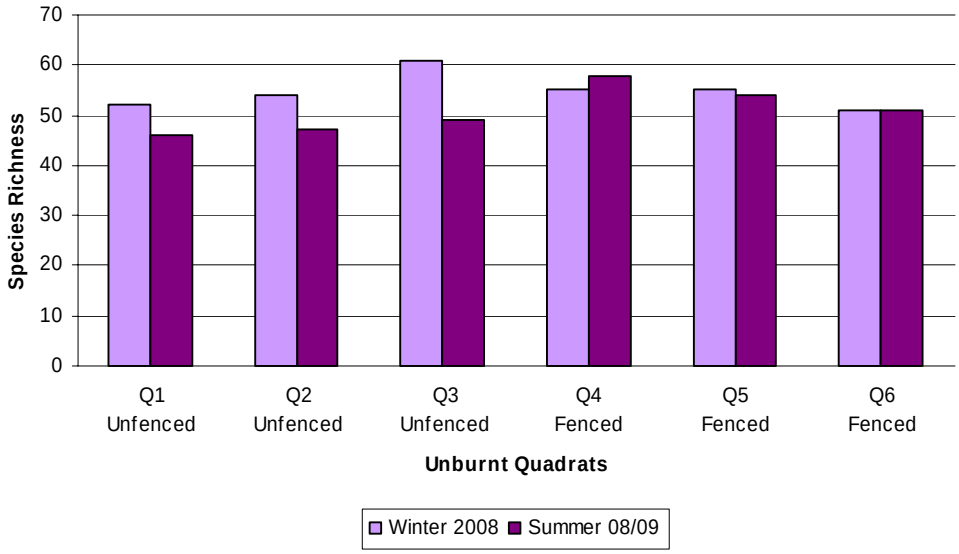

Figure 12: Species Richness in Unburnt Quadrats, both Fenced and Unfenced, at Caraban

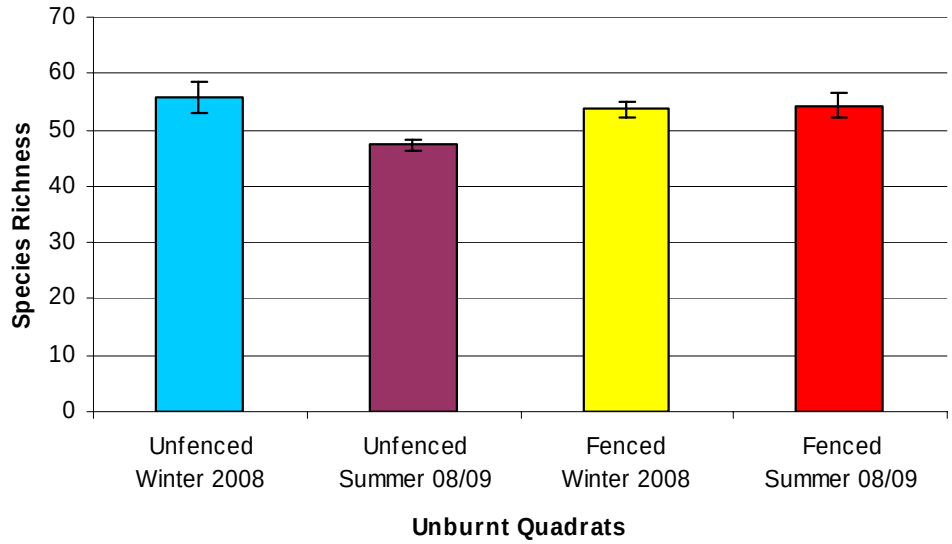

Figure 13: Mean Species Richness in Unburnt Quadrats, both Fenced and Unfenced, at Caraban

The highest dead species density was recorded in Q2 in both Winter 2008 and Summer 08/09 with 0.43 ± 0.14 and 0.54 ± 0.16 plants per m^2 respectively (Figure 14). The mean dead species density was not significantly lower in the fenced quadrats compared to the unfenced quadrats in Winter 2008 but was in the Summer 08/09 (Figure 15).

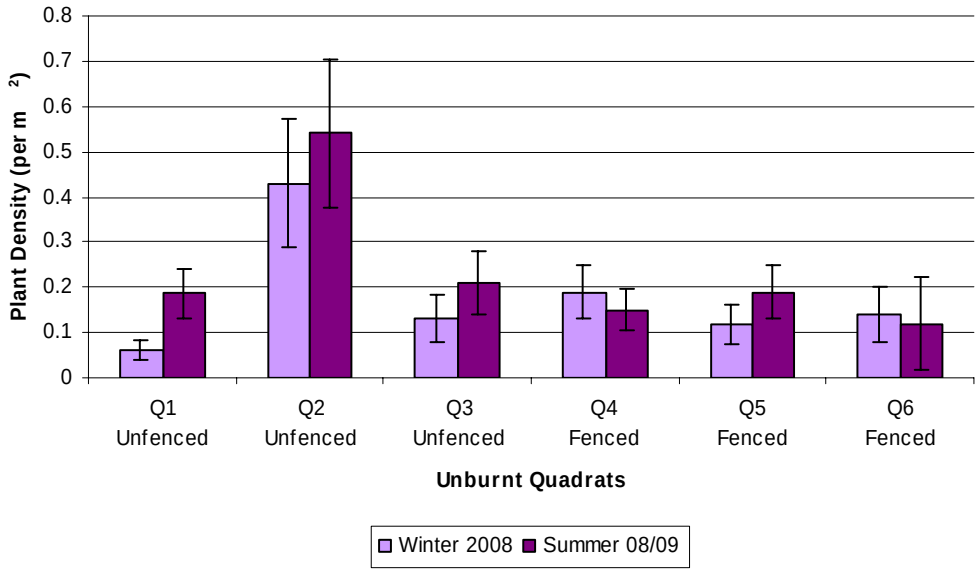

Figure 14: Mean Dead Species Density per Unburnt Quadrats, both Fenced and Unfenced, at Caraban

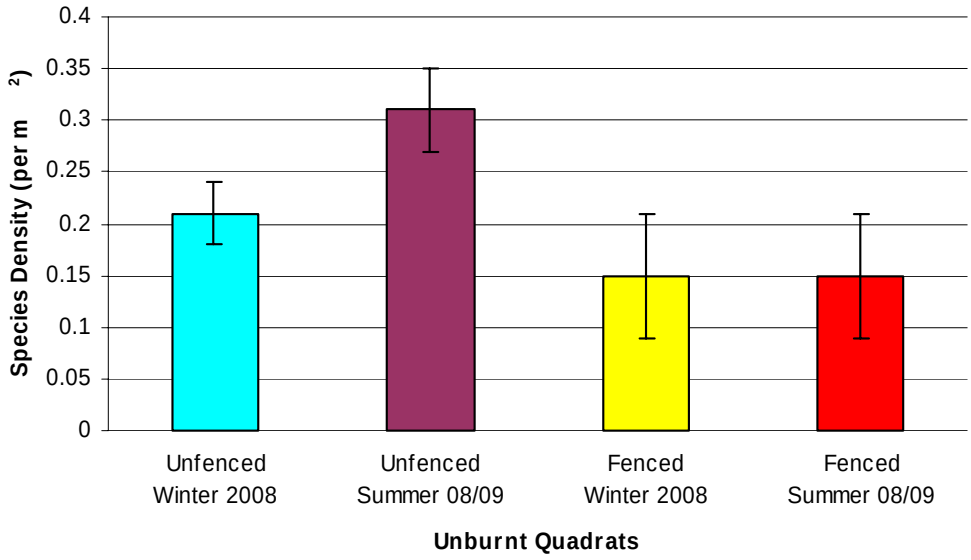

Figure 15: Mean Dead Species Density Overall in Unburnt Quadrats, both Fenced and Unfenced, at Caraban

5.3 Rare and Priority Flora

No Rare Plant taxa pursuant to subsection 2 of section 23F of the *Wildlife Conservation Act 1950* (WA) (Department of Environment and Conservation, 2009b) were found within any of the monitoring quadrats at Caraban.

No Priority Plant taxa pursuant to section 179 of the Environment Protection Biodiversity Conservation Act (1999), as listed by the Department of Environment, Water, Heritage and the Arts (2009a) were located within any monitoring quadrats at Caraban.

5.4 Introduced (Exotic) Plant Species

Only one introduced plant species was recorded during the monitoring of the quadrats at Caraban in Winter 2008 and Summer 08/09. There was *Hypochaeris glabra*, which was only recorded once in Q3, an unburnt unfenced quadrat. This introduced species is not a declared weed according to Department of Agriculture and Food (2009).

6. DISCUSSION

Mattiske Consulting Pty Ltd was commissioned by the Department of Environment and Conservation to establish and monitor vegetation monitoring quadrats to assist in quantifying the effect of grazing after fire. A total of Twelve – 10m x 10m vegetation quadrats were established and monitored. Grazing was the main factor being assessed. However eliminating trampling of vegetation by fauna species will also have a positive effect on the fenced quadrats.

The six quadrats established in the unburnt areas were control quadrats where the effect of grazing without being burnt can be monitored. This report compared the fenced and unfenced quadrats in burnt and unburnt areas to determine the difference in species regrowth with and without grazing.

6.1 Burnt Quadrats

There was slight variation in the common species between the fenced and unfenced species. The most common species in the fenced quadrats were *Scholtzia involucrata, Patersonia occidentalis, Hibbertia subvaginata* and, *Lomandra hermaphrodita*. The most common species in the unfenced quadrats are *Patersonia occidentalis, Mesomelaena pseudostygia, Adenanthos cygnorum* and *Lomandra hermaphrodita*.

Mean alive species density was significantly higher in the fenced quadrats compared to the unfenced quadrats. This indicates that fencing increased the number of species when protected from animal grazing. Mean foliage cover was not significantly different between fenced and unfenced.

The Summer 08/09 monitoring showed higher species richness in the fenced quadrats compared to the unfenced quadrats however the difference was not significant. This indicates that eliminating grazing and trampling may allow more young species to establish.

Dead species density has decreased in most burnt quadrats indicating healthy species establishment after burning.

The fenced quadrats recorded more seedlings of species such as *Adenanthos cygnorum* and *Banksia menziesii*. This is to be expected as many native Australian species have reproductive cycles that are cued to post-fire conditions. Species such as *Calytrix fraseri, Conostephium pendulum, Desmocladus flexuosus, Hibbertia hypericoides, Hibbertia subvaginata, Lomandra hermaphrodita* and *Lyginia barbata* had much higher densities in fenced quadrats compared to unfenced quadrats. This result supports the use of fencing to prevent grazing and trampling to speed up species establishment after fire.

6.2 Unburnt Quadrats (Control)

The most common species in the unburnt quadrats did not vary between fenced and unfenced quadrats. These species were *Mesomelaena pseudostygia, Scholtzia involucrata* and *Hibbertia hypericoides*.

Mean alive species density was not significantly different between the fenced and unfenced quadrats. The Summer 08/09 monitoring showed a decrease in foliage cover in unfenced quadrats. This indicates that grazing does significantly reduce foliage cover however may not necessarily affect species density.

The monitoring in Winter 2008 and Summer 08/09 showed dead species density in the unburnt quadrats was higher in the unfenced quadrats compared to the fenced quadrats; although the results from Q2 may have influenced this trend. Over time this could become more prominent as grazing will continue in unfenced quadrats and more plants will get eaten or trampled.

Species such as *Calytrix fraseri*, *Conostephium pendulum, Conostylis setigera*, *Dasypogon bromeliifolius* and *Patersonia occidentalis* all recorded higher numbers in the fenced quadrats compared to the unfenced quadrats. This supports the use of fencing to prevent grazing and trampling to speed up species establishment after fire.

7. CONCLUSIONS AND RECOMMENDATIONS

In both the burnt and unburnt quadrats the fenced quadrats showed a higher species richness and density. This indicates that the fencing does prevent grazing and trampling in both burnt and unburnt quadrats. Species such as *Calytrix fraseri, Conostephium pendulum* and *Conostylis setigera* had increased in density in the fenced areas in both burnt and unburnt quadrats indicating better species establishment when not under pressure from grazing.

This study is very limited by sample size because it is a preliminary study into the effect of grazing after fire. It is recommended that the sample size be increased in a bigger study area. Future monitoring should continue to show accurate trends over time.

8. ACKNOWLEDGEMENTS

The authors would like to thank Alice Reavesley from Department of Environment and Conservation for their assistance with this project.

9. LIST OF PERSONELL:

The following personnel of Mattiske Consulting Pty Ltd were involved in this project:

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	Mr M Boardman
	Mr R Burrows
	Ms F Chandler
	Ms R Chesney
	Ms J Jones
	Ms L Maddox
	Ms S Robinson
	Mr S Reiffer
	Mr J See
	Ms F Smith
	Mr T Sleigh
	Ms M Van Wees

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http://www.bom.gov.au/climate/averages/tables/ca_wa_names.shtml

Department of Agriculture and Food (2009*)*
Declared Plants List.
http://www.agric.wa.gov.au/content/PW/WEED/DECP/DECLAREDPLANTS_INDEX.HTM

Department of Environment and Conservation (2009a)
Florabase. Department of Environment and Conservation (http://www.dec.wa.gov.au)

Department of Environment and Conservation (2009b) L*ist of declared rare flora (endorsed by the Minister – January 2008),* viewed 3rd December 2008. http://www.naturebase.net/component/option,com_docman/Itemid,708/task,doc_download/gid,2125/

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Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

Wildlife Conservation Act 1950 (WA)

APPENDIX A1: DEFINITION OF RARE AND PRIORITY FLORA SPECIES (Department of Environment and Conservation 2009a)

Conservation Code	Category
R	**Declared Rare Flora – Extant Taxa** "Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection and have been gazetted as such."
P1	**Priority One – Poorly Known Taxa** "Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
P2	**Priority Two – Poorly Known Taxa** "Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but urgently need further survey."
P3	**Priority Three – Poorly Known Taxa** "Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but need further survey."
P4	**Priority Four – Rare Taxa** "Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years."

APPENDIX A2: DEFINITION OF THREATENED FLORA SPECIES (*Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth])

Category Code	Category
Ex	**Extinct** Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

APPENDIX A3 : DEFINITION OF THREATENED ECOLOGICAL COMMUNITIES (Department of Environment and Conservation 2009d)

Category Code	Category
PTD	**Presumed Totally Destroyed** An ecological community will be listed as Presumed Totally Destroyed if there are no recent records of the community being extant and either of the following applies: (i) records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or; (ii) all occurrences recorded within the last 50 years have since been destroyed.
CE	**Critically Endangered** An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting any one of the following criteria: (i) The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the immediate future.
E	**Endangered** An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. The ecological community must meet any one of the following criteria: (i) The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the short term future.
V	**Vulnerable** An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one of the following criteria: (i) The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; (ii) The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; (iii) The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.

APPENDIX A4: DEFINITION OF PRIORITY ECOLOGICAL COMMUNITIES (Department of Environment and Conservation 2009d)

Category Code	Category
P1	**Poorly-known ecological communities** Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist.
P2	**Poorly-known ecological communities** Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, un-allocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.
P3	**Poorly known ecological communities** (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.
P5	**Conservation Dependent ecological communities** Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX A5: DEFINITION OF STANDARD CONTROL CODES FOR DECLARED PLANT SPECIES IN WESTERN AUSTRALIA (Department of Agriculture and Food 2009)

CONTROL CODE REQUIREMENTS	CONDITIONS
P1 Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2 Aim is to eradicate infestation	Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P3 Aims to control infestation by reducing area and/or density of infestation	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • Within 100 metres inside of the boundaries of the infestation • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Of the remaining infested area:- Where plant density is 1-10 per hectare treat 100% of infestation. Where plant density is 11-100 per hectare treat 50% of infestation. Where plant density is 101-1000 per hectare treat 10% of infestation. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
P4 Aims to prevent infestation spreading beyond existing boundaries of infestation.	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • within 100 metres inside of the boundaries of the infested property • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
Special considerations	In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.

APPENDIX B: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE CARABAN MONITORING PLOTS, 2008 AND 2009

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC 2009a)

FAMILY	SPECIES
POACEAE	*Amphipogon amphipogonoides*
	Amphipogon turbinatus
	Amphipogon sp.
	Poaceae sp.
CYPERACEAE	*Lepidosperma leptostachyum*
	Lepidosperma pubisquameum
	Lepidosperma tenue
	Mesomelaena pseudostygia
	Schoenus clandestinus
	Schoenus curvifolius
	Schoenus sp.
	Tetraria capillaris
RESTIONACEAE	*Alexgeorgea nitens*
	Chordifex sinuosus
	Desmocladus flexuosus
	Hypolaena exsulca
	Loxocarya cinerea
	Lyginia barbata
	Lyginia imberbis
DASYPOGONACEAE	*Acanthocarpus preissii*
	Calectasia narragara
	Dasypogon bromeliifolius
	Lomandra caespitosa
	Lomandra hermaphrodita
	Lomandra ?*integra*
	Lomandra preissii
	Lomandra sericea
	Lomandra sonderi
	Lomandra sp.
	Dasypogonaceae sp.
XANTHORRHOEACEAE	*Xanthorrhoea gracilis*
	Xanthorrhoea preissii
ANTHERICACEAE	*Chamaescilla corymbosa*
	Corynotheca micrantha
	Laxmannia ramosa subsp. *ramosa*
	Thysanotus sp.
	Tricoryne elatior
COLCHICACEAE	*Burchardia congesta*
BORYACEAE	*Borya* ?*sphaerocephala*

APPENDIX B: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE CARABAN MONITORING PLOTS, 2008 AND 2009

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC 2009a)

FAMILY	SPECIES
HAEMODORACEAE	*Conostylis aculeata*
	Conostylis aculeata subsp. *aculeata*
	Conostylis juncea
	Conostylis serrulata
	Conostylis setigera
	Conostylis setosa
	Haemodorum laxum
	Haemodorum paniculatum
	Haemodorum spicatum
	Haemodorum sp.
	Phlebocarya ciliata
	Haemodoraceae sp.
IRIDACEAE	*Patersonia occidentalis*
ORCHIDACEAE	*Caladenia* sp.
	Leporella fimbriata
	Orchidaceae sp.
CASUARINACEAE	*Allocasuarina fraseriana*
	Allocasuarina humilis
PROTEACEAE	*Adenanthos barbiger*
	Adenanthos cygnorum
	Banksia attenuata
	Banksia dallanneyi var. *dallanneyi*
	Banksia menziesii
	Banksia sp.
	Conospermum canaliculatum subsp. *canaliculatum*
	Hakea ruscifolia
	Persoonia comata
	Petrophile linearis
	Petrophile macrostachya
	Petrophile serruriae
	Stirlingia latifolia
LORANTHACEAE	*Nuytsia floribunda*
AMARANTHACEAE	*Ptilotus manglesii*
	Ptilotus sp.
LAURACEAE	*Cassytha* sp.
DROSERACEAE	*Drosera erythrorhiza*
	Drosera platystigma
	Drosera sp.
	Drosera sp. (climbing)

APPENDIX B: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE CARABAN MONITORING PLOTS, 2008 AND 2009

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC 2009a)

FAMILY	SPECIES
MIMOSACEAE	*Acacia extensa*
	Acacia sessilis
	Acacia stenoptera
	Acacia sp.
PAPILIONACEAE	*Bossiaea eriocarpa*
	Bossiaea ornata
	Daviesia decurrens
	Daviesia nudiflora
	Daviesia sp.
	Gastrolobium capitatum
	Gastrolobium plicatum
	Gompholobium tomentosum
	Hovea trisperma
	Hovea trisperma var. *trisperma*
	Jacksonia sternbergiana
RUTACEAE	*Philotheca spicata*
DILLENIACEAE	*Hibbertia acerosa*
	Hibbertia huegelii
	Hibbertia hypericoides
	Hibbertia racemosa
	Hibbertia subvaginata
	Hibbertia sp.
THYMELAEACEAE	*Pimelea sulphurea*
	Pimelea sp.
MYRTACEAE	*Baeckea camphorosmae*
	Baeckea sp.
	Beaufortia elegans
	Beaufortia squarrosa
	Calothamnus quadrifidus
	Calothamnus sp.
	Calytrix flavescens
	Calytrix fraseri
	Eremaea asterocarpa
	Eremaea asterocarpa subsp. *asterocarpa*
	Eremaea pauciflora
	Eremaea pauciflora var. *pauciflora*
	Eucalyptus todtiana
	Leptospermum spinescens
	Melaleuca trichophylla
	Scholtzia involucrata
	Verticordia nitens
	Myrtaceae sp.

APPENDIX B: SUMMARY OF VASCULAR PLANT SPECIES RECORDED WITHIN THE CARABAN MONITORING PLOTS, 2008 AND 2009

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC 2009a)

FAMILY		SPECIES
HALORAGACEAE		*Gonocarpus cordiger*
		Gonocarpus sp.
APIACEAE		*Xanthosia huegelii*
EPACRIDACEAE		*Conostephium pendulum*
		Leucopogon conostephioides
		Leucopogon sp.
		Lysinema ciliatum
		Lysinema ciliatum forma ?. *Insufficient specimen*
GOODENIACEAE		*Dampiera linearis*
		Scaevola repens
STYLIDIACEAE		*Stylidium brunonianum*
		Stylidium carnosum
		Stylidium piliferum
		Stylidium repens
		Stylidium sp.
ASTERACEAE	*	*Hypochaeris glabra*

APPENDIX C: VASCULAR PLANT SPECIES RECORDED IN MONITORING PLOTS AT CARABAN IN 2008 AND 2009

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC 2009a)

SPECIES	MONITORING PLOT																							
	1		2		3		4		5		6		7		8		9		10		11		12	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Acacia extensa													x	x										
Acacia sessilis			x	x	x	x																		
Acacia stenoptera	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x
Acacia sp.			x	x																				
Acanthocarpus preissii													x	x					x	x	x	x		
Adenanthos barbiger																	x	x						
Adenanthos cygnorum							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Adenanthos cygnorum (seedling)															x	x	x	x	x	x	x	x		
Adenanthos sp. (seedling)																	x	x						
Alexgeorgea nitens	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Allocasuarina fraseriana																			x	x	x	x	x	x
Allocasuarina humilis							x	x																
Amphipogon turbinatus															x	x								
Amphipogon amphipogonoides	x	x																						
Amphipogon sp.									x	x							x	x						
Baeckea camphorosmae					x	x											x	x						
Baeckea sp.																	x	x						
Banksia attenuata	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Banksia dallanneyi var. *dallanneyi*	x	x	x	x	x	x	x	x			x	x					x	x			x	x		
Banksia menziesii	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Banksia menziesii (seedling)																							x	x
Banksia sp.							x	x															x	x
Beaufortia elegans			x	x																				
Beaufortia squarrosa																					x	x		
Borya ?sphaerocephala									x	x														
Bossiaea eriocarpa	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Bossiaea ornata											x	x	x	x										
Burchardia congesta	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x			x	x	x	x
Caladenia sp.									x	x														
Calectasia narragara	x	x	x	x																				
Calothamnus quadrifidus									x	x														
Calothamnus sp.													x	x										
Calytrix flavescens			x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Calytrix fraseri			x	x			x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x
Cassytha sp.																	x	x						

APPENDIX C: VASCULAR PLANT SPECIES RECORDED IN MONITORING PLOTS AT CARABAN IN 2008 AND 2009

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC 2009a)

SPECIES	MONITORING PLOT																							
	1		2		3		4		5		6		7		8		9		10		11		12	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Chamaescilla corymbosa			x	x	x	x																		
Chordifex sinuosus											x	x												
Conospermum canaliculatum subsp. *canaliculatum*									x	x														
Conostephium pendulum	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Conostylis aculeata							x	x													x	x	x	x
Conostylis aculeata subsp. *aculeata*											x	x												
Conostylis juncea																					x	x		
Conostylis serrulata																							x	x
Conostylis setigera	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x
Conostylis setosa	x	x																						
Corynotheca micrantha									x	x	x	x												
Dampiera linearis			x	x	x	x									x	x	x	x						
Dasypogon bromeliifolius	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Dasypogonaceae sp.							x	x																
Daviesia decurrens	x	x															x	x						
Daviesia nudiflora	x	x	x	x			x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x
Daviesia sp.	x	x			x	x	x	x	x	x			x	x										
Desmocladus flexuosus	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Drosera erythrorhiza	x	x	x	x	x	x	x	x	x	x														
Drosera platystigma									x	x														
Drosera sp.			x	x							x	x	x	x	x	x	x	x	x	x	x	x	x	x
Drosera sp. (climbing)							x	x	x	x			x	x			x	x						
Eremaea asterocarpa			x	x			x	x			x	x					x	x	x	x				
Eremaea asterocarpa subsp. *asterocarpa*			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Eremaea pauciflora									x	x	x	x	x	x									x	x
Eremaea pauciflora var. *pauciflora*			x	x																				
Eucalyptus todtiana	x	x			x	x	x	x	x	x	x	x												
Gastrolobium capitatum	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x
Gastrolobium plicatum													x	x										
Gompholobium tomentosum	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Gonocarpus cordiger	x	x	x	x	x	x	x	x	x	x	x	x												
Gonocarpus sp.	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Haemodoraceae sp.			x	x	x	x			x	x														
Haemodorum laxum							x	x			x	x	x	x										
Haemodorum paniculatum																	x	x						

APPENDIX C: VASCULAR PLANT SPECIES RECORDED IN MONITORING PLOTS AT CARABAN IN 2008 AND 2009

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC 2009a)

SPECIES	MONITORING PLOT																							
	1		2		3		4		5		6		7		8		9		10		11		12	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Haemodorum spicatum							x	x	x	x			x	x										
Haemodorum sp.	x	x	x	x	x	x	x	x	x	x														
Hakea ruscifolia							x	x	x	x														
Hibbertia acerosa	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Hibbertia huegelii	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Hibbertia hypericoides	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Hibbertia racemosa																							x	x
Hibbertia subvaginata	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Hibbertia sp.																							x	x
Hovea trisperma					x	x			x	x	x	x	x	x			x	x			x	x		
Hovea trisperma var trisperma	x	x			x	x																		
**Hypochaeris glabra*					x	x																		
Hypolaena exsulca	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Jacksonia sternbergiana	x	x																						
Laxmannia ramosa subsp. *ramosa*													x	x										
Lepidosperma leptostachyum			x	x	x	x	x	x					x	x							x	x		
Lepidosperma pubisquameum	x	x			x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x	x
Lepidosperma tenue							x	x	x	x	x	x												
Leporella fimbriata					x	x			x	x														
Leptospermum spinescens			x	x	x	x			x	x	x	x												
Leucopogon conostephioides													x	x	x	x	x	x	x	x				
Leucopogon sp.															x	x								
Lomandra caespitosa							x	x																
Lomandra hermaphrodita	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Lomandra ?integra							x	x																
Lomandra preissii	x	x	x	x	x	x					x	x	x	x			x	x	x	x			x	x
Lomandra sericea					x	x																		
Lomandra sonderi							x	x																
Lomandra sp.							x	x													x	x		
Loxocarya cinerea	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Lyginia barbata	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Lyginia imberbis					x	x																		
Lysinema ciliatum																			x	x	x	x		
Lysinema ciliatum forma ? Insufficient specimen															x	x					x	x		
Melaleuca trichophylla	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

APPENDIX C: VASCULAR PLANT SPECIES RECORDED IN MONITORING PLOTS AT CARABAN IN 2008 AND 2009

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC 2009a)

SPECIES	MONITORING PLOT																							
	1		2		3		4		5		6		7		8		9		10		11		12	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Mesomelaena pseudostygia	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Myrtaceae sp.					x	x					x	x												
Nuytsia floribunda	x	x																	x	x	x	x		
Orchidaceae sp.	x	x	x	x	x	x	x	x	x	x														
Patersonia occidentalis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Persoonia comata	x	x			x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x		
Petrophile linearis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Petrophile macrostachya					x	x	x	x									x	x			x	x		
Petrophile serruriae																	x	x					x	x
Philotheca spicata	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x			x	x		
Phlebocarya ciliata	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pimelea sulphurea	x	x			x	x	x	x	x	x	x	x	x	x			x	x	x	x			x	x
Pimelea sp.													x	x			x	x	x	x			x	x
Poaceae sp.											x	x	x	x			x	x						
Ptilotus manglesii	x	x	x	x	x	x	x	x	x	x			x	x									x	x
Ptilotus sp.	x	x																						
Scaevola repens											x	x	x	x			x	x					x	x
Schoenus clandestinus	x	x	x	x	x	x	x	x	x	x	x	x									x	x	x	x
Schoenus curvifolius	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x		
Schoenus sp.									x	x							x	x						
Scholtzia involucrata	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Stirlingia latifolia	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Stylidium brunonianum			x	x	x	x											x	x						
Stylidium carnosum							x	x	x	x														
Stylidium piliferum	x	x					x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x
Stylidium repens			x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Stylidium sp.			x	x			x	x	x	x					x	x								
Tetraria capillaris	x	x			x	x	x	x	x	x			x	x	x	x	x	x						
Thysanotus sp.	x	x	x	x	x	x	x	x							x	x	x	x						
Tricoryne elatior			x	x			x	x																
Verticordia nitens													x	x										
Xanthorrhoea gracilis													x	x			x	x	x	x				
Xanthorrhoea preissii	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Xanthosia huegelii	x	x	x	x	x	x			x	x														