

The Bunkers C.P. Goat Browse Assessment June 2015



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Lethbridge, M., Andrews, L. and Stead, M. 2015. *The Bunkers Conservation Park Goat Browse Assessment, June 2015*. Report to the Department of Environment, Water and Natural Resources.



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AIMS

1. Assess yellow-footed rock-wallaby occupancy and habitat quality in targeted sample areas identified as potential yellow-footed rock-wallaby habitat.
2. Assess goat and other herbivore browse on palatable perennial plant species in target sample areas, to gauge effectiveness of goat management in areas identified as potential yellow-footed rock-wallaby habitat.

PURPOSE

This round of assessment will provide a baseline on yellow-footed rock-wallaby occupancy and habitat suitability of surveyed areas, and the state of the more palatable perennial shrubs and trees in those areas. The browse assessments on palatable plants is an effective measure of the damage that goats have done over the previous growing season, making it a good way to gauge goat management effectiveness. With effective management a significant proportion of shrubs and immature trees will be recorded as intact or recovering at the majority of surveyed areas.

CONCLUSIONS

- The property is in excellent condition overall thanks to the hard work of the Yellow-footed Rock-wallaby Preservation Association Inc and Sporting Shooters S.A.
- Ongoing goat and fox control has allowed Yellow-footed Rock-wallabies to re-establish themselves in locations that probably have not been occupied for more than 100 years. Importantly, wallabies are now found at locations on the reserve that are usually marginal. While these more marginal habitats may fluctuate over time (i.e. they may not be good refuges during prolonged drought), they are nevertheless providing important gene flow between core colonies in good times. This would not have been the case prior to the Yellow-footed Rock-wallaby Preservation Society managing the property, with the support of Bounceback.
- Overall, the results of the browse impact assessment suggest that the recovery of palatable plant species is very encouraging following the implementation of goat control.
- What little goat impact had been identified was evident towards the periphery of the property, particularly in the south where there appears to be some goat movement in and out of the property. The core of the property shows little to no goat impact.
- Palatable perennial plant species most impacted were *Alectryon oleifolius* ssp. *canescens*, *Exocarpus aphyllus*, *Pittosporum angustifolium* and *Prostanthera striatiflora*
- A number of highly palatable species (e.g. *Pimelea microcephala*, *Santalum* spp.) were so rarely encountered, or exhibited such a skewed age distribution (i.e. all mature), that it is probably too early to determine whether they will recover from historic browse impacts (i.e. pre-1993).
- Reasonable numbers of *Santalum spicatum* were located at Site 1. These are listed as Vulnerable in South Australia. No small to medium individuals were located, suggesting a lack of recruitment.



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MANAGEMENT RECOMMENDATIONS

- We continue to encourage fox and goat control.
- In addition to the browse assessments conducted here, the Yellow-footed Rock-Wallaby Preservation Association Inc. may choose to monitor the condition and recruitment of highly palatable species (e.g. *Santalum*) at selected sites more closely.

Monitoring the geographical expansion (rather than the abundance) of the wallabies and their associated habitat will provide better insights about their longer-term viability, particularly since aerial surveys are no longer undertaken in this area. This is because when their abundance reaches the habitat's carrying capacity at a particular location, the abundance becomes meaningless since individuals will move out, expanding their range.

METHODS USED

Field assessment was coordinated by Michael Stead, from EcoKnowledge and Dr Mark Lethbridge. Assistance was provided by five volunteers (Chris Baker, Chris March, Andrew Frost, Adriana Fuessel, and Emily Zabel). Personnel were divided into two independent survey teams; led by M. Stead and M. Lethbridge. On day one of the survey, Robert Brandle (DEWNR) assisted.

Yellow-footed rock-wallaby presence was assessed by searching rocky areas and sheltered gullies for their distinctive faecal pellets, which were collected by the volunteers and confirmed by team leaders. Sites searched were also assessed for habitat quality using the methods of Lethbridge *et al.* (2012).

Herbivore browse was assessed using methods outlined in the guidelines. At each site a number of plant species subject to goat browse were assessed for structural form as dictated by recent browse, browse intensity, height class and presence of herbivore faecal pellets.

Data was entered into an Access database to be held by Natural Resources SA Arid Lands.

SITE LOCATIONS

The Bunkers Conservation Park (BCP) is a 140 km² private reserve located west of the Flinders Ranges National Park. It was originally part of Willow Springs Station, owned by the Reynolds family. In 1993, in support of the Bounceback Program, the removal of goats was authorised by the family, and in 2001, the Yellow-footed Rock-wallaby Preservation Association Inc. purchased the Bunkers Block. Continual goat (and fox) control has been undertaken on this property since this time.



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Three distinct areas were sampled (see Figure 1) using three sites per area, which were generally separated by at least 300 m.

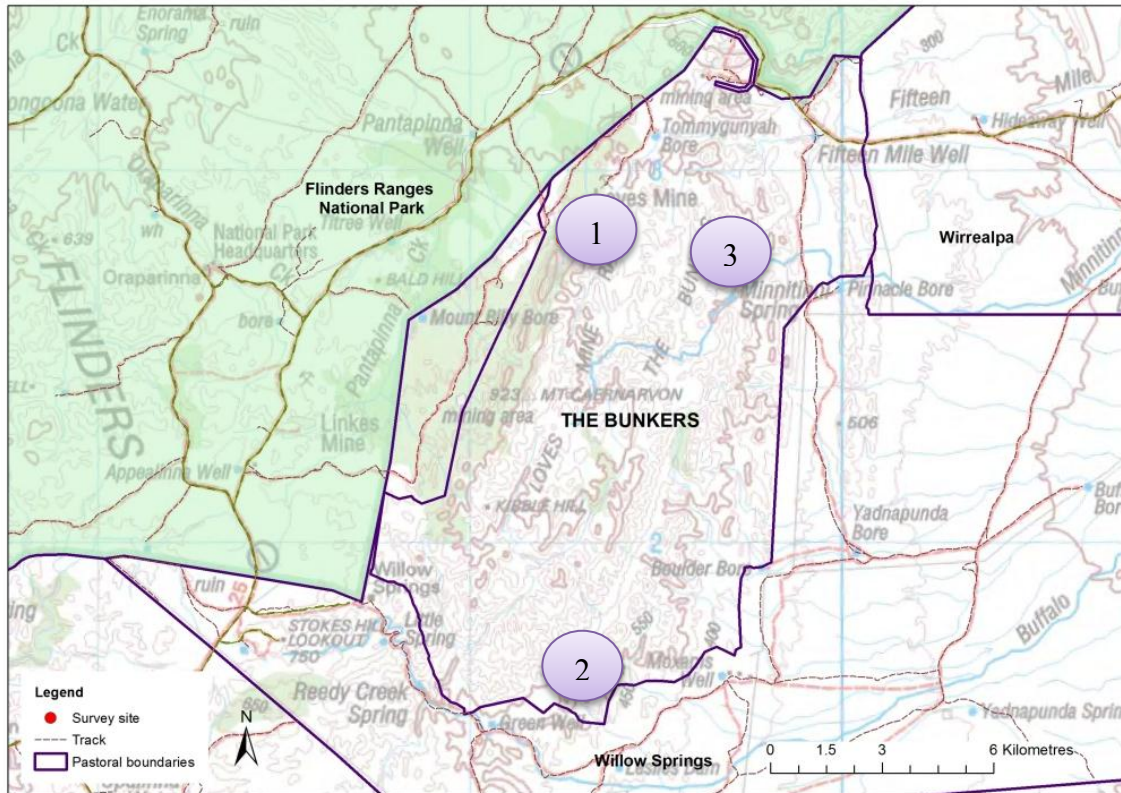


Figure 1 The Bunkers Conservation Park



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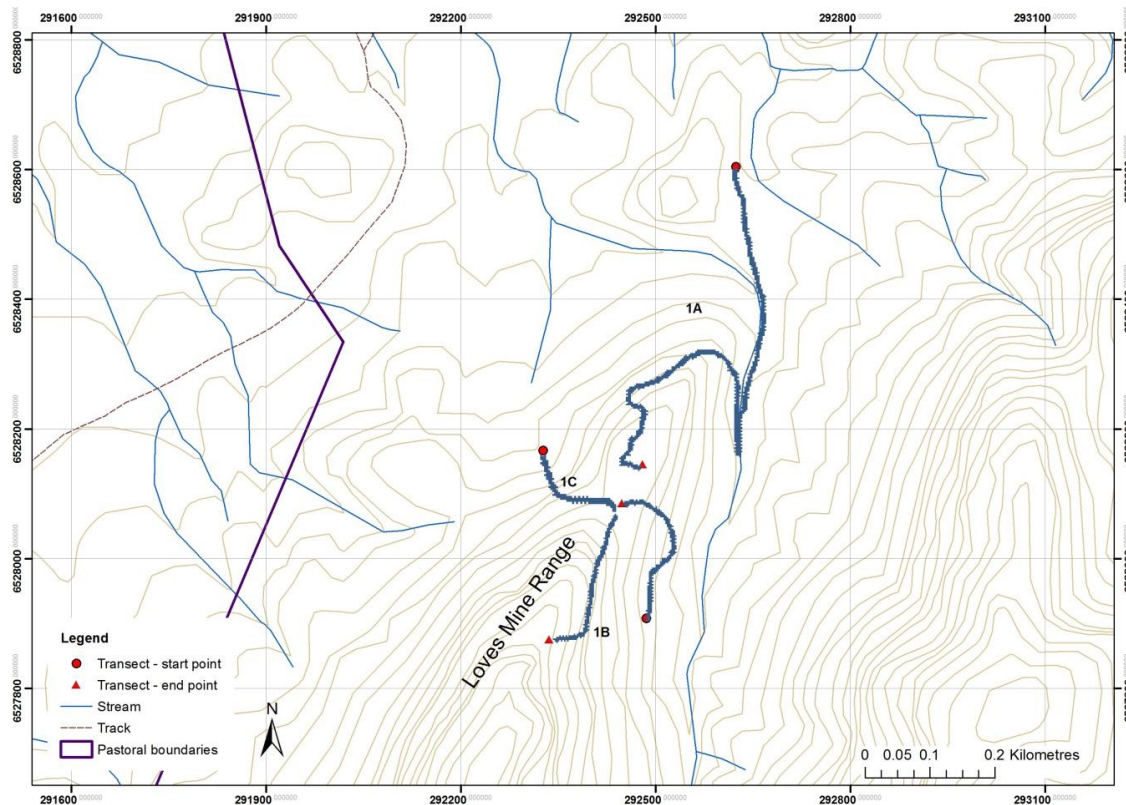


Figure 2 The Bunkers site 1 (showing approximate track lines)

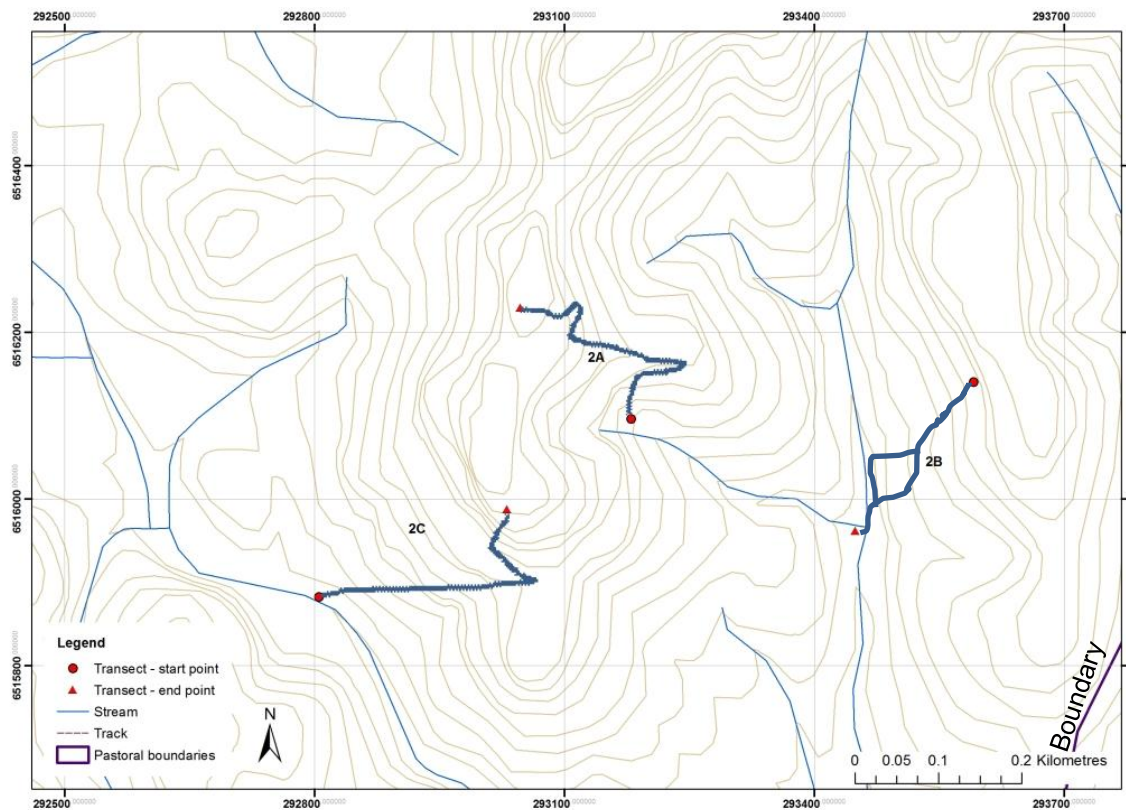


Figure 3 The Bunkers site 2 (showing approximate track lines)

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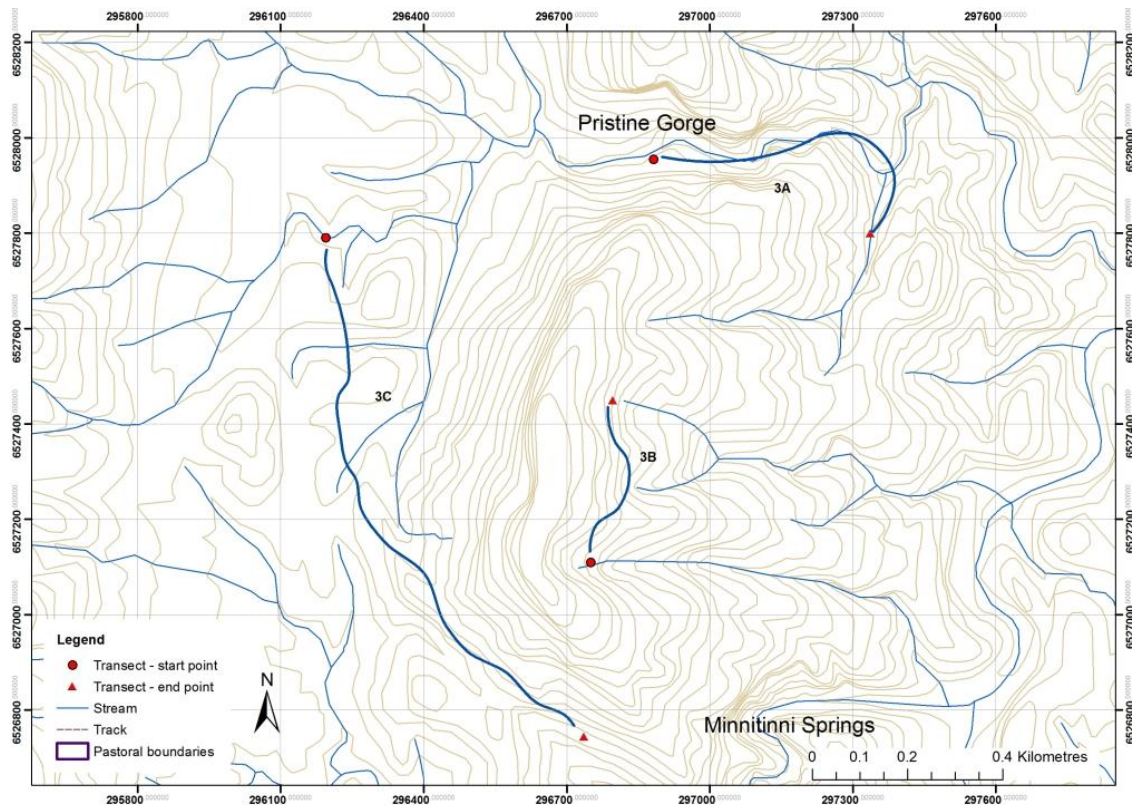


Figure 4 The Bunkers site 3 (showing approximate track lines)

FINDINGS

Yellow-footed rock-wallaby occupancy and habitat quality

Seven sites were searched for yellow-footed rock-wallaby presence in BCP, all of which showed recent signs of the species. Two animals were seen at Loves Mine Range, and another near Halfway Mine/Pristine Gorge. Thirty individuals were seen in the Pristine Gorge boulder field. Abundant faecal pellets were seen around Minnitinni Springs.

Importantly, one individual was also seen at Site 2C, just inside the southern boundary adjoining Willow Springs. Lethbridge *et al.* (2012) report that the common driver of rock-wallaby presence in the Flinders Ranges is the abundance of food resources. Each of the survey sites recorded high levels of resources, and included known food plants such as *Ptilotus obovatus* and *Sida petrophila*.

A summary of the surveyed sites can be seen in Table 1.



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Table 1 Indication summary of yellow-footed rock-wallaby occupancy

Site	YFRW faecal pellets	YFRW sighting	Resource	Shelter
Loves Mine Range	Numerous & fresh	1	>1 species & abundant	High number of deep cracks
Loves Mine Range	Old & fresh scarce	1	>1 species & abundant	Low number of deep cracks
Halfway Mine/Pristine Gorge #1	Numerous & fresh	1	>1 species & abundant	Nil
Halfway Mine/Pristine Gorge #2	Scarce but fresh	0	>1 species & abundant	Nil
Pristine Gorge	Numerous	30	>1 species & abundant	Boulder field
Minnitinni Springs	Numerous & fresh	0	>1 species	High number of deep cracks
Site 2	Scarce.	1	>1 species & abundant	High number of deep cracks

Herbivore frequency

Kangaroos were the dominant herbivore within BCP, with kangaroo faecal pellets recorded at all sites (Figure 5). Goat faecal pellets were recorded at five of the nine sites, and was highest at Site 2 (2A, 2B and 2C), but with no record of goat presence at Site 3. Site 3 is located in the core of the property where goat activity was negligible. Conversely, Site 2 was near the southern boundary of the property. Movement of goats in and out of BCP was evident along the southern property boundary. This was reflected in the herbivore impact assessment results that follow.

This is only a summary report and as such we have not as yet teased out plant-by-plant relationships to faecal pellets. In other words the more heavily browsed plants have not as yet been individually correlated with the type of faecal pellets found at those locations. So it should not be assumed that goats are responsible for all of the browsing observed on the species which follow. For example, in the steeper landsystems, euros and wallabies will account for some browsing.



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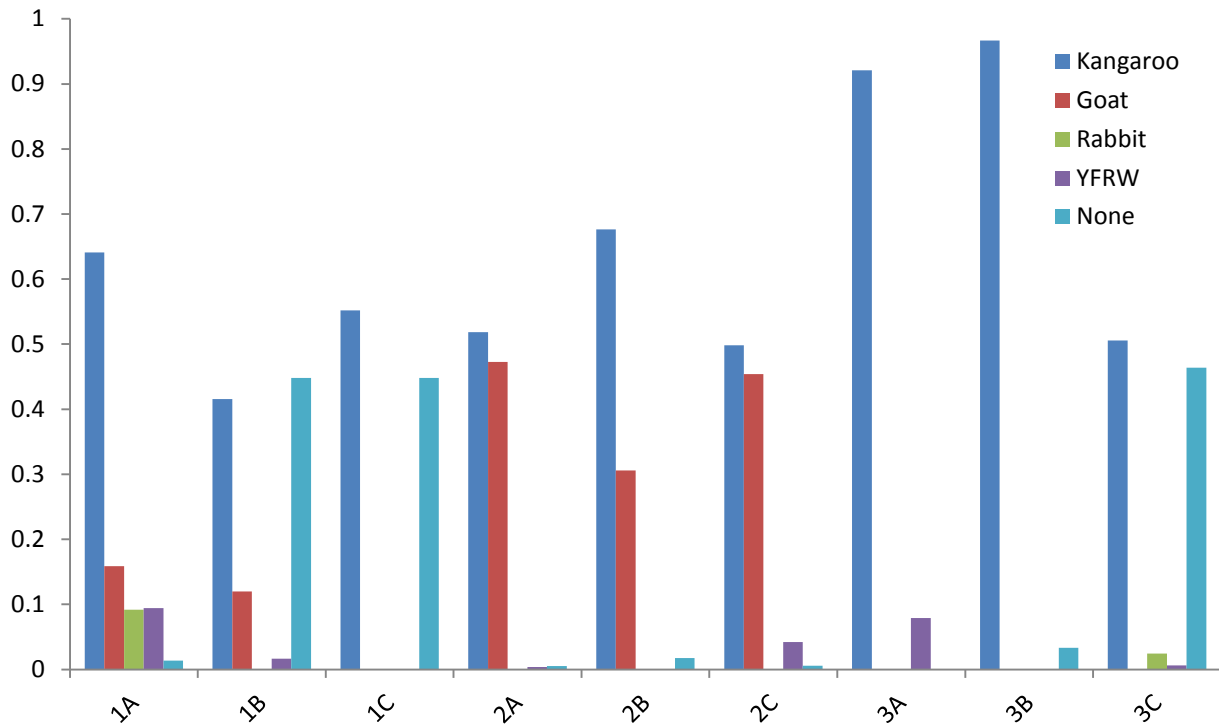


Figure 5 Frequency index for herbivore species based on the proportion of sampled plants with faecal pellets, measured up to 1 m beyond the line of the canopy cover from the base of the plant

Herbivore Impact Assessments

Twelve plant species (990 individuals) were assessed across the nine sampled sites.

Plant Browse Form

Plants were considered to be in a 'desirable' state if they were categorised as 'intact' or 'recovering'. Figure 6 illustrates the proportion (%) of plants at each site, by species, which were in these categories.

Overall, the browse form results suggest that the current goat management at BCP is effective.

Browse impact was highest towards the periphery of the property, particularly in the south where goat movement in and out of the property was evident. At these southern sites (2A-2C), *Exocarpus aphyllus*, *Prostanthera striatiflora*, and to a lesser degree *Alectryon oleifolius* ssp. *canescens* were particularly impacted. The core of the property had comparatively little goat browse impact.

Browse-up, that is, where a plant has grown beyond the reach of herbivores, and there is a canopy beyond herbivore reach, was recorded on 18.6% of the surveyed plant species known to grow over 1.2 m in height (Figure 7).

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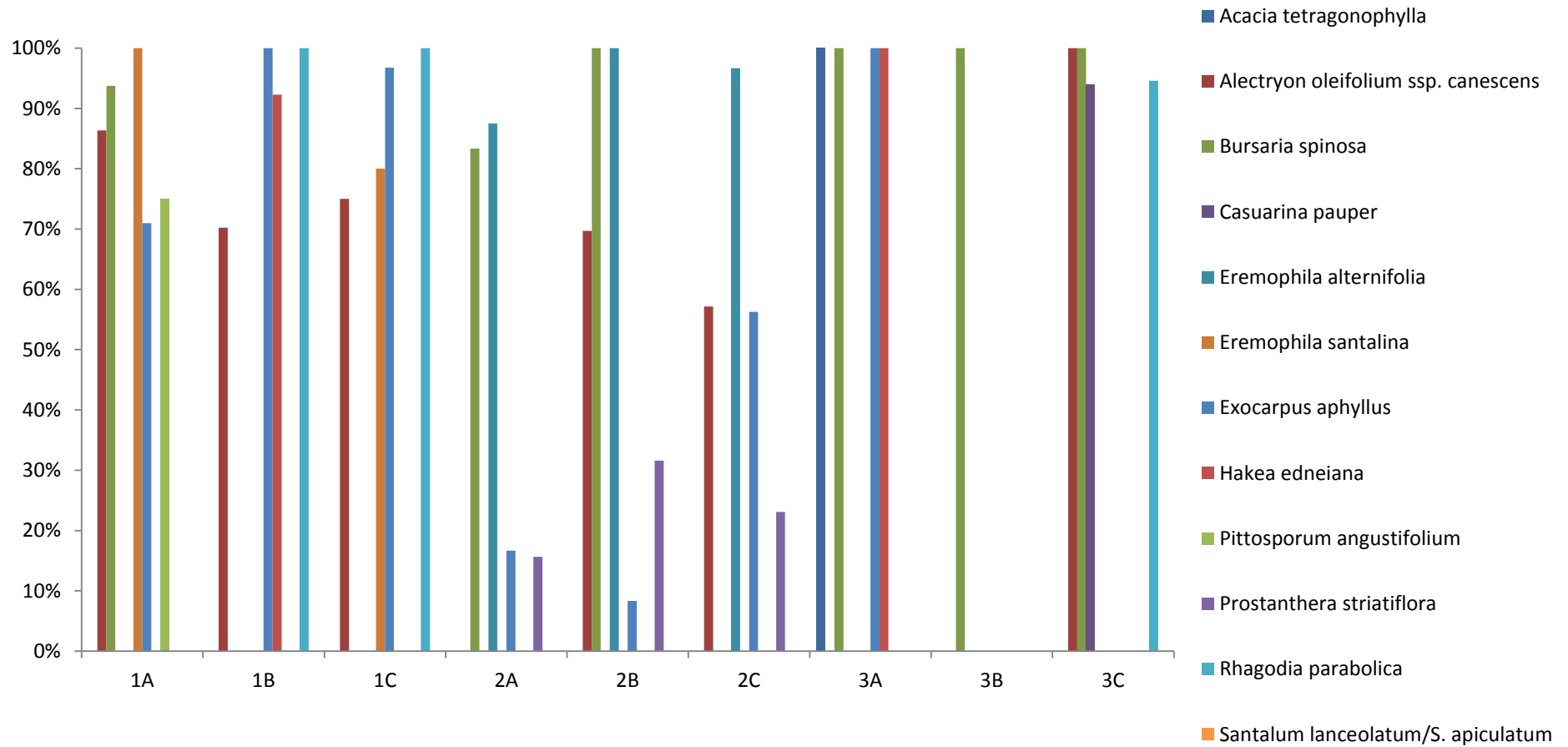


Figure 6. Proportion (%) of plants in desirable 'intact' or 'recovering' states

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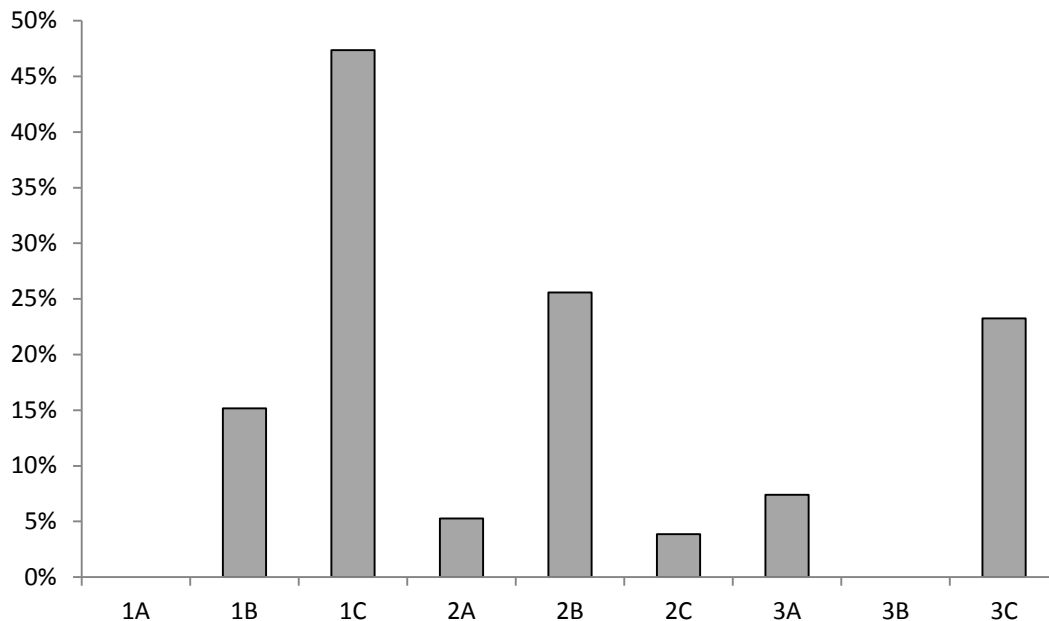


Figure 7 Proportion (%) of plants with recorded 'browse-up' (confined to *Alectryon oleifolium* ssp. – *canescens*, *Casuarina pauper*, *Exocarpus aphyllus*, *Hakea edneiana*, *Pittosporum angustifolium*, *Santalum lanceolatum*/*S. apiculatum* over 1.2 m in height)

Browse Intensity

Browse intensity assesses the level of browse by examining the size of the most recently browsed stems within herbivore reach (< 2 m). Plants with an average stem diameter below 3mm indicate minimal browsing ('Intact'), and are of no concern. Conversely, plants with an average stem diameter above 3 mm possibly indicate a level of herbivore activity that is unsustainable and may prompt management action. However, this needs to be evaluated on a species by species basis, as some plant species naturally have stem diameters greater than 3 mm.

Figure 8 illustrates, by species, the proportion (%) of plants at each site that had the majority of their canopies browsed beyond 3 mm. This is of concern where it exceeds 50 % and is probably unsustainable for plants approaching 100 %.

Once again, browse intensity was highest at the sites along the southern boundary of the BCP. Here, more than 80% of individuals for *A. oleifolius* ssp. *canescens* and *E. aphyllus* had stem diameters > 3 mm. For some species the results need to be interpreted with caution. For example, even at high browse intensities the average browse diameter for species such as *P. striatiflora* would rarely exceed 3 mm. Nonetheless, the current browse intensity at Site 2 may be sufficient to prevent its' recruitment.

Otherwise, browse intensity was generally low for all species at the others sites.



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Adventitious growth is new growth that generates from a trunk of a woody plant, often following heavy physical (e.g. browse) or environmental stress. It was recorded in 7.50 % of plants (Figure 9).

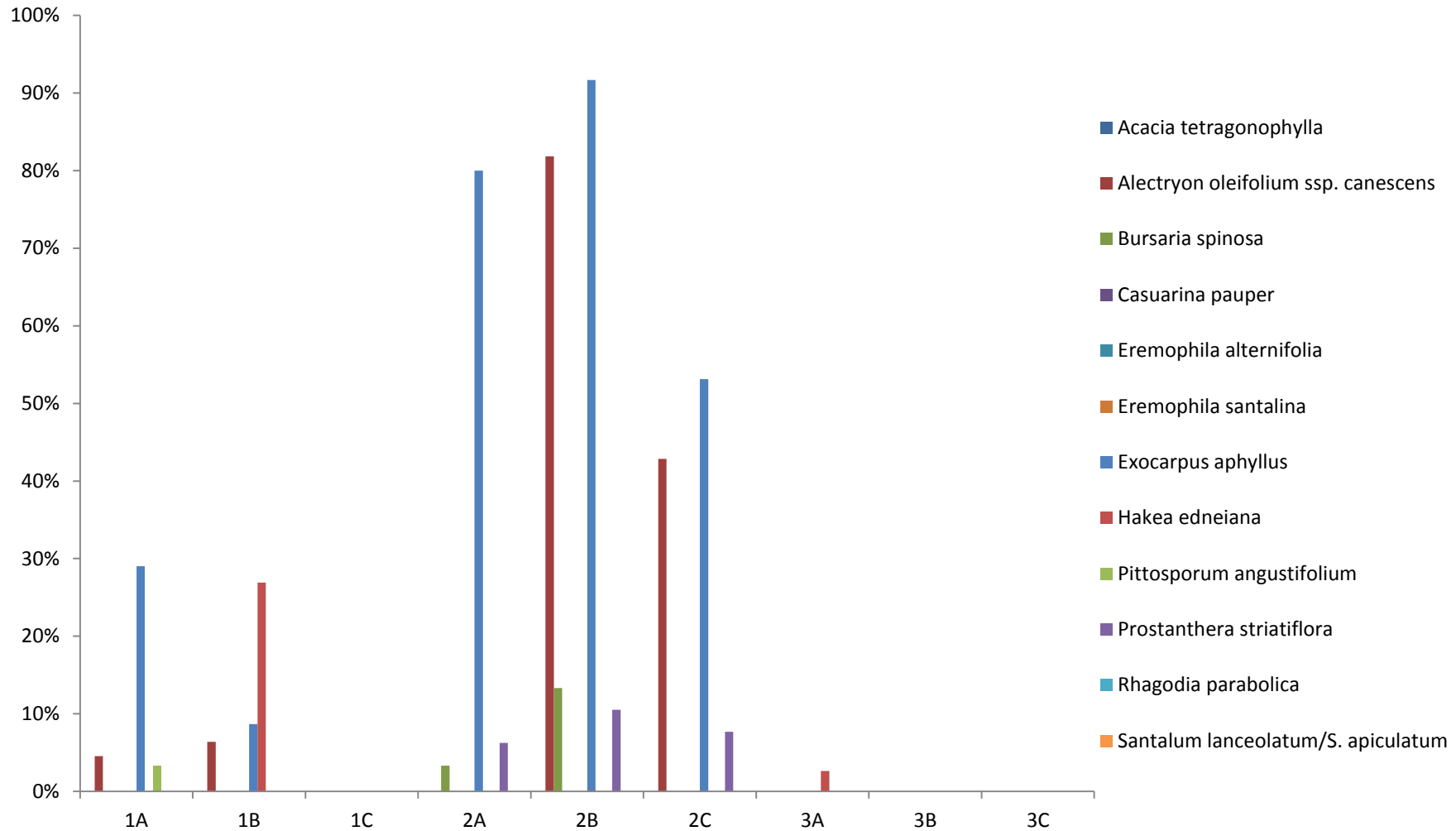


Figure 8 Proportion of plants with browse tips >3 mm



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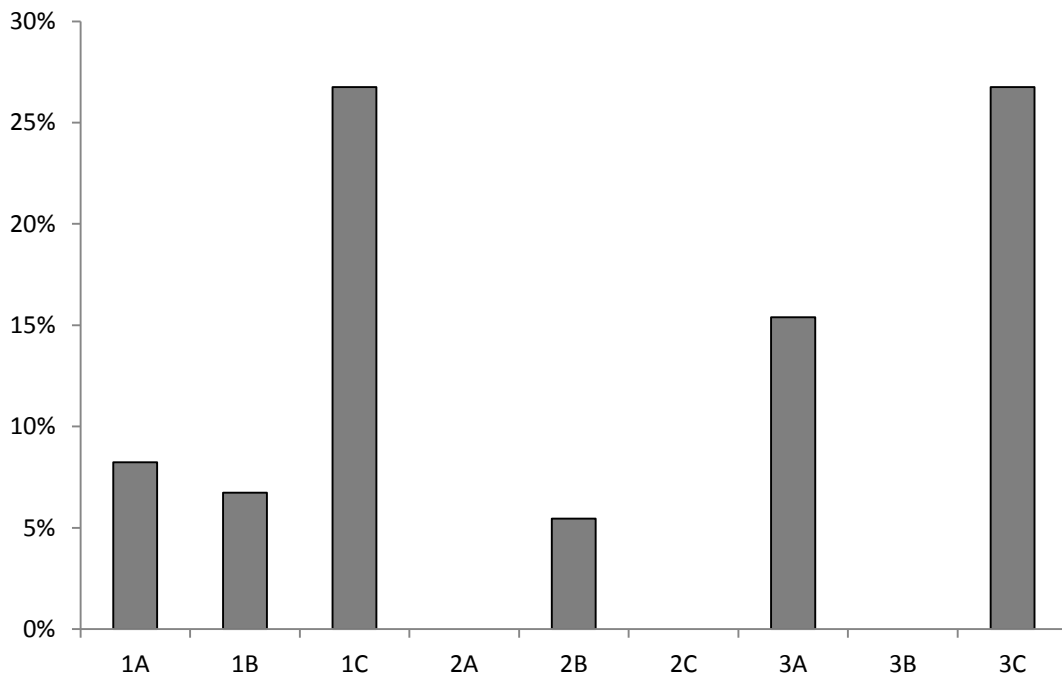


Figure 9 Proportion of plants with recorded adventitious growth

Height Class

The heights of all plants were recorded and classified into height classes as an approximation of population age structure. This measure can provide insight into historic interruptions in recruitment through an absence of particular height cohorts.

At sites subjected to low browse intensity, younger plants below 1.2 m often make up a large proportion of plants present. For example, in heavily browsed areas, the black oak (*Casuarina pauper*) occurs as mature adult trees > 2.5 m or heavily browsed and stunted suckers ~0.5 m in height, and as a result have an indeterminate age. The lack of intermediate height classes suggests that current browse pressure is sufficient to inhibit further growth.

Similarly, the *Santalum* spp. (quandong and sandalwood) were only present as mature adults above 2.5 m. Their presence suggests that historic browse impacts at BCP have been lower than on many other holdings in the Flinders Ranges, where today they are usually rare or entirely absent. Still, the recovery of these species from historic browse impacts on BCP, if it occurs, is likely to be slow.

Conversely, the skew towards low and medium height class for *Pittosporum angustifolium* (native apricot) suggests that this species is rapidly recruiting and spreading through the landscape following the relaxation of browse pressure.



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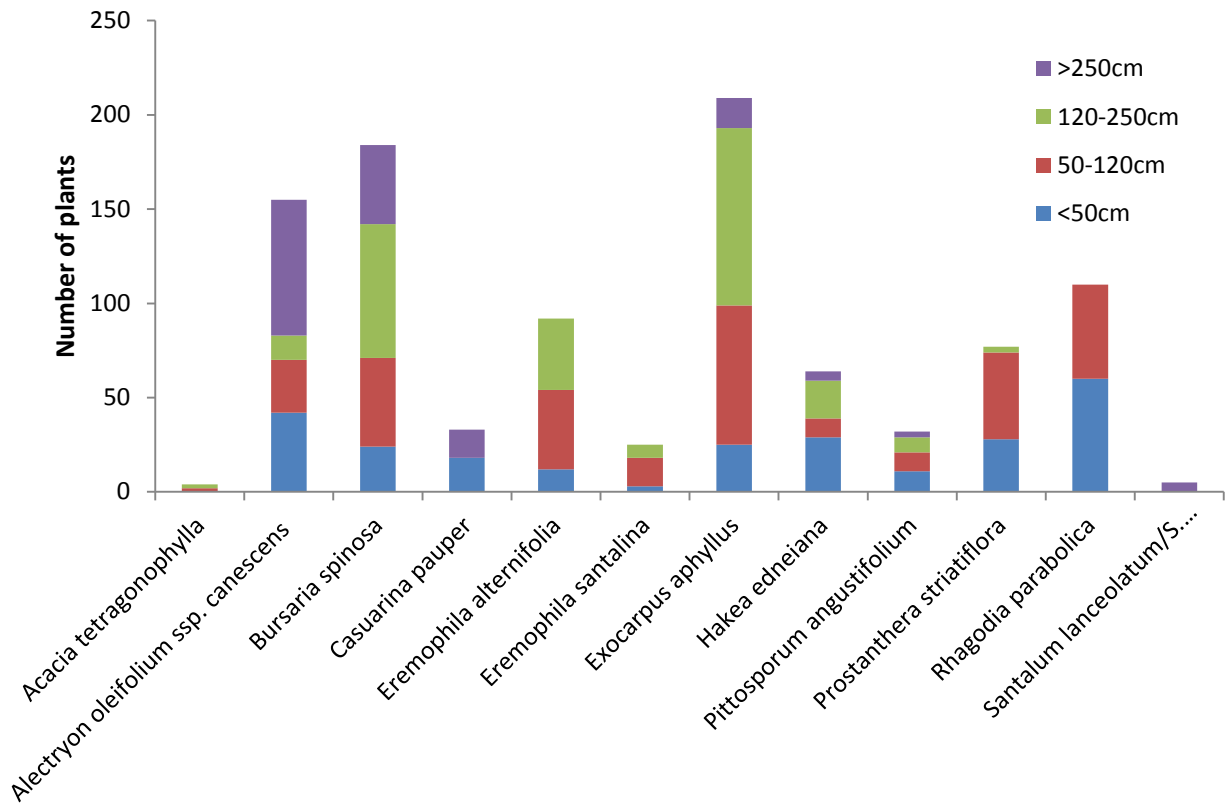


Figure 10 Number of plants in each height category



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References

Lethbridge, M., Andrews, L. and Stead, M. (2012). *An analysis of Yellow-footed Rock-wallaby ground survey data in the Flinders and Olary Ranges*. Report to Department of Environment, Water and Natural Resources.



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Appendix – Site data summaries

Sites sampled, location and physical description.

Site_ID	Start_easting	Start_northing	End_easting	End_northing	Land_type
1A	292481	6528157	292624	6528616	ridge
1B	292337	6527887	292486	6527920	hill top; midslopes
1C	292449	6528097	292327	6528179	midslopes; creekline
2A	293048	6516241	293181	6516108	hill top; escarpment; midslopes; gully
2B	293450	6515973	293592	6516152	midslopes; gully; river
2C	293032	6515999	292806	6515894	hill top; midslopes; foot slopes
3A	297338	6527811	296883	6527967	
3B	296798	6527461	296751	6527121	
3C	296737	6526755	296195	6527802	gully/gorge

Yellow-footed rock-wallaby ground survey & habitat quality data summary

Site_ID	Faecal pellets	Sightings	Bones & remains	Boulder sizes	Deep cracks in rocks	Boulder field extent	Protected rock terraces	Resources	Distance to water	Overstorey density	Understorey density
Loves Mine Range	4	1	0	0	3	0	2	3	0	1	1
Halfway Mine/Pristine Gorge	4	1	0	0	0	0	0	3	0	0	1
Halfway Mine/Pristine Gorge	3	0	0	0	0	0	0	3	0	0	1
Pristine Gorge	4	30	0	3	3	4	0	3	0	1	1
Minnitinni Springs	4	0	0	3	3	4	3	2	0	0	1
Loves Mine Range	2.5	1	0	0	1	0	1	3	0	1	1
2C	2.5	1	0	0	3	0	0	3	0	1	1

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Browse form data summary

The percentage of plants at each site in the 'desirable' categories of 'intact' or 'recovering'

	1A	1B	1C	2A	2B	2C	3A	3B	3C
<i>Acacia tetragonophylla</i>							100%		
<i>Alectryon oleifolium ssp. canescens</i>	86%	70%	75%		70%	57%			100%
<i>Bursaria spinosa</i>	94%			83%	100%		100%	100%	100%
<i>Casuarina pauper</i>									94%
<i>Eremophila alternifolia</i>				88%	100%	97%			
<i>Eremophila santalina</i>	100%		80%						
<i>Exocarpus aphyllus</i>	71%	100%	97%	17%	8%	56%	100%		
<i>Hakea edneiana</i>		92%					100%		
<i>Pittosporum angustifolium</i>	75%								
<i>Prostanthera striatiflora</i>				16%	32%	23%			
<i>Rhagodia parabolica</i>		100%	100%						95%
<i>Santalum lanceolatum/S. apiculatum</i>	0%								



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Plant browse intensity data summary

The percentage of plants at each site with tips > 3mm (NB: <= 3mm is more desirable for most plants – suggesting less browsing by herbivores).

	1A	1B	1C	2A	2B	2C	3A	3B	3C
<i>Acacia tetragonophylla</i>							0%		
<i>Alectryon oleifolium ssp. canescens</i>	5%	6%	0%		82%	43%			0%
<i>Bursaria spinosa</i>	0%			3%	13%		0%	0%	0%
<i>Casuarina pauper</i>									0%
<i>Eremophila alternifolia</i>				0%	0%	0%			
<i>Eremophila santalina</i>	0%		0%						
<i>Exocarpus aphyllus</i>	29%	9%	0%	80%	92%	53%	0%		
<i>Hakea edneiana</i>		27%					3%		
<i>Pittosporum angustifolium</i>	3%								
<i>Prostanthera striatiflora</i>				6%	11%	8%			
<i>Rhagodia parabolica</i>		0%	0%						0%
<i>Santalum lanceolatum/S. apiculatum</i>	0%								



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Plant size data summary

The percentage of plants at each site < 1.2m

	1A	1B	1C	2A	2B	2C	3A	3B	3C
<i>Acacia tetragonophylla</i>							50%		
<i>Alectryon oleifolium ssp. canescens</i>	55%	98%	0%		6%	57%			18%
<i>Bursaria spinosa</i>	31%			33%	20%		6%	30%	91%
<i>Casuarina pauper</i>									55%
<i>Eremophila alternifolia</i>				44%	50%	83%			
<i>Eremophila santalina</i>	75%		60%						
<i>Exocarpus aphyllus</i>	52%	65%	77%	37%	0%	28%	33%		
<i>Hakea edneiana</i>		38%					76%		
<i>Pittosporum angustifolium</i>	66%								
<i>Prostanthera striatiflora</i>				97%	89%	100%			
<i>Rhagodia parabolica</i>		100%	100%						100%
<i>Santalum lanceolatum/S. apiculatum</i>	0%								



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Herbivore faecal pellet frequency at plants data summary

The percentage of plants at each site that recorded faecal pellets from different herbivore species

Bunkers	1A	1B	1C	2A	2B	2C	3A	3B	3C
Kangaroo	64%	42%	55%	52%	68%	50%	92%	97%	51%
Goat	16%	12%	0%	47%	31%	45%	0%	0%	0%
Rabbit	9%	0%	0%	0%	0%	0%	0%	0%	2%
YFRW	9%	2%	0%	0%	0%	4%	8%	0%	1%
None	1%	45%	45%	1%	2%	1%	0%	3%	46%

