

Floristic Survey of Poorly Known Remnant Vegetation Types and Revegetation in the Coorong, Lower Lakes and Murray Mouth Region



December 2014



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Executive summary

Quadrat and transect based data were gathered from 114 sites in the Coorong, Lower Lakes Murray Mouth Program area in spring of 2013 and 2014 using a method analogous to the Biological Survey of South Australia methodology. Fifty two sites were located in areas with remnant vegetation, and 62 sites were located in areas where revegetation has been undertaken. Remnant sites were located in vegetation types for which there is a current paucity of data.

Sites were allocated to an ecosystem type, based upon soil type, vegetation and location in the landscape. These ecosystem types have been used as the primary grouping for analysis. There was a consistently higher number of species across different life forms in remnant vegetation sites compared with revegetation sites. Sites in remnant vegetation also showed a general pattern of a higher density of native species than revegetation sites, which was reflected across all life forms. Some of the generally lower densities observed for trees and shrubs in revegetation could be attributed to mortality rates of revegetation, although this observation is anecdotal only as no specific data was gathered on these rates. However, it was also apparent that for the grasses, shrubs, mat plants and sedges noted in the environmental settings above that, irrespective of mortality rates, the original plantings were at densities much lower than observed in remnant sites. Ongoing research should focus upon the loss of ecological functionality as a result of a paucity of these life form types in revegetation, to help determine whether revegetation efforts need to focus upon improving the species richness and cover of these particular life forms and species.

Future revegetation programs could consider the current state of sites to help set a realistic goal restoration state. Highly degraded sites, such as those dominated by Perennial Veldt Grass, are likely to have recovery limited by their initial poor state. In contrast, sites where there are still remnant species or strata present, such as in many of the samphire sites, are likely to have a restoration state that more closely resembles their remnant form. Considering the current and potential restoration state of each site, and prioritising to sites where the restoration state is most desirable, may help improve the overall effectiveness of revegetation efforts.

The methodology used for this project was reviewed, and suggestions are made for potential changes or improvements for future work. The data gathered in this project will prove valuable in ongoing landscape level planning, and will help inform and improve the continued delivery of the vegetation program through better design of habitat restoration strategies.

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1.0 Introduction:

The Coorong, Lower Lakes Murray Mouth Program (CLLMM) began in 2009 as part of the Commonwealth's Bioremediation and Revegetation Project. Works were undertaken as an emergency response to the prolonged drought. Before water returned to the Lower Lakes system, mid-2010, the Bioremediation and Revegetation Project (BRP) was designed to build community resilience and support for the broader program through involvement and capacity building of local community groups to have the skills, experience and equipment necessary to be involved in the ongoing environmental care of the region.

The BRP has now transitioned from emergency works to habitat restoration through revegetation of the Coorong Lower Lakes region, and is now part of the Commonwealth's broader Murray Futures Initiative. To maximise the benefit of habitat restoration, it is necessary to gain an understanding of the existing vegetation composition in the CLLMM region so as to better understand the communities the CLLMM restoration project are trying to restore.

The purpose of this project is to fill in the spatial gaps in plant knowledge across the CLLMM region as well as compare how revegetated areas are tracking floristically and structurally towards a remnant state. This will help inform and improve the continued delivery of the vegetation program through better design of habitat restoration strategies. The vegetation assessment survey aims to characterise the condition, age and composition of the vegetation within different environmental settings, including remnant vegetation and revegetation. This information will also be used to determine if any particular environmental settings are under particular threat and require restoration and how our restored sites are tracking towards a desirable state.

2.0 Methods:

One hundred and fourteen sites were chosen across the Coorong Lower Lakes program area (Figures 1,2). Sixty two sites were located in areas that have been revegetated, and fifty two sites were located in remnant vegetation (Table 1). Remnant sites were located in vegetation types that were under-represented in existing biological survey data in the region. Remnant and revegetated areas were allocated into one of 15 Ecosystem types based on the dominant vegetation and soil types present at a site, along with location in the landscape. This allocation was undertaken using expert opinion with reference to soil type, vegetation and location in the landscape (Milne & Jellinek pers. com.) with reference to Jellinek and Te 2014¹.

A waypoint was generated that was used for vegetation sampling (see below).

Landholders were contacted for permission to access the sites, and to provide any detail required regarding access. All landholder liaison was recorded in a log.

Two key components to describe vegetation were gathered at each site:

1. Vegetation composition and structure:

¹ Jellinek, S. and Te, T. (2014). Site Planners' Guide for the CLLMM Region. Unpublished document for the Department for Environment, Water and Natural Resources, Adelaide.

A circle of radius 17m was established around each waypoint (Figure 2), which corresponds to an overall area of 900m². Within each cell, all plant species were identified to species level, or were vouchered for subsequent identification. For each species, the following attributes were estimated using a modified Braun-Blanquet cover-abundance scale, as shown by, the codes and descriptions provided in Appendix 1:

- cover abundance;
- life form;
- strata dominance; and
- life stage.

The ground cover of live plants, dead plants, moss/microphytic crust, bare ground and rock was also estimated and categorised as per the codes in Appendix 1. The structural formation of the vegetation was also delineated, based upon the cover and height of the dominant overstorey species. The overstorey height, crown depth, canopy diameter and gap between canopies was measured for 10 individuals or discrete foliage clumps of the species that formed the dominant overstorey.

2. Estimating number of individuals per hectare:

At each site, four 50m transects running north, south, east and west were established from the central waypoint (Figure 2). The number of individuals for all species of tree, shrub, sedge and grass species that occurred within 1 metre on either side of the 50 metre transect was recorded. A photograph was also taken along each transect in all four directions from the central point. If there was insufficient native vegetation of a similar type to that at the GPS waypoint in any direction, the short-fall was added to one of the other transects so the final total of the four transects was 200 metres.

Sites were sampled in the October to December period in both 2013 and 2014, corresponding to the time period when plants were most readily identified, particularly grasses.

2.1 Data analysis:

Ecosystem types were used as the primary grouping for analysis, with overall species richness, species richness by lifeform, plant density and plant density by lifeform being the attributes analysed. Where possible, remnant systems were compared to revegetated ones, both descriptively and also inferentially using t-tests. A simplified lifeform description was also used for analysis, where the multiple height classes for each lifeform were consolidated into one lifeform – so, for example, the five height classes for shrub forms were summed together to form one shrub form category. Data for remnant vegetation and revegetation for each ecosystem type was also compiled as individual ecosystem descriptions (section 3), including a description of the quantitative data gathered in both cells and transects.

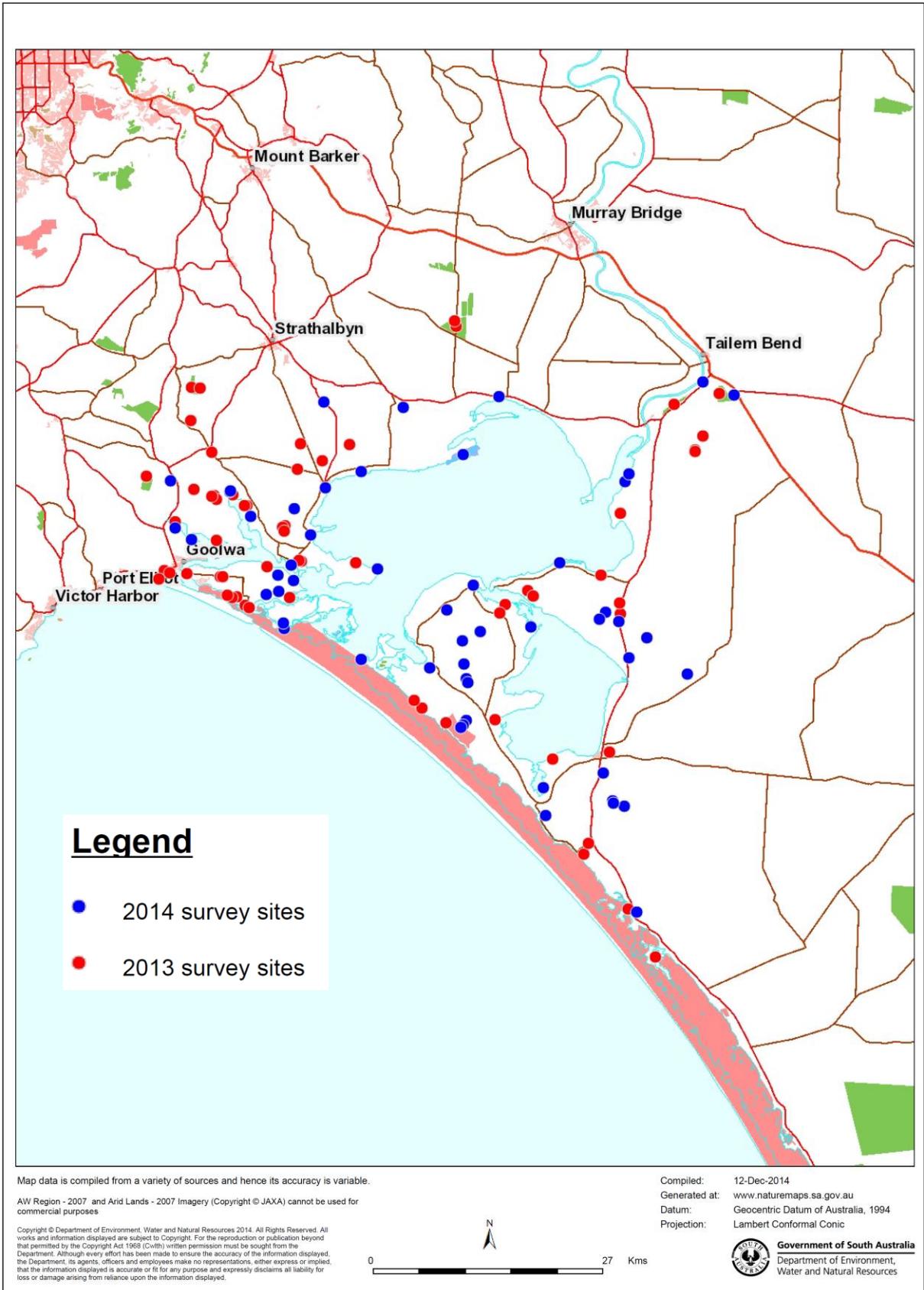


Figure 2: Location of survey sites within the CLMM region.

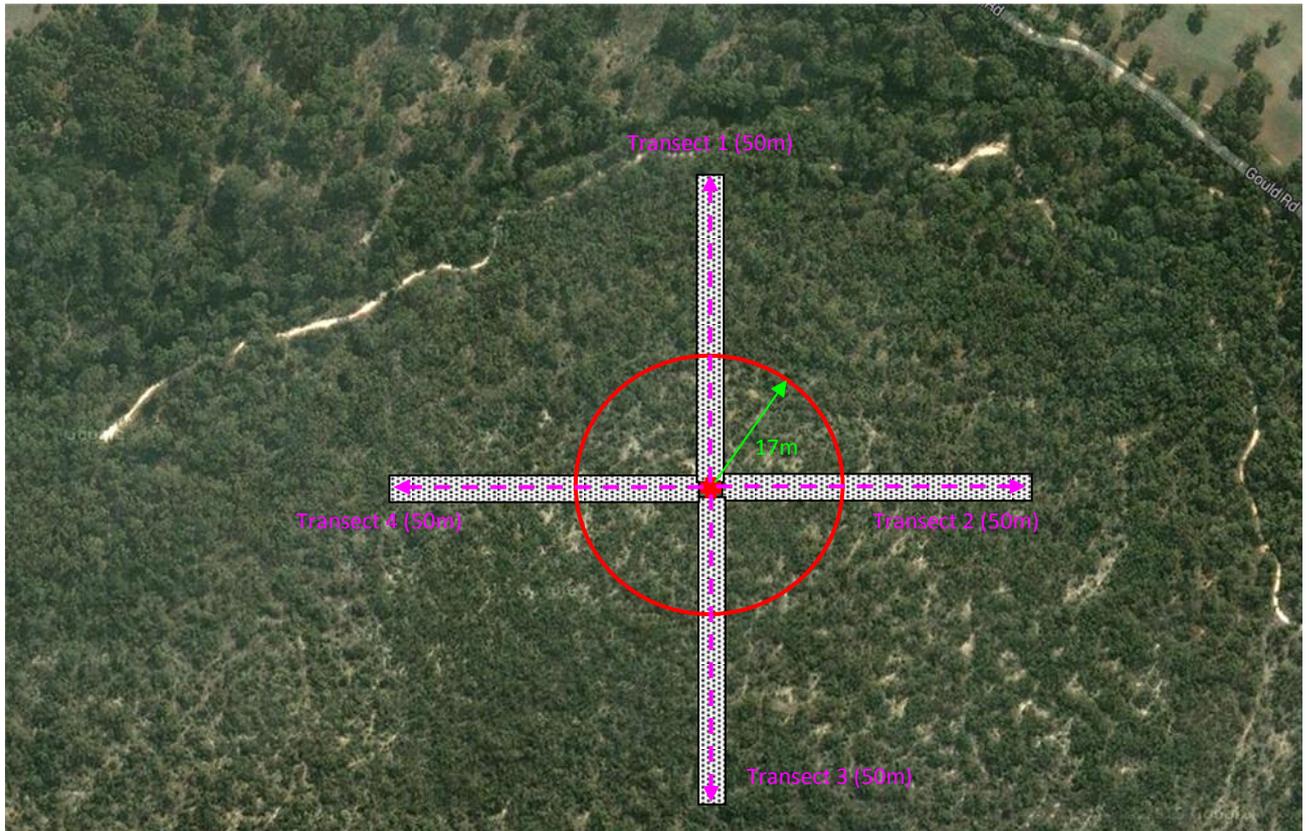


Figure 3: Example of 900 m² cells and direction of transects used for vegetation surveys

3.0 Results summary:

Appendix 2 describes the characteristics of each ecosystem type. Of the fifteen ecosystem types sampled, there were only seven ecosystems where samples were taken from both remnant and revegetation sites (Table 1).

Table 1: Number of remnant and revegetation sites by ecosystem type

Ecosyst em number	Ecosystem description	Number of remnant sites	Number of revegetation sites
1	Pink Gum (<i>Eucalyptus fasciculosa</i>) Low Open Grassy Woodland of the Mount Lofty Ranges	7	6
2	Cup Gum (<i>Eucalyptus cosmophylla</i>) / Brown Stringybark (<i>E. baxteri</i>) Woodland over heath of the Mount Lofty Ranges	2	
3	Coastal Shrubland of the Coorong		6
4	<i>Eucalyptus diversifolia</i> Mallee Communities of the South East	7	6
5	Sheoak (<i>Allocasuarina verticillata</i>) low woodland with shrubby understorey	5	19
6.1	Mallee Box (<i>Eucalyptus porosa</i>) Grassy Woodland	2	5
6.2	Peppermint Box (<i>Eucalyptus odorata</i>) Grassy Woodland	3	
6.3	<i>Eucalyptus incrassata</i> / <i>E. leptophylla</i> +/- <i>E. socialis</i> Mallee Community	6	1
6.4	<i>Eucalyptus leucoxydon</i> Grassy Woodland	2	
7	Freshwater Fringing Wetland Community		1

9	Samphire (+/- <i>Melaleuca halmaturorum</i>) Shrubland Community	7	12
10.1	<i>Gahnia filum</i> Sedgeland		2
10.2	<i>Eucalyptus camaldulensis</i> var. <i>camaldulensis</i> Grassy Woodland	2	
10.3	Grassland community	1	
10.4	Non Eucalypt (<i>Allocasuarina verticillata</i> and <i>Callitris gracilis</i>) Grassy Woodland	8	4

Species richness

Native species richness within the 900m² cells was highest in remnant vegetation in ecosystems 1,2,4,5,6.1, 6.2, 6.3, 6.4 and 10.4, all of which averaged in excess of 30 species total (Figure 4). Contrastingly, revegetation sites all averaged 20 or less native species. Paired t-test comparison of mean richness values for ecosystems that were sampled as both remnant and revegetation indicates remnant sites have significantly more native species overall than analogous revegetation sites (t-stat=5.07, df=6, P=0.001).

The highest number of introduced species was also found in remnant sites, with ecosystems 5,6.1, 6.2, 6.4 and 10.3 all averaging 15 or more introduced species (Figure 5). T-test comparison of mean richness values for ecosystems that were sampled as both remnant and revegetation showed no significant difference in introduced species richness overall (t-stat=1.45, df=6, P=0.10).

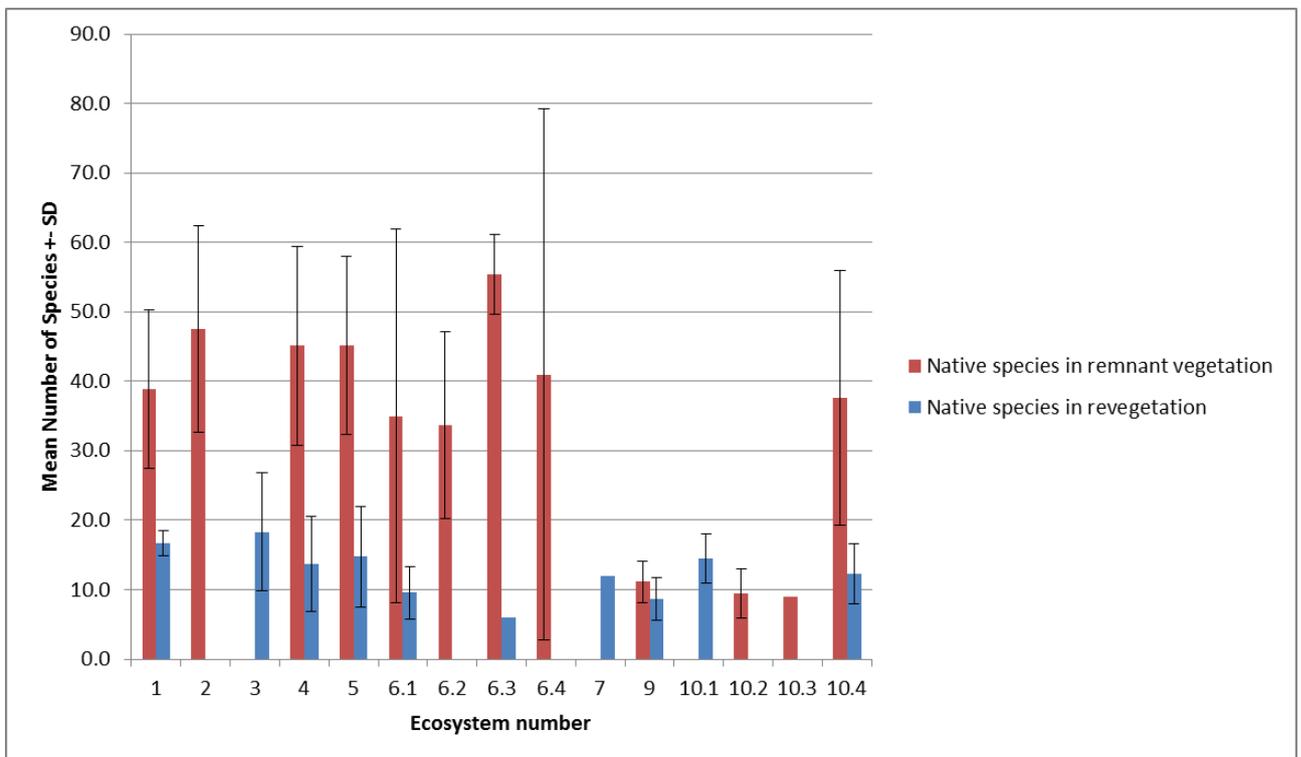


Figure 4: Species richness for native species for sites in remnant vegetation and revegetation in different ecosystem types

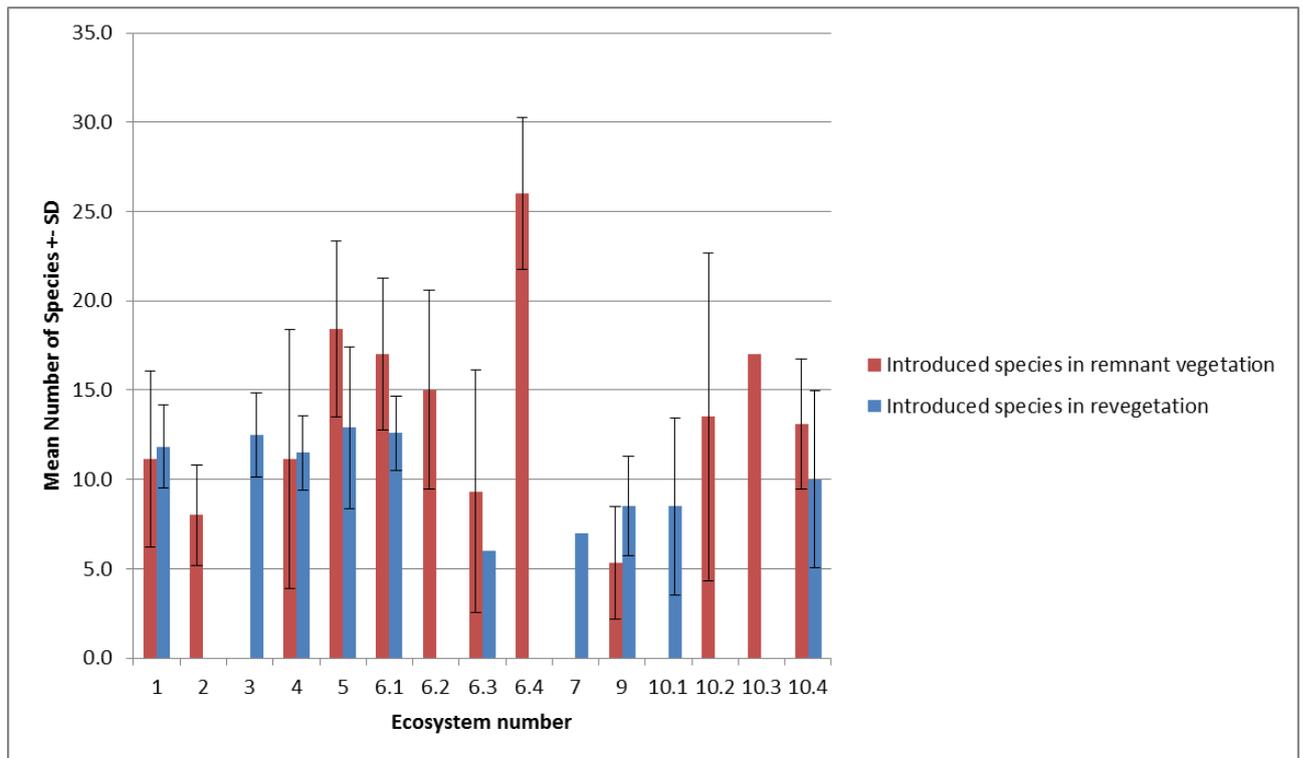


Figure 5: Species richness for introduced species for sites in remnant vegetation and revegetation in different ecosystem types

Species richness by life form

A greater variety of vines and twiners, grasses, sedges and herbaceous species were generally found in remnant sites when compared to revegetation sites (Figures 6,7). Table 2 shows sites where data was collected for both remnant and revegetation patches. The values in the table are the average number of species observed in remnant vegetation divided by the average number of species in revegetation. A score of greater than 1 means more species occurred for that life form type in remnant vegetation, and a score of less than 1 indicates more species occurred in revegetation. The data show that there is consistently a higher number of species in remnant vegetation sites than in revegetation, with only trees in ecosystems 6.1,9 and 10.4 and vines/twiners in ecosystem 9 having more species in revegetation than remnant. In all other cases the number of species in remnant vegetation was higher. The most marked differences were in grasses in 6.1 and 6.3, sedges and herbaceous species in all ecosystem types other than 9, and vines and twiners in ecosystems 4 and 5, where the average number of remnant species was at least five-fold higher than revegetation sites.

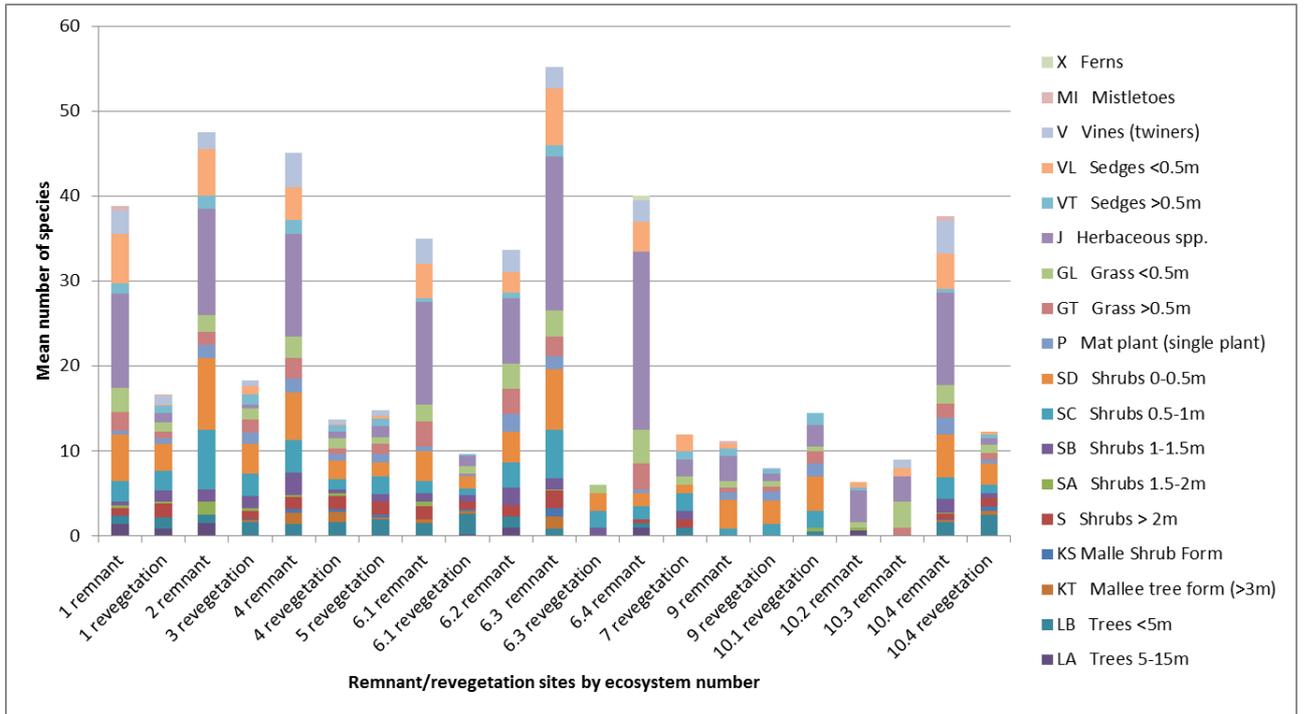


Figure 6: Native species richness by life form for sites in different ecosystems

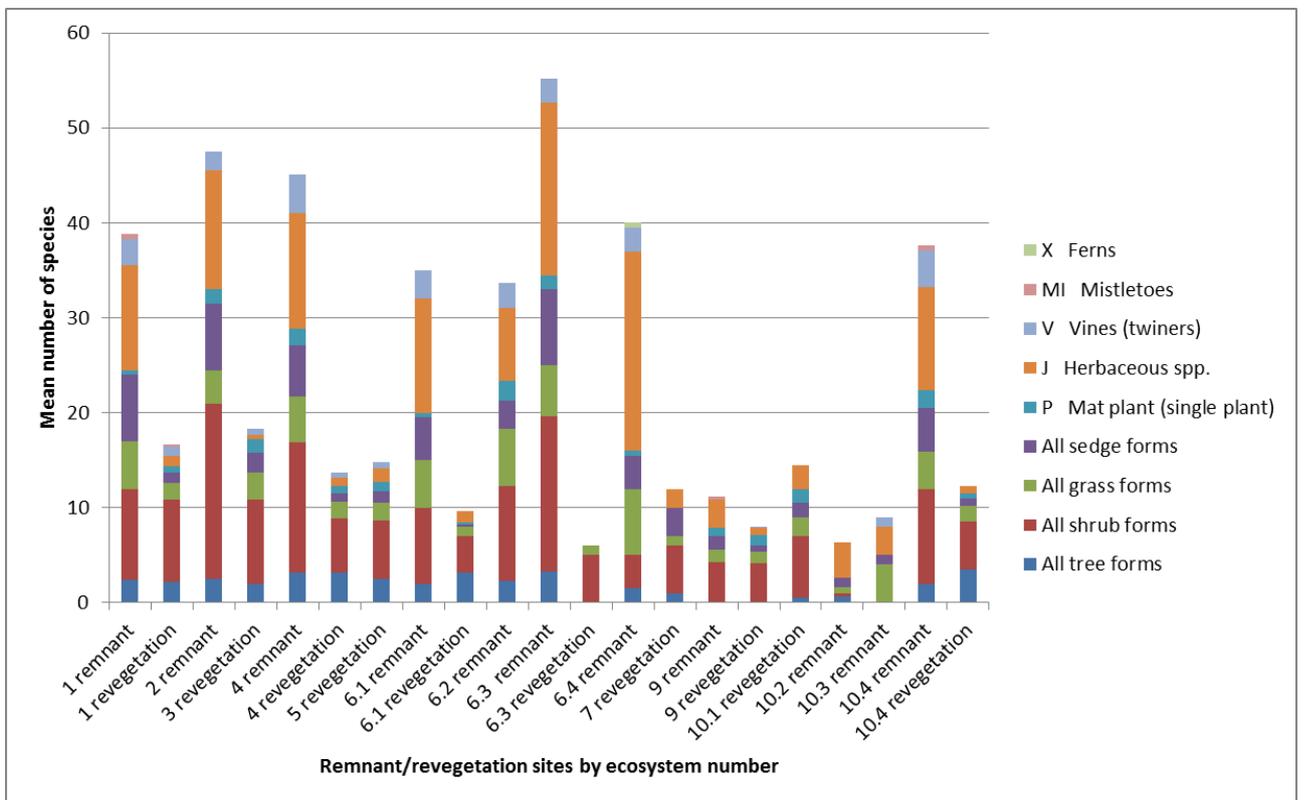


Figure 7: Native species richness by simplified life form classification for sites in different ecosystems

Table 2: Comparison of species richness in remnant vegetation and revegetation by ecosystem type
 Note: ferns were not included in this analysis as they were only observed in one site in these ecosystem types. Mistletoes were not included as they are not a revegetation species.

Ecosystem number	Average number of species in remnants/average number of species in revegetation							
	All tree forms	All shrub forms	All grass forms	All sedge forms	Mat plants	Herbaceous species	Vines (twiners)	Total
1	1.1	1.1	2.7	7.0	0.6	9.6	2.7	2.3
4	1.0	2.4	2.6	6.5	2.1	14.6	8.3	3.3
5	1.0	1.4	3.4	6.0	2.3	9.2	7.0	3.0
6.1	0.6	2.1	5.0	22.5	2.5	10.0	*	3.6
6.3	*	3.3	5.3	*	*	*	*	9.2
9	**	1.1	1.0	2.3	0.8	3.5	**	1.4
10.4	0.6	2.0	2.2	6.2	3.8	14.5	*	3.1

* no individuals of this life form observed in revegetation

** no individuals of this life form observed in remnant vegetation

Density of different lifeforms

Sites in remnant vegetation had average plant densities per hectare of tree, shrub, grass, mat plant and sedge species ranging from 10,788 up to 44,275 (Figure 8, Table 3). All ecosystem types in remnant vegetation exceeded 10 000 native tree, shrub, grass, sedge and vine/twiner individuals per hectare. In revegetation sites average plant densities for the different ecosystems ranged from 975 to 13,354 individuals per hectare (Table 4), with all except two ecosystems (3 and 9) having densities of 10 000 or fewer individuals per hectare. This shows a general pattern of a higher density of native species in remnant than revegetation sites. Paired t-test comparison of mean densities of native plants for ecosystems that were sampled as both remnant and revegetation indicates remnant sites have a significantly higher density of native species overall than analogous revegetation sites (t-stat=5.12, df=6, P=0.002).

Tables 3 and 4 and Figure 9 show data for consolidated life form types. Remnant sites have generally higher densities for all life form types. Table 5 shows sites where data was collected along transects for both remnant and revegetation patches. The values in the table are the number of individuals observed in remnant vegetation divided by the number of individuals in revegetation. A score of >1 means more individuals occurred in remnant vegetation, and a score of less than 1 indicates more individuals were observed in revegetation. The data again reflect that life form densities are generally higher in remnant vegetation, with only vines/twiners in ecosystem 1 (Pink Gum woodlands), and vines/twiners and trees in ecosystem 9 (Samphire (+/- *Melaleuca halmaturorum*) Shrubland Community) having higher densities in revegetation. The most marked differences were sedges in ecosystem 1,4 and 10.4, grasses in ecosystem 1,4,5 and 6.1, shrubs in ecosystem 6.1, and the total number of plants in 1, 6.1 and 6.3, where densities were an order of magnitude or more higher in remnant vegetation than in revegetation.

Figure 10 shows consolidated lifeform density data for aggregated data for remnant vegetation and revegetation for ecosystem types where data was collected for both remnant vegetation and

revegetation (1,4,5,6.1,6.3,9,10.4). Grasses and sedges are clearly of much higher density per hectare in remnant vegetation than revegetation.

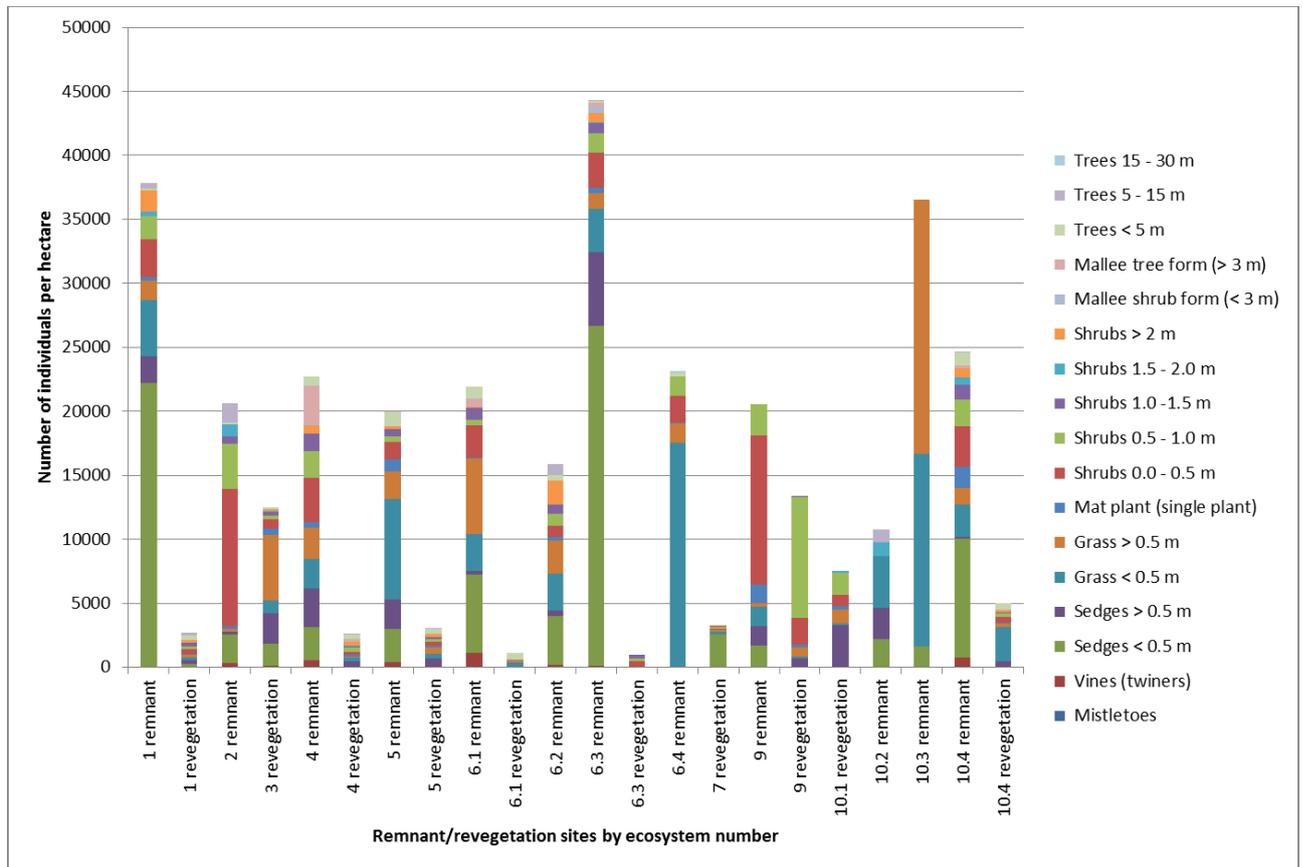


Figure 8: Native species densities by life form for sites in different ecosystems

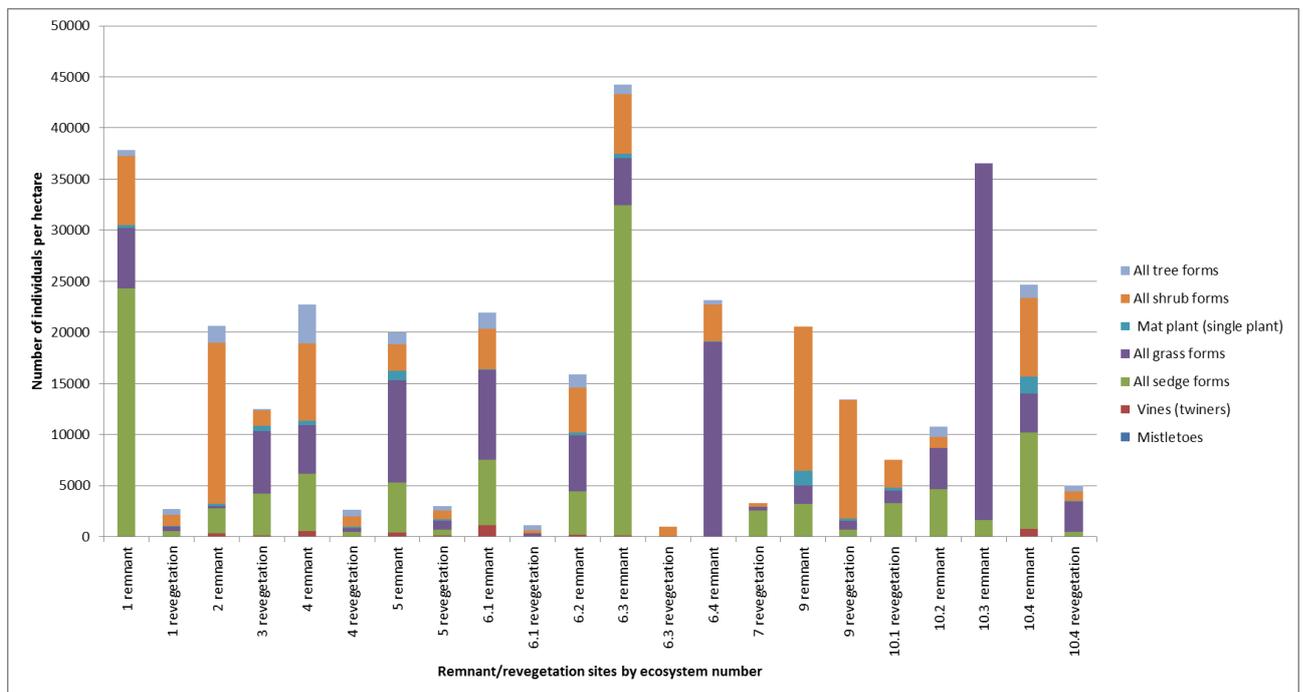


Figure 9: Native species densities by simplified life form classification for sites in different ecosystems

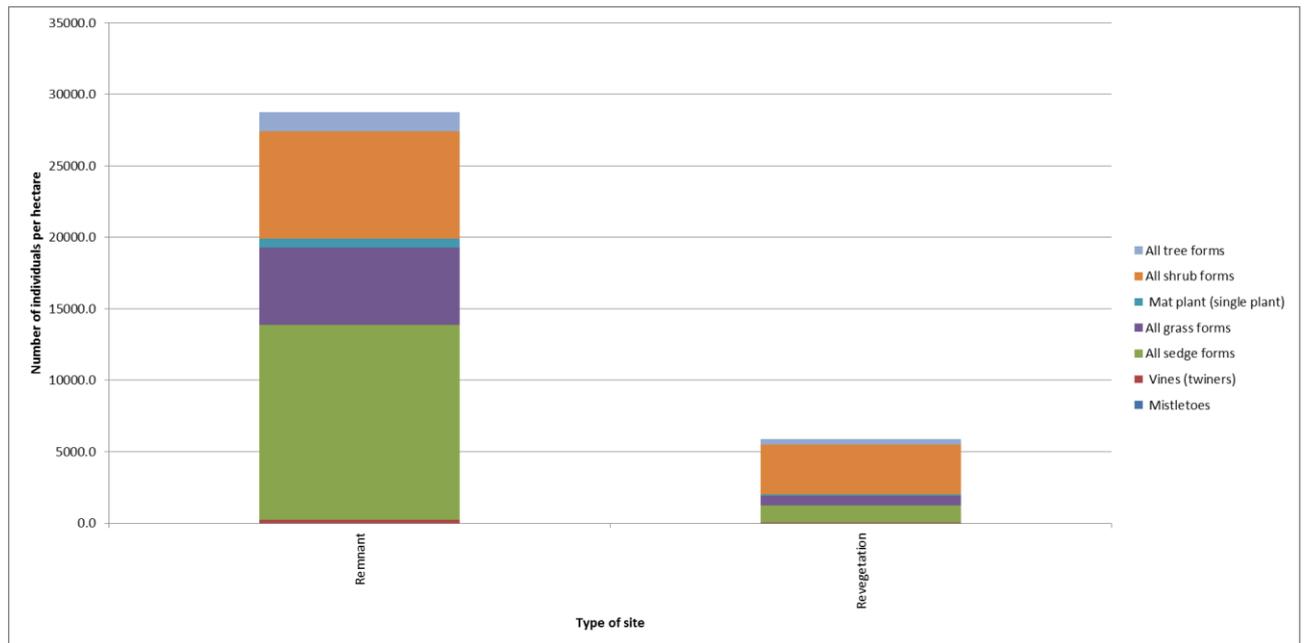


Figure 10: Native lifeform densities in remnant vegetation versus revegetation in ecosystems where both remnant vegetation and revegetation data was collected

Table 3: Total number of tree, shrub, grass, sedge and vine individuals per hectare by ecosystem type for remnant vegetation

Ecosystem number	Number of sites	Vines (twiners)	All sedge forms	All grass forms	Mat plant (single plant)	All shrub forms	All tree forms	Total
1	7	43	24225	5957	239	6789	564	37818
2	2	300	2388	275	175	15813	1650	20650
4	7	571	5561	4807	379	7596	3821	22736
5	5	365	4910	9990	965	2585	1130	19945
6.1	2	1138	6350	8825	38	3988	1600	21938
6.2	3	200	4250	5450	292	4400	1283	15875
6.3	6	75	32392	4613	383	5821	992	44275
6.4	2	0	0	19063	25	3663	400	23150
9	7	0	3221	1814	1375	14164	0	20575
10.2	2	0	4675	4000	0	1088	1025	10788
10.3	1	0	1600	34950	0	0	0	36550
10.4	8	747	9466	3756	1678	7744	1247	24638
Average for remnant vegetation		287	8253	8625	462	6137	1143	24911

Table 4: Total number of tree, shrub, grass, sedge and vine individuals per hectare by ecosystem type for revegetation

Ecosystem number	Number of sites	Vines (twiners)	All sedge forms	All grass forms	Mat plant (single plant)	All shrub forms	All tree forms	Total
1	6	58	471	450	33	1129	571	2713
3	6	83	4108	6129	550	1463	138	12471
4	6	38	417	400	100	1000	646	2600
5	19	72	604	886	109	882	414	2967
6.1	5	0	0	315	5	285	515	1120
6.3	1	0	0	0	0	975	0	975
7	1	0	2575	325	0	375	0	3275
9	12	8	665	869	204	11585	23	13354
10.1	2	0	3263	1213	325	2713	0	7513
10.4	4	69	425	2944	50	906	631	5025
Average for revegetation		33	1253	1353	138	2131	294	5201

Table 5: Comparison of lifeform densities in remnant vegetation and revegetation by ecosystem type

Ecosystem number	Number of individuals in remnants/number of individuals in revegetation						
	Vines (twiners)	All sedge forms	All grass forms	Mat plant (single plant)	All shrub forms	All tree forms	Total
1	0.7	51.5	13.2	7.2	6.0	1.0	13.9
4	15.2	13.3	12.0	3.8	7.6	5.9	8.7
5	5.0	8.1	11.3	8.8	2.9	2.7	6.7
6.1	*	*	28.0	7.5	14.0	3.1	19.6
6.3	*	*	*	*	6.0	*	45.4
9	**	4.8	2.1	6.7	1.2	**	1.5
10.4	10.9	22.3	1.3	33.6	8.5	2.0	4.9

* no individuals of this lifeform observed in revegetation

** no individuals of this lifeform observed in remnant vegetation

3.1 Descriptions of ecosystems: remnant

Ecosystem Number: 1 Pink Gum (*Eucalyptus fasciculosa*) Low Open Grassy Woodland of the Mount Lofty Ranges

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 479, 482, 488, 494, 495, 505, 540

Description of ecosystem: Sites allocated to this ecosystem were generally healthy low woodlands on sandy soils, with Pink Gum (*Eucalyptus fasciculosa*) being the most commonly occurring native tree species. Mean native species richness was moderate to high, with *Ehrharta calycina* and *Asparagus asparagoides* being the most predominant threatening weed species. Low shrub and sedge species richness, and overall low shrub and sedge densities were high in comparison to other ecosystems.

Indicative Photographs:



Site : 540 *Eucalyptus fasciculosa* ssp. *fasciculosa* Low Woodland



Site 505: *Eucalyptus fasciculosa* +/- *Eucalyptus incrassata* Woodland

Cell data:

Number of sites in this vegetation type: 7

Mean native plant species richness per site (±SD): 38.86 (11.35)

Mean introduced plant species richness per site (±SD): 11.14 (4.91)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:					4	1	2
Mean dead plant litter & fallen timber:				6	1		
Mean moss and microphytic crust:				3	4		
Mean bare ground:		3	1	3			
Other (e.g. rock, calcrete):			1				

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%) , 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3= any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Austrostipa</i> sp.	7	<i>Ehrharta calycina</i>	7
<i>Eucalyptus fasciculosa</i>	7	<i>Hypochaeris glabra</i>	7
<i>Clematis microphylla</i>	6	<i>Asparagus asparagoides</i>	6

		<i>f.</i>	
<i>Hibbertia virgata</i>	6	<i>Plantago bellardii</i>	5
<i>Rytidosperma sp.</i>	6	<i>Aira cupaniana</i>	4
<i>Helichrysum leucopsideum</i>	5	<i>Trifolium arvense var. arvense</i>	4
<i>Neurachne alopecuroidea</i>	5	<i>Trifolium campestre</i>	4
<i>Thelymitra sp.</i>	5	<i>Sonchus oleraceus</i>	3
<i>Acacia paradoxa</i>	4	<i>Vulpia fasciculata</i>	3
<i>Acacia pycnantha</i>	4	<i>Vulpia myuros f. myuros</i>	3
<i>Amyema miquelii</i>	4	<i>Briza maxima</i>	2
<i>Arthropodium strictum</i>	4	<i>Bromus diandrus</i>	2
<i>Daucus glochidiatus</i>	4	<i>Ehrharta longiflora</i>	2
<i>Dianella revoluta var. revoluta</i>	4	<i>Hypochaeris radicata</i>	2
<i>Dillwynia hispida</i>	4	<i>Lagurus ovatus</i>	2
<i>Hibbertia devitata</i>	4	<i>Lolium rigidum</i>	2
<i>Lepidosperma carphoides</i>	4	<i>Trifolium angustifolium</i>	2
<i>Lepidosperma congestum</i>	4		
<i>Lomandra juncea</i>	4		
<i>Lomandra micrantha ssp.</i>	4		
<i>Lomandra sororia</i>	4		
<i>Muehlenbeckia gunnii</i>	4		
<i>Rytidosperma geniculatum</i>	4		
<i>Thomasia petalocalyx</i>	4		

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m	1.43 (0.53)		393 (358)
LB Trees <5m	0.86 (0.69)		161 (248)
KT Mallee >3m			
KS Mallee <3m	0.14 (0.38)		11 (11)
S Shrubs > 2m	0.86 (0.69)		1618 (3299)
SA Shrubs 1.5-2m	0.29 (0.49)		357 (611)
SB Shrubs 1-1.5m	0.43 (0.79)		21 (30)
SC Shrubs 0.5-1m	2.43 (3.6)	0.14 (0.38)	1793 (4403)
SD Shrubs 0-0.5m	5.57 (3.26)		3000 (6637)
P Mat plant (single plant)	0.43 (0.53)		239 (520)
GT Grass >0.5m	2.14 (1.07)	1.14 (0.38)	1514 (2328)
GL Grass <0.5m	2.86 (0.9)	4.0 (2.45)	4442 (5609)
J Herbaceous spp.	11.14 (4.67)	5.0 (2.45)	NA
VT Sedges >0.5m	1.14 (0.9)		2025 (4064)
VL Sedges <0.5m	5.86 (2.19)		22200 (26752)
V Vines (twiners)	2.71 (0.76)	0.86 (0.38)	43 (103)
MI Mistletoes	0.57 (0.53)		NA
X Ferns			NA

Ecosystem Number: 2 Cup Gum (*Eucalyptus cosmophylla*) / Brown Stringybark (*E. baxteri*) Woodland over heath of the Mount Lofty Ranges

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 489, 490

Description of ecosystem: This ecosystem type was characterised by low woodlands or forest of *Eucalyptus baxteri* or *Eucalyptus cosmophylla* with a dense heathy understorey. Species richness was high (47.5). Compared to other ecosystems there was a high density and diversity of all shrub life forms. Weeds were of low cover.

Indicative Photographs:



Site 489: *Eucalyptus baxteri* Low woodland



Site 490 : *Eucalyptus fasciculosa*, *Eucalyptus cosmophylla*, *Allocasuarina striata* Low open forest

Cell data:

Number of sites in this vegetation type: 2

Mean native plant species richness per site (\pm SD): 47.5 (14.85)

Mean introduced plant species richness per site (\pm SD): 8.0 (2.83)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:						1	1
Mean dead plant litter & fallen timber:			1	1			
Mean moss and microphytic crust:				2			
Mean bare ground:			1	1			
Other (e.g. rock, calcrete):							

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%) , 1 = plentiful, but of small cover(less than 5%), 2 = any number of individuals covering 5-25% of area, 3= any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Acacia pycnantha</i>	2	<i>Hypochaeris glabra</i>	2
<i>Hibbertia devitata</i>	2	<i>Ehrharta calycina</i>	1
<i>Lomandra micrantha ssp.</i>	2	<i>Aira cupaniana</i>	1
<i>Burchardia umbellata</i>	2	<i>Vulpia fasciculata</i>	1
<i>Lepidosperma viscidum</i>	2	<i>Briza maxima</i>	1
<i>Astroloma humifusum</i>	2	<i>Hypochaeris radicata</i>	1
<i>Calytrix tetragona</i>	2	<i>Aira elegantissima</i>	1
<i>Hypolaena fastigiata</i>	2	<i>Avena barbata</i>	1

<i>Xanthorrhoea semiplana</i> ssp. <i>semiplana</i>	2	<i>Bromus rubens</i>	1
		<i>Disa bracteata</i>	1
		<i>Romulea rosea</i> var. <i>australis</i>	1
		<i>Avellinia michelii</i>	1
		<i>Billardiera heterophylla</i>	1
		<i>Vulpia bromoides</i>	1
		<i>Zaluzianskya divaricata</i>	1

Transect and Cell Data: Number and density of plant species by lifeform type (±SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m	1.5 (0.71)		1563 (548)
LB Trees <5m	1.0		88 (88)
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m			
SA Shrubs 1.5-2m	1.5 (0.71)		975 (778)
SB Shrubs 1-1.5m	1.5 (0.71)		538 (88)
SC Shrubs 0.5-1m	7.0 (4.24)		3538 (4190)
SD Shrubs 0-0.5m	8.5 (2.12)		10763 (12321)
P Mat plant (single plant)	1.5 (0.71)		175 (106)
GT Grass >0.5m	1.5 (0.71)	1.0	238 (88)
GL Grass <0.5m	2.0 (1.41)	3.5 (2.12)	38 (18)
J Herbaceous spp.	12.5 (4.95)	3.0	NA
VT Sedges >0.5m	1.5 (0.71)		213 (124)
VL Sedges <0.5m	5.5 (0.71)		2175 (106)
V Vines (twiners)	2.0 (1.41)	0.5 (0.71)	300 (424)
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 4 *Eucalyptus diversifolia* Mallee Communities of the South East

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 464, 468, 470, 471, 526, 528, 554

Description of ecosystem: This system was characterised by an overstorey comprising *Eucalyptus diversifolia*, with a diverse understorey, comprising small, medium and large shrubs, and a relatively high density of sedges and grasses. There was often exposed limestone present. Weed diversity and cover were comparatively low, with Bridal Creeper (*Asparagus asparagoides*) the most common weed.

Indicative Photographs:



Site 464: *Eucalyptus diversifolia* Open mallee



Site 528: *Eucalyptus diversifolia*, *E. incrassata* Low Mallee

Cell data:

Number of sites in this vegetation type: 7

Mean native plant species richness per site (±SD): 45.14 (14.31)

Mean introduced plant species richness per site (±SD): 11.14 (7.27)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:				2	2	2	1
Mean dead plant litter & fallen timber:				4	2	1	
Mean moss and microphytic crust:				4	3		
Mean bare ground:		1	3	3			
Other (e.g. rock, calcrete):	1		4				

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%) , 1 = plentiful, but of small cover(less than 5%), 2 = any number of individuals covering 5-25% of area, 3= any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Eucalyptus diversifolia</i> ssp. <i>diversifolia</i>	7	<i>Asparagus asparagoides</i> f.	6
<i>Helichrysum leucopsideum</i>	6	<i>Hypochaeris glabra</i>	4
<i>Acacia pycnantha</i>	5	<i>Ehrharta calycina</i>	4
<i>Billardiera versicolor</i>	5	<i>Aira cupaniana</i>	4
<i>Dianella brevicaulis</i>	5	<i>Plantago bellardii</i>	4
<i>Hibbertia sericea</i>	5	<i>Sonchus oleraceus</i>	4
<i>Thysanotus patersonii</i>	5	<i>Vulpia</i> sp.	4

<i>Acacia leiophylla</i>	5	<i>Avena barbata</i>	3
<i>Acrotriche affinis</i>	5	<i>Trifolium arvense</i> var. <i>arvense</i>	3
<i>Xanthorrhoea caespitosa</i>	5	<i>Trifolium campestre</i>	3
<i>Rytidosperma caespitosum</i>	4	<i>Anagallis arvensis</i>	3
<i>Clematis microphylla</i>	4	<i>Gomphocarpus</i> <i>cancellatus</i>	3
<i>Lepidosperma carphoides</i>	4	<i>Bromus rubens</i>	2
<i>Muehlenbeckia gunnii</i>	4	<i>Bromus diandrus</i>	2
<i>Thomasia petalocalyx</i>	4	<i>Ehrharta longiflora</i>	2
<i>Allocasuarina verticillata</i>	4	<i>Centaurium tenuiflorum</i>	2
<i>Olearia axillaris</i>	4	<i>Petrorhagia dubia</i>	2
<i>Rhagodia candolleana</i> ssp.	4	<i>Senecio pterophorus</i>	2

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			
LB Trees <5m	1.43 (0.79)		771 (797)
KT Mallee >3m	1.29 (0.49)		2968 (1671)
KS Mallee <3m	0.43 (0.53)		82 (82)
S Shrubs > 2m	1.43 (0.98)		682 (933)
SA Shrubs 1.5-2m	0.29 (0.49)		04 (09)
SB Shrubs 1-1.5m	2.57 (0.53)		1343 (1201)
SC Shrubs 0.5-1m	3.86 (3.72)	0.57 (0.53)	2111 (2375)
SD Shrubs 0-0.5m	5.57 (4.12)		3457 (4287)
P Mat plant (single plant)	1.71 (1.6)		379 (693)
GT Grass >0.5m	2.43 (2.3)	1.0 (0.82)	2471 (3662)
GL Grass <0.5m	2.43 (2.3)	3.29 (1.8)	2335 (2380)
J Herbaceous spp.	12.14 (4.53)	5.43 (4.28)	NA
VT Sedges >0.5m	1.57 (0.53)		3011 (2671)
VL Sedges <0.5m	3.86 (3.58)		2550 (3680)
V Vines (twiners)	4.14 (1.46)	0.86 (0.38)	571 (658)
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 5 Sheoak (*Allocasuarina verticillata*) low woodland with shrubby understorey

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 473, 500, 501, 530, 535

Description of ecosystem: This ecosystem generally consisted of sites of a low woodland, woodland or open forest with *Allocasuarina verticillata* as the dominant species, aside from site 530 which was in a more degraded condition where *Allocasuarina verticillata* was not dominant. Whilst relatively rich in native species (45 species on average), weed species were also diverse (18 species on average), especially grassy and herbaceous weeds. Grass and sedge densities were also relatively high.

Indicative Photographs:



Site 535: *Allocasuarina verticillata* Low Open Forest



Site 473: *Allocasuarina verticillata* Low open woodland

Cell data:

Number of sites in this vegetation type: 5

Mean native plant species richness per site (\pm SD): 45.2 (12.83)

Mean introduced plant species richness per site (\pm SD): 18.4 (4.93)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:				1	2	2	
Mean dead plant litter & fallen timber:				4	1		
Mean moss and microphytic crust:		1		3		1	
Mean bare ground:		3		2			
Other (e.g. rock, calcrete):		4					

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Austrostipa eremophila</i>	5	<i>Asparagus asparagoides</i> f.	4
<i>Clematis microphylla</i>	5	<i>Hypochaeris glabra</i>	4
<i>Rhagodia candolleana</i> ssp.	5	<i>Ehrharta calycina</i>	4
<i>Allocasuarina verticillata</i>	4	<i>Avena barbata</i>	4
<i>Austrostipa elegantissima</i>	4	<i>Lagurus ovatus</i>	4
<i>Bursaria spinosa</i> ssp. <i>spinosa</i>	4	<i>Lycium ferocissimum</i>	4

<i>Dianella brevicaulis</i>	4	<i>Aira cupaniana</i>	3
<i>Kennedia prostrata</i>	4	<i>Plantago bellardii</i>	3
<i>Kunzea pomifera</i>	4	<i>Sonchus oleraceus</i>	3
<i>Lepidosperma carphoides</i>	4	<i>Petrorhagia dubia</i>	3
<i>Linum marginale</i>	4	<i>Briza minor</i>	3
<i>Muehlenbeckia gunnii</i>	4	<i>Centaurium sp.</i>	3
<i>Oxalis perennans</i>	4	<i>Vulpia sp.</i>	2
<i>Rytidosperma caespitosum</i>	4	<i>Trifolium campestre</i>	2
<i>Acacia pycnantha</i>	3	<i>Anagallis arvensis</i>	2
<i>Daucus glochidiatus</i>	3	<i>Gomphocarpus cancellatus</i>	2
<i>Dianella revoluta var. revoluta</i>	3	<i>Bromus diandrus</i>	2
<i>Helichrysum leucopsidium</i>	3	<i>Hypochaeris radicata</i>	2
<i>Lomandra densiflora</i>	3	<i>Vulpia myuros f.</i>	2
<i>Lomandra micrantha ssp.</i>	3	<i>Briza maxima</i>	2
<i>Lysiana exocarpi ssp. exocarpi</i>	3	<i>Romulea rosea var. australis</i>	2
<i>Poranthera microphylla</i>	3	<i>Galium murale</i>	2

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m	0.6 (0.55)		
LB Trees <5m	1.8 (1.3)		1130 (1024)
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m	0.4 (0.55)		210 (207)
SA Shrubs 1.5-2m			
SB Shrubs 1-1.5m	1.6 (0.55)	0.2 (0.45)	595 (959)
SC Shrubs 0.5-1m	3.2 (1.3)	1.2 (0.84)	420 (193)
SD Shrubs 0-0.5m	3.4 (2.07)		1360 (1465)
P Mat plant (single plant)	2.4 (0.55)		965 (880)
GT Grass >0.5m	4.0 (2.55)	1.6 (0.55)	2160 (1364)
GL Grass <0.5m	2.4 (0.55)	5.2 (1.1)	7830 (8924)
J Herbaceous spp.	12.6 (4.98)	9.4 (4.88)	NA
VT Sedges >0.5m	1.8 (0.84)		2255 (3005)
VL Sedges <0.5m	5.2 (2.39)		2655 (2503)
V Vines (twiners)	4.8 (1.1)	0.8 (0.45)	365 (639)
MI Mistletoes	0.6 (0.55)		NA
X Ferns	0.2 (0.45)		NA

Ecosystem Number: 6.1 Mallee Box (*Eucalyptus porosa*) Grassy Woodland

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 532, 567

Description of ecosystem: The two sites surveyed in this ecosystem type were quite varied in condition – one had 54 native species (site 532) compared to 16 in site 567. *Eucalyptus porosa* was the dominant overstorey. Herbaceous and grassy weeds were prominent in both sites, and exposed rock was present in both sites but most prominent in the more degraded area.

Indicative Photographs:



Site 532: *Eucalyptus porosa*, *E.diversifolia* ssp. *diversifolia* Mallee

Site 567: *Eucalyptus porosa* Open Mallee

Cell data:

Number of sites in this vegetation type: 2

Mean native plant species richness per site (\pm SD): 35.0 (26.87)

Mean introduced plant species richness per site (\pm SD): 17.0 (4.24)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:					1	1	
Mean dead plant litter & fallen timber:				2			
Mean moss and microphytic crust:				2			
Mean bare ground:				2			
Other (e.g. rock, calcrete):		1		1			

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%) , 1 = plentiful, but of small cover(less than 5%), 2 = any number of individuals covering 5-25% of area, 3= any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Austrostipa eremophila</i>	2	<i>Asparagus asparagoides</i> f.	2
<i>Rhagodia candolleana</i> ssp.	2	<i>Hypochaeris glabra</i>	2
<i>Oxalis perennans</i>	2	<i>Lagurus ovatus</i>	2
<i>Eucalyptus porosa</i>	2	<i>Gomphocarpus cancellatus</i>	2
<i>Podolepis rugata</i> var.	2	<i>Ehrharta calycina</i>	1
		<i>Avena barbata</i>	1

		<i>Lycium ferocissimum</i>	1
		<i>Aira cupaniana</i>	1
		<i>Plantago bellardii</i>	1
		<i>Sonchus oleraceus</i>	1
		<i>Petrorhagia dubia</i>	1
		<i>Anagallis arvensis</i>	1
		<i>Bromus diandrus</i>	1
		<i>Vulpia myuros f.</i>	1
		<i>Briza maxima</i>	1
		<i>Bromus rubens</i>	1
		<i>Ehrharta longiflora</i>	1
		<i>Avellinia michelii</i>	1
		<i>Brassica tournefortii</i>	1
		<i>Erodium botrys</i>	1
		<i>Arctotheca calendula</i>	1
		<i>Asphodelus fistulosus</i>	1
		<i>Euphorbia terracina</i>	1
		<i>Reichardia tingitana</i>	1
		<i>Medicago sp.</i>	1
		<i>Hordeum sp.</i>	1
		<i>Marrubium vulgare</i>	1
		<i>Mesembryanthemum crystallinum</i>	1
		<i>Neatostema apulum</i>	1
		<i>Romulea minutiflora</i>	1

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			
LB Trees <5m	1.5 (0.71)		925 (778)
KT Mallee >3m	0.5 (0.71)		675 (955)
KS Mallee <3m			
S Shrubs > 2m	1.5 (2.12)		100 (141)
SA Shrubs 1.5-2m	0.5 (0.71)		
SB Shrubs 1-1.5m	1.0 (1.41)		925 (1308)
SC Shrubs 0.5-1m	1.5 (0.71)	1.5 (0.71)	413 (477)
SD Shrubs 0-0.5m	3.5 (2.12)		2550 (35)
P Mat plant (single plant)	0.5 (0.71)		38 (53)
GT Grass >0.5m	3.0 (1.41)	1.0	5900 (3960)
GL Grass <0.5m	2.0 (1.41)	5.0 (1.41)	2925 (3536)
J Herbaceous spp.	12.0 (8.49)	8.5 (4.95)	NA
VT Sedges >0.5m	0.5 (0.71)		288 (407)
VL Sedges <0.5m	4.0 (5.66)		6063 (8574)
V Vines (twiners)	3.0 (1.41)	1.0	1138 (1114)
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 6.2 Peppermint Box (*Eucalyptus odorata*) Grassy Woodland

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 493, 574, 575

Description of ecosystem: The Peppermint Box (*Eucalyptus odorata*) systems surveyed were generally fairly open in nature, although the density of shrubs species was quite variable among sites. Native species diversity was moderate, and introduced species diversity was moderate to high.

Indicative Photographs:



Site 574: *Eucalyptus odorata* Low Woodland with emergent *Callitris gracilis*

Site 493: *Eucalyptus odorata* Low woodland

Cell data:

Number of sites in this vegetation type: 3

Mean native plant species richness per site (\pm SD): 33.67 (13.5)

Mean introduced plant species richness per site (\pm SD): 15.0 (5.57)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:				1		1	1
Mean dead plant litter & fallen timber:				3			
Mean moss and microphytic crust:				2	1		
Mean bare ground:		2	1				
Other (e.g. rock, calcrete):							

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Oxalis perennans</i>	3	<i>Asparagus asparagoides</i> f.	3
<i>Acacia pycnantha</i>	3	<i>Ehrharta calycina</i>	2
<i>Eucalyptus odorata</i>	3	<i>Avena barbata</i>	2
<i>Clematis microphylla</i>	2	<i>Anagallis arvensis</i>	2
<i>Bursaria spinosa</i> ssp. <i>spinosa</i>	2	<i>Bromus diandrus</i>	2
<i>Rytidosperma caespitosum</i>	2	<i>Briza maxima</i>	2
<i>Rytidosperma</i> sp.	2	<i>Ehrharta longiflora</i>	2
<i>Thysanotus patersonii</i>	2	<i>Trifolium arvense</i> var. <i>arvense</i>	2

<i>Austrostipa flavescens</i>	2	<i>Aira sp.</i>	2
<i>Austrostipa scabra ssp. falcata</i>	2	<i>Lolium rigidum</i>	2
<i>Lomandra multiflora ssp. dura</i>	2	<i>Lepidium africanum</i>	2
<i>Arthropodium sp.</i>	2		
<i>Astroloma humifusum</i>	2		
<i>Billardiera versicolor</i>	2		
<i>Atriplex semibaccata</i>	2		
<i>Chenopodium desertorum ssp.</i>	2		
<i>Daviesia benthamii ssp. humilis</i>	2		
<i>Einadia nutans ssp.</i>	2		
<i>Eutaxia microphylla</i>	2		
<i>Melaleuca uncinata</i>	2		
<i>Schoenus apogon</i>	2		

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m	1.0		842 (315)
LB Trees <5m	1.33 (0.58)		442 (440)
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m	1.33 (1.53)		1867 (2013)
SA Shrubs 1.5-2m			
SB Shrubs 1-1.5m	2.0 (1.73)		767 (965)
SC Shrubs 0.5-1m	3.0 (2.65)	0.33 (0.58)	875 (766)
SD Shrubs 0-0.5m	3.67 (2.08)		892 (383)
P Mat plant (single plant)	2.0 (1.0)	0.33 (0.58)	292 (505)
GT Grass >0.5m	3.0 (3.0)	1.67 (0.58)	2608 (2870)
GL Grass <0.5m	3.0	5.33 (1.15)	2842 (543)
J Herbaceous spp.	7.67 (4.73)	6.0 (3.61)	NA
VT Sedges >0.5m	0.67 (0.58)		467 (663)
VL Sedges <0.5m	2.33 (1.53)		3783 (6402)
V Vines (twiners)	2.67 (1.53)	1.33 (0.58)	200 (200)
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 6.3 *Eucalyptus incrassata* / *E. leptophylla* +/- *E. socialis* Mallee Community

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 480, 497, 498, 527, 529, 539

Description of ecosystem: These sites were characterised by the presence of *Eucalyptus incrassata* and/or *E. leptophylla*. They had the highest average species richness of all ecosystem types, with notably high richness and density of shrub and sedge species. *Ehrharta calycina* was the most common weed species, but was generally of low cover.

Indicative Photographs:



Site 480: *Melaleuca acuminata* Tall open shrubland with emergent *Eucalyptus leptophylla* and *Eucalyptus phenax*



Site 539: *Eucalyptus incrassata*, *E. diversifolia* ssp. *diversifolia* Open Mallee

Cell data:

Number of sites in this vegetation type: 6

Mean native plant species richness per site (\pm SD): 55.33 (5.75)

Mean introduced plant species richness per site (\pm SD): 9.33 (6.8)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:					3	3	
Mean dead plant litter & fallen timber:				4	2		
Mean moss and microphytic crust:				2	4		
Mean bare ground:		6					
Other (e.g. rock, calcrete):		2					

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Lepidosperma viscidum</i>	5	<i>Ehrharta calycina</i>	6
<i>Lepidosperma carphoides</i>	5	<i>Hypochaeris glabra</i>	5
<i>Daucus glochidiatus</i>	5	<i>Avellinia michelii</i>	5
<i>Lomandra juncea</i>	5	<i>Vulpia muralis</i>	3
<i>Eucalyptus incrassata</i>	5	<i>Asparagus asparagoides</i> f.	2
<i>Rytidosperma caespitosum</i>	4	<i>Aira sp.</i>	2
<i>Thelymitra sp.</i>	4	<i>Aira cupaniana</i>	2

<i>Lomandra micrantha</i> ssp.	4	<i>Pentaschistis</i> sp.	2
<i>Cassytha glabella</i> f. <i>dispar</i>	4		
<i>Schoenus breviculmis</i>	4		
<i>Neurachne alopecuroidea</i>	4		
<i>Podotheca angustifolia</i>	4		
<i>Acacia spinescens</i>	4		
<i>Dillwynia hispidula</i>	4		
<i>Wahlenbergia gracilentia</i>	4		
<i>Eucalyptus leptophylla</i>	4		
<i>Hibbertia devitata</i>	4		
<i>Hypolaena fastigiata</i>	4		
<i>Millotia tenuifolia</i> var.	4		
<i>Rhagodia crassifolia</i>	4		
<i>Trachymene pilosa</i>	4		

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			17 (30)
LB Trees <5m	0.83 (0.98)		150 (321)
KT Mallee >3m	1.5 (0.84)		379 (724)
KS Mallee <3m	1.0 (0.63)		446 (446)
S Shrubs > 2m	2.0 (1.41)		671 (651)
SA Shrubs 1.5-2m	0.17 (0.41)		104 (255)
SB Shrubs 1-1.5m	1.33 (1.03)		792 (1084)
SC Shrubs 0.5-1m	5.67 (1.03)	0.33 (0.82)	1513 (1158)
SD Shrubs 0-0.5m	7.17 (2.56)		2742 (2315)
P Mat plant (single plant)	1.5 (1.22)		383 (855)
GT Grass >0.5m	2.33 (1.03)	1.17 (0.41)	1283 (2318)
GL Grass <0.5m	3.0 (1.79)	3.83 (1.33)	3329 (3611)
J Herbaceous spp.	18.17 (2.56)	3.33 (3.39)	NA
VT Sedges >0.5m	1.33 (0.82)		5758 (9550)
VL Sedges <0.5m	6.67 (1.75)		26633 (17526)
V Vines (twiners)	2.5 (1.05)	0.5 (0.84)	75 (92)
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 6.4 *Eucalyptus leucoxylon* Grassy Woodland

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 485, 491

Description of ecosystem: Two sites were scored in this ecosystem type. One of these sites, site 491, was quite degraded and so data generated from this site needs to be treated with caution as it is unlikely to represent an undisturbed system. The diversity of weeds overall was the highest of all remnant sites, with grassy and herbaceous weeds prominent. Native grass density was high, with low density and richness of medium and tall shrubs.

Indicative Photographs:



Site 485: *Eucalyptus leucoxylon ssp leucoxylon* Woodland



Site 491: Mixed native and exotic Grassland with emergent *Eucalyptus leucoxylon ssp leucoxylon*

Cell data:

Number of sites in this vegetation type: 2

Mean native plant species richness per site (\pm SD): 41.0 (38.18)

Mean introduced plant species richness per site (\pm SD): 26.0 (4.24)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:					1		1
Mean dead plant litter & fallen timber:		1			1		
Mean moss and microphytic crust:		1			1		
Mean bare ground:		2					
Other (e.g. rock, calcrete):		1					

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Austrostipa sp.</i>	2	<i>Aira cupaniana</i>	2
<i>Dichondra repens</i>	2	<i>Ehrharta longiflora</i>	2
<i>Microlaena stipoides var. stipoides</i>	2	<i>Trifolium campestre</i>	2
<i>Acaena echinata</i>	2	<i>Aira elegantissima</i>	2
<i>Eucalyptus leucoxylon ssp. leucoxylon</i>	2	<i>Brachypodium distachyon</i>	2
<i>Convolvulus angustissimus ssp. angustissimus</i>	2	<i>Bromus diandrus</i>	2

		<i>Lolium rigidum</i>	2
		<i>Hypochaeris radicata</i>	2
		<i>Romulea rosea</i> var. <i>australis</i>	2

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m	1.0		
LB Trees <5m	0.5 (0.71)		275 (389)
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m	0.5 (0.71)		25 (35)
SA Shrubs 1.5-2m			
SB Shrubs 1-1.5m		0.5 (0.71)	13 (18)
SC Shrubs 0.5-1m	1.5 (2.12)		1525 (2157)
SD Shrubs 0-0.5m	1.5 (2.12)	0.5 (0.71)	2100 (2970)
P Mat plant (single plant)	0.5 (0.71)		25 (35)
GT Grass >0.5m	3.0 (1.41)	1.0 (1.41)	1500 (2121)
GL Grass <0.5m	4.0	11.0 (1.41)	17563 (22539)
J Herbaceous spp.	21.0 (24.04)	11.0 (1.41)	NA
VT Sedges >0.5m			
VL Sedges <0.5m	3.5 (4.95)	1.5 (2.12)	
V Vines (twiners)	2.5 (0.71)	0.5 (0.71)	
MI Mistletoes			NA
X Ferns	0.5 (0.71)		NA

Ecosystem Number: 9 Samphire (+/- *Melaleuca halmaturorum*) Shrubland Community

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 475, 478, 503, 507, 536, 537, 544

Description of ecosystem: Sites allocated in this ecosystem type were characterised by the presence of samphire species. These sites all sat in depressions or drainage lines in the landscape, and would at times be inundated with water. Species richness for both native and weed species was low in comparison to other environmental settings in remnant vegetation. The density of low shrubs (principally samphire species) and mat plants (*Wilsonia spp.*, *Mimulus repens*, *Disphyma crassifolium ssp. clavellatum*) is high in comparison to sites in other ecosystems.

Indicative Photographs:



Site 475: *Tecticornia arbuscula*, *Gahnia filum* Low closed shrubland



Site 536: *Tecticornia arbuscula* Very Open Shrubland

Cell data:

Number of sites in this vegetation type: 7

Mean native plant species richness per site (\pm SD): 11.14 (2.97)

Mean introduced plant species richness per site (\pm SD): 5.33 (3.14)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:						1	6
Mean dead plant litter & fallen timber:		5	1	1			
Mean moss and microphytic crust:		7					
Mean bare ground:		4	1	2			
Other (e.g. rock, calcrete):							

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Sarcocornia quinqueflora</i>	6	<i>Parapholis incurva</i>	5
<i>Frankenia pauciflora var.</i>	5	<i>Polypogon monspeliensis</i>	3
<i>Samolus repens</i>	5	<i>Sonchus oleraceus</i>	2
<i>Tecticornia arbuscula</i>	4	<i>Lagurus ovatus</i>	2
<i>Gahnia filum</i>	3	<i>Hordeum sp.</i>	2
<i>Melaleuca halmaturorum</i>	3	<i>Hordeum marinum</i>	2

<i>Puccinellia stricta</i>	3	<i>Plantago coronopus ssp.</i>	2
<i>Suaeda australis</i>	3		
<i>Triglochin striata</i>	3		
<i>Amyema melaleucae</i>	2		
<i>Distichlis distichophylla</i>	2		
<i>Juncus kraussii</i>	2		
<i>Spergularia marina</i>	2		
<i>Wilsonia backhousei</i>	2		
<i>Wilsonia humilis</i>	2		

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			
LB Trees <5m			
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m			
SA Shrubs 1.5-2m			
SB Shrubs 1-1.5m			
SC Shrubs 0.5-1m	0.86 (0.69)		2493 (3769)
SD Shrubs 0-0.5m	3.43 (1.62)		11671 (7768)
P Mat plant (single plant)	0.86 (0.9)		1375 (1844)
GT Grass >0.5m	0.57 (0.79)		296 (700)
GL Grass <0.5m	0.71 (0.76)	3.17 (2.04)	1518 (4016)
J Herbaceous spp.	3.0 (1.15)	2.0 (1.55)	NA
VT Sedges >0.5m	0.86 (0.69)		1511 (1648)
VL Sedges <0.5m	0.57 (0.79)		1711 (4471)
V Vines (twiners)		0.17 (0.41)	
MI Mistletoes	0.29 (0.49)		NA
X Ferns			NA

Ecosystem Number: 10.2 *Eucalyptus camaldulensis* var. *camaldulensis* Grassy Woodland

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 492, 518

Description of ecosystem: The presence of Red Gum (*Eucalyptus camaldulensis*) in a woodland form defined this ecosystem type. Species diversity was low, with relatively high weed species richness and cover. This suggests that these areas may be degraded, and thus density and richness data may not represent an undisturbed condition state. Tree density was relatively high.

Indicative Photographs:



Site 518: *Eucalyptus camaldulensis* var. *camaldulensis* Woodland



Site 492: *Eucalyptus camaldulensis* var. *camaldulensis* Woodland

Cell data:

Number of sites in this vegetation type: 2

Mean native plant species richness per site (\pm SD): 9.5 (3.54)

Mean introduced plant species richness per site (\pm SD): 13.5 (9.19)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:						2	
Mean dead plant litter & fallen timber:		1		1			
Mean moss and microphytic crust:		1					
Mean bare ground:			1	1			
Other (e.g. rock, calcrete):		1					

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Alternanthera denticulata</i>	2	<i>Hordeum marinum</i>	2
<i>Eucalyptus camaldulensis</i> var. <i>camaldulensis</i> (NC)	2	<i>Rumex conglomeratus</i>	2
<i>Lythrum hyssopifolia</i>	2	<i>Polypogon monspeliensis</i>	1
Gramineae sp.	1	<i>Sonchus oleraceus</i>	1
Herb sp.	1	<i>Lolium rigidum</i>	1
<i>Sonchus</i> sp.	1	<i>Lolium perenne</i>	1

<i>Apium sp.</i>	1	<i>Cotula coronopifolia</i>	1
<i>Centipeda cunninghamii</i>	1	<i>Bromus diandrus</i>	1
<i>Chenopodium sp.</i>	1	<i>Hypochaeris radicata</i>	1
<i>Cyperus gymnocaulos</i>	1	<i>Arctotheca calendula</i>	1
<i>Eleocharis acuta</i>	1	<i>Acetosella vulgaris</i>	1
<i>Helichrysum luteoalbum</i>	1	<i>Anthoxanthum odoratum</i>	1
<i>Lachnagrostis filiformis</i>	1	<i>Atriplex prostrata</i>	1
<i>Muehlenbeckia sp.</i>	1	<i>Berula erecta</i>	1
<i>Ranunculus sp.</i>	1	<i>Cirsium vulgare</i>	1
<i>Triglochin procera</i>	1	<i>Conyza bonariensis</i>	1
		<i>Crassula natans var. minus</i>	1
		<i>Cynodon dactylon var. dactylon</i>	1
		<i>Kickxia elatine ssp.</i>	1
		<i>Lactuca serriola f.</i>	1
		<i>Lythrum junceum</i>	1
		<i>Ranunculus trilobus</i>	1
		<i>Solanum nigrum</i>	1
		<i>Trifolium tomentosum</i>	1
		<i>Vicia sativa ssp.</i>	1

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m	0.67 (0.58)		1025 (1308)
LB Trees <5m			
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m			
SA Shrubs 1.5-2m	0.33 (0.58)		1088 (1538)
SB Shrubs 1-1.5m			
SC Shrubs 0.5-1m			
SD Shrubs 0-0.5m			
P Mat plant (single plant)			
GT Grass >0.5m		0.5 (0.71)	
GL Grass <0.5m	0.67 (1.15)	3.5 (2.12)	4000 (5657)
J Herbaceous spp.	3.67 (2.52)	9.5 (7.78)	NA
VT Sedges >0.5m	0.33 (0.58)		2513 (1962)
VL Sedges <0.5m	0.67 (1.15)		2163 (3058)
V Vines (twiners)			
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 10.3 Grassland community

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 477

Description of ecosystem: Only one site was surveyed in this ecosystem. This site was a *Lomandra effusa*, *Austrostipa eremophila*, *Avena barbata* Grassland. Native plant species richness was relatively low. There were no tree or shrub species in either the surveyed cell or along the transect. Grass density was higher than in any other environmental setting. There was also 5-25% exposed rock.

Indicative Photographs:



Site 477: *Lomandra effusa*, *Austrostipa eremophila*, *Avena barbata* Grassland



Site 477: *Lomandra effusa*, *Austrostipa eremophila*, *Avena barbata* Grassland

Cell data:

Number of sites in this vegetation type: 1

Mean native plant species richness per site (\pm SD): 9.0

Mean introduced plant species richness per site (\pm SD): 17.0

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:					1		
Mean dead plant litter & fallen timber:				1			
Mean moss and microphytic crust:				1			
Mean bare ground:		1					
Other (e.g. rock, calcrete):				1			

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Convolvulus angustissimus ssp. peninsularum</i>	1	<i>Aira cupaniana</i>	1
<i>Aristida behriana</i>	1	<i>Avena barbata</i>	1
<i>Rytidosperma caespitosum</i>	1	<i>Hypochaeris glabra</i>	1
<i>Lomandra effusa</i>	1	<i>Plantago bellardii</i>	1
<i>Austrostipa eremophila</i>	1	<i>Vulpia sp.</i>	1
<i>Vittadinia cuneata var.</i>	1	<i>Centaurium sp.</i>	1
<i>Enneapogon nigricans</i>	1	<i>Leontodon</i>	1

		<i>rhagadioloides</i>	
<i>Hyalosperma semisterile</i>	1	<i>Petrorhagia dubia</i>	1
<i>Podolepis rugata var. rugata</i>	1	<i>Asphodelus fistulosus</i>	1
		<i>Reichardia tingitana</i>	1
		<i>Neatostema apulum</i>	1
		<i>Carthamus lanatus</i>	1
		<i>Salvia verbenaca var.</i>	1
		<i>Trifolium scabrum</i>	1
		<i>Medicago minima var. minima</i>	1
		<i>Poa bulbosa</i>	1
		<i>Rostraria cristata</i>	1

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			
LB Trees <5m			
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m			
SA Shrubs 1.5-2m			
SB Shrubs 1-1.5m			
SC Shrubs 0.5-1m			
SD Shrubs 0-0.5m			
P Mat plant (single plant)			
GT Grass >0.5m	1.0	1.0	19900
GL Grass <0.5m	3.0	4.0	15050
J Herbaceous spp.	3.0	11.0	NA
VT Sedges >0.5m			
VL Sedges <0.5m	1.0		1600
V Vines (twiners)	1.0		
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 10.4 Non Eucalypt (*Allocasuarina verticillata* and *Callitris gracilis*) Grassy Woodland

Remnant or revegetation: Remnant

Sites included in this ecosystem type: 465, 466, 472, 476, 524, 533, 534, 538

Description of ecosystem: Sites in this ecosystem were of woodland form, with either *Allocasuarina verticillata* or *Callitris gracilis* as the dominant overstorey. This ecosystem type had moderate-high diversity of both native and introduced species. Low shrubs and sedges were prominent features of the ground layer. Bridal Creeper was present in all of the sites surveyed.

Indicative Photographs:



Site 465: *Allocasuarina verticillata*, *Callitris gracilis* Low Woodland



Site : *Allocasuarina verticillata* Low Open Woodland

Cell data:

Number of sites in this vegetation type: 8

Mean native plant species richness per site (\pm SD): 37.63 (18.33)

Mean introduced plant species richness per site (\pm SD): 13.13 (3.64)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:					2	6	
Mean dead plant litter & fallen timber:			1	6	1		
Mean moss and microphytic crust:				6	2		
Mean bare ground:		1	2	4	1		
Other (e.g. rock, calcrete):		1	1				

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%) , 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3= any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Allocasuarina verticillata</i>	7	<i>Asparagus asparagoides</i> f.	8
<i>Clematis microphylla</i>	6	<i>Ehrharta calycina</i>	7
<i>Podotherca angustifolia</i>	6	<i>Hypochaeris glabra</i>	6
<i>Helichrysum leucopsidium</i>	6	<i>Plantago bellardii</i>	6
<i>Thysanotus patersonii</i>	5	<i>Vulpia</i> sp.	6
<i>Astroloma humifusum</i>	5	<i>Avena barbata</i>	5

<i>Lepidosperma carphoides</i>	5	<i>Petrorhagia dubia</i>	5
<i>Schoenus breviculmis</i>	5	<i>Lagurus ovatus</i>	5
<i>Rhagodia candolleana ssp.</i>	5	<i>Brassica tournefortii</i>	5
<i>Enchylaena tomentosa var.</i>	4	<i>Lycium ferocissimum</i>	4
<i>Cassytha glabella f. dispar</i>	4	<i>Pentaschistis sp.</i>	3
<i>Millotia tenuifolia var.</i>	4	<i>Trifolium arvense var. arvense</i>	3
<i>Callitris gracilis</i>	4	<i>Aira cupaniana</i>	2
<i>Acrotriche affinis</i>	4	<i>Centaurium sp.</i>	2
<i>Arthropodium fimbriatum</i>	4	<i>Hypochaeris radicata</i>	2
<i>Kunzea pomifera</i>	4	<i>Aira sp.</i>	2
<i>Xanthorrhoea caespitosa</i>	4	<i>Ehrharta longiflora</i>	2
<i>Muehlenbeckia gunnii</i>	4	<i>Avellinia michelii</i>	2
<i>Lomandra leucocephala ssp. robusta</i>	4	<i>Silene nocturna</i>	2
		<i>Euphorbia terracina</i>	2
		<i>Zaluzianskya divaricata</i>	2
		<i>Sonchus asper ssp.</i>	2

Transect and Cell Data: Number and density of plant species by lifeform type (±SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			41 (115)
LB Trees <5m	1.63 (0.52)		1000 (1600)
KT Mallee >3m	0.25 (0.46)		203 (545)
KS Mallee <3m	0.13 (0.35)		03 (03)
S Shrubs > 2m	0.63 (0.52)		722 (1256)
SA Shrubs 1.5-2m	0.13 (0.35)	0.13 (0.35)	628 (1175)
SB Shrubs 1-1.5m	1.63 (1.92)		1144 (1428)
SC Shrubs 0.5-1m	2.5 (2.67)	0.63 (0.52)	2056 (4719)
SD Shrubs 0-0.5m	5.13 (3.94)		3194 (3385)
P Mat plant (single plant)	1.88 (1.64)		1678 (2668)
GT Grass >0.5m	1.75 (1.83)	1.5 (0.76)	1256 (1551)
GL Grass <0.5m	2.13 (0.83)	3.63 (0.74)	2500 (3580)
J Herbaceous spp.	10.88 (5.19)	6.25 (2.82)	NA
VT Sedges >0.5m	0.5 (0.53)		188 (228)
VL Sedges <0.5m	4.13 (2.9)		9278 (10290)
V Vines (twiners)	3.88 (1.64)	1.0	747 (1147)
MI Mistletoes	0.5 (0.53)		NA
X Ferns			NA

3.2 Descriptions of ecosystems: revegetation

Ecosystem Number: 1 Pink Gum (*Eucalyptus fasciculosa*) Low Open Grassy Woodland of the Mount Lofty Ranges

Remnant or revegetation: Revegetation

Sites included in this ecosystem type: 5, 77, 78, 417, 561, 562

Description of ecosystem: Sites where revegetation aimed to recover this ecosystem had notably less bare ground present than in remnant patches, due to the high cover of non-native grasses in the ground layer. Species richness was low, and densities of native grasses and sedges were much lower than in remnant patches of the same ecosystem type.

Indicative Photographs:



Site 5: *Eucalyptus fasciculosa* Very Low Woodland



Site 562: Emergent *Allocasuarina verticillata*, *Eucalyptus fasciculosa* Very Low Open Woodland

Cell data:

Number of sites in this vegetation type: 6

Mean native plant species richness per site (\pm SD): 16.67 (1.86)

Mean introduced plant species richness per site (\pm SD): 11.83 (2.32)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:					1	3	2
Mean dead plant litter & fallen timber:			1	3		2	
Mean moss and microphytic crust:		3		2			
Mean bare ground:	1	4		1			
Other (e.g. rock, calcrete):							

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Bursaria spinosa ssp. spinosa</i>	4	<i>Ehrharta calycina</i>	6
<i>Melaleuca uncinata</i>	4	<i>Arctotheca calendula</i>	6
<i>Eucalyptus fasciculosa</i>	4	<i>Vulpia sp.</i>	5
<i>Clematis microphylla</i>	3	<i>Bromus diandrus</i>	5
<i>Dodonaea viscosa ssp.</i>	3	<i>Trifolium arvense var.</i>	4

<i>spatulata</i>		<i>arvense</i>	
<i>Acacia pycnantha</i>	3	<i>Sonchus oleraceus</i>	4
<i>Acacia paradoxa</i>	3	<i>Lolium rigidum</i>	4
<i>Distichlis distichophylla</i>	3	<i>Hypochaeris glabra</i>	3
<i>Acacia myrtifolia</i>	3	<i>Avena barbata</i>	3
<i>Eucalyptus sp.</i>	3	<i>Hypochaeris radicata</i>	3
<i>Allocasuarina verticillata</i>	2	<i>Trifolium campestre</i>	3
<i>Rhagodia candolleana ssp.</i>	2	<i>Lagurus ovatus</i>	2
<i>Thomasia petalocalyx</i>	2	<i>Oxalis pes-caprae</i>	2
<i>Olearia ramulosa</i>	2		
<i>Kennedia prostrata</i>	2		
<i>Leptospermum myrsinoides</i>	2		
<i>Melaleuca lanceolata</i>	2		
<i>Bursaria spinosa ssp.</i>	2		
<i>Ficinia nodosa</i>	2		
<i>Melaleuca halmaturorum</i>	2		
<i>Vittadinia australasica var.</i>	2		
<i>Allocasuarina sp.</i>	2		
<i>Banksia ornata</i>	2		

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m	0.83 (0.75)		208 (325)
LB Trees <5m	1.33 (0.82)		363 (488)
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m	1.67 (1.03)		238 (267)
SA Shrubs 1.5-2m	0.17 (0.41)		08 (20)
SB Shrubs 1-1.5m	1.33 (0.82)		296 (222)
SC Shrubs 0.5-1m	2.33 (1.03)		179 (185)
SD Shrubs 0-0.5m	3.17 (1.17)		408 (383)
P Mat plant (single plant)	0.67 (0.52)		33 (61)
GT Grass >0.5m	0.83 (0.98)	1.67 (0.82)	217 (261)
GL Grass <0.5m	1.0 (1.26)	3.67 (1.03)	233 (500)
J Herbaceous spp.	1.17 (0.41)	6.33 (1.51)	NA
VT Sedges >0.5m	0.83 (0.75)		288 (482)
VL Sedges <0.5m	0.17 (0.41)		183 (302)
V Vines (twiners)	1.0 (0.63)	0.17 (0.41)	58 (47)
MI Mistletoes	0.17 (0.41)		NA
X Ferns			NA

Ecosystem Number: 3 Coastal Shrubland of the Coorong

Remnant or revegetation: Revegetation

Sites included in this ecosystem type: 232, 255, 364, 521, 522, 569

Description of ecosystem: This ecosystem was generally found in close proximity to the coast. Some sites (eg site 232 below) contained plants that appeared to be natural regenerates rather than revegetation, although all sites also showed evidence of revegetation activities. Annual grassy weeds, such as *Bromus diandrus*, *Avena barbata* and *Lagurus ovatus* were present at all sites and formed a high proportion of the ground cover.

Indicative Photographs:



Site 569: *Ficinia nodosa* Very Open Sedgeland



Site 232: *Myoporum insulare*, *Olearia axillaris*, *Dodonaea viscosa ssp spatulata* Tall very open shrubland

Cell data:

Number of sites in this vegetation type: 6

Mean native plant species richness per site (\pm SD): 18.33 (8.45)

Mean introduced plant species richness per site (\pm SD): 12.5 (2.35)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:						3	3
Mean dead plant litter & fallen timber:		1	2	2	1		
Mean moss and microphytic crust:		1	2				
Mean bare ground:		3		1			
Other (e.g. rock, calcrete):				2			

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Rhagodia candolleana ssp.</i>	5	<i>Bromus diandrus</i>	5
<i>Enchylaena tomentosa var.</i>	5	<i>Avena barbata</i>	5
<i>Myoporum insulare</i>	5	<i>Lagurus ovatus</i>	5
<i>Distichlis distichophylla</i>	4	<i>Sonchus oleraceus</i>	4
<i>Dodonaea viscosa ssp. spatulata</i>	3	<i>Vulpia sp.</i>	3
<i>Acacia pycnantha</i>	3	<i>Lolium rigidum</i>	3
<i>Allocasuarina verticillata</i>	3	<i>Plantago coronopus ssp.</i>	3

<i>Ficinia nodosa</i>	3	<i>Medicago polymorpha</i> <i>var. polymorpha</i>	3
<i>Dianella brevicaulis</i>	3	<i>Scabiosa atropurpurea</i>	3
<i>Olearia axillaris</i>	3	<i>Trifolium campestre</i>	2
<i>Acacia cupularis</i>	3	<i>Reichardia tingitana</i>	2
<i>Poa poiformis</i> <i>var. poiformis</i>	3	<i>Bromus hordeaceus</i> <i>ssp. hordeaceus</i>	2
<i>Atriplex paludosa</i> <i>ssp.</i>	3	<i>Euphorbia terracina</i>	2
		<i>Asphodelus fistulosus</i>	2
		<i>Hordeum marinum</i>	2
		<i>Carduus tenuiflorus</i>	2
		<i>Catapodium rigidum</i>	2

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			
LB Trees <5m	1.67 (1.51)		129 (149)
KT Mallee >3m	0.17 (0.41)		08 (20)
KS Mallee <3m	0.17 (0.41)		
S Shrubs > 2m	1.0 (0.89)		154 (199)
SA Shrubs 1.5-2m	0.33 (0.52)	0.17 (0.41)	33 (82)
SB Shrubs 1-1.5m	1.33 (1.03)		267 (356)
SC Shrubs 0.5-1m	2.67 (0.82)	0.33 (0.52)	358 (217)
SD Shrubs 0-0.5m	3.5 (1.64)		650 (431)
P Mat plant (single plant)	1.33 (1.75)	0.17 (0.41)	550 (1179)
GT Grass >0.5m	1.5 (0.55)	1.33 (0.82)	5125 (5299)
GL Grass <0.5m	1.33 (0.52)	4.17 (1.6)	1004 (1290)
J Herbaceous spp.	0.5 (0.55)	6.33 (2.66)	NA
VT Sedges >0.5m	1.17 (0.98)		2367 (2864)
VL Sedges <0.5m	1.0 (1.67)		1742 (4062)
V Vines (twiners)	0.67 (1.03)		83 (144)
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 4 *Eucalyptus diversifolia* Mallee Communities of the South East

Remnant or revegetation: Revegetation

Sites included in this ecosystem type: 511, 516, 546, 547, 550, 573

Description of ecosystem: Species richness in revegetation sites was low when compared with remnant sites (average 13.67 compared with 45.14). One site, 573 pictured below, was primarily exposed sand on calcrete, leading to a high bare ground score. Densities and richness of all life forms were low when compared to remnant sites.

Indicative Photographs:



Site 511: *Acacia longifolia* spp *sophorae* Tall Very Open Shrubland



Site 573: Bare inland sand dune slope with emergent plantings

Cell data:

Number of sites in this vegetation type: 6

Mean native plant species richness per site (\pm SD): 13.67 (6.8)

Mean introduced plant species richness per site (\pm SD): 11.5 (2.07)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:		1		1	1	1	2
Mean dead plant litter & fallen timber:		2	1	3			
Mean moss and microphytic crust:		2		1	1	1	
Mean bare ground:			1	2	1		1
Other (e.g. rock, calcrete):				2			

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Enchylaena tomentosa</i> var.	4	<i>Bromus diandrus</i>	5
<i>Eucalyptus diversifolia</i> ssp. <i>diversifolia</i>	4	<i>Avena barbata</i>	5
<i>Rhagodia candolleana</i> ssp.	3	<i>Lagurus ovatus</i>	4
<i>Acacia pycnantha</i>	3	<i>Ehrharta calycina</i>	4
<i>Ficinia nodosa</i>	3	<i>Trifolium arvense</i> var. <i>arvense</i>	4
<i>Eucalyptus</i> sp.	3	<i>Sonchus oleraceus</i>	3

<i>Melaleuca lanceolata</i>	3	<i>Euphorbia terracina</i>	3
<i>Enneapogon nigricans</i>	3	<i>Hypochaeris radicata</i>	3
<i>Dodonaea viscosa ssp. spatulata</i>	2	<i>Oenothera stricta ssp. stricta</i>	3
<i>Allocasuarina verticillata</i>	2	<i>Vulpia sp.</i>	2
<i>Acacia cupularis</i>	2	<i>Medicago polymorpha var. polymorpha</i>	2
<i>Austrostipa eremophila</i>	2	<i>Trifolium campestre</i>	2
<i>Acacia longifolia ssp. sophorae</i>	2	<i>Reichardia tingitana</i>	2
<i>Kennedia prostrata</i>	2	<i>Asphodelus fistulosus</i>	2
<i>Muehlenbeckia gunnii</i>	2	<i>Lactuca serriola f.</i>	2
<i>Banksia ornata</i>	2	<i>Bromus rubens</i>	2
<i>Kunzea pomifera</i>	2	<i>Chondrilla juncea</i>	2
<i>Pelargonium australe</i>	2		

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m		0.17 (0.41)	17 (41)
LB Trees <5m	1.67 (1.03)		421 (631)
KT Mallee >3m	1.17 (0.98)		175 (125)
KS Mallee <3m	0.33 (0.82)		33 (33)
S Shrubs > 2m	1.5 (1.05)	0.17 (0.41)	292 (505)
SA Shrubs 1.5-2m	0.33 (0.82)		17 (41)
SB Shrubs 1-1.5m	0.5 (0.84)		83 (128)
SC Shrubs 0.5-1m	1.17 (1.33)	0.17 (0.41)	388 (518)
SD Shrubs 0-0.5m	2.17 (2.93)		221 (323)
P Mat plant (single plant)	0.83 (0.98)		100 (200)
GT Grass >0.5m	0.67 (0.82)	1.5 (0.55)	92 (124)
GL Grass <0.5m	1.17 (0.98)	3.0 (0.89)	308 (695)
J Herbaceous spp.	0.83 (0.41)	6.33 (2.25)	NA
VT Sedges >0.5m	0.67 (0.52)		417 (561)
VL Sedges <0.5m	0.17 (0.41)		
V Vines (twiners)	0.5 (0.84)	0.17 (0.41)	38 (70)
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 5 Sheoak (*Allocasuarina verticillata*) low woodland with shrubby understorey

Remnant or revegetation: Revegetation

Sites included in this ecosystem type: 322, 323, 328, 345, 348, 408, 444, 509, 512, 513, 514, 515, 520, 542, 557, 558, 559, 560, 564

Description of ecosystem: These sites ranged from semi-mature revegetated woodlands (Site 564) to recently planted seedlings in highly degraded grasslands dominated by *Ehrharta calycina* (eg site 322 below). Richness and density of all life forms was low compared to remnant sites, but weed diversity was lower in revegetation sites.

Indicative Photographs:



Site 564: *Allocasuarina verticillata* Very Low Open Woodland



Site 322: *Ehrharta calycina* Exotic grassland

Cell data:

Number of sites in this vegetation type: 19

Mean native plant species richness per site (\pm SD): 14.79 (7.23)

Mean introduced plant species richness per site (\pm SD): 12.89 (4.53)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:				2	4	5	7
Mean dead plant litter & fallen timber:		1	3	12	1		
Mean moss and microphytic crust:		9	1	4	1		
Mean bare ground:		7	1	7	2		
Other (e.g. rock, calcrete):		4		1	1	1	

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Allocasuarina verticillata</i>	17	<i>Bromus diandrus</i>	16
<i>Melaleuca lanceolata</i>	11	<i>Ehrharta calycina</i>	14
<i>Acacia cupularis</i>	10	<i>Avena barbata</i>	9
<i>Myoporum insulare</i>	10	<i>Sonchus oleraceus</i>	8
<i>Ficinia nodosa</i>	8	<i>Lagurus ovatus</i>	7
<i>Olearia axillaris</i>	8	<i>Trifolium arvense</i> var. <i>arvense</i>	7

<i>Acacia pycnantha</i>	7	<i>Euphorbia terracina</i>	7
<i>Atriplex semibaccata</i>	7	<i>Reichardia tingitana</i>	7
<i>Rhagodia candolleana</i> ssp.	6	<i>Cynodon dactylon</i> var. <i>dactylon</i>	7
<i>Bursaria spinosa</i> ssp. <i>spinosa</i>	6	<i>Arctotheca calendula</i>	7
<i>Eucalyptus incrassata</i>	6	<i>Oenothera stricta</i> ssp. <i>stricta</i>	6
<i>Poa poiiformis</i> var. <i>poiiformis</i>	6	<i>Vulpia</i> sp.	6
<i>Enchylaena tomentosa</i> var.	5	<i>Asphodelus fistulosus</i>	5
<i>Eucalyptus diversifolia</i> ssp. <i>diversifolia</i>	5	<i>Lactuca serriola</i> f.	5
<i>Eucalyptus porosa</i>	5	<i>Oxalis pes-caprae</i>	5
<i>Distichlis distichophylla</i>	5	<i>Vulpia fasciculata</i>	5
<i>Hakea mitchellii</i>	5	<i>Plantago coronopus</i> ssp.	5
		<i>Scabiosa atropurpurea</i>	5
		<i>Bromus hordeaceus</i> ssp. <i>hordeaceus</i>	5
		<i>Hypochaeris radicata</i>	4
		<i>Medicago polymorpha</i> var. <i>polymorpha</i>	4
		<i>Marrubium vulgare</i>	4
		<i>Lolium perenne</i>	4

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m	0.11 (0.32)	0.05 (0.23)	05 (13)
LB Trees <5m	1.84 (1.01)	0.05 (0.23)	364 (272)
KT Mallee >3m	0.26 (0.45)		30 (74)
KS Mallee <3m	0.32 (0.48)		14 (14)
S Shrubs > 2m	1.47 (0.77)	0.05 (0.23)	247 (226)
SA Shrubs 1.5-2m		0.05 (0.23)	01 (06)
SB Shrubs 1-1.5m	0.95 (0.97)		93 (105)
SC Shrubs 0.5-1m	2.05 (1.35)	0.05 (0.23)	208 (214)
SD Shrubs 0-0.5m	1.63 (1.74)		332 (343)
P Mat plant (single plant)	1.05 (1.31)	0.05 (0.23)	109 (153)
GT Grass >0.5m	1.21 (1.65)	1.42 (0.69)	507 (823)
GL Grass <0.5m	0.68 (0.67)	3.63 (1.57)	379 (640)
J Herbaceous spp.	1.37 (0.96)	7.26 (2.81)	NA
VT Sedges >0.5m	0.89 (0.94)		563 (1118)
VL Sedges <0.5m	0.26 (0.45)		41 (87)
V Vines (twiners)	0.68 (0.95)	0.11 (0.32)	72 (136)
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 6.1 Mallee Box (*Eucalyptus porosa*) Grassy Woodland

Remnant or revegetation: Revegetation

Sites included in this ecosystem type: 360, 510, 541, 545, 553

Description of ecosystem: There were 5 sites where revegetation was being used to restore this ecosystem type, with a variety of time scales since planting (eg refer to sites 545 and 510 below). Sedges, vines and twiners were conspicuous life forms in remnant patches that were completely absent from revegetated areas. Richness and cover for all life forms was lower in the revegetation than in the remnant patches.

Indicative Photographs:



Site 545: *Eucalyptus porosa* Mallee



Site 510: *Eucalyptus porosa*, *Eucalyptus diversifolia*, *Allocasuarina verticillata* Very Low Open Woodland

Cell data:

Number of sites in this vegetation type: 5

Mean native plant species richness per site (\pm SD): 9.6 (3.78)

Mean introduced plant species richness per site (\pm SD): 12.6 (2.07)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:			1		2	1	1
Mean dead plant litter & fallen timber:		1		3			1
Mean moss and microphytic crust:		2		1			
Mean bare ground:		2	1	1	1		
Other (e.g. rock, calcrete):							

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Allocasuarina verticillata</i>	4	<i>Bromus diandrus</i>	5
<i>Eucalyptus porosa</i>	4	<i>Ehrharta calycina</i>	4
<i>Enchylaena tomentosa</i> var.	3	<i>Lagurus ovatus</i>	3
<i>Eucalyptus diversifolia</i> ssp. <i>diversifolia</i>	2	<i>Oenothera stricta</i> ssp. <i>stricta</i>	3
<i>Distichlis distichophylla</i>	2	<i>Marrubium vulgare</i>	3
<i>Acacia paradoxa</i>	2	<i>Lolium perenne</i>	3
<i>Dodonaea viscosa</i> ssp.	2	<i>Brassica tournefortii</i>	3

<i>spatulata</i>			
<i>Crassula sp.</i>	2	<i>Sonchus oleraceus</i>	2
<i>Callitris gracilis</i>	2	<i>Reichardia tingitana</i>	2
<i>Salsola australis</i>	2	<i>Arctotheca calendula</i>	2
		<i>Vulpia sp.</i>	2
		<i>Hypochaeris radicata</i>	2
		<i>Diplotaxis tenuifolia</i>	2
		<i>Bromus rubens</i>	2

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m	0.2 (0.45)		
LB Trees <5m	2.4 (0.89)		490 (208)
KT Mallee >3m	0.4 (0.55)		10 (14)
KS Mallee <3m	0.2 (0.45)		15 (15)
S Shrubs > 2m	0.8 (0.84)		100 (170)
SA Shrubs 1.5-2m			
SB Shrubs 1-1.5m	0.8 (0.84)		30 (54)
SC Shrubs 0.5-1m	0.8 (0.45)		80 (125)
SD Shrubs 0-0.5m	1.4 (1.14)		75 (50)
P Mat plant (single plant)	0.2 (0.45)	0.2 (0.45)	05 (11)
GT Grass >0.5m	0.2 (0.45)	1.0	15 (34)
GL Grass <0.5m	0.8 (0.84)	3.8 (1.3)	300 (536)
J Herbaceous spp.	1.2 (1.64)	7.4 (2.7)	NA
VT Sedges >0.5m	0.2 (0.45)		
VL Sedges <0.5m			
V Vines (twiners)			
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 6.3 *Eucalyptus incrassata* / *E. leptophylla* +/- *E. socialis* Mallee Community

Remnant or revegetation: Revegetation

Sites included in this ecosystem type: 563

Description of ecosystem: Only one site was allocated to this community type. The site had been recently slashed, but clearly had a dominant introduced grass layer which would hamper efforts to revegetate, especially with non-shrub or tree lifeforms such as grasses and sedges. This vegetation type was highly floristically and structurally diverse in remnant sites, but was the reverse in this revegetated site.

Indicative Photographs:



Site 563: *Myoporum insulare* Tall Very Open Shrubland



Site 563: *Myoporum insulare* Tall Very Open Shrubland

Cell data:

Number of sites in this vegetation type: 1

Mean native plant species richness per site (\pm SD): 6.0

Mean introduced plant species richness per site (\pm SD): 6.0

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:				1			
Mean dead plant litter & fallen timber:							1
Mean moss and microphytic crust:							
Mean bare ground:							
Other (e.g. rock, calcrete):							

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%) , 1 = plentiful, but of small cover(less than 5%), 2 = any number of individuals covering 5-25% of area, 3= any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Enchylaena tomentosa</i> var.	1	<i>Bromus diandrus</i>	1
<i>Distichlis distichophylla</i>	1	<i>Brassica tournefortii</i>	1
<i>Rhagodia candolleana</i> ssp.	1	<i>Avena barbata</i>	1
<i>Maireana brevifolia</i>	1	<i>Malva parviflora</i>	1
<i>Myoporum insulare</i>	1	<i>Lolium rigidum</i>	1
<i>Atriplex paludosa</i> ssp.	1	<i>Hordeum</i> sp.	1

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			
LB Trees <5m			
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m			
SA Shrubs 1.5-2m			
SB Shrubs 1-1.5m	1.0		325
SC Shrubs 0.5-1m	2.0		175
SD Shrubs 0-0.5m	2.0		475
P Mat plant (single plant)			
GT Grass >0.5m		1.0	
GL Grass <0.5m	1.0	3.0	
J Herbaceous spp.		2.0	NA
VT Sedges >0.5m			
VL Sedges <0.5m			
V Vines (twiners)			
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 7 Freshwater Fringing Wetland Community

Remnant or revegetation: Revegetation

Sites included in this ecosystem type: 556

Description of ecosystem: Only one site was allocated to this ecosystem type, a low lying area which contained species tolerant or dependent on freshwater inundation such as *Cyperus gymnocaulos*, *Melaleuca brevifolia* and *Callistemon rugulosus*. Cover of weeds, notably *Ehrharta calycina*, was high.

Indicative Photographs:



Site 556: *Ehrharta calycina* Exotic Grassland



Site 556: *Ehrharta calycina* Exotic Grassland

Cell data:

Number of sites in this vegetation type: 1

Mean native plant species richness per site (\pm SD): 12.0

Mean introduced plant species richness per site (\pm SD): 7.0

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:						1	
Mean dead plant litter & fallen timber:				1			
Mean moss and microphytic crust:			1				
Mean bare ground:		1					
Other (e.g. rock, calcrete):							

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%) , 1 = plentiful, but of small cover(less than 5%), 2 = any number of individuals covering 5-25% of area, 3= any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Distichlis distichophylla</i>	1	<i>Ehrharta calycina</i>	1
<i>Ficinia nodosa</i>	1	<i>Sonchus oleraceus</i>	1
<i>Eucalyptus sp.</i>	1	<i>Hypochaeris radicata</i>	1
<i>Cyperus gymnocaulos</i>	1	<i>Trifolium arvense var. arvense</i>	1
<i>Dodonaea viscosa ssp. angustissima</i>	1	<i>Senecio pterophorus</i>	1
<i>Crassula colligata ssp.</i>	1	<i>Aira cupaniana</i>	1
<i>Melaleuca brevifolia</i>	1	<i>Vulpia myuros f.</i>	1
<i>Baumea juncea</i>	1		
<i>Calytrix tetragona</i>	1		

<i>Callistemon rugulosus</i>	1		
<i>Goodenia ovata</i>	1		
<i>Compositae sp.</i>	1		

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			
LB Trees <5m	1.0		
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m	1.0		75
SA Shrubs 1.5-2m			
SB Shrubs 1-1.5m	1.0		50
SC Shrubs 0.5-1m	2.0		150
SD Shrubs 0-0.5m	1.0		100
P Mat plant (single plant)			
GT Grass >0.5m		1.0	100
GL Grass <0.5m	1.0	2.0	225
J Herbaceous spp.	2.0	4.0	NA
VT Sedges >0.5m	1.0		50
VL Sedges <0.5m	2.0		2525
V Vines (twiners)			
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 9 Samphire (+/- *Melaleuca halmaturorum*) Shrubland Community

Remnant or revegetation: Revegetation

Sites included in this ecosystem type: 204, 270, 325, 406, 454, 523, 548, 549, 568, 570, 571, 572

Description of ecosystem: Sites allocated to this environmental setting generally still had significant remnancy, with all twelve sites having remnant samphire species present (as can be seen from site 570 and 270 photographs below). Site 325 had no revegetation evident in the cell assessed. The cover of introduced grass species was generally higher than in remnant sites. Average species richness was 8.67 compared to 11.14 in the remnant sites. Herbaceous species richness was lower than the remnant sites, as well as sedge density. This may be an indication that the sites chosen for revegetation were more degraded, probably through grazing, than the remnant sites.

Indicative Photographs:



Site 570: *Bromus diandrus*, *Lolium sp.*, *Medicago polymorpha* Grassland with emergent mixed plantings



Site 270: *Halosarcia halocnemoides ssp. halocnemoides* Low Open Shrubland

Cell data:

Number of sites in this vegetation type: 12

Mean native plant species richness per site (\pm SD): 8.67 (3.03)

Mean introduced plant species richness per site (\pm SD): 8.5 (2.78)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:				1	2		9
Mean dead plant litter & fallen timber:		3	3	5	1		
Mean moss and microphytic crust:		5	1	1	3		
Mean bare ground:		6	1	2	1		
Other (e.g. rock, calcrete):		1	1				

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Melaleuca halmaturorum</i>	8	<i>Sonchus oleraceus</i>	8
<i>Enchylaena tomentosa var.</i>	7	<i>Avena barbata</i>	8
<i>Disphyma crassifolium ssp. clavellatum</i>	7	<i>Medicago polymorpha var. polymorpha</i>	8
<i>Distichlis distichophylla</i>	6	<i>Lolium rigidum</i>	7

<i>Frankenia pauciflora</i> var.	5	<i>Bromus diandrus</i>	5
<i>Puccinellia stricta</i>	4	<i>Hordeum</i> sp.	5
<i>Suaeda australis</i>	4	<i>Hordeum marinum</i>	5
<i>Ficinia nodosa</i>	3	<i>Lagurus ovatus</i>	4
<i>Gahnia filum</i>	3	<i>Plantago coronopus</i> ssp.	4
<i>Wilsonia backhousei</i>	3	<i>Bromus hordeaceus</i> ssp. <i>hordeaceus</i>	4
<i>Sarcocornia quinqueflora</i>	3	<i>Parapholis incurva</i>	4
<i>Tecticornia pergranulata</i> ssp.	3	<i>Trifolium arvense</i> var. <i>arvense</i>	2
<i>Rhagodia candolleana</i> ssp.	2	<i>Oenothera stricta</i> ssp. <i>stricta</i>	2
<i>Myoporum insulare</i>	2	<i>Reichardia tingitana</i>	2
<i>Atriplex paludosa</i> ssp.	2	<i>Cynodon dactylon</i> var. <i>dactylon</i>	2
<i>Atriplex semibaccata</i>	2	<i>Trifolium campestre</i>	2
<i>Poa labillardieri</i> var. <i>labillardieri</i>	2	<i>Lolium</i> sp.	2
<i>Rhagodia crassifolia</i>	2	<i>Polygomon monspeliensis</i>	2
<i>Oxalis</i> sp.	2	<i>Sonchus asper</i> ssp.	2
<i>Samolus repens</i>	2		
<i>Tecticornia arbuscula</i>	2		
<i>Tecticornia indica</i> ssp.	2		
<i>Tecticornia halocnemoides</i> ssp. <i>halocnemoides</i>	2		

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			
LB Trees <5m	0.08 (0.28)		23 (72)
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m			08 (29)
SA Shrubs 1.5-2m	0.08 (0.28)		
SB Shrubs 1-1.5m			04 (14)
SC Shrubs 0.5-1m	1.23 (1.24)		9492 (11451)
SD Shrubs 0-0.5m	2.77 (1.88)		2081 (2407)
P Mat plant (single plant)	1.08 (0.95)	0.08 (0.29)	204 (411)
GT Grass >0.5m	0.54 (0.52)	0.75 (0.45)	750 (1394)
GL Grass <0.5m	0.69 (0.63)	3.58 (1.31)	119 (237)
J Herbaceous spp.	0.85 (0.9)	4.08 (2.23)	NA
VT Sedges >0.5m	0.62 (0.77)		633 (1155)
VL Sedges <0.5m			31 (108)
V Vines (twiners)	0.08 (0.28)		08 (29)
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 10.1 *Gahnia filum* Sedgeland

Remnant or revegetation: Revegetation

Sites included in this ecosystem type: 208, 565

Description of ecosystem: This ecosystem was found in lower lying clay soils where water salinity was low. One site (208) contained some remnant/regenerated *Gahnia* and it was unclear if any revegetation was present, whereas the other site (565) had no discernible original remnant *Gahnia* left and revegetation had occurred recently. No analogous remnant sites were scored.

Indicative Photographs:



Site 208: *Gahnia filum* Open Sedgeland over Samphire sp
Low Closed Shrubland



Site 565: *Rhagodia crassifolia*, *Maireana oppositifolia*,
Disphyma crassifolium, *Enchylaena tomentosa* Chenopod
Shrubland

Cell data:

Number of sites in this vegetation type: 2

Mean native plant species richness per site (\pm SD): 14.5 (3.54)

Mean introduced plant species richness per site (\pm SD): 8.5 (4.95)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:					1		1
Mean dead plant litter & fallen timber:			1		1		
Mean moss and microphytic crust:				1			
Mean bare ground:		1		1			
Other (e.g. rock, calcrete):							

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Suaeda australis</i>	2	<i>Lolium rigidum</i>	2
<i>Gahnia filum</i>	2	<i>Bromus diandrus</i>	2
<i>Samolus repens</i>	2	<i>Sonchus oleraceus</i>	1
<i>Senecio</i> sp.	2	<i>Avena barbata</i>	1
		<i>Medicago polymorpha</i> var. <i>polymorpha</i>	1
		<i>Malva parviflora</i>	1

		<i>Vulpia sp.</i>	1
		<i>Lepidium africanum</i>	1
		<i>Polygonum aviculare</i>	1
		<i>Erodium cicutarium</i>	1
		<i>Oxalis pes-caprae</i>	1
		<i>Brachypodium distachyon</i>	1
		<i>Cirsium vulgare</i>	1
		<i>Polypogon sp.</i>	1
		<i>Atriplex prostrata</i>	1

Transect and Cell Data: Number and density of plant species by lifeform type (±SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			
LB Trees <5m	0.5 (0.71)		
KT Mallee >3m			
KS Mallee <3m			
S Shrubs > 2m			
SA Shrubs 1.5-2m	0.5 (0.71)		138 (194)
SB Shrubs 1-1.5m			
SC Shrubs 0.5-1m	2.0 (1.41)		1713 (1432)
SD Shrubs 0-0.5m	4.0 (4.24)		863 (583)
P Mat plant (single plant)	1.5 (0.71)		325 (460)
GT Grass >0.5m	1.5 (0.71)	0.5 (0.71)	1025 (1414)
GL Grass <0.5m	0.5 (0.71)	3.5 (2.12)	188 (265)
J Herbaceous spp.	2.5 (0.71)	4.5 (6.36)	NA
VT Sedges >0.5m	1.5 (0.71)		3263 (1679)
VL Sedges <0.5m			
V Vines (twiners)			
MI Mistletoes			NA
X Ferns			NA

Ecosystem Number: 10.4 Non Eucalypt Grassy Woodland

Remnant or revegetation: Revegetation

Sites included in this ecosystem type: 351, 363, 552, 566

Description of ecosystem: Species richness and density was low in revegetation types in this ecosystem type when compared to remnant sites. Sites also had a prominent weedy grass coverage, incorporating both annual and perennial species.

Indicative Photographs:



Site 566: *Ehrharta calycina* Exotic Grassland



Site 351: *Callitris gracilis*, *Allocasuarina verticillata*, *Melaleuca lanceolata* Very Low Open Woodland

Cell data:

Number of sites in this vegetation type: 4

Mean native plant species richness per site (\pm SD): 12.25 (4.35)

Mean introduced plant species richness per site (\pm SD): 10.0 (4.97)

Ground Cover Components for this Ecosystem Type

Ground Cover Component:	N	T	1	2	3	4	5
Mean live plant cover:					1	1	2
Mean dead plant litter & fallen timber:			3		1		
Mean moss and microphytic crust:		3					
Mean bare ground:		2		2			
Other (e.g. rock, calcrete):							

Key to codes: N = Not many (1-10 plants and <5%), T = sparsely present; cover small (less than 5%), 1 = plentiful, but of small cover (less than 5%), 2 = any number of individuals covering 5-25% of area, 3 = any number of individuals covering 25-50% of area, 4 = any number of individuals covering 50-75% of area, 5 = covering more than 75% of area

Most commonly occurring species (number of sites):

Native:	Number of sites:	Introduced:	Number of sites:
<i>Callitris gracilis</i>		<i>Bromus diandrus</i>	3
<i>Hakea mitchellii</i>	3	<i>Euphorbia terracina</i>	3
<i>Melaleuca lanceolata</i>	3	<i>Avena barbata</i>	2
<i>Acacia pycnantha</i>	3	<i>Vulpia sp.</i>	2
<i>Allocasuarina verticillata</i>	2	<i>Lagurus ovatus</i>	2
<i>Rhagodia candolleana ssp.</i>	2	<i>Oenothera stricta ssp. stricta</i>	2
<i>Bursaria spinosa ssp. spinosa</i>	2	<i>Reichardia tingitana</i>	2
<i>Eucalyptus diversifolia ssp. diversifolia</i>	2	<i>Cynodon dactylon var. dactylon</i>	2

<i>Ficinia nodosa</i>	2	<i>Ehrharta calycina</i>	2
<i>Eucalyptus incrassata</i>	2	<i>Hypochaeris radicata</i>	2
<i>Melaleuca halmaturorum</i>	2	<i>Marrubium vulgare</i>	2
<i>Distichlis distichophylla</i>	2		

Transect and Cell Data: Number and density of plant species by lifeform type (\pm SD):

Lifeform type	Mean number of native species (cell data)	Mean number of introduced species (cell data)	Mean density of native species (transect data)
LA Trees 5-15m			
LB Trees <5m	2.5 (0.58)		544 (272)
KT Mallee >3m	0.5 (0.58)		38 (75)
KS Mallee <3m	0.5 (0.58)		50 (50)
S Shrubs > 2m	1.0 (0.82)		131 (160)
SA Shrubs 1.5-2m			
SB Shrubs 1-1.5m	0.5 (0.58)		44 (43)
SC Shrubs 0.5-1m	1.0 (0.82)		300 (124)
SD Shrubs 0-0.5m	2.5 (2.08)		431 (83)
P Mat plant (single plant)	0.5 (1.0)		50 (71)
GT Grass >0.5m	0.75 (1.5)	1.0	281 (546)
GL Grass <0.5m	1.0 (1.41)	2.75 (1.89)	2663 (4340)
J Herbaceous spp.	0.75 (0.96)	6.25 (3.4)	NA
VT Sedges >0.5m	0.5 (0.58)		425 (767)
VL Sedges <0.5m	0.25 (0.5)		
V Vines (twiners)			69 (105)
MI Mistletoes			NA
X Ferns			NA

4.0 Discussion:

Quadrat and transect based data were gathered from 114 sites in the Coorong, Lower Lakes Murray Mouth Program area using a methodology analogous to the Biological Survey of South Australia methodology, along with transect based density counts. Sites in remnant vegetation focussed upon ecosystem types for which there is a current paucity of data. This will prove valuable in ongoing landscape level planning, and will help inform and improve the continued delivery of the vegetation program through better design of habitat restoration strategies.

A greater variety of vines and twiners, grasses, sedges and herbaceous species were generally found in remnant sites when compared to revegetation sites. There was consistently a higher number of species across different life forms in remnant vegetation sites than in revegetation, with only trees in ecosystems 6.1, 9 and 10.4 and vines/twiners in ecosystem 9 having more species in revegetation than remnant. Thus there was an overall general trend for higher species richness in remnant sites. Sites in remnant vegetation also showed a general pattern of a higher density of native species than revegetation sites, which was reflected across all life forms.

Some of the generally lower densities observed for trees and shrubs in revegetation could be attributed to mortality rates of revegetation, although this observation is anecdotal only as no specific data was gathered on these rates. However, it was also apparent that for the grasses, shrubs, mat plants and sedges noted in the environmental settings above, irrespective of mortality rates, the original plantings were at densities much lower than observed in remnant sites. Ongoing research should focus upon the loss of ecological functionality as a result of a paucity of these life form types in revegetation, to help determine whether revegetation efforts need to focus upon improving the species richness and cover of these particular life forms and species.

The presence of planted trees in ecosystem 9 (Samphire (+/- *Melaleuca halmaturorum*) Shrubland Community) may indicate planting of inappropriate life forms, but review of the site based data indicated there was only one species (*Allocasuarina verticillata*) planted at one site in an area that could be considered an overlap between the lower lying saline ecosystem 9 and non-saline fringing vegetation. This is not considered to be inappropriate.

Many revegetation sites were highly degraded, with the Perennial Veldt Grass (*Ehrharta calycina*) a particular problem. There were 10 sites (sites 556, 78, 322, 323, 360, 406, 552, 550, 553, 566) where this species was the dominant overstorey, with revegetation currently smaller, or at insufficient density to be classified as dominant. These sites may require ongoing follow-up to ensure the revegetation species remain viable. Establishing native grass, sedge and herb species may also be problematic due to the highly competitive, invasive nature of Perennial Veldt Grass, which is likely to suppress growth and recruitment of any herb, sedge or grass species planted. Future revegetation programs could consider the current state of the site to help set a realistic goal restoration state. Highly degraded sites, such as those flagged above where Perennial Veldt Grass is dominant, are likely to have recovery limited by their initial poor state. In contrast, sites where there are still remnant species or strata present, such as in many of the samphire sites, are likely to have a restoration state that more closely resembles their remnant form. Considering the current and potential restoration state of each site, and prioritising to sites where the restoration state is most desirable, may help improve the overall effectiveness of revegetation efforts.

4.1 Comments on methodology

Data gathered from the 900m² cells in this project were gathered using the standard Biological Survey of South Australia methodology. This enables comparison and analysis with data already collected using this method in this region. It is suggested that it may be worthwhile, if a key part of the project is to describe sites (as done in this report), to gather overall native and introduced species cover/abundance data by life form. In the standard methodology, data is categorised for each individual species cover and abundance, but these cannot be accumulated for an overall cover score (eg if a site has two grassy weeds that are categorised as 5-25% cover then this data only tells us that they could cumulatively cover somewhere between 10% to 50%). Most revegetation sites anecdotally had high introduced grass cover, but this was difficult to demonstrate from the data collected. If cover data was gathered by life form for both native and introduced species, then general patterns in cover could be easily identified.

Only data on species was gathered along transects – no life form was noted. It is suggested that in future there may be value in also gathering life form data, as this would help to better quantify the structure of the vegetation (as some species may occur as more than one life form in the site). It may also be of value to gather information on mortality rates in revegetation by including a count of dead plants or empty tree-guards in the transect count, although in many cases the species would not be able to be identified (and thus mortality rates by species or life form could not be calculated).

The transect sampling method seemed appropriate overall as a method to calculate plant densities, however there may be some imprecision for species at lower densities. The probability (P) of encountering at least one individual of a species of density (d) using the transect methodology (ie a sample of 400m²) from the project can be calculated as below:

$$P(\text{encountering at least one individual}) = 1 - P(\text{encountering no individuals})$$

where in this case $P = 1 - 0.96^d$

Table 6 shows that at low densities there is a low probability that a species will be detected using the sampling method from this project. This may not be a concern for detecting general patterns, but it may be worth considering supplementing the transect method (which was considered effective for species with moderate to high density) with a plotless sampling methodology, such as the point centred quarter technique² (described in Appendix 3), if there are key species (e.g. trees) which may be at low densities. Clumping species, or species that are difficult to discern as individual plants were also problematic.

Table 6: Probability of detecting species of different densities along transects as used in this project

Number of individuals per hectare	1	5	10	20	30	40	50	60	70	80	90	100
Probability of encountering at least one individual along a transect	4	18	34	56	71	80	87	91	94	96	97	98

² Cottam, G. and Curtis, J.T. (1956). The use of distance measures in phytosociological sampling. Ecology, 37(3):451-460.

Appendix 1: Datasheets and Categorisations used for this Project

900m² Cell Datasheets

BIOLOGICAL SURVEY of SA - BS 886											
SA Department of Environment, Water & Natural Resources											
VEGETATION PATCH / QUADRAT DATA											
Site ID	Waypoint	Quadrat					DD	MM	YY		
CLL		01								Date	
Observers			Climatic Condition								1= Wet -rainfall prior to survey, annuals 2 = Dry - vegetation dry, few annuals present
Vegetation Condition			1 = virtually no cover, 2 = undisturbed natural, 3 = disturbed natural 4 = degraded natural, 5 = highly degraded								
LF = Life form;		T Trees >30m	S Shrubs >2m	H Hummock Grass	V Vines (twiners)						
	M Trees 15-30m	SA Shrubs 1.5-2m	GT Grass >0.5m	MI Mistletoes							
	LA Trees 5-15m	SB Shrubs 1-1.5m	GL Grass <0.5m	X Ferns							
	LB Trees <5m	SC Shrubs 0.5-1m	J Herbaceous spp.	MO Mosses							
	KT Mallee tree form (>3m)	SD Shrubs 0-0.5m	VT Sedges >0.5m	LI Lichens							
	KS Mallee shrub form (<3m)	P Mat plant (single plant)	VL Sedges <0.5m								
AD = Flag the dominant/codominant species for Overstorey (up to 3 spp), Emergents (up to 3 spp) and Understorey (up to 5 spp) (O/E/U).											
*Note: an emergent species is defined as a species that emerges above the dominant overstorey and has a cover abundance of less than 2.											
AD: Cover Abundance scale adapted from Braun-Blanquet system					LS = Life stages; enter code where relevant to >10% of that species at site and if ?10% of reproductive organs are at that stage. Enter						
N = Not many (1-10 plants and <5%)					seedlings always.						
T = sparsely present; cover small (less than 5%)					V = vegetative						
1 = plentiful, but of small cover (less than 5%)					R = regenerating						
2 = any number of individuals covering 5-25% of area					D = dead/dominant						
3 = any number of individuals covering 25-50% of area					B = budding						
4 = any number of individuals covering 50-75% of area					F = flowering						
5 = covering more than 75% of area					I = immature fruits						
S where large shrubs or trees are involved upgrade the category to reflect the cover rather than the number of individuals					M = mature fruits						
					X = recently shed						
					S = seedling						
Ground Layer Cover for the site			Braun-Blanquet Percentage Cover				Comments				
Live plant cover											
Dead plant litter & fallen timber											
Moss and microphytic crust											
Bare ground											
Others (e.g. rock, calcrete)											
	Species	Previous Voucher No	Voucher No	AD O/E/U	LF	CA	LS	Comments			
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

VEGETATION ASSOCIATION DESCRIPTION (PLA)

ASSEMBLAGE INFORMATION (VEGETATION STRUCTURAL SUMMARY): (From highest to lowest stratum):

Life form height class LF / Canopy cover (d=70-100% / c=30-70% / i = 10-30% / r=1-10%) (Muir 1977)

From observations of site, not plant list. Strike out life forms not present as a +/- consistent/identifiable 'layer' in vegetation.

T / _____	KS / _____	SD / _____	VL / _____	X / _____
M / _____	S / _____	GT / _____	P / _____	MO / _____
LA / _____	SA / _____	GL / _____	J / _____	LI / _____
LB / _____	SB / _____	H / _____	VL / _____	
KT / _____	SC / _____	VT / _____	MI / _____	

SA STRUCTURAL FORMATION: (Overstorey structural category)

Check that **all** dominants (O, E, U) are entered in AD column on plant list.

--

Record the vegetation structure, using the adapted Forward & Robinson table (below), based on the cover and average height of the overstorey at the site.

Overstorey is the tallest stratum with a canopy cover of 5% or more (taller 'layers' of less than 5% are emergents), or the tallest layer where no layers attain 5% cover. If two different lifeforms are more or less codominant eg. a Mallee/Callitris mix, then use both combined average height and cover, but conspicuous to select a name select most prevalent or conspicuous to select a name. Canopy cover is based on projected foliage cover - refer to manual.

Life Form/Height Class	Projective Foliage Cover of Tallest Stratum			
	Dense (70-100%)	Mid-dense (30-70%)	Sparse (10-30%)	Very sparse (<10%)
Trees >30m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland
Trees 10-30m	Closed forest	Open forest	Woodland	Open woodland
Trees 5-10m	Low closed forest	Low open forest	Low woodland	Low open woodland
Trees <5m	Very low closed forest	Very low open forest	Very low woodland	Very low open woodland
Mallee (>3m)	Closed mallee	Mallee	Open mallee	Very open mallee
Low Mallee (<3m)	Closed low mallee	Low mallee	Open low mallee	Very open low mallee
Shrubs >3m	Tall closed shrubland	Tall shrubland	Tall open shrubland	Tall very open shrubland
Shrubs 1-2m	Closed shrubland	Shrubland	Open shrubland	Very open shrubland
Shrubs <1m	Low closed shrubland	Low shrubland	Low open shrubland	Low very open shrubland
Mat plants	Closed mat plants	Mat plants	Open mat plants	Very open mat plants
Hummock grasses	Closed Hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland
Tussock grasses	Closed (tussock) grassland	(Tussock) grassland	Open (tussock) grassland	Very open (tussock) grassland
Sedges	Closed sedgeland	Sedgeland	Open sedgeland	Very open sedgeland
Herbs	Closed herbland	Herbland	Open herbland	Very open herbland
Ferns	Closed fernland	Fernland	Open fernland	Very open fernland

Upper Stratum Age Class (for dominant / codominant species) Circle if present; Slash if absent (Tree layer only)

		Comments
Seedling (<1m)	SE	
Sapling (juvenile)	SA	
Mature	MA	
Senescent	SN	
Hollows	HO	

OVERSTOREY MEASUREMENTS (OVE) (Dominant / co-dominant overstorey, including if shrubland; 10 estimates)

Eyeball the site in cross-section to distinguish the stratum and to determine the overstorey height range. For overstorey, measure 10 individuals or discrete foliage clumps of any species that occur in the broad lifeform category that corresponds to the structural description completed above. Broad lifeform categories include trees, mallees and shrubs. Include all individuals regardless of height, except where there is a recognisable height gap corresponding to a separate lower stratum. In circumstances where two lifeforms are codominant include measurements for both.

Canopy Type	<input type="checkbox"/>	% Estimate average canopy type	Overstorey Height (m)	<input type="text"/>						
	<input type="checkbox"/>	For overstorey species measured	Crown Depth (m)	<input type="text"/>						
VEGETATION COMMENTS (*VEG)			Canopy Diameter (m)	<input type="text"/>						
.....			Gap (m)	<input type="text"/>						
.....				<input type="text"/>						

Appendix 2: Ecosystem Descriptions (reproduced from Jellinek in prep 2014)

Below is a list of all the ecosystems found in the CLLMM region and an explanation of the landscapes they are likely to be found in and the soil types they are associated with. There is a revegetation species list associated with each ecosystem provided below each of the soil maps in the appendices. This species list is for revegetation purposes and is based, where possible, on surveys undertaken in remnant areas (**Error! Reference source not found.**). A diagram of where the ecosystems are likely to be located in the CLLMM landscapes can be found in **Error! Reference source not found.**

1. *Eucalyptus fasciculosa* (Pink Gum) Woodland

This ecosystem is found only in the Mt Lofty Ranges management landscape in the CLLMM region (**Error! Reference source not found.**) (Bonifacio et al., 2014). It is also found on Kangaroo Island and in the south-east (Nicolle, 2013). It is usually found on lower to mid slopes in poor quality (infertile) sandy soils (Nicolle, 2013) and on flats to low sandy rises in plains and low hills with sand over clay soils (G3 & G4) and/or dune type systems with bleached siliceous sand (H3).

Found associated with *E. baxteri* with an understorey dominated by grasses and sparse shrubs including *Rytosperma* spp., *Austrostipa* spp., *Lepidosperma* spp., and *Lomandra* spp., *Enchylaena tomentosa*, *Hibbertia virgata*, *Muehlenbeckia gunnii*, *Pimelea humilis* and *Acacia paradoxa*.

Note: On sandy soils this low woodland comprises scrubby smaller *E. fasciculosa* that other eucalypt communities are not strongly associated with. For example, *E. cosmophylla* prefers lateritic infertile loam, while *E. leptophylla* prefers sandy loam soils. *E. leucoxydon* prefers loam soils or shallow sandy soils.

2. *Eucalyptus cosmophylla* (Cup Gum) & *E. baxteri* (Brown Stringy Bark) Woodland over Heath

Found predominantly in the Mt Lofty Ranges management landscape (**Error! Reference source not found.**) on sand over clay soils (G3 & G5) and to a lesser extent on acidic sandy loam over red clay (K3) or hard loamy sand over red clay (D5). It is found in higher elevation and rainfall areas compared to the Pink Gum (*Eucalyptus fasciculosa*) ecosystem.

While the dominant overstorey species are usually *E. cosmophylla* +/- *E. baxteri*, while Pink Gum (*E. fasciculosa*) can also occur in these areas. Grass tree (*Xanthorrhoea semiplana*) is a common species of the understorey mixed with *Allocasuarina striata* and/or *Acacia* spp., *Banksia* and *Calytrix*.

Note: *E. cosmophylla* & *E. baxteri* ecosystems are usually found on low fertility sandy loams to loams with lateritic influence, where some blown in sand is present.

3. Coastal Shrubland of the Coorong

This ecosystem mostly occurs along the coastal dunes of the Coorong (Young Husband Peninsula), but may also occur in a small proportion of the Lower Lakes Terrestrial management landscape (**Error! Reference source not found.**). It predominantly grows on deep sands (H1, H2), and to a lesser extent shallow sandy loam on calcrete (B3).

Dominant species occurring in this ecosystem are *Olearia axillaris*, *Leucopogon parviflorus* and *Acacia longifolia* var. *sophorae*, and commonly comprised of shrubland and grassland species of the Coorong.

4. *Eucalyptus diversifolia* ssp. *diversifolia* (Coastal White Mallee) Mallee

This ecosystem can occur in all management landscapes of the CLLMM region, but predominantly it is found in the South East and to a lesser extent the Lower Lakes Terrestrial area (**Error! Reference source not found.**). Predominantly it occurs on shallow sandy soil on calcrete (B2 & B3) and deep sands (H1 & H3), and to a lesser extent sand over clay (G3 & G5). In rare cases it can also occur on the upper margins of Samphire ecosystems in saline soils (N2) in the South East management landscape. Outcropping calcrete can often be seen.

This ecosystem is dominated by an *E. diversifolia* ssp. *diversifolia* and/or *E. incrassata* overstorey with a heathy-shrubby understorey. Common understorey species include *Xanthorrhoea caespitosa* (SE only), *Lepidosperma carphoides* and *Billardiera cymosa*. It occurs on a wide variety of soil types, so can co-occur with many of the ecosystems described here.

5. *Allocasuarina verticillata* (Drooping Sheoak) Low Woodland

This ecosystem is mainly found in the South East but also occurs in the Lower Lakes Terrestrial management landscape (**Error! Reference source not found.**). It occurs on shallow sandy soil on calcrete (B3 & B8) and to a lesser extent bleached sand over sandy clay (G3) bleached siliceous sand (H3) and rarely saline soils (N2).

This ecosystem has been severely cleared in the past. It has a shrubby understorey, although may have a grassy understorey in its original state (based on expert opinion). Current remnants have *Allocasuarina verticillata* as the dominant overstorey species with understorey species including *Xanthorrhoea caespitosa* (SE only), *Hibbertia sericea*, *Kunzea pomifera* and *Clematis microphylla*.

Note: The coastal form of this ecosystem has coastal heath or shrub understorey. Elsewhere it tends to be grassy and open.

6. Mixed Eucalypt Woodland/Mallee communities

6.1 *Eucalyptus porosa* (Mallee Box) Grassy Woodland

Found in the Mt Lofty Ranges and Lower Lakes Terrestrial management landscapes in the CLLMM region (**Error! Reference source not found.**) (Bonifacio et al., 2014) associated with a moderate rainfall in semi-arid areas (Berkinshaw, 2009). Not found in wetter areas on the Mt Lofty Ranges (Nicolle, 2013). It is also found on the Yorke and Eyre Peninsulas, Flinders Ranges and the South-east (Nicolle, 2013).

It is usually found in poorly drained depressions on clay over limestone and coastal limestone bluffs (Nicolle, 2013). In the CLLMM landscape it is associated with loam over poorly structured red clay (D3), shallow calcareous loam on calcrete (B2) or shallow sandy loam on calcrete (B3).

Found associated with *E. fasciculosa*, *E. leucoxydon*, *E. odorata*, *Allocasuarina verticillata* and *Callitris gracilis* with a sparsely distributed mid and understorey dominated by grasses and sparse shrubs including, *Austrostipa* sp., *Rytidosperma* sp., *Acacia* sp., *Dianella*

revoluta, *Dodonaea viscosa*, *Clematis microphylla*, *Oxalis perennans*, *Lomandra effusa* and *Melaleuca* spp.

Therefore, in a bare landscape this ecosystem is most likely to occur in the Mt Lofty Ranges and Lower Lakes Terrestrial management landscapes on level to gently undulating plains but can occur on rises and low hills associated with coastal dune in loam or sandy loam over calcrete (B2 & B3) or sandy loam (D3).

6.2 *Eucalyptus odorata* (Peppermint Box) Grassy Woodland

Found in the Mt Lofty Ranges management landscape in the CLLMM region (**Error! Reference source not found.**) (Bonifacio et al., 2014) associated with moderate rainfall in semi-arid areas (Berkinshaw, 2009). It is also found on the Yorke and Eyre Peninsulas, South-east and Kangaroo Island (Nicolle, 2013).

This ecosystem is usually found on undulating plains with shallow loamy soils (Nicolle, 2013). In the CLLMM landscape it is associated with loam over poorly structured red clay (D3) and sand over poorly structured clay (G4).

Found associated with *E. fasciculosa*, *E. leucoxylo*n and *E. phenax* with an understorey dominated by grasses and sparse shrubs including *Allocasuarina verticillata*, *Austrostipa* sp., *Rytidosperma* sp., *Dianella revoluta*, *Clematis microphylla*, *Oxalis perennans*, *Lomandra effusa* and *Melaleuca* spp.

Therefore, in a bare landscape this ecosystem is most likely to occur in the Mt Lofty Ranges management landscape on lower to mid slopes (up to 30m elevation) in loam over red clay (D3) and/or sand over clay (G4) soils.

Note: While it can be associated with drainage lines in other locations, in these management landscapes *E. porosa* is more likely to dominate while *E. odorata* tends to be associated with well drained situations at times tops of hills.

6.3 *Eucalyptus incrassata* / *E. leptophylla* +/- *E. socialis* Mallee Community

This community occurs on sand over clay soils (G1 & G3) and bleached siliceous sand (H3) in the Mount Lofty Ranges (**Error! Reference source not found.**). A mixture of *Acacia* spp and *Melaleuca* spp as well as *E. phenax* can occur in the ecosystem. Common understorey species are *Clematis microphylla*, *Dianella revoluta*, *Rhagodia candolleana*, *Austrostipa* spp., *Lomandra effusa* and *Oxalis perennans*.

6.4 *Eucalyptus leucoxylo*n ssp. *leucoxylo*n (SA Blue Gum) Woodland

Found in the Lower Lakes Terrestrial and South East Coorong management landscapes in the CLLMM region (**Error! Reference source not found.**) (Bonifacio et al., 2014). Only one subspecies occurs in the CLLMM region; *E. leucoxylo*n ssp. *leucoxylo*n (Nicolle, 2013). *Eucalyptus leucoxylo*n ssp. *stephaniae* is probably not found in the CLLMM region but is located inland of the South East Coorong management landscape around Tintinara.

*Eucalyptus leucoxylo*n ssp. *leucoxylo*n is usually found in undulating or hilly terrain on loam soils while *E. leucoxylo*n ssp. *stephaniae* is found on well drained sandy to loamy soils in shallow depressions surrounded by sand dunes. In the CLLMM region it is found on soils with shallow calcareous loam on calcrete (B2), shallow loam over red clay on calcrete (B6), shallow sand on calcrete (B8) and lesser extent thick sand over clay (G3).

This ecosystem can be found at times associated with *E. cosmophylla*, *E. fasciculosa*, *E. odorata*, *E. diversifolia*, *E. incrassata*, *E. leptophylla* and *Allocasuarina verticillata* with a sparsely distributed mid and understorey dominated by grasses and shrubs including

Austrostipa spp., *Rytidosperma* spp., *Acacia* spp., *Bursaria spinosa*, *Hakea* spp., *Xanthorrhoea* spp., *Dianella revoluta*, *Dodonaea viscosa*, *Clematis microphylla*, *Oxalis perennans*, *Lomandra effusa* and *Melaleuca* spp.

Therefore, in a bare landscape this ecosystem is most likely to occur in Lower Lakes Terrestrial and South East Coorong management landscapes in undulating or hilly terrain on loam soils (G3 - *E. leucoxyton* ssp. *leucoxyton*) or well drained sandy to loamy soils over calcrete, associated with sand dunes (B3, B6, & B8 - *E. leucoxyton* ssp. *stephaniae*).

7. Freshwater Fringing Wetland Ecosystem

Predominantly found in wet soils (N3) in the Lower Lakes aquatic ecosystem. The community requires constant or regular inundation and needs to have some tolerance to salinity up to brackish water. Dominant species are *Phragmites australis*, *Schoenoplectus validus*, *Hydrocotyle verticillata*, *Typha domingensis* and *Juncus kraussii*.

Note: This ecosystem is generally only associated with N3 (freshwater) soils, while samphire & *M. halmaturorum* is associated with N2 (saline) soils.

8. *Duma florulenta* (Lignum) Shrubland

Found in the Mt Lofty Ranges and the Lower Lakes aquatic ecosystems and to a lesser degree the Lower Lakes Terrestrial ecosystem (**Error! Reference source not found.**). It mainly occurs in wet soils (N3) as well as loam over poorly structured red clay (D3). To a lesser extent it can grow on shallow sandy loam on calcrete (B3) and loam over brown or dark clay (F1)

This ecosystem is dominated by Lignum along with some flora species that are tolerant of water logging such as *Agrostis avenacea*, *Atriplex semibaccata* and *Distichlis distichophylla*.

9. Samphire Swamp (including *Melaleuca halmaturorum* swamp, *Duma florulenta* low shrubland & *Gahnia filum* sedgeland)

Found in all of the CLLMM management landscapes (Bonifacio et al., 2014) and across South Australia (**Error! Reference source not found.**). Found in sub-coastal and semi-saline swamps and wetlands, rivers, estuaries and seasonally inundated depressions and floodplains associated with heavy saline soil (N2) and to a much lesser extent wet soil (N3) ranging from deep clays to sand-over-clays to deep sand (Hall et al., 2009).

Samphire swamp is found in wet depressions dominated by *Tecticornia* spp. and surrounded by *Melaleuca halmaturorum*. *Gahnia filum* and/or *Duma florulenta* may also be dominant plant species where N3 wet soils occur. The associated species composition is dependent on the salinity of the standing water and quantity of freshwater run-off.

Therefore, in a bare landscape this ecosystem can be found in all the CLLMM management landscapes which have saline or wet clays, sandy clays or deep sands associated with tidal flats, backswamps, valley floors, closed depressions and drainage depressions. The salinity level of the soil will determine the range of vegetation that will grow in the area. Very saline soils would be dominated by Samphire and *M. halmaturorum* swamps while saline with freshwater run-off would also include *M. halmaturorum* with *G. filum*.

10. Expert Opinion based Ecosystems

10.1 *Gahnia filum* sedgeland

This ecosystem is associated with wetlands and is dominated by *Gahnia filum*. The distribution of this ecosystem is now very limited in the CLLMM landscape (**Error! Reference source not found.**) (T. Croft, pers. com.).

Note: In the CLLMM landscape this ecosystem is associated with depressions, and may fringe Samphire and *M. halmaturorum* areas. It is a plant community that has suffered from adjacent terrestrial vegetation clearance, which has raised the saline groundwater, increasing salinity.

10.2 *Eucalyptus camaldulensis* var. *camaldulensis* grassy woodland

Associated with river floodplains and freshwater swamps (N3 soils), especially those in the Mt Lofty Ranges (Berkinshaw, 2009). This ecosystem has been largely cleared through-out the CLLMM landscape as this land is generally fertile. This ecosystem is dominated in the overstorey by *E. camaldulensis* and has a grassy, sedge and rush understorey, including shrubs such as *D. florulenta*. Expert knowledge indicates that the majority of its distribution is limited to creek lines of Langhorne Creek, although it is likely to occur in most landscapes where temporary freshwater inundation occurs (**Error! Reference source not found.**).

10.3 Grassland Community

This community has largely been cleared in the CLLMM landscape and only a few examples of what it may have resembled remains in the Lower Lakes Terrestrial management landscape (**Error! Reference source not found.**). This ecosystem is composed of tussock grassland species including *Lomandra effusa*, *Austrostipa* spp., *Rytidosperma* spp. and *Poa* spp.

10.4 Non-Eucalypt (*Allocasuarina verticillata* and *Callitris gracilis*) Woodland

Found in the Lower Lakes Terrestrial management landscape in the CLLMM region (**Error! Reference source not found.**) (Bonifacio et al., 2014). In the CLLMM region it is associated with sub-coastal plains and dunes and steep slopes of low hills (Berkinshaw, 2009) on shallow sandy loam on calcrete (B3).

For the CLLMM region, non-eucalyptus woodland will be dominated by *Allocasuarina verticillata* and/or *Callitris gracilis* with a sparsely distributed mid and understorey dominated by grasses and shrubs including *Austrostipa* spp., *Rytidosperma* spp., *Acacia* spp., *Bursaria spinosa*, *Hakea* spp., *Xanthorrhoea* spp., *Dianella revoluta*, *Dodonaea viscosa*, *Clematis microphylla*, *Oxalis perennans*, *Lomandra effusa* and *Melaleuca* spp.

Therefore, in a bare landscape this ecosystem is most likely to occur in the Lower Lakes Terrestrial management landscape on level to gently undulating plains and low hills associated with dunefields in sandy loam soils over calcrete (B3).

Appendix 3: Point Centred Quarter method

Description of method

The Point Centred Quarter (PCQ) method is a type of plotless density estimator. These estimators are also commonly called distance methods because they make use of the distances between plants or between plants and sampling points to estimate the average area occupied by a plant in the population. Density, plants per unit area, is then simply the inverse of the average area occupied per plant. Representative sampling by plotless methods is much less dependent upon consideration of scale than quadrat based methods because the density of plants defines the scale, rather than the size of the sampling unit as in quadrat based techniques. So, for example, one sampling point could be used to measure density of native grasses, that may occur within centimetres of the reference point, as well as trees, that may be tens of metres away. These would require different size quadrats for a quadrat based assessment. Therefore, greater replication and dispersion throughout a vegetation stand can be achieved per unit of sampling effort. This also means that the methods are equally applicable to plants of any life form and size, from grasses and herbs to large trees, at any scale within reason. Consequently, there is no requirement for time consuming pilot measurements and calculations to determine appropriate quadrat sizes for each particular community and life form within it.

Using the PCQ method, the area around a sample point is divided into four equal quadrants and the distance is measured to the individual of interest within each quadrant nearest to the point (**Error! eference source not found.**).

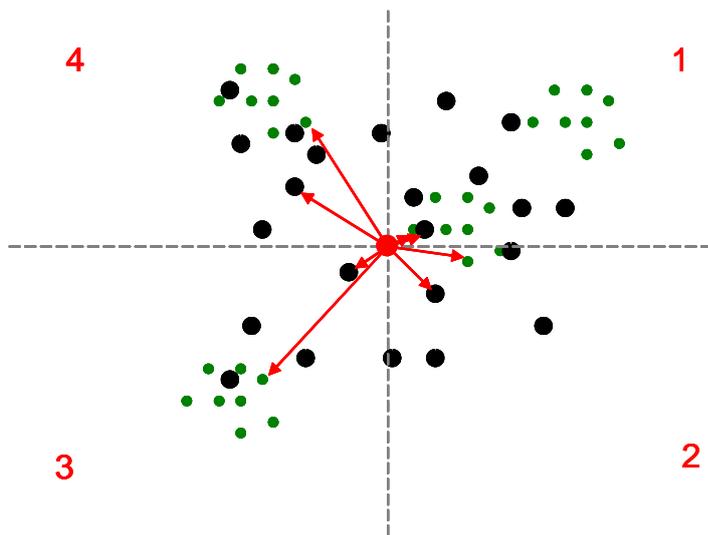


Figure 1. Schematic showing the point centered quarter method with the area around the sampling point divided into four 90° quadrants. The red arrows represent the distances measured from the point to the nearest plant in each quadrant. Two plant populations are being sampled in this example, each with a different kind of spatial distribution.

Data treatment follows Cottam *et al.* (1953):

$$\bar{\lambda} = \frac{n}{\sum_{i=1}^n d_i^2}$$

Where $\bar{\lambda}$ is the density estimate, d is an individual point to plant distance measurement (4 per sample point) and n is the number of such measurements. Dahdouh-Guebas and Koedam (2006)³ suggest a correction factor to allow for quadrants where no plant can be found as follows:

$$\bar{\lambda} = \frac{n}{\sum_{i=1}^n d_i^2} \times \frac{q_n}{q_t}$$

Where q_n is the number of quadrants containing a tree and q_t is the total number of quadrants.

Other plotless density estimators exist, most notably the closest individual, the nearest neighbour and the random pairs method. The PCQ method is considered the most appropriate for use as it provides the most accurate estimate of density⁴, is least susceptible to subjective bias⁵ and provides more data per sampling effort^{4, 6} than these other estimators.

³ Dahdouh-Guebas, F. and Koedam, N. (2006). Empirical estimate of the reliability of the use of the Point-Centred Quarter Method: Solutions to ambiguous field situations and description of the PCQM+ protocol. *Forest Ecology and Management* 228: 1-18.

⁴ Beasom, S.L. and Haucke, H.H (1975). A comparison of four distance sampling techniques in south Texas live oak mottes. *Journal of Range Management*, 28(2):142-144.

⁵ Cottam, G. and Curtis, J.T. (1956). The use of distance measures in phytosociological sampling. *Ecology*, 37(3):451-460.

⁶ Gillespie, C. (2008). Evaluating Plotless Density Estimators as a Method for Rapidly Assessing Native Vegetation. Unpublished report for the Native Vegetation Council, Adelaide.