# The flora and vegetation of the seasonal and perennial wetlands of the southern Carnarvon Basin, Western Australia

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**Abstract** – A total flora of 265 taxa was recorded from 58 wetland areas in the southern Carnarvon Basin. The flora was dominated by arid species but also included 34 temperate taxa at the northern end of their range and 18 tropical taxa at the southern end of their range. Five species (*Dichopogon tyleri*, *Calandrinia* sp. Coolcalalaya (GJK and NG 698), *Myriocephalus gascoynensis* ms, *Lythrum* sp. Towrana (RJC 2183), *Psammagrostis wiseana*) are endemic to the study area. The *Calandrinia* sp. appears not to have been collected previously. A collection of *Rumex crystallinus* was the first recorded in Western Australia since 1885.

Classification of the wetlands was undertaken at two different scales; at both scales heterogeneity was high. The major division in the data sets was between the saline and non-saline wetlands. Percentage of single species occurrences was high in both datasets, ranging from 46–55%; this component of the flora adds significantly to plant biodiversity but is not a predictable component of vegetation communities. In the seven-group classification no floristic groups were restricted to particular habitat types but at the finer scale sampling there is a stronger correlation between floristic community type and habitat type. At this scale the major habitat types (e.g. river pools) encompassed a range of floristic groupings. The patterns in low species richness and very patchy species distribution found in this study are similar to those reported for wetlands in the higher rainfall areas of the south west but the underlying causal factors determining these patterns remain unclear.

## **INTRODUCTION**

The flora and vegetation of the wetlands of the southern Carnarvon Basin (Anonymous, 1975) have been little studied (Figure 1). In the most recent and comprehensive review of nationally significant wetlands only two non-marine wetlands are listed from the study area (ANCA, 1996). These two large wetland systems highlight the diverse nature of wetlands in this area. Lake MacLeod covers some 150 000 ha formed on calcareous marine deposits and lies 30 km north west from Carnarvon. In part, it is fed by ocean water through 18 km of coastal limestone which upwells in sinkholes in the central western section of the wetland, but precipitation can also make a significant contribution to water supply in wetter years (Scott, 1962; ANCA, 1996). The mangrove community of Lake MacLeod is one of only two inland occurrences (ANCA, 1996). In contrast the McNeill claypan system is located on outwash alluvial deposits near the mouth of the Gascoyne River. The soils have been described by Bettenay et al. (1971) as saline-alkaline with high levels of exchangeable sodium and a high content of soluble salts. These flats are inundated with fresh water when the Gascoyne River floods. Both wetlands are important for migratory birds (ANCA, 1996).

Other major wetland habitats found in the study area include those associated with permanent and semi permanent river pools, and freshwater and saline springs, wetlands of seasonally inundated claypans, and the widespread saline samphire flats and birridas (gypsum pans) (Battye, 1915; Payne *et al.*, 1987). The flora and vegetation of Rocky Pool on the Gascoyne River (Kenneally, 1978) and the occurrence of *Psilotum nudum* in the lower Murchison River (Smith and Butler, 1961) are among the few accounts of wetland vegetation that have been published for this area.

Numerous classification systems for wetlands have been published both at the regional (Paijamans *et al.*, 1985; Lane and McComb, 1988; Jacobs and Brock, 1993; ANCA, 1996) and local scales (Semeniuk, 1987), using geomorphic and physical features, but none of these systems clearly differentiate the major geomorphic types recognised in the study area; as a consequence the terminology of Payne *et al.* (1987) is adopted here.

The aim of this paper is to describe the flora and vegetation of the major seasonal and permanent wetland types of the southern Carnarvon Basin and determine how floristic units correlate with major habitat types.

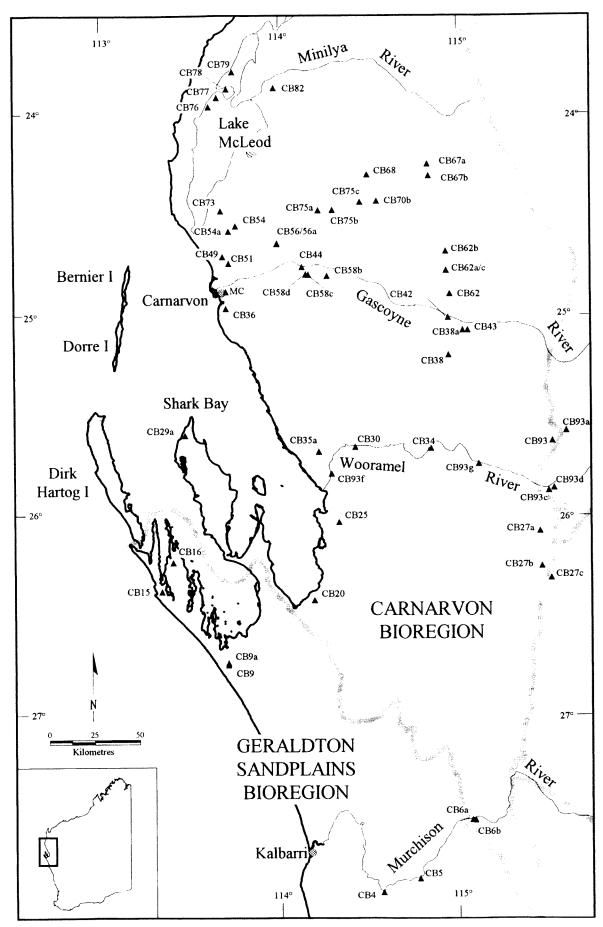


Figure 1 Location of wetland areas sampled and showing boundaries of major phytogeographic regions (Thackway and Cresswell, 1996).

#### METHODS

Fifty-eight wetland areas were sampled across the study area (Figure 1 and Appendix 1) in August and September 1995. No coastal saline wetlands or mangroves were included in the present survey. Several locations within some of the larger wetlands (e.g. Lake MacLeod) were sampled. The sites were the same as those used for the invertebrate sampling by Halse et al. (2000) with one exception, and the addition of a site on McNeill claypan. As clear vegetation zonation was apparent around many of the wetlands a series of 1 m x 1 m quadrats was used to sample each vegetation type, running along a transect at right angles to the shoreline. Lists were compiled of all taxa (species, subspecies and varieties) found in these quadrats. Taxa seen at each wetland but not recorded in quadrats were also noted. Sites were classified according to similarities in species composition using the Czekanowski coefficient and 'unweighted pair-group mean average' fusion method (UPGMA; Sneath and Sokal, 1973), while species were classified using the 'two step' method of Austin and Belbin (1982) and the UPGMA fusion method. This analysis of vegetation patterning was carried out at two scales - a larger scale using lists of species from each wetland area and the finer scale based on individual quadrats. Trees were excluded from the analysis of the quadrat data.

Water chemistry data were collected during the sampling of these sites for macro invertebrates in August 1994 and/or March 1995 [see Halse *et al.* (2000) for detailed methods]. These data were used as correlates for soil chemistry in analysis of between group differences. Statistical relationships between site groups were tested using Kruskal -Wallis non-parametric analysis of variance and Mann-Whitney U-tests (Siegel, 1956).

Species habitat preference and distribution information were compiled from collections held in the Western Australian Herbarium. Nomenclature follows Green (1985) and current usage at the Western Australian Herbarium. Selected voucher specimens have been lodged in that institution.

#### RESULTS

#### Flora

The flora of the wetlands was found to be dominated by arid zone species (Jessop, 1985). Two hundred and sixty three taxa were recorded from the fifty-eight wetland areas (Appendix 1). The best represented families were Asteraceae (32 native, 4 introduced species), Poaceae (25 native, 10 introduced species), Chenopodiaceae (24 natives), Cyperaceae (17 native, 1 introduced species) and Scrophulariaceae (10 natives). This composition clearly reflects the arid nature of the flora. At the

Table 1	Wetland	taxa	endemic	to	the	southern
	Carnarvor	ı Basir	۱.			

Díchopogon tyleri	
Calandrinia sp. Coolcalalaya (GJK and NG 698)	
Myriocephalus gascoynensis ms	
Lythrum sp. Towrana (RJC 2183)	
Psammagrostis wiseana	

generic level *Calandrinia* (8 taxa), *Eragrostis* (8 taxa), *Cyperus* (7 taxa), *Atriplex* (5 taxa) and *Goodenia* (5 taxa) were the most species rich.

Thirty-one introduced species were recorded from the wetlands. The wetland vegetation was heavily disturbed around some of the springs and river pools with either the complete removal of understorey, or with taxa such as *Cenchrus ciliaris* and *Asphodelus fistulosus* becoming dominant. The vegetation of the saline wetlands and the wetlands of the ephemeral claypans was generally much less impacted.

A total of seven new populations of four taxa (*Bergia auriculata, Goodenia neogoodenia, Rumex crystallinus, Wurmbea murchisoniana*) listed on CALM's priority flora list (CALM, 1996) were located during the course of the survey. These taxa require further investigation before consideration of listing as threatened flora. *Rumex crystallinus* was collected on the McNeill claypan near Carnarvon; this was the first collection of this species in Western Australia since 1885 when it was recorded by Carey on the Lyndon River some 150 km to the north.

Five taxa endemic to the study area were recorded from the fifty-eight wetlands (Table 1). Of these, *Calandrinia* sp. Coolcalalaya (GJK and NG 698) and *Lythrum* sp. Towrana (RJC 2183) appear to be restricted to edges of ephemeral claypans. *Myriocephalus gascoynensis* ms may also be restricted to this habitat.

Seven of the taxa recorded in this study are totally restricted to water bodies while another six generally grow as emergents around permanent or semipermanent wetlands (Table 2). Two of the

Table 2List of submerged and emergent aquatic taxa<br/>recorded from 58 wetlands in the southern<br/>Carnarvon Basin (\* indicates introduced<br/>species).

Submerged or floating aquatic	Emergent aquatic
* Callitriche stagnalis	Alternanthera nodiflora
* Crassula natans	Avicennia marina
Elatine gratioloides	Baumea articulata
Najas marina	Eleocharis acuta
Potamogeton pectinatus	Eleocharis geniculata
Ruppia megacarpa	Schoenoplectus subulatus
Ruppia polycarpa	Typha domingensis
Ruppia tuberosa	

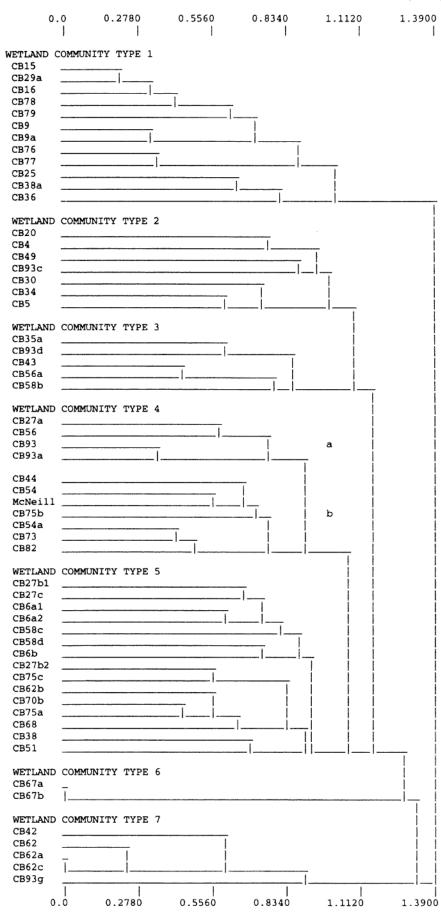


Figure 2 Dendrogram showing the UPGMA fusion of the wetland vegetation of 57 wetland areas in the southern Carnarvon Basin.

submerged aquatic taxa are widespread weed species across southern Australia (Aston, 1973). The habitat preference of other taxa generally restricted to wetland areas is listed (Appendix 1) where such information could be determined from herbarium labels. This information is lacking for some genera where the material is on loan.

The poor state of knowledge of the wetland flora of the southern Carnarvon Basin is highlighted by the first collections of one apparently undescribed *Calandrinia* sp. and major range extensions of 15 other taxa (Appendix 1).

Thirty-four taxa reach the northern limit of their range in the study area and another 18 primarily tropical taxa reach the southern ends of their range. The study area straddles Beard's (1990) major phytogeographic boundary between the temperate south west and the Eremaean zones (Figure 1).

#### Vegetation

#### *Large scale patterning – the wetland classification*

Amalgamation of some species was necessary as material could not always be positively identified to species level (e.g. *Centipeda* spp.). One of the claypans was completely bare of vegetation and was excluded from the analysis. Of the 259 taxa included in the final dataset some 142 taxa (55%) occurred only at one wetland area. The dataset was analysed with and without singletons (i.e. taxa that occurred at only one site). The results of both analyses were similar with clearer patterning seen in the analysis with the singletons excluded; these are the results presented below. Species richness varied from one to 25 taxa per wetland (with singletons excluded), with individual taxa occurring at between two and 22 wetlands. In this analysis

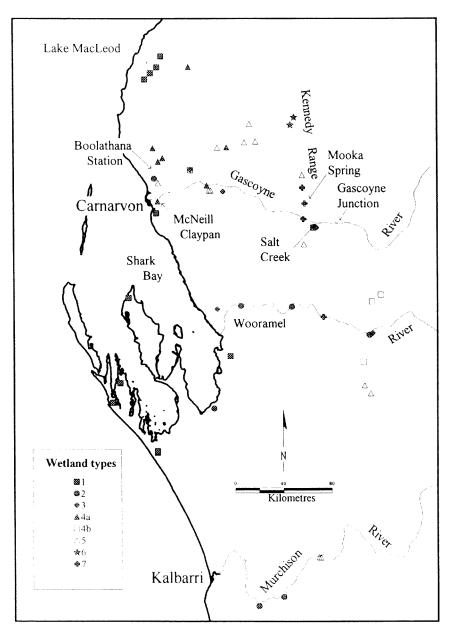


Figure 3 Distribution of the seven wetland community types across the southern Carnarvon Basin.

 Table 3
 Two way table showing species distribution across the seven wetland community types identified by the UPGMA fusion.

	1	2	WE' 3	TLAND 4a	COMMUNI	FY TYPES 5	6	7	SPECIES GROUPS
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						BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB			
	101770077002	0000000			AEN7E70	226655627677635		100000	
TETLAND AREAS	121//99//233	2449333	153455	12099	4511/578	77aa88b75205881	177	140003	
ETLAND AREAS			ad ab		4403434	bc12cd bcbba	ab		
	a a			a a		1 2		acy 	
			1						
Actinobole uliginosum				*		* *			А
Isoetopsis graminifolia				*	ļ	**	ļ		
Peplidium sp. C (Burbidge and Kain 8152) Calotis hispidula		2000	*	*	*	** * * *			
Calandrinia granulifera		+	+ · 	+ 	+	+	+ 	+	
Gnephosis eriocephala			1	1	1	**		1	
Gypsophila australis			1	1		*	1	*	В
Crassula natans				İ*		*	1		
Pentaschistis airoides		1		İ *		* *	1		
Melaleuca uncinata			+	* +		* * +	 +	 +	
Atriplex holocarpa			**			*	ļ	-	
Myriocephalus gascoynensis MS				1	1	* *			
Eragrostis leptocarpa		}		1	1	* * *	[		
Trichanthodium skirrophorum		1	*			* *	1		
Calotis multicaulis		*	*		*	** **			
Cyperus rigidellus		l			*	* ** ***			
Calandrinia ptychosperma				1	1	** *	1		
Bergia auriculata						***			C
Bergia perennis subsp. obtusifolia			1	1	1	* *** ** *		1	
Calandrinia pumila		1	1			*** * **			
Goodenia neogoodenia		1		1	1	** *			
Eragrostis pergracilis	*					*	ļ		
Peplidium aithocheilum				1		**			
Glossostigma drummondii						* ** **			
Marsilea angustifolia		1				* * * *		1	
Isoetes sp.	*******	* +	+		+	* * * +	 +	+	
Calandrinia sp.Coolcalalaya (GJK and NG 698)	*			1		*			
Pogonolepis muelleriana	*			1		**	1		
Crassula colorata	* *			1		** *			D
Eragrostis dielsii	* **		**	1		* * * * * * *			
Triglochin calcitrapum	* *	* +	 +	* +	+	*** * +	 +	+	
Asphodelus fistulosus			****		1				
Myriocephalus guerinae			**		1	*			
Atriplex lindleyi	*	1	*	1			1		

		I	*	1			*		
Dysphania rhadinostachya		1	:   *		*		i	Í	
Sclerolaena diacantha	*	1	   *	1		*	1		
Diplachne muelleri	<u>^</u>			1	1		*	1	
Atriplex semilunaris			Î	ļ	1	4	** *	l I	
Cenchrus ciliaris		*				1	**	1	
Centaurium spicatum					*		**		
Lythrum sp. Towrana (RJ Cranfield 2183)								ļ	
Sclerolaena recurvicuspis	*	l		1			*		
Tetragonia diptera	*		ĺ				*		
Tetragonia diptera		; +	+	, +	+	+	+	+	
Alternanthera nodiflora		1	1	***	***** *	** *	**		
		*	**	* **	***** *	*** * *	* * * * *	1	
Centipeda sp.				   * *	*** **	** * *		i	
Myriocephalus nudus			1	· *	* * *				
Ammannia multiflora						1			
Eriochloa procera		1				 			
Marsilea drummondii		ļ		****	**	<sup>•</sup>			
Ranunculus pumílio				** *	*	ļ			
Pseudognaphalium luteoalbum		*		*	*				
		+	+	+	+	+	+	+	
Chenopodium auricomum		1		1	***	*			
Mimulus gracilis			i	i	* *	ĺ	*		
		*		i	**		1		
Eleocharis pallens				i i	****		i	ĺ	
Goodenia corynocarpa		1		1	***	1	*	*	
Eulalia aurea		•		1	** ***	1	*	i	
Sporobolus mitchellii	*			++	1 * ***			* * * * *	
Cyperus vaginatus	*					+	1	! ! *	
Stemodia viscosa		1			^ <b>^</b>			1	
Emex australis		*		*					
Eragrostis australasica			*		**		*		
Sonchus oleraceus		1		*	*	[	*		
Muehlenbeckia cunninghamii		1	İ		*	*			
Polycarpon tetraphyllum			ĺ	i	*		1	*	
		+	, +	+	+	+	+	+	
Brachyscome ciliaris		1	1	1	*	*			
Eriachne flaccida		1	i	i	*	*	1	1	
			ł		1	* *	i	i i	
Goodenia berardiana	*	1	1	1	· *	*	i		
Calandrinia polyandra	~			1	!   *	*	ł		
Lotus cruentus		1		-		*			
Paractaenum novae-hollandiae	*	1	1			1	1	1	
		+	+	+	+	+	+	1	
Apium prostratum			1		1	1			
Tetragonia cristata		* *	ļ		1				
Medicago polymorpha		**		ļ	ļ			1	
Wurmbea murchisoniana		*			1	*		ļ	
Heliotropium curassavicum		* *	1						
Typha domingensis		*	İ	ĺ.				* * *	
Ruppia sp.	*	**	i	Í	1		ĺ		
		* * **	*	i	i		i	Í	
Cyperus gymnocaulos		*	*	i	1		ĺ	**	
Eucalyptus camaldulensis var. obtusa		*	*				1	*	
Polypogon monspeliensis		1 ^				1	1	l [	
Lotus australis		**	1	]		-	1		
Samolus junceus		* *		1	1	1		I	
-		+	+	+	+	+	+	+	

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Tab	le 3	(cont.)
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			WE	TLAND	COMMUNI	TY TYPES			SPECIES
	1	2	3	4a	<b>4</b> b	5	6	7	GROUPS
	CCCCCCCCCCCCC	CCCCCCC	lecce	lecce	LCCMCCCC	cccccccccccccc	Icc		
						BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB			
	121779977233	2449335	139455	2599	45N7578	226655627677635	166	46669	
VETLAND AREAS	59689 a67586	0 9304	153368	7633	44e5432	77aa88b75205881	77	22223	
	a a	c			iba	bc12cd bcbba	lab		
						1 2	i 	<u> </u>	
Avicennia marina	* **								
Halodule uninervis	**		i	i	l		i –		
Halosarcia pterygosperma subsp. denticulata	* * ***		Ì	i	İ		İ	ł	
Ruppia tuberosa	*** *		i	i	İ		i	ĺ	
Frankenia pauciflora	* * **		i	i	i		i	1	
Muellerolimon salicorniaceum	** * ***		1	i	i		i	ĺ	
Sarcocornia quinqueflora	* * * * * *		i	i	1		i	1	
Halosarcia halocnemoides	** *** ***		l	1	i		i i		J
Halosarcia indica	**** *** **	**		i	1		i		
Cotula cotuloides	*	*	1		1		i		
Triglochin centrocarpum	*	*	i	1			i		
Lawrencia viridigrisea	**			1	1		i		
Neosciadium glochidiatum	**		1		1		i	1	
Samolus repens	**				1		1		
Triglochin mucronatum	**	*			1		i		
Rostraria pumila	* *				*		1		
Senecio glossanthus	* * *			1	*				
			+   *	+ 1 ***	+	, #====================================	+	+   +	
Anagallis arvensis Schoenoplectus lateriflorus				* **	*			*	
		***	1	* * *	1	1	1		
Eucalyptus victrix Daucus glochidiatus		*		***	1	1	1	1	
		~		* **	1			-	
Glossostigma diandrum Setaria dielsii				* *				1	
Isolepis congrua				* **		* *			
		*		*			1	*	ĸ
Centrolepis eremica		*		*			1		K
Hypericum japonicum		Ŷ		*	1	*	1	1	
Brachyscome iberidifolia				**					
Cyperus aff. cunninghamii (GJK and NG 592)				**   **	1				
Lipocarpha microcephala				**	1			1	
Oldenlandia galioides				1			-	1	
Schoenus elegans				**	1	   *		1	
Drosera indica			1	1	1				
Eragrostis basedowii Blatina amatialaidaa				**	1	*  *			
Elatine gratioloides				**	1		1	1	
Wahlenbergia tumidifructa			ł	1	1	1	1	1	

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site groups are discussed at the seven group level (referred to as 'wetland community types' or 'community types') which best reflected the scale of patterning seen in the field.

The wetland areas sampled showed a high level of heterogeneity in species composition (Figure 2). The primary division in the classification separates the vegetation of the saline flats (wetland community type 1) from all other sites. This can also be seen in the sorted two-way table (Table 3) where species group J is largely restricted to this community type. Most taxa in this group are highly faithful to it and species such as Halosarcia halocnemoides, H. indica and Sarcocornia quinqueflora have a high level of constancy. All other species groups are completely or almost completely lacking from this wetland community type except for low frequencies of species in species groups D and E. Species richness in this community type ranges from three to 16 taxa/wetland (average 6.8). This community type is largely restricted to the near coastal samphires and birridas between Shark Bay and Lake MacLeod (Figure 3). One outlying site was found at Salt Gully near Gascoyne Junction. The inland mangrove stands from Lake MacLeod are members of this group. While coastal samphires and mangroves were not sampled in this study they appear very similar to this community type.

Wetland community type 2 is generally associated with deeper river pools; one wetland formed from an uncapped artesian bore also belongs with this group. This community type is characterised by the occurrence of species group I. While a number of species are restricted to this community type, constancy values rarely exceed 50%. Species in species groups A, B, E and H are completely lacking, while species frequency in other species groups is low to very low. Average species richness was low (6 taxa/wetland). This community type was associated with the deepest pools which would not dry out in any but the driest years; it occurred from the Murchison River to north of Carnarvon and east along the Wooramel River (Figure 3).

Community type 3 are typically species-poor claypans (mean species richness 5.6 taxa/wetland). The only species constant and faithful to this group is the weed *Asphodelus fistulosus*. One species poor riverine site also belongs to this group. The occurrence of *A. fistulosus* indicates moderate levels of grazing. Whether the low species richness of these sites is also related to disturbance or local soil or moisture conditions is not clear. Several chenopod species were also recorded from this wetland community type.

Community types 4 and 5 encompass riverine wetlands and ephemeral claypans and swamps characterised by the occurrence of *Alternanthera nodiflora*, *Centipeda* spp. and to a lesser extent *Myriocephalus nudus*. Community type 4 differs from type 5 by the reasonably high frequency of other taxa in species group F while largely lacking taxa in species groups A, B, C, D and E which further characterise community type 5, although constancy of species in these groups is generally only moderate to low. Community type 4 was found both in riverine vegetation and ephemeral wetlands of the claypans and swamps while community type 5 was largely restricted to claypans and swamps (Table 4).

Two distinct subtypes are discernible in wetland community type 4. Subtype 4a was the most species-rich of the wetland groups sampled (mean species richness of 17.0/wetland), while community subtype 4b was much less rich (mean species richness of 10.6 taxa/wetland). Both subtypes are characterised by the occurrence of taxa in species group F, while the occurrences of species in species groups G and K define the subgroupings.

Three of the four sites in community subtype 4a are riverine and this subgroup is characterised by a moderate to high fidelity and constancy of taxa in species group K. The river pools tended to have a variety of microhabitats generally with a dense band of sedges (*Schoenoplectus lateriflorus* and/or *Cyperus vaginatus*) along the water's edge. This community subtype was found on upstream areas of the Wooramel River and its tributaries and around a large semi-permanent water body on Boolathana Station (north of Carnarvon) (Figure 3).

Community subtype 4b is restricted to claypans, ephemeral swamps and two river pools in the north west of the study area (Figure 3). Wetlands in this

Wetland community type	Birrida (gypsum pan)	Samphire	River pool	Spring	Ephemeral swamp	Claypan
1	7	4	1		_	_
2	autori		6	1		
3	-	-	1		_	4
4	-	-	6	-	1	4
5	-	-	1	_	8	6
6			1	1	_	-
7	_	_	4	1	www	

 Table 4
 Comparison of the occurrences of the seven wetland community types with a broad habitat classification.

group were characterised by taxa in species group G while almost totally lacking taxa in species group K, which are typical of community subtype 4a. Subtype 4b wetlands tended to have a significant shrub component and the claypans and swamps were quite extensive.

The majority of the ephemeral swamps and claypans form wetland community type 5, and while Centipeda spp. and Alternanthera nodiflora were also common in this community type, the herbs of species groups A, B, C and D clearly differentiate it from the previous type. The sites in this type were quite heterogenous, with few constant taxa, but none the less species rich (mean 10.7 taxa/wetland). The most constant taxon was Eragrostis dielsii, occurring in 75% of sites in this group and totally lacking from the related community type 4. Species group C is most typical of this community type and is composed of annual taxa that either germinate in very shallow waters or rapidly germinate as the clay soils dry. This community type was very widespread across the study area (Figure 3). One riverine site was classified into this group. That site had rich alluvial soil on which suites of annuals were growing. Typically the riverbanks in the study area are either sandy or rocky.

A series of permanent springs are found along the western foothills of the Kennedy Range. These have until recently long been used as watering points for cattle. Some of the springs are fenced off and water piped from them but two have been used as cattle yards. There are no understorey species left at these two sites. The overstorey tree is *Eucalyptus camaldulensis* subsp. *obtusa*. These two sites form wetland community type 6 based on the sole occurrence of this species. One site was located at the spring itself while the second was along the watercourse below the spring.

The final community type (type 7) is comprised of tall dense species-poor sedgelands that occur at the less modified springs and the streams draining the west side of the Kennedy Range and as far south as a dammed section of the Wooramel River. These stands are typical of permanent or near permanent water bodies. *Cyperus vaginalis* is constant in this group but is also common in wetland community subtype 4b. *Typha domingensis* is also a common component of this community type. Mean species richness is 3.2 taxa/wetland.

While no soil sampling or analysis was undertaken during the present study, Halse *et al.* (2000) collected water chemistry data from all but one of these wetlands in their study of invertebrate patterning. This water chemistry data could be expected to be related to aspects of the soil chemistry. Measures of electrical conductivity and turbidity highlight patterns as discussed above (Figure 4).

When the claypans fill, the water becomes red brown in colour due to suspended clay particles. Only wetland community types 3, 4, and 5 occur in claypans, with the percentage of claypan sites

Turbidity (NTU) Kruskal-Wallis: 20.236, df: 6, Probability = 0.0025

Electrical conductivity (mSm<sup>-1</sup>) Kruskal-Wallis: 37.524, df: 6, Probability < 0.0000

**Figure 4** Turbidity (NTU) and electrical conductivity (mSm<sup>-1</sup>) for the seven community types. L = lower limit, 1 = Mean – 1 standard deviation, M = mean, D = Median, 3 = Mean + 1 standard deviation, U = upper limit, \* = more than one symbol at print position.

Wetland flora and vegetation

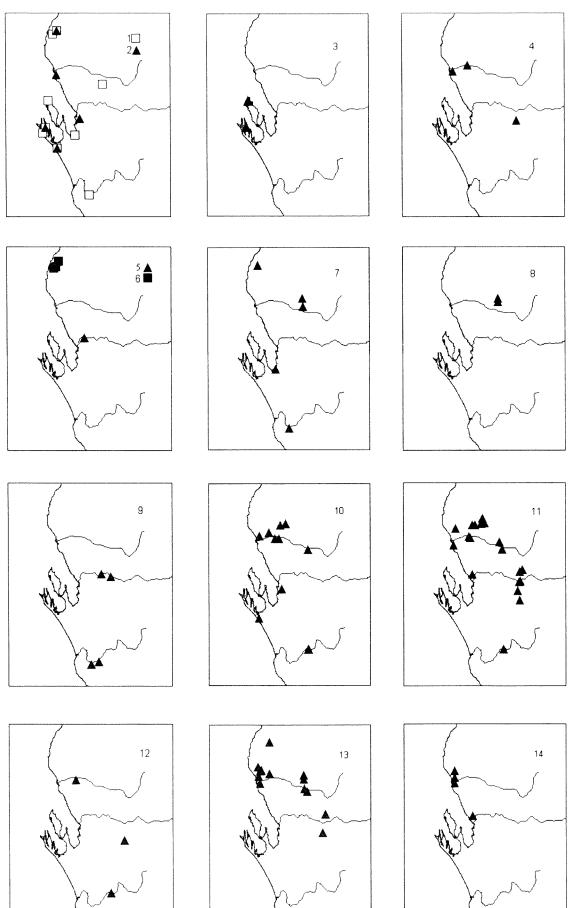


Figure 5 Distribution of the 14 site groups based on individual 1 m<sup>2</sup> across the southern Carnarvon Basin.

Table 5Two-way table derived from the UPGMA classification of the 124 wetland quadrats from the southern Carnarvon Basin study area.

												-		· · · · ·	SPECIES
	1	2	3	45 45	ITE GR 6	0099 7	8	9	10		11	12	13	14	GROUPS
QUADRAT IDENTIFER	58_6999556860_0_aa_ aaaaq_gq qq1qqqq_qq3q2qq3	68a56    qqqqq	69 _a q_ 2q	74r 00 a_o _qw qq	66769	022_8  _acq_  q1q	222	443_ qqcq qq22_3	5_5aab11 _q_22 q4qqqq 3 4qq123	3688855 _abbdbc q 1qqqqqq	7 29924999393767766766222663555 5 73374333538520522588777aa6488 c a_aa_aad_bbbabbc_cccl1_acc - q_q_q_q_qq q qqq2q2qqq1qqqqqq12qqqq2qq 2 2 3 3 121 2311121 13212 321	7777b877  bbbb_dbb  1212q_12  2q_	76682223934422r434 aa_a_gaoa _qq_q_q_qq_qqqw_qq q21q2q4q11q212nq23 1 1 3 1 1 _2	514c aN _qqe q11i	
Actinobole uliginosum									**						
Calandrinia granulifera Pentaschistis airoides									**						
Crassula natans Wahlenbergia preissii Brachyscome iberidifolia Isoetopsis graminifolia				*	-		-		* ** *		•	     •			۵
Calandrinia sp.Coolcalalaya (GJK and NG 698) Pogonolepis muelleriana Maireana oppositifolia Rostraria pumila		+	+         		+   	+   		•       	* * *  * * *  * *	*		*			b
Bergia perennis subsp. obtusifolia Calandrinia pumila Goodenia neogoodenia Gnephosis eriocephala Wurmbea murchisoniana		+     			+	+	+	•       	*   *     *	•	· · · · · · · · · · · · · · · · · · ·	*   *   	•	•     	
Triglochin calcitrapum Elatine gratioloides Melaleuca uncinata Peplidium aithocheilum Glossostigma drummondii Peplidium sp. C (Burbidge and Kain 8152)		*			and a second second second second second second second second second second second second second second second				** *     **   **	•		* **    * *  *  *			c
Marsilea angustifolia		į +	 +		i +	i +	 	i +	i •		· * * *	• +	 +	 +	
Asphodelus fistulosus Myriocephalus guerinae Atriplex lindleyi Dysphania rhadinostachya Cenchrus ciliaris Eragrostis dielsii Calotis hispidula Atriplex holocarpa Myriocephalus gascoynensis MS Trichanthodium skirrophorum Eragrostis leptocarpa	*								** ** *	****			•		đ
Brachyscome ciliaris Lotus cruentus Diplachne muelleri Eriachne flaccida Chenopodium auricomum Calotis multicaulis Cyperus rigidellus Goodenia berardiana					areas and a super state			             		•••		•			•
Avicennia marina Halodule uninervis Halosarcia pterygosperma subsp. denticulata Ruppia tuberosa Eragrostis australasica Ruppia sp. Typha domingensis	•••••	+     +   	*			* **	*	+             			•			*         * * * *	

186

Halosarcia pruinosa	***	1	1 1						ļ		
Heliotropium curassavicum	*	i	i i	1		*					r
Samolus junceus	•	i	1	1 1		•			1		
Polypogon monspeliensis		i	i i	i i	i i	*			1	*	
Cyperus gymnocaulos		i	i i	i i	i i	*****		*		1	
Tetragonia cristata		i	11	i i	i i	**			1		
Decazesia hecatocephala		1	1 1	i i	i	**					
						**				1	
Phalaris minor								***		1	
Bergia auriculata		1	**					***	1	· ·	
Schoenoplectus lateriflorus		· · ·							i	i *i	
Calandrinia polyandra								 	+		
	•	• 1	1 1	i i	i			1	1	1	
Cotula cotuloides		**						1	i	1	
Lawrencia viridigrisea		•						1			
Samolus repens		***	! !								
Neosciadium glochidiatum										-	
Triglochin mucronatum								1	1		a
Parapholis incurva							•				-
Frankenia pauciflora	*** *	***  ***!****						1	1		
Halosarcia halocnemoides		* *	'İ İ								
Muellerolimon salicorniaceum		* *									
Sarcocornia guinqueflora	*** *	••••	1 1		*						
Halosarcia indica	** ********	*			1		•		1	1	
		+	· <b>+ +</b>	-++	+	+	**	+		1*** *** ***	
Alternanthera nodiflora		ļ					**	· · · · · · · · · · · · · · · · · · ·	1	*****	
Centipeda sp.		1				*	* * *		1		
Cyperus vaginatus		1			*				1		
Eleocharis pallens									1		
Goodenia corynocarpa											
Eulalía aurea							*	** **			<b>h</b>
Myriocephalus nudus									1		1
Sporobolus mitchellii							*				
Marsilea drummondii		1							1-		
Ranunculus pumilio											
Helipterum strictum											
Streptoglossa tenuiflora		1									
Paractaenum novae-hollandiae		1									
Pseudognaphalium luteoalbum		1			1			*	1	1 * 1	
		+	++	-++	++	+++		+	+	·+	
Ammannia multiflora		l						* * *		***	
Eriochloa procera		1		1 1				•		***	
Emex australis		i							l		
Mímulus gracilis		ĺ.	i i	11				*		* *	i
Muehlenbeckia cunninghamii		i	11	•1 1					*	•	
Stemodia viscosa		i	Í Í	11			**	*	1	• • •	
Senecio glossanthus		•	i i	i i	i		*	*		•	
,,		+		- <b>+</b>	+	++		+	+	*	
Anagallis arvensis		1						* *	1	* *	
Daucus glochidiatus		i i	11	11	1	1 1			1	**	
Setaria dielsii		i		11				*		*	
Cyperus aff. cunninghamii (GJK and NG 592)		i	1	i i							
Wahlenbergia tumidifructa		i	11	11				**	******		ť
Drosera indica		i	i i	i i		i i		* *			
Lipocarpha microcephala		i	i i	11				+ +	1	1	
Eragrostis basedowii		i	i i	11				** *	1	1	
Glossostigma diandrum		i	11	11			l	****	1	1	
Isolepis congrua			i i	11		1 1	•	****	1		
e			· • • ·	-++	+	++	+	+	+	*	
Atriplex semilunaris		1	11	11	I.		** *		ł	1	
Dysphania glomulifera subsp. eremaea		i	11	i i		ii	**		1		
Tecticornia verrucosa		1	11	1 1	i	ii	**	1	1	1	
Tragus australianus			1	1		i i	**	1	1	1	
Tetragonia diptera		i	i i	1	i	ii	* **	1	1	1	k
Sclerolaena recurvicuspis			• 1	1	i	ii	i •	1	1		
Sonchus oleraceus					1	i i	••	<b>*</b>	İ	•	
Calandrinia ptychosperma					1	i i	• •	1	l.	1	
Centaurium spicatum					1		*	**	1		
Crassula colorata						1	** * **	i +	i		
crussura corotara		1	1 1	1 1	•		,	1	•		

increasing from 31% in community type 4 to 80% in community type 3. Mean turbidity values increase in the same fashion. Only one wetland in the saline community type 1 has turbidity values approaching those of claypan groups. The high levels of electrical conductivity seen in community type 1 clearly separates it from all other wetland types. Essentially the same pattern was seen for other elements such Ca, Mg, Na, K, Cl, and SO<sub>4</sub>. The only other community types with significant but much lower levels of electrical conductivity, Ca, Mg, Na, K, Cl, and SO<sub>4</sub> were the wetlands fed from springs along the western edge of the Kennedy Range (community types 6 and 7).

#### Fine scale patterning - the quadrat classification

In addition to the floristic analysis of the wetland areas a second analysis was undertaken of the 1 m x 1 m quadrats which sampled the finer scale vegetation pattern. In all, 124 quadrats were established in 55 of the 58 wetland areas. Three of the wetland areas had no shrub or herb layer. Two hundred and thirteen taxa were recorded from these quadrats. Of these 213 taxa, 99 (46%) only occurred in one quadrat; these taxa were excluded from the analysis as discussed above. With these exclusions species richness varied from one to 13 taxa/quadrat with individual taxa represented in between two and 31 quadrats.

Fourteen quadrat groupings (referred to as 'site groups') and 11 species groupings were recognised (Table 5). The data set showed high levels of heterogeneity with few quadrats in many of the site groups and generally low species richness (Table 6). The first division in the classification again separated the *Halosarcia* flats (site groups 1 and 2) from the rest of the data set. The two remaining saline groups, the quadrats containing *Ruppia tuberosa* (site group 3) and the mangrove quadrats (site group 6), totally lack taxa in species group g which are faithful to site groups 1 and 2.

Table 6	Mean species richness of the 14 site groups
	identified in the analysis of the 124 wetland
	quadrats.

Site group	Mean species richness	Number of quadrats				
1	4.2	19				
2	2.2	5				
3	1.0	2				
4	1.7	3				
5	1.5	2				
6	1.8	5				
7	1.4	5				
8	2.0	3				
9	3.8	6				
10	9.9	15				
11	6.6	29				
12	4.0	8				
13	5.6	18				
14	1.3	4				

Other species-poor site groups include groups 4, 7, 8, and 9 which are mostly fringing freshwater sedgelands or *Typha* stands, and site group 14, the cane grass swamps (*Eragrostis australasica*). The characteristic taxa of each of these communities are different but all belong to species group f. The other species-poor site group (group 5) occurred on the Wooramel River flats which had been heavily grazed. The sole species recorded in these quadrats was the introduced Buffel Grass (*Cenchrus ciliaris*).

The three remaining site groups are herblands (groups 10, 11, and 12). *Eragrostis dielsii* is the typical species of site group 10. Species groups a, b, d and k are largely confined to this type. Site groups 11 and 12 differ from each other primarily in the proportions of species groups c and h (Table 5). Site group 13 is generally a sedgeland on riverbanks or drainage channels usually dominated by *Cyperus vaginatus*. Taxa in species group h are also well represented in this group.

This fourteen site group classification showed a

Site group	Birrida (gypsum pan)	Samphire	Spring	River pool	Ephemeral swamp	Claypan
1	14	1	2	2	<u> </u>	
2	2	3	-	-	-	-
3	2	—	_	-	_	_
4	_	-	_	2	_	1
5	_	-	-	2	_	
6	4	1	_	_	_	-
7	_	1	2	2	_	
8	_	-	_	3	_	_
9		-	-	6	_	_
10	1	2		-	3	9
11	_	1	_	10	13	5
12		-	-	-	6	2
13			_	11	-	7
14	-	-	-	_	-	4

Table 7 Comparison of the number of quadrats of the fourteen site groups with a broad habitat classification.

strong correlation with the broad habitat classification, again with the wetlands associated with major stream being the most diverse (Table 7). Turbidity and electrical conductivity of the wet season water body showed significance differences between site type means (Figure 4). The occurrence of claypans in site types 10 – 14 is highlighted by high mean turbidity values, and some of the saline water bodies had slightly elevated turbidity (Figure 6). The water bodies associated with site types 1, 2, 3 and 6 were moderately to highly saline. A lesser saline influence can also be seen in site types 7, 10 and 13.

The highly saline site groups (groups 1, 2, 3 and 6) were largely restricted to the coastal belt except for a quadrat at Salt Creek near Gascoyne Junction (Figure 5). The hyper saline *Ruppia tuberosa* quadrats

of site group 3 were restricted to Shark Bay and the mangrove dominated quadrats (group 6) were restricted to Lake MacLeod. However, as was noted previously, the coastal mangrove communities were not sampled in this survey. Site groups 5, 8, 9, and 14 were found to be quite restricted, with group 8 being restricted to Mooka Springs area, group 9 to the Murchison and Wooramel Rivers and group 14 (cane grass swamps) to the area around Carnarvon (Figure 5). In contrast site groups 10 and 11 were widespread in the study area and group 13 was widespread in the northern half.

Many of the wetland areas had more than one site group present and this concentric zonation of the vegetation around the wetland was an obvious feature of the study area. At five of the 57 wetlands three different site groups were recorded, a further

0.5	5000E-01	0.1550E+05	0.3100E+05	0.4650E+05	0.6200E+05
GRP	+	+		+	+
1	*				
2	*==M===3U				
3	*				
4	*				
5	*				
6	*				
7	*				
8	* .				
9	*				
10	L==D===========	=====M=======	=======================================		U
11	*====M=======	======3		U	
12	*======M====	=======================================	=====3		U
13	LD======M===	=======================================	3		
14	*=========	D====M=======	========3U		

Turbidity (NTU) Kruskal-Wallis: 45.819, df: 13, Probability < 0.0001

Electrical conductivity (mSm<sup>-1</sup>) Kruskal-Wallis: 74.103, df: 13, Probability < 0.0001

29.00 0.5102E+05 0.1020E+06 0.1530E+06 0.2040E+06 ---+ 2 L-----U 3 \*======\*=======\* 4 \* 5 \* 6 L1=M=\* 7 \*===D==M=====3----U 8 9 \* 11 \*\* 12 \* 13 \*M=3--U 14 \*

**Figure 6** Turbidity (NTU) and electrical conductivity (mSm<sup>-1</sup>) for the 14 site types. L = lower limit, 1 = Mean - 1 standard deviation, M = mean, D = Median, 3 = Mean + 1 standard deviation, U = upper limit, \* = more than one symbol at print position.

19 had two distinct site groups and a single group was recorded from the remaining wetlands.

## DISCUSSION

The present survey has improved on the poor state of knowledge of the flora and vegetation of the seasonal and permanent wetlands of the southern Carnarvon Basin. During the course of this work one apparently new species was collected, seven new populations of priority flora were located and major range extensions were recorded for a further 15 taxa (Appendix 1). The flora of the wetlands is largely arid (Jessop, 1985) but with both a significant temperate component (34 taxa reaching their northern range limit) and a significant tropical component (18 taxa reaching their southern limit).

The composition and affinities of the wetlands reported here do not accord with the recently published review of biogeography of freshwater plants, which concentrated almost entirely on wet temperate and tropical regions (Jacobs and Wilson, 1996). Our study area overlaps the northern edge of their south west Western Australian region but the affinities of the freshwater plants (defined in Jacobs and Wilson's study as plants that grow in or near water) in our study are largely with the arid zone (Jessop, 1985) and not with New Zealand. Jacobs and Wilson's (1996) work does indicate the lack of knowledge of the seasonal and permanent wetlands in the arid temperate zone (south of the Tropic) is not restricted to southern Carnarvon Basin but is true across Australia. With an increase in knowledge of the wetland systems of arid areas of both the temperate and tropical zones the very strong division between the tropical and temperate regions reported by them can be expected to break down.

Detailed quadrat-based floristic surveys of the Swan Coastal Plain, the coastal communities of the Warren bioregion (Thackway and Cresswell, 1995), and the Tingle forests of the high rainfall zone have all shown that there is a high proportion of naturally rare species in south west Western Australian ecosystems (Gibson et al., 1994; Gibson and Lyons, unpublished data; Wardell-Johnson and Williams, 1996). In all three studies approximately 25% of total floras (1485 taxa in 509 quadrats; 901 taxa in 301 quadrats; and 857 taxa in 441 quadrats respectively) were only recorded at one site. Data from the present survey shows the same pattern with taxa being recorded at only one site comprising 55% of species at the individual wetland scale (58 wetland areas) and 46% at the 1 m<sup>2</sup> quadrat scale (124 quadrats). The regional vegetation survey of the southern Carnarvon Basin study area and a detailed study of the sandplain vegetation in the south of the study area show essentially similar trends (Keighery et al., 2000; Gibson *et al.*, 2000). This rare component of the floras adds significantly to the biodiversity but is not a predictable component of vegetation communities. The conservation status of this component of the flora will continue to be difficult to assess.

The highly variable nature of wetlands in southwest Western Australia has been reported both at the landscape scale (Churchward et al., 1988) and plant and animal community scales (Gibson et al., 1994; Wardell-Johnson and Williams, 1996; Wardell-Johnson and Horwitz, 1996). In the survey of the plant communities of the Swan Coastal Plain the seasonal wetlands were found to comprise 16 of the 30 groups defined (Gibson et al., 1994), while in a study in high rainfall forest areas near Walpole wetlands comprised 22 of the 44 community types defined (Wardell-Johnson and Williams, 1996). The reasons for these high levels of heterogeneity are not clear but appear to result at least in part from differences in substrate and differences in period and depth of inundation. High levels of heterogeneity can be seen from the present study at both scales examined.

It could be argued that part of the reason for heterogeneity at the larger scale could be related to the obvious zonation of the vegetation around many of the wetlands. Vegetation zonation is commonly observed in wetlands across Western Australia (Hopper *et al.*, 1996; Halse *et al.*, 1993). However when sampled at a finer scale the wetland classification still showed a high level of heterogeneity, indicating factors other than zonation are involved.

While some of the community types in the seven group classification generally occur in a particular wetland habitat (e.g. birridas/samphires or claypans/ephemeral swamps), none were restricted to these habitats (Table 4). At the finer scale sampling there is a much stronger correlation between site groups and wetland habitat (Table 7). Even at this scale, however, some site groups are recorded from several wetland habitats. The most diverse wetland habitat was the riverine wetlands reflecting the heterogeneous nature of these areas with variation in substrate composition, texture, slope, degree of disturbance and salinity to which the floristic groups respond.

Examination of the distribution maps of the floristic groupings indicate only moderate biogeographic patterning (Figures 3 and 6). In the seven group wetland classification, the saline community type is generally restricted to the coastal belt but with an outlier near Gascoyne Junction and type 7 is restricted to wetlands at the base of the Kennedy Range south to Wooramel River. The other community types (with the exception of type 3 which are highly disturbed) are widespread across the region, although community type 4 only occurs

in the north of the study area (Figure 3).

At the finer scale of analysis of the 14 site groups, much stronger biogeographic patterning is seen. Eight site groups (groups 1, 2, 3, 5, 6, 8, 9 and 14 – Figure 5) have a restricted distribution, while site groups 10, 11 and 13 are widespread. This increased patterning results from the finer subdivisions possible in the larger dataset.

While most wetlands visited were not obviously impacted by grazing, the use of two springs in the Kennedy Range as cattle yards had resulted in the total removal of the understorey (wetland community type 6). Grazing impacts could also be seen in the claypans and riverine areas of wetland community type 3. These sites were generally dominated by *Asphodelus fistulosus*, a weed indicative of over grazing (Parsons and Cuthbertson, 1992), and were typically quite species poor.

The seasonal and permanent wetlands of the southern Carnarvon Basin have a diverse and poorly known flora. The present study has shown that patterns in species distribution and species richness are similar to those reported for wetlands in higher rainfall area of the southwest, however as in the southwest, the causal factors operating are still poorly understood.

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# Appendix 1

List of taxa found in the 57 wetlands in the southern Carnarvon Basin study area, showing aquatic taxa (taxa restricted or almost restricted to aquatic habitats), habitat, the endemic taxa, range ends and geographic limits of the 265 taxa recorded. (Aquatic taxa – EAq emergent aquatic; Aq submerged or floating aquatic. Habitat – EW ephemeral wetlands; HW heavy soil wetlands; R riverine; R/F riverine or fringing; S saline. Range ends – N northern; S southern. \* indicates an introduced species).

Aquatics	Taxon	Habitat	Endemics	Range ends	Geographic limits
	Family: Aizoaceae				
	Gunniopsis septifraga				
	Tetragonia cristata				
	Tetragonia diptera				
	Family: Amaranthaceae				
Aq	Alternanthera nodiflora				
	Hemichroa diandra	EW			
	Ptilotus gaudichaudii Dtilotus magnoomholus				
	Ptilotus macrocephalus Ptilotus murrayi				
	Family: Anthericaceae				
	Dichopogon tyleri		endemic		Shark Bay to Lake McLeoc
	Family: Apiaceae				
	Apium annuum				
	Apium prostratum				
	Daucus glochidiatus			<b>X</b> Y	
	Neosciadium glochidiatum Trachymene glaucifolia			Ν	Dirk Hartog Island
	Family: Asphodelaceae * Asphodelus fistulosus				
	Family: Asteraceae				
	Actinobole uliginosum				
	Angianthus tomentosus				
	* Bidens bipinnata				
	Brachyscome ciliaris Brachyscome ibaridifelia				
	Brachyscome iberidifolia Calotis hispidula				
	Calotis multicaulis				
	Centipeda cunninghamii	HW		Ν	Rocky Pool, Gascoyne Riv
	Centipeda minima	HW		S	Carnarvon
	Centipeda thespidioides	HW		S	Gascoyne River
	Chthonocephalus pseudevax			N	40 km N Gascoyne Junctio
	Cotula cotuloides	HW		N	Dirk Hartog Island
	Decazesia hecatocephala			S	93 km N Carnarvon
	Gnephosis arachnoidea Gnephosis brevifolia				
	Gnephosis oreololia Gnephosis eriocephala			Ν	56 km N Carnarvon
	Isoetopsis graminifolia			1 N	50 km in Carnarvon
	Minuria integerrima				
	Myriocephalus gascoynensis ms		endemic		Carnarvon area
	Myriocephalus guerinae			Ν	Gascoyne River
	Myriocephalus nudus	HW			
	Myriocephalus pygmaea				
	Pluchea rubelliflora	HW		S	Rocky Pool, Gascoyne Riv
	Podolepis lessonii				
	Pogonolepis muelleriana				<b>m n</b> o
	Pogonolepis stricta			N	Three Rivers Station, Gascoyne R.
	* Pseudognaphalium luteoalbum				2
	Rhodanthe chlorocephala subsp. splendia Rhodanthe margarethae				

Rhodanthe stricta         Sericia glossanthus         Sorichus obraceus         Streptogiosa tenuiflora         HW         Streptogiosa tenuiflora         Trichanthodium skirophorum         Urospermum picroides         Family: Avicenniaceae         Avicennia marina         Heliotorpium consassoicum         EAq         Family: Boraginaceae         Heliotorpium consassoicum         EW         Pamily: Brassicaceae         Brassica tournfortii         Coronopus dulymus         Lepidium crystriohum         Lepidium crystriohum         Lepidium crystriohum         Lepidium crystriohum         Lepidium crystriohum         Merkae austratis         Merkae austratis         Merkae austratis         Stenopetalum paterocarpun         Family: Callitrichaceae         Serina sp. Austin (A. Strid. 20210)         Aq         Family: Carpophyllaceae         Calkienbergia presisi         Walkenbergia presisi         Walkenbergia tumilifurat         Family: Carpophyllaceae         Cartrolpiy termica         Cartrolpiy termica         Cartrolpiy termica	Aquatics	Taxon	Habitat	Endemics	Range ends	Geographic limits
<ul> <li>Sonchus Genzeus Streptoplessa teunighora Trichanthodium skirrophorum</li> <li>Urospermum picroides</li> <li>Family: Avicenniaceae</li> <li>Avicennia marina</li> <li>Family: Boraginaceae Heliotropium curassovicum</li> <li>Family: Boraginaceae Heliotropium curassovicum</li> <li>Family: Brassicaceae</li> <li>Brassian tournefortii</li> <li>Coronopa didymus Lepidium oxytrichum Lepidium oxytrichum Lepidium oxytrichum Lepidium pedicellare Stenopetalum pedicellare Stenopetalum pedicellare</li> <li>Family: Caesalpiniaceae Stenopetalum pedicellare</li> <li>Family: Callitrichaceae Supporting</li> <li>Coolcalalaya</li> <li>Market australis</li> <li>Family: Callitrichaceae Stenopetalum pedicellare</li> <li>Coolcalalaya</li> <li>Family: Callitrichaceae Cupsophila nustralis</li> <li>Polycarpon teriaphyllum</li> <li>Spergularia rubra</li> <li>Family: Centrolepidaceae Curtolepis tumidifructa</li> <li>Family: Centrolepidaceae Curtolepis tumidifructa</li> <li>Family: Centrolepidaceae Curtolepis tumilima</li> <li>N Wooramel River</li> <li>Family: Chenopodiaceae Artiplex holocarpa Artiplex holocarpa Artiplex paludos subsp. moquiniana Artiplex semiluantis</li> <li>S Artiplex paludos subsp. moquiniana Artiplex contalous subsp. moquiniana Artiplex contalous subsp. moquiniana Artiplex contalous subsp. moquiniana Artiplex contalous subsp. moquiniana Artiplex contalous subsp. moquiniana Artiplex contalous subsp. moquiniana Artiplex contalous subsp. mo</li></ul>						
Sireptoglissa transform     HW     S     Boolathana       Sireptoglissa transform     HW     S     Boolathana       Trichantholium skirrophorum     Histopermum picrolades     N     Coolcalalaya       EAq     Family: Doraginaceae     EW     N     Coolcalalaya       Family: Brassicaceae     Brassicaceae     N     Coolcalalaya       Family: Brassicaceae     Brassica tournefortii     EW     N     Coolcalalaya       Family: Brassicaceae     Brassica tournefortii     EW     N     Coolcalalaya       Family: Brassicaceae     Brassica tournefortii     EW     N     Coolcalalaya       Family: Caroophy aldymus     EW     Sisophrium crysinoides     EW       Sisophrium cysinoides     Stenopetalum spearcoarpum     Family: Casuprinaceae     N     Coolcalalaya       Aq     Callitrich estagnatis     EW     Sisophrium crysinoides     N     Coolcalalaya       Aq     Callitrich estagnatis     Family: Caroophyllaceae     N     Coolcalalaya       Casuarina obea     R/F     Family: Caroophyllaceae     N     Hake MacLeod       Casuarina obea     R/F     Family: Caroophyllaceae     N     Lake MacLeod       Cartrolepis humilinna     N     Lake MacLeod     N     Flats near Gascopt       Arriptax holozera						
Trichardhodium skrrophorum         • Urospermum picroides         EAq       Family: Avicenniaceae         Family: Boraginaceae       EW         Plagiobothrys plurisepalus       EW         Family: Brassicaceae       EW         Parnily: Brassicaceae       Family: Brassicaceae         Heiotoptium curasswicum       EW         Family: Brassicaceae       Family: Brassicaceae         - Brassica tournefortii       Coronopus didymus         Lepidium peudonudende       Epidium oxytindum         Menkoa villosula       EW         * Sisymbrium crysimoides       EW         * Sisymbrium erysimoides       Stenopetalum pedicellare         Stenopetalum pedicellare       Stenopetalum pedicellare         Stenopetalum spherocarpum       Family: Casapanulaceae         Vallenbergia preissi       N         Coolcalalaya       Waltenbergia transificue         * Colycophila usitralis       Family: Caropophylaceae         Capsophila usitralis       Pamily: Caropophylaceae         Capsophila usitralis       N         * Polycarpon letraphyllum       N         * Spergularia rubra       N         Family: Cantrolepidaceae       N         Centrolepi seremica       N <td< td=""><td></td><td>Solicing olerweens</td><td>* ***</td><td></td><td>C</td><td>D. Latherer</td></td<>		Solicing olerweens	* ***		C	D. Latherer
<ul> <li>Urospermum picroides</li> <li>Family: Avicenniaceae Avicennia marina</li> <li>Family: Boraginaceae Heitotropion cursosovicum</li> <li>Family: Brassicaceae</li> <li>Brassicaceae</li> <li>Branily: Callitrichaceae</li> <li>Sema sp. Austin (A. Strid. 20210)</li> <li>Family: Callitrichaceae</li> <li>Senan sp. Austin (A. Strid. 20210)</li> <li>Family: Callitrichaceae</li> <li>Senan sp. Austin (A. Strid. 20210)</li> <li>Family: Callitrichaceae</li> <li>Callitriche stagnalis</li> <li>Family: Carpophyllaceae</li> <li>Cypsophila australis</li> <li>Polycarone terphyllum</li> <li>Spergularia rubra</li> <li>Family: Casuarinaceae</li> <li>Casuarina obesa</li> <li>R/F</li> <li>Family: Chenopodiaceae</li> <li>Artiplex biolograpa</li> <li>Artiplex biolograpa</li> <li>Artiplex biolograpa</li> <li>Artiplex sellumaris</li> <li>S</li> <li>Artiplex sellumaris</li> <li>S</li> <li>Artiplex sellumaris</li> <li>S</li> <li>Artiplex securina subsp. moquiniana</li> <li>Artiplex securina</li> <li>Chenopodium cristatum</li> <li>Dysphania glumilfera subsp. eremaea</li> <li>EW</li> <li>Dysphania italionstaclyucarpa</li> <li>FW</li> <li>Dysphania platenemolics</li> <li>S</li> </ul>			HW		5	Boolathana
Family: Avicenniaceae       Avicennia marina         Family: Boraginaceae       Family: Boraginaceae         Heliotropium curassoricum       EW         Plagiobolitys plurisepalus       EW         Family: Brassica covee       *         * Brassica tourneforti       *         * Concopus didymus       Lepidium crystrichum         Lepidium oxytrichum       Lepidium crystmolae         Sieymbrium erysimoides       EW         * Sisymbrium erysimoides       EW         * Sisymbrium erysimoides       EW         * Stempetalum policellare       Stempetalum policellare         Stempetalum policellare       Stempetalum policellare         Stempetalum sphaerocarpum       Family: Cassafiniaceae         Family: Cathride stagnalis       N         Family: Carpophyllaceae       Cypsophila ustralis         * Polycarpon tetraphyllum       *         * Spergularia runba       N         * Polycarpon tetraphyllum       *         * Spergularia runba       N         * Polycarpon tetraphyllum       *         * Polycarpon tetraphyllum       *         * Polycarpon tetraphyllum       *         * Polycarpon tetraphylluma       N         * Polycarpon tetraphylluma       N     <						
Avicennia marina         Family: Boraginaceae         Heliotopium curassocium       EW         Plagiobilitys plurisepalus       N         Coolcalalaya         Family: Brassica tournefortii         Coronopus didymus         Lepidium crystrichum         Lepidium crystrichum         Lepidium crystrichum         Menkea valstralis         Menkea valstralis         Menkea valstralis         Menkea valstralis         Menkea valstralis         Menkea valstralis         Menkea valstralis         Menkea valstralis         Menkea valstralis         Menkea valstralis         Menkea valstralis         Menkea valstralis         Stenopetalum sphareocarpum         Family: Caesalpiniaceae         Stenopetalus sphareocarpum         Family: Carsupharoaceae         Valienbergia tunidifructa         Family: Carpophyllaceae         Capyophyllaceae         Casuarina obesa         R/F         Family: Clentrolepidaceae         Centrolepis eremica         Centrolepis eremica         Centrolepis eremica         Centrolepis in unillina         N		* Urospermum picroides				
Family: Boraginaceae       Heliotropium curassavicum       EW       N       Coolcalalaya         Plagiobethrys plurisepalus       EW       N       Coolcalalaya         Family: Brassicaceae       *       Brossica tournefortii       *         *       Coronopus didymus       Lepidium notundum       Lepidium posudonuderale         Lepidium notundum       Menkea villosula       EW       *         *       Sisymbrium erysinoides       Sisymbrium erysinoides       *         Stenopetalum pedicellare       Stenopetalum sphaerocarpum       F         Family: Caesalpiniaceae       Senna sp. Austin (A. Strid: 20210)       N       Coolcalalaya         Yahlenbergia preissii       W       M       Coolcalalaya         Yaq       Family: Caesalpiniaceae       N       Coolcalalaya         Yahlenbergia tumidifructa       N       Coolcalalaya         Yaq       Family: Caryophyllaceae       R/F         Guysophila australis       R/F       N       Wooramel River         Pamily: Chenopodiaceae       N       Flats near Gascoya         Atriplex holocarpa       N       Flats near Gascoya         Atriplex tholocarpa       N       Flats near Gascoya         Atriplex tosclaria       S       N <td< td=""><td></td><td>-</td><td></td><td></td><td></td><td></td></td<>		-				
Heliotopium curassavicum     EW       Plagiobothrys plurisepalus     N       Coolcalalaya       Family: Brassicaceae       * Brassica tournefortii       Coronopus didymus       Lepidium ortinelor       Lepidium ortinelor       Lepidium ortinelor       Menka villosula       Wenka villosula       Sisymbrium erysinoides       Stemopetalum splaneocarpum       Family: Caesalpiniaceae       Stenopetalum splaneocarpum       Family: Caesalpiniaceae       Stenopetalum splaneocarpum       Family: Campanulaceae       Wahlenbergia preissii       Wahlenbergia preissii       Wahlenbergia tumidifructa       Family: Caryophyllaceae       Gypsophila australis       Pamily: Centrolepidaceae       Centrolepis numilima       Pamily: Chenopodicaee       Artiplex platocarpa       Artiplex platocarpa       Artiplex sublocarpa       Artiplex sublocarpa       Artiplex sublocarpa       Artiplex sesiaria       Chenopodium aricomum       EW       Chenopodium cristatum       Dysphania glomuilifera       Dysphania glomuilifera       S       Halasarcia Haloneemoides       S	Aq	Avicennia marina				
Plagiobothrys plurisepalus     N     Coolecalalaya       Family: Brassicaceae     Brassica tournefortii     Coronopus didymus Lepidium oxytrichum Lepidium oxytrichum Menkea australis     EW       *     Gronopus didymus Lepidium oxytrichum Menkea vilosula     EW       *     Sisymbrium gesudoruderale Lepidium spheroarpum     EW       *     Sisymbrium erysimoides Stenopetalum spheroarpum     EW       *     Sisymbrium erysimoides Stenopetalum spheroarpum     Family: Caesalpiniaceae Senna sp. Austin (A. Strid. 20210)       *     Family: Campanulaceae Wahlenbergia preissii Waklenbergia tumidifructa     N       *     Family: Caropohyllaceae Cypsophila australis     N       *     Spergularia rubra     N       *     Spergularia rubra     N       *     Spergularia rubra     N       *     Spergularia rubra     N       *     Spergularia rubra     N       *     Spergularia nubra     N       *     Spergularia nubra     N       *     Family: Centrolepidaceae Centrolepis numilima     N       *     Family: Chenopodiaceae     N       *     Family: Chenopodiaceae     N       *     Atriplex smilunaris     S       *     Atriplex sesicaria     N       *     Chenopodium aricomum     EW    C						
Family: Brassica courrefortii         • Brassica tournefortii         • Coronopus didymus Lepidium orgurichum Lepidium peudoruderale Lepidium rotundum Menkea australis Menkea villosula       EW         • Sisymbrium reysinoides Stenopetalum pedicellare Stenopetalum pedicellare Stenopetalum sphaerocarpum       Family: Caesalpiniaceae Senna sp. Austin (A. Strid. 20210)         • Family: Callitrich scaae Wahlenbergia tumidifructa       N         Family: Campanulaceae Wahlenbergia tumidifructa       N         • Coolcalalaya       Wahlenbergia tumidifructa         • Family: Caryophyllaceae Cypsophila australis       N         • Polycarpon tetraphyllum       * Spergularia rubra         • Spergularia rubra       N         • Spergularia rubra       N         • Spergularia rubra       R/F         • Family: Centrolepidaceae Centrolepis tumillima       N         • Ariplex holocarpa       N         • Lake MacLeod Artriplex indicy subsp. inflata Artriplex sentuma autosp. moquiniana Artriplex sentuma autoronum       EW         • Chenopodium cristatum Dysphania platycarpa       EW         • Dysphania platocenencides       S         • Halosarcia halonoennoides       S			EW			
<ul> <li>Brasica tournefortii</li> <li>Coronopus didymus Lepidium organization periodouderale Lepidium organization periodouderale Lepidium organization periodoudina EW</li> <li>Sisymbrium eryinoides</li> <li>Stenopetalum pedicellare</li> <li>Stenopetalum sphaerocarpum</li> <li>Family: Caesalpiniaceae</li> <li>Senna sp. Austin (A. Strid. 20210)</li> <li>Family: Caesalpiniaceae</li> <li>Senna sp. Austin (A. Strid. 20210)</li> <li>Family: Calitrichaceae</li> <li>Valienbergia preissii</li> <li>N Coolcalalaya</li> <li>Wahlenbergia preissii</li> <li>Valienbergia preissii</li> <li>Polycarpon tetraphyllum</li> <li>Spergularia rubra</li> <li>Family: Caryophyllaceae</li> <li>Casuarina obesa</li> <li>R/F</li> <li>Family: Centrolepidaceae</li> <li>Centrolepis humillima</li> <li>N Wooramel River</li> <li>Family: Chenopodiaceae</li> <li>Atriplex holocarpa</li> <li>Atriplex semilumaris</li> <li>Atriplex semilumaris</li> <li>Atriplex semilumaris</li> <li>Atriplex semilumaris</li> <li>Chenopodium autoromum</li> <li>EW</li> <li>Chenopodium cristatum</li> <li>Dysphania platycarpa</li> <li>EW</li> <li>Dysphania platycarpa</li> <li>EW</li> <li>Dysphania platycarpa</li> <li>EW</li> <li>Dysphania platocenoides</li> <li>S</li> </ul>		Plagiobothrys plurisepalus			N	Coolcalalaya
<ul> <li>Coronopus didymus Lepidium oxytrichum Lepidium pseudoruderale Lepidium pseudoruderale Lepidium rotundum Menkea australis</li> <li>Menkea australis</li> <li>Menkea australis</li> <li>Menkea australis</li> <li>Stenopetalum sphaerocarpum</li> <li>Family: Caesalpiniaceae Senna sp. Austin (A. Strid. 20210)</li> <li>Family: Callitrichaceae</li> <li>Sena sp. Austin (A. Strid. 20210)</li> <li>Family: Callitrichaceae</li> <li>Vallenbergia preissii</li> <li>N Coolcalalaya</li> <li>Wahlenbergia preissii</li> <li>Vallenbergia preissii</li> <li>Polycarpon tetraphyllum</li> <li>Spergularia rubra</li> <li>Family: Casuarinaceae</li> <li>Costoaria australis</li> <li>Polycarpon tetraphyllum</li> <li>Spergularia rubra</li> <li>Family: Casuarinaceae</li> <li>Centrolepis tumilima</li> <li>N Wooramel River</li> <li>Family: Cherolopidaceae</li> <li>Centrolepis humilima</li> <li>N Lake MacLeod</li> <li>Arriplex indicarpa subsp. maquiniana</li> <li>Arriplex indicas subsp. maquiniana</li> <li>Arriplex indicas subsp. maquiniana</li> <li>Arriplex indicas subsp. maquiniana</li> <li>Arriplex coinaria</li> <li>Chenopodium auricomum</li> <li>EW</li> <li>Chenopodium auricomum</li> <li>EW</li> <li>Chenopodium auricomum</li> <li>EW</li> <li>Dysphania platycarpa</li> <li>EW</li> <li>Dysphania platycarpa</li> <li>EW</li> <li>Dysphania platycarpa</li> <li>EW</li> </ul>						
Lepidium oxytrichum         Lepidium rotundum         Merka australis         Merka australis         Merka australis         Merka vilosula       EW         * Sisymbrium erysimoides         Stenopetalum splaerocarpum         Family: Caesalpiniaceae         Senna sp. Austin (A. Strid. 20210)         Aq         Family: Callitrichaceae         Walkenbergia preissii       N         Coolcalalaya         Wakhenbergia tumidifructa         Family: Caryophyllaceae         Gyspophil australis         * Polycarpon tetraphyllum         * Spergularia rubra         Family: Centrolepidaceae         Centrolepis eremica         Centrolepis eremica         Centrolepis humillima         N         Handley: Subsp. inflata         Atriplex holocarpa         Atriplex induesa subsp. moquiniana         Atriplex centulous subsp. moquiniana         Atriplex semilunarris         S         Atriplex semilunarris         Dysphania platycarpa         EW         Dysphania platorenia         Maripex osciaria         Chenopodium cristatum         Dysphania platycarpa </td <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>						
Lepidium pseudoruderale         Lepidium rotundum         Menkaa australis         Menka australis         Menka australis         Menka australis         Menka australis         Menka australis         Menka australis         Stenopetalum sphaerocarpum         Family: Caesalpiniaceae         Senna sp. Austin (A. Strid. 20210)         Family: Callitriche stagnalis         Family: Caropanulaceae         Wahlenbergia tunidifructa         Family: Caropophyllaceae         Gypsophila australis         * Polycarpon tetraphyllum         * Spergularia rubra         Ramily: Casuarinaceae         Casuarina obesa         R/F         Family: Caropophyllaceae         Centrolepis eremica         Centrolepis eremica         Centrolepis seremica         Centrolepis seremica         Centrolepis seremica         Chenopodiaceae         Atriplex holocarpa         Atriplex semilunaris         S         Atriplex securita         Dysphania glounlifera subsp. remaea         EW         Dysphania platycarpa         EW         Dysphania platocemedes						
Lepidium rotundum Menkea australis Menkea australis Menkea villosula EW Sisymbrium erysimoides Stenopetalum sphaerocarpum Family: Caesalpiniaceae Senna sp. Austin (A. Strid. 20210) Family: Callitrichaceae Callitriche stagnalis Family: Campanulaceae Wahlenbergia tumidifructa Family: Caryophyllaceae Gypsophila australis Polycarpon tetraphyllum * Spergularia rubra Family: Casuarinaceae Casuarina obesa R/F Family: Casuarinaceae Casuarina obesa R/F Family: Centrolepidaceae Centrolepis eremica Centrolepis humillima N Wooramel River Family: Chenopodiaceae Atriplex holocarpa N Lake MacLeod Atriplex londcarpa S Atriplex inflata Atriplex londcarpa S Atriplex conduction Atriplex semilunaris S Atriplex	Lepidium oxytrichum					
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Menkea australis Menkea villosula       EW         Sisymbrium erysinoides Stenopetalum pedicellare Stenopetalum sphaerocarpum       EW         Family: Caesalpiniaceae Senna sp. Austin (A. Strid. 20210)       Family: Callitricheseae         Aq       • Callitriche stagnalis         Family: Callitriche stagnalis       N         Colcalalaya       Wahlenbergia preissi       N         Wahlenbergia tumidifructa       N       Coolcalalaya         Family: Caryophyllaceae Cypsophila australis       Polycarpon tetraphyllum       *         * Spergularia rubra       Family: Casuarinaceae Casuarina obesa       R/F         Family: Centrolepidaceae Centrolepis enemica Centrolepis tumillima       N       Wooramel River         Family: Chenopodiaceae Atriplex holocarpa Atriplex veisaria       N       Lake MacLeod N       Flats near Gascoyn Atriplex seisaria         Atriplex sevisaria       S       S       Atriplex sevisaria       S         Atriplex sevisaria       S       S       Atriplex sevisaria       S         Atriplex sevisaria       EW       Dysphania platycarpa       EW         Dysphania platycarpa       EW       Dysphania rhadinostadya       S						
<ul> <li>Sisymbrium erysimoides Stenopetalum pedicellare Stenopetalum sphaerocarpum</li> <li>Family: Caesalpiniaceae Senna sp. Austin (A. Strid. 20210)</li> <li>Family: Callitrichaeae</li> <li>Callitriche stagnalis</li> <li>Family: Campanulaceae Wahlenbergia preissii</li> <li>Family: Campanulaceae Wahlenbergia preissii</li> <li>Family: Caryophyllaceae Gypsophila australis</li> <li>Folycarpon tetraphyllum</li> <li>Spergularia rubra</li> <li>Family: Casuarinaceae Centrolepis eremica Centrolepis eremica</li> <li>Family: Centrolepidaceae Centrolepis humillima</li> <li>Family: Chenopodiaceae</li> <li>Artiplex holocarpa</li> <li>Atriplex paludosa subsp. inflata</li> <li>Atriplex seinilum aris</li> <li>Atriplex seinilum aris</li> <li>Atriplex seinilum aris</li> <li>Chenopodium auricomum</li> <li>EW Chenopodium aricomum</li> <li>EW Dysphania platycarpa</li> <li>Halosarcia halocnemoides</li> <li>S</li> </ul>						
<ul> <li>Sisymbrium erysimoides Stenopetalum pedicellare Stenopetalum sphaerocarpum</li> <li>Family: Caesalpiniaceae Senna sp. Austin (A. Strid. 20210)</li> <li>Family: Callitriche stagnalis</li> <li>Family: Callitriche stagnalis</li> <li>Family: Campanulaceae Wahlenbergia preissit</li> <li>Family: Caryophyllaceae Gypsophila australis</li> <li>Family: Caryophyllaceae Gypsophila australis</li> <li>Family: Caryophyllaceae Gypsophila australis</li> <li>Polycarpon tetraphyllum</li> <li>Spergularia rubra</li> <li>Family: Casuarinaceae Centrolepis eremica Centrolepis eremica</li> <li>Family: Centrolepidaceae Centrolepis humillima</li> <li>Family: Chenopodiaceae Atriplex holocarpa</li> <li>Atriplex peludosa subsp. inflata</li> <li>Atriplex seisaria</li> <li>Chenopodium auricomum</li> <li>EW Chenopodium auricomum</li> <li>EW Dysphania platycarpa</li> <li>Halosarcia halocnemoides</li> <li>S</li> </ul>		Menkea villosula	EW			
Stenopetalum pedicellare         Stenopetalum sphaerocarpum         Family: Caesalpiniaceae         Senna sp. Austin (A. Strid. 20210)         Family: Callitrichaceae         &         Callitriche stagnalis         Family: Campanulaceae         Wahlenbergia preissii         Wahlenbergia tumidifructa         Family: Caryophyllaceae         Gyposphila australis         * Polycarpon tetraphyllum         * Spergularia rubra         Family: Centrolepidaceae         Centrolepis serenica         Centrolepis serenica         Centrolepis humillima         N         Vooramel River         Family: Chenopodiaceae         Atriplex holocarpa         Atriplex sesiaria         Chenopodium aricomum         EW         Dysphania glomul/fera subsp. eremaea         EW         Dysphania platycarpa         Supplania rhadinostachya						
Stenopetalum sphaerocarpum         Family: Caesalpiniaceae Senna sp. Austin (A. Strid. 20210)         Family: Callitrichaceae         Aq         * Callitriche stagnalis         Family: Campanulaceae Wahlenbergia preissii       N         Coolcalalaya         Wahlenbergia tumidifructa         Family: Caryophyllaceae Gypsophila australis         * Polycarpon tetraphyllum         * Spergularia rubra         Family: Casuarinaceae Casuarina obesa         Centrolepis deceae Centrolepis numilima         Arriplex holocarpa Atriplex holocarpa Atriplex semilunaris         S         Atriplex nolucarina         Atriplex semilunaris         S         Atriplex vesticaria         Chenopodium aricomum         EW         Dysphania glonul/fera subsp. eremaea         EW         Dysphania planuligera subsp. eremaea         EW         Dysphania fundionstachya         S						
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Aq       * Callitriche stagnalis         Family: Campanulaceae       N         Wahlenbergia preissii       N         Coolcalalaya         Wahlenbergia tumidifructa         Family: Caryophyllaceae         Cypsophila australis         * Polycarpon tetraphyllum         * Spergularia rubra         Family: Casuarinaceae         Casuarina obesa         R/F         Family: Centrolepidaceae         Centrolepis eremica         Centrolepis humillima         Family: Chenopodiaceae         Atriplex holocarpa         Atriplex lindleyi subsp. inflata         Atriplex semilunaris         S         Atriplex semilunaris         S         Atriplex semilunaris         S         Atriplex semilunaris         S         Atriplex semilunaris         S         Atriplex semilunaris         S         Atriplex semilunaris         S         Atriplex semilunaris         S         Atriplex semilunaris         S         Atriplex semilunaris         S         Atriplex semiluna islomulifera subsp. eremaea <td></td> <td>Family: Callitrichaceae</td> <td></td> <td></td> <td></td> <td></td>		Family: Callitrichaceae				
Wahlenbergia preissii       N       Coolcalalaya         Wahlenbergia tumidifructa       N       Coolcalalaya         Family: Caryophyllaceae       Gypsophila australis       *         *       Polycarpon tetraphyllum       *         *       Spergularia rubra       Family: Casuarinaceae         Casuarina obesa       R/F         Family: Centrolepidaceae       Centrolepis eremica         Centrolepis eremica       N         Wooramel River       Family: Chenopodiaceae         Atriplex holocarpa       N         Atriplex paludosa subsp. inflata       N         Atriplex semilunaris       S         Atriplex vesicaria       Chenopodium auricomum         Dysphania glomulifera subsp. eremaea       EW         Dysphania glomulifera subsp. eremaea       EW         Dysphania rhadinostachya       S         Halosarcia halocnemoides       S	Aq					
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Family: Caryophyllaceae         Gypsophila australis         * Polycarpon tetraphyllum         * Spergularia rubra         Family: Casuarinaceae         Casuarina obesa       R/F         Family: Centrolepidaceae         Centrolepis eremica         Centrolepis humillima         N       Wooramel River         Family: Chenopodiaceae         Atriplex holocarpa       N         Atriplex lindleyi subsp. inflata       N         Atriplex semilunaris       S         Atriplex semilunaris       S         Atriplex vesicaria       EW         Chenopodium cristatum       EW         Dysphania platycarpa       EW         Dysphania thadinostachya       S         Halosarcia halocnemoides       S		Wahlenbergia preissii			N	Coolcalalaya
Gypsophila australis         * Polycarpon tetraphyllum         * Spergularia rubra         Family: Casuarinaceae         Casuarina obesa       R/F         Family: Centrolepidaceae         Centrolepis eremica         Centrolepis humillima         N       Wooramel River         Family: Chenopodiaceae         Atriplex holocarpa       N         Atriplex indleyi subsp. inflata       N         Atriplex semilunaris       S         Atriplex semilunaris       S         Atriplex vesicaria       EW         Chenopodium auricomum       EW         Dysphania glomulifera subsp. eremaea       EW         Dysphania platycarpa       EW         Dysphania rhadinostachya       S         Halosarcia halocnemoides       S						
<ul> <li>Polycarpon tetraphyllum</li> <li>Spergularia rubra</li> <li>Family: Casuarinaceae Casuarina obesa</li> <li>R/F</li> <li>Family: Centrolepidaceae Centrolepis eremica Centrolepis humillima</li> <li>N Wooramel River</li> <li>Family: Chenopodiaceae Atriplex holocarpa</li> <li>Atriplex holocarpa</li> <li>Atriplex paludosa subsp. inflata</li> <li>Atriplex paludosa subsp. moquiniana</li> <li>Atriplex semilunaris</li> <li>S Atriplex vesicaria</li> <li>Chenopodium auricomum</li> <li>EW</li> <li>Chenopodium cristatum</li> <li>Dysphania glomulifera subsp. eremaea</li> <li>EW</li> <li>Dysphania platycarpa</li> <li>EW</li> <li>Dysphania hadinostachya</li> <li>S</li> <li>Halosarcia halocnemoides</li> </ul>		Family: Caryophyllaceae				
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Centrolepis eremica       N       Wooramel River         Centrolepis humillima       N       Wooramel River         Family: Chenopodiaceae       N       Lake MacLeod         Atriplex holocarpa       N       Lake MacLeod         Atriplex lindleyi subsp. inflata       N       Flats near Gascoyr         Atriplex semilunaris       S         Atriplex vesicaria       S         Chenopodium auricomum       EW         Chenopodium cristatum       EW         Dysphania glomulifera subsp. eremaea       EW         Dysphania platycarpa       EW         Dysphania rhadinostachya       S         Halosarcia halocnemoides       S		Casuarina obesa	R/F			
Centrolepis humillima       N       Wooramel River         Family: Chenopodiaceae       N       Lake MacLeod         Atriplex holocarpa       N       Lake MacLeod         Atriplex lindleyi subsp. inflata       N       Flats near Gascoyr         Atriplex paludosa subsp. moquiniana       N       Flats near Gascoyr         Atriplex semilunaris       S         Atriplex vesicaria       Chenopodium auricomum         Chenopodium cristatum       EW         Dysphania glomulifera subsp. eremaea       EW         Dysphania platycarpa       EW         Dysphania rhadinostachya       S         Halosarcia halocnemoides       S						
Family: Chenopodiaceae       N       Lake MacLeod         Atriplex holocarpa       N       Flats MacLeod         Atriplex lindleyi subsp. inflata       N       Flats near Gascoyr         Atriplex paludosa subsp. moquiniana       N       Flats near Gascoyr         Atriplex semilunaris       S         Atriplex vesicaria       Chenopodium auricomum       EW         Chenopodium cristatum       EW         Dysphania glomulifera subsp. eremaea       EW         Dysphania platycarpa       EW         Dysphania rhadinostachya       S         Halosarcia halocnemoides       S						
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Atriplex lindleyi subsp. inflata       N       Flats near Gascoyn         Atriplex paludosa subsp. moquiniana       S         Atriplex semilunaris       S         Atriplex vesicaria       Chenopodium auricomum         Chenopodium cristatum       EW         Dysphania glomulifera subsp. eremaea       EW         Dysphania platycarpa       EW         Dysphania rhadinostachya       S         Halosarcia halocnemoides       S						
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Dysphania rhadinostachya S Halosarcia halocnemoides S						
Halosarcia halocnemoides S						
		Dysprinnin mainosinchyn Halaannia halammaidaa				
Halosarcia inaica 5						
Halosarcia pruinosa S Halosarcia pterygosperma subsp. denticulata S		Halosarcia pruinosa				

Aquatics	Taxon	Habitat	Endemics	Range ends	Geographic limits
	Maireana aphylla				
	Maireana oppositifolia			Ν	Yaringa
	Maireana stipitata			S	Tamala
	Osteocarpum acropterum var. acropterum			Ν	Boolathana
	Salsola kali	D/F			
	Sarcocornia quinqueflora	R/F			
	Sarcocornia sp. Sclerolaena diacantha				
	Sclerolaena recurvicuspis				
	Tecticornia verrucosa	HW			
	Threlkeldia diffusa				
	Family: Clusiaceae				
	Hypericum gramineum				
	Hypericum japonicum				
	Family: Colchicaceae Wurmbea murchisoniana	EW		NI	Caslalalarra
		EVV		Ν	Coolcalalaya
	Family: Crassulaceae Crassula colorata				
	Crassula exserta				
Aq	* Crassula natans				
	Crassula pedicellosa				
	Family: Cymodoceaceae	EW/			
	Halodule uninervis	EW			
	Family: Cyperaceae	_			
EAq	Baumea articulata	R			
	Cyperus aff. cunninghamii Cymerus hifer	D/C.		c	Talisker
	Cyperus bifax Cyperus gymnocaulos	R/F; R		S	Tallsker
	* Cyperus hamulosus	IX .			
	Cyperus rigidellus	EW			
	Cyperus squarrosus	EW		S	50 km S Carnarvon
	Cyperus vaginatus	R			
EAq	Eleocharis acuta			N	Carnarvon
EAq	Eleocharis geniculata	17147		S	Mooka Creek, range extension
	Eleocharis pallens Isolepis congrua	EW		Ν	Kannady Panga Boolathana
	Isolepis congritu Isolepis cyperoides			N	Kennedy Range, Boolathana Coolcalalaya, range extensior
	Lipocarpha microcephala			14	cooleanarya, range extension
	Schoenoplectus lateriflorus	EW		S	Cardilya Ck, Carey Downs,
EAq	Schoenoplectus subulatus			S	range extension Murchison River
1	Schoenus elegans				
	Schoenus humilis			Ν	Wooramel River
	Family: Droseraceae	way s			
	Drosera indica	EW			
	Family: Elatinaceae	TT 1 - 7			
	Bergia auriculata Bargia annousia aukan aktuaifalia	EW			Dan ao automaine
Aq	Bergia perennis subsp. obtusifolia Elatine gratioloides	EW EW			Range extension Range extension
	Family: Frankeniaceae				
	Frankenia cinerea			_	
	Frankenia laxiflora			Ν	Talisker
	Frankenia pauciflora				
	Family: Gentianaceae				
	Centaurium spicatum				

Taxon	Habitat	Endemics	Range ends	Geographic limits
* Family: Geraniaceae				
Erodium cicutarium				
Family: Goodeniaceae Goodenia berardiana				
Goodenia corynocarpa Goodenia maideniana				
Goodenia neogoodenia				Range extension
Goodenia pinnatifida Velleia hispida				
Family: Haloragaceae				
Haloragis trigonocarpa Myriophyllum decussatum			Ν	Doorawarrah
Family: Hypoxidaceae Hypoxis occidentalis			N	Kalbarri
Isoetes muelleri				
-				
Juncus aridicola			Ν	Cardilya Creek, Carey Downs
* Juncus bufonius				
			Ν	Kennedy Range
Triglochin centrocarpum				
Triglochin minutissimum Triglochin mucronatum			N N	Boolathana Dirk Hartog Island
Family: Lythraceae			C	
-				Wooramel River, range extension
·	17147	) A	5	Cardilya Creek, Carey Downs, range extension
	EW	endemich		Carnarvon - Gascoyne Junction area
Rotala diandra			S	Cardilya Creek, Carey Downs, range extension
Family: Malvaceae				
* Malva parviflora				
Family: Marsileaceae	E1A/			
Marsilea sp.				
Family: Mimosaceae				
Eremophila oldfieldii subsp. oldfieldii Myoporum acuminatum				
Family: Myrtaceae				
Eucalyptus camaldulensis var. obtusa	R/F			
	<ul> <li>* Family: Geraniaceae Erodium cicutarium</li> <li>Family: Goodeniaceae Goodenia berardiana Goodenia i orynocarpa Goodenia maideniana Goodenia pinnatifida Velleia hispida</li> <li>Family: Haloragaceae Haloragis trigonocarpa Myriophyllum decussatum</li> <li>Family: Hypoxidaceae Hypoxis occidentalis</li> <li>Family: Isoetaceae Isoetes muelleri Isoetes sp.</li> <li>Family: Juncaceae Juncus aridicola</li> <li>Juncus kraussii</li> <li>Family: Juncaginaceae Triglochin calcitrapum Triglochin centrocarpum Triglochin minutissimum Triglochin minutissimum Triglochin mucronatum</li> <li>Family: Lythraceae Ammannia baccifera</li> <li>Ammannia multiflora</li> <li>Lythrum sp. Towrana (RJC 2183) Rotala diandra</li> <li>Family: Malvaceae Abutilon sp. Lawrencia glomerata Lawrencia viridigrisea</li> <li>Malva parviflora</li> <li>Family: Marsileaceae Marsilea angustifolia Marsilea sp.</li> <li>Family: Mimosaceae Acacia aneura</li> <li>Family: Myrtaceae</li> <li>Family: Mimosaceae Acacia aneura</li> <li>Family: Myrtaceae</li> </ul>	<ul> <li>* Family: Geraniaceae Erodium cicularium</li> <li>Family: Goodeniaceae Goodenia maideniana Goodenia meigodenia Goodenia neogodenia Goodenia pinnatifida Velleia hispida</li> <li>Family: Haloragaceae Haloragis trigonocarpa Myriophyllum decussatum</li> <li>Family: Hypoxidaceae Hypoxis occidentalis</li> <li>Family: Isoetaceae Isoetes muelleri Isoetes sp.</li> <li>Family: Juncaceae Juncus aridicola</li> <li>Juncus kraussii</li> <li>Family: Juncaceae Triglochin centrocarpum Triglochin centrocarpum Triglochin mutissimum Triglochin mutorantum</li> <li>Family: Lythraceae Ammannia multiflora Lythrum sp. Towrana (RJC 2183)</li> <li>EW Rotala diandra</li> <li>Family: Malvaceae Abutilon sp. Lawrencia viridigrisea</li> <li>Malva parviflora</li> <li>Family: Marsileaceae Marsilea angustifolia Marsilea angustifolia Sp.</li> <li>Family: Mimosaceae Acacia aneura</li> <li>Family: Myoporaceae Eremophila oldfieldii subsp. oldfieldii Myeporum acuminatum</li> <li>Family: Myrtaceae</li> </ul>	<ul> <li>* Family: Geraniaceae Erodium cicutarium</li> <li>Family: Goodeniaceae Goodenia berardiana Goodenia neogoodenia Goodenia neogoodenia Goodenia neogoodenia Goodenia pinnatifida Velleia hispida</li> <li>Family: Haloragaceae Haloragis trigonocarpa Myriophyllum decussatum</li> <li>Family: Isocidentalis</li> <li>Family: Isocidentalis</li> <li>Family: Isocidentalis</li> <li>Family: Isocidentalis</li> <li>Family: Isocidentalis</li> <li>Family: Juncaceae Juncus bufonius Juncus kraussii</li> <li>Family: Juncagenae Pancius aridicola</li> <li>Juncus kraussii</li> <li>Family: Juncaginaceae Triglochin calcitrapum Triglochin mitutissimum Triglochin mitutissimum Triglochin mutronatum</li> <li>Family: Lythraceae Anmannia multiflora</li> <li>Lythrum sp. Towrana (RJC 2183)</li> <li>EW endemic<sup>A</sup> Rotala diandra</li> <li>Family: Malvaceae Abution sp. Lawrencia glomerata Lawrencia virifigrisea</li> <li>Maloa parvifloia</li> <li>Family: Marsileaceae Acacia aneura</li> <li>Family: Myoporaceae Eremophila oldfieldii subsp. oldfieldii Myoporum acuminatum</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Myoporaceae</li> <li>Family: Mytaceae</li> </ul>	* Family: Geraniaceae         Erodum cicutarium         Parnily: Goodenia berardiana         Goodenia berardiana         Goodenia berardiana         Goodenia neogoodenia         Goodenia megoodenia         Goodenia megoodenia         Goodenia neogoodenia         Goodenia neogoodenia         Goodenia neogoodenia         Goodenia pinnatifida         Velleia hispida         Family: Haloragaceae         Haloragis trigoncarpa         Myriophyllum decussatum         N         Family: Haotagaceae         Hypoxis occidentalis         N         Family: Isoetaceae         Isoetes muelleri         Isoetes sp.         Family: Juncaceae         Triglochin calcitrapum         Triglochin mutrissimum         Triglochin ateritrapun         Triglochin ventorapusea         Ammannia

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* Hordeum leporinum					3	Carunya Creek, Carey Downs
					Ν	Minilya

Aquatics	Taxon	Habitat	Endemics	Range ends	Geographic limits
	Paractaenum novae-hollandiae				
	* Parapholis incurva			Ν	Tamala, range extension
	<ul> <li>Pentaschistis airoides</li> </ul>				
	* Phalaris minor				
	* Polypogon monspeliensis		1		Laber Mard and anon
	Psammagrostis wiseana		endemic		Lake MacLeod area
	* Rostraria pumila				
	Setaria dielsii				
	Sporobolus mitchellii Tragus australianus				
	Family: Polygonaceae				
	* Emex australis				
	Muehlenbeckia cunninghamii	EW			
	Rumex crystallinus	EW			Lyndon R. and McNeill Claypan, Gascoyne R. in W
	* Rumex vesicarius				
	Family: Portulacaceae				
	Calandrinia corrigioloides				
	Calandrinia eremaea				
	Calandrinia granulifera				
	Calandrinia polyandra				
	Calandrinia ptychosperma				
	Calandrinia pumila				
	Calandrinia sp. Coolcalalaya (GJK and	EW	endemic		Coolcalalaya area
	NG 698) Calandrinia stagnensis		endenne		Coolcalalaya area
	Portulaca oleracea				
	Family: Potamogetonaceae				
Aq	Potamogeton pectinatus				
Aq	Ruppia megacarpa				
Aq	Ruppia polycarpa				
Aq	Ruppia tuberosa			N	Shark Bay
	Family: Primulaceae				
	* Anagallis arvensis				
	Samolus junceus				
	Samolus repens				
	Family: Ranunculaceae Ranunculus pumilio			N	Boolathana, range extensio
	Ranunculus sessiliflorus			N	Eurardy
	Rununcutus sessinjiotus				Earandy
	Family: Rubiaceae				
	Oldenlandia galioides	EW		S	Cardilya Creek, Carney
	Synaptantha tillaeacea				Downs, range extension
	Family: Sapindaceae Dodonaea petiolaris				
	Family: Scrophulariaceae				_
	Elacholoma hornii				Range extension
	Glossostigma diandrum	EW		N	Kennedy Range
	Glossostigma drummondii	EW		N	Doorawarrah
	Mimulus gracilis	EW		S	McNeill claypan, Gascoyne River, range extension
	Peplidium aithocheilum	EW			
	Peplidium muelleri	EW			
	Peplidium sp. C (N.T. Burbidge and				
	A. Kain 8152)	EW			

Aquatics	Taxon	Habitat	Endemics	Range ends	Geographic limits
	Stemodia florulenta	EW			
	Stemodia grossa				
	Stemodia viscosa				
	Family: Solanaceae				
	Nicotiana occidentalis				
	Solanum lasiophyllum				
	Family: Thymelaeaceae				
	Pimelea trichostachya				Range extension
	Family: Tiliaceae				
	Corchorus walcottii				
	Family: Typhaceae				
EAq	Typha domingensis				
	Family: Urticaceae				
	Parietaria debilis				
	Family: Zygophyllaceae				
	Zygophyllum ammophilum				

<sup>A</sup> A recent (August 2000) taxonomic review of the genus *Lythrum* in WA (Lepschi, 2000, *Nutysia* **13**: 273–282) has included this taxon in *Lythrum wilsonii* which is widespread across the arid and semi-arid regions of New South Wales, the Northern Territory, Queensland and South Australia.