III Vegetation and Flora

K.R. Newbey and R.J. Hnatiuk

Vegetation

The structural formations have been described and mapped at a scale of 1: 250,000 (Beard 1972, 1978). During the present survey, 166 sites were sampled using the plotless sites relevé technique. This technique, the selection of sites and the parameters recorded are detailed by the Biological Surveys Committee (1984). The sites were broadly classified on vegetation structure and plant species composition of the upper stratum into 52 types, including two vegetation complexes: Granite Complex and Breakaway Complex. The soil thickness of complexes varied from shallow to skeletal over less than a metre. The area of bare rock usually exceeded soil area. These conditions resulted in rapid changes in vegetation structure and species composition. A typical site for each vegetation type is described in Appendix I, together with relevant data on geology, landforms and soils.

Any nomenclature changes since the first report (Newbey *et al.* 1984) are indicated by a double asterisk where the name first appears in the text. Comments on the name change are at the bottom of that page. A single asterisk denotes an introduced species.

Woodlands (15-18 m) and Low Woodlands (6-9 m) were common on Undulating Plain (greenstone) and Broad Valley. Low Woodlands also occurred on Granite Exposure, Hill (banded ironstone formation) and Salt Lake Feature but were scattered. Mallees (3-6 m) were common on Sandplain and Hill (banded ironstone formation); frequent on Granite Exposure and Undulating Plain (greenstone); absent from Hill (quartz); and scattered on the remaining landforms. Tall Shrubland was the only vegetation present on Hill (quartz). It was common on Granite Exposure, Salt Lake Feature and Sandplain; and scattered on Hill (banded ironstone formation), Salt Lake Feature and Undulating Plain (greenstone). Low Shrubland was common on Saltlake Feature and rare on Breakaway. Complexes of Tall Shrubs, Low Shrubs, Perennial Grasses and Herbs occurred on Breakaway and Granite Exposure.

The occurrence of vegetation types, by landform units, is outlined below and summarized in Table 3. The correlations between geology, landforms, soils and vegetation, are shown in Table 2.

The most common trees, tall shrubs, low shrubs, perennial grasses, annuals etc. are listed for each vegetation type. For the purpose of this publication, 'annuals' includes geophytes. *Acacia aneura* (Mulga) occurred in many forms and the taxon requires detailed revision. For the purpose of this publication, it was separated into two life forms that were almost ecologically discrete in the Study Area. First is the tree form, with a variety of phyllode shapes, referred to as *'Acacia aneura'*. Second is the shrub form referred to as *'Acacia* aff. *aneura'*. Few of the species occurring in the Study Area have accepted common names,

Table 2 The Relationships between Landform units, Geology, Soils and Vegetation types

Geological Surface Ja	Ka	Landform element	Soil	Vegetation
BREAKAWAY (B)				
Tl	To(Ag)			
	Qtf	Whole landform	Gritty Loams	*E. wandoo* Low Woodland
	Qtf	Summit	Gritty Loams	*E. loxophleba* Mallee
	To(Ag)	Pediment	Sub-saline Soils	*Frankenia pauciflora* Low Shrubland
Tl	Qtf	Whole landform	Gritty Loams	Breakaway Complex
	To(Ag)	Rim & summit	Gritty Loams	Breakaway Complex
GRANITE EXPOSURE (G)				
		Outer apron	Granitic Soils	*A. lasiocalyx* Low Woodland *Allocasuarina heugeliana* Low Woodland *Casuarina cristata* ssp. *pauper* Low Woodland
Agv Agg Amv Anl Afx Agc	Qpm Ag Qpa			*E. ewartiana* Mallee *E. loxophleba* Mallee *A. acuminata* Tall Shrubland *A.* aff. *aneura* Tall Shrubland *A. jibberdingensis* Tall Shrubland *A. tetragonophylla* Tall Shrubland
		Inner apron	Granitic Soils	Granite Complex
		Thick soil sheets on exposure	Granitic Soils	Mixed Tall Shrubland
		Year-round wet drainage line	Granitic Soils	*Leptospermum erubescens* Tall Shrubland
		Shallow soil over weathered bedrock	Granitic Soils	*E. corrugata* Low Woodland *E. brachycorys* Mallee

Table 2 (cont.) The Relationships between Landform units, Geology, Soils and Vegetation types

Geological Surface Ja	Ka	Landform element	Soil	Vegetation
HILL, BIF (HI)				
Tl	Ab	Pediment	Red Sands	*A. aneura* Low Woodland
Aiw	Ab	Lower slope and pediment	Red Sands	*E. oleosa* Low Woodland
Tl, Aiw		Slopes	Red Sands	*E. ebbanoensis* Mallee
Aab, Aiw		Middle slope	Red Sands	*E. oleosa* Mallee
Tl, Aiw		Lower slope	Red Sands	*E. loxophleba* Mallee *A.* aff. *aneura* Tall Shrubland
Aab		Middle and lower slope	Red Sands	*A. quadrimarginea* Tall Shrubland
	Ab	Laterized ridge	Red Sands	*Allocasuarina acutivalvis* Tall Shrubland
Aiw		Steep upper slope	Red Sands	*Dryandra arborea* Tall Shrubland
		Low mountain range	Red Sands	*Melaleuca filifolia* Tall Shrubland
Tl		Poorly developed breakaway	Red Sands	*E. wandoo* Low Woodland
HILL, quartz (HQ)				
	Aq	Whole landform	Gritty Sands	*Allocasuarina acutivalvis* Tall Shrubland
SALT LAKE FEATURE (L)				
Qg, Qd		Dune peripheral to salt lake	Aeolian Sands	*Callitris columellaris* Low Woodland *E. foecunda* Low Woodland
	Qas	Dune peripheral to salt lake	Aeolian Sands	*E. foecunda* Mallee
Qg		Well-drained flat	Aeolian Sands	*Casuarina cristata* spp. *pauper* Low Woodland *Dodonaea angustissima* Tall Shrubland

Table 2 (cont.) The Relationships between Landform units, Geology, Soils and Vegetation types

Geological Surface Ja	Ka	Landform element	Soil	Vegetation
		Sub-saline flats	Sub-saline soils	*Cratystylis subspinescens* Low Shrubland *Dodonaea angustissima* Tall Shrubland
		Upper lake margin.....	Sub-saline Soils.....	*Eremophila miniata* Tall Shrubland
Ql	Qra	Salt lake floors and lower margins	Saline Soils	*Halosarcia* Low Shrubland
	Qrb	Choked salt lake floor....	Sub-saline Soils.....	*Melaleuca* aff. *cuticularis* Tall Shrubland
SANDPLAIN (S)				
Ts.....	Qts, Qfs	Almost flat surface.....	Deep Sands	*E. foecunda* Mallee *E. leptopoda* Mallee *E. oldfieldii* Mallee *A.* aff. *aneura* Tall Shrubland *Banksia elderiana* Tall Shrubland
	Qfs	Almost flat surface.....	Deep Sands	*Callitris preissii* spp. *verrucosa* Tall Shrubland
	To(Ag)	Almost flat surface.....	Shallow Sands	*A. aneura* Low Woodland
Ame	.....	Almost flat surface.....	Shallow Sands	*E. corrugata* Low Woodland
Tl.....	Qtg.....	Almost flat surface.....	Gravelly Sands.....	*E. leptopoda* Mallee *A.* aff. *aneura* Tall Shrubland *Allocasuarina acutivalvis* Tall Shrubland
	Qtg.....	Low rise.....	Gravelly Sands.....	*Allocasuarina campestris* ssp. *eriochlamys* Tall Shrubland
UNDULATING PLAIN, greenstone (UN)				
Qa,Qc.....	Qpa	Colluvial flat	Deep Calcareous Earths.....	*E. salmonophloia* Woodland *E. salubris* Low Woodland

Table 2 (cont.) The Relationships between Landform units, Geology, Soils and Vegetation types

Geological Surface Ja	Ka	Landform element	Soil	Vegetation
Qc.....	.....	Colluvial flat	Deep Calcareous Earths.....	*E. longicornis* Low Woodland
	Qqf	Minor drainage line.....	Deep Calcareous Earths.....	*E. transcontinentalis* Low Woodland
Aiw Aab Asa	Qqf, Ab.....	Low rises or ridges	Shallow Calcareous Earths..	*Casuarina cristata* ssp. *pauper* Low Woodland *E. clelandii* Low Woodland *E. griffithsii* Mallee
Akf	.....	Low rise.....	Shallow Calcareous Earths..	*E. corrugata* Low Woodland
Akb.....	.....	Low rise.....	Shallow Calcareous Earths..	*A. quadrimarginea* Tall Shrubland
Aab.....	.....	Low ridge.....	Shallow Calcareous Earths..	*A. acuminata* Tall Shrubland *A.* aff. *aneura* Tall Shrubland
BROAD VALLEY (V)				
Qa Qc Qz.....	Qqs Qa Qc	Valley bottom.....	Deep Calcareous Earths.....	*E. salmonophloia* Woodland
Qg.....	.....	Valley bottom.....	Deep Calcareous Earths.....	*E. clelandii* Low Woodland
Qc Qg	.....	Valley bottom.....	Deep Calcareous Earths.....	*E. corrugata* Low Woodland
Qc.....	Qqs	Valley bottom.....	Deep Calcareous Earths.....	*E. longicornis* Low Woodland *E.* Mixed Low Woodland *E. salubris* Low Woodland *E. sheathiana* Low Woodland *E. transcontinentalis* Low Woodland
Qc.....	.....	Valley bottom.....	Meta-granitic Soils.....	*E. plenissima* Low Woodland
.....	Qa.....	Valley bottom.....	Deep Calcareous Earths.....	*E. oleosa* Low Woodland
Qc Qa	Qc.....	Valley bottom.....	Deep Calcareous Earths.....	*E. loxophleba* Mallee
Qg.....	.....	Claypan.....	Red Cracking Clays.....	*E. cylindrocarpa* Mallee
			Alluvium	*Melaleuca lateriflora* Tall Shrubland

Geological Surfaces columns: Ja = Jackson (Chin & Smith 1981)
Ka = Kalgoorlie (Kriewaldt 1969)

A. = Acacia, E. = Eucalyptus

Granite surfaces are presented as a single group because the vegetation types were not specific to a particular surface.

Table 3 Distribution of vegetation types by landform units, representation in reserved areas, and adequacy of fauna sampling.

JK No	F	Association	Landform Unit B	G	HI	HQ	L	S	UN	V	Cons. W
BREAKAWAY (B)											
1	L	*Eucalyptus wandoo*	31.	...	11.	...	...	...	...	...	P
2	S	*Frankenia pauciflora*	11.	...	...	...	...	...	...	...	.
3	C	Breakaway	41.	...	...	...	...	...	...	...	.
GRANITE EXPOSURE (G)											
4	M	*Acacia lasiocalyx*	...	11.	...	...	...	...	...	...	.
5	L	*Allocasuarina heugeliana*	...	11.	...	...	...	...	...	...	.
6	M	*Eucalyptus brachycorys*	...	12.	...	...	...	...	...	...	.
7	M	*Eucalyptus ewartiana*	...	12.	...	...	...	...	...	...	.
8	M	*Eucalyptus loxophleba*	11.	21.	11*	...	...	...	...	22X	P
9	T	*Acacia acuminata*	...	22.	...	...	...	...	11.	...	.
10	T	*Acacia* aff. *aneura*	...	22*	22.	...	...	33X	11.	...	.
11	*T*	*Acacia jibberdingensis*	...	11.	...	...	...	...	...	...	P
12	T	*Acacia tetragonophylla*	...	12.	...	...	...	...	...	...	.
13	T	*Leptospermum erubescens*	...	11.	...	...	...	...	...	...	.
14	T	Mixed spp.	...	12.	...	...	...	...	...	...	P
15	C	Granite	...	21*	...	...	...	...	...	...	A
HILL, BIF (HI)											
16	L	*Acacia aneura*	...	...	11.	...	...	12.	...	...	.
17	L	*Eucalyptus oleosa*	...	...	12.	...	...	...	...	22.	.
18	M	*Eucalyptus ebbanoensis*	...	...	33X	...	...	...	...	...	.
19	M	*Eucalyptus oleosa*	...	...	22.	...	...	...	...	...	.
20	T	*Acacia quadrimarginea*	...	...	22.	...	...	...	22.	...	.
21	T	*Dryandra arborea*	...	...	21.	...	...	...	...	...	.
22	T	*Melaleuca filifolia*	...	...	13.	...	...	...	...	...	.
HILL, quartz (HQ)											
23	T	*Allocasuarina acutivalvis*	...	...	13.	43.	...	12.	...	...	P
SALT LAKE FEATURE (L)											
24	L	*Callitris columellaris*	...	...	...	...	22.	...	...	...	.
25	L	*Casuarina cristata* ssp. *pauper*	...	...	...	...	12.	...	21.	...	.

Table 3 (contd.) Distribution of vegetation types by landform units, representation in reserved areas, and adequacy of fauna sampling.

JK No	F	Association	Landform Unit B	G	HI	HQ	L	S	UN	V	Cons. W
26	L	*Eucalyptus foecunda*	...	...	...	...	22.	...	...	...	.
27	M	*Eucalyptus foecunda*	...	...	...	...	11.	22.	...	...	.
28	T	*Acacia ligulata*	...	...	...	...	11.	...	...	...	.
29	T	*Acacia lineolata*	...	...	...	...	23.	...	...	...	.
30	T	*Dodonaea angustissima*	...	...	...	...	32+	...	...	...	.
31	T	*Eremophila miniata*	...	...	...	...	22.	...	...	...	.
32	T	*Melaleuca* aff. *cuticularis*	...	...	...	...	12.	...	...	...	.
33	S	*Cratystylis subspinescens*	...	...	...	...	22.	...	...	...	.
34	S	*Haloscarcia*	...	...	...	...	52.	...	...	...	.
SANDPLAIN (S)											
35	M	*Eucalyptus leptopoda*	...	...	...	...	...	23X	...	...	.
36	M	*Eucalyptus oldfieldii*	...	...	...	...	...	23.	...	...	P
37	T	*Acacia coolgardiensis*	...	...	...	...	...	43X	...	...	A
38	T	*Allocasuarina campestris* ssp. *eriochlamys*	...	...	...	...	...	11.	...	...	.
39	T	*Banksia elderana*	...	...	...	...	...	22X	...	...	.
40	T	*Callitris preissii* ssp. *verrucosa*	...	...	...	...	...	12.	...	...	.
UNDULATING PLAIN, greenstone (UN)											
41	L	*Eucalyptus clelandii*	...	...	...	...	...	...	42.	12.	.
42	L	*Eucalyptus corrugata*	...	11.	...	...	...	11X	32.	21.	.
43	M	*Eucalyptus griffithsii*	...	...	...	...	...	...	12.	...	.
BROAD VALLEY (V)											
44	W	*Eucalyptus salmonophloia*	...	...	...	...	...	...	32X	43X	A
45	L	*Eucalyptus longicornis*	...	...	...	...	...	...	22.	32.	.
46	L	*Eucalyptus* mixed	...	...	...	...	...	...	...	14.	.
46	L	*Eucalyptus plenissima*	...	...	...	...	...	...	...	11.	.
48	L	*Eucalyptus salubris*	...	...	...	...	...	...	42X	42.	A
49	L	*Eucalyptus sheathiana*	...	...	...	...	...	...	12.	...	P
50	L	*Eucalyptus transcontinetalis*	...	...	...	...	...	...	11.	32.	.

Table 3 (contd.)

51	M	*Eucalyptus cylindrocarpa*	...	...	...	...	...	...	...	12.
52	T	*Melaleuca lateriflora*	...	...	...	...	...	...	12.	...
		Fauna surveys	.	M	M	.	M	A	M	M
		Approx. % of Study Area	T	2	1	T	5	31	7	54

Vegetation types are listed in the order of their names in Appendix I.

F = Vegetation formation
C = Complex, L = Low Woodland (<15 m), M = Mallee, T = Tall Shrubland (>1 m),
S = Low Shrubland (<1 m), W = Woodland (>15 m)

Landform Unit
B = Breakaway, G = Granite Exposure, HI = Hill, BIF, HQ = Hill, quartz,
L = Salt Lake Features, S = Sandplain, UN = Undulating Plain (greenstone), V = Broad Valley.

Three attributes are presented:
(1) Abundance – . = absent, 1 = rare, 2 = scattered, 3 = frequent, 4 = common
(2) Average size of individual areas – . = absent, 1 = <1 ha, 2 = 2-5 ha, 3 = 6-50 ha, 4 = >50 ha.
(3) Fauna sampled: . = no, X = yes, * = part of sample site,
+ = equivalent to *Cratystylis subspinescens* Low Shrubland in other Study Area reports.

Cons. = Conservation areas W = Walyahmoning Rock Nature Reserve

Representation of vegetation type: . = absent, P = poor, A = adequate

Fauna surveys (adequacy): . = absent, M = moderate, A = adequate

T = <0.1%

but where they are known they are listed where the species first occurs in the text.

Breakaway (B): Most of the breakaways supported *Eucalyptus wandoo* Low Woodland on the scree slope and nearby sections of the pediment. Breakaway Complex commonly occurred on pockets of soil on the rim, and skeletal to shallow soil sheets on the summit. *Eucalyptus loxophleba* Mallee was occasionally present on shallow soil sheets. The pediment of one Breakaway in the north-eastern sector was sub-saline and supported *Frankenia pauciflora* Low Shrubland. The annuals *Blennospora drummondii* and *Myriocephalus gracilis* were present in most vegetation types and are not listed below.

Growing with *Eucalyptus wandoo* (Wandoo) were tall shrubs that included *Acacia acuminata* (Jam), *Dodonaea inaequifolia, Eremophila oppositifolia* and *Melaleuca uncinata* (Broombush). *Eremophila oldfieldii* was present in the northern sector, and *A. densiflora* and *M. lateriflora* in the south-western sector. Also present were low shrubs of *A. erinacea, A. hemiteles* and *Alyxia buxifolia. Ptilotus helichrysoides* was the dominant shrub present on some of the taller and steeper scree slopes in the eastern sector. *Eremophila drummondii* was common in the south-western sector. Annuals present included **Aira caryophyllea, Calocephalus angianthoides, Helipterum laeve* and *Helipterum* sp. (KRN 7727).

The main tall shrubs present in Breakaway Complex were *Acacia acuminata, A. tetragonophylla, Allocasuarina acutivalvis, Eriostemon brucei* ssp. *brucei, Hakea recurva* and *Melaleuca leiocarpa.* The low shrubs included *Acacia andrewsii* and *Dodonaea inaequifolia. Grevillea haplantha* occured in the southern sector, and *Baeckea carnosa* and *Wrixonia prostantheroides* in the south-western sector. Many annual species were present – the most common being *Actinobole uliginosum, *Aira caryophyllea, Helipterum hyalospermum, H. laeve* and *Millotia myosuroides. Rutidotis multiflora* occurred in the south-western sector. *Cheilanthes* sp. (KRN 7046) was a common small fern.

Tall shrubs with *E. loxophleba* (York Gum) were *Acacia acuminata, Dodonaea angustissima, Eremophila gibbosa* and *Eriostemon brucei* ssp. *brucei;* and low shrubs of *Prostanthera grylloana.* With *Frankenia pauciflora* were the annuals, *Brachycome perpusilla, B. pusilla, Chthonocephalus pseudevax, Gnephosis burkittii* and *Pogonolepis stricta.*

Granite Exposure (G): Granite Complex of annuals and low shrubs was present on skeletal sheets of Granitic Soils on Granite Exposure, and on the same skeletal soil of the inner apron. Thicker soil sheets on the exposure supported Mixed spp. Tall Shrubland. The vegetation on the deep Granitic Soils of the outer apron varied from south to north. In the south were *Eucalyptus loxophleba* Mallee, *Acacia acuminata* Tall Shrubland and occasionally *Allocasuarina huegeliana* Low Woodland. In some places, the outer apron butted onto the outcrop and received additional run-off. In these places, *Acacia lasiocalyx* Low Woodland or *A. jibberdingensis* Tall Shrubland usually occurred. A drainage line from Wallaroo Rock received year-round seepage from a dam constructed for the

Woodline, and supported dense *Leptospermum erubescens* Tall Shrubland. In the central and northern sectors, *A.* aff. *aneura* Tall Shrubland was the main vegetation on the outer apron. *A. tetragonophylla* Tall Shrubland was present in the north-eastern sector and *Eucalyptus ewartiana* Mallee in the central sector.

In a few places of small area, the underlying granite bedrock was within 1 m of the soil surface but did not outcrop. Granitic Soils were present and supported *Casuarina cristata* ssp. *pauper* Low Woodland or *Eucalyptus corrugata* Low Woodland. *Eucalyptus brachycorys* Mallee was only recorded in the north-eastern sector.

Granite Complex consisted mainly of annuals but an occasional shrub was present. Tall shrubs included *Kunzea pulchella* and *Persoonia coriacea.* Common small shrubs were *Stackhousia huegelii, Isotoma petraea* and *Solanum lasiophyllum.* The most common annuals were *Actinobole uliginosum, *Aira caryophyllea, Chrysocoryne pusilla, Crassula exserta, Goodenia havilandii, Helipterum australe, Hyalochlamys globifera, *Pentaschistis airoides* and *Toxanthes perpusillus. Drosera andersoniana, Quinetia urvillei* and *Rutidosis multiflora* occurred in the southern sector. Ferns were small and included *Cheilanthes lasiophylla, C. austrotenuifolia,** *C.* sp. (KRN 7046) and *Pleurosorus rutifolia.* Aquatics were present in deeper pools and included *Glossostigma drummondii, G. trichodes* and *Isoetes australis.*

The main shrubs in Mixed spp. Tall Shrubland were *Acacia tetragonophylla, Calothamnus quadrifidis, Calycopeplus ephedroides, Kunzea pulchella* and *Thryptomene australis;* low shrubs were sparse; and annuals included *Chrysocoryne pusilla* and *Trachymene ornata.*

Growing with *Eucalyptus loxophleba* were tall shrubs of *Acacia acuminata, Dodonaea inaequifolia* and *Melaleuca uncinata. A.* aff. *aneura* was often present in the northern sector and *A. densiflora* in the south-western sector. Low shrubs present usually included *Eriostemon brucei* ssp. *brucei, Olearia muelleri* and *Cassia nemophila* var. *nemophila. A. hemiteles* occurred in the southern sector. Main annuals were *Chthonocephalus pseudevax, Chrysocoryne pusilla, Myriocephalus gracilis* and *Pentaschistis airoides;* and perennial grasses were *Stipa trichophylla* and *Triodia scariosa.*

Other tall shrubs growing with *Acacia acuminata* included *Hakea recurva, Melaleuca uncinata* and *Santalum spicatum* (Sandalwood); low shrubs were sparse; annuals included *Chrysocoryne pusilla, Chthonocephalus pseudevax, Podolepis lessonii* and *Waitzia acuminata;* the perennial grass, *Spartochloa scirpoidea* and sedge, *Lepidosperma viscidum* were present. Tall shrubs of *Melaleuca fulgens* and *Thyptomene australis* were often present in the southern sector.

Under *Allocasuarina huegeliana* (Granite Sheoak) were few shrubs. *Persoonia coriacea* was the common tall shrub. Annuals included *Aira caryophyllea, Calocephalus francisii, Millotia tenuifolia, Podotheca angustifolia* and *Trachymene ornata.*

A dense upper stratum of *Acacia lasiocalyx* (canopy cover = 75%) limited the

**Listed as *Cheilanthes tenuifolia* in the previous report (Newbey *et al.* 1984).

understory. Present were tall shrubs of *Kunzea pulchella;* annuals were *Drosera andersoniana* and *D. subhirtella* ssp. *moorei;* and the sedge *Lepidosperma resinosum.* This vegetation occurred in belts that rarely exceeded 12 m in width.

Other tall shrubs growing with *Acacia jibberdingensis* were *A. lasiocalyx, A. neurophylla, A. assimilis* and *Grevillea paniculata;* low shrubs *A. restiacea* and *Stypandra imbricata;* the climber, *Comesperma volubile;* and parasitic climber, *Cassytha glabella.*

Other tall shrubs growing with *Leptospermum erubescens* were *Acacia lasiocalyx, Kunzea pulchella* and *Melaleuca eleuterostachya;* and the annuals, **Aira caryophyllea, Drosera subhirtella* ssp. *moorei, Hydrocotyle callicarpa, Rutidosis multiflora* and *Gonocarpus nodulosus.* Growing in a waterlogged area were *Isolepis congrua, *Juncus bufonius* and *Schoenus odontocarpus.*

Growing with *Acacia* aff. *aneura* were other tall shrubs of *A. tetragonophylla, A. acuminata, Melaleuca uncinata* and *Santalum spicatum;* low shrubs of *Baeckea maidenii, Mirbelia depressa* and *Solanum lasiophyllum;* the annuals, *Chrysocoryne pusilla, Helipterum roseum, Millotia tenuifolia, Schoenia cassiniana, Velleia rosea* and *Waitzia acuminata;* and the perennial grasses, *Danthonia caespitosa, Monachather paradoxa* and *Triodia scariosa.*

Under *Acacia tetragonophylla* were low shrubs of *Solanum nummularium;* and annuals of *Chrysocoryne pusilla. Chthonocephalus pseudevax, Calocephalus angianthoides, C. francisii* and **Pentaschistis airoides.*

Tall shrubs growing with *Eucalyptus ewartiana* included *Acacia* aff. *aneura* and *A. coolgardiensis* (a form); low shrubs of *Olearia propinqua;* the annuals, *Myriocephalus gracilis* and *Podolepis lessonii;* and the perennial grasses, *Enneapogon* sp. (KRN 7755) and *Monachather paradoxa.*

Under *Casuarina cristata* ssp. *pauper* were tall shrubs of *Acacia acuminata, A.* aff. *aneura* and *Alyxia buxifolia;* low shrubs of *Grevillea acuaria, Olearia muelleri* and *Scaevola spinescens;* and the perennial grass, *Stipa eremophila.*

Growing with *Eucalyptus corrugata* were low trees of *Casuarina cristata* ssp. *pauper;* tall shrubs of *Santalum spicatum;* low shrubs of ***Atriplex nummularia* ssp. *spathulata* (Old Man Saltbush) and *Olearia muelleri;* and the annuals, *Cephalipterum drummondii, Gnephosis skirrophora* and *Myriocephalus gracilis.*

Tall shrubs growing with *Eucalyptus brachycorys* were *Acacia acuminata* and *A. prainii;* the annual, *Waitzia acuminata;* and the perennial grasses, *Amphipogon* aff. *strictus* and *Triodia scariosa.*

***Hill** (banded ironstone formation)*(HI): Each hill or range had its own set of vegetation types which occurred on Red Sands that were skeletal on steep slopes, shallow on erosional upper slopes, and deeper on colluvial lower slopes, pediment and subdued small foothills. On the Aurora Range, the steep slopes supported *Dryandra arborea* Tall Shrubland, upper and lower slopes supported *Eucalyptus ebbanoensis* Mallee, and *Acacia aneura* Low Woodland occurred on the pediment. Near the crest of the range, a small area of banded ironstone had

**Listed as *Atriplex nummularia* in the previous report (Newbey *et al.* 1984).

been highly laterized and supported *Eucalyptus wandoo* Low Woodland. The nearby Helena Range was only sampled on the eastern end where *Melaleuca filifolia* Tall Shrubland was present. *Eucalyptus ebbanoenis* Mallee covered Mt Jackson. Unnamed peaks, 7 km north of Windarling Peak, supported *Dryandra arborea* Tall Shrubland on steeper slopes, *Acacia* aff. *aneura* Tall Shrubland on middle and lower slopes, and *Eucalyptus oleosa* Low Woodland on subdued foothills. Only one Hill (banded ironstone formation), was sampled in the mainly greenstone Highclere Hills. Upper and lower slopes supported *Eucalyptus oleosa* Mallee, while *Eucalyptus loxophleba* Mallee was present on a small foothill. Stony slopes of the Koolyanobbing Range supported *Acacia quadrimarginea* Tall Shrubland while *Eucalyptus oleosa* Mallee occurred on gentler slopes with a thicker covering of soil. A small section of a steep slope near the crest was laterized and supported *Eucalyptus wandoo* Low Woodland. A section of a lower scree slope had become laterized and supported *Acacia quadrimarginea* Tall Shrubland. The upper slopes of Mt Finnerty supported *Allocasuarina acutivalvis* Tall Shrubland and on the lower slopes *Eucalyptus oleosa* Low Woodland. *Dryandra arborea* Tall Shrubland was seen on one 10 m high banded ironstone formation ridge in the Weld Range but not sampled. *Eriostemon brucei* ssp. *brucei* was present as a tall shrub in most vegetation types and is not listed below.

Growing with *Dryandra arborea* were other tall shrubs of *Acacia quadrimarginea, Calycopeplus ephedroides, Melaleuca leiocarpa* and *Grevillea obliquistigma;* low shrubs of *Ptilotus obovatus* var. *obovatus;* annuals *Blennospora drummondii, *Erodium cicutarium, Helipterum laeve, H. strictum* and *Waitzia acuminata;* and the perennial grasses *Plectrachne* sp. (KRN 5925) and *Stipa trichophylla.* The annual, *H. battii* occurred on the hills north of Windarling Peak.

Tall shrubs occurring with *Eucalyptus ebbanoensis* were *Calycopeplus ephedroides, Dryandra arborea, Eremophila oppositifolia,* and *Melaleuca leiocarpa;* low shrubs of *Allocasuarina campestris* ssp. *campestris* and *Jacksonia* sp. (KRN 9302); the annuals, *Blennospora drummondii, Gilruthia osbornii, Helipterum fitzgibbonii, H. roseum, Millotia myosuroides* and *Waitzia acuminata;* and the perennial grasses, *Plectrachne* sp. (KRN 5925), *Stipa elegantissima* and *S. eremophila.*

Occurring in *Acacia aneura* Low Woodland were tall shrubs of *A. tetragonophylla, Eremophila alternifolia* and *Dodonaea lobulata;* low shrubs of *Prostanthera campbellii* and *P. grylloana;* and the annuals, *Bellida graminea, Helipterum roseum, H. strictum* and *Podolepis canescens.*

Eucalyptus wandoo Low Woodland had few shrubs and the only common annuals were *Helipterum pygmaeum* and *Trachymene ornata.*

Melaleuca filifolia Tall Shrubland included mallees of *Eucalyptus oleosa* and *E. ebbanoensis;* tall shrubs of *Acacia* aff. *aneura, Calycopeplus ephedroides, Grevillea obliquistigma* and *G.* sp. (KRN 9646); low shrubs of *Baeckea elderiana;* and the annuals, *Bellida graminea, Helichrysum lindleyi, Millotia myosuroides* and *Myriocephalus gracilis.*

Other tall shrubs growing in *Acacia* aff. *aneura* Tall Shrubland were *A. quadrimarginea, A. tetragonophylla* and *Eremophila oldfieldii;* low shrubs of *Ptilotus obovatus* var. *obovatus;* and the annuals, *Helipterum battii, H. roseum, Millotia tenuifolia, Myriocephalus gracilis* and *Waitzia acuminata.*

Growing in *Eucalyptus oleosa* Low Woodland were tall shrubs of *Acacia* aff. *aneura, Allocasuarina acutivalvis, Eremophila oldfieldii* and *Melaleuca leiocarpa;* low shrubs of *E. latrobei; Hibbertia pungens sens. lat.* and *Olearia stuartii;* and the annuals, *Gilruthia osbornii, Helipterum strictum, H. roseum, Millotia myosuroides, M. tenuifolia* and *Waitzia acuminata.*

Eucalyptus oleosa Mallee sometimes included mallees of *E. loxophleba.* Usually present were tall shrubs of *Acacia acuminata, A. quadrimarginea, Allocasuarina acutivalvis, Dodonaea inaequifolia* and *Grevillea obliquistigma;* low shrubs of *Scaevola spinescens, Hibbertia pungens sens. lat.* and *Ptilotus obovatus* var. *obovatus;* and the annuals, *Erodium crinitum, Gilruthia osbornii, Helipterum roseum, Trachymene ornata, Velleia rosea* and *Waitzia acuminata.*

Growing with *Eucalyptus loxophleba* were tall shrubs of *Acacia acuminata, A. tetragonophylla, Brachychiton gregori* and *Dodonaea inaequifolia;* low shrubs of *Olearia propinqua;* and the annual *Waitzia acuminata.*

Other tall shrubs growing with *Acacia quadrimarginea* included *A.* aff. *aneura, Allocasuarina acutivalvis, A. campestris* ssp. *campestris, Grevillea obliquistigma;* low shrubs of *Hemigenia divaricata* and *Hibbertia* sp. (KRN 8736); and the annuals, *Helipterum roseum, Myriocephalus gracilis* and *Trachymene ornata.*

Growing with *Allocasuarina acutivalvis* was an occasional mallee of *E. griffithsii;* tall shrubs of *Eremophila gibbosa, E. oppositifolia, Melaleuca leiocarpa;* low shrubs of *Hibbertia pungens;* and the annuals, *Helipterum laeve, H. roseum, Millotia tenuifolia, Myriocephalus gracilis* and *Trachymene ornata.*

***Hill** (quartz)* (HI): The middle and upper slopes of Mt Walter supported *Allocasuarina acutivalis* Tall Shrubland on Gritty Sands. The main species present were: mallees of *Eucalyptus loxophleba* and *E. petraea;* other tall shrubs of *Acacia acuminata, Allocasuarina campestris* ssp. *campestris, Eriostemon brucei* ssp. *brucei* and *Grevillea obliquistigma;* low shrubs of *Hibbertia glomerosa, Stypandra imbricata* and *Thryptomene australis;* the annuals, *Helipterum laeve, Millotia myosuroides, *Pentaschistis airoides, Trachymene ornata* and *Waitzia acuminata;* and the sedge *Lepidosperma* sp. (KRN 9039).

Salt Lake Feature (L): Each lake system had its own set of vegetation types. *Halosarcia* Low Shrubland was common to all. It occurred on Saline Soils on floors of small salt lakes and as a narrow strip around the margin of larger salt lakes. The floors of large salt lakes were bare. On the aeolian flats of the Hamersley Lake system, three vegetation types occurred on Aeolian Sands. The well-drained flats supported *Casuarina cristata* ssp. *pauper* Low Woodland on Aeolian Sands. Slightly lower in the landscape were flats with a similar soil but with a sandier A horizon. They supported *Dodonaea angustissima* Tall Shrubland. The

most extensive flats were 50-60 cm above the salt lake floors and had slightly saline Aeolian Sands supporting *Acacia lineolata* Tall Shrubland. The sub-saline flats supported *Cratystylis subspinescens* Low Shrubland.

Peripheral lake dunes were well developed and common in the Lake Deborah system. Dunes of Aeolian Sands 3-10 m high supported either *Callitris columellaris* Low Woodland or *Eucalyptus foecunda* Low Woodland, Lower dunes and thick aeolian sand sheets supported *Eucalyptus foecunda* Mallee. Well-drained and thinner soil sheets supported mainly *Dodonaea angustissima* Tall Shrubland, with *Acacia ligulata* Tall Shrubland in a few places. Some low dunes consisted of Aeolian Loams and supported *Eremophila miniata* Tall Shrubland. *Acacia lineolata* Tall Shrubland and *Cratystylis subspinescens* Low Shrubland were present in the same landscape positions as on the Lake Hamersley system.

Only a small portion of the Lake Walton system was sampled. *Eucalyptus foecunda* Mallee occurred on thick sheets of Aeolian Sands and *Melaleuca* aff. *cuticularis* Tall Shrubland on a salt lake choked by colluvium and alluvium.

Halosarcia Low Shrubland consisted mainly of three to six species of this genus. The most common species were *H. doleiformis, H. halocnemoides* ssp. *halocnemoides, H. indica* ssp. *bidens* and *H. undulata.* Other species recorded were *H. lylei, H. peltata* and *H. pergranulata* ssp. *pergranulata.* Other low shrubs were ****Disphyma crassifolium, Frankenia brachyphylla, F. desertorum* and *Maireana glomerifolia;* and the annuals, ****Atriplex holocarpa, Brachycome* sp. (KRN 8696), *Gunniopsis septifraga* and *Hyalochlamys globifera.*

Growing under *Casuarina cristata* ssp. *pauper* were tall shrubs of *Dodonaea angustissima* and *Eremophila scoparia;* low shrubs of ****Atriplex vesicaria* ssp. *variabilis, E. decipiens, Lepidium platypetalum* and *Rhagodia crassifolia;* annuals, *Helipterum splendidum* and **Pentaschistis airoides;* and the perennial grass *Stipa scabra.*

Other tall shrubs growing with *Dodonaea angustissima* were *Acacia acuminata, A. lineolata, Bossiaea walkeri* and *Eremophila miniata;* low shrubs were *Atriplex vesicaria* ssp. *variabilis, Cratystylis subspinescens, Grevillea acuaria, Lycium australe, Rhagodia crassifolia* and *R. drummondii;* annuals, **Aira caryophyllea, Cephalipterum drummondii, Helipterum roseum, Hydrocotyle pilifera* var. *glabrata, Plantago debilis* and *Pogonolepis stricta;* and perennial grasses, *Aristata contorta* and *Stipa eremophila.*

Occurring with *Acacia lineolata* were other tall shrubs of *Eremophila scoparia, Exocarpos aphyllus* and *Lycium australe;* low shrubs of *Atriplex vesicaria* ssp. *variabilis, Cratystylis subspinescens, Rhagodia drummondii* and *Sclerostegia disarticulata;* and the annuals, *Helipterum pygmaeum, H. splendidum, *Lophochloa pumila, *Mesembryanthemum nodiflorum, Pogonolepis stricta* and **Vulpia myuros.*

**Listed as *Disphyma clavellatum* in the previous report (Newbey *et al.* 1984).
**Listed as *Atriplex spongiosa* in the previous report (Newbey *et al.* 1984).
**Listed as *Atriplex vesicaria* in the previous report (Newbey *et al.* 1984).

Growing in *Cratystylis subspinescens* Low Shrubland were occasional tall shrubs of *Acacia lineolata* and *Dodonaea subspinescens;* low shrubs of *Atriplex vesicaria* ssp. *variabilis* and *Rhagodia drummondii;* annuals, *Helipterum* sp. (KRN 7727), *Maireana carnosa* and *Podolepis capillaris;* and the perennial grass, *Stipa eremophila.*

Mallees of *Eucalyptus corrugata* were sometimes present under *Callitris columellaris.* Common tall shrubs were *Acacia quadrimarginea, Dodonaea angustissima, Eremophila miniata* and *Templetonia smithiana;* low shrubs of *Rhagodia drummondii;* annuals, *Blennospora drummondii, Brachycome perpusilla, Calocephalus angianthoides, Helipterum pygmaeum, Podotheca gnaphalioides* and *Ptilotus polystachyus;* and the perennial grass *Aristida contorta.*

Tall shrubs in *Eucalyptus foecunda* Low Woodland included *Acacia* aff. *aneura, A. ligulata, Dodonaea angustissima* and *Eremophila miniata;* low shrubs of *Rhagodia crassifolia* and *R. drummondii;* and the annuals, **Brassica tournefortii, Toxanthes perpusillus* and **Vulpia myuros.*

Eucalyptus foecunda Mallee had few dominant species: tall shrubs of *Acacia* cf. *densiflora* and *Melaleuca uncinata;* and low shrubs of *Grevillea* aff. *concinna.*

Acacia ligulata Tall Shrubland had few species and dominants. Other tall shrubs were *A.* aff. *aneura* and *Dodonaea angustissima;* low shrubs of *Rhagodia drummondii;* and the annual, **Brassica tournefortii.*

The main tall shrubs growing with *Eremophila miniata* were *Dodonaea angustissima, Hakea arida* and *Jacksonia* sp. (KRN 9046); low shrubs of *Calytrix leschenaultii, Crenidium spinescens* and *Rhagodia drummondii;* and the annuals, *Calocephalus angianthoides, Helipterum hyalospermum, *Pentaschistis airoides* and *Podotheca gnaphalioides.*

Under *Melaleuca* aff. *cuticularis* were low shrubs of *Frankenia cinerea, Halosarcia indica* ssp. *bidens, H. pergranulata* ssp. *pergranulata* and *Maireana glomerifolia;* annuals, *Atriplex holocarpa, Calocephalus angianthoides* and *Chrysocoryne pusilla;* and the perennial grass, *Stipa scabra.*

Sandplain (S): The greater parts of Sandplain were covered with Deep Sands. *Eucalyptus leptopoda* Mallee, *Acacia coolgardiensis* Tall Shrubland and *Acacia* aff. *aneura* Tall Shrubland were common. The first two vegetation types tended to be slightly more common in southern and central areas. *Eucalyptus foecunda* Mallee and *Banksia elderana* Tall Shrubland were confined to these areas, and *Eucalyptus oldfieldii* Mallee tended to replace *Eucalyptus leptopoda* Mallee in the south-western sector. The Deep Sands of one small south-eastern area had been formed into low dunes during a Recent arid period and now supported *Callitris preissii* ssp. *verrucosa* Tall Shrubland. Less common on the Sandplains were small areas of Gravelly Sands, usually on slight rises in the landscape. *Allocasuarina acutivalvis* Tall Shrubland was usually present but *Allocasuarina campestris* ssp. *eriochlamys* Tall Shrubland occurred in the north-eastern sector. Near the northern boundary, Gravelly Sands occurred on flat Sandplain and supported *Acacia aneura* Low Woodland. A major portion of the soil's gravel

content was colluvial banded ironstone. Rare small areas of Shallow Sands supported *Eucalyptus corrugata* Low Woodland.

The main tall shrubs growing with *Eucalyptus leptopoda* were *Allocasuarina acutivalvis, Grevillea didymobotrya, G. nematophylla* and *Leptospermum roei.* Low shrubs varied from *Conospermum stoechadis* and *Wehlia thryptomenoides* in the south, to *Calytrix birdii* and *Thryptomene aspera* in the north. *Phebalium canaliculatum* was widespread. The main perennial grasses were *Triodia scariosa* and *Amphipogon* aff. *strictus.* The sedges *Lepidobolus preissianus* and *Chrysitrix distigmatosa* also occurred, the latter in more southern areas.

Growing with *Acacia coolgardiensis* were other tall shrubs including *Grevillea filifolia, Hakea minyma* and *Phebalium filifolium. Callitris preissii* ssp. *verrucosa* and *Hakea francisiana* were present in the southern sector. The main low shrubs were *Baeckea maidenii, Thryptomene aspera, T. urceolata. Melaleuca cordata* was more common in southern areas while *Eriostemon tomentosus* occurred mainly in the north. Present were the annuals *Helipterum laeve, Schoenia cassiniana* and *Waitzia acuminata;* the perennial grasses, *Triodia scariosa* and *Danthonia caespitosa;* and the sedge, *Lepidosperma viscidum.*

Growing in *Acacia* aff. *aneura* Tall Shrubland was an occasional mallee of *Eucalyptus leptopoda* or *E. loxophleba.* Other tall shrubs were *Grevillea obliquistigma, Hakea minyma* and *Phebalium canaliculatum. Grevillea petrophiloides* (a form) and *Allocasuarina campestris* ssp. *eriochlamys* occurred in the north-eastern sector. Low shrubs included *Baeckea elderiana, Eremophila granitica, Leucopogon* sp. (KRN 6954) and *Prostanthera grylloana.* The main annuals were *Chrysocoryne pusilla, Helipterum roseum, Myriocephalus gracilis, Schoenia cassiniana, Velleia rosea* and *Waitzia acuminata.* Perennial grasses were *Amphipogon* aff. *strictus* and *Danthonia caespitosa.*

The main tall shrubs present with *Eucalyptus foecunda* were *Acacia signata, Allocasuarina corniculata* and *Leptospermum roei. Grevillea excelsior* occurred in some southern areas. Low shrubs included *Baeckea maidenii, Beaufortia* sp. (KRN 9247), *Melaleuca* aff. *leptospermoides* and *Petrophile* sp. (KRN 8756). The perennial grass *Triodia scariosa* and the sedges *Lepidobolus preissianus* and *Schoenus brevisetis* also occurred.

Growing with *Banksia elderana* were tall shrubs of *Grevillea filifolia;* low shrubs of *Calytrix cresswellii, Conospermum stoechadis* and *Pachnema junceum;* the perennial grass, *Triodia scariosa;* and sedges, *Lepidobolus preissianus* and *Lepidosperma resinosum.*

Present with *Eucalyptus oldfieldii* were tall shrubs of *Acacia signata, Baeckea elderiana* and *Callitris preissii* ssp. *verrucosa;* and low shrubs of *Baeckea maidenii, Melaleuca cordata, Phebalium tuberculosum* ssp. *megaphyllum* and *Thryptomene kochii.*

Tall shrubs growing with *Callitris preissii* ssp. *verrucosa* included *Allocasuarina corniculata, Calothamnus gilesii, Grevillea didymobotrya* and *Leptospermum roei;* low shrubs were *Banksia audax, Conospermum stoechadis, Petrophile ericifolia* var. *scabriuscula* and *Verticordia roei.* Also associated were the peren-

nial grass, *Triodia scariosa;* and the sedges, *Lepidobolus preissianus, Mesomelaena preissii* and *Schoenus brevisetis.*

Present with *Allocasuarina acutivalvis* were other tall shrubs of *Allocasuarina campestris* ssp. *campestris, Grevillea filifolia, Leptospermum roei* and *Melaleuca uncinata;* low shrubs of *Calothamnus gilesii, Grevillea paradoxa, Melaleuca cordata* and *Prostanthera semiteres* ssp. *semiteres;* perennial grasses, *Enneapogon* sp. (KRN 7755) and *Triodia scariosa;* and the sedges, *Lepidobolus preissianus* and *Schoenus brevisetis.*

Acacia coolgardiensis and *Calothamnus gilesii* were the main tall shrubs with *Allocasuarina campestris* ssp. *eriochlamys.* Also present were the perennial grasses, *Amphipogon* aff. *strictus* and *Triodia scariosa.*

The main tall shrubs in *Acacia aneura* Low Woodland were *A. acuminata, A.* aff. *aneura* and *A. prainii* var. *prainii;* low shrubs were *Eremophila granitica* and *Prostanthera baxteri;* and the annuals were *Bellida graminea, Blennospora drummondii, Gilruthia osbornii, Helipterum roseum, Velleia rosea* and *Waitzia acuminata.* The perennial grass *Danthonia caespitosa* also occurred.

Mallees of *Eucalyptus loxophleba* occurred in *E. corrugata* Low Woodland, as well as tall shrubs of *Acacia acuminata* and *Eremophila oldfieldii;* low shrubs of *Acacia erinacea;* the annuals, *Gilruthia osbornii* and *Myriocephalus gracilis;* and the perennial grass, *Plectrachne* sp. (KRN 5925).

Undulating Plain *(greenstone)* (UN): Each major greenstone area had its own set of vegetation types. The soils on stony ridges and rises were Shallow Calcareous Earths, and Deep Calcareous Earths occurred on the colluvial flats. The Callion area had *Eucalyptus clelandii* (Cleland's Blackbutt) Low Woodland on the low and stony ridges, and *Eucalyptus salmonophloia* Woodland and *Eucalyptus salubris* Low Woodland on colluvial flats between the ridges. A small area of *Eucalyptus transcontinentalis* (Redwood) Low Woodland was noted on a minor drainage line where a thin covering of alluvium had accumulated. The Jaurdi area had a similar set of vegetation types. Absent was *Eucalyptus transcontinentalis* Low Woodland but *Eucalyptus griffithsii* (Griffith's Grey Gum) Mallee occurred occasionally on low stony rises.

Low Woodlands of both *Eucalyptus clelandii* and *Casuarina cristata* ssp. *pauper* occurred on low stony ridges in the Mt Jackson area. *Eucalyptus salubris* Low Woodland was present on the colluvial flats. The Highclere Hills supported mainly *Eucalyptus corrugata* Low Woodland on low stony ridges, and *Eucalyptus salmonophloia* Woodland and *Eucalyptus salubris* Low Woodland on the colluvial flats. Occurring rarely were shrublands of both *Acacia acuminata* and *A.* aff. *aneura* on stony rises, and *Eucalyptus longicornis* Low Woodland on colluvial flats where the soil pH exceeded 8.2.

During a single crossing of the low and narrow Weld Range, *Eucalyptus clelandii* Low Woodland was observed on the ridges and *Eucalyptus salubris* Low Woodland on the colluvial flats. The Koolyanobbing Range consisted mainly of banded ironstone formation, but also present were a few low and stony green-

stone ridges and they supported *Acacia quadrimarginea* Tall Shrubland. The annual *Cephalipterum drummondii* was present in most vegetation types, a species not listed below.

Present with *Eucalyptus clelandii* were mallees of *E. celastroides;* tall shrubs of *Acacia tetragonophylla, Dodonaea lobulata, Eremophila alternifolia* and *E. ionantha;* low shrubs of *Atriplex vesicaria* ssp. *variabilis, Olearia muelleri* and *Maireana radiata;* annuals, *Angianthus tomentosus, Helipterum strictum* and *Zygophyllum ovatum;* and a perennial grass, either *Stipa eremophila* or *S. trichophylla.*

Growing under *Eucalyptus salmonophloia* (Salmon Gum) were tall shrubs of *Atriplex nummularia* ssp. *spathulata* and *Eremophila scoparia. Maireana sedifolia* was present near the eastern boundary. Low shrubs included *Atriplex vesicaria* ssp. *variabilis, Olearia muelleri, Rhagodia drummondii* and *Sclerolaena diacantha.* The main annuals were **Erodium cicutarium, E. crinitum, Gnephosis skirrophora* and *Pogonolepis stricta.* The perennial grass *Stipa trichophylla,* was present.

Under *Eucalyptus salubris* (Gimlet) were tall shrubs of *Atriplex nummularia* ssp. *spathulata;* low shrubs of *A. vesicaria* ssp. *variabilis, Maireana triptera* and *Sclerolaena diacantha;* annuals, *Erodium crinitum, Helipterum pygmaeum, H. roseum, H.* sp. (KRN 7727) and **Lophochloa pumila;* and the perennial grass, *Stipa trichophylla.*

Tall shrubs growing with *Eucalyptus transcontinentalis* were *Acacia acuminata, A. tetragonophylla* and *Cassia nemphila* var. *nemophila;* low shrubs were *Atriplex vesicaria* ssp. *variabilis* and *Rhagodia crassifolia.*

Tall shrubs present with *Eucalyptus griffithsii* included *Alyxia buxifolia, Eremophila interstans, Santalum acuminatum* (Quondong) and *S. spicatum;* low shrubs were *Dodonaea stenozyga, E. scoparia, Grevillea acuaria, Scaevola spinescens* and *Templetonia sulcata;* and annuals were *Asteridea athrixioides* and *Gnephosis skirrophora.*

Present with *Casuarina cristata* ssp. *pauper* were other trees of *Eucalyptus corrugata;* tall shrubs of *Eremophila oldfieldii* var. *angustifolia;* low shrubs of *Ptilotus obovatus* var. *obovatus, Rhagodia drummondii* and *Sclerolaena diacantha;* and the annuals, *Menkea australis* and *Zygophyllum ovatum.*

The main tall shrubs present with *Eucalyptus corrugata* were *Acacia tetragonophylla, Atriplex nummularia* ssp. *spathulata* and *Eremophila ionantha;* low shrubs were *Acacia acanthoclada* and *Olearia muelleri;* and the perennial grass *Stipa trichophylla* also occurred.

Occasional mallees of *Eucalyptus ewartiana* were present in *Acacia acuminata* Tall Shrubland. Other tall shrubs were *Brachychiton gregori, Dodonaea inaequifolia* and *Eremophila serrulata;* low shrubs were *Ptilotus obovatus* var. *obovatus;* and the annual *Velleia cycnopotamica* was also present.

Growing with *Acacia* aff. *aneura* were other tall shrubs of *A. acuminata, A. tetragonophylla;* low shrubs of *Ptilotus obovatus* var. *obovatus;* and the annuals, **Erodium cicutarium* and *Podolepis canescens.*

Few species were common in *Eucalyptus longicornis* (Morrel) Low Woodland: tall shrubs of *Atriplex nummularia* ssp. *spathulata,* low shrubs of *A. vesicaria*

ssp. *variabilis,* annuals of *Gilruthia osbornii* and perennial grasses of *Stipa eremophila.*

Other tall shrubs growing with *Acacia quadrimarginea* were *A. acuminata, A. tetragonophylla* and *Dodonaea inaequifolia;* low shrubs of *Cassia nemophila* var. *nemophila* and *Vittadinia* sp. (KRN 3375); annuals, *Gnephosis skirrophora, Helipterum pygmaeum, H. strictum* and *Stenopetalum lineare;* and the perennial grass, *Stipa trichophylla.*

Broad Valley (V): The vegetation types on Broad Valley occurred on Deep Calcareous Earths and they can be grouped according to attributes of the A horizon. The most widespread group occurred on a sandy loam to clay loam A horizon with a pH between 7.0 and 8.25. *Eucalyptus salmonophloia* Woodland and *Eucalyptus salubris* Low Woodland dominated. Small and scattered areas occurred of Low Woodlands of either *Eucalyptus clelandii, Eucalyptus corrugata* or *Eucalyptus oleosa,* as well as an occasional area of *Eucalyptus griffithsii* Mallee. Where the A horizon had a pH range of 7.0 to 7.5 and consisted of a loamy sand, *Eucalyptus transcontinentalis* Low Woodland was common with scattered areas of *Eucalyptus loxophleba* Mallee. Confined to the southern section, and occurring rarely, were *Eucalyptus plenissima* Low Woodland and *Eucalyptus sheathiana* Low Woodland. *Eucalyptus longicornis* Low Woodland occurred on a loamy A horizon with a pH of 8.25 to 8.75. A patch of *Eucalyptus* Mixed Low Woodland occurred between the Aurora and Helena Ranges. The vegetation was a complex mosaic of *E. salmonophloia, E. salubris, E. longicornis, E. transcontinentalis.*

Two claypans were noted during field work. The first had a clayey sand A horizon and contained not more than 40 cm of water when full. *Melaleuca lateriflora* Tall Shrubland was present with a few low shrubs of *Frankenia* sp. (KRN 6592) on the higher ground of the claypan floor. The other claypan had a floor of poorly developed gilgai consisting of red clay loam. It only contained *c.* 30 cm of water when full and supported *Eucalyptus cylindrocarpa* Mallee. Also present were other mallees of *E. gracilis* var. *gracilis;* low shrubs of *Muehlenbeckia cunninghamii;* and the annuals, *Gnephosis skirrophora.*

Eucalyptus salmonophloia Woodland occasionally contained other trees of *E. transcontinentalis,* or mallees of *E. gracilis* var. *gracilis.* Also present were tall shrubs of *Atriplex nummularia* ssp. *spathulata, Eremophila scoparia* and *Santalum acuminatum.* In the southern sector *Acacia colletioides* and *A. hemiteles* sometimes occurred. Low shrubs included *Atriplex vesicaria* ssp. *variabilis, Cassia nemophila* var. *nemophila, Sclerolaena diacantha;* annuals, *Cephalipterum drummondii, Menkea australis, Ptilotus exaltatus* var. *exaltatus* and *Zygophyllum ovatum;* and the perennial grasses *Stipa eremophila* and *S. trichophylla.*

Tall shrubs growing with *Eucalyptus salubris* were *Eremophila oppositifolia* var. *angustifolia, Exocarpos aphyllus* and *Santalum acuminatum. Melaleuca pauperiflora* occurred in the southern sector. Low shrubs present were *Acacia erinacea, Maireana triptera, Scaevola spinescens* and *Sclerolaena diacantha. Templetonia sulcata* was present near the southern boundary. The main annuals

were *Helipterum* sp. (KRN 7727), *Pogonolepis stricta, Menkea australis* and *Stellaria filifolia.* Perennial grasses were *Stipa trichophylla* and *S.* aff. *trichophylla.*

The main species growing with *Eucalyptus clelandii* were mallees of *E. loxophleba* and tall shrubs of *Acacia acuminata, A. enervia* and *Eremophila paisleyi.*

Tall shrubs occurring with *Eucalyptus corrugata* were *Acacia* aff. *aneura, Bossiaea walkeri, Eremophila ionantha* and *Pittosporum phylliraeoides;* low shrubs were *Olearia exiguifolia* and *O. muelleri;* annuals were *Cephalipterum drummondii, Chrysocoryne pusilla, Goodenia berardiana, Helipterum fitzgibbonii, H. zacchaeus* and *Waitzia acuminata;* and perennial grasses were *Stipa trichophylla* and *Triodia scariosa.*

Growing with *Eucalyptus oleosa* were tall shrubs of *Acacia* aff. *aneura* and *Atriplex nummularia* ssp. *spathulata;* low shrubs of *A. vesicaria* ssp. *variabilis, Cassia nemophila* var. *nemophila* and *Zygophyllum apiculatum;* annuals, *Cephalipterum drummondii, Chthonocephalus pseudevax, Erodium crinitum* and *Helipterum hyalospermum;* and the perennial grass, *Stipa trichophylla.*

Few common plants were present with *Eucalyptus griffithsii.* Associated were tall shrubs of *Acacia* aff. *aneura;* annuals, *Helipterum laeve, H. roseum* and *Waitzia acuminata;* and the perennial grasses, *Danthonia caespitosa* and *Triodia scariosa.*

Tall shrubs occurring with *Eucalyptus transcontinentalis* included *Dodonaea angustissima, Eremophila paisleyi, Pittosporum phylliraeoides* and *Santalum acuminatum. Acacia colletioides, A. hemiteles* and *Daviesia benthamii* ssp. *benthamii* occurred in southern areas while *Eremophila latrobei* was sometimes present in northern areas. Low shrubs included *Atriplex vesicaria* ssp. *variabilis, Cassia nemophila* var. *nemophila, Maireana triptera* and *Olearia muelleri,* with the annual, *Maireana carnosa;* and the perennial grass, *Stipa trichophylla,* also occurring.

Many species occurred with *Eucalyptus loxophleba.* Tall shrubs included *Acacia acuminata, A.* aff. *aneura, A. prainii* var. *prainii, Cassia nemophila* var. *nemophila, Eremophila ionantha* and *Santalum acuminatum. Acacia densiflora* was present in south-western sector. Low shrubs were *Maireana trichoptera, Olearia exiguifolia, O. muelleri, Sclerolaena diacantha* and *S. drummondii;* annuals were *Actinoble uliginosum, Cephalipterum drummondii, Helipterum demissum, H. pygmaeum, Schoenia cassiniana;* and the perennial grasses were *Enneapogon* sp. (KRN 7755) and *Stipa trichophylla.*

Tall shrubs growing with *Eucalyptus plenissima* were *Acacia* aff. *aneura, A. inceana* and *Melaleuca uncinata;* low shrubs were *Eremophila* aff. *drummondii* and *Olearia revoluta;* annuals were *Chrysocoryne pusilla* and *Chthonocephalus pseudevax.* The perennial grass, *Stipa trichophylla* was associated, as was the sedge-like *Lomandra effusa.*

Trees of *Eucalyptus wandoo* occurred with *E. sheathiana* (Ribbon-barked Mallee), as well as mallees of *E. eremophila;* tall shrubs of *Daviesia benthamii* ssp. *benthamii, Dodonaea angustissima* and *Melaleuca uncinata;* low shrubs of *D. bursarifolia, Olearia revoluta, Westringia cephalantha* and *W. rigida;* annuals,

*Actinobole uliginosum, *Aira caryophyllea, Helipterum laeve, Podolepis capillaris* and *Trachymene cyanopetala;* and the perennial grass *Stipa eremophila.*

Mallees of *E. gracilis* var. *gracilis* were often present in *Eucalyptus longicornis* Low Woodland. Tall shrubs present were *Eremophila interstans, E. ionantha, E. paisleyi* and *E. scoparia. Acacia colletioides* and *A. hemiteles* were common in the southern sector. Present were low shrubs of *Atriplex vesicaria* ssp. *variabilis, Cassia nemophila* var. *nemophila* and *Olearia muelleri;* the annual, *Zygophyllum ovatum;* and the perennial grasses, *Stipa eremophila* and *S. trichophylla.*

Mixed *Eucalyptus* spp. Low Woodland included the species mentioned previously; mallees of *E. celastroides;* tall shrubs of *Eremophila scoparia;* low shrubs of *Atriplex nummularia* ssp. *spathulata, A. vesicaria* ssp. *variabilis, Sclerolaena diacantha* and *S. drummondii;* and the annual, *Helipterum* sp. (KRN 7727).

Discussion

About 90% of the Study Area is within the Coolgardie Botanical System of the South-western Interzone (Beard 1980). The remainder in the South-West corner, is within the Avon Botanical System of the South-West Botanical Province. The Mulga-Eucalypt tree-line is situated approximately along the northern boundary of the Study Area. Much of the Study Area was covered with tall shrublands and mallees on Sandplain, and low woodlands and woodlands on Broad Valley and Undulating Plain (greenstone). The sandplain vegetation types extended west and south of the Study Area, while the woodlands and low woodlands extended in a SSE direction following the greenstone belt and continuing on to the Calcareous Plain (Newbey and Hnatiuk 1984). Throughout the Study Area there was a gradual change from south-west to north-east in the distribution of vegetation types on the same soil group – land form unit. Decreasing rainfall appeared to be the major factor.

No vegetation type appeared to be confined to the Study Area. However, the area did contain some good examples of vegetation patterns on particular landforms. Foremost was vegetation in the Aurora and Helena Ranges area. The Aurora Range, including Bungalbin Hill, represents the highest and largest example of Hill (banded ironstone formation) in the Eastern Goldfields.

The area had experienced slight modification by the construction of mining exploration tracks. Wallaroo Rock is a large Granite Exposure with a wide range of associated vegetation types. The Sandplain between Wallaroo Rock (47 spp.) north to near Musson Soak (17 spp.) was a good example of species richness gradation.

The flora of the Study Area had not previously been systematically recorded and documented. Consequently, the ranges of some species were extended and some species were collected for the first time. For example, *Allocasuarina tessellata* had previously only been recorded on Mt Singleton, but was collected on Mt Jackson during the survey – an extension of 80 km.

During the survey, 3 species of fern and 777 species, 16 subspecies and 20

varieties of flowering plants were recorded. These are listed in Appendix II with a subjective assessment of their frequency and cover abundance on each landform unit. Families with the largest number of taxa were Asteraceae (103), Myrtaceae (96) and Leguminosae (93). Genera with the most taxa were *Acacia* (56), *Eucalyptus* (35), *Grevillea* (23), *Helipterum* (21) and *Eremophila* (19).

Based on specimens housed in the Western Australian Herbarium, 19 species were collected for the first time (Table 4). Apart from two, all are only known from single collections. *Acacia* sp. (KRN 9204), collected on the Aurora Range, was collected again at another locality on the same range. *Hybanthus* sp. (KRN 8668) was first collected near Musson Soak and was later collected near Walyahmoning Rock, and recorded near Mt Jackson. All were on breakaways. Twenty-four taxa, collected during field work, had been rarely collected previously (Table 4).

Some other notable extensions of range (Table 4) were: *Acacia jamesiana* (from Leinster Downs station and Wiluna to near Yacke Yackine Dam); *Banksia lullfitzii* (from Koorarawalyee and south of Queen Victoria Rock, to north-east of Aurora Range); *Hakea* sp. (KRN 9589)(from Campion to near Highclere Hills); *Hemigenia divaricata* (from Mullewa, Cue and Cundeelee, to Koolyanobbing Range); *Lepidium genistoides* (from Mukinbudin, Bencubbin and Marvel Loch to near Yacke Yackine Dam); *L. merrallii* (from Marvel Loch and Coolgardie, to near Koolyanobbing Range and Mt Jackson); *Leptosema chambersii* ssp. nov. (from Sandstone to near Highclere Hills); and *Pomaderris intangenda* (from Mt Ridley, north-east of Esperance, to Mt Walter and Walyahmoning Rock).

Twenty taxa were recorded which appear to be confined to the Study Area (Table 4). No Gazetted Rare Flora (Patrick and Hopper 1982) were recorded.

Table 4 Important Plant Collections from the Study Area

Taxon	1st Coll.	Rarely Coll.	Ext. Range	Endemic
Acacia jamesiana	.	.	X	.
Acacia sp. (KRN 9204)	X	.	.	X
Allocasuarina tesellata	.	.	X	.
Angianthus sp. (KRN 9204)	X	.	.	X
Banksia lullfitzii	.	.	X	.
Beckea sp. (KRN 9298)	X	.	.	X
Baeckea sp. (KRN 9418)	X	.	.	X
Burtonia sp. (KRN 9544)	X	.	.	X
Caryophyllaceae genus indet. (KRN 7235A)	.	X	.	.
Calytrix birdii	.	X	.	.
Calytrix creswellii	.	X	.	.
Coleanthera sp. (KRN 8754)	?	?	?	?
Crenidium spinescens	.	X	.	.
Dampiera sp. (KRN 9546)	X	.	.	X
Darwinia sp. (KRN 9414)	X	.	.	X
Epacridaceae genus indet. (KRN 8698)	.	X	.	.
Epacridaceae genus indet. (KRN 9429)	X	.	.	X
Epacridaceae genus indet. (KRN 9592)	.	X	.	.
Euphorbia aff. *wheeleri* (KRN 8682)	.	X	.	.
Glossostigma trichodes	.	X	.	.
Gnephosis intosa	.	X	.	.
Grevillea erectiloba	.	X	.	.
Grevillea sp. (KRN 9464)	.	X	.	.
Gunniopsis rubra	X	.	.	.
Gyrostemon sp. (KRN 8710)	X	.	.	X
Hakea sp. (KRN 9589)	.	X	X	.
Helichrysum cassiope	.	X	.	.
Helipterum fuscensens	.	X	.	.
Hemigenia divaricata	.	.	X	.
Hybanthus sp. (KRN 8668)	X	.	.	X
Jacksonia sp. (KRN 9302)	.	X	X	.

Table 4 (cont.) Important Plant Collections from the Study Area

Taxon	1st Coll.	Rarely Coll.	Ext. Range	Endemic
Lepidium genistoides	.	X	X	.
Lepidium merrallii	.	X	X	.
Leptosema chambersii ssp. nov (KRN 9596)	.	.	X	.
Leptospermum sp. (KRN 9095)	X	.	.	X
Leucopogon sp. (KRN 8697)	.	X	.	.
Logania sp. (KRN 9428)	X	.	.	X
Menkea lutea	.	X	.	.
Mirbelia sp. (KRN 8949)	.	2nd	X	.
Mirbelia sp. (KRN 10834)	.	X	.	X
Myriophyllum sp. (KRN 8562)	.	X	X	.
Patersonia rudis var. nov. (KRN 8382)	.	X	.	.
Pityrodia sp. (KRN 9285)	X	.	.	X
Pomaderris intangenda	.	X	X	.
Ptilotus sp. (KRN 5689)	.	2nd	.	.
Ricinocarpus aff. *muricatus (KRN 9559)*	X	.	.	X
Rulingia sp. (KRN 9588)	X	.	.	X
Tetratheca harperi	.	X	.	X
Tetratheca sp. (KRN 9203)	X	.	.	X
Verticordia sp. (KRN 9436)	X	.	.	X
Total	19	24	12	20

Coll. = Collection
Ext. = Extension of
Endemic = Only known from Jackson-Kalgoorlie Study Area.

Plate 1: *Acacia* aff. *aneura* Tall Shrubland similar to JK10. *c.* 30 km north of Koolyanobbing. September 1981.

Plate 2: Vegetation type JK37. *Acacia coolgardiensis* Tall Shrubland. 16 km north-east of Bungalbin Hill. December 1981.

Plate 3: Vegetation type JK39. *Banksia elderana* Tall Shrubland in foreground with eastern end of Aurora Range in background. 16 km north-east of Bungalbin Hill. April 1980.

Plate 4: Vegetation type JK21. *Dryandra arborea* Tall Shrubland at western end of Aurora Range near Bungalbin Hill. Hunt Range on horizon. September 1979.

Plate 5: Vegetation type JK18a. *Eucalyptus ebbanoensis* Mallee in foreground with Helena and Aurora Ranges in distance. November 1981.

Plate 6: Vegetation type JK44a. *Eucalyptus salmonophloia* Woodland. 1 km west of Mt Jackson. November 1981.

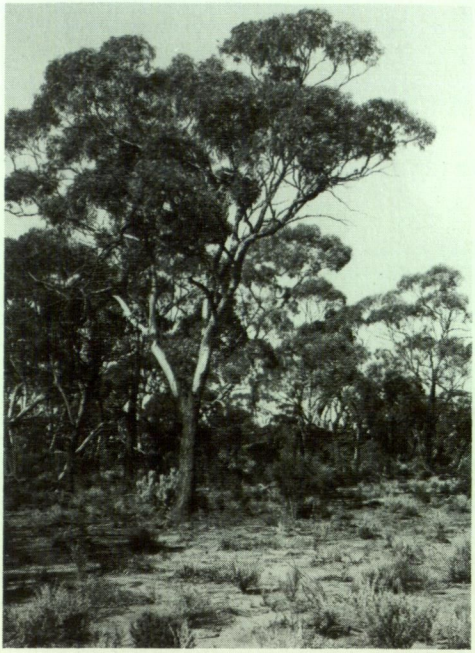

Plate 7: Vegetation type JK48a. *Eucalyptus salubris* Low Woodland. 4 km north of Mt Jackson. April 1980.

Plate 8: *Eucalyptus transcontinentalis* Low Woodland similar to JK50. 5 km west of Yacke Yackine Dam. October 1981.

Plate 9: Breakaway. 9 km north of Jaudi Homestead. September 1981.