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HSA

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YOGANUP EXTENDED, 90' DEPOSIT.

VEGETATION STUDY.

Prepared by

Hart, Simpson and Associates Pty Ltd

for

Iluka Resources Limited

December 1999

CONTENTS.

1. SUMMARY.

Iluka Resources Limited is examining the Yoganup Extended 90' Deposit east of Capel. The site is private property but includes an area of remnant vegetation in good condition as well as some vegetation previously disturbed. A detailed botanical study of the vegetation in good condition was carried out in August and October 1999. The survey examined the total flora, rare species and the vegetation units defined by structure and floristics to provide information for environmental assessment of the site.

The study identified a total of 196 native species from 110 genera and 42 families, although some were not fully identifiable. In addition there were 11 weeds in 11 genera and three families, producing a total flora of 207 species from 121 genera and 43 families. No Declared Rare Flora species were found, but eight Priority species were identified:

Priority 1	Eremaea asterocarpa subsp. brachyclada
	Caustis sp. Boyanup
Priority 2	Acacia mooreana
Priority 3	Acacia semitrullata
	Synaphea whicherensis
Priority 4	Caladenia speciosa
	Drosera marchantii subsp. marchantii
	Franklandia triaristata

The presence of these rare plant species is not necessarily sufficient to prevent mining.

The vegetation was mapped into four units on species and vegetation structure:

- A Banksia woodland dominated by *Banksia attenuata* with scattered Jarrah, Marri, *Banksia ilicifolia*, *Banksia grandis* and *Nuytsia floribunda*, over a diverse and variable shrub and perennial herb stratum.
- A Eucalypt forest of Jarrah and *Corymbia haematoxylon* to 20m tall with *Allocasuarina fraseriana*, *Banksia grandis*, Marri and *Banksia attenuata* over a shrub and perennial herb stratum less dense and diverse than that seen in unit 1.
- A Eucalypt open forest of Jarrah and *Corymbia haematoxylon* to 15m tall with occasional *Allocasuarina fraseriana*, *Banksia grandis* and *Banksia attenuata* over a variable and diverse shrub and perennial herb stratum.
- A Eucalypt forest of Jarrah, *Corymbia haematoxylon* and Marri to 20m tall with *Banksia grandis* and *Banksia attenuata* over a shrub and perennial herb stratum less dense and diverse than that seen in unit 1.

The vegetation is generally in excellent condition except for some old disturbances leading to weed invasion, mainly in the last unit.

Detailed floristic analysis was carried out by identifying every species in each of nine plots of $100m^2$. The results were compared with the plots used to generate community types in the Southern Swan Coastal Plain survey. The floristic study showed that the plots were all closely related and sites could be divided into a Banksia group and a Eucalypt woodland group, which agreed well with the mapping by structure. The plots are not closely related to any of the community types in the Southern Swan Coastal Plain survey, but

- The Banksia plots are closest to 21b which is the southern *B. attenuata* unit.

- The Eucalypt woodland plots are closest to 21b which is the southern *B. attenuata* unit, followed by 20b which is the eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the base of the scarp and 1a which is the *Corymbia haematoxylon-Eucalyptus marginata* woodlands on Whicher foothills.

These results are reasonable, but the degree of similarity is low in all cases. The plots are slightly less similar to other units which do not occur regionally.

The vegetation has an extremely high species diversity, and this appears to be confusing the floristic analysis and may also be generating spurious similarities to some community types.

There are various possible interpretations reasons of the results:

- The site is unique or unusual in some way, with an extreme species diversity not seen elsewhere.

- The survey was intensive rather than extensive and has detected a high degree of heterogeneity in the vegetation which confuses the identification of units.

- The previous regional survey did not cover the vegetation adequately, and there are many other units or variations present which have not been described.

At this stage these possibilities cannot be resolved fully. Information from an unpublished survey of the northern scarp suggests the vegetation units may be undescribed community types characterised by very high species diversities.

The status of the floristic units is uncertain. The most similar community types are poorly conserved, and any new units may be similar. The vegetation considered here is on private property but it is likely that some regulatory authorities will regard the vegetation as unique or at least of very high conservation value, and any proposal to carry out mining will be subject to a high degree of scrutiny and opposition. More regional information is required.

2. INTRODUCTION.

Iluka Resources Limited is examining the Yoganup Exended 90' Deposit east of Capel. The site is private property but includes an area of remnant vegetation in good condition as well as some vegetation previously disturbed. A detailed botanical study of the vegetation in good condition was carried out in August and October 1999. The survey examined the total flora, rare species and the vegetation units defined by structure and floristics to provide information for environmental assessment of the site.

Specifically the survey was designed to:

- Examine the flora of the site.
- Determine if any rare plant species are present.
- Record the condition of the vegetation.
- Identify the community types present in terms of the types identified in the Southern Swan Coastal Plain survey.
- Determine the conservation values of the vegetation.

The results of the study are given here.

3. METHODS.

The flora was collected opportunistically and in plots on 22/7/99, 25-28/8/99 and 28/9-1/10/99.

The vegetation was first examined by making extensive traverses on foot. The vegetation types were identified and mapped on the basis of structure, and then by recording all species in plots of 10m x 10m in accordance with the methods used by the Southern Swan Coastal Plain survey (Gibson *et al.* 1994) . Each plot was examined twice except for plot 9 which was added in September to replicate another plot which did not contain the intended flora. All species were identified as far as possible from keys, reference to material in the W.A. Herbarium, or by experts.

The condition of the vegetation was recorded by looking at disturbance, the diversity of species, dieback, weeds, grazing and other factors. The condition was rated on the scale of Keighery (1994) which is a scale of 1 to 6:

1. Pristine or nearly so.

2. Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.

3. Vegetation structure altered, obvious signs of disturbance.

4. Vegetation structure significantly altered by very obvious signs of multiple disturbance, retains basic vegetation structure or ability to regenerate it.

5. Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.

6. The structure of the vegetation is no longer intact and the area is completely or almost without native species.

The floristic information was adjusted to the species and format used in the Southern Swan Coastal Plain survey and tested by the methods defined in the Southern Swan Coastal Plain survey. The data set was bought from the Department of Conservation and Land Management.

4. RESULTS.

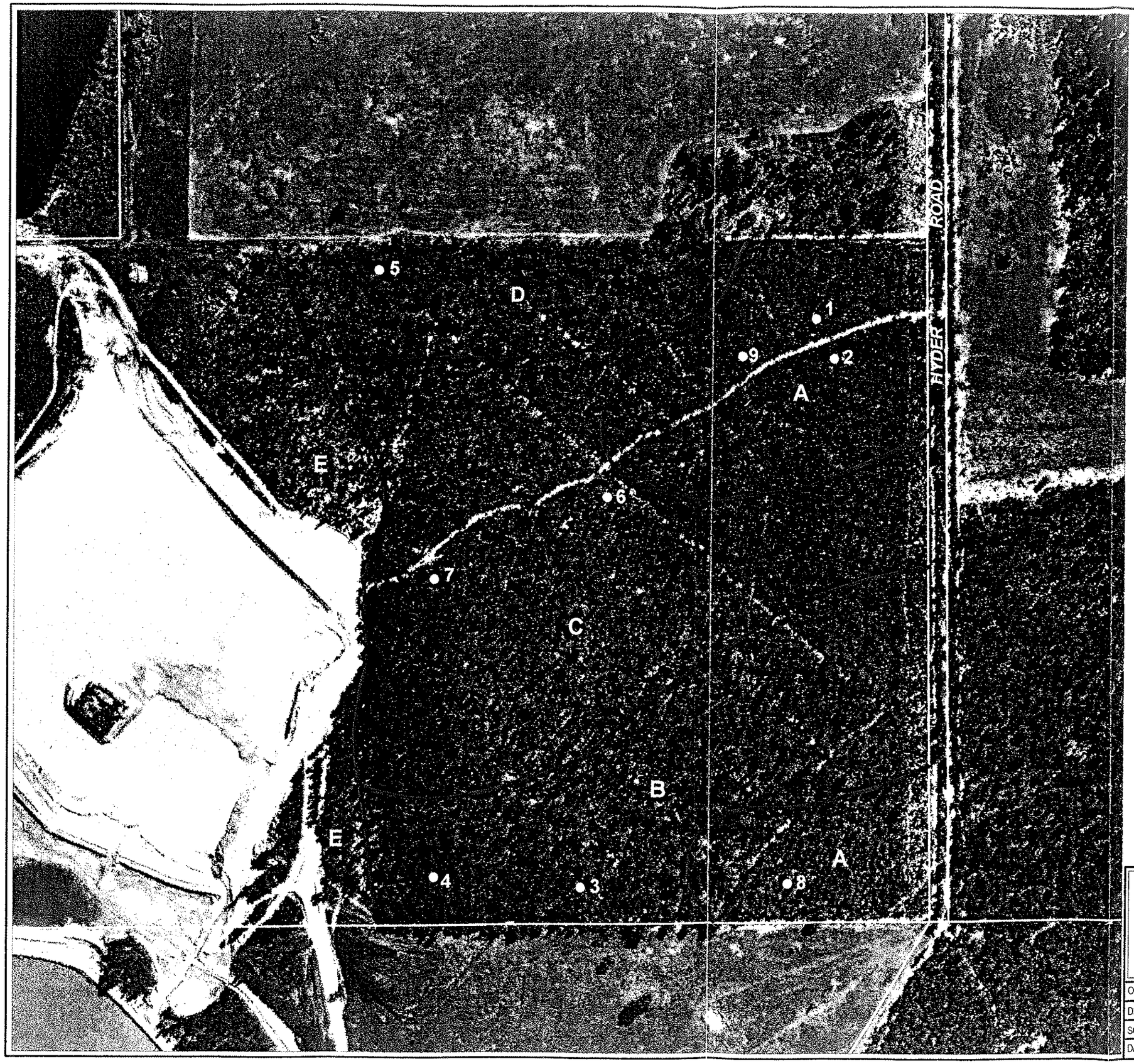
The flora recorded on the site is listed in Appendix 1, with the weed species identified. The study recorded a total of 196 native species from 110 genera and 42 families, although some were not fully identifiable. In addition there were 11 weeds in 11 genera and three families, producing a total flora of 207 species from 121 genera and 43 families. The weeds are herbaceous and grass species which are all common locally and regionally. In the native flora the most diverse groups are the Proteaceae (21 species), orchids (18 species), Papilionaceae (16 species), Myrtaceae (15 species), Cyperaceae (14 species), Epacridaceae (10 species), Dasypogonaceae (10 species) and the Anthericaceae (9 species).

No Declared Rare Flora species were found, but eight Priority species were identified. These were:

Priority 1
Eremaea asterocarpa subsp. *brachyclada*, which is very rare on the site and was found only once in the southern corner.
Caustis sp. Boyanup, which is scarce on the site and occurs in the more sandy areas.
Priority 2
Acacia mooreana, which is sparse but scattered through the Eucalypt woodlands.
Priority 3
Acacia semitrullata, which is scattered in the more sandy areas.
Synaphea whicherensis, which is reasonably common in the Eucalypt woodlands.
Priority 4
Caladenia speciosa, which was found only twice in Banksia woodland.
Drosera marchantii subsp *marchantii*, which was found only once in a Eucalypt woodland.
Franklandia triaristata, which is reasonably common in the more sandy areas.

The site lies on the base of the Whicher Scarp, and although the surface soils are all grey sands they can be expected to lie over a variety of more clayey soils or even laterite which are not apparent from a surface examination. The vegetation was divided into four units on the basis of vegetation structure and species (Map 1, next page):

A. A Banksia woodland dominated by *Banksia attenuata* 5m tall with scattered Jarrah, Marri, *Banksia ilicifolia*, *Banksia grandis* and *Nuytsia floribunda*, over a diverse and variable shrub and perennial herb stratum with *Melaleuca thymoides* as the single most common species, and a very sparse stratum of annual herbs and grasses. This unit was rated as Condition 2 (excellent), with very little weed invasion, except for the patch in the south-eastern corner which was rated at 2-3 due to grazing and a greater weed invasion.



LEGEND:

Quadrat site -10m x 10m

Vegetation units

- **A** Banksia woodland
- **B** Jarrah / Haemotoxylon forest
- **C** Jarrah / Haemotoxylon open forest
- **D** Jarrah / Haemotoxylon / Marri forest
- **E** Disturbed

N

100 0 100m

Survey by: Hart, Simpson & Assoc. December 1999

ILUKA

YOGANUP EXTENDED

FLORA SURVEY 90' STRAND

ORIG : N.McMULKIN			
DRAWN : D.G.S.			
SCALE : 1:4000			
DATE : 5 JAN 2000	DWG No : YXR0133A	MAP: 1	

B. A Eucalypt forest of Jarrah and *Corymbia haematoxylon* to 20m tall with *Allocasuarina fraseriana*, *Banksia grandis*, Marri and *Banksia attenuata* over a shrub and perennial herb stratum with *Melaleuca thymoides* as the single most common species but very variable and less dense and diverse than that seen in unit A, and a very sparse stratum of annual herbs and grasses. This unit was rated as Condition 2 (excellent), with very little weed invasion.

C. A Eucalypt open forest of Jarrah and *Corymbia haematoxylon* to 15m tall with occasional *Allocasuarina fraseriana*, *Banksia grandis* and *Banksia attenuata* over a variable and diverse shrub and perennial herb stratum with *Melaleuca thymoides* as the single most common species and a very sparse stratum of annual herbs and grasses. This unit was rated as Condition 2 (excellent), with very little weed invasion,

D. A Eucalypt forest of Jarrah, *Corymbia haematoxylon* and Marri to 20m tall with *Banksia grandis* and *Banksia attenuata* over a shrub and perennial herb stratum with *Melaleuca thymoides* as the single most common species but very variable and less dense and diverse than that seen in unit A, and a sparse stratum of annual herbs and grasses. This unit was rated as Condition 3, due to past disturbance and the resulting weed invasion. This has resulted from impacts from the adjacent cleared farm land.

The vegetation which was too disturbed to study is also shown in Map 1. These areas have been partly cleared under a power line or in preparation for mining which never took place. Disturbed areas were not examined for flora, vegetation or condition. The generally excellent condition of the block results from the lack of grazing in the past, which is unusual in this area.

No evidence of dieback due to *Phytophthora cinnamomi* was seen in the bulk of the block but it appeared to be present along the road in the south-east in disturbed vegetation not studied here.

The locations of the nine plots for floristic study are given in Map 1. The species recorded in each plot are given in Appendix 2. Some species could not be identified fully, and several were confused or mis-identified in the field and the results could not be corrected for each plot. Some species recorded were not found in the Southern Swan Coastal Plain survey. Others have been subjected to name changes since the time of the Southern Swan Coastal Plain survey. The final interpretation of the plot results is given in Appendix 3 along with the species codes used in the analysis. The final plot results used in the analysis are given in Appendix 4 as a spread sheet.

It was intended that plots 1, 2 and 8 would represent the Banksia woodland unit, but it became apparent that plot 8 was different and plot 2 was transitional to unit C. Plot 9 was set up to provide replication of plot 1. Plots 3 and 4 were designed as replicates, as were 6 and 7. Plot 5 covered an apparent variation of the Eucalypt woodlands.

The computer analysis of the results was carried out by Biostat, and the complete report is given in Appendix 5.

The analysis presented significant difficulties. The Southern Swan Coastal Plain survey methods supposedly reported on the full data set of species and plots with results merged only where a small number of species could not be separated, and the results were supplied by CALM in that form with 1369 taxa in 509 plots. In fact the results section stated that singletons contributed little to the community classification and the data set was edited to remove singletons, and a second data set was subsequently supplied by CALM in this form. This reduced the data set to 1097 taxa in 509 sites. Removing the singletons reduces the complexity of the data but also removes information on species which are relatively rare in the results (for whatever reason).

The nine plots were first examined in relation to each other with the singletons removed, and then to the full data set. For the full analysis the results from the nine plots were added to the CALM data set, with the singletons then removed. The addition of the nine plots changes the status of some species as singletons. For ease of presentation the original 509 sites were grouped into the 43 community types identified in the Southern Swan Coastal Plain survey, and compared with the nine new plots as independent entries. The addition of nine new plots should not have changed the classification as nine is a relatively small number in relation to 509.

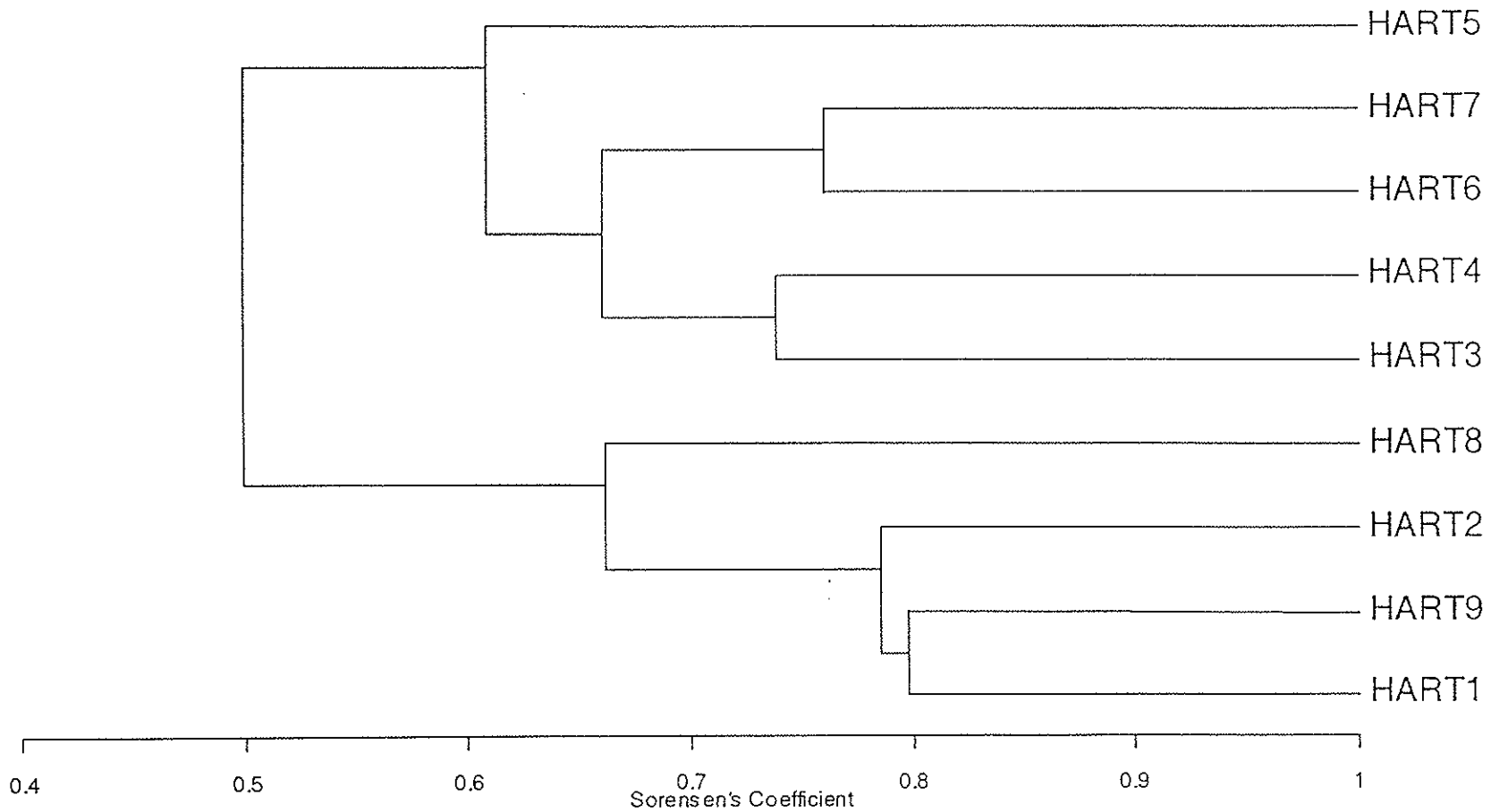
Figure 1 from Biostat (1999) is reproduced on the next page. This Figure shows that the nine plots are very similar, with a high degree of similarity of all plots (greater than 50%), but they fall sharply into two basic groups:

- Plots 1, 2, 8 and 9, (which are all Banksia woodlands), and
- Plots 3, 4, 5, 6 and 7 (which are all Eucalypt woodlands).

Figure 1 also shows that the replicate pairs (1 and 9, 3 and 4, and 6 and 7) all closely related within the pairs with 75-80% similarity. Plot 2 is surprisingly close to plots 1 and 9, while plot 8 is less similar. The two pairs of Eucalypt woodland sites (3 and 4, and 6 and 7) are clearly related but definitely separated, while Plot 5 is slightly more distant.

Despite the high similarity between all of the plots, the highest values even for the most closely related plots are not extremely high, with all values less than 0.8. This can be interpreted as due to a very high species diversity so that single plots are not sampling all of the species diversity seen within each apparently homogeneous variation of the vegetation.

Figure 1. *Classification of the Client's data indicates the existence of two groups of sites.*



The results for the full data set are less clear. Figure 2 from Biostat (1999) is reproduced on the next page. This Figure needs to be read from left to right across the similarity scale and not from top to bottom across the vegetation groups. The Figure shows that the nine new plots form a distinct group not closely related to any of the others, with the similarity less than 25%. The least similar groups are the northern and coastal wetlands (community types 11 to 19), followed by the coastal dry land units (community types 24 to 30 except 28 which is the Spearwood Banksia unit). The remaining groups split roughly into the eastern coastal plain/scarp woodlands (community types 1a, 1b, 3b, and 21b which is the southern *B. attenuata* unit) and the other Banksia-Jarrah communities (community types 20 to 23 without 21b, and 28), and the southern and central wetlands (community types 2, 3a, 3c, and 4 to 10).

This last result is surprising, and is discussed further below. Individual similarity values between the nine plots discussed here and the community types are given in Table 1 (page 12) reproduced from Biostat (1999) and marked up to identify the results of most interest.

The species richness of the nine plots is given in Table 2 (page 13).

Figure 2. *The classification of community types and the Client's data resulted in a number of loose groupings based on low similarity values. However, the classification dendrogram does indicate the affinity of the Client's data to a groups of community types.*

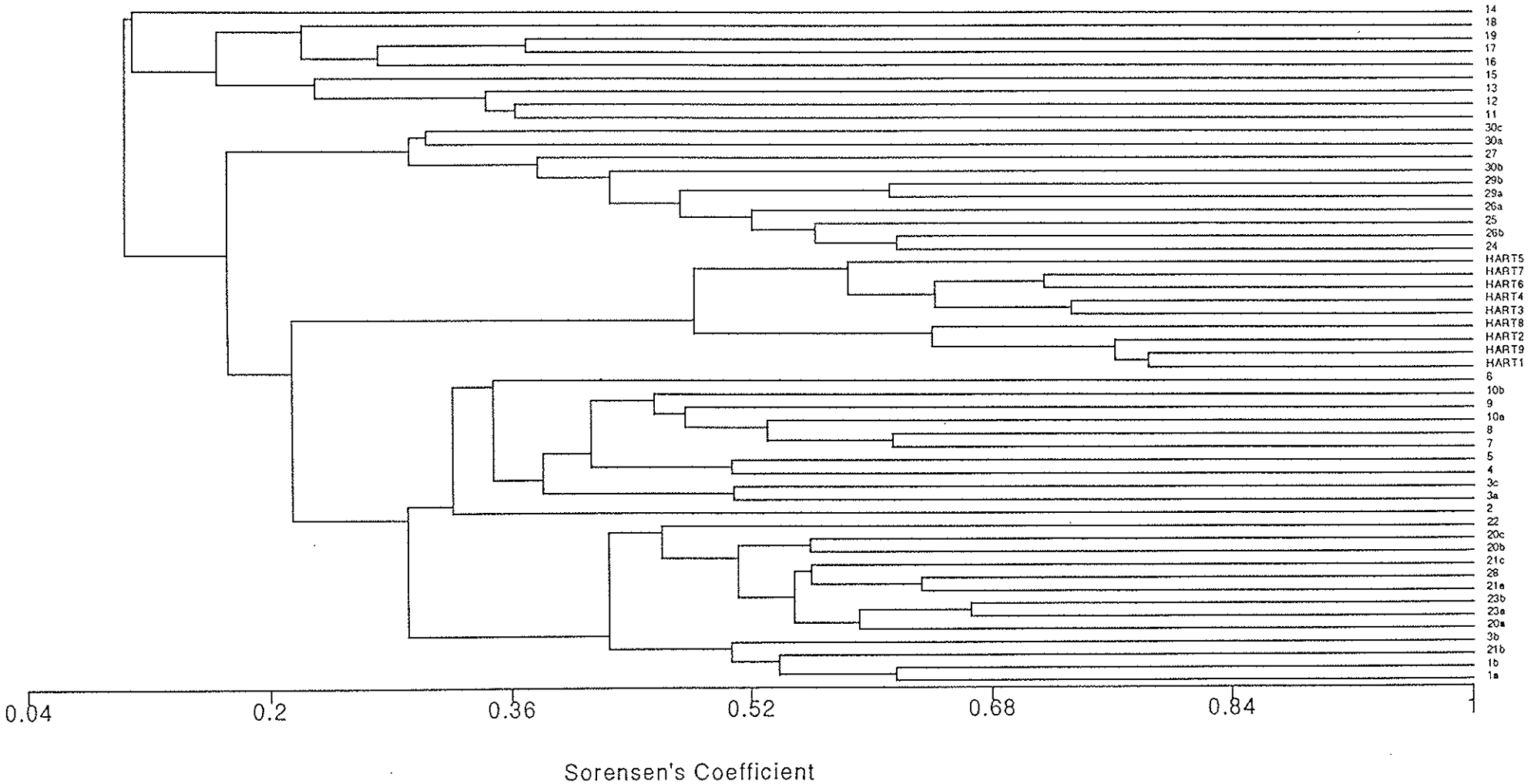


Table 3. Similarity measures for the 52 sites and community types were generally low.

TABLE 1. Table 3 from Biostat (1999), showing similarity values of the Southern Swan Coastal Plain survey community types and the plots at Yoganup.

Community Type Code

	1a	1b	2	3a	3b	3c	4	5	6	7	8	9	10a	10b	11	12	13	14	15	16	17	18	19	20a	20b	20c	21a	21b	21c	22	23a	23b	24	25	26a	26b	27	28	29a	29b	30a	30b	30c	HART1	HART2	HART3	HART4	HART5	HART6	HART7	HART8	HART9
1a	1.00																																																			
1b	0.62	1.00																																																		
2	0.35	0.40	1.00																																																	
3a	0.41	0.40	0.36	1.00																																															
3b	0.52	0.54	0.31	0.50	1.00																																														
3c	0.30	0.35	0.24	0.51	0.46	1.00																																														
4	0.37	0.44	0.39	0.41	0.43	0.31	1.00																																													
5	0.29	0.31	0.29	0.42	0.37	0.36	0.51	1.00																																												
6	0.22	0.22	0.24	0.34	0.31	0.37	0.37	0.42	1.00																																											
7	0.15	0.18	0.24	0.39	0.26	0.32	0.36	0.50	0.34	1.00																																									
8	0.24	0.28	0.28	0.53	0.34	0.46	0.36	0.45	0.35	0.61	1.00																																								
9	0.24	0.28	0.35	0.40	0.26	0.29	0.37	0.38	0.30	0.47	0.48	1.00																																							
10a	0.23	0.26	0.38	0.40	0.25	0.30	0.38	0.46	0.32	0.55	0.52	0.48	1.00																																						
10b	0.31	0.33	0.43	0.41	0.32	0.33	0.43	0.44	0.32	0.44	0.45	0.44	0.49	1.00																																						
11	0.19	0.25	0.25	0.31	0.29	0.29	0.38	0.43	0.35	0.40	0.37	0.37	0.32	0.32	1.00																																						
12	0.11	0.12	0.17	0.15	0.15	0.13	0.23	0.29	0.25	0.25	0.19	0.24	0.24	0.23	0.36	1.00																																						
13	0.07	0.15	0.20	0.18	0.09	0.15	0.17	0.25	0.21	0.32	0.30	0.39	0.26	0.22	0.33	0.36	1.00																																					
14	0.06	0.06	0.07	0.07	0.11	0.11	0.14	0.14	0.13	0.07	0.07	0.07	0.05	0.08	0.17	0.14	0.14	1.00																																					
15	0.01	0.03	0.04	0.05	0.03	0.04	0.05	0.06	0.13	0.15	0.12	0.08	0.10	0.06	0.20	0.28	0.22	0.03	1.00																																					
16	0.01	0.01	0.02	0.04	0.02	0.04	0.05	0.06	0.09	0.16	0.07	0.06	0.07	0.05	0.14	0.11	0.11	0.06	0.25	1.00																																				
17	0.03	0.06	0.06	0.04	0.04	0.06	0.07	0.10	0.12	0.16	0.10	0.10	0.10	0.07	0.24	0.18	0.26	0.14	0.22	0.32	1.00																																			
18	0.11	0.10	0.14	0.15	0.11	0.14	0.16	0.22	0.13	0.25	0.20	0.19	0.19	0.18	0.23	0.18	0.23	0.11	0.08	0.16	0.25	1.00																																		
19	0.04	0.06	0.06	0.05	0.06	0.08	0.08	0.09	0.09	0.10	0.09	0.08	0.09	0.08	0.20	0.08	0.10	0.10	0.09	0.23	0.37	0.26	1.00																																	
20a	0.44	0.38	0.25	0.37	0.37	0.30	0.29	0.28	0.22	0.13	0.18	0.16	0.17	0.24	0.16	0.09	0.07	0.03	0.01	0.00	0.05	0.11	0.05	1.00																																	
20b	0.51	0.49	0.26	0.46	0.55	0.37	0.35	0.30	0.33	0.17	0.25	0.21	0.18	0.25	0.18	0.09	0.05	0.07	0.02	0.02	0.03	0.08	0.04	0.57	1.00																																	
20c	0.36	0.36	0.26	0.46	0.41	0.41	0.34	0.35	0.34	0.19	0.26	0.21	0.21	0.29	0.20	0.11	0.10	0.10	0.01	0.02	0.04	0.09	0.04	0.57	0.56	1.00																																	
21a	0.46	0.52	0.26	0.39	0.55	0.38	0.47	0.44	0.35	0.25	0.32	0.28	0.25	0.29	0.35	0.16	0.13	0.09	0.04	0.05	0.10	0.17	0.11	0.50	0.54	0.46	1.00																																	
21b	0.56	0.52	0.26	0.34	0.46	0.29	0.45	0.34	0.26	0.17	0.19	0.22	0.18	0.31	0.21	0.15	0.08	0.09	0.02	0.01	0.04	0.10	0.04	0.51	0.51	0.46	0.56	1.00																																	
21c	0.35	0.39	0.25	0.39	0.44	0.34	0.49	0.47	0.39	0.25	0.29	0.24	0.24	0.33	0.34	0.18	0.13	0.13	0.03	0.05	0.07	0.11	0.07	0.48	0.50	0.53	0.61	0.53	1.00																																	
22	0.31	0.30	0.27	0.28	0.30	0.21	0.40	0.38	0.28	0.14	0.17	0.23	0.20	0.22	0.23	0.15	0.13	0.12	0.03	0.02	0.05	0.10	0.04	0.48	0.36	0.39	0.41	0.44	0.50	1.00																																	
23a	0.38	0.38	0.21	0.37	0.40	0.33	0.44	0.43	0.31	0.21	0.23	0.20	0.20	0.27	0.27	0.18	0.11	0.11	0.04	0.03	0.06	0.10	0.06	0.59	0.50	0.53	0.63	0.56	0.65	0.56	1.00																																	
23b	0.33	0.32	0.23	0.32	0.32	0.24	0.35	0.35	0.26	0.15	0.17	0.18	0.16	0.23	0.16	0.13	0.09	0.04	0.03	0.01	0.04	0.08	0.04	0.60	0.46	0.49	0.51	0.46	0.53	0.61	0.67	1.00																																	
24	0.25	0.29	0.15	0.28	0.35	0.32	0.29	0.33	0.30	0.24	0.25	0.16	0.19	0.23	0.29	0.10	0.12	0.10	0.05	0.08	0.17	0.17	0.22	0.37	0.30	0.36	0.49	0.33	0.40	0.28	0.44	0.38	1.00																																	
25	0.26	0.30	0.11	0.23	0.39	0.33	0.30	0.31	0.31	0.25	0.25	0.17	0.16	0.21	0.37	0.12	0.12	0.12	0.03	0.09	0.17	0.22	0.20	0.30	0.30	0.30	0.52	0.33	0.39	0.23	0.40	0.29	0.56	1.00																																	
26a	0.18	0.20	0.10	0.21	0.24	0.25	0.25	0.25	0.25	0.22	0.22	0.17	0.17	0.23	0.22	0.15	0.10	0.08	0.04	0.06	0.13	0.21	0.24	0.23	0.23	0.25	0.36	0.25	0.30	0.19	0.31	0.26	0.51	0.47	1.00																																	
26b	0.26	0.28	0.12	0.27	0.32	0.30	0.28	0.34	0.28	0.22	0.25	0.16	0.18	0.22	0.25	0.13	0.10	0.08	0.04	0.05	0.14	0.20	0.17	0.34	0.31	0.35	0.51	0.34	0.41	0.26	0.42	0.36	0.62	0.56	0.59	1.00																																	
27	0.22	0.23	0.12	0.22	0.25	0.19	0.16	0.21	0.16	0.11	0.16	0.10	0.13	0.17	0.15	0.07	0.05	0.06	0.01	0.01	0.06	0.17	0.17	0.28	0.24	0.22	0.29	0.28	0.25	0.20	0.28	0.24	0.40	0.32	0.50	0.43	1.00																																	
28	0.38	0.41	0.20	0.41	0.46	0.42	0.37	0.40	0.33	0.24	0.31	0.21	0.21	0.25	0.28	0.13	0.09	0.10	0.03	0.04	0.11	0.15	0.13	0.51	0.50	0.50	0.63	0.46	0.51	0.38	0.60	0.53	0.60	0.50	0.40	0.59	0.32	1.00																																	
29a	0.10	0.13	0.08	0.13	0.16	0.19	0.15	0.19	0.20	0.18	0.16	0.12	0.12	0.15	0.21	0.12	0.09	0.04	0.04	0.16	0.21	0.21	0.28	0.13	0.11	0.14	0.27	0.16	0.19	0.10	0.21	0.14	0.50	0.38	0.48	0.47	0.33	0.32	1.00																																	
29b	0.11	0.14	0.05	0.13	0.18	0.17	0.17	0.20	0.21	0.19	0.15	0.12	0.11	0.12	0.19	0.09	0.09	0.07	0.04	0.06	0.16	0.17	0.22	0.17	0.15	0.18	0.30	0.17	0.21	0.11	0.25	0.20	0.49	0.41	0.54	0.53	0.40	0.37	0.61	1.00																																	
30a	0.03	0.06	0.03	0.07	0.09	0.11	0.07	0.09	0.10	0.09	0.07	0.04	0.03	0.05	0.14	0.04	0.03	0.02	0.06	0.17	0.21	0.12	0.22	0.05	0.07	0.06	0.11	0.07	0.11	0.06	0.09	0.06	0.32	0.23	0.27	0.26	0.22	0.18	0.43	0.30	1.00																																	
30b	0.09	0.16	0.06	0.13	0.16	0.18	0.17	0.19	0.21	0.18	0.17	0.10	0.12	0.14	0.23	0.09	0.10	0.04	0.05	0.14	0.25	0.21	0.25	0.10	0.10	0.11	0.24	0.14	0.18	0.09	0.16	0.11	0.39	0.46	0.42	0.40	0.28	0.29	0.47	0.42	0.40	1.00																																	
30c	0.08	0.10	0.07	0.11	0.11	0.13	0.09	0.14	0.18	0.14	0.10	0.06	0.09	0.13	0.16	0.06	0.06	0.10	0.02	0.02	0.08	0.24	0.13	0.20	0.12	0.11	0.13	0.16	0.12	0.17	0.10	0.16	0.12	0.28	0.27	0.28	0.28	0.23	0.20	0.33	0.28	0.30	0.31	1.00																																	
HART1	0.29	0.27	0.16	0.20	0.25	0.14	0.25	0.19	0.21	0.09	0.09	0.10	0.09	0.15	0.10	0.10	0.06	0.07	0.00	0.00	0.03	0.06	0.00	0.39	0.35	0.34	0.28	0.42	0.31	0.36	0.32	0.30	0.19	0.19	0.12	0.18	0.15	0.22	0.05	0.05	0.01	0.04	0.07	1.00																																	
HART2	0.28	0.25	0.17	0.19	0.22	0.15	0.22	0.16	0.20	0.07	0.07	0.11	0.10	0.16	0.07	0.09	0.05	0.08	0.00	0.00	0.03	0.01	0.00	0.33	0.33	0.30	0.26	0.39	0.28	0.32	0.30	0.28	0.16	0.15	0.07	0.14	0.13	0.19	0.01	0.01	0.00	0.01	0.06	0.77	1.00																																	
HART3	0.31	0.26	0.15	0.15	0.26	0.12	0.15	0.09	0.16	0.05	0.06	0.09	0.05	0.12	0.07	0.04	0.01	0.06	0.00	0.00	0.02	0.02	0.00	0.27	0.31	0.19	0.18	0.30	0.20	0.21	0.19	0.18	0.12	0.16	0.07	0.13	0.12	0.17	0.02	0.03	0.00	0.01	0.07	0.40	0.42	1.00																																	
HART4	0.30	0.25	0.17	0.14	0.23	0.14	0.16	0.11	0.15	0.04	0.06	0.08	0.08	0.13	0.07	0.07	0.03	0.11	0.00	0.00	0.02	0.03	0.02	0.28	0.29	0.19	0.20	0.32	0.21	0.21	0.20	0.20	0.13	0.16	0.08	0.13	0.09	0.16	0.02	0.03	0.02	0.01	0.05	0.47	0.52	0.73	1.00																																	
HART5	0.29	0.28	0.16	0.22	0.29	0.19	0.26	0.21	0.25	0.12	0.12	0.13	0.15	0.22	0.12	0.15	0.09	0.10	0.00	0.04	0.03	0.10	0.02	0.34	0.33	0.28	0.27	0.39	0.29	0.26	0.28	0.25	0.20	0.21	0.13	0.20	0.17	0.21	0.07	0.07	0.04	0.08	0.09	0.53	0.55	0.51	0.61	1.00																																	
HART6	0.35	0.30	0.22	0.19	0.26	0.16	0.21	0.17	0.18	0.07	0.11	0.11	0.16	0.18	0.08	0.08	0.06	0.07	0.00	0.02	0.01	0.08	0.03	0.30	0.33	0.25	0.23	0.37	0.25	0.23	0.24	0.22	0.16	0.15	0.10	0.15	0.17	0.19	0.03	0.04	0.00	0.04	0.07	0.54	0.60	0.64	0.70	0.63	1.00																																	
HART7	0.36	0.30	0.17	0.20	0.28	0.14	0.22	0.15	0.19	0.06	0.09	0.10	0.10	0.16	0.09	0.06	0.03	0.07	0.00	0.00	0.01	0.01	0.00	0.33	0.35	0.29	0.25	0.43	0.27	0.26	0.26	0.22	0.15	0.16	0.07	0.16	0.13	0.22	0.03	0.04	0.01	0.03	0.03	0.61	0.59	0.61	0.63	0.59	0.72	1.00																																	
HART8	0.22	0.20	0.11	0.15	0.21	0.16	0.22	0.21	0.22	0.10	0.06	0.10	0.10	0.18	0.10	0.16	0.06	0.11	0.00	0.00	0.03	0.05	0.00	0.34	0.28	0.31	0.25	0.37	0.31	0.35	0.32	0.32	0.20	0.20	0.16	0.19	0.14	0.22	0.06	0.07	0.03	0.08	0.12	0.64	0.57	0.30	0.38	0.53	0.37	0.43	1.00																																	
HART9	0.24	0.22	0.13	0.17	0.22	0.15	0.21	0.17	0.19	0.07	0.06	0.10	0.11	0.15	0.07	0.08	0.06	0.08	0.00	0.00	0.03	0.04	0.00	0.31	0.31	0.32	0.25	0.37	0.28	0.30	0.29	0.28	0.17	0.16	0.07	0.16	0.12	0.20	0.02	0.03	0.01	0.02	0.06	0.78	0.76	0.37	0.45	0.54	0.52	0.55	0.71	1.00

TABLE 2. Species diversity in the plots

Plot	Native species	Weeds	Total
1	89	0	89
2	81	0	81
3	67	1	68
4	70	1	71
5	72	7	79
6	91	1	92
7	96	0	96
8	62	5	67
9	77	0	77

5. DISCUSSION.

The results in Figure 1 show that all of the plots are closely related, which can be interpreted as due to their close proximity on a similar soil and landform, with many species in common. There are no wetlands or other clearly distinctive units.

The floristic analysis in Figure 1 shows that the plots fall sharply into two basic groups which agree well with the mapping of the vegetation on conventional species and structure (illustrated in Plates 1-6, next three pages):

- Plots 1, 2, 8 and 9, (which are all Banksia woodlands), and
- Plots 3, 4, 5, 6 and 7 (which are all Eucalypt woodlands).

The pairs chosen as replicates (1 and 9, 3 and 4, and 6 and 7) are all closely related to each other with 75-80% similarity between the plots within each pair. Plot 2 (Plate 3) was regarded in the field an inadequate replicate for plot 1, but by floristics is extremely close to plots 1 and 9. This illustrates the difficulty of interpreting floristic information by subjective study. Plot 8 (Plate 2) was recognised as different to plots 1 and 2, with a lower species diversity and more weeds, and the floristic analysis supports this. The two pairs of Eucalypt woodland sites (3 and 4, and 6 and 7) are clearly related but also clearly separated, while Plot 5 is slightly more distant again. These two pairs show a great difference in species totals, with plot 5 being intermediate and having more weeds (Table 2).

Despite the high similarity between all of the plots, the highest values even for the most closely related replicate plots are not extremely high, with all values less than 0.8. This can be interpreted as due to a very high species diversity so that in spite of the fundamental similarity single plots are not sampling all of the species diversity seen in each presumably homogeneous variation of the vegetation.

The results for the analysis of the nine plots within the context of the Southern Swan Coastal Plain survey produced the surprising result that none of the plots is closely related to the community types in that survey (Figure 2). The least similar groups are the northern and coastal wetlands (community types 11 to 19), followed by the coastal dry land units (community types 24 to 30 except 28 which is the Spearwood Banksia unit). The remaining groups split roughly into the eastern coastal plain/scarp woodlands (community types 1a, 1b, 3b, and 21b which is the southern *B. attenuata* unit) and the other Banksia-Jarrah communities (community types 20 to 23 without 21b, and 28), and the southern and central wetlands (community types 2, 3a, 3c, and 4 to 10).

PLATE 1. Typical Banksia woodland (Plots 1 and 9).

PLATE 2. Banksia woodland variant in Plot 8.

PLATE 3. Banksia woodland variant in Plot 2, subjectively different but floristically very similar to Plots 1 and 9.

PLATE 4. Jarrah/Corymbia haematoxylon Forest (Plots 3 and 4).

PLATE 5. Jarrah/Corymbia haematoxylon Open Forest (Plots 6 and 7).

PLATE 6. Jarrah/Corymbia haematoxylon/Marri Forest (Plot 5).

This analysis agrees with the general floristic result from the Southern Swan Coastal Plain survey (see Figure 3 which is Figure 6 of the report reproduced on the next page: Note that the scale is a dissimilarity measure rather than similarity). Community types 11 to 19 and 4 to 10 form a wetland group, community types 24 to 30 form a coastal group, community types 20 to 23 form a Bassendean dune Banksia group, while community types 1, 2 and 3 form an eastern coastal plain and base of the scarp group.

The general result of the floristic analysis places the nine sites considered here closest to the eastern coastal plain/scarp woodlands (community types 1a, 1b, 3b, and 21b which is the southern *B. attenuata* unit) and the other Banksia-Jarrah communities (community types 20 to 23 without 21b, and 28). The southern and central wetlands (community types 2, 3a, 3c, and 4 to 10) are also included, but can be removed on landform considerations alone.

From Table 1, the following results can be seen from the individual values:

- Plots 1, 2, 8 and 9 are most similar to the Banksia units, followed by the scarp units. The highest values are with 21b which is the southern *B. attenuata* unit, followed by 20a which is the *Banksia attenuata* woodlands over species rich dense shrublands, and 22 which is *Banksia ilicifolia* woodlands of the northern areas. It should be noted that the differences are not large, and therefore some differences may not be significant.

- Plots 3, 4, 5, 6 and 7 are most similar to both some of the Banksia units and the scarp units. The highest values are with 21b which is the southern *B. attenuata* unit, followed by 20b which is the eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the base of the scarp and 1a which is the *Corymbia haematoxylon - Eucalyptus marginata* woodlands on Whicher foothills. Again it should be noted that the differences are not large, with for example 20a which is the *Banksia attenuata* woodlands over species rich dense shrublands also scoring some higher values.

- There is some evidence that plots 3 and 4 are the most different, with the highest similarity value to any community type being only 0.32.

- The wetlands group (community types 2, 3a, 3c, and 4 to 10) do not produce any high values.

While these results may be meaningful, the similarity values in Table 1 are all low, with no value exceeding 0.43, and only two values over 0.39. This result suggests that there may be other factors involved and which need to be examined.

Figure 6. Dendrogram showing the four super groups and the 30 community types defined from the floristic presence / absence data set.

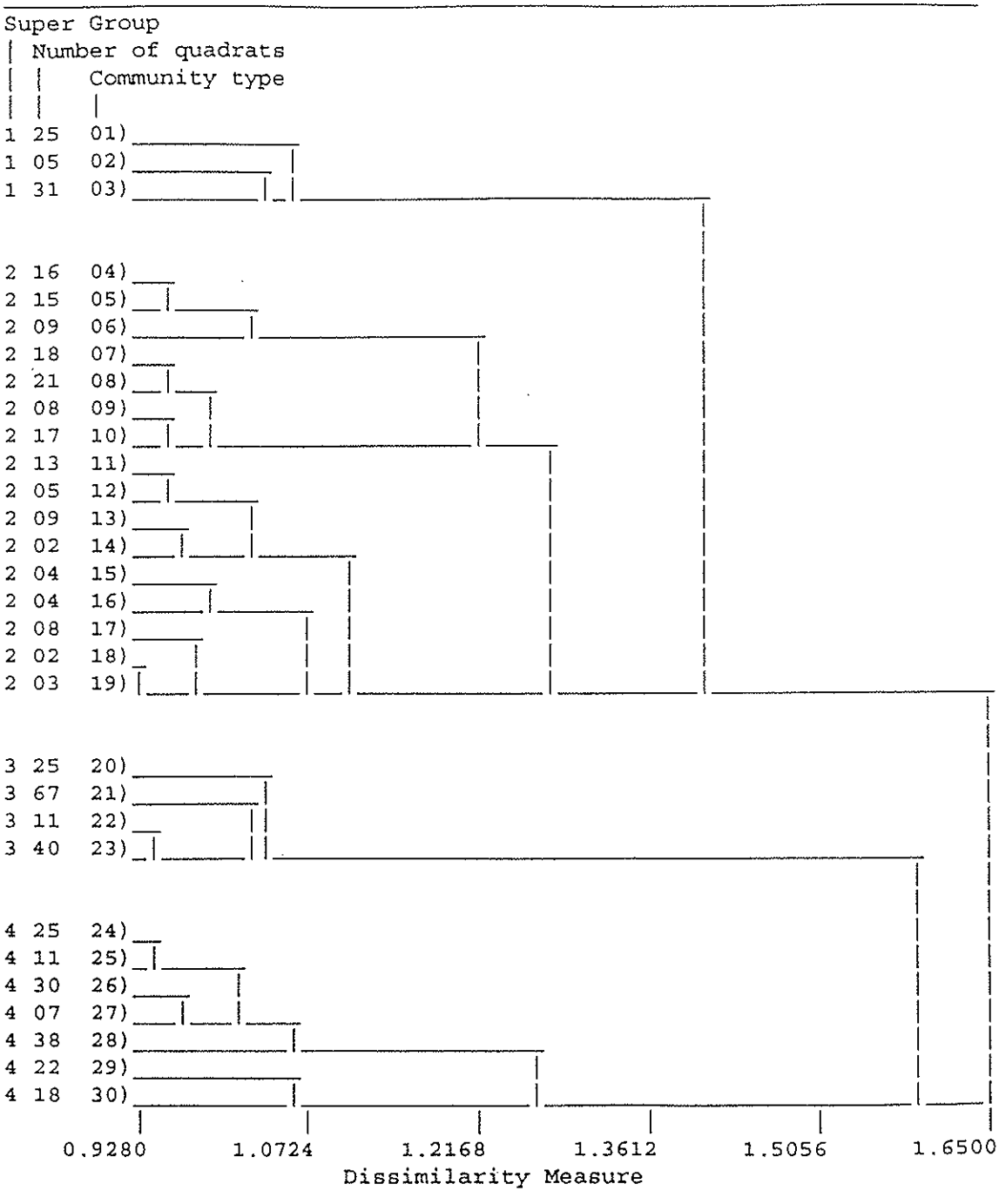


FIGURE 3. COMMUNITY TYPE CLASSIFICATION (Figure 6 reproduced from Southern Swan Coastal Plain survey report).

The values for species richness given for the plots in Table 2 may explain some of the results. The values are very high:

Banksia group:
Plot 1 (89 species)
Plot 9 (77 species)
Plot 2 (81 species)
Plot 8 (67 species)

Eucalypt woodland group:
Plot 3 (68 species)
Plot 4 (71 species)
Plot 5 (79 species)
Plot 6 (92 species)
Plot 7 (96 species)

Figure 4 (next page) is reproduced from the Southern Swan Coastal Plain survey and shows the frequency distribution of species diversities. It can be seen that

- Plots 1, 2, 6 and 7 are in the top one percentile.
- Only plots 8 and 3 fall outside the top 10% on species totals.
- No plot from this single site falls outside the regional top 15% on species total.
- The average value of the plots considered here from a single site (80 species) is in the top 2% of the regional values.

Much of the difference is due to the low species diversity in the wetland units (which do not occur at Yoganup), but the top one percentile in the 509 plots represents only 5 plots in the entire regional survey.

The results above also show that the highest species totals are in plots 6 and 7 (averaging 94 species), followed by the Banksia units (ranging from 67 to 89 and averaging 78.5), plot 5 with 79 species, and plots 3 and 4 (average of 69.5 species). Again there is evidence that plots 3 and 4 are distinct from plots 6 and 7.

In total 12 species were recorded in the plots considered here which were not recorded in the Southern Swan Coastal Plain survey (see Appendix 3), but the significance if any of these is not known. They may simply be sampling differences.

These species totals are very high and may be confusing the floristic analysis.

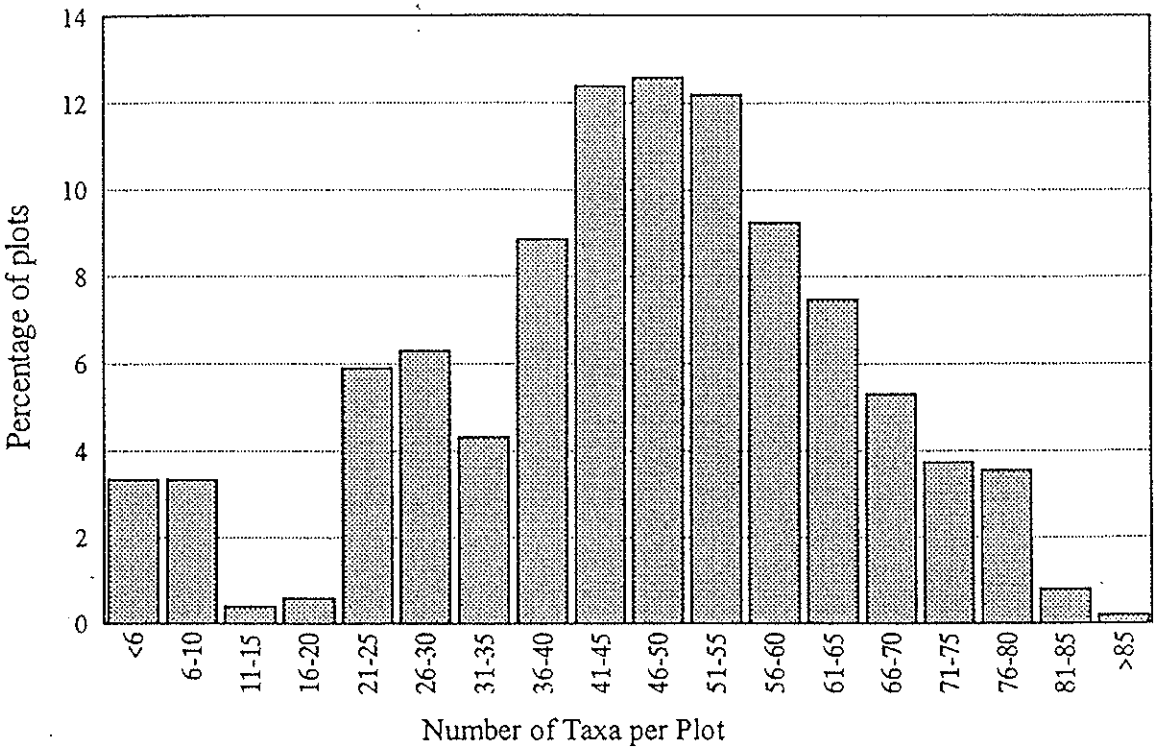


Figure 4. Histogram showing percentage of plots with different species richness. Note the group of species poor wetlands at one end and the very high species richness of some woodlands and shrublands at the other.

FIGURE 4. SPECIES DIVERSITY IN SOUTHERN SWAN COASTAL PLAIN SURVEY (Figure 4 reproduced from Southern Swan Coastal Plain survey report).

In some cases the most similar floristic groups produced by the analysis are clearly reasonable:

- The Banksia plots are closest to 21b which is the southern *B. attenuata* unit.

- The Eucalypt woodland plots are closest to 21b which is the southern *B. attenuata* unit, followed by 20b which is the eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the base of the scarp and 1a which is the *Corymbia haematoxylon-Eucalyptus marginata* woodlands on Whicher foothills.

In other cases the results are not reasonable:

- The Banksia plots are close to 20a which is the *Banksia attenuata* woodlands over species rich dense shrublands from the Perth area including the base of the scarp. Examination of the description of this unit in the Southern Swan Coastal Plain report shows that it is a diverse unit but that some of the characteristic species are not present in the plots considered here. Large differences in species north-south would be expected, and the plots recorded at Yoganup cannot be fitted within the definition of that community type without changing it significantly.

- The Banksia plots are also close to 22 which is *Banksia ilicifolia* woodlands of the northern areas. This was found on Bassendean and Spearwood dunes north of Rockingham, and is characterised by a very open understorey and low species diversity (mean 32.5). It does not fit the Yoganup site at all.

- The Eucalypt plots have some higher similarity values with 20a which is the *Banksia attenuata* woodlands over species rich dense shrublands. The highest values occur with plots 6 and 7, which probably results from the very high species diversity and consequent high degree of overlap.

In total it is difficult to assess the floristic units because of the low similarity values. The most reasonable conclusions are that:

- The Banksia vegetation is closest to 21b which is the southern *B. attenuata* unit, and possibly to something like 20a which is the *Banksia attenuata* woodlands over species rich dense shrublands from the Perth area including the base of the scarp, but the similarities are not strong. The species total are very high, ranging from 67 to 89 and averaging 78.5 compared to mean values of 61.3 for 21b and 67.4 for 20a.

- The Eucalypt woodlands are closest to 21b which is the southern *B. attenuata* unit, followed by 20b which is the eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the base of the scarp and 1a which is the *Corymbia haematoxylon - Eucalyptus marginata* woodlands on Whicher foothills, but the similarities are not strong for any of them. The species total are very high, ranging from 68 to 96 compared to mean values of 61.3 for 21b, 62.7 for 20b, and 67.6 for 1a.

- The results are probably confused by the very high species diversity, producing some overlap but low similarities to the regional community types.

- If the plots from this study were included in the community types of the Southern Swan Coastal Plain survey, they might change the definition of some units significantly, particularly that of 20a.

This situation can be interpreted in several ways:

- The site is unique or unusual in some way, with vegetation types not previously recorded.

- The site is unique or unusual in some way, with an extreme species diversity not seen elsewhere.

- The survey was intensive rather than extensive and has detected a high degree of heterogeneity in the vegetation which confuses the identification of units.

- The previous regional survey did not cover the vegetation adequately, and there are many other units or variations present on this and probably other sites. Community type 21b was represented by 12 plots, 20a by 7 plots, 20b by 9 plots and 1a by 13 plots.

At this stage it is not possible to resolve these possibilities fully. It has not been possible to fully identify the vegetation units present, and the results suggest that they may be undescribed variations of the wider community types characterised by very high species diversities.

A possible explanation of the results can be found in an unpublished floristic study of the northern Darling Scarp (Markey 1997). This study showed that there were floristic units not identified in the Southern Swan Coastal Plain report. None of the new units identified agree with the units identified at Yoganup because they do not come from the same landform units, but most interestingly the species diversities reported are very high. The average values ranged from 45.5 to 75.7, and the highest individual values for several floristic units were around 90.

The most reasonable conclusion is that there are floristic units on the southern scarp which have not yet been identified. There is a high species diversity which is producing the partially spurious result that these scarp units are most closely related to known and published community types.

The results to date can be used to partly assess the conservation values of the vegetation. The values of the vegetation derive from:

- The presence of rare species.
- The rarity and conservation status of the landforms, vegetation units and fauna habitats provided by the remnants.
- The value of the remnant vegetation in a local and regional context because of its position and regardless of its intrinsic values.

No Declared Rare Flora species were found, but the eight Priority species identified have the following status:

Priority 1
Eremaea asterocarpa subsp. *brachyclada*. This is very rare on the site and found only once in the southern corner. This species appears to be known only from a few collections on sand in the Perth area. It is poorly known.

Caustis sp. Boyanup. This is scarce on the site and occurs in the more sandy areas. This species is widespread on the southern coastal plain and in jarrah forest from Busselton across to the Albany Highway. It is common locally.

Priority 2
Acacia mooreana. This is sparse but scattered through the Eucalypt woodlands. This species is widespread on the southern coastal plain and in jarrah forest, on sand often over laterite and in wet places.

Priority 3
Acacia semitrullata. This is scattered in the more sandy areas. This species is widespread on the southern coastal plain and in jarrah forest, on sand often over laterite and in wet places.

Synaphea whicherensis. This is reasonably common in the Eucalypt woodlands. This species is widespread on the southern coastal plain and in jarrah forest, on sand and laterite, often in wet places.

Priority 4
Caladenia speciosa. This was found only twice in Banksia woodland. This species is widespread on the coastal plain in Banksia-Jarrah, from Gingin to Ludlow. It is most often seen flowering after fire.

Drosera marchantii subsp *marchantii*. This was found only once in a Eucalypt woodland. This species is widespread on the southern coastal plain and in jarrah forest, on laterite often in wet places.

Franklandia triaristata. This is reasonably common in the more sandy areas. This species is widespread in the lower South-West from Bunbury across to Albany on sand often.

Priority species do not have the same legal protection as Declared Rare Flora species. The presence of these Priority species is not in itself sufficient to prevent mining because they are not rare and restricted enough.

The landforms, vegetation units and associated habitats are of uncertain status in the region. The scarp areas have generally been heavily cleared for farming, but extensive areas remain. In the Southern Swan Coastal Plain survey the community types discussed here are given the following classification (where Susceptible means it can be modified or destroyed by human activities, and Vulnerable means it is likely to become endangered if the causal factors continue to operate):

- Community Type 21b (southern *Banksia attenuata* woodlands): Well reserved but Susceptible.

- Community type 20b (eastern *Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the base of the scarp): Poorly reserved and Vulnerable, and regionally already rare.

- Community type 1a (*Corymbia haematoxylon* - *Eucalyptus marginata* woodlands on Whicher foothills): Unreserved and Susceptible.

The status of these units results from the extensive clearing which has taken place over a long time. On this basis the vegetation must be given a high conservation value.

It is not possible to assess the conservation status of the precise vegetation units present because these have not been fully identified. The results and discussion here suggest that they may be undescribed community types, with at least a very high species diversity as a characteristic feature. If this is true it is likely that some regulatory authorities will regard the vegetation as unique or at least of very high conservation value. Further regional study is required to deal with this problem.

The remnant considered here is private property and has no existing or proposed status as conservation land, but it is in excellent condition and is a good example of the original vegetation. In a regional context it must be given a high conservation value due to the extent of clearing. Further information is also required on the extent of this vegetation regionally, and the extent of clearing.

The conservation values of the vegetation need further study, but they are likely to be high enough to make any proposal to carry out mining subject to a high degree of scrutiny and possibly a high degree of opposition from some regulatory authorities which will make it difficult to obtain approval. The problems would be compounded by the lack of knowledge about the vegetation within a local and regional context. The lack of knowledge makes it easy for regulatory authorities to conclude that it is unique and therefore of very high value.

The lack of information is likely to be recurring problem for Iluka, and the gathering of such information over time will be useful.

6. REFERENCES.

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Keighery, B. (1994). Bushland Plant Survey. Wildflower Society of W.A., Perth.

Markey, A. (1997). Floristic Survey of the northern Darling Scarp. Report for the Australian Heritage Commission.

APPENDIX 1. List of all plant species recorded in the Yoganup Extended 90' block.

Collection numbers are given where specimens were collected. Introduced species are identified by an asterisk (*).

SPECIES	Collection number.
FERNS	
LINDSAEACEAE	
Lindsaea linearis	6374
CYCADS	
ZAMIACEAE	
Macrozamia riedlei	
GYMNOSPERMS	
PODOCARPACEAE	
Podocarpus drouynianus	
CUPRESSACEAE	
Actinostrobus acuminatus	6444
DICOTYLEDONS	
APIACEAE	
Hydrocotyle callicarpa	6422
Platysace anceps	6389
Trachymene pilosa	6306
Xanthosia ciliata	6326
Xanthosia huegelii	6314
ASTERACEAE	
* Arctotheca calendula	
* Cotula turbinata	6430
* Hypochaeris glabra	
Millotia tenuifolia	6411
Podotheca angustifolia	6440B
Rhodanthe citrina	6410
* Ursinia anthemoides	
CAESALPINIACEAE	
Labichea punctata	6368

	Collection Number
CASUARINACEAE	
Allocasuarina fraseriana	
Allocasuarina humilis	
Allocasuarina thuyoides	6336
CRASSULACEAE	
Crassula colorata	6427/8
DILLENIACEAE	
Hibbertia acerosa	6291
Hibbertia amplexicaulis	6369
Hibbertia commutata	6375
Hibbertia ferruginea	6291
Hibbertia hypericoides	
Hibbertia racemosa	6400
Hibbertia vaginata	6309
DROSERACEAE	
Drosera erythrorhiza	6318
Drosera marchantii ssp. marchantii	6423
Drosera menziesii	6413
Drosera pallida	6303
Drosera stolonifera ssp. stolonifera	6452
Drosera ?paleacea	6293
EPACRIDACEAE	
Andersonia caerulea	6274
Astroloma pallidum	6373
Brachyloma preissii	6388
Conostephium pendulum	6297
Leucopogon carinatus	6304 1289
Leucopogon conostephioides	6341
Leucopogon glabellus	6339
Leucopogon pendulus	6398
Leucopogon polymorphus	6304 34567
Lysinema ciliatum	6325
EUPHORBIACEAE	
Amperea simulans	6402
Ricinocarpos glaucus	6376
Stachystemon sp. aff. axillaris	6407

	Collection Number
GERANIACEAE	
* Erodium botrys	6434
GOODENIACEAE	
Dampiera linearis	6316
Lechenaultia biloba	
Scaevola ?striata ssp. striata	6319, 6381
LAMIACEAE	
Hemiandra pungens	6379
LAURACEAE	
Cassytha sp.	6343/6366
LOBELIACEAE	
Lobelia rhombifolia	6406
LOGANIACEAE	
Phyllangium paradoxum	6408
LORANTHACEAE	
Nuytsia floribunda	6322
MIMOSACEAE	
Acacia extensa	6358
Acacia mooreana	6391, 6446
Acacia pulchella	
Acacia semitrullata	6332
Acacia stenoptera	6321
Acacia urophylla	6380
MYRTACEAE	
Calothamnus sanguineus	6386
Calytrix flavescens	6275
Calytrix leschenaultii	6270
Corymbia calophylla	
Corymbia haematoxylon	
Darwinia vestita	6353
Eremaea asterocarpa ssp. brachyclada	6271
Eremaea pauciflora	6271

	Collection Number
Eucalyptus marginata	
Hypocalymma robustum	6273
Kunzea recurva	6324, 6345
Melaleuca scabra	6305
Melaleuca thymoides	6401
Pericalymma ellipticum	6349
Verticordia densiflora ssp. densiflora	6272, 6298
PAPILIONACEAE	
Bossiaea eriocarpa	6307
Chorizema glycinifolium	6438B, 6395
Daviesia divaricata	6372
Daviesia inflata	6342
Daviesia nudiflora	6371
Daviesia physodes	6296
Gompholobium knightianum	6439B
Gompholobium polymorphum	6447
Gompholobium scabrum	6440A
Gompholobium tomentosum	
Hovea trisperma	6288
Jacksonia horrida	6340
Jacksonia lehmannii	6279
Kennedia coccinea	6445
Sphaerolobium drummondii	6441
Sphaerolobium medium	6397
PITTOSPORACEAE	
Billardiera sp.	6393
POLYGALACEAE	
Comesperma calymega	
PROTEACEAE	
Adenanthos barbiger	6363
Adenanthos meisneri	6331
Adenanthos obovatus	
Banksia attenuata	
Banksia grandis	
Banksia ilicifolia	
Conospermum teretifolium	6354

	Collection Number
Dryandra lindleyana subsp. lindleyana	23
Franklandia triaristata	6289
Grevillea quercifolia	6451
Hakea amplexicaulis	
Hakea cyclocarpa	
Hakea ruscifolia	
Isopogon sphaerocephalus	
Petrophile linearis	
Persoonia ellipticum	
Persoonia saccata	68
Stirlingia latifolia	
Synaphea floribunda	6356
Synaphea whicherensis	6356
Xylomelum occidentale	
RUTACEAE	
Boronia dichotoma	6337
Philotheca spicata	6350
SANTALACEAE	
Exocarpos aphyllus	6454
STACKHOUSIACEAE	
Stackhousia monogyna	6337
Philotheca spicata	6350
STYLIDIACEAE	
Levenhookia pusilla	6404
Stylidium amoenum	6370
Stylidium brunonianum	6313
Stylidium diversifolium	6295
Stylidium piliferum	6327
Stylidium repens	6284
THYMELAEACEAE	
Pimelea rosea	6418
TREMANDRACEAE	
Platytheca galioides	6435
Tetratheca hirsuta	6315, 6449

	Collection Number
MONOCOTYLEDONS	
ANTHERICACEAE	
Caesia sp.	6300
Chamaescilla corymbosa var. corymbosa	6286
Johnsonia pubescens	6312
Laxmannia sessiliflora ssp. sessiliflora	6396
Thysanotus arbusculus	6330/84
Thysanotus sparteus	6330/84
Thysanotus tenellus	6405
Tricoryne elatior	6450
Tricoryne tenella	6377
COLCHICACEAE	
Burchardia congesta	6320
CENTROLEPIDACEAE	
Aphelia cyperoides	6426
Centrolepis drummondiana	6412
CYPERACEAE	
Caustis sp. Boyanup	6328
Cyathochaeta equitans	6287
Cyathochaeta sp.	6394
Lepidosperma leptostachyum	6392
Lepidosperma squamatum	6348
Lepidosperma ?pubisquameum	6346
Mesomelaena tetragona	6378
Schoenus caespititius	6334
Schoenus curvifolius	6311
Schoenus sublateralis	6329
Schoenus sublaxus	6453
Tetraria capillaris	6387
Tetraria octandra	6367
Sp. indet.	6352

	Collection Number
DASYPOGONACEAE	
Dasypogon bromeliifolius	
Kingia australis	
Lomandra caespitosa	6280/3
Lomandra hermaphrodita	6281
Lomandra integra	6282/6347
Lomandra preissii	6335
Lomandra purpurea	6347
Lomandra sericea	6294
Lomandra sonderi	6361, 6403
Lomandra spartea	6280/3
HAEMODORACEAE	
Conostylis serrulata	6302
Conostylis setigera	6344
Haemodorum sp.	6357
Phlebocarya ciliata	6276
Phlebocarya filifolia	6310
IRIDACEAE	
Patersonia occidentalis	6299
Patersonia umbrosa ssp. xanthina	6299
ORCHIDACEAE	
Caladenia flava	
Caladenia longiclavata	6429, 37A
Caladenia reptans	
Caladenia speciosa	6415, 38A
Cyanicula sericea	6442
Diuris aff. corymbosa	6455
Elythranthera brunonis	6417, 39A
Eriochilus ?dilatatus	6390
Leporella fimbriata	6301
Paracaleana nigrita	6414
Prasophyllum parvifolium	6456
Pterostylis barbata	6382
Pterostylis pyramidalis	6399
Pterostylis recurva	
Pterostylis aff. vittata	6338
Pyrorchis nigricans	6355
Thelymitra crinita	6419, 6424
Thelymitra ?pauciflora	6420

	Collection Number
POACEAE	
* Aira caryophyllea	6433
Amphipogon ?laguroides	6278
Amphipogon turbinatus	6278
* Briza minor	6431
* Ehrharta longifolia	
* Lolium sp.	
* Poa annua	6432
Stipa compressa	6425
* Sp. indet.	6436
Sp. indet.	6448
RESTIONACEAE	
Anarthria prolifera	6285
Desmocladus fasciculatus	6360
Hypolaena exsulca	6292, 6359
Lyginia imberbis	6290
XANTHORRHOEACEAE	
Xanthorrhoea preissii	
Xanthorrhoea gracilis	

APPENDIX 2. List of the species recorded in each plot.

Introduced species are identified by an asterisk (*).

Plot		1	2	3	4	5	6	7	8	9
Acacia extensa	6358		X			X	X			
Acacia huegelii									X	X
Acacia mooreana	6391/ 6446			X	X		X			
Acacia pulchella		X	X		X	X	X	X	X	X
Acacia semitrullata	6332	X							X	X
Acacia stenoptera	6321	X	X			X	X	X		X
Acacia urophylla	6380					X	X	X		
Adenanthos barbiger	6363			X	X	X	X	X		
Adenanthos meisneri	6331	X	X	X	X	X		X		
Adenanthos obovatus	6317	X						X		
* Aira caryophyllea	6433					X			X	
Allocasuarina fraseriana				X	X			X		
Allocasuarina humilis		X	X				X			X
Allocasuarina thuyoides	6336	X								X
Amperea simulans	6402		X		X	X				
Amphipogon ?laguroides	6383						X	X		
Amphipogon turbinatus	6278	X	X			X			X	X
Anarthria prolifera	6285	X	X	X	X	X	X	X		
Andersonia caerulea	6274	X	X							X
Aphelia cyperoides	6426					X				
* Arctotheca calendula		X				X	X			X
Astroloma pallidum	6373			X	X	X				
Austrostipa compressa	6425								X	X
Banksia attenuata		X	X			X		X	X	X
Banksia grandis		X		X	X			X		
Banksia ilicifolia		X	X							
Billardiera sp.	6393		X				X			
Boronia dichotoma	6337	X	X	X	X	X	X	X		X
Bossiaea eriocarpa	6307	X	X	X	X	X	X	X	X	X
Brachyloma preissii	6388						X	X		
* Briza minor	6431					X				
Burchardia congesta	6320	X	X		X	X	X	X	X	X
Caesia sp.	6300	X	X							
Caladenia flava			X	X	X	X	X	X	X	X
Caladenia longiclavata	6437									X
Caladenia speciosa	6438									X
Calothamnus sanguineus	6386						X	X		
Calytrix flavescens	6275	X	X					X	X	X
Calytrix leschenaultii	6270	X	X					X	X	X
Cassytha sp.	6343/ 66	X	X	X			X		X	
Caustis sp. Boyanup	6328	X								
Centrolepis drummondiana	6412	X							X	
Chamaescilla corymbosa	6286	X	X			X		X	X	X
Chorizema glycinifolium	6395							X		

Plot		1	2	3	4	5	6	7	8	9
Conospermum teretifolium	6354		X							
Conostephium pendulum	6297	X	X	X	X	X	X	X	X	X
Conostylis serrulata	6302	X	X		X	X	X	X		X
Conostylis setigera	6344	X	X	X	X		X	X		
Corymbia calophylla			X	X						
Corymbia haematoxylon				X	X	X	X	X		
* Cotula turbinata						X			X	
Crassula colorata	6427/8					X				
Cyathochaeta equitans	6287	X	X				X	X		X
Cyathochaeta sp.	6394							X		
Dampiera linearis	6316	X	X	X						
Darwinia vestita	6353		X						X	
Dasypogon bromeliifolius		X	X	X	X	X	X	X	X	X
Daviesia divaricata	6372			X	X			X		
Daviesia inflata	6342	X	X				X	X		
Daviesia nudiflora	6371			X	X					
Daviesia physodes	6296	X	X			X		X		
Desmocladus fasciculatus	6360		X	X	X	X	X	X		
Drosera erythrorhiza	6318	X	X	X	X	X	X			
Drosera marchantii ssp. marchantii								X		
Drosera menziesii				X		X		X	X	X
Drosera pallida	6303	X	X		X	X	X	X	X	
Drosera ?paleacea	6293	X							X	X
Dryandra lindleyana	6308	X				X	X	X		
Elythranthera brunonis									X	
Eremaea pauciflora	6271	X	X			X		X	X	X
Eriochilus ?dilatatus	6390						X			
* Erodium botrys						X			X	
Eucalyptus marginata				X	X	X	X	X		
Franklandia triaristata	6289	X	X					X	X	X
Gompholobium knightianum	6439			X				X		
Gompholobium polymorphum	6447			X	X					
Gompholobium tomentosum	6323	X						X	X	
* Grass indet.	6436				X					
Grass indet.	6448					X				
Haemodorum sp.	6357		X							X
Hakea amplexicaulis	6364			X	X					
Hakea ruscifolia	6362			X		X	X	X		
Hemiandra pungens	6379			X		X		X		
Hibbertia acerosa	6333	X	X	X			X	X		X
Hibbertia amplexicaulis	6369			X	X		X	X		
Hibbertia commutata	6375			X	X		X	X		
Hibbertia ferruginea	6291	X	X	X	X	X	X		X	X
Hibbertia hypericoides		X	X	X	X	X	X	X	X	X
Hibbertia racemosa	6400								X	
Hibbertia vaginata	6309	X	X	X	X	X	X	X	X	X
Hovea trisperma		X	X	X	X		X		X	X
Hydrocotyle callicarpa							X			

Plot		1	2	3	4	5	6	7	8	9
Hypocalymma robustum	6273	X	X	X	X	X	X	X	X	X
Hypochaeris glabra		X	X	X	X	X	X		X	X
Hypolaena exsulca	6292	X	X	X	X	X	X	X	X	X
Isopogon sphaerocephalus				X	X		X	X		
Jacksonia horrida	6340	X	X				X	X	X	X
Jacksonia lehmannii	6279	X	X				X			X
Johnsonia pubescens	6312	X							X	X
Kingia australis							X			
Kunzea recurva	6324/ 35	X	X		X	X	X	X		X
Labichea punctata	6368			X	X	X	X	X		
Laxmannia sessiliflora	6396							X		
Lechenaultia biloba	6437							X		
Lepidosperma ?pubisquameum	6346	X			X					
Lepidosperma squamatum	6348		X			X		X		X
Lepidosperma leptostachyum	6392			X			X	X		
Leporella fimbriata	6301	X	X					X	X	X
Leucopogon carinatus		X	X						X	X
Leucopogon conostephioides	6341	X	X						X	X
Leucopogon glabellus	6339	X								X
Leucopogon pendulus	6398							X		
Leucopogon polymorphus	include 6421			X	X		X	X		
Levenhookia pusilla						X			X	
Lindsaea linearis	6374			X			X	X		
* Lolium sp.									X	
Lomandra integra	6282	X	X		X		X	X	X	X
Lomandra hermaphrodita	6281	X	X	X		X	X	X	X	X
Lomandra purpurea/integra	6347	X	X	X	X	X	X			X
Lomandra preissii	6335	X	X	X	X		X	X		
Lomandra spartea/caespitosa	6280/3	X	X	X			X	X	X	X
Lomandra sericea	6294	X	X	X	X	X	X	X		X
Lomandra sonderi	6361/ 6403		X							
Lyginia imberbis	6290	X	X		X	X	X	X	X	X
Lysinema ciliatum	6325	X	X							X
Melaleuca scabra	6305	X	X						X	X
Melaleuca thymoides		X	X	X	X	X	X	X	X	X
Mesomelaena tetragona	6378				X	X	X	X		
Millotia tenuifolia	6411	X				X			X	
Nuytsia floribunda	6322	X		X		X				X
Patersonia occidentalis	6299	X				X	X	X	X	X
Patersonia umbrosa ssp. xanthina	6416			X	X		X			
Pericalymma ellipticum	6349		X				X			
Persoonia saccata	6351		X							
Petrophile linearis		X	X			X	X	X	X	X
Philotheca spicata	6350		X			X	X			X

Plot		1	2	3	4	5	6	7	8	9
Phlebocarya ciliata	6276	X	X	X	X	X	X	X	X	X
Phlebocarya filifolia	6310	X	X		X	X	X	X	X	X
Phyllangium paradoxum	6408	X				X			X	
Pimelea rosea								X		
Platysace anceps	6389			X			X			
* Poa annua						X				
Pterostylis pyramidalis	6399						X		X	
Pterostylis barbata	6382				X	X	X		X	
Pterostylis recurva			X		X	X	X			X
Pterostylis aff. vittata	6338	X		X	X	X	X	X		X
Pyrorchis nigricans	6355		X						X	X
Ricinocarpos glaucus	6376				X					
Scaevola striata	6319/ 81	X	X	X			X	X		X
Schoenus curvifolius	6311	X	X						X	X
Schoenus sublateralis	6329	X	X		X		X	X		X
Schoenus caespititius	6334	X								
Sedge sp. indet.	6352		X							
Sphaerolobium medium	6397			X				X		
Stackhousia monogyna	6385						X			
Stirlingia latifolia		X	X	X	X	X	X	X	X	X
Stylidium amoenum	6370			X	X		X	X		
Stylidium brunonianum	6313	X	X						X	X
Stylidium diversifolium	6295	X	X				X	X		
Stylidium piliferum	6327	X	X	X	X		X	X	X	X
Stylidium repens	6284	X	X						X	X
Synaphea floribunda	6356		X		X	X	X	X		X
Synaphea whicherensis	6365			X	X					
Tetraria capillaris	6387			X	X		X	X		
Tetraria octandra	6367			X	X	X	X	X		
Tetratheca hirsuta	6315	X			X	X				
Thelymitra crinita				X	X	X	X	X		
Thelymitra ?pauciflora				X			X	X		
Thysanotus arbusculus/sparteus	6384	X	X		X		X	X	X	X
Thysanotus tenellus	6405		X	X	X	X	X	X	X	X
Trachymene pilosa	6306	X				X		X	X	X
Tricoryne elatior	6450				X					
Tricoryne tenella	6377				X	X	X	X		
* Ursinia anthemoides				X		X			X	
Verticordia densiflora	6272	X	X				X	X		X
Xanthosia ciliata	6326	X				X		X		
Xanthosia huegelii	6314	X			X			X	X	X
Xanthorrhoea gracilis				X		X	X			
Xanthorrhoea preissii						X	X			
Xylomelum occidentale		X	X	X	X	X	X	X		X

APPENDIX 3. Interpretation of the species identified in this survey for analysis.

Introduced species are identified by an asterisk (*).
Species listed as New were not recorded in the Southern Swan Coastal Plain Survey

Species in this report	No.	Old name or decision	Code
Acacia extensa	6358		ACAEXT
Acacia huegelii			ACAHUE
Acacia mooreana	6391/6446		ACAMOO
Acacia pulchella			ACAPUL
Acacia semitrullata	6332		ACASEM
Acacia stenoptera	6321		ACASTE
Acacia urophylla	6380		ACAURO
Adenanthos barbiger	6363	New	ADEBAR
Adenanthos meisneri	6331		ADEMEI
Adenanthos obovatus	6317		ADEOBO
* Aira caryophyllea	6433		AIRCAR
Allocasuarina fraseriana			ALLFRA
Allocasuarina humilis			ALLHUM
Allocasuarina thuyoides	6336		ALLTHU
Amperea simulans	6402	New	AMPSIM
Amphipogon ?laguroides	6383	Amphipogon laguroides	AMPLAG
Amphipogon turbinatus	6278		AMPTUR
Anarthria prolifera	6285		ANAPRO
Andersonia caerulea	6274		ANDCAE
Aphelia cyperoides	6426		APHCYP
* Arctotheca calendula			ARCCAL
Astroloma pallidum	6373		ASTPAL
Austrostipa compressa	6425	Stipa compressa	STICOM
Banksia attenuata			BANATT
Banksia grandis			BANGRA
Banksia ilicifolia			BANILI
Billardiera sp.	6393	Omitted: unidentifiable	
Boronia dichotoma	6337		BORDIC
Bossiaea eriocarpa	6307		BOSERI
Brachyloma preissii	6388		BRAPRE
* Briza minor	6431		BRIMIN
Burchardia congesta	6320	Burchardia umbellata	BURUMB
Caesia sp.	6300	Omitted: unidentifiable	
Caladenia flava			CALFLA
Caladenia longiclavata	6437	New	CALLLL
Caladenia speciosa	6438		CALSPE
Calothamnus sanguineus	6386		CALSAN
Calytrix flavescens	6275		CALFLAve
Calytrix leschenaultiii	6270		CALLES
Cassytha sp	6343/66	Omitted: unidentifiable	
Caustis sp. Boyanup	6328	New	CAUBBB
Centrolepis drummondiana	6412		CENDRU
Chamaescilla corymbosa	6286		CHACOR
Chorizema glycinifolium	6395		CHOGLY
Conospermum teretifolium	6354		CONTER
Conostephium pendulum	6297		CONPEN

Species in this report	No.	Old name or decision	Code
Conostylis serrulata	6302		CONSER
Conostylis setigera	6344		CONSET
Corymbia calophylla		Eucalyptus calophylla	EUCCAL
Corymbia haematoxylon		Eucalyptus haematoxylon	EUCHAE
* Cotula turbinata			COTTUR
Crassula colorata	6427/8		CRACOL
Cyathochaeta equitans	6287	Cyathochaeta clandestina	CYACLA
Cyathochaeta sp.	6394	New but omitted (probably mixed with previous species)	
Dampiera linearis	6316		DAMLIN
Darwinia vestita	6353	New	DARVES
Dasypogon bromeliifolius			DASBRO
Daviesia divaricata	6372		DAVDIV
Daviesia inflata	6342		DAVINF
Daviesia nudiflora	6371		DAVNUD
Daviesia physodes	6296		DAVPHY
Desmocladus fasciculatus	6360	Loxocarya fasciculata	LOXFAS
Drosera erythrorhiza	6318		DROERY
Drosera marchantii ssp. marchantii	6423		DROMARMA
Drosera menziesii			DROMENME
Drosera pallida	6303		DROPALPA
Drosera ?paleacea	6293	Drosera paleacea	DROPAL
Dryandra lindleyana	6308	Dryandra nivea	DRYNIV
Elythranthera brunonis			ELYBRU
Eremaea pauciflora	6271		EREPAU
Eriochilus ?dilatatus	6390	Eriochilus dilatatus	ERIDIL
* Erodium botrys			EROBOT
Eucalyptus marginata			EUCMARMA
Franklandia triaristata	6289		FRATRI
Gompholobium knightianum	6439		GOMKNI
Gompholobium polymorphum	6447		GOMPOL
Gompholobium tomentosum	6323		GOMTOM
* Grass indet.	6436	Omitted: unidentifiable	
Grass indet.	6448	Omitted: unidentifiable	
Haemodorum sp.	6357	Omitted: unidentifiable	
Hakea amplexicaulis	6364		HAKAMP
Hakea ruscifolia	6362		HAKRUS
Hemiandra pungens	6379		HEMPUN
Hibbertia acerosa	6333		HIBACE
Hibbertia amplexicaulis	6369		HIBAMP
Hibbertia commutata	6375		HIBCOM
Hibbertia ferruginea	6291	New	HIBFER
Hibbertia hypericoides			HIBHYP
Hibbertia racemosa	6400		HIBRAC
Hibbertia vaginata	6309		HIBVAG
Hovea trisperma			HOVTRITR

Species in this report	No.	Old name or decision	Code
Hydrocotyle callicarpa			HYDCAL
Hypocalymma robustum	6273		HYPROB
* Hypochaeris glabra			HYPGLAbr
Hypolaena exsulca	6292		HYPEXS
Isopogon sphaerocephalus			ISOSPH
Jacksonia horrida	6340	New	KACHOR
Jacksonia lehmannii	6279		JACLEH
Johnsonia pubescens	6312		JOHPUB
Kingia australis			KINAUS
Kunzea recurva	6324/35		KUNREC
Labichea punctata	6368		LABPUN
Laxmannia sessiliflora	6396		LAXSESAU
Lechenaultia biloba	6437		LECBIL
Lepidosperma ?pubisquameum	6346	Omitted: unidentifiable	
Lepidosperma squamatum	6348		LEPSQU
Lepidosperma leptostachyum	6392		LEPLEP
Leporella fimbriata	6301		LEPFIM
Leucopogon carinatus	6304	New	LEUCCC
Leucopogon conostephioides	6341		LEUCON
Leucopogon glabellus	6339		LEUGLA
Leucopogon pendulus	6398		LEUPEN
Leucopogon polymorphus	6304,6421		LEUPOL
Levenhookia pusilla	6404		LEVPUS
Lindsaea linearis	6374		LINLIN
* Lolium sp.		Omitted: unidentifiable	
Lomandra hermaphrodita	6281		LOMHER
Lomandra integra	6282		LOMINT
Lomandra preissii	6335		LOMPRE
Lomandra purpurea/integra	6347	Omitted: confused	
Lomandra sericea	6294		LOMSER
Lomandra sonderi	6361/6403		LOMSON
Lomandra spartea/caespitosa	6280/3	Omitted: confused	
Lyginia imberbis	6290	Lyginia barbata	LYGBAR
Lysinema ciliatum	6325		LYSCIL
Melaleuca scabra	6305		MELSCA
Melaleuca thymoides	6401		MELTHY
Mesomelaena tetragona	6378		MESTET
Millotia tenuifolia	6411		MILTEN
Nuytsia floribunda	6322		NUYFLO
Patersonia occidentalis	6299		PATOCC
Patersonia umbrosa ssp. xanthina	6416		PATUMBXA
Pericalymma ellipticum	6349		PERELLip
Persoonia saccata	6351		PERSAC
Petrophile linearis			PETLIN
Philotheca spicata	6350	Eriostemon spicatus	ERISPI
Phlebocarya ciliata	6276		PHLCIL
Phlebocarya filifolia	6310		PHLFIL
Phyllangium paradoxum	6408	Mitrasacme paradoxa	MITPAR
Pimelea rosea			PIMROS

Species in this report	No.	Old name or decision	Code
Platysace anceps	6389	New	PLAAAA
* Poa annua			POAANN
Pterostylis pyramidalis	6399	Pterostylis aff. nana	PTEAFFNA
Pterostylis barbata	6382		PTEBAR
Pterostylis recurva			PTEREC
Pterostylis aff. vittata	6338		PTEAFFVI
Pyrorchis nigricans	6355	Lyperanthus nigricans	LYPNIG
Ricinocarpos glaucus	6376	New	RICGLA
Scaevola striata	6319/81		SCASTR
Schoenus curvifolius	6311		SCHCUR
Schoenus sublateralis	6329	New	SCHSSS
Schoenus caespititius	6334		SCHCAE
Sedge indet.	6352	Omitted: unidentifiable	
Sphaerolobium medium	6397		SPHMED
Stackhousia monogyna	6385		STAMON
Stirlingia latifolia			STILAT
Stylidium amoenum	6370		STYAMO
Stylidium brunonianum	6313		STYBRU
Stylidium diversifolium	6295	New	STYDDD
Stylidium piliferum	6327		STYPIL
Stylidium repens	6284		STYREP
Synaphea floribunda	6356	Synaphea sp. (Smith Rd BJK & NG 244)	SYNFLO
Synaphea whicherensis	6365	Synaphea sp. Whicher Range	SYNWICH
Tetraria capillaris	6387		TETCAP
Tetraria octandra	6367		TETOCT
Tetratheca hirsuta	6315		TETHIRSC
Thelymitra crinita			THECRI
Thelymitra ?pauciflora		Thelymitra pauciflora	THEPAU
Thysanotus arbusculus/sparteus	6384	Omitted: confused	
Thysanotus tenellus	6405		THYTEN
Trachymene pilosa	6306		TRAPIL
Tricoryne elatior	6450		TRIELA
Tricoryne tenella	6377		TRITEN
* Ursinia anthemoides			URSANT
Verticordia densiflora densiflora	6272	Verticordia densiflora	VERDEN
Xanthosia ciliata	6326		XANCIL
Xanthosia huegelii	6314		XANHUE
Xanthorrhoea gracilis			XANGRA
Xanthorrhoea preissii			XANPRE
Xylomelum occidentale			XYLOCC

APPENDIX 4. Plot results as analysed (spread sheet).

Species codes are from Appendix 3.

ACAEXT		1			1	1				
ACAHUE									1	1
ACAMOO			1	1		1				
ACAPUL	1	1		1	1	1	1	1	1	1
ACASEM	1								1	1
ACASTE	1	1			1	1	1			1
ACAURO					1	1	1			
ADEBAR			1	1	1	1	1			
ADEMEI	1	1	1	1	1		1			
ADEOBO	1						1			
AIRCAR					1			1		
ALLFRA			1	1			1			
ALLHUM	1	1				1				1
ALLTHU	1									1
AMPSIM		1		1	1					
AMPLAG						1	1			
AMPTUR	1	1			1			1	1	
ANAPRO	1	1	1	1	1	1	1			
ANDCAE	1	1								1
APHCYP					1					
ARCCAL	1				1	1				1
ASTPAL			1	1	1					
STICOM								1	1	
BANATT	1	1			1		1	1	1	
BANGRA	1		1	1			1			
BANILI	1	1								
BORDIC	1	1	1	1	1	1	1			1
BOSERI	1	1	1	1	1	1	1	1	1	
BRAPRE						1	1			
BRIMIN					1					
BURUMB	1	1		1	1	1	1	1	1	
CALFLA		1	1	1	1	1	1	1	1	
CALLLL										1
CALSPE										1
CALSAN						1	1			
CALFLAve	1	1					1	1	1	
CALLES	1	1					1	1	1	
CAUBBB	1									
CENDRU	1							1		
CHACOR	1	1			1		1	1	1	
CHOGLY							1			
CONTER		1								
CONPEN	1	1	1	1	1	1	1	1	1	
CONSER	1	1		1	1	1	1			1
CONSET	1	1	1	1		1	1			
EUCCAL		1	1							
EUCHAE			1	1	1	1	1			
COTTUR					1			1		
CRACOL					1					
CYACLA	1	1				1	1			1
DAMLIN	1	1	1							

DARVES		1					1		
DASBRO	1	1	1	1	1	1	1	1	1
DAVDIV			1	1			1		
DAVINF	1	1				1	1		
DAVNUD			1	1					
DAVPHY	1	1			1		1		
LOXFAS		1	1	1	1	1	1		
DROERY	1	1	1	1	1	1			
DROMARMA							1		
DROMENME			1		1		1	1	1
DROPALPA	1	1		1	1	1	1	1	
DROPAL	1							1	1
DRYNIV	1				1	1	1		
ELYBRU								1	
EREPAU	1	1			1		1	1	1
ERIDIL						1			
EROBOT					1			1	
EUCMARMA			1	1	1	1	1		
FRATRI	1	1					1	1	1
GOMKNI			1				1		
GOMPOL			1	1					
GOMTOM	1						1	1	
HAKAMP			1	1					
HAKRUS			1		1	1	1		
HEMPUN			1		1		1		
HIBACE	1	1	1			1	1		1
HIBAMP			1	1		1	1		
HIBCOM			1	1		1	1		
HIBFER	1	1	1	1	1	1		1	1
HIBHYP	1	1	1	1	1	1	1	1	1
HIBRAC								1	
HIBVAG	1	1	1	1	1	1	1	1	1
HOVTRITR	1	1	1	1		1		1	1
HYDCAL						1			
HYPROB	1	1	1	1	1	1	1	1	1
HYPGLAbr	1	1	1	1	1	1		1	1
HYPEXS	1	1	1	1	1	1	1	1	1
ISOSPH			1	1		1	1		
KACHOR	1	1				1	1	1	1
JACLEH	1	1				1			
JOHPUB	1							1	1
KINAUS						1			
KUNREC	1	1		1	1	1	1		1
LABPUN			1	1	1	1	1		
LAXSESAU							1		
LECBIL							1		
LEPSQU		1			1		1		1
LEPLEP			1			1	1		
LEPFIM	1	1					1	1	1
LEUCCC	1	1						1	1
LEUCON	1	1						1	1

LEUGLA	1								1
LEUPEN							1		
LEUPOL			1	1		1	1		
LEVPUS					1			1	
LINLIN			1			1	1		
LOMHER	1	1	1		1	1	1	1	1
LOMINT	1	1		1		1	1	1	1
LOMPRE	1	1	1	1		1	1		
LOMSER	1	1	1	1	1	1	1		1
LOMSON		1							
LYGBAR	1	1		1	1	1	1	1	1
LYSCIL	1	1							1
MELSCA	1	1						1	1
MELTHY	1	1	1	1	1	1	1	1	1
MESTET				1	1	1	1		
MILTEN	1				1			1	
NUYFLO	1		1		1				1
PATOCC	1				1	1	1	1	1
PATUMBXA			1	1		1			
PERELLip		1				1			
PERSAC		1							
PETLIN	1	1			1	1	1	1	1
ERISPI		1			1	1			1
PHLCIL	1	1	1	1	1	1	1	1	1
PHLFIL	1	1		1	1	1	1	1	1
MITPAR	1				1			1	
PIMROS							1		
PLAAAA			1			1			
POAANN					1				
PTEAFFNA						1		1	
PTEBAR				1	1	1		1	
PTEREC		1		1	1	1			1
PTEAFFVI	1		1	1	1	1	1		1
LYPNIG		1						1	1
RICGLA				1					
SCASTR	1	1	1			1	1		1
SCHCUR	1	1						1	1
SCHSSS	1	1		1		1	1		1
SCHCAE	1								
SPHMED			1				1		
STAMON						1			
STILAT	1	1	1	1	1	1	1	1	1
STYAMO			1	1		1	1		
STYBRU	1	1						1	1
STYDDD	1	1				1	1		
STYPIL	1	1	1	1		1	1	1	1
STYREP	1	1						1	1
SYNFLO		1		1	1	1	1		1
SYNWICH			1	1					
TETCAP			1	1		1	1		
TETOCT			1	1	1	1	1		

TETHIRSC	1			1	1				
THECRI			1	1	1	1	1		
THEPAU			1			1	1		
THYTEN		1	1	1	1	1	1	1	1
TRAPIL	1				1		1	1	1
TRIELA				1					
TRITEN				1	1	1	1		
URSANT			1		1			1	
VERDEN	1	1				1	1		1
XANCIL	1						1		
XANHUE	1			1			1	1	1
XANGRA			1		1	1			
XANPRE					1	1			
XYLOCC	1	1	1	1	1	1	1		1

APPENDIX 5. Analysis of the plot results (Biostat 1999).

Analysis of Vegetation Plot Data

prepared for

Hart Simpson & Associates Pty Ltd

by

November 1999

Analysis of Vegetation Plot Data

BIOSTAT
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1.0 INTRODUCTION

Floristic data collected from 9 sites was provided by Hart Simpson & Associates Pty Ltd (the Client) for statistical analysis. This data was to be used in conjunction with data collected from an earlier study on the Swan Coastal Plain (Gibson *et al.* 1994). This report will only provide results of the analysis. All interpretations of the vegetation are to be undertaken by the Client.

2.0 METHODS

2.1 Procedural Considerations

The Client required that their data be compared with the data collected for the original study by Gibson *et al.* 1994 to determine the affinity of their sites to defined vegetation community types. The Gibson study found their 509 sites could be represented by 30 general vegetation communities which were further subdivided to create a total of 43 vegetation communities.

2.2 Data Handling

Data to be used in the analysis was provided from two sources. The first data set consisted of presence-absence data for nine vegetation sites collected by the Client (Appendix 1). The species codes were those used in the Gibson *et al.* 1994 study. The sites were coded consecutively HART1 → HART9.

The second data set was the original presence-absence data from the Gibson *et al.* 1994 study consisting of 1436 taxa and 509 sites. The Client's data added 13 more taxa to the original species list. The use of presence/absence data provides an adequate representation of general trends between sites (*cf.*, Lamont and Grant 1979).

The original study determined that the 509 sites could be grouped according to 43 vegetation community types (Appendix 2). The data set was reduced by grouping these 509 sites into their respective community type resulting in a database of 1436 taxa and 43 vegetation communities. The Client's data was merged with the resulting data to produce a data set containing 1449 taxa and 52 sites (ie., 43 community groups and the 9 sites surveyed by the Client).

In accordance with the original study, singletons were removed from the data set after the inclusion of the Client's data. This data set resulted in a matrix of 1072 taxa and 52 sites and was used in the subsequent analyses.

The data sets used in selected analyses were as follows:

- The Client's Data Set without Singletons (142 taxa by 9 sites).
- Full Data Set without Singletons (1072 taxa by 52 "sites").

The former data set will classify the Client's data within community types identified in the Gibson study. The classification of the Client's data will assist in interpreting the affinity of the 9 sites to each other.

2.3 Analytical Methods

BIOSTAT was asked to follow the classification methods employed in Gibson *et al* 1994 study. In that study Czekanowski coefficient was applied to the presence/absence data set followed by hierarchical, polythetic agglomerative classification.

The original Czekanowski coefficient was created to handle quantitative data. Its complement for presence/absence (binary) data is equivalent to Sørensen's coefficient (Greig-Smith 1983), ie.,

Czekanowski coefficient of similarity, Sc_c (≡ Sørensen's coefficient):

$$Sc_c = \frac{2a}{(2a+b+c)}$$

where,

		Sample j	
		Presence	Absence
Sample i	Presence	a	b
	Absence	c	d

and,

the range of Sc_c is 0 (no similarity) to 1 (complete similarity).

The coefficient doubles the weighting of species coincidences thus reducing the effect of species not common between samples (ie., b and c).

An hierarchical, polythetic agglomerative technique was used to classify the similarity matrix using unweighted pair-group mean average (UPGMA) fusion method.

3.0 RESULTS

The distance matrix of the Client's data (Table1) indicates a high degree of similarity between most sites. However, the highest similarity value is only 0.797 suggesting a relatively high species diversity within sites.

Table 1. Most of the measures range above 50% (ie., 0.5) indicating a high degree of similarity between sites. Sites with values lower than 50% are highlighted.

	HART1	HART2	HART3	HART4	HART5	HART6	HART7	HART8	HART9
HART1	1.000								
HART2	0.790	1.000							
HART3	0.395	0.429	1.000						
HART4	0.476	0.529	0.738	1.000					
HART5	0.545	0.571	0.526	0.628	1.000				
HART6	0.558	0.633	0.649	0.716	0.658	1.000			
HART7	0.635	0.626	0.627	0.654	0.625	0.760	1.000		
HART8	0.662	0.593	0.304	0.384	0.545	0.392	0.459	1.000	
HART9	0.797	0.781	0.368	0.456	0.559	0.545	0.579	0.733	1.000

The classification of these sites (Figure 1) reflects the high similarity between sites but also defines two major groups of sites. The first consists of five sites HART3, HART4, HART5, HART6 and HART7. The second group consists of the remaining sites and there are greater similarities between sites. Species commonality is illustrated in Table 2.

The classification of the Client's sites with the vegetation communities produced low similarity values indicating only loose relationships between sites (Table 3). The classification of these 52 communities and sites (Figure 2) resulted in the 7 general groups (Table 4).

Figure 1. *Classification of the Client's data indicates the existence of two groups of sites.*

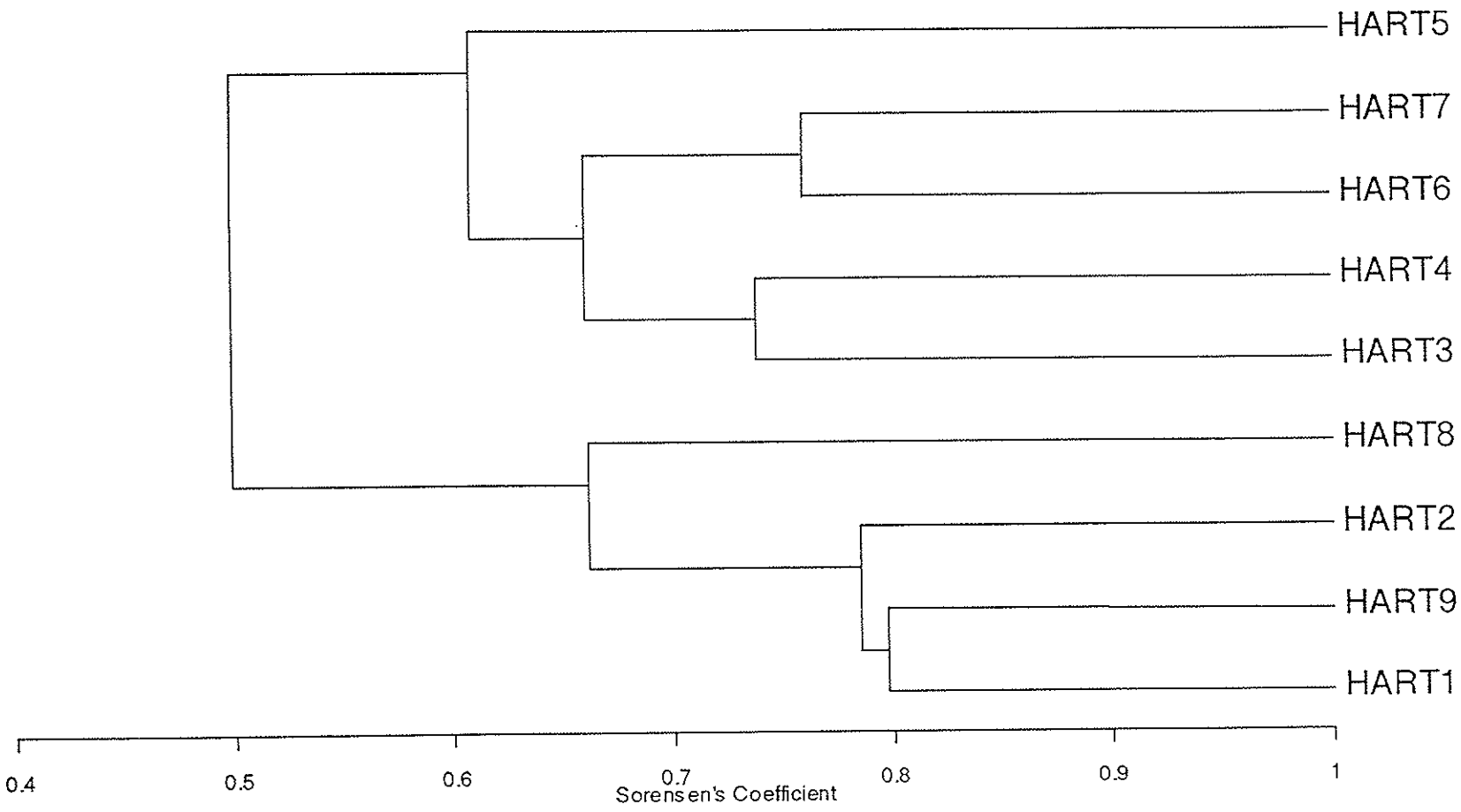

Table 2. The data set used in classifying the Client's sites are ordered according to species distribution similarity (Singletons have been removed). "X" indicates species presence.

Species Code	HART1	HART9	HART2	HART8	HART3	HART4	HART6	HART7	HART5
BOSERI	X	X	X	X	X	X	X	X	X
CONPEN	X	X	X	X	X	X	X	X	X
DASBRO	X	X	X	X	X	X	X	X	X
HIBHYP	X	X	X	X	X	X	X	X	X
HIBVAG	X	X	X	X	X	X	X	X	X
HYPEXS	X	X	X	X	X	X	X	X	X
HYPROB	X	X	X	X	X	X	X	X	X
MELTHY	X	X	X	X	X	X	X	X	X
PHLCIL	X	X	X	X	X	X	X	X	X
STILAT	X	X	X	X	X	X	X	X	X
ACAPUL	X	X	X	X		X	X	X	X
BORDIC	X	X	X		X	X	X	X	X
BURUMB	X	X	X	X		X	X	X	X
HIBFER	X	X	X	X	X	X	X		X
HYPGLAbr	X	X	X	X	X	X	X		X
LOMHER	X	X	X	X	X		X	X	X
LOMSER	X	X	X		X	X	X	X	X
LYGBAR	X	X	X	X		X	X	X	X
PHLFIL	X	X	X	X		X	X	X	X
STYPIL	X	X	X	X	X	X	X	X	
XYLOCC	X	X	X		X	X	X	X	X
CONSER	X	X	X			X	X	X	X
HOVTRITR	X	X	X	X	X	X	X		
KUNREC	X	X	X			X	X	X	X
LOMINT	X	X	X	X		X	X	X	
PETLIN	X	X	X	X			X	X	X
ACASTE	X	X	X				X	X	X
BANATT	X	X	X	X				X	X
CHACOR	X	X	X	X				X	X
EREPAU	X	X	X	X				X	X
HIBACE	X	X	X		X		X	X	
KACHOR	X	X	X	X			X	X	
SCASTR	X	X	X		X		X	X	
SCHSSS	X	X	X			X	X	X	
AMPTUR	X	X	X	X					X
CALFLAve	X	X	X	X				X	
CALLES	X	X	X	X				X	
CYACLA	X	X	X				X	X	
FRATRI	X	X	X	X				X	
LEPFIM	X	X	X	X				X	
LEUCCC	X	X	X	X					
LEUCON	X	X	X	X					
SCHCUR	X	X	X	X					
VERDEN	X	X	X				X	X	
ALLHUM	X	X	X				X		
MELSCA	X	X	X	X					

Species Code	HART1	HART9	HART2	HART8	HART3	HART4	HART6	HART7	HART5
STYBRU	X	X	X	X					
STYREP	X	X	X	X					
ANDCAE	X	X	X						
LYSCIL	X	X	X						
PTEAFFVI	X	X			X	X	X	X	X
PATOCC	X	X		X			X	X	X
TRAPIL	X	X		X				X	X
XANHUE	X	X		X		X		X	
ARCCAL	X	X					X		X
NUYFLO	X	X			X				X
DROPAL	X	X		X					
ACASEM	X	X		X					
JOHPUB	X	X		X					
ALLTHU	X	X							
LEUGLA	X	X							
ANAPRO	X		X		X	X	X	X	X
DROPALPA	X		X	X		X	X	X	X
ADEMEI	X		X		X	X		X	X
CONSET	X		X		X	X	X	X	
DROERY	X		X		X	X	X		X
LOMPRE	X		X		X	X	X	X	
DAVINF	X		X				X	X	
DAVPHY	X		X					X	X
STYDDD	X		X				X	X	
DAMLIN	X		X		X				
JACLEH	X		X				X		
BANILI	X		X						
GOMTOM	X			X				X	
MILTEN	X			X					X
MITPAR	X			X					X
CENDRU	X			X					
BANGRA	X				X	X		X	
TETHIRSC	X					X			X
DRYNIV	X						X	X	X
ADEOBO	X							X	
XANCIL	X							X	
CALFLA		X	X	X	X	X	X	X	X
THYTEN		X	X	X	X	X	X	X	X
LYPNIG		X	X	X					
SYNFLO		X	X			X	X	X	X
PTEREC		X	X			X	X		X
LEPSQU		X	X					X	X
ERISPI		X	X				X		X
DROMENME		X		X	X			X	X
ACAHUE		X		X					
STICOM		X		X					
LOXFAS			X		X	X	X	X	X
EUCCAL			X		X				
AMPSIM			X			X			X
ACAEXT			X				X		X

Table 3. Similarity measures for the 52 sites and community types were generally low.

Community Type Code

	1a	1b	2	3a	3b	3c	4	5	6	7	8	9	10a	10b	11	12	13	14	15	16	17	18	19	20a	20b	20c	21a	21b	21c	22	23a	23b	24	25	26a	26b	27	28	29a	29b	30a	30b	30c	HART1	HART2	HART3	HART4	HART5	HART6	HART7	HART8	HART9
1a	1.00																																																			
1b	0.62	1.00																																																			
2	0.35	0.40	1.00																																																	
3a	0.41	0.40	0.36	1.00																																															
3b	0.52	0.54	0.31	0.50	1.00																																														
3c	0.30	0.35	0.24	0.51	0.46	1.00																																													
4	0.37	0.44	0.39	0.41	0.43	0.31	1.00																																												
5	0.29	0.31	0.29	0.42	0.37	0.36	0.51	1.00																																											
6	0.22	0.22	0.24	0.34	0.31	0.37	0.37	0.42	1.00																																										
7	0.15	0.18	0.24	0.39	0.26	0.32	0.36	0.50	0.34	1.00																																									
8	0.24	0.28	0.28	0.53	0.34	0.46	0.36	0.45	0.35	0.61	1.00																																								
9	0.24	0.28	0.35	0.40	0.26	0.29	0.37	0.38	0.30	0.47	0.48	1.00																																							
10a	0.23	0.26	0.38	0.40	0.25	0.30	0.38	0.46	0.32	0.55	0.52	0.48	1.00																																						
10b	0.31	0.33	0.43	0.41	0.32	0.33	0.43	0.44	0.32	0.44	0.45	0.44	0.49	1.00																																						
11	0.19	0.25	0.25	0.31	0.29	0.29	0.38	0.43	0.35	0.40	0.37	0.37	0.32	0.32	1.00																																					
12	0.11	0.12	0.17	0.15	0.15	0.13	0.23	0.29	0.25	0.25	0.19	0.24	0.24	0.23	0.36	1.00																																					
13	0.07	0.15	0.20	0.18	0.09	0.15	0.17	0.25	0.21	0.32	0.30	0.39	0.26	0.22	0.33	0.36	1.00																																				
14	0.06	0.06	0.07	0.07	0.11	0.11	0.14	0.14	0.13	0.07	0.07	0.07	0.05	0.08	0.17	0.14	0.14	1.00																																				
15	0.01	0.03	0.04	0.05	0.03	0.04	0.05	0.06	0.13	0.15	0.12	0.08	0.10	0.06	0.20	0.28	0.22	0.03	1.00																																				
16	0.01	0.01	0.02	0.04	0.02	0.04	0.05	0.06	0.09	0.16	0.07	0.06	0.07	0.05	0.14	0.11	0.11	0.06	0.25	1.00																																				
17	0.03	0.06	0.06	0.04	0.04	0.06	0.07	0.10	0.12	0.16	0.10	0.10	0.10	0.07	0.24	0.18	0.26	0.14	0.22	0.32	1.00																																			
18	0.11	0.10	0.14	0.15	0.11	0.14	0.16	0.22	0.13	0.25	0.20	0.19	0.19	0.18	0.23	0.18	0.23	0.11	0.08	0.16	0.25	1.00																																		
19	0.04	0.06	0.06	0.05	0.06	0.08	0.08	0.09	0.09	0.10	0.09	0.08	0.09	0.08	0.20	0.08	0.10	0.10	0.09	0.23	0.37	0.26	1.00																																	
20a	0.44	0.38	0.25	0.37	0.37	0.30	0.29	0.28	0.22	0.13	0.18	0.16	0.17	0.24	0.16	0.09	0.07	0.03	0.01	0.00	0.05	0.11	0.05	1.00																															
20b	0.51	0.49	0.26	0.46	0.55	0.37	0.35	0.30	0.33	0.17	0.25	0.21	0.18	0.25	0.18	0.09	0.05	0.07	0.02	0.02	0.03	0.08	0.04	0.57	1.00																														
20c	0.36	0.36	0.26	0.46	0.41	0.41	0.34	0.35	0.34	0.19	0.26	0.21	0.21	0.29	0.20	0.11	0.10	0.10	0.01	0.02	0.04	0.09	0.04	0.57	0.56	1.00																														
21a	0.46	0.52	0.26	0.39	0.55	0.38	0.47	0.44	0.35	0.25	0.32	0.28	0.25	0.29	0.35	0.16	0.13	0.09	0.04	0.05	0.10	0.17	0.11	0.50	0.54	0.46	1.00																													
21b	0.56	0.52	0.26	0.34	0.46	0.29	0.45	0.34	0.26	0.17	0.19	0.22	0.18	0.31	0.21	0.15	0.08	0.09	0.02	0.01	0.04	0.10	0.04	0.51	0.51	0.46	0.56	1.00																													
21c	0.35	0.39	0.25	0.39	0.44	0.34	0.49	0.47	0.39	0.25	0.29	0.24	0.24	0.33	0.34	0.18	0.13	0.13	0.03	0.05	0.07	0.11	0.07	0.48	0.50	0.53	0.61	0.53	1.00																													
22	0.31	0.30	0.27	0.28	0.30	0.21	0.40	0.38	0.28	0.14	0.17	0.23	0.20	0.22	0.23	0.15	0.13	0.12	0.03	0.02	0.05	0.10	0.04	0.48	0.36	0.39	0.41	0.44	0.50	1.00																													
23a	0.38	0.38	0.21	0.37	0.40	0.33	0.44	0.43	0.31	0.21	0.23	0.20	0.20	0.27	0.27	0.18	0.11	0.11	0.04	0.03	0.06	0.10	0.06	0.59	0.50	0.53	0.63	0.56	0.65	0.56	1.00																												
23b	0.33	0.32	0.23	0.32	0.32	0.24	0.35	0.35	0.26	0.15	0.17	0.18	0.16	0.23	0.16	0.13	0.09	0.04	0.03	0.01	0.04	0.08	0.04	0.60	0.46	0.49	0.51	0.46	0.53	0.61	0.67	1.00																											
24	0.25	0.29	0.15	0.28	0.35	0.32	0.29	0.33	0.30	0.24	0.25	0.16	0.19	0.23	0.29	0.10	0.12	0.10	0.05	0.08	0.17	0.17	0.22	0.37	0.30	0.36	0.49	0.33	0.40	0.28	0.44	0.38	1.00																										
25	0.26	0.30	0.11	0.23	0.39	0.33	0.30	0.31	0.31	0.25	0.25	0.17	0.16	0.21	0.37	0.12	0.12	0.12	0.03	0.09	0.17	0.22	0.20	0.30	0.30	0.30	0.52	0.33	0.39	0.23	0.40	0.29	0.56	1.00																									
26a	0.18	0.20	0.10	0.21	0.24	0.25	0.25	0.25	0.25	0.22	0.22	0.17	0.17	0.23	0.22	0.15	0.10	0.08	0.04	0.06	0.13	0.21	0.24	0.23	0.23	0.25	0.36	0.25	0.30	0.19	0.31	0.26	0.51	0.47	1.00																									
26b	0.26	0.28	0.12	0.27	0.32	0.30	0.28	0.34	0.28	0.22	0.25	0.16	0.18	0.22	0.25	0.13	0.10	0.08	0.04	0.05	0.14	0.20	0.17	0.34	0.31	0.35	0.51	0.34	0.41	0.26	0.42	0.36	0.62	0.56	0.59	1.00																									
27	0.22	0.23	0.12	0.22	0.25	0.19	0.16	0.21	0.16	0.11	0.16	0.10	0.13	0.17	0.15	0.07	0.05	0.06	0.01	0.01	0.06	0.17	0.17	0.28	0.24	0.22	0.29	0.28	0.25	0.20	0.28	0.24	0.40	0.32	0.50	0.43	1.00																									
28	0.38	0.41	0.20	0.41	0.46	0.42	0.37	0.40	0.33	0.24	0.31	0.21	0.21	0.25	0.28	0.13	0.09	0.10	0.03	0.04	0.11	0.15	0.13	0.51	0.50	0.50	0.63	0.46	0.51	0.38	0.60	0.53	0.60	0.50	0.40	0.59	0.32	1.00																								
29a	0.10	0.13	0.08	0.13	0.16	0.19	0.15	0.19	0.20	0.18	0.16	0.12	0.12	0.15	0.21	0.12	0.09	0.04	0.04	0.16	0.21	0.21	0.28	0.13	0.11	0.14	0.27	0.16	0.19	0.10	0.21	0.14	0.50	0.38	0.48	0.47	0.33	0.32	1.00																							
29b	0.11	0.14	0.05	0.13	0.18	0.17	0.17	0.20	0.21	0.19	0.15	0.12	0.11	0.12	0.19	0.09	0.09	0.07	0.04	0.06	0.16	0.17	0.22	0.17	0.15	0.18	0.30	0.17	0.21	0.11	0.25	0.20	0.49	0.41	0.54	0.53	0.40	0.37	0.61	1.00																						
30a	0.03	0.06	0.03	0.07	0.09	0.11	0.07	0.09	0.10	0.09	0.07	0.04	0.03	0.05	0.14	0.04	0.03	0.02	0.06	0.17	0.21	0.12	0.22	0.05	0.07	0.06	0.11	0.07	0.11	0.06	0.09	0.06	0.32	0.23	0.27	0.26	0.22	0.18	0.43	0.30	1.00																							
30b	0.09	0.16	0.06	0.13	0.16	0.18	0.17	0.19	0.21	0.18	0.17	0.10	0.12	0.14	0.23	0.09	0.10	0.04	0.05	0.14	0.25	0.21	0.25	0.10	0.10	0.11	0.24	0.14	0.18	0.09	0.16	0.11	0.39	0.46	0.42	0.40	0.28	0.29	0.47	0.42	0.40	1.00																						
30c	0.08	0.10	0.07	0.11	0.11	0.13	0.09	0.14	0.18	0.14	0.10	0.06	0.09	0.13	0.16	0.06	0.10	0.02	0.02	0.08	0.24	0.13	0.20	0.12	0.11	0.13	0.16	0.12	0.17	0.10	0.16	0.12	0.28	0.27	0.28	0.28	0.23	0.20	0.33	0.28	0.30	0.31	1.00																						
HART1	0.29	0.27	0.16	0.20	0.25	0.14	0.25	0.19	0.21	0.09	0.09	0.10	0.09	0.15	0.10	0.10	0.06	0.07	0.00	0.00	0.03	0.06	0.00	0.39	0.35	0.34	0.28	0.42	0.31	0.36	0.32	0.30	0.19	0.19	0.12	0.18	0.15	0.22	0.05	0.05	0.01	0.04	0.07	1.00																						
HART2	0.28	0.25	0.17	0.19	0.22	0.15	0.22	0.16	0.20	0.07	0.07	0.11	0.10	0.16	0.07	0.09	0.05	0.08	0.00	0.00	0.03	0.01	0.00	0.33	0.33	0.30	0.26	0.39	0.28	0.32	0.30	0.28	0.16	0.15	0.07	0.14	0.13	0.19	0.01	0.01	0.00	0.01	0.06	0.77	1.00																						
HART3	0.31	0.26	0.15	0.15	0.26	0.12	0.15	0.09	0.16	0.05	0.06	0.09	0.05	0.12	0.07	0.04	0.01	0.06	0.00	0.00	0.02	0.02	0.00	0.27	0.31	0.19	0.18	0.30	0.20	0.21	0.19	0.18	0.12	0.16	0.07	0.13	0.12	0.17	0.02	0.03	0.00	0.01	0.07	0.40	0.42	1.00																						
HART4	0.30	0.25	0.17	0.14	0.23	0.14	0.16	0.11	0.15	0.04	0.06	0.08	0.08	0.13	0.07	0.07	0.03	0.11	0.00	0.00	0.02	0.03	0.02	0.28	0.29	0.19	0.20	0.32	0.21	0.21	0.20	0.20	0.13	0.16	0.08	0.13	0.09	0.16	0.02	0.03	0.02	0.01	0.05	0.47	0.52	0.73	1.00																						
HART5	0.29	0.28	0.18	0.22	0.29	0.19	0.26	0.21	0.25	0.12	0.12	0.13	0.15	0.22	0.12	0.15	0.09	0.10	0.00	0.04	0.03	0.10	0.02	0.34	0.33	0.28	0.27	0.39	0.29	0.26	0.28	0.25	0.20	0.21	0.13	0.20	0.17	0.21	0.07	0.07	0.04	0.08	0.09	0.53	0.55	0.51	0.61	1.00																						
HART6	0.35	0.30	0.22	0.19	0.26	0.16	0.21	0.17	0.18	0.07	0.11	0.11	0.16	0.18	0.08	0.08	0.06	0.07	0.00	0.02	0.01	0.08	0.03	0.30	0.33	0.25	0.23	0.37	0.25	0.23	0.24	0.22	0.16	0.15	0.10	0.15	0.17	0.19	0.03	0.04	0.00	0.04	0.07	0.54	0.60	0.64	0.70	0.63	1.00																						
HART7	0.36	0.30	0.17	0.20	0.28	0.14	0.22	0.15	0.19	0.06	0.09	0.10	0.10	0.16	0.09	0.06	0.03	0.07	0.00	0.00	0.01	0.01	0.00	0.33	0.35	0.29	0.25	0.43	0.27	0.26	0.26	0.22	0.15	0.16	0.07	0.16	0.13	0.22	0.03	0.04	0.01	0.03	0.03	0.61	0.59	0.61	0.63	0.59	0.72	1.00																						
HART8	0.22	0.20	0.11	0.15	0.21	0.16	0.22	0.21	0.22	0.10	0.06	0.10	0.10	0.18	0.10	0.16	0.06	0.11	0.00	0.00	0.03	0.05	0.00	0.34	0.28	0.31	0.25	0.37	0.31	0.35	0.32	0.32	0.20	0.20	0.16	0.19	0.14	0.22	0.06	0.07	0.03	0.08	0.12	0.64	0.57	0.30	0.38	0.53	0.37	0.43	1.00																						
HART9	0.24	0.22	0.13	0.17	0.22	0.15	0.21	0.17	0.19	0.07	0.06	0.10	0.11	0.15	0.07	0.08	0.06	0.08	0.00	0.00	0.03	0.04	0.00	0.31	0.31	0.32	0.25	0.37	0.28	0.30	0.29	0.28	0.17	0.16	0.07	0.16	0.12	0.20	0.02	0.03	0.01	0.02	0.06	0.78	0.76	0.37	0.45	0.54	0.52	0.55	0.71	1.00																						

Figure 2. *The classification of community types and the Client's data resulted in a number of loose groupings based on low similarity values. However, the classification dendrogram does indicate the affinity of the Client's data to a groups of community types.*

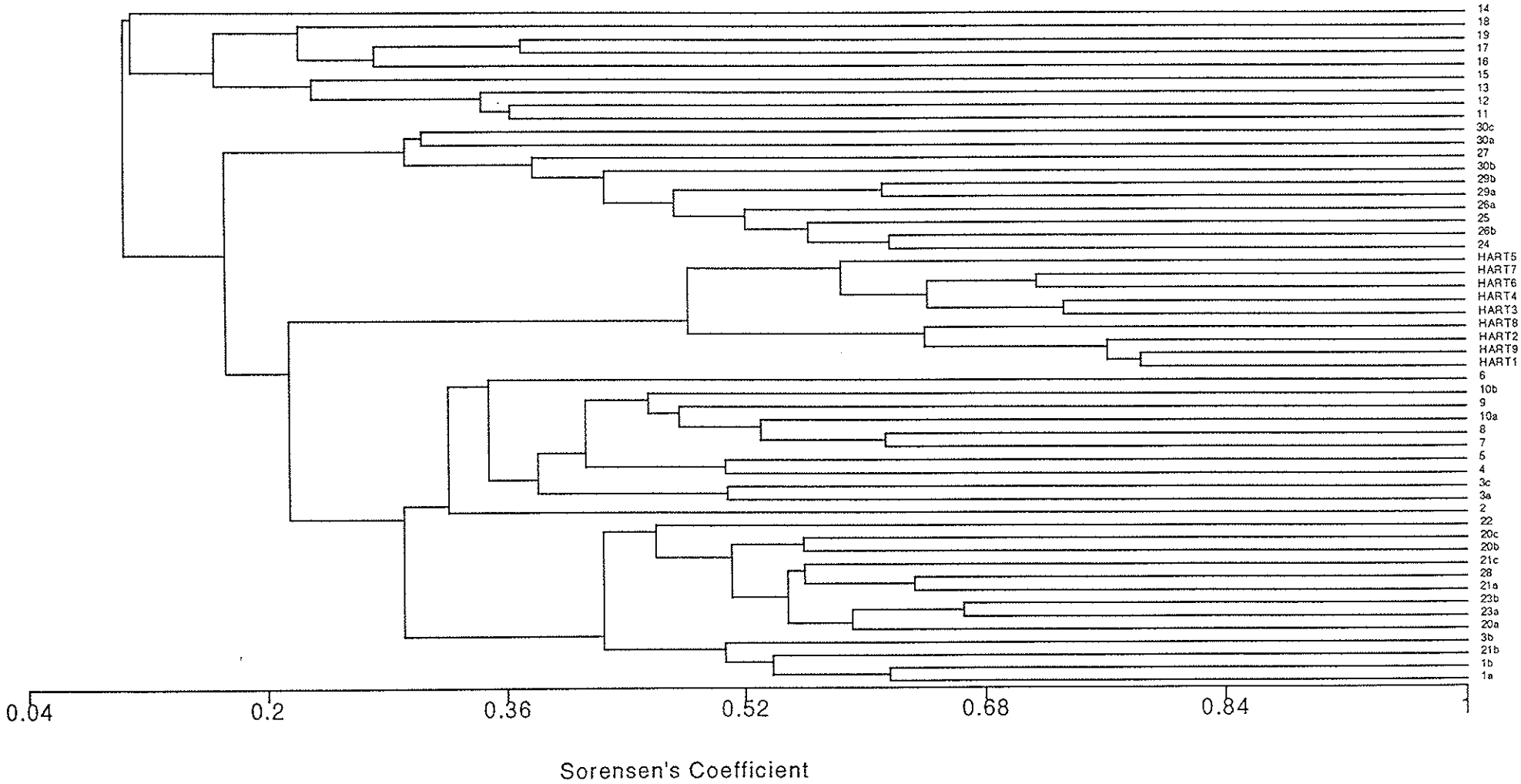

Table 4. *The community types and Client's sites are listed under the 7 general groupings derived from the classification analysis.*

Group Number	Sites/Vegetation Community Codes
1	14
2	11, 12, 13, 15, 16, 17, 18, 19
3	24, 25, 26a, 26b, 27, 29a, 29b, 30a, 30b, 30c
4	HART1, HART2, HART3, HART4, HART5, HART6, HART7, HART8, HART9
5	2, 3a, 3c, 4, 5, 6, 7, 8, 9, 10a, 10b
6	20a, 20b, 20c, 21a, 21c, 22, 23a, 23b, 28
7	1a, 1b, 3b, 21b

4.0 REFERENCES

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Greig-Smith, P. (1983) "Quantitative Plant Ecology. Studies in Ecology Volume 9". 3rd Edition. Blackwell Scientific Publications. Oxford.

Lamont, B. B. and Grant, K. J. (1979) "A Comparison of Twenty-one Measures of Site Dissimilarity" in Multivariate Methods in Ecological Work. L. Orloci, C. R. Rao and W. M. Stiteler (eds.). International Co-operative Publishing House, Maryland. Pp 101-126.

Appendix 1 – Data provided by Hart Simpson & Associates Pty Ltd

Only the species codes are provided. The key for these codes is available from Gibson *et al* 1994.

Species Code	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9
ACAEXT		1			1	1			
ACAHUE								1	1
ACAMOO			1	1		1			
ACAPUL	1	1		1	1	1	1	1	1
ACASEM	1							1	1
ACASTE	1	1			1	1	1		1
ACAURO					1	1	1		
ADEBAR			1	1	1	1	1		
ADEMEI	1	1	1	1	1		1		
ADEOBO	1						1		
AIRCAR					1			1	
ALLFRA			1	1			1		
ALLHUM	1	1				1			1
ALLTHU	1								1
AMPLAG						1	1		
AMPSIM		1		1	1				
AMPTUR	1	1			1			1	1
ANAPRO	1	1	1	1	1	1	1		
ANDCAE	1	1							1
APHCYP					1				
ARCCAL	1				1	1			1
ASTPAL			1	1	1				
BANATT	1	1			1		1	1	1
BANGRA	1		1	1			1		
BANILI	1	1							
BORDIC	1	1	1	1	1	1	1		1
BOSERI	1	1	1	1	1	1	1	1	1
BRAPRE						1	1		
BRIMIN					1				
BURUMB	1	1		1	1	1	1	1	1
CALFLA		1	1	1	1	1	1	1	1
CALFLAve	1	1					1	1	1
CALLES	1	1					1	1	1
CALLLL									1
CALSAN						1	1		
CALSPE									1
CAUBBB	1								
CENDRU	1							1	
CHACOR	1	1			1		1	1	1
CHOGLY							1		
CONPEN	1	1	1	1	1	1	1	1	1
CONSER	1	1		1	1	1	1		1
CONSET	1	1	1	1		1	1		

Species Code	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9
CONTER		1							
COTTUR					1			1	
CRACOL					1				
CYACLA	1	1				1	1		1
DAMLIN	1	1	1						
DARVES		1					1		
DASBRO	1	1	1	1	1	1	1	1	1
DAVDIV			1	1			1		
DAVINF	1	1				1	1		
DAVNUD			1	1					
DAVPHY	1	1			1		1		
DROERY	1	1	1	1	1	1			
DROMARMA							1		
DROMENME			1		1		1	1	1
DROPAL	1							1	1
DROPALPA	1	1		1	1	1	1	1	
DRYNIV	1				1	1	1		
ELYBRU								1	
EREPAU	1	1			1		1	1	1
ERIDIL						1			
ERISPI		1			1	1			1
EROBOT					1			1	
EUCCAL		1	1						
EUCHAE			1	1	1	1	1		
EUCMARMA			1	1	1	1	1		
FRATRI	1	1					1	1	1
GOMKNI			1				1		
GOMPOL			1	1					
GOMTOM	1						1	1	
HAKAMP			1	1					
HAKRUS			1		1	1	1		
HEMPUN			1		1		1		
HIBACE	1	1	1			1	1		1
HIBAMP			1	1		1	1		
HIBCOM			1	1		1	1		
HIBFER	1	1	1	1	1	1		1	1
HIBHYP	1	1	1	1	1	1	1	1	1
HIBRAC								1	
HIBVAG	1	1	1	1	1	1	1	1	1
HOVTRITR	1	1	1	1		1		1	1
HYDCAL						1			
HYPEXS	1	1	1	1	1	1	1	1	1
HYPGLAbr	1	1	1	1	1	1		1	1
HYPROB	1	1	1	1	1	1	1	1	1
ISOSPH			1	1		1	1		
JACLEH	1	1				1			
JOHPUB	1							1	1
KACHOR	1	1				1	1	1	1
KINAUS						1			
KUNREC	1	1		1	1	1	1		1
LABPUN			1	1	1	1	1		

Species Code	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9
LAXSESAU							1		
LECBIL							1		
LEPFIM	1	1					1	1	1
LEPLEP			1			1	1		
LEPSQU		1			1		1		1
LEUCCC	1	1						1	1
LEUCON	1	1						1	1
LEUGLA	1								1
LEUPEN							1		
LEUPOL			1	1		1	1		
LEVPUS					1			1	
LINLIN			1			1	1		
LOMHER	1	1	1		1	1	1	1	1
LOMINT	1	1		1		1	1	1	1
LOMPRE	1	1	1	1		1	1		
LOMSER	1	1	1	1	1	1	1		1
LOMSON		1							
LOXFAS		1	1	1	1	1	1		
LYGBAR	1	1		1	1	1	1	1	1
LYPNIG		1						1	1
LYSCIL	1	1							1
MELSCA	1	1						1	1
MELTHY	1	1	1	1	1	1	1	1	1
MESTET				1	1	1	1		
MILTEN	1				1			1	
MITPAR	1				1			1	
NUYFLO	1		1		1				1
PATOCC	1				1	1	1	1	1
PATUMBXA			1	1		1			
PERELLip		1				1			
PERSAC		1							
PETLIN	1	1			1	1	1	1	1
PHLCIL	1	1	1	1	1	1	1	1	1
PHLFIL	1	1		1	1	1	1	1	1
PIMROS							1		
PLAAAA			1			1			
POAANN					1				
PTEAFFNA						1		1	
PTEAFFVI	1		1	1	1	1	1		1
PTEBAR				1	1	1		1	
PTEREC		1		1	1	1			1
RICGLA				1					
SCASTR	1	1	1			1	1		1
SCHCAE	1								
SCHCUR	1	1						1	1
SCHSSS	1	1		1		1	1		1
SPHMED			1				1		
STAMON						1			
STICOM								1	1
STILAT	1	1	1	1	1	1	1	1	1
STYAMO			1	1		1	1		

Species Code	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9
STYBRU	1	1						1	1
STYDDD	1	1				1	1		
STYPIL	1	1	1	1		1	1	1	1
STYREP	1	1						1	1
SYNFLO		1		1	1	1	1		1
SYNWICH			1	1					
TETCAP			1	1		1	1		
TETHIRSC	1			1	1				
TETOCT			1	1	1	1	1		
THECRI			1	1	1	1	1		
THEPAU			1			1	1		
THYTEN		1	1	1	1	1	1	1	1
TRAPIL	1				1		1	1	1
TRIELA				1					
TRITEN				1	1	1	1		
URSANT			1		1			1	
VERDEN	1	1				1	1		1
XANCIL	1						1		
XANGRA			1		1	1			
XANHUE	1			1			1	1	1
XANPRE					1	1			
XYLOCC	1	1	1	1	1	1	1		1

Appendix 2 – General Description of the 43 Vegetation Community Types

Code	Vegetation Community Type Description
1a	*Eucalyptus haemotoxylon – E. marginata* woodlands on Whicher foothills
1b	Southern *Corymbia calophylla* woodlands on heavy soils
2	Southern wet shrublands
3a	*C. calophylla – Kingia australis* woodlands on heavy soils
3b	*C. calophylla – E. marginata* woodlands on sandy clay soils
3c	*C. calophylla – Xanthorrhoea preisii* woodlands and shrublands
4	*Melaleuca preissiana* damplands
5	Mixed shrub damplands
6	Weed dominated wetlands on heavy soils
7	Herb rich saline shrublands in clay pans
8	Herb rich shrublands in clay pans
9	Dense shrublands on clay flats
10a	Shrublands on dry clay flats
10b	Shrublands on southern ironstone
11	Wet forests and woodlands
12	*Melaleuca teretifolia* and/or *Astartea* aff. *fascicularis* shrublands
13	Deeper wetlands on heavy soils
14	Deeper wetlands on sandy soils
15	Forests and woodlands of deep seasonal wetlands
16	Highly saline seasonal wetlands
17	*Melaleuca raphiophylla – Gahnia trifida* seasonal wetlands
18	Shrublands on calcareous silts
19	Sedgelands in Holocene dune swales
20a	*Banksia attenuata* woodlands over species rich shrublands
20b	Eastern *B. attenuata* and/or *E. marginata* woodlands
20c	Eastern shrublands and woodlands
21a	Central *B. attenuata – E. marginata* woodlands
21b	Southern *B. attenuata* woodlands
21c	Low lying *B. attenuata* woodlands or shrublands
22	*B. illicifolia* woodlands
23a	Central *B. attenuata – B. menziessii* woodlands
23b	Northern *B. attenuata – B. menziessii* woodlands
24	Northern Spearwood shrublands and woodlands
25	Southern *E. gomphocephala – Agonis flexuosa* woodlands
26a	*Melaleuca huegelii – M. acerosa* shrublands of limestone ridges
26b	Woodlands and mallees on limestone

Code	Vegetation Community Type Description
27	Species poor mallees and shrublands on limestone
28	Spearwood *B. attenuata* or *B. attenuata – Eucalyptus* woodlands
29a	Coastal shrublands on shallow sands
29b	*Acacia* shrublands on taller dunes
30a	*Callitris preissii* (or *M. lanceolata*) forests and woodlands
30b	Quindalup *E. gomphocephala* and/or *A. flexuosa* woodlands
30c	Other mallees or scrubs