Plate 7. Vine thicket (type 3),Goodedulla National Park, west of Rockhampton (site 73). Note browning and loss of foliage due to extreme drought conditions (August 1994). Species include *Backhousia kingii, Croton insularis, Owenia venosa, Geijera paniculata* and *Acalypha eremorum* (foreground).

Plate 8. Interior of (type 3) vine thicket, "Cerberus", west of Marlborough (site 67). Species include *Backhousia kingii, Excoecaria dallachyana, Guettardella putaminosa* and *Planchonella cotinifolia* var. *pubescens.*

CHAPTER FOUR

A REGIONAL CONTEXT FOR VINE THICKET COMMUNITIES - FLORISTIC PATTERNS IN THE BRIGALOW BELT BIOGEOGRAPHIC REGION AND RELATIONSHIPS WITH ENVIRONMENTAL ATTRIBUTES, PARTICULARLY CLIMATE.

Although the core area of distribution and major remnants of semi-evergreen vine thicket are located in central and southern Queensland, outliers of these communities occur extensively in the northern and southern Brigalow Belt Biogeographic Region. Time and other constraints resulted in the southern (i.e. north-western New South Wales) vine thickets being excluded from the detailed field survey (**Chapter 3**) and in the northern vine thickets being relatively under-sampled. The latter areas have since been included in a comprehensive floristic survey of northern inland vine thickets by Fensham (1995). Floristic data are available for several southern vine thicket locations (Floyd 1991, J.B.Williams, unpubl. lists), three of which were included in Webb, Tracey and Williams' (1984) floristic analysis of Australian rainforests.

It was considered desirable to test the robustness of the vine thicket classification/typology derived above (**Chapter 3**) using an enlarged floristic data set compiled across the entire Brigalow Belt Biogeographic Region. Inclusion of site data from Fensham's (1995) survey has two purposes; (i) to improve the intensity of sampling from the northern Brigalow Belt Biogeographic Region (see above) and (ii) to provide an opportunity to compare the vine thicket classifications from this study and that of Fensham, using a common data set.

Webb *et al.* (1984) described several floristic subunits (elements) within the northern Australian vine thickets (B_3 ecofloristic province). They also referred to, but did not describe, elements within the C_2 province, which closely approximates in geographical extent the central and southern Brigalow Belt Biogeographic Region. A regional floristic analysis, using a larger data set than that previously available, may thus provide definitions of subunits, i.e. a finer spatial resolution, within the framework established by Webb *et al.* (1984).

A preliminary study of climatic relationships in Australian rainforests was undertaken by Nix (1993). Structural data for 644 sites, essentially a slightly expanded version of the data set used by Webb *et al.* (1984), were matched against an analysis of climatic indices generated for each site using BIOCLIM (see section **3.3.3**). The climatic framework developed by Nix corresponded relatively closely with the main groups of Webb's (1968) structural types. Semi-evergreen vine thicket sites formed one of three rainforest types within the subtropical (mesotherm) group, occurring on soils of high nutrient status under relatively low rainfall conditions (Nix 1993).

Nix, Stein, McMahon, Tassell and Hodges (1992) later undertook an agglomerative classification of a subset of 290 sites (the mesotherm group), which was broadly equivalent to the combined C_1 and C_2 floristic provinces of Webb *et al.* (1984). Nix *et al.* described 10 floristic groups, with vine thicket (SEVT) sites concentrated in their groups 1 and 2, which contained 71 and 17 sites respectively (see **Table 4.11** below).

The present study sets out to identify floristic patterns in vine thicket communities throughout the Brigalow Belt Biogeographic Region, and to place within this context the community-types described in the previous chapter. Floristic sub-groups within the northern Brigalow Belt are compared with the results of a complementary study by Fensham (1995). The study also seeks to determine relationships at the regional scale between floristic patterns and climatic factors.

4.1 The data set

Additional site lists were gathered from several sources. Many vine thicket remnants visited during the detailed survey (**Chapter 3**) were found to be too small and/or fragmented for meaningful quantitative data to be gathered. Several locations were checklisted in the northern Central Highlands, including the Zig Zag Range north of Bogantungan, "Taunton" and Charlevue Creek near Dingo and a group of sites in the Nebo-Moranbah district (see **Table 4.1**).

Although vine thickets were not extensively developed in the northern Brigalow Belt Biogeographic Region in comparison with areas south of the Tropic of Capricorn, it was felt nonetheless that the northern stands were undersampled for a regional study. A representative subset (30 sites) from the floristic survey undertaken by Fensham (RJF) (Fensham 1995) was added to the database. These sites were located mainly in the Northern Bowen Basin and Marlborough Plains biogeographic provinces (see **Figure 3.1**), but also included the Peak Range and Mt Narrien, north of Alpha, the most inland occurrence of vine thicket in Queensland.

In northern New South Wales, lists for several vine thicket sites have been published by Floyd (1990) (AGF) and Benson (1995) (JB) (for *Cadellia pentastylis* communities). Other unpublished lists were made available by J.B. Williams (JBW) - these were also included in the analysis by Webb *et al.* (1984).

Forster, Bostock, Bird and Bean (1991) (WWF) published lists for 232 vine forest and vine thicket locations in south-eastern Queensland. Most of these lists were compiled from traverses through patches and along their margins with up to 10 hectares being intensively listed. This contrasts with the narrowly defined sites in the present survey and that of Fensham and is reflected in the relatively larger number of species recorded for each location by Forster *et al.* (e.g Nangur State Forest (S059) - 124 species vs 73 in the present study). Lists were selected for several small vine thicket remnants, mostly in the Southern Subcoastal Lowlands province (see **Table 3.1**), e.g. Boonah and Marburg districts.

Table 4.1 lists the 160 sites included in the bioregional database. Detailed map references (1:100 000 topographic series), altitude in metres and parent materials for each site are given in **Appendices 3** and **4.**

The database was restricted to trees, shrubs and vines/climbers, as it was felt that records for other lifeforms were generally incomplete. Epiphytes, herbs (including ferns) and subshrubs were not recorded in a consistent fashion across the sites and were therefore excluded from the analysis. It has already been noted that seasonal conditions and grazing pressure have a major influence on the ground stratum in these communities.

Floristic data from 136 subplots in the detailed vine thicket survey (see **Chapter 3**) were combined into 75 site-lists (S001-S075). These lists also incorporated any additional tree, shrub or vine species noted in the immediate vicinity of the subplots.

Records of *Cassine australis* from moister vine thicket sites published by Forster *et al.* (1991) did not stipulate the particular subspecies. Since both subsp. *australis* and subsp. *angustifolius* are known from these localities (Queensland Herbarium records), it was necessary to combine subspecies records for the entire data set.

Table 4.1 List of 160 vine thicket sites and their site-groups from 2 classifications based on species presence/absence data.

SITE	Cl 1*	Cl 2	LOCALITY	SITE	Cl 1	Cl 2	LOCALITY
S001	1	2	Portion 64 Woroon W of Windera	S037	2	6	Bullaroo Creek N of Injune (Carnarvon NP)
S002	2	6	Mt Narayen Narayen Research Station (Narayen A)	S038	3	6	East Palmgrove (Palmgrove A)
S003	2	6	Dingo Trap Hill Narayen RS (Narayen B)	S039	3	6	Central Palmgrove (Palmgrove B)
S004	2	6	Koko Scrub State Forest 40	S040	3	6	Palmgrove Creek (Palmgrove C)
S005	2	2	Wonga Hills	S041	3	7	"Welcome" Section Carnarvon National Park
S006	2	2	Cracow Mine	S042	3	7	"Telemon" Springsure
S007	3	7	Brigalow Research Station	S043	8	7	Bonewood Site "Bonnie Doon" (Bonnie Doon B)
S008	3	7	Oombabeer Bauhinia Downs	S044	3	7	Belah Site Dipperu National Park (Dipperu B)
S009	2	6	Bauhinia Ck W of Gogango Range Capricorn Highway	S045	6	6	E of Denison Creek Nebo-Sarina Road
S010	3	7	South Blackwater ooline site	S046	5	4	Mount Britten "Homevale"
S011	3	7	Wallalee Springsure	S047	6	8	Blenheim Creek
S012	3	6	Lake Nuga Nuga bonewood site (Nuga Nuga A)	S048	7	9	Mingela Bluff "Maidavale" E of Mingela
S013	3	7	Lake Nuga Nuga ooline site (Nuga Nuga B)	S049	2	6	Northern Scrub Isla Gorge National Park (Isla Gorge A)
S014	3	6	Dawson Highway Expedition Range	S050	3	6	Ridge Site "Bimbadeen" Taroom (Bimbadeen A)
S015	2	6	Cannondale Mt Expedition Range National Park	S051	3	6	Scrub Belt Site "Bimbadeen" (Bimbadeen B)
S016	2	6	Transect Scrub Amphitheatre Expedition Range NP	S052	3	6	Upper Zamia Creek Palmgrove National Park
S017	3	6	Glenleigh E of Glenhaughton	S053	2	6	Gurulmundi Ooline Reserve
S018	3	6	Gerrards Scrub Glenhaughton Road	S054	3	7	Broad Gully Creek Scrub Ka Ka Mundi (Carnarvon NP)
S019	2	2	South Mundubbera	S055	3	7	Bottletree Flat Ka Ka Mundi
S020	2	2	"Oakpark" W of Eidsvold	S056	3	7	Upper Vandyke Creek "Kareela"
S021	1	1	Yarrol Scrub Monto	S057	2	6	Southern Expedition Range near "Yebna"
S022	4	3	Koolkoorum Scrub Ubobo	S058	2	6	Devils Nest Scrub Isla Gorge National Park (Isla Gorge B)
S023	4	3	Dan Dan Scrub (State Forest 53)	S059	1	2	Western Road Nangur State Forest W of Goomeri
S024	4	3	Mount Larcom	S060	2	6	Northern Scrub Allies Creek (Allies Creek A)
S025	4	3	Bracewell (Kearney's Scrub)	S061	2	2	Southern scrub remnant Allies Creek) (Allies Creek B)
S026	4	3	Rundle Range	S062	1	2	State Forest 130 Mundowran N of Nantglyn
S027	4	3	Moores Creek Rockhampton	S063	3	6	"Stuart Downs" Wandoan
S028	4	4	Mount O'Connell Princhester	S064	1	2	Reinkes Scrub Proston
S029	4	3	"Commanche" Boomer Range	S065	2	2	Peanga Scrub Barakula State Forest
S030	6	4	Mount Adder Road "Homevale"	S066	2	2	Walkers Creek Bunya Mountains National Park
S031	6	8	Mt Hillalong Pipeline Road	S067	4	3	"Cerberus" Marlborough
S032	3	7	Bonewood Site Dipperu National Park (Dipperu A)	S068	1	2	Timber Reserve 140 Spier Callide Range
S033	2	3	"Rockyvale" Dululu	S069	1	2	Terrace Site Coominglah State Forest (Hurdle Gully A)
S034	3	7	Dry Creek Ka Ka Mundi (Carnarvon National Park)	S070	1	2	Coominglah SF (Hurdle Gully B)
S035	8	7	Bendee Site "Bonnie Doon" E of Gindie (Bonnie Doon A)	S071	4	3	Dry Creek Kroombit Holding
S036	2	6	"Oakwells" W of Injune	S072	4	3	S of The Palms Goodedulla National Park (Rookwood A)

Table 4.1 (cont.)

SITE	Cl 1	Cl 2	LOCALITY	SITE	Cl 1	Cl 2	LOCALITY
S073	4	3	Crows Apple Scrub Goodedulla NP (Rookwood B)	S108	9	10	3km E of Bingara
S074	1	1	Berlin Scrub Nature Refuge Mount Berryman	S109	10	10	Terry Hie Hie SE of Moree
S075	1	1	Dean Logging Area Yarraman State Forest	S110	9	10	Glenbawn Dam E of Scone
S076	6	6	Upper Charlevue Creek (Blackdown Tableland)	S111	2	6	Bauhinia Downs
S077	3	7	E of "Planet Downs" turnoff Dawson Highway	S112	1	2	SE of Ban Ban Springs
S078	5	6	Zig Zag Range N of Bogantungan	S113	2	2	Burnett Highway Dawes Range
S079	3	7	"Daunia" E of Moranbah	S114	1	1	Coalstoun Lakes
S080	3	7	Moranbah Bendee Site	S115	9	11	Mt Dangar Goulbourn River NP
S081	3	7	Taunton Scientific Reserve Dingo	S116	10	11	Scrub Myrtle Flora Reserve E of Narribri
S082	4	3	"Rookwood" E of Melaleuca Creek	S117	10	11	Ooline Gorge Sundown National Park
S083	5	8	Flora Range SW of Nebo	S118	4	3	Butlerville N of Targinnie
S084	3	6	Roadside E of "Eurombah" Taroom	S119	4	5	Littlemore S of Ubobo
S085	1	1	Minerva Road Kalpowar State Forest Monto	S120	4	5	Mt Scoria nr Thangool
S086	3	7	"Charlton Park" NE of Clermont	S121	2	6	Monogorilby
S087	3	7	"Eaglefield" Nebo-Mount Coolon Road	S122	1	2	Proston Town Reserve
S088	3	7	Dilly Pinnacle Arcturus Downs Road Springsure	S123	1	2	Brigooda W of Proston
S089	3	7	Mt Hope Springsure	S124	1	1	Mt Wooroolin nr Kingaroy
S090	3	6	Marengo Extension Carnarvon National Park	S125	1	1	Mt Beppo NE of Esk
S091	3	6	"Stuart Downs" near homestead Wandoan	S126	1	1	Mt Stradbroke Marburg Range
S092	3	6	Taroom-Cracow Road near Nathan Road junction	S127	1	1	Tallegalla
S093	4	4	"Bar Plains" St Lawrence	S128	1	1	Coulson NE of Boonah
S094	4	1	Upper Dry Creek Kroombit Tops	S129	1	2	Hoya NE of Boonah
S095	4	3	"Spring Creek" Craiglands via Jambin	S130	1	2	Mt Sturt E of Warwick
S096	2	6	Ooline Remnant Burnett Highway N of Mundubbera	S131	6	8	Harrow Range NE of Clermont
S097	6	8	"Kemmis Creek" W of Nebo	S132	6	8	"Kerlong" S of Coppabella
S098	3	6	Dawson Range W of Moura	S133	7	9	"Strathmore" Collinsville
S099	1	1	Serpentine Logging Area Oakview State Forest	S134	7	9	Mt Bella Vista W of Collinsville
S100	1	1	"B" Traverse Grongah State Forest	S135	7	9	Havilah Plug S of Collinsville
S101	1	1	Nangur State Forest Eastern Road	S136	7	9	"Exmoor" SE of Collinsville
S102	1	1	Round Scrub S of Wondai	S137	3	8	Newlands 1 NW of Glendon
S103	1	1	Jack Smith Environmental Park Murgon	S138	3	8	Newlands 8
S104	6	8	Pine Mountain State Forest (SF70) W of Sarina	S139	7	9	Mt Blackjack S of Collinsville
S105	9	10	Planchonella Hill nr Yallaroi	S140	6	7	SW of "Burton Downs"
S106	9	10	Booroola E of Crooble	S141	5	4	Lake Elphinstone
S107	9	10	Little Sugarloaf Mt 5km WSW of Gunnedah	S142	6	4	Shell Ck E of Scotts Peak

Table 4.1 (cont.)

SITE	Cl 1	Cl 2	LOCALITY	SITE	Cl 1	Cl 2	LOCALITY
S143	6	7	Mt Dalrymple NW of Expedition Peak	S152	7	9	Mt St Martin S of Collinsville
S144	3	7	"Orana" N of "May Downs"	S153	6	8	Upper Clarke Creek Broadsound Range
S145	5	4	"The Alps" Connors Range W of St Lawrence	S154	6	8	Mt Raddle WNW of St Lawrence
S146	5	4	"Tooloombah" Broadsound Range	S155	4	4	N of Cattle Creek "Doreen"
S147	6	8	"Clive" Broadsound Range	S156	5	4	Mt Coxenden SE of Moranbah
S148	6	8	Mt Marion Kerlong Range	S157	4	3	Scrub Creek W of Rockhampton
S149	5	4	Mt Orange Kerlong Range	S158	6	8	Mt Leura NW of Emerald
S150	5	5	Bee Creek Dipperu National Park	S159	6	8	Narrien Range
S151	5	4	Denham Range N of "Fort Cooper"	S160	6	6	Isaac River "Batheaston"

*** Classificatory groups: Cl. 1 = B/C-UPGMA (10 groups), Cl. 2 = TWINSPAN (11 groups).**

The combined database included 370 species of trees, shrubs and vines. Species recorded from a single site (60 trees/shrubs, 18 vines) were excluded from subsequent analysis. Of the remaining species, 160 occurred in 20 or more sites, with 47 recorded from more than 50 sites.

4.2 Data analyses

The bioregional floristic data (160 sites X 292 species) were classified using both agglomerative and divisive methods (Bray & Curtis/UPGMA and TWINSPAN). Details of these procedures are provided in section **3.4.2 (Chapter 3)**.

Data were also subjected to two ordination procedures - detrended correspondence analysis (DCA) and semi-strong-hybrid multidimensional scaling/principal axis rotation (SSR) - as described in section **3.4.2**.

The results of ordination were used to explore possible relationships between vine thicket floristic site-groups (community-types) and a range of climatic attributes. Correlations were calculated between 35 climatic attributes (BIOCLIM 3.6) and the vector scores for sites in each of 3 ordination dimensions (DCA 1-3 and the 3 SSR axes with highest total variance). Attribute values were standardised (between 0 and 1) prior to analysis.

Two correlation procedures were used, (i) **principal axis correlation** (PCC), a linear regression procedure within PATN, and (ii) **Spearman rank order correlations** (SROC), a non-parametric procedure.

Analyses of variance were undertaken using the non-parametric Kruskal-Wallis ANOVA by ranks test, while levels of significance of differences between group means were determined using the Tukey honest significant difference test for unequal numbers (Spjotvoll and Stoline 1975).

4.3 Results

4.3.1 Site classifications

4.3.1.1 Agglomerative classification

The agglomerative procedure produced an initial (default) 13-group classification. The fusions at this level involved single sites joining with larger groups, and it was concluded that a 10-group classification was more appropriate.

Examination of the ordination plots (see **Figure 4.3**) suggested that 4 sites (9, 33, 56 and 83) might have been misclassified. Network analysis (5 nearest-neighbours, see **Chapter 3**) confirmed that S56 (Vandyke Creek) had been misclassified and it was transferred from group 6 to group 3.

The final classification is shown in **Figure 4.1** (dendrogram) and in **Table 4.2**. Distribution of the site-groups within the Brigalow Belt Biogeographic Region is illustrated in **Figure 4.2**.

4.3.1.2 Divisive classification

Comparison of the results of the TWINSPAN classification at the 8- and 16-group levels indicated that 11 groups would be an appropriate compromise (see **Figure 4.4**), providing a broadly equivalent result in terms of numbers and sizes of site-groups to the final (10-group) agglomerative classification (see **Table 4.2**). Distribution of these 11 groups is displayed in **Figure 4.5**.

4.3.2 Species classification.

The 292 species of trees, shrubs and vines recorded from the 160 sites were classified (by TWO-STEP/UPGMA clustering) into 7 groups. Their arrangement in (DCA) ordination space is shown in **Figure 4.6**, with all 3 dimensions displayed.

The geographic trends noted from the results from the detailed vine thicket survey are also apparent in the data from the biogeographic region. A single group (group 3) (81 species) again occupies a central (core) position in the ordination plot. All species recorded from 60 or more sites

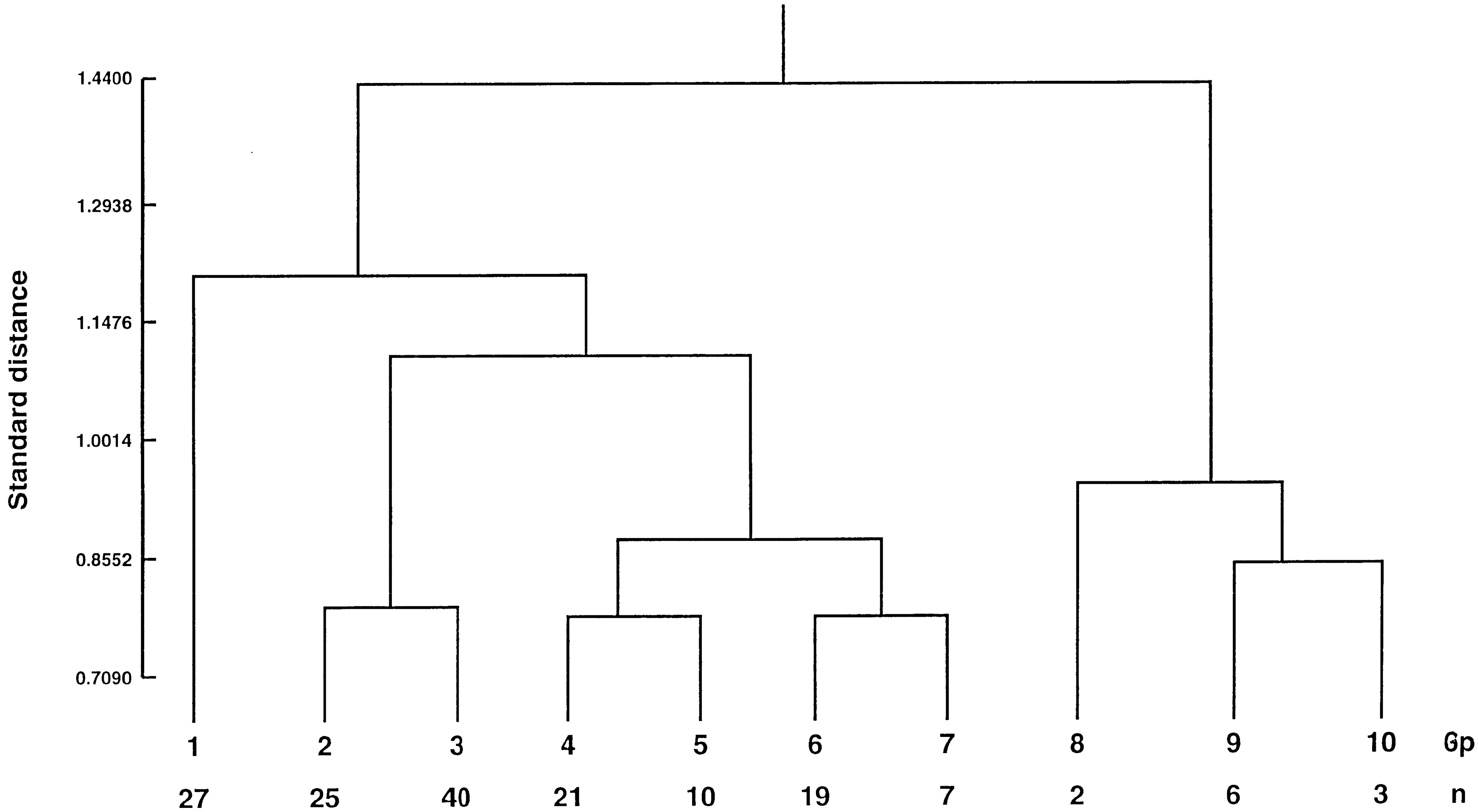


Figure 4.1 Classification of 160 vine thicket sites within the Brigalow Belt Biogeographic Region, based on species presence/absence data and Bray-Curtis coef ficient with UPGMA clustering.

Table 4.2 Composition of site-groups produced by classification of floristic data for 160 vine thicket sites in the Brigalow Belt Biogeographic Region of eastern Australia.

Agglomerative classification (B/C-UPGMA)

Group	Sites		Species (Range)
1	27	S001 S021 S059 S062 S064 S068 S069 S070 S074 S075 S085 S099 S100 S101 S102 S103 S112 S114 S122 S123 S124 S125 S126 S127 S128 S129 S130	68 (43-100)
2	25	S002 S003 S004 S005 S006 S009 S015 S016 S019 S020 S033 S036 S037 S049 S053 S057 S058 S060 S061 S065 S066 S096 S111 S113 S121	45 (25-62)
3	40	S007 S008 S010 S011 S012 S013 S014 S017 S018 S032 S034 S038 S039 S040 S041 S042 S044 S050 S051 S052 S054 S055 S056 S063 S077 S079 S080 S081 S084 S086 S087 S088 S089 S090 S091 S092 S098 S137 S138 S144	33 (19-49)
4	21	S022 S023 S024 S025 S026 S027 S028 S029 S067 S071 S072 S073 S082 S093 S094 S095 S118 S119 S120 S155 S157	62 (44-74)
5	10	S046 S078 S083 S141 S145 S146 S149 S150 S151 S156	41 (28-55)
6	19	S030 S031 S045 S047 S076 S097 S104 S131 S132 S140 S142 S143 S147 S148 S153 S154 S158 S159 S160	38 (15-54)
7	7	S048 S133 S134 S135 S136 S139 S152	40 (27-50)
8	2	S035 S043	10 (9-12)
9	6	S105 S106 S107 S108 S110 S115	25 (17-39)
10	3	S109 S116 S117	10 (9-12)

Divisive classification (TWINSPAN)

Group	Sites		Species (Range)
1	16	S021 S074 S075 S085 S094 S099 S100 S101 S102 S103 S114 S124 S125 S126 S127	68 (47-101)
2	20	S001 S005 S006 S019 S020 S059 S061 S062 S064 S065 S066 S068 S069 S070 S112 S113 S122 S123 S129 S130	61 (34-80)
3	16	S022 S023 S024 S025 S026 S027 S029 S033 S067 S071 S072 S073 S082 S095 S118 S157	61 (44-73)
4	12	S028 S030 S046 S093 S141 S142 S145 S146 S149 S151 S155 S156	48 (24-64)
5	3	S119 S120 S150	59 (40-69)
6	36	S002 S003 S004 S009 S012 S014 S015 S016 S017 S018 S036 S037 S038 S039 S040 S045 S049 S050 S051 S052 S053 S057 S058 S060 S063 S076 S078 S084 S090 S091 S092 S096 S098 S111 S121 S160	39 (25-52)
7	26	S007 S008 S010 S011 S013 S032 S034 S035 S041 S042 S043 S044 S054 S055 S056 S077 S079 S080 S081 S086 S087 S088 S089 S140 S143 S144	29 (9-42)
8	15	S031 S047 S083 S097 S104 S131 S132 S137 S138 S147 S148 S153 S154 S158 S159	36 (15-49)
9	7	S048 S133 S134 S135 S136 S139 S152	40 (27-50)
10	6	S105 S106 S107 S108 S109 S110	23 (9-39)
11	3	S115 S116 S117	15 (10-18)

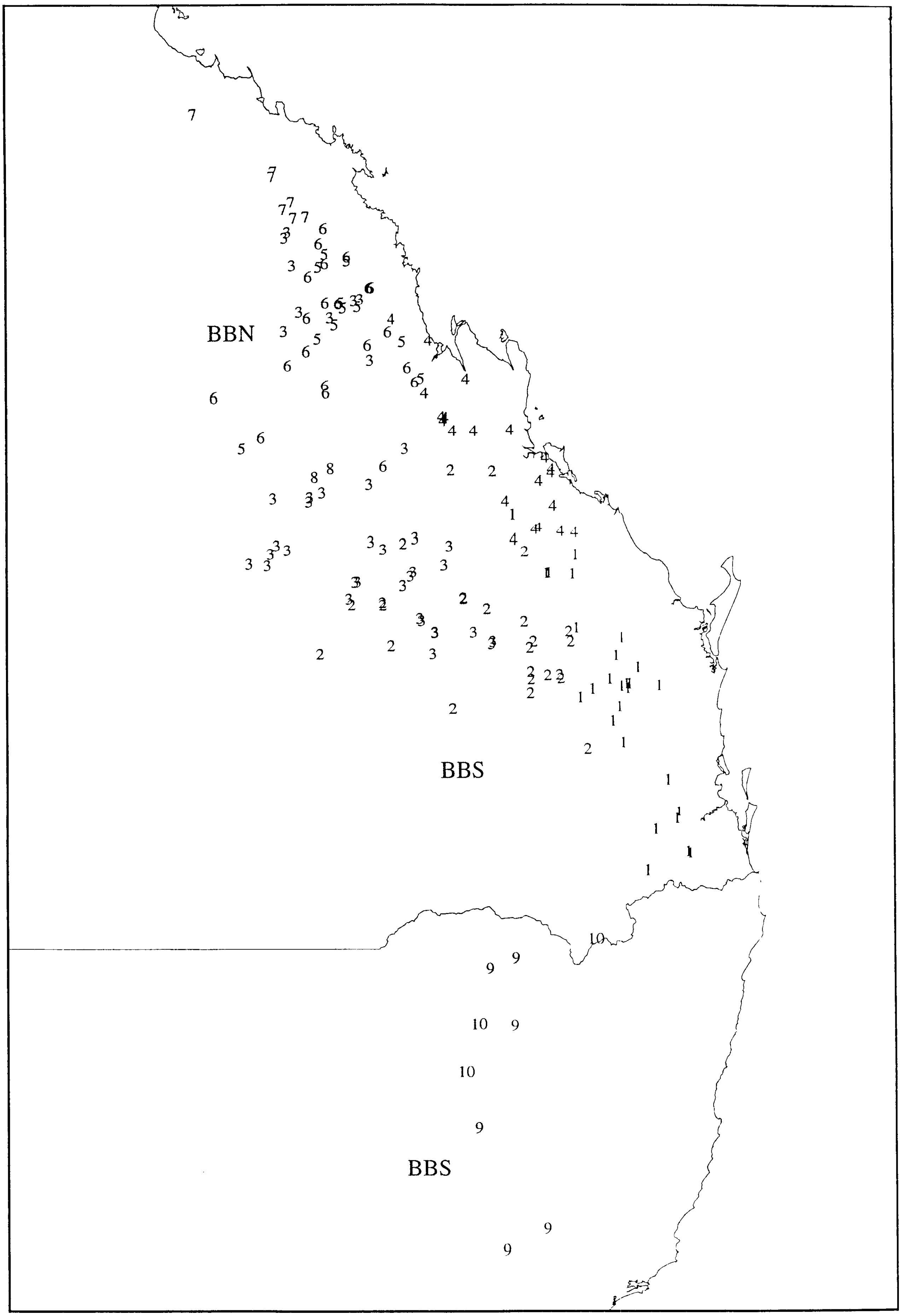
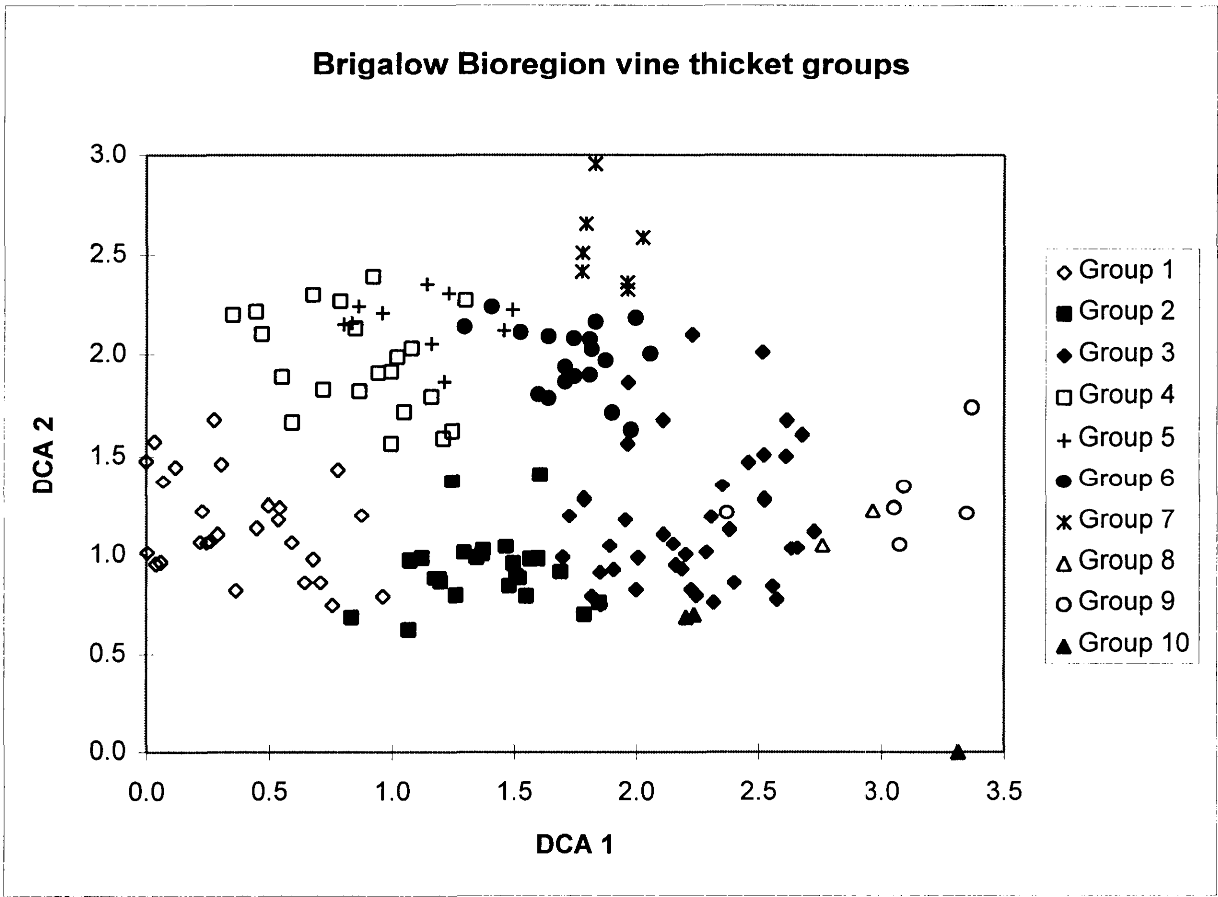


Figure 4.2 Distribution of 10 vine thicket community-types within the Brigalow Belt Biogeographic Region. Types based on agglomerative classification (B-C/UPGMA clustering) of presence/absence data for trees, shrubs and vines.



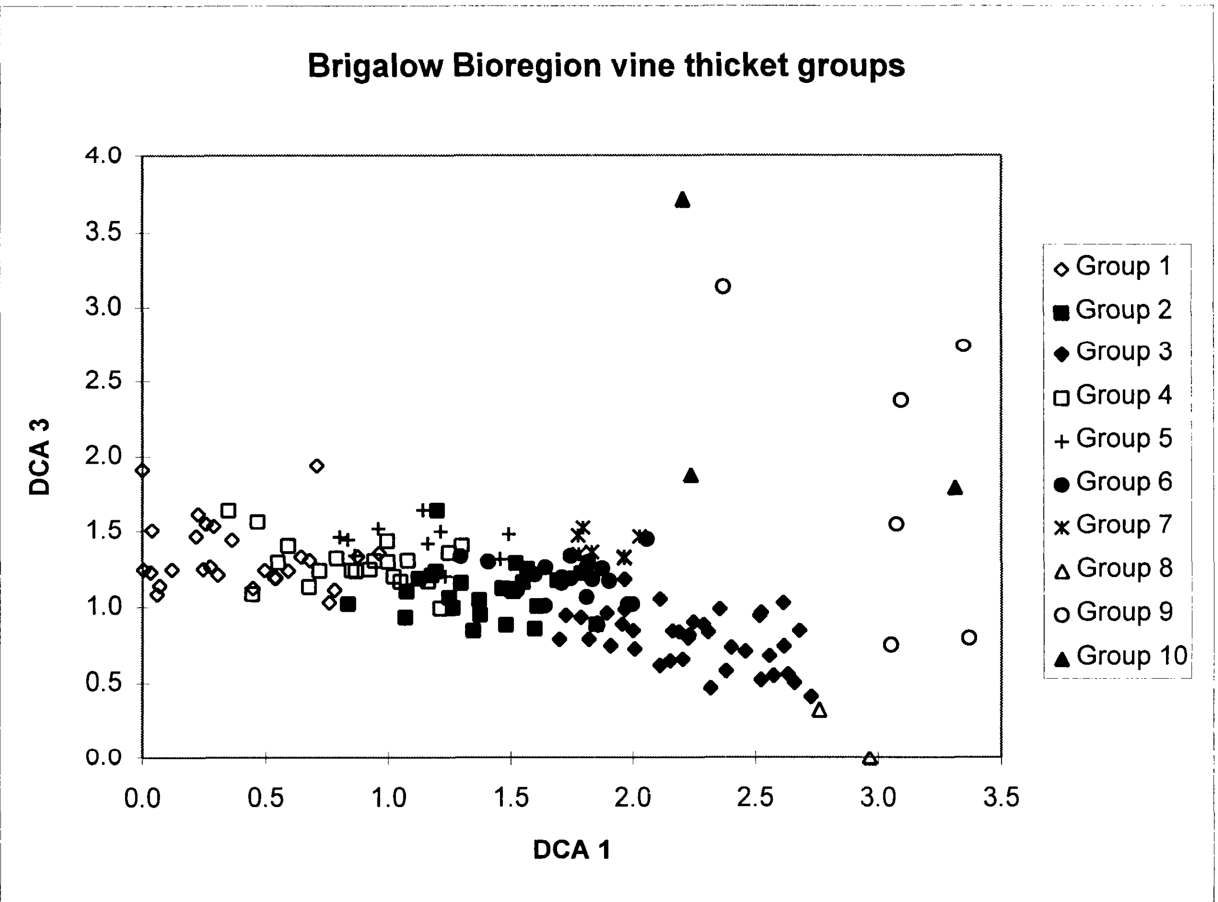
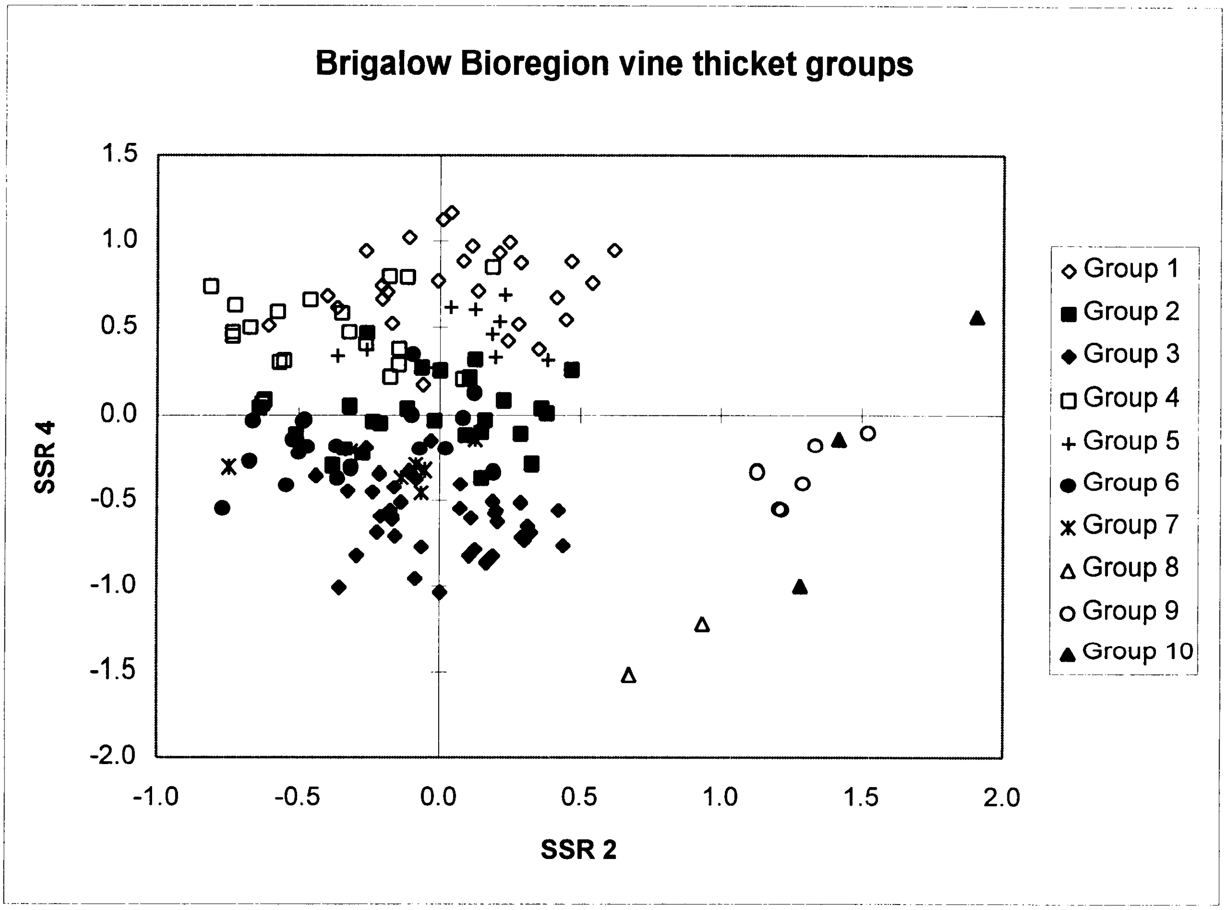


Figure 4.3 (a) Ordination (DCA) of 160 vine thicket plots. Symbols show community-types based on agglomerative (B-C/UPGMA clustering) classification of presence/absence data.



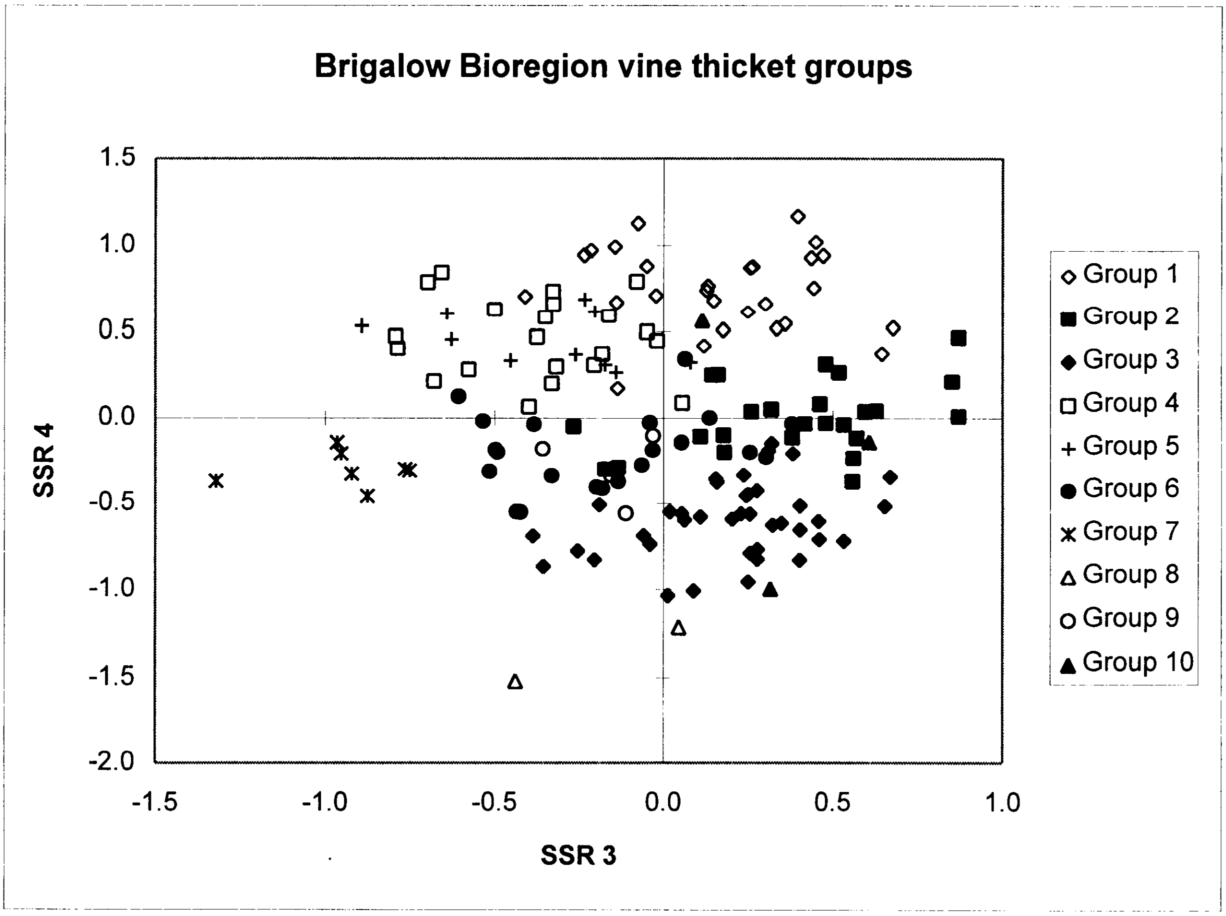


Figure 4.3 (b) Ordination (SSR) of 160 vine thicket plots. Symbols show community-types based on agglomerative (B-C/UPGMA clustering) classification of presence/absence data.

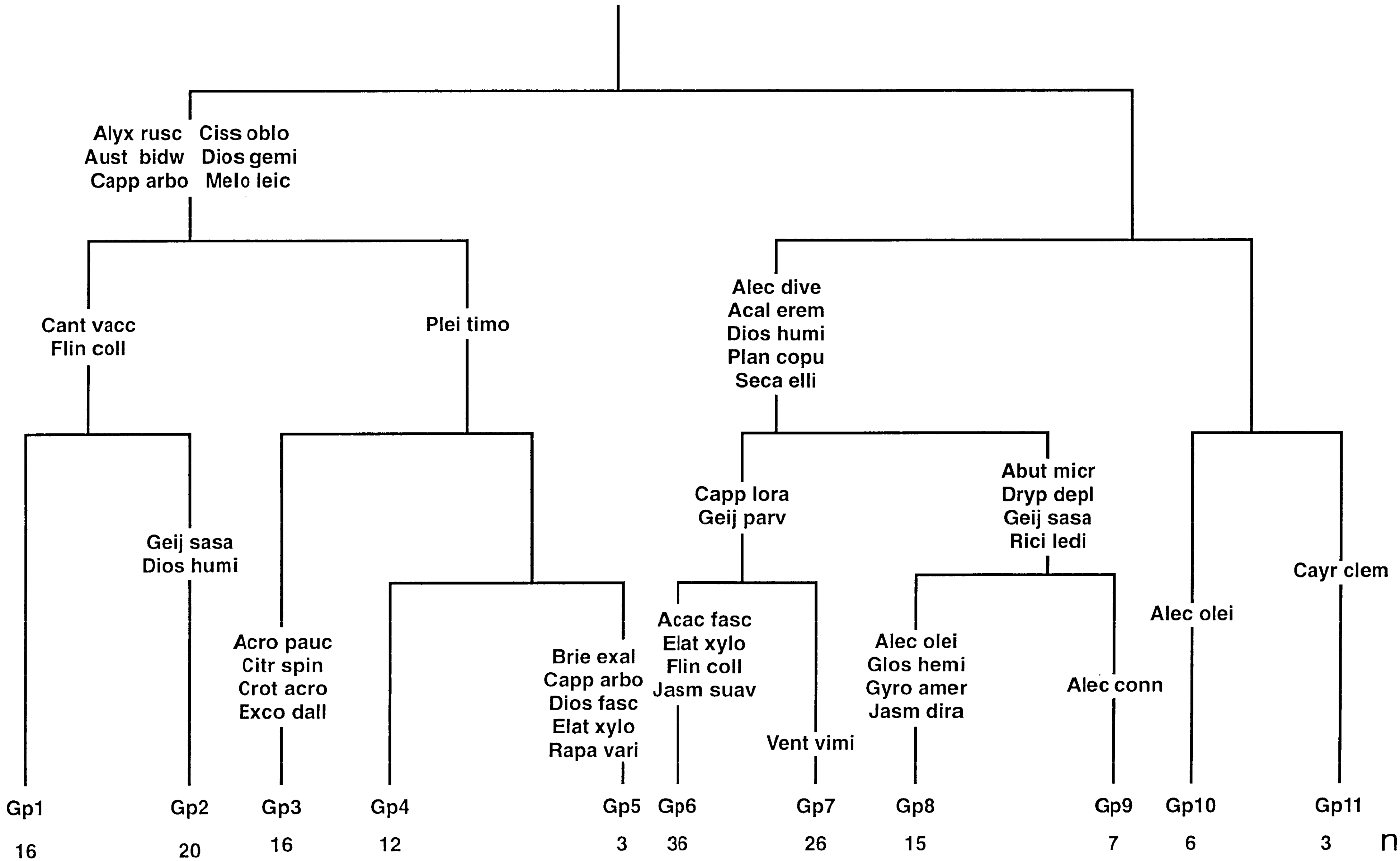


Figure 4.4 Divisive (TWINSPAN) classification of 160 vine thicket sites within the Brigalow Belt Biographic Region, based on species presence/absence data for trees, shrubs and vines.

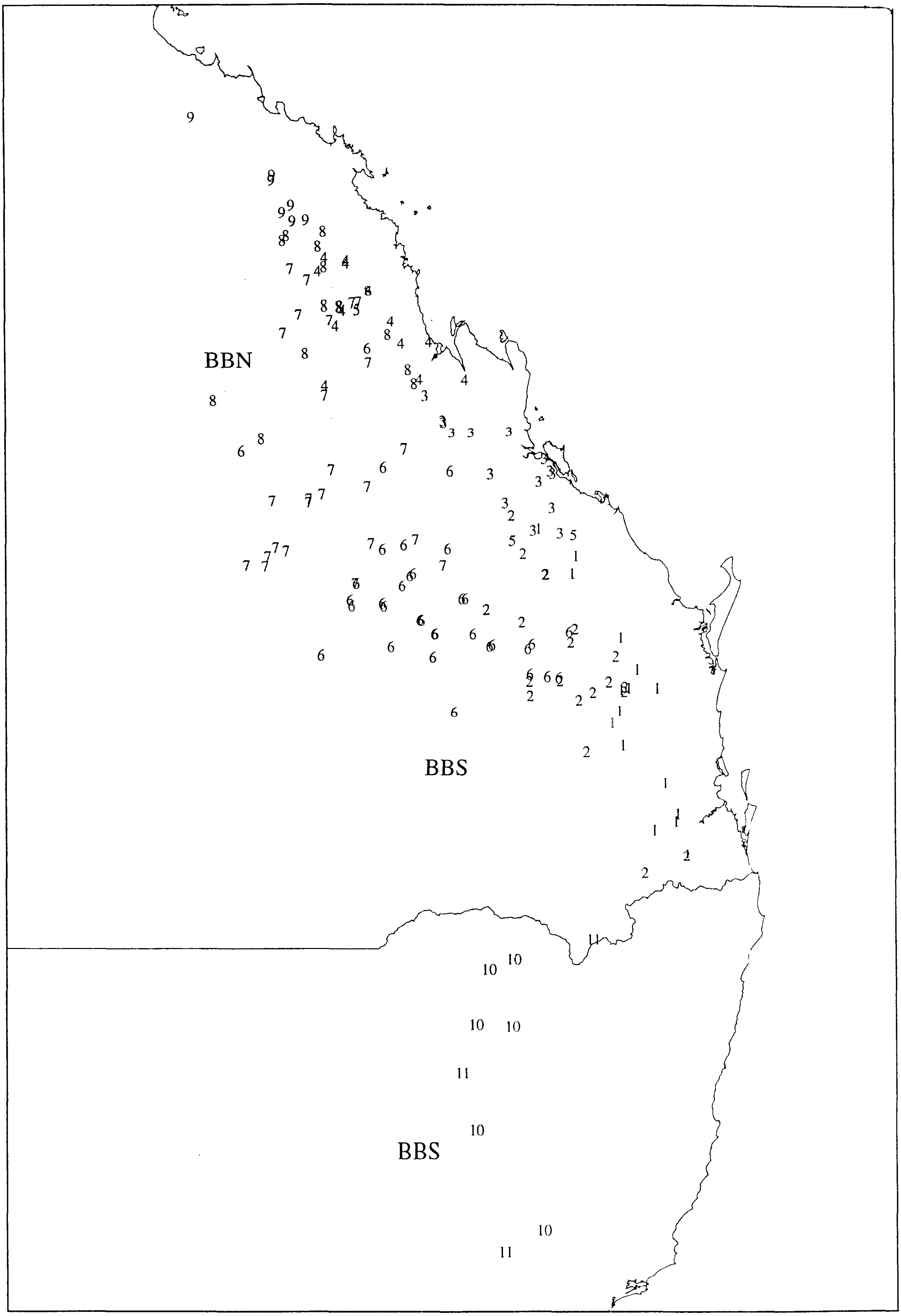
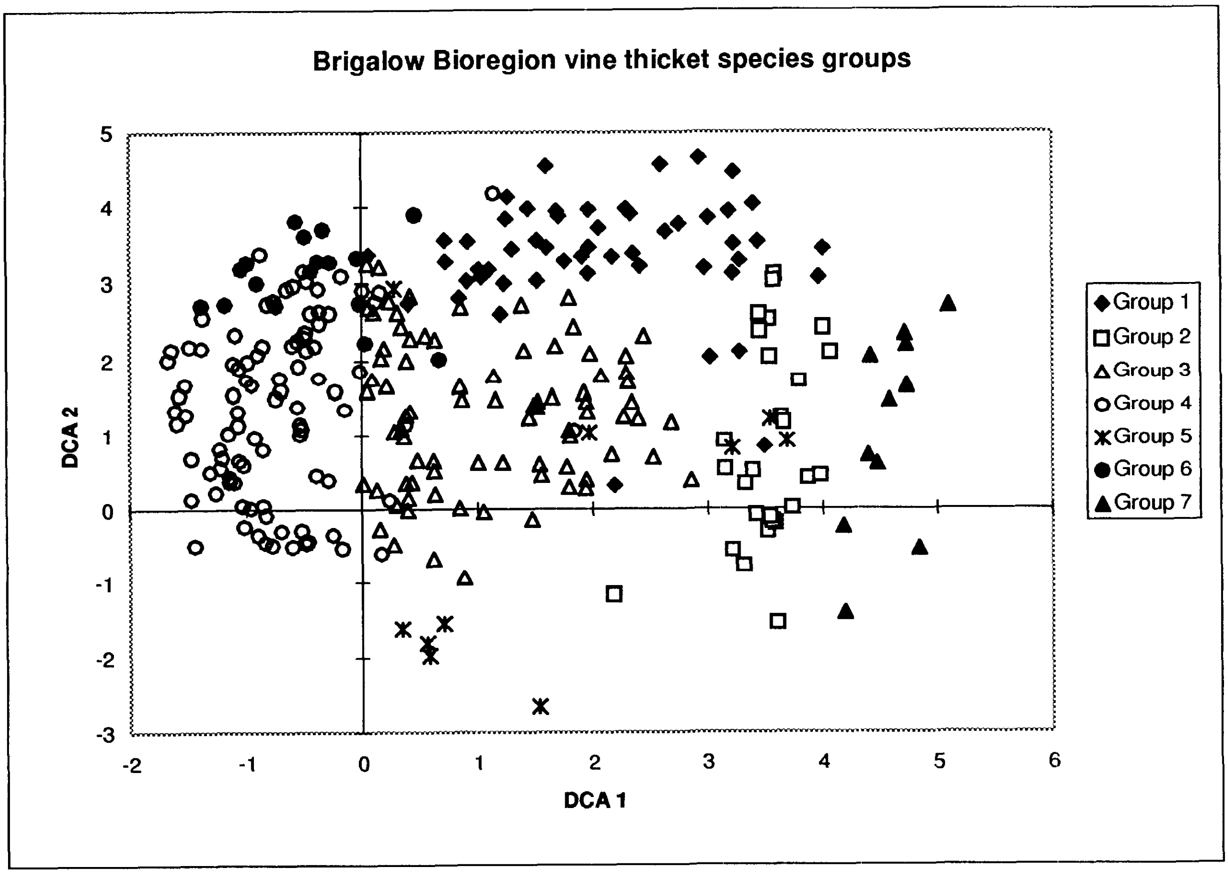


Figure 4.5 Distribution of 11 vine thicket community-types within the Brigalow Belt Biogeographic Region. Types based on divisive (TWINSPAN) classification of presence/absence data for trees, shrubs and vines.



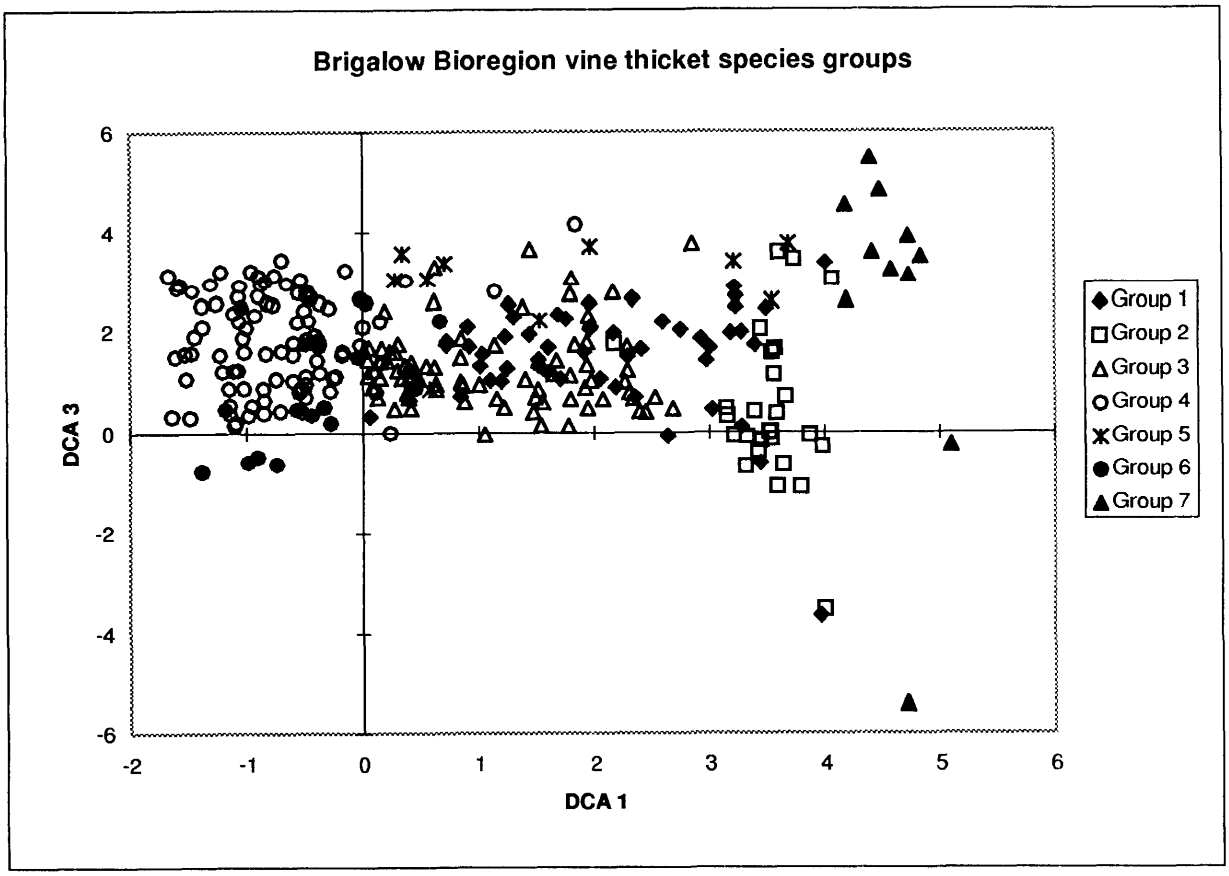


Figure 4.6 Ordination (DCA) of 291 vine thicket species (trees, shrubs and vines). Symbols indicate species-groups based on classification (Two-Step/UPGMA clustering) of presence/absence data.

are included in this group, and they are the same species which dominate species-group 5 from the detailed survey.

Group 2 is likewise equivalent to group 2 from the detailed survey, made up of species from more inland and/or transitional vine thicket communities associated with *Acacia harpophylla*-dominated communities.

The inclusion in the bioregional database of more than 30 sites from the northern brigalow region is reflected in the composition of group 1 (52 species). Apart from the species which are representative of the northern vine thickets, it now includes several of the more characteristic Central Queensland species, e.g. *Archidendropsis thozetiana, Backhousia kingii, Pleiogynium timorense* and *Terminalia porphyrocarpa* (species-group 6 from the detailed survey). There is still a group of Central Queensland species (group 6), but only 3 *(Cassine melanocarpa, Cupaniopsis wadsworthii* and *Atalaya rigida*) were recorded from 5 or more sites.

The largest group, group 4 comprising 94 species, represents the relatively moist ("araucarian") element characteristic of the south-eastern Queensland vine thickets. It comprises 2 main subgroups, one of 58 species which is equivalent to group 3 from the detailed survey and includes the more frequent members of this moist element, and a second group of 29 species which were recorded from relatively small numbers of sites.

The geographic/ecological affinities of group 5 are difficult to explain. It appears to include some relatively infrequent species from the Main Range and South Burnett district.

Group 7 is the most clearly delineated species-group, comprising the main species associated with the southern (i.e. northern New South Wales) vine thickets, e.g. *Brachychiton populneus* and *Eucalyptus albens*.

The results of this classification were used to determine the species order in the frequency table for the Brigalow Belt Biogeographic Region vine thicket flora (**Table 4.4**).

4.3.3 Bioregional floristic site-groups*

4.3.3.1 Bray-Curtis/UPGMA

Most of the bioregional community-types (**Bg 1-10**) are broadly equivalent in geographical distribution to the site-groups derived from the detailed vine thicket study (see **Chapter 3**), although there are considerable overlaps in northern central Queensland (see **Figure 4.2**). Groups **Bg1**, **Bg2** and **Bg3** are centred in southern Queensland, with group **Bg3** also extending into northern central Queensland. Group **Bg4** is centred on subcoastal central Queensland, while groups **Bg5**, **Bg6** and **Bg7** occur in northern central Queensland. Group **Bg8** is a single locality, the "Bonnie Doon" residual in the Emerald district, while groups **Bg9** and **Bg10** include the southern (NSW) vine thicket sites. These latter groups all represent relatively species-poor vine thicket stands, with 10 of the 11 sites containing 25 or fewer species.

Floristic data from the 10 site-groups have been summarised in two tables. **Table 4.3** includes those species (160) which occur in more than 10 sites, and identifies 49 species with high fidelity, i.e. having more than half of their records from a single site-group. Group **Bg1** contains 29 of these species, group **Bg3** 12 species and group **Bg4** 7 species.

The floristic relationships between the community-types are displayed in **Table 4.4**, which includes those species (116) with frequencies (or constancies) of 0.50 or greater in one or more community-types. The frequency table has been sorted to reflect the species classification (see **4.3.2** above). The table excludes several characteristic vine thicket species which occur at frequencies of less than 0.50 across three or more site-groups - these species include *Acronychia pauciflora, Backhousia angustifolia, Clerodendrum floribundum, Denhamia oleaster, Melicope erythrococca, Hoya australis, Passiflora aurantia* and *Pittosporum rhombifolium.*

Group **Bg1** comprises the relatively moist subcoastal vine thickets of south-east Queensland and extends northward to the Callide Range and west to the Proston and Mundubbera districts. The main species characterising these stands include *Alchornea ilicifolia, Acalypha capillipes, Arytera foveolata, Casearia multinervosa, Cupaniopsis parvifolia, Planchonella cotinifolia* subsp. *cotinifolia* and the climbers *Capparis sarmentosa* and *Parsonsia leichhardtii* (see **Table 4.4**).

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* To avoid confusion, community types derived from the two bioregional classifications are called **Bg** (Bray-Curtis/UPGMA) **1-10** and **Tg** (TWINSPAN) **1-11** respectively.

Table 4.3 List of species recorded from 10 or more vine thicket sites in the Brigalow Belt Biogeographic Region.

	Community-types										
NAMECODE	1	2	3	4	5	6	7	8	9	10	Total
	27	25	40	21	10	19	7	2	6	3	160
ABUTMICR	0	1	0	5	3	17	4	0	0	0	30
ACACAULA	7	1	0	2	1	0	0	0	0	0	11
ACACFASC	11	14	13	8	0	3	2	0	0	0	51
ACACHARP	5	3	23	1	0	3	4	0	0	0	39
ACACMAID	11	0	0	0	0	0	0	0	0	0	11
ACALCAPI	19	2	0	0	0	0	0	0	0	0	21
ACALEREM	9	16	34	20	5	17	3	0	0	0	104
ACROLAEV	13	0	0	7	4	1	0	0	0	0	25
ACROPAUC	7	7	1	9	0	1	0	0	0	0	25
ALCHILIC	20	1	0	5	1	1	0	0	0	0	28
ALECCONN	13	12	16	17	6	16	2	0	0	0	82
ALECDIVE	11	23	37	7	0	16	4	0	0	0	98
ALECOLEI	0	0	1	0	0	0	6	0	6	0	13
ALECPUBE	1	6	6	0	0	0	0	0	0	0	13
ALECSUBD	18	7	1	9	1	1	0	0	2	2	41
ALPHEXCE	10	0	6	6	7	6	2	0	4	0	41
ALSTCONS	14	15	18	7	3	3	0	0	3	0	63
ALYXRUSC	22	1	2	17	9	12	2	0	0	0	65
APOPANOM	1	7	22	0	0	1	2	0	1	0	34
ARAUCUNN	12	0	0	3	0	0	0	0	0	0	15
ARCHTHOZ	2	0	3	15	2	10	2	0	0	0	34
ARYTFOVE	17	0	0	0	0	0	0	0	0	0	17
ARYTMICR	12	0	0	0	0	0	0	0	0	0	12
ATALSALI	21	15	6	7	0	1	0	0	0	0	50
AUSTBIDW	26	16	3	19	8	9	4	0	0	0	85
AUSTBLAC	14	0	0	9	1	0	0	0	0	0	24
BACKANGU	10	12	9	1	1	2	0	0	0	0	35
BACKKING	2	0	0	8	0	2	0	0	0	0	12
BRACAUST	4	15	20	15	6	15	5	0	0	0	80
BRACDISC	11	0	0	0	0	0	0	0	0	0	11
BRACRUPE	16	23	32	9	3	12	0	0	0	0	95
BREYOBLO	12	14	19	10	3	11	5	0	1	0	75
BRIELEIC	11	14	10	13	6	11	0	0	0	0	65
BURSINCA	13	14	4	1	0	0	0	0	1	0	33
CADEPENT	0	2	7	0	0	0	0	0	0	3	12
CANTBRIG	2	10	25	0	0	6	3	0	0	0	46
CANTBUXI	17	5	0	1	0	0	0	0	0	0	23
CANTCOPR	6	2	1	0	1	1	0	0	0	0	11
CANTODOR	15	11	17	20	6	17	2	0	4	0	92
CANTVACC	23	17	19	5	0	0	1	2	0	0	67
CAPPARBO	25	11	1	18	2	6	0	0	0	0	63
CAPPLASI	0	3	28	1	0	5	7	2	2	0	48
CAPPLORA	2	13	29	0	2	2	0	0	0	0	48
CAPPMITC	2	4	6	0	0	1	1	0	3	1	18
CAPPORNA	0	1	0	7	2	6	3	0	0	0	19
CAPPSARM	21	3	0	1	0	0	0	0	0	0	25
CARIOVAT	23	26	39	20	7	16	6	0	3	2	142
CASEMULT	16	6	0	0	0	0	0	0	0	0	22
CASSAUST	17	15	17	4	2	7	0	0	3	1	66
CASSBREW	0	0	5	0	2	2	0	1	0	0	10
CASSMELA	0	0	0	9	0	1	0	0	0	0	10
CASSTOME	2	2	4	3	0	2	0	0	0	0	13
CASUCRIS	3	4	8	0	0	2	0	0	2	0	19
CAYRACRI	7	4	0	5	2	0	0	0	0	0	18
CAYRCLEM	7	3	2	3	2	1	0	0	2	2	22

Table 4.3 (cont.)

NAMECODE	Community-types 1	2	3	4	5	6	7	8	9	10	Total
CISSOBLO	9	4	0	19	6	2	0	0	0	0	**40**
CISSOPAC	10	15	34	16	6	14	6	0	2	0	**103**
CISSRENI	0	1	4	9	6	4	5	0	0	0	**29**
CITRLINE	**20**	11	0	2	0	0	0	0	0	0	**33**
CITRSPIN	9	17	39	17	0	11	1	0	1	0	**95**
CLAOTENE	0	6	5	7	4	0	0	0	0	0	**22**
CLERFLOR	11	5	6	4	0	3	0	0	0	0	**29**
CROTACRO	**15**	1	0	13	0	0	0	0	0	0	**29**
CROTINSU	22	23	30	11	3	9	0	0	0	0	**98**
CROTPHEB	9	11	19	10	5	12	6	1	3	0	**76**
CUPAANAC	2	1	0	6	8	3	2	0	0	0	**22**
CUPAPARV	**18**	4	0	1	0	0	0	0	0	0	**23**
CYNABOWM	10	13	6	9	2	2	1	0	0	0	**43**
DENDPHOT	10	4	0	5	2	0	0	0	0	0	**21**
DENHOLEA	0	2	**17**	3	1	9	1	0	0	0	**33**
DENHPITT	22	14	8	9	0	3	1	0	0	0	**57**
DIOSGEMI	17	4	0	19	8	5	4	0	0	0	**57**
DIOSHUMI	9	23	33	13	4	18	5	0	0	0	**105**
DIOSTRAN	13	3	3	17	3	6	1	0	0	0	**46**
DIPLIXOR	9	17	26	15	2	5	0	0	0	0	**74**
DIPLPALM	2	2	6	3	2	2	0	0	0	0	**17**
DRYPDEPL	23	8	7	18	6	11	5	0	0	0	**78**
EHREGRAH	0	0	2	3	2	7	2	0	0	0	**16**
EHREMEMB	12	21	36	12	5	12	5	2	3	2	**110**
ELATXYLO	21	15	6	16	1	5	0	0	0	0	**64**
EREMMITC	0	0	**9**	0	0	2	0	0	1	0	**12**
ERYTAUST	14	16	22	13	4	8	3	0	0	0	**80**
EUROFALC	7	0	0	9	5	2	1	0	0	0	**24**
EUSTLATI	7	2	1	1	2	0	0	0	1	0	**14**
EXCODALL	19	10	7	14	1	3	0	0	0	0	**54**
EXOCLATI	20	9	12	9	3	7	2	0	0	0	**62**
FICUPLAT	9	4	2	7	8	6	4	0	0	0	**40**
FLINAUST	19	9	5	3	7	4	0	0	0	0	**47**
FLINCOLL	20	20	14	2	0	0	0	0	0	0	**56**
FLUELEUC	0	2	8	8	5	11	6	0	0	0	**40**
GEIJPANI	8	5	0	14	0	2	0	0	0	0	**29**
GEIJPARV	2	13	**30**	2	0	1	0	2	6	1	**57**
GEIJSALA	**13**	1	0	8	0	2	0	0	0	0	**24**
GEIJSASA	6	13	8	5	6	9	7	0	0	0	**54**
GEITCYMO	12	5	0	9	1	0	0	0	0	1	**28**
GLOSHEMI	11	4	5	18	1	8	7	0	0	0	**54**
GREVHELM	5	4	1	7	0	1	1	0	0	0	**19**
GREWLATI	1	1	0	3	2	8	3	0	0	0	**18**
GREWSCAB	0	0	3	1	1	4	5	0	0	0	**14**
GUETPUTA	0	0	1	5	3	4	0	0	0	0	**13**
GYMNMICR	**11**	5	0	4	0	1	0	0	0	0	**21**
GYMNPLEI	8	10	6	5	1	3	1	0	4	0	**38**
GYROAMER	0	0	0	9	3	2	7	0	0	0	**21**
HOMAALNI	3	0	0	**10**	0	2	0	0	0	0	**15**
HOVELONG	1	1	8	3	1	5	1	0	3	0	**23**
HOYAAUST	4	2	3	10	1	3	0	0	0	0	**23**
JASMDILI	0	1	**9**	0	0	0	0	0	4	1	**15**
JASMDIRA	17	18	19	20	3	5	6	0	0	0	**88**
JASMSIAU	22	22	7	15	4	6	0	0	0	0	**76**
LANTCAMA	8	0	0	10	7	3	1	0	0	0	**29**
LYSIHOOK	0	2	10	8	0	14	7	1	0	0	**42**
MACRLEIC	0	1	**20**	0	0	0	0	2	0	0	**23**
MACRLEIO	1	1	1	4	1	1	1	0	0	0	**10**

Table 4.3 (cont.)

NAMECODE	1	2	3	4	5	6	7	8	9	10	Total
	Site-groups										
MALASCAN	22	11	1	13	6	6	1	0	0	0	**60**
MALLCLAO	9	0	0	8	0	1	0	0	0	0	**18**
MALLPHIL	6	1	0	3	2	1	0	0	0	0	**13**
MARSVIRI	2	3	12	2	1	2	0	0	2	0	**24**
MAYTBILO	**15**	6	2	2	0	0	0	0	1	0	**26**
MAYTDISP	17	13	4	7	3	1	0	0	0	0	**45**
MELIERYT	10	8	3	7	0	0	1	0	0	0	**29**
MELOLEIC	18	11	3	16	4	3	0	0	0	0	**55**
MICRMINU	4	0	0	3	3	0	0	0	0	0	**10**
MURROVAT	6	2	6	18	5	3	5	0	0	0	**45**
NOTEMICR	26	23	31	17	7	11	3	1	6	3	**128**
OPUNTOME	1	4	25	4	7	14	1	1	0	0	**57**
OWENVENO	20	15	4	6	0	0	0	0	0	0	**45**
PANDPAND	16	13	8	6	4	4	1	0	5	1	**58**
PARSEUCA	1	11	20	1	1	0	0	2	3	1	**40**
PARSLANC	15	20	25	11	3	14	4	0	4	0	**96**
PARSLEIC	**15**	4	0	2	0	0	0	0	0	0	**21**
PARSLENT	**9**	0	0	3	0	0	0	0	0	0	**12**
PARSPLAE	3	2	3	6	4	5	1	0	0	0	**24**
PARSROTA	8	6	1	1	0	0	0	0	0	0	**16**
PASSAURA	10	7	5	7	0	2	0	0	0	0	**31**
PAVEAUST	**15**	3	0	3	7	1	0	0	0	0	**29**
PITTRHOM	13	11	0	3	2	1	0	0	0	0	**30**
PLANCOCO	**21**	2	0	1	0	0	0	0	0	0	**24**
PLANCOPU	6	22	36	18	7	18	6	0	1	0	**114**
PLANMYRS	**10**	0	0	3	0	0	0	0	0	0	**13**
PLEITIMO	0	1	0	**17**	6	3	4	0	0	0	**31**
PLEOAUST	6	0	0	6	0	0	1	0	0	0	**13**
POLYELEG	12	4	0	14	9	3	0	0	0	0	**42**
PREMLIGN	**16**	1	0	1	0	0	0	0	0	0	**18**
PSYCDAPH	4	3	1	9	4	1	0	0	0	0	**22**
RAPAVARI	14	8	1	11	3	2	0	0	0	0	**39**
RICILEDI	3	1	3	5	1	5	7	0	0	0	**25**
SANTLANC	1	1	4	3	1	0	1	0	2	0	**13**
SARCVIBR	3	4	8	5	0	5	0	0	0	0	**25**
SECAELLI	22	19	29	18	7	15	2	2	0	0	**114**
SENNSURE	0	0	1	2	5	4	1	0	0	0	**13**
SIPHAUST	16	10	3	6	0	1	0	0	0	0	**36**
SMILAUST	7	0	0	**13**	1	0	0	0	0	0	**21**
SOLASEAF	8	6	4	8	5	4	0	0	0	0	**35**
STERQUAD	7	0	0	**13**	1	1	1	0	0	0	**23**
STREBRUN	**11**	0	0	4	0	0	0	0	0	1	**16**
STRYAXIL	18	4	1	21	8	8	6	0	0	0	**66**
TERMOBLO	0	0	4	1	0	6	3	0	0	0	**14**
TERMPORP	0	0	0	**11**	0	0	4	0	0	0	**15**
TETRNITE	4	0	0	7	1	0	0	0	0	0	**12**
TINOSMIL	9	14	15	8	5	6	3	0	0	0	**60**
TRAGNOVA	**7**	2	0	2	0	0	0	0	0	0	**11**
TURRPUBE	19	14	14	19	4	4	5	0	0	0	**79**
VENTVIMI	0	2	**20**	0	0	4	0	1	2	0	**29**
ZANTBRAC	**10**	4	1	3	0	0	0	0	0	0	**18**

Highlighted cells e.g. **21** indicate those species with >50% records from a single community-type (ie. high fidelity to that group).

Table 4.4 Species with frequencies of 0.50 or greater in 10 site-groups (community-types) produced by agglomerative classification of floristic data for 160 vine thicket sites.

	Community-type									
	1	2	3	4	5	6	7	8	9	10
SPECIES	[27]	[25]	[40]	[21]	[10]	[19]	[7]	[2]	[6]	[3]
ALECOLEI			+				0.86		1.00	
CROTARNH					+		0.57			
GREWSCAB			+	+	+	+	0.71			
ABUTMICR		+		+	+	0.89	0.57			
FLUELEUC		+	+	+	0.50	0.58	0.86			
LYSIHOOK		+	+	+		0.74	1.00	+		
OPUNTOME	+	+	0.63	+	0.70	0.74	+	+		
CISSRENI		+	+	+	0.60	+	0.71			
GYROAMER				+	+	+	1.00			
RICILEDI	+	+	+	+	+	+	1.00			
ARCHTHOZ	+		+	0.71	+	0.53	+			
PLEITIMO		+		0.81	0.60	+	0.57			
GLOSHEMI	+	+	+	0.86	+	+	1.00			
MURROVAT	+	+	+	0.86	0.50	+	0.71			
TERMPORP				0.52			0.57			
CUPAANAC	+	+		+	0.80	+	+			
SENNSURE			+	+	0.50	+	+			
ACACHARP	+	+	0.58	+		+	0.57			
APOPANOM	+	+	0.55			+	+		+	
CAPPLORA	+	0.52	0.73		+	+				
GEIJPARV	+	0.52	0.75	+		+		1.00	1.00	+
PARSEUCA	+	0.50	+	+	+			1.00	0.50	+
CANTBRIG	+	+	0.63			+	+			
CAPPMITC	+	+	+			+	+		0.50	+
JASMDILI		+	+						0.67	+
CAPPLASI		+	0.70	+		+	1.00	1.00	+	
MACRLEIC		+	+					1.00		
VENTVIMI		+	0.50			+		+	+	
CADEPENT		+	+							1.00
HOVELONG		+	+	+	+	+	+		0.50	
MAYTCUNN		+		+		+			0.50	
ACACFASC	+	0.56	+	+		+	+			
CYNABOWM	+	0.52	+	+	+	+	+			
ALECCONN	+	+	+	0.81	0.60	0.84	+			
CANTODOR	0.56	+	+	0.95	0.60	0.89	+		0.67	
BRIELEIC	+	0.56	+	0.62	0.60	0.58				
JASMDIRA	0.63	0.72	+	0.95	+	+	0.86			
TURRPUBE	0.70	0.56	+	0.90	+	+	0.71			
ALSTCONS	0.52	0.60	+	+	+	+			0.50	
CASSAUST	0.63	0.60	+	+	+	+			0.50	+
CROTINSU	0.81	0.92	0.75	0.52	+	+				
BRACRUPE	0.59	0.92	0.80	+	+	0.63				
DIPLIXOR	+	0.68	0.65	0.71	+	+				
BREYOBLO	+	0.56	+	+	+	0.58	0.71		+	
PARSLANC	0.56	0.80	0.63	0.52	+	0.74	0.57		0.67	
CARIOVAT	0.85	1.00	0.98	0.95	0.70	0.84	0.86		0.50	0.67
NOTEMICR	0.96	0.92	0.78	0.81	0.70	0.58	+	+	1.00	1.00
SECAELLI	0.81	0.76	0.73	0.86	0.70	0.79	+	1.00		
ERYTAUST	0.52	0.64	0.55	0.62	+	+	+			

+ denotes frequency of less than 0.50.

Table 4.4 (cont.)

	Community-type									
	1	2	3	4	5	6	7	8	9	10
TINOSMIL	+	0.56	+	+	0.50	+	+			
GYMNPLEI	+	+	+	+	+	+	+		0.67	
PANDPAND	0.59	0.52	+	+	+	+	+		0.83	+
ACALEREM	+	0.64	0.85	0.95	0.50	0.89	+			
CISSOPAC	+	0.60	0.85	0.76	0.60	0.74	0.86		+	
DIOSHUMI	+	0.92	0.83	0.62	+	0.95	0.71			
PLANCOPU	+	0.88	0.90	0.86	0.70	0.95	0.86		+	
CITRSPIN	+	0.68	0.98	0.81		0.58	+		+	
BRACAUST	+	0.60	0.50	0.71	0.60	0.79	0.71			
ALECDIVE	+	0.92	0.93	+		0.84	0.57			
EHREMEMB	+	0.84	0.90	0.57	0.50	0.63	0.71	1.00	0.50	0.67
CROTPHEB	+	+	+	+	0.50	0.63	0.86	+	0.50	
GEIJSASA	+	0.52	+	+	0.60	+	1.00			
ALYXRUSC	0.81	+	+	0.81	0.90	0.63	+			
DIOSGEMI	0.63	+		0.90	0.80	+	0.57			
STRYAXIL	0.67	+	+	1.00	0.80	+	0.86			
AUSTBIDW	0.96	0.64	+	0.90	0.80	+	0.57			
DRYPDEPL	0.85	+	+	0.86	0.60	0.58	0.71			
DIOSTRAN	+	+	+	0.81	+	+	+			
CISSOBLO	+	+		0.90	0.60	+				
POLYELEG	+	+		0.67	0.90	+				
SOLASEAF	+	+	+	+	0.50	+				
GEIJPANI	+	+		0.67		+				
EUROFALC	+			+	0.50	+	+			
LANTCAMA	+			+	0.70	+	+			
ATALSALI	0.78	0.60	+	+		+				
OWENVENO	0.74	0.60	+	+						
DENHPITT	0.81	0.56	+	+		+	+			
ELATXYLO	0.78	0.60	+	0.76	+	+				
JASMSIAU	0.81	0.88	+	0.71	+	+				
EXCODALL	0.70	+	+	0.67	+	+				
MAYTDISP	0.63	0.52	+	+	+	+				
SIPHAUST	0.59	+	+	+		+				
CAPPARBO	0.93	+	+	0.86	+	+				
MALASCAN	0.81	+	+	0.62	0.60	+	+			
MELOLEIC	0.67	+	+	0.76	+	+				
RAPAVARI	0.52	+	+	0.52	+	+				
EXOCLATI	0.74	+	+	+	+	+	+			
FLINAUST	0.70	+	+	+	0.70	+				
BURSINCA	+	0.56	+	+					+	
CANTVACC	0.85	0.68	+	+			+	1.00		
FLINCOLL	0.74	0.80	+	+						
ALPHEXCE	+		+	+	0.70	+	+		0.67	
FICUPLAT	+	+	+	+	0.80	+	0.57			
CAYRCLEM	+	+	+	+	+	+			+	0.67
ALCHILIC	0.74	+		+	+	+				
PAVEAUST	0.56	+		+	0.70	+				
ALECSUBD	0.67	+	+	+	+	+			+	0.67
AUSTBLAC	0.52			+	+					
CROTACRO	0.56	+		0.62						
SMILAUST	+			0.62	+					

+ denotes frequency of less than 0.50.

Table 4.4 (cont.)

	Community-type									
	1	2	3	4	5	6	7	8	9	10
STERQUAD	+			0.62	+	+	+			
ACALCAPI	0.70	+								
ARYTFOVE	0.63									
PLANCOCO	0.78	+		+						
CANTBUXI	0.63	+		+						
CAPPSARM	0.78	+		+						
CUPAPARV	0.67	+		+						
CASEMULT	0.59	+								
CITRLINE	0.74	+		+						
MAYTBILO	0.56	+	+	+					+	
PARSLEIC	0.56	+		+						
PREMLIGN	0.59	+		+						
BEYEVISC		+							0.67	
BRACPOPU									0.83	
CLEMMICR									0.50	
EUCAALBE									0.50	

+ denotes frequency of less than 0.50.

The inland southern Queensland vine thickets fall into groups **Bg2** and **Bg3**. These are the typical "bottle tree scrubs" and *Brachychiton rupestris, Citriobatus spinescens,* and to a lesser degree, *Alectryon diversifolius, Capparis loranthifolia, Ehretia membranifolia* and *Geijera parviflora* distinguish these communities from other site-groups (see **Table 4.4**).

The group **Bg2** vine thickets occupy an intermediate position (geographically and in ordination space) between groups **Bgl** and **Bg3** (see **Figures 4.2** and **4.3**). They extend from the Bunya Mountains westward to the Injune and Taroom districts with outliers near Bauhinia Downs, Duaringa and Mount Morgan. In the Taroom district, they overlap with group **Bg3,** represented by a series of relatively open vine thicket stands with characteristic emergent *Acacia harpophylla* (e.g. "Bimbadeen", "Eurombah" and "Stuart Downs").

Group **Bg2** vine thickets have a greater floristic diversity than those of group **Bg3** and contain many species which are also frequent in group **Bgl** stands. These include *Austromyrtus bidwillii, Atalaya salicifolia, Denhamia pittosporoides, Elattostachys xylocarpa, Owenia venosa* and the vine *Jasminum simplicifolium* subsp. *australiense*. They generally lack *Apophyllum anomalum, Ventilago viminalis* and *Macropteranthes leichhardtii* (all characteristic of group **Bg3).**

Group **Bg3** extends from the Dawson River valley northward to the Collinsville district (**Figure 4.2**) and includes most of the *Macropteranthes leichhardtii* and *Cadellia pentastylis* -

dominated vine thickets. These communities are found predominantly on sediments, with a minority on volcanic rocks. In northern areas it overlaps with Group **Bg6** and, to a minor extent, Group **Bg5**. Outliers include Newlands north-west of Nebo (S137, S138) and Moranbah (S080).

Apart from *Apophyllum anomalum, Ventilago viminalis* and *Macropteranthes leichhardtii* (see above), major indicator species for this group include *Capparis lasiantha, C. loranthifolia, Denhamia oleaster* and *Geijera parviflora*. The introduced *Opuntia tomentosa* is most frequent in this group of sites.

Group **Bg4** is centred on the subcoastal ranges of central Queensland, and extends from the Dawes Range north to the St Lawrence district. Its closest floristic affinities are with Group **Bg5**, and the major distinguishing species are *Archidendropsis thozetiana, Glossocarya hemiderma, Terminalia porphyrocarpa, Diplospora ixoroides* and *Citriobatus spinescens*, as well as the high fidelity species *Backhousia kingii, Cassine melanocarpa* and *Homalium alnifolium*.

Groups **Bg5, Bg6** and **Bg7** include most of the vine thicket sites within the northern Brigalow Biogeographic Region. Most occur on rocky hillslopes (providing protection from fire), on a range of substrates. Group **Bg5** sites range from "Tooloombah" west of Marlborough north to Mt Britten and inland to the Zig Zag Range near Bogantungan and include S150 on the alluvia of Bee Creek, Dipperu National Park. *Flindersia australis, Alphitonia excelsa, Ficus platypoda* and *Pavetta australiensis* are the main species characterising this group.

The geographic distribution of group **Bg6** overlaps completely that of group **Bg5** (see **Figure 4.2**), extending west to Mt Leura north-west of Emerald and the Narrien Range north of Alpha. Both groups are represented in the same locality (and on the same parent material) at Mt Britten and on the Kerlong Range south-west of Nebo. Distinguishing species include (for group **Bg5**) *Pleiogynium timorense, Cupaniopsis anacardioides, Polyscias elegans, Pavetta australiensis, Lantana camara* and (for group **Bg6**) *Lysiphyllum hookeri* and *Alectryon diversifolius*.

Group **Bg7**, the northern-most site-group in the classification, is based on vine thickets on volcanic peaks in the Collinsville district, and also includes S048, on Mingela Bluff. Indicator species are *Alectryon oleifolius, Grewia scabrella, Croton arnhemicus, Gyrocarpus americanus* and *Capparis lasiantha*.

As noted above, the vine thickets of groups **Bg8, Bg9** and **Bg10** are distinguished by their relatively low numbers of species. Group **Bg8** comprises the *Macropteranthes leichhardtii - Acacia catenulata* community at "Bonnie Doon" near Emerald, and group **Bg10** the southern *Cadellia pentastylis* stands. Both are essentially extreme forms of group **Bg3**.

Group **Bg9** combines the more diverse southern vine thickets from the basaltic hills of the north-western slopes and the southernmost outliers in the upper Hunter River valley. These thickets are characterised by *Alectryon oleifolius* and *Brachychiton populneus*.

4.3.3.2 TWINSPAN

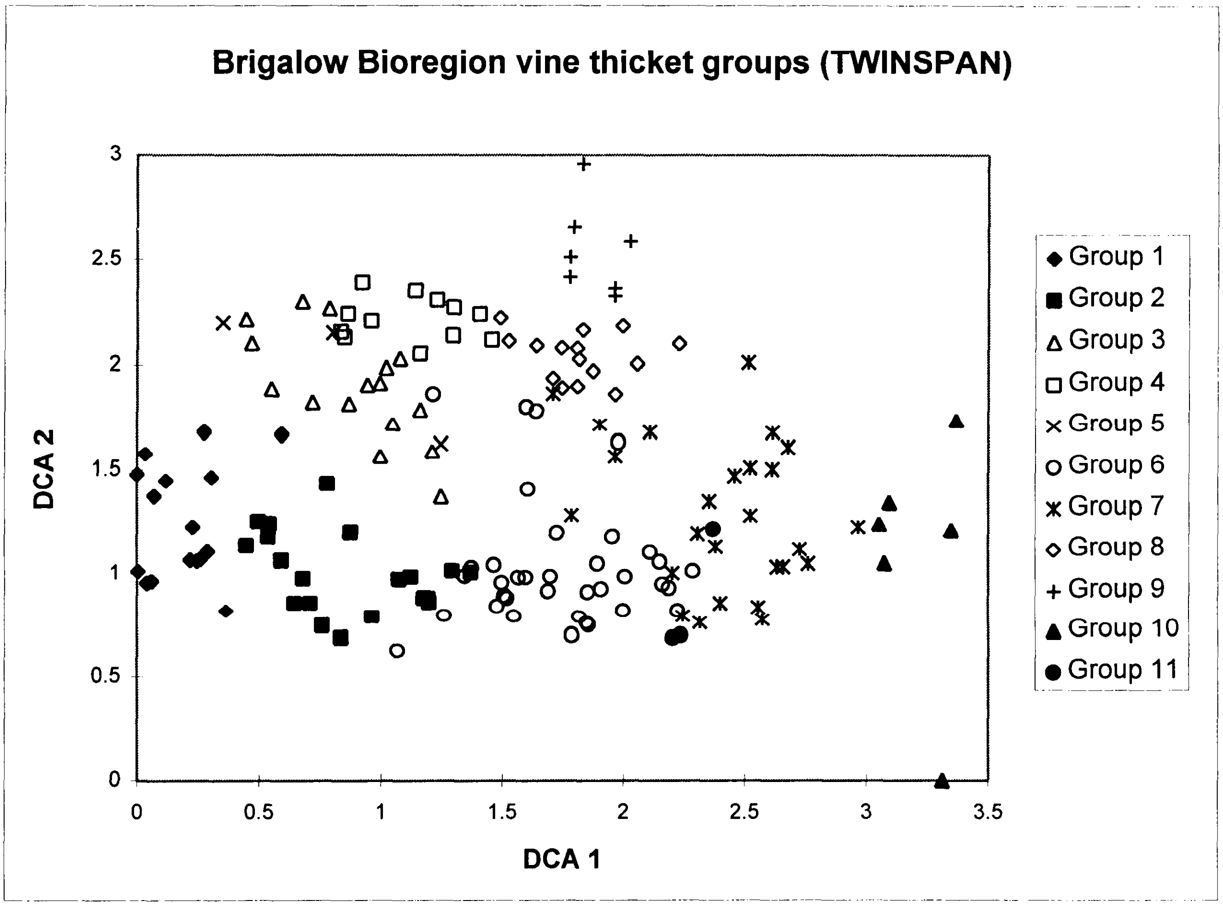
The distributions of the 11 floristic groups (**Tg1-11**) produced by TWINSPAN classification (**Figure 4.5**) show broad similarities with the results of the agglomerative classification (see **Figure 4.2**). The agreement is especially marked in the more northerly sites, where group **Tg9** and **(B/C)** group **Bg7** are identical and groups **Tg8** and **Bg6** have 12 sites in common (see **Table 4.2**)..

Group **Tg4** combines group **Bg5** and the northern subcoastal central Queensland **(Bg4)** sites. The remainder of the **Bg4** sites form (TWINSPAN) group **Tg3**.

The major differences between the two classifications occur across southern Queensland, with the group **Bg1, Bg2** and **Bg3** sites being split among 4 TWINSPAN groups (**Tg1, Tg2, Tg6** and **Tg7**). There is some overlap between groups **Tg2** and **Tg6** in the Mundubbera - Cracow district, and their floristic distinctions are not as sharp as implied by their relative positions in the classificatory dendrogram (see **Figure 4.4**).

Overall, the groups derived from TWINSPAN classification are less clearly defined in ordination space than those derived by the agglomerative methodology, although significant outliers are present on both ordination plots (see **Figure 4.7**).

The most common tree, shrub and climber species (i.e. those with a frequency of 0.50 or greater) in the 11 TWINSPAN groups are listed in **Table 4.5**.



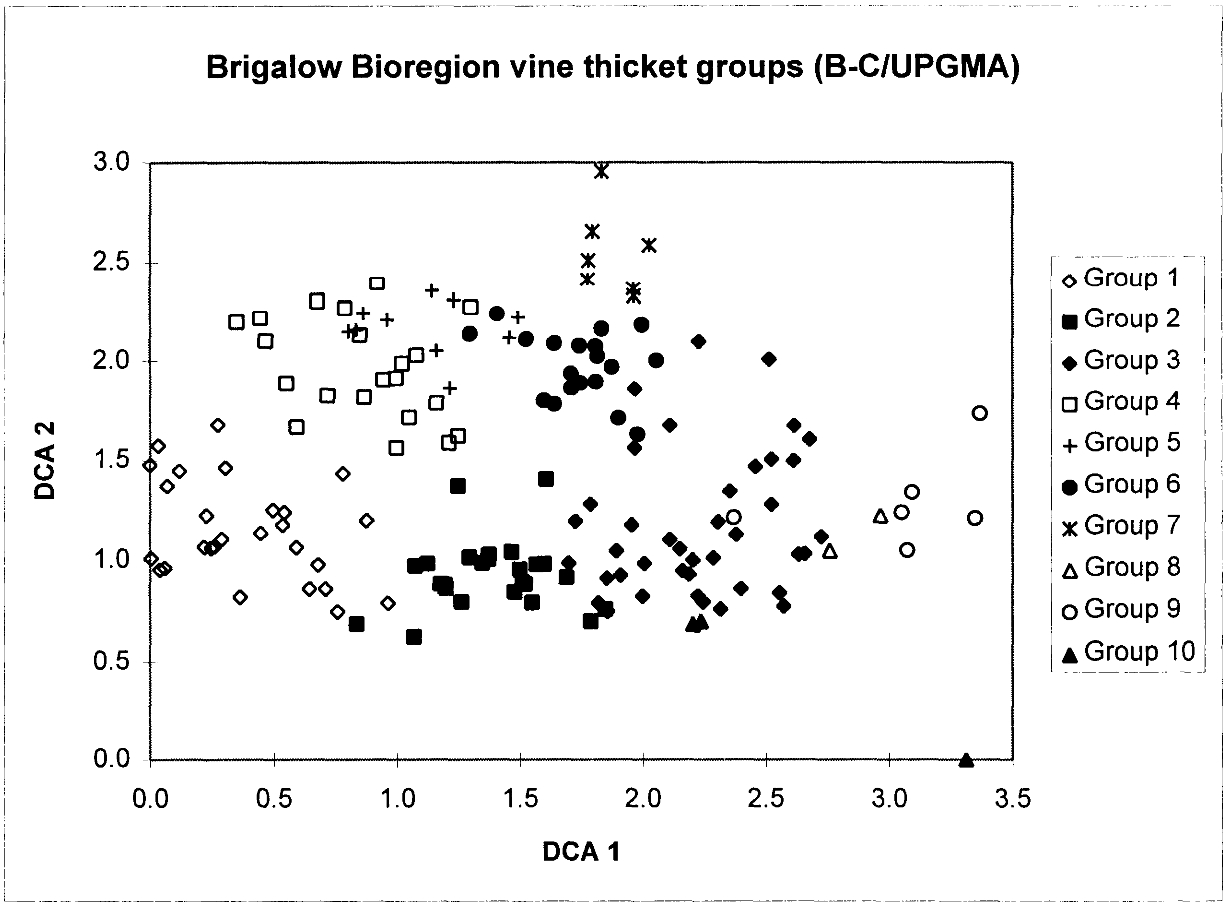


Figure 4.7 Ordination (DCA) of 160 vine thicket plots. Comparison of community-types based on divisive (TWINSPAN) and agglomerative (B-C/UPGMA clustering) of presence/absence data.

Table 4.5 Species with frequencies of 50% or greater in 11 community-types produced by divisive (TWINSPAN) classification of floristic data for 160 vine thicket sites.

	Community-type										
	1	2	3	4	5	6	7	8	9	10	11
	[16]	[20]	[16]	[12]	[3]	[36]	[26]	[15]	[7]	[6]	[3]
ABUTMICR			+	+		+	+	0.87	0.57		
ACACFASC	0.50	+	0.56			0.61	+	+	+		
ACACHARP	+	+			+	+	+	+	0.57		
ACALCAPI	0.63	0.55									
ACALEREM	+	+	0.94	0.67	0.67	0.78	0.77	0.87	+		
ACROLAEV	0.56	+	+	+	+	+	+				
ACROPAUC	+	+	0.63			+					
ALCHILIC	0.81	+	+	+							
ALECCONN	+	0.60	0.69	0.67	0.67	0.50	+	0.93	+		
ALECDIVE	+	0.70	+	+	+	0.94	0.85	0.73	0.57		
ALECOLEI							+		0.86		+
ALECOLEL										0.83	
ALECSUBD	0.81	+	+	+	0.67	+		+		+	0.67
ALPHEXCE	+	+	+	0.75	+	+	+	+	+	0.50	+
ALSTCONS	0.50	0.65	+	+	+	0.53	+	+		0.50	
ALYXRUSC	0.81	0.55	0.69	1.00	0.67	+	+	0.60	+		
ARAUCUNN	0.63	+	+	+							
ARCHTHOZ	+		0.75	0.50			+	+	+		
ARYTFOVE	0.69	+									
ATALSALI	0.75	0.75	+		+	+	+	+			
AUSTBIDW	1.00	0.90	0.88	0.92	1.00	+	+	+	0.57		
AUSTBLAC	0.56	+	0.56	+							
BACKANGU	+	0.55		+	+	+	+	+			
BEYEVISC						+				0.67	
BRACAUST	+	0.50	0.69	0.67	+	0.61	+	0.73	0.71		
BRACDISC	0.50	+									
BRACPOPU										0.67	+
BRACRUPE	+	0.85	0.50	+	+	0.92	0.62	0.53			
BREYOBLO	+	0.65	+	+	+	0.53	+	+	0.71	+	
BRIEEXAL	+	+			0.67						
BRIELEIC	+	0.50	0.50	0.67	0.67	+	+	+			
BURSINCA	0.56	0.55	+			+	+				+
CADEPENT						+	+			+	0.67
CANTBRIG		+	+			+	0.50	+	+		
CANTBUXI	0.63	0.55	+			+					
CANTODOR	0.50	0.50	0.94	0.92	0.67	0.53	+	0.73	+	0.67	
CANTVACC	0.88	0.85	+			0.58	+	+	+		
CAPPARBO	0.94	0.85	0.88	+	1.00	+		+			
CAPPLASI		+			+	+	0.73	+	1.00	+	
CAPPLORA		+		+		0.78	0.58				
CAPPMITC		+				+	+	+	+	0.67	
CAPPSARM	0.75	0.55				+					
CARIOVAT	0.81	1.00	0.94	0.83	1.00	0.97	0.88	0.80	0.86	0.67	+
CASEMULT	0.56	0.55				+					
CASSAUST	+	0.75	+	+	0.67	0.56	+	+		0.50	+
CAYRCLEM	+	+	+	+	0.67		+	+		+	1.00
CISSOBLO	+	+	0.81	0.75	1.00	+					
CISSOPAC	+	0.60	0.69	0.83	1.00	0.75	0.77	0.60	0.86	+	+
CISSRENI			+	0.83	0.67	+		+	0.71		
CITRLINE	0.75	0.70	+		+	+					

+ denotes frequency of less than 0.50.

Table 4.5 (cont.)

	Community-type										
	1	2	3	4	5	6	7	8	9	10	11
CITRSPIN	+	0.55	0.88	+	+	0.86	0.81	0.60	+	+	
CLEICUNN	0.50	+									
CLEMMICR										0.50	
CLERFLOR	+	0.55	+	+	+	+	+	+			
CROTACRO	0.69	+	0.75								
CROTARNH				+					0.57		
CROTINSU	0.75	0.95	0.56	+	+	0.78	0.69	+			
CROTPHEB	+	+	0.50	0.58		+	0.54	0.60	0.86	0.50	
CRYPTRIP	+	+	+	+	0.67						
CUPAANAC	+	+	+	0.50	0.67	+	+	+	+		
CUPAPARV	0.63	0.50	+			+					
DENDPHOT	0.56	+	+	+		+					
DENHOLEA			+		+	+	+	0.53	+		
DENHPITT	0.88	0.65	0.50		+	+	+	+	+		
DIOSFASC	+	+	+		0.67						
DIOSGEMI	0.56	0.60	0.81	0.92	1.00	+		+	0.57		
DIOSHUMI		0.75	0.75	+	0.67	0.86	0.85	0.87	0.71		
DIOSTRAN	0.50	+	0.75	0.50	0.67	+		+	+		
DIPLIXOR	+	0.50	0.81	+	+	0.81	+	+			
DODOANGU										0.50	
DRYPDEPL	0.88	0.70	0.75	0.75	0.67	+	+	0.73	0.71		
EHREMEMB	+	0.75	0.63	0.58	+	0.86	0.88	0.60	0.71	0.67	+
ELATXYLO	0.81	0.70	0.81	+	1.00	0.50		+			
ERYTAUST	0.50	0.65	0.63	0.58		0.53	0.50	+	+		
EUCAALBE										0.50	
EUROFALC	+	+	+	0.83	+				+		
EXCODALL	0.56	0.65	0.88	+	+	+		+			
EXOCLATI	0.63	0.65	+	+	1.00	+	+	+	+		
FICUPLAT	+	+	+	0.67	0.67	+	+	+	0.57		
FICURUBI										+	0.67
FLINAUST	0.69	0.65	+	0.50	0.67	+	+	+			
FLINCOLL	0.63	0.95	+			0.69	+				
FLUELEUC			+	0.58		+	+	+	0.86		
GEIJPANI	+	+	0.69	+	0.67	+		+			
GEIJPARV	+	+		+	+	0.72	0.73			1.00	+
GEIJSALA	0.63	+	+	+				+			
GEIJSASA		0.65	+	0.58		+	+	0.67	1.00		
GEITCYMO	0.56	+	+	+	0.67	+					+
GLOSHEMI	+	+	0.81	+	+	+		+	1.00		
GREWSCAB				+		+	+	+	0.71		
GYMNPLEI	+	+	+	+	0.67	+	+	+	+	0.50	+
GYROAMER			+	+	+			+	1.00		
HARPPEND	+				0.67						
HOMAALNI	+		0.63	+				+			
HOVELONG		+	+	+	+	+	+	+	+	0.50	
HOYAAUST	+	+	+	+	0.67	+	+	+			
JASMDILI						+	+			0.67	+
JASMDIRA	0.63	0.70	0.94	0.50	0.67	0.72	+	+	0.86		
JASMSIAU	0.69	1.00	0.75	+	0.67	0.58	+	+			
LANTCAMA	+	+	+	0.75	+			+	+		
LYSIHOOK			+	+	+	+	+	0.67	1.00		
MACRLEIC						+	0.58				
MALASCAN	0.88	0.75	0.56	0.50	0.67	+		+	+		

+ denotes frequency of less than 0.50.

Table 4.5 (cont.)

	Community-type										
	1	2	3	4	5	6	7	8	9	10	11
MALLCLAO	0.50	+	0.50					+			
MALLPHIL	+	+	+	+	0.67	+					
MAYTBILO	+	0.65	+			+	+			+	
MAYTCUNN			+			+		+		0.50	
MAYTDISP	0.50	0.75	+	+		+	+	+			
MELIERYT	+	0.50	+			+			+		
MELOLEIC	0.75	0.70	0.69	0.50	1.00	+	+	+			
MICRMINU	+	+	+	+	0.67						
MURROVAT	+	+	0.81	0.58	1.00	+	+	+	0.71		
NOTEMICR	0.94	1.00	0.75	0.83	0.67	0.81	0.69	0.67	+	1.00	1.00
OPUNTOME		+	+	0.67		+	0.65	0.60	+		
OWENVENO	0.63	0.80	+			+					
PANDPAND	0.63	0.65	+	+	+	+	+	+	+	0.67	0.67
PARSEUCA		+	+		0.67	+	0.50	+		0.67	
PARSLANC	+	0.85	+	+	0.67	0.78	0.50	0.67	0.57	0.67	
PARSLEIC	0.50	0.50	+			+					
PARSLENT	0.50	+	+								
PARSPLAE		+	+	+	0.67	+	+	+	+		
PAVEAUST	0.50	+	+	0.58	0.67	+					
PLANCOCO	0.94	+	+								
PLANCOPU	+	0.60	0.81	0.75	1.00	0.97	0.77	0.93	0.86	+	
PLANMYRS	0.63	+	+		+						
PLEITIMO	+		0.75	0.75	0.67			+	0.57		
POLYELEG	0.50	+	0.69	1.00	+	+		+			
PREMLIGN	0.50	+	+								
PSYCDAPH	+	+	+	+	0.67	+					
RAPAVARI	+	+	+	+	1.00	+	+				
RICILEDI	+	+	+	+		+	+	+	1.00		
SARCVIBR	+	+	+	+	0.67	+	+	+			
SECAELLI	0.75	0.80	0.88	0.67	0.67	0.89	0.62	0.80	+		
SIPHAUST	0.56	0.50	+	+		+					
SMILAUST	+	+	0.50	+	0.67						
SOLASEAF	+	+	+	0.50		+	+	+			
STERQUAD	+	+	0.50	+	+			+	+		
STREBRUN	0.63	+	+		+						+
STRYAXIL	0.69	+	1.00	0.92	0.67	+		+	0.86		
TERMPORP			0.56	+					0.57		
TINOSMIL	+	0.55	+	0.50		+	+	+	+		
TURRPUBE	0.75	0.60	1.00	0.50	0.67	0.53	+	+	0.71		
VENTVIMI				+		+	0.73	+		+	
ZANTBRAC	0.56	+	+			+					

+ denotes frequency of less than 0.50.

4.4 Relationships between bioregional floristic groups and climatic attributes

Analysis of variance (Kruskal-Wallis ANOVA by ranks test) indicated highly significant differences ($P<0.001$) between vine thicket site-groups for all 35 climatic attributes (see **Table 4.6**). Sixteen of those attributes had also been associated with significant between-group differences for vine thicket communities derived from the detailed survey data (**Chapter 3**) but "H" values were more than twice as high for the bioregional data, reflecting the larger data set (160 sites vs 75 sites).

Table 4.6 Analysis of variance - vine thicket groups (based on analyses of bioregional data) and 35 climatic (BIOCLIM) attributes.

	Attribute	H value	Significance
1	Annual Mean Temperature	112.64	P<0.001
2	Mean Diurnal Range(Mean (period max-min))	71.48	P<0.001
3	Isothermality (2/7)	46.14	P<0.001
4	Temperature Seasonality (C of V)	68.06	P<0.001
5	Max. Temperature of Warmest Period	116.11	P<0.001
6	Min. Temperature of Coldest Period	105.89	P<0.001
7	Temperature Annual Range (5-6)	91.00	P<0.001
8	Mean Temperature of Wettest Quarter	108.11	P<0.001
9	Mean Temperature of Driest Quarter	105.71	P<0.001
10	Mean Temperature of Warmest Quarter	110.79	P<0.001
11	Mean Temperature of Coldest Quarter	108.11	P<0.001
12	Annual Precipitation	80.51	P<0.001
13	Precipitation of Wettest Period	108.14	P<0.001
14	Precipitation of Driest Period	111.43	P<0.001
15	Precipitation Seasonality(C of V)	119.12	P<0.001
16	Precipitation of Wettest Quarter	99.96	P<0.001
17	Precipitation of Driest Quarter	110.91	P<0.001
18	Precipitation of Warmest Quarter	98.05	P<0.001
19	Precipitation of Coldest Quarter	101.63	P<0.001
20	Annual Mean Radiation	108.63	P<0.001
21	Highest Period Radiation	56.34	P<0.001
22	Lowest Period Radiation	113.38	P<0.001
23	Radiation Seasonality (C of V)	118.78	P<0.001
24	Radiation of Wettest Quarter	61.29	P<0.001
25	Radiation of Driest Quarter	120.53	P<0.001
26	Radiation of Warmest Quarter	65.18	P<0.001
27	Radiation of Coldest Quarter	119.53	P<0.001
28	Annual Mean Moisture Index	96.20	P<0.001
29	Highest Period Moisture Index	105.15	P<0.001
30	Lowest Period Moisture Index	114.14	P<0.001
31	Moisture Index Seasonality (C of V)	111.11	P<0.001
32	Mean Moisture Index of Highest Qtr. MI	106.57	P<0.001
33	Mean Moisture Index of Lowest Qtr. MI	115.67	P<0.001
34	Mean Moisture Index of Warmest Qtr. MI	110.19	P<0.001
35	Mean Moisture Index of Coldest Qtr. MI	102.69	P<0.001

Correlation matrices (Spearman rank order correlation) were produced between the 35 climatic attributes. Many were highly correlated, being derived for the same seasonal periods (e.g. the mean temperatures for the warmest and wettest and coldest and driest quarters (attributes 8/10 and 9/11 respectively)) while many (e.g. radiation and moisture indices) are derived from other attributes (e.g. temperature and rainfall indices (see McMahon *et al.* 1995)). The major correlations between attributes (i.e. >0.90) are indicated in **Table 4.7**.

Table 4.7 Correlations between BIOCLIM attributes, based on bioregional vine thicket floristic data.

	Attribute	>0.95	0.90-0.95
1	Annual Mean Temperature	9,11	6,14,15,17,20,23,25,27,30
2	Mean Diurnal Range(Mean(period max-min))	7	
3	Isothermality (2/7)		
4	Temperature Seasonality (C of V)		
5	Max Temperature of Warmest Period		
6	Min Temperature of Coldest Period	11	1,9,15
7	Temperature Annual Range (5-6)		
8	Mean Temperature of Wettest Quarter	10	35
9	Mean Temperature of Driest Quarter	1,11	6,15,23,25,27
10	Mean Temperature of Warmest Quarter	8	35
11	Mean Temperature of Coldest Quarter	1,6,9	15,22,23,25,27
12	Annual Precipitation		
13	Precipitation of Wettest Period	16,18	
14	Precipitation of Driest Period	17,25,27,30	1,15,20,23,33
15	Precipitation Seasonality(C of V)	22,23,25,27	1,6,9,11,14,20,31
16	Precipitation of Wettest Quarter	13,18	34
17	Precipitation of Driest Quarter	14,30,33	1,19,20,23,25,27,35
18	Precipitation of Warmest Quarter	13,16	34
19	Precipitation of Coldest Quarter	35	17
20	Annual Mean Radiation	22,25,27	1,14,15,17,23,30
21	Highest Period Radiation		
22	Lowest Period Radiation	15,20,23,25,27	11
23	Radiation Seasonality (C of V)	15,22,25,27	1,9,11,14,17,20,30
24	Radiation of Wettest Quarter		
25	Radiation of Driest Quarter	14,15,20,22,23,27	1,9,11,17,30,31
26	Radiation of Warmest Quarter		
27	Radiation of Coldest Quarter	14,15,20,22,23,25	1,9,11,17,30,31
28	Annual Mean Moisture Index		
29	Highest Period Moisture Index	32	
30	Lowest Period Moisture Index	14,17,33	1,20,23
31	Moisture Index Seasonality (C of V)		15
32	Mean Moisture Index of Highest Qtr. MI	29	
33	Mean Moisture Index of Lowest Qtr. MI	17,30	14
34	Mean Moisture Index of Warmest Qtr. MI		16,18
35	Mean Moisture Index of Coldest Qtr. MI	19	8,10,17

Climatic attributes were identified with correlations of 0.80 or greater (PCC) and/or 0.70 or greater (SROC) with vector scores from ordinations (DCA and SSR) of species presence/absence data. Values from the non-parametric procedure were consistently lower than those from PCC, hence the lower "threshold" value.

27 attributes were highly correlated (PCC and SROC) with vector scores from DCA and/or SSR ordination (see **Table 4.8**). In order to simplify the task of identifying and illustrating the major climatic relationships, a subset of 18 attributes was selected. These were determined primarily from their relative ranking from principal axis correlation, and also the extent of correlation between individual attributes (see **Table 4.7**). Where two or more attributes were highly correlated the lower-ranked attributes were removed from the data set.

Arrangements of the attribute vectors and the 10 floristic site-groups in DCA and SSR ordination space are shown in **Figures 4.8** and **4.9** respectively. Four symbols are used to denote the groups of attributes, namely temperature, rainfall, radiation indices and moisture indices. Dimensions 1 and 2 of the DCA ordination show a clear gradient (aligned with axis 1) from groups Bg1 (Southeast Queensland) and Bg4 (Central Queensland) through groups Bg2 (Auburn/Taroom) and Bg6/7 (Marlborough/Nebo and Nebo/Collinsville respectively) to group Bg3 (Central Highlands/Moranbah) and group Bg9 (Narrabri/Gunnedah). The most strongly correlated climatic attributes are attribute 12 (annual precipitation) and attribute 5 (max. temp. warmest period).

Axis (DCA) 2 separates group Bg4 from groups Bg1 and 2 (at the "moister" end of axis 1) and groups Bg6 and 7 from group Bg3 (at the "drier" end). Most attributes (except the radiation indices) are highly correlated with this axis (see **Table 4.8**).

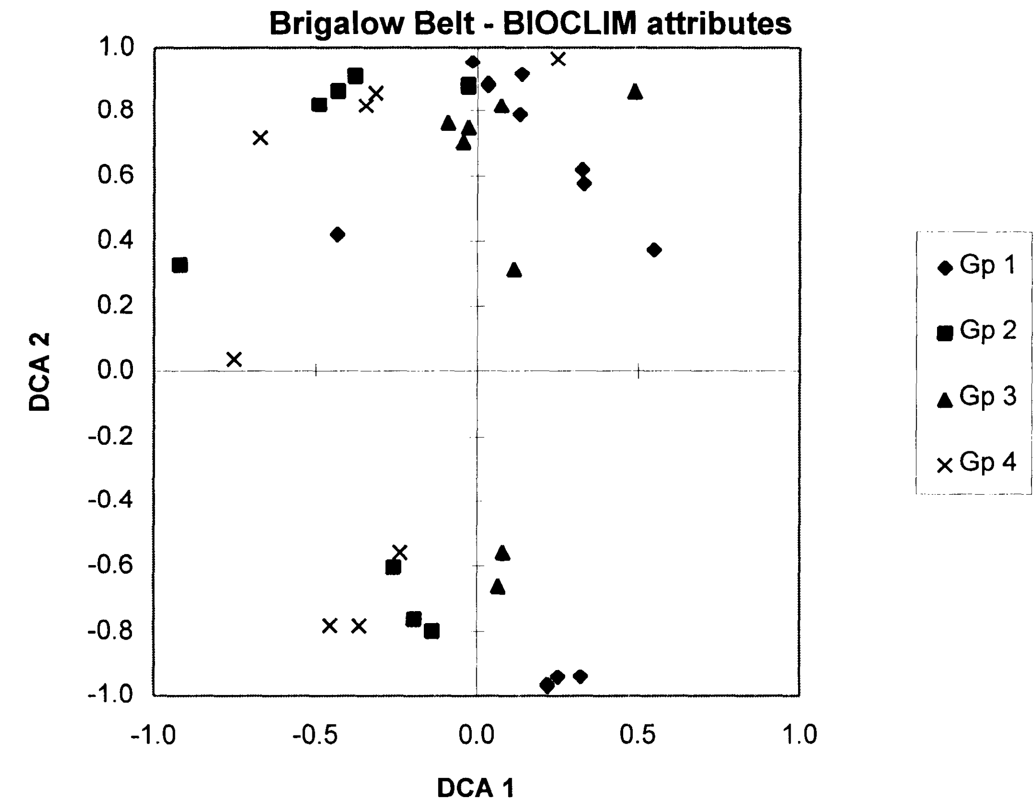
Substitution of the third dimension (DCA3) for DCA 2 does not clarify these patterns, resulting only in a compressed array of sites.

The most obvious trend evident in the results of SSR (2 and 4) is along the direction of axis 4, which separates groups Bg1, 4 and 5 (subcoastal sites) from groups Bg3, 6, 7 and 8 (more inland, drier sites). Attributes 5 (max. temp. warmest period) and 28 (annual mean moisture index) are strongly correlated with this axis. There is also a clear differentiation of the southern sites (groups Bg9 and Bg10) along axis 2, which is most closely correlated with attributes 3 (isothermality) and 23 and 24 (radiation seasonality and radiation of wettest quarter).

Table 4.8 Correlations (PATN-PCC and Spearman rank order correlation) between 35 BIOCLIM attributes and vector scores from ordinations of presence/absence data for 160 vine thicket sites.

		PATN-PCC						Spearman rank order correlation					
	Attribute	DCA1	DCA2	DCA3	SSR2	SSR3	SSR4	DCA_1	DCA_2	DCA_3	SSR_2	SSR_3	SSR_4
1	Annual Mean Temperature	0.13	0.79	-0.60	-0.64	-0.53	-0.39	0.26	0.68	-0.15	-0.45	-0.51	-0.32
2	Mean Diurnal Range(Mean(period max-min))	0.25	-0.95	-0.20	0.28	0.75	-0.35	0.32	-0.68	-0.42	0.26	0.55	-0.33
3	Isothermality (2/7)	-0.43	0.42	-0.80	-0.96	-0.13	0.23	-0.21	0.19	0.04	-0.19	-0.13	0.17
4	Temperature Seasonality (C of V)	0.22	-0.97	-0.10	0.28	0.77	-0.30	0.30	-0.68	-0.40	0.26	0.59	-0.30
5	Max Temperature of Warmest Period	0.55	0.37	-0.75	-0.38	-0.09	-0.87	0.75	0.04	-0.56	-0.08	0.03	-0.81
6	Min Temperature of Coldest Period	-0.01	0.95	-0.30	-0.52	-0.70	-0.06	-0.01	0.80	0.10	-0.44	-0.63	-0.03
7	Temperature Annual Range (5-6)	0.32	-0.94	-0.05	0.38	0.72	-0.37	0.41	-0.74	-0.43	0.34	0.60	-0.40
8	Mean Temperature of Wettest Quarter	0.33	0.58	-0.75	-0.59	-0.30	-0.69	0.56	0.35	-0.44	-0.30	-0.23	-0.64
9	Mean Temperature of Driest Quarter	0.14	0.91	-0.39	-0.49	-0.72	-0.26	0.20	0.74	-0.04	-0.43	-0.60	-0.24
10	Mean Temperature of Warmest Quarter	0.33	0.62	-0.71	-0.58	-0.34	-0.67	0.55	0.40	-0.40	-0.30	-0.26	-0.62
11	Mean Temperature of Coldest Quarter	0.03	0.88	-0.47	-0.61	-0.63	-0.20	0.12	0.76	-0.03	-0.47	-0.59	-0.18
12	Annual Precipitation	-0.92	0.33	0.21	-0.14	-0.39	0.79	-0.72	0.19	0.38	-0.20	-0.21	0.69
13	Precipitation of Wettest Period	-0.38	0.91	-0.18	-0.46	-0.71	0.39	-0.49	0.71	0.39	-0.44	-0.55	0.45
14	Precipitation of Driest Period	-0.14	-0.80	0.59	0.63	0.46	0.36	-0.28	-0.65	0.13	0.40	0.42	0.31
15	Precipitation Seasonality(C of V)	-0.03	0.88	-0.48	-0.63	-0.59	-0.11	0.10	0.80	0.02	-0.44	-0.58	-0.13
16	Precipitation of Wettest Quarter	-0.43	0.86	-0.26	-0.49	-0.65	0.41	-0.53	0.62	0.37	-0.41	-0.50	0.48
17	Precipitation of Driest Quarter	-0.19	-0.76	0.62	0.61	0.38	0.43	-0.36	-0.60	0.20	0.36	0.36	0.40
18	Precipitation of Warmest Quarter	-0.49	0.82	-0.30	-0.55	-0.62	0.46	-0.54	0.60	0.36	-0.41	-0.48	0.49
19	Precipitation of Coldest Quarter	-0.26	-0.60	0.75	0.61	0.17	0.59	-0.48	-0.34	0.35	0.24	0.14	0.54
20	Annual Mean Radiation	0.08	0.82	-0.57	-0.60	-0.46	-0.22	0.19	0.73	-0.03	-0.36	-0.50	-0.20
21	Highest Period Radiation	0.49	0.86	-0.14	0.10	-0.21	-0.15	0.29	0.37	0.02	0.07	-0.22	-0.19
22	Lowest Period Radiation	-0.09	0.76	-0.64	-0.75	-0.47	-0.10	0.06	0.80	0.03	-0.44	-0.59	-0.08
23	Radiation Seasonality (C of V)	0.07	-0.66	0.75	0.83	0.33	0.22	-0.19	-0.75	0.07	0.43	0.52	0.22
24	Radiation of Wettest Quarter	0.08	-0.56	0.83	0.83	0.10	0.34	-0.15	-0.01	0.21	0.15	-0.09	0.24
25	Radiation of Driest Quarter	-0.04	0.70	-0.71	-0.80	-0.40	-0.23	0.21	0.75	-0.07	-0.42	-0.51	-0.24
26	Radiation of Warmest Quarter	0.11	0.31	0.94	0.67	-0.57	0.41	-0.19	0.31	0.43	0.10	-0.35	0.33
27	Radiation of Coldest Quarter	-0.03	0.75	-0.66	-0.74	-0.42	-0.19	0.18	0.77	-0.04	-0.42	-0.54	-0.20
28	Annual Mean Moisture Index	-0.75	0.04	0.66	0.18	-0.30	0.91	-0.75	0.12	0.58	-0.01	-0.19	0.79
29	Highest Period Moisture Index	-0.32	0.86	0.41	-0.12	-0.78	0.53	-0.50	0.69	0.62	-0.25	-0.61	0.57
30	Lowest Period Moisture Index	-0.36	-0.78	0.51	0.50	0.44	0.54	-0.43	-0.63	0.18	0.34	0.42	0.44
31	Moisture Index Seasonality (C of V)	0.25	0.97	-0.08	-0.29	-0.71	-0.20	0.28	0.80	0.07	-0.35	-0.62	-0.24
32	Mean Moisture Index of Highest Qtr. MI	-0.35	0.82	0.46	-0.06	-0.76	0.58	-0.54	0.64	0.66	-0.20	-0.58	0.61
33	Mean Moisture Index of Lowest Qtr. MI	-0.45	-0.78	0.43	0.39	0.43	0.58	-0.52	-0.58	0.22	0.29	0.38	0.53
34	Mean Moisture Index of Warmest Qtr. MI	-0.67	0.72	-0.18	-0.52	-0.54	0.65	-0.71	0.56	0.47	-0.35	-0.45	0.67
35	Mean Moisture Index of Coldest Qtr. MI	-0.24	-0.56	0.79	0.67	0.17	0.61	-0.48	-0.36	0.38	0.31	0.17	0.57

Eigenvalues			Variances		
0.376	0.224	0.166	35.38	28.43	49.37



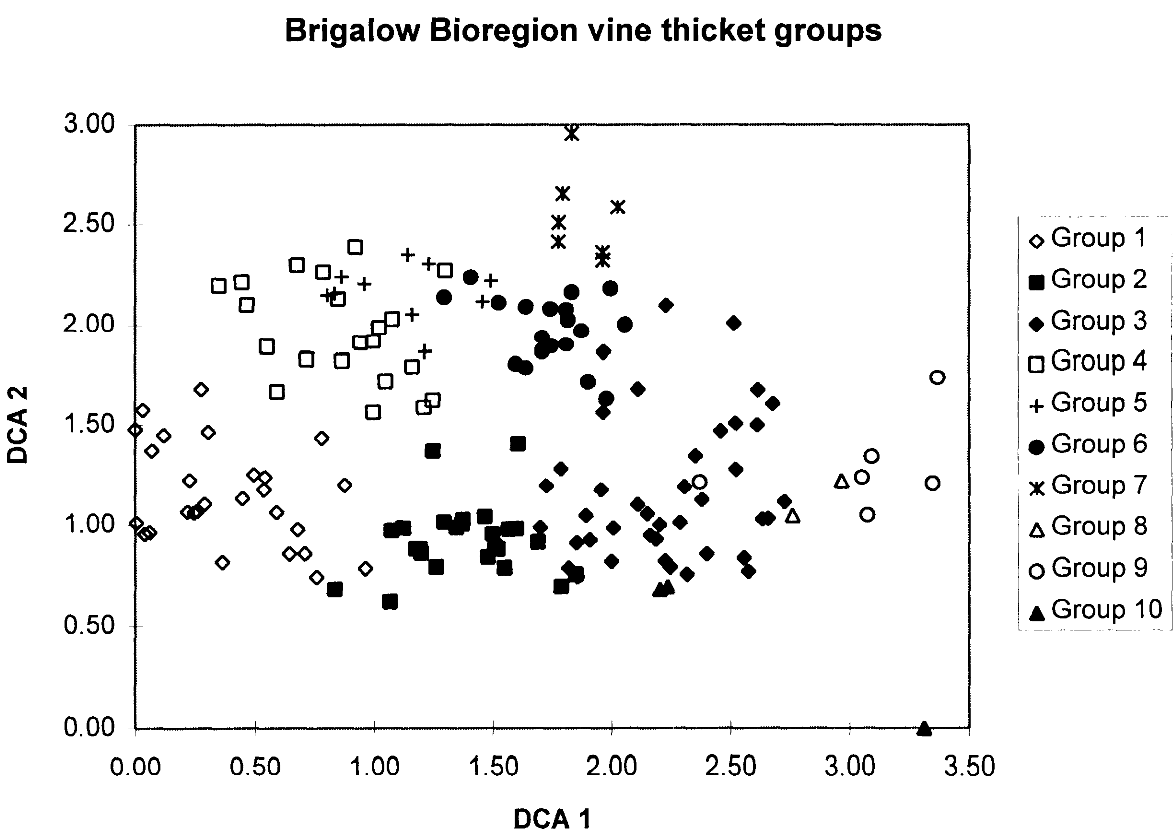
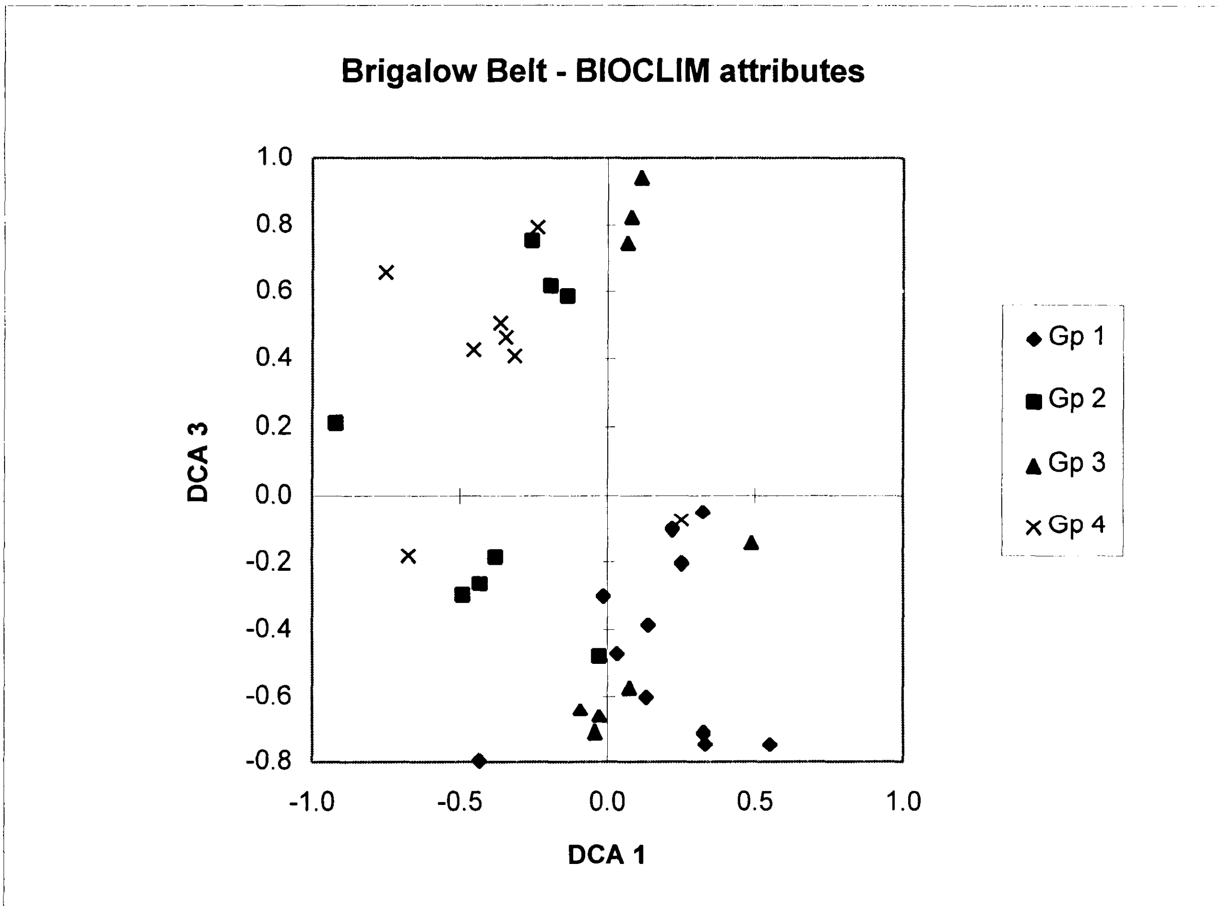


Figure 4.8 (a) Comparison of DCA ordination of bioregional vine thicket community-types (based on species presence/absence data) and vector directions for 35 climatic (BIOCLIM) attributes.



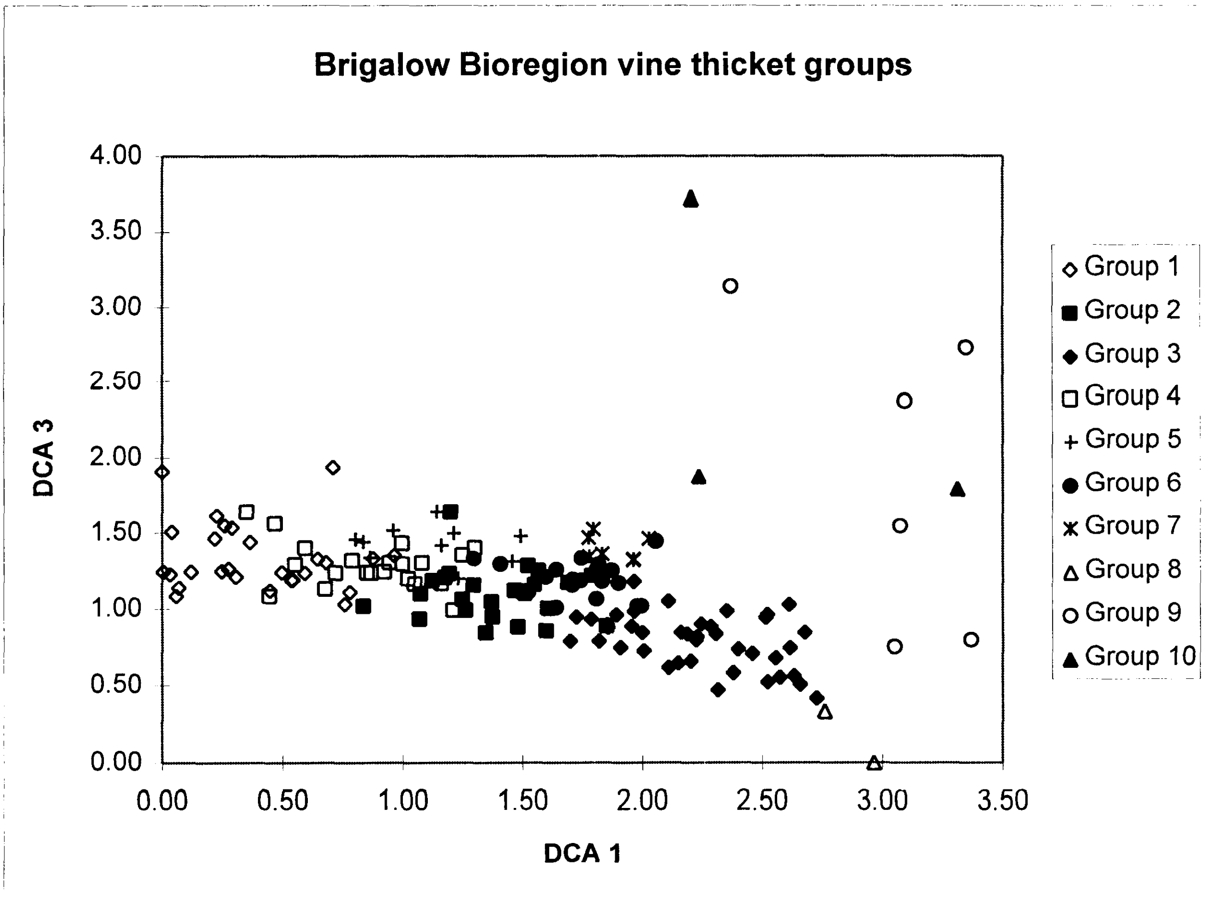
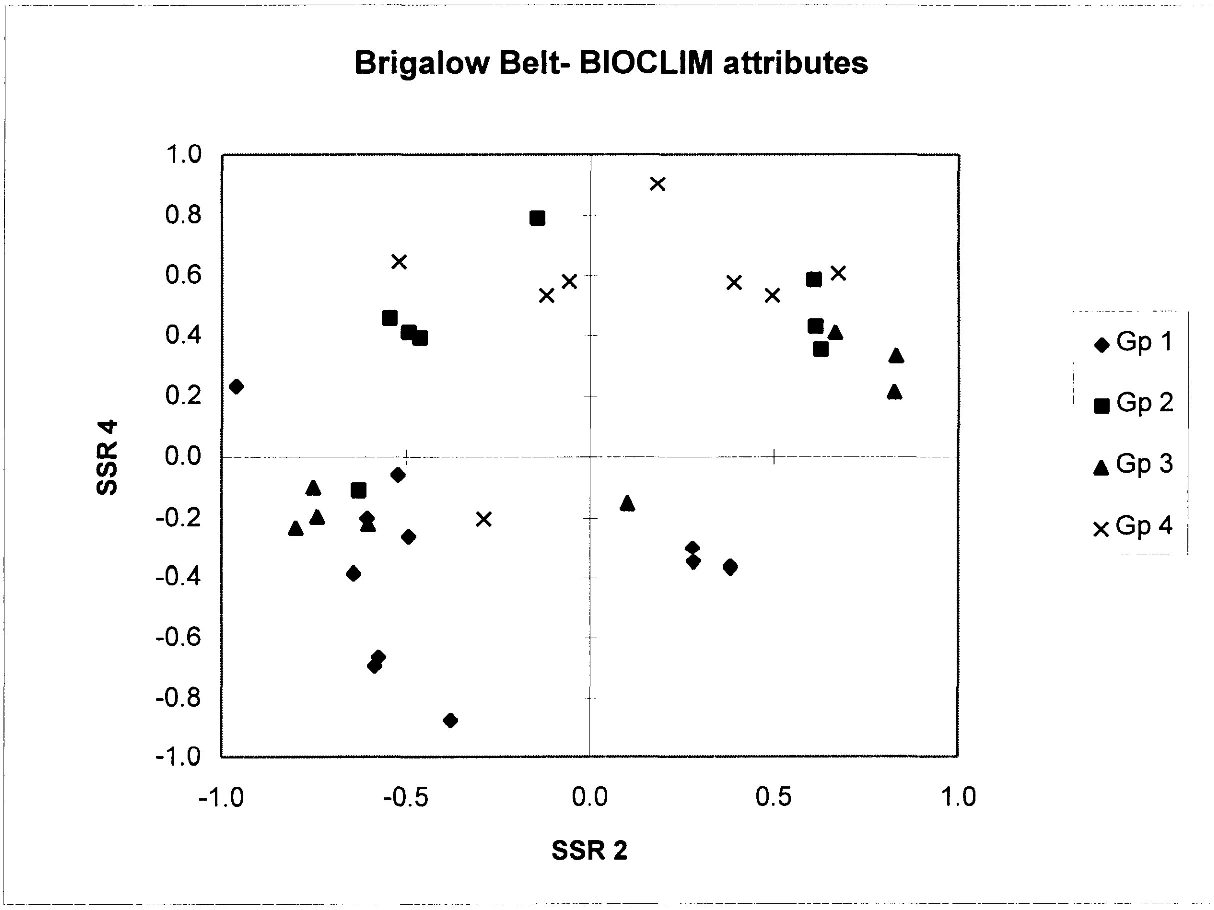


Figure 4.8 (b) Comparison of DCA ordination of bioregional vine thicket community-types (based on species presence/absence data) and vector directions for 35 climatic (BIOCLIM) attributes.



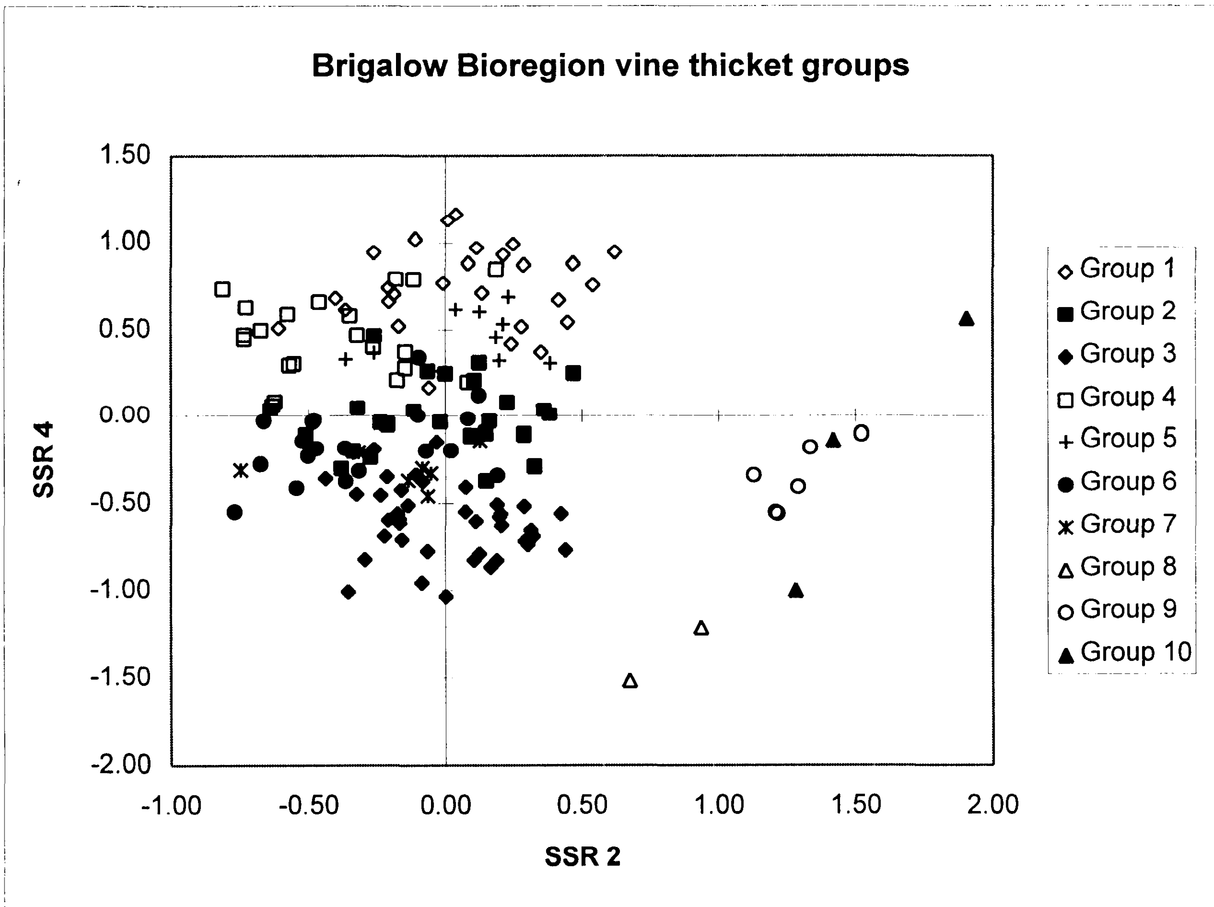
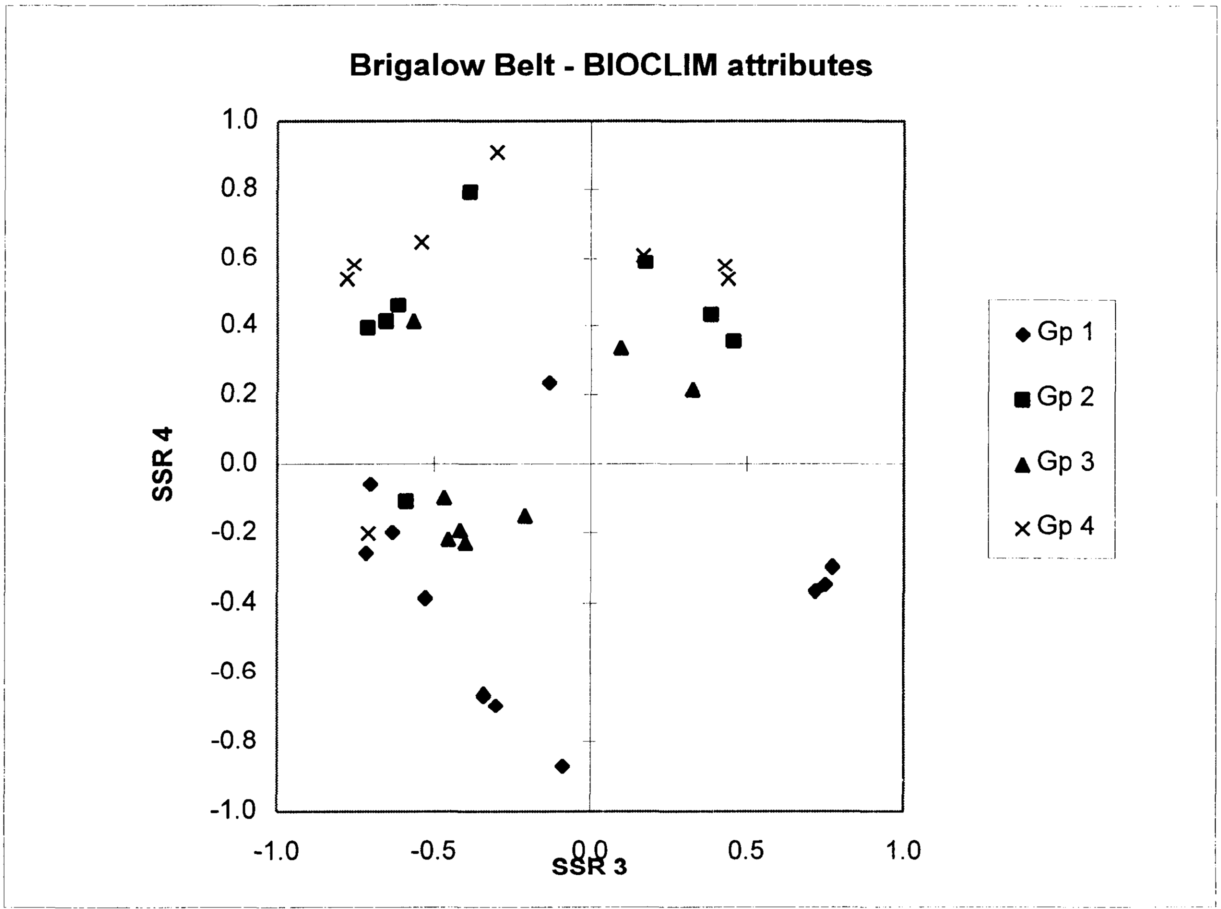


Figure 4.9 (a) Comparison of SSR ordination of bioregional vine thicket community-types (based on species presence/absence data) and vector directions for 35 climatic (BIOCLIM) attributes.



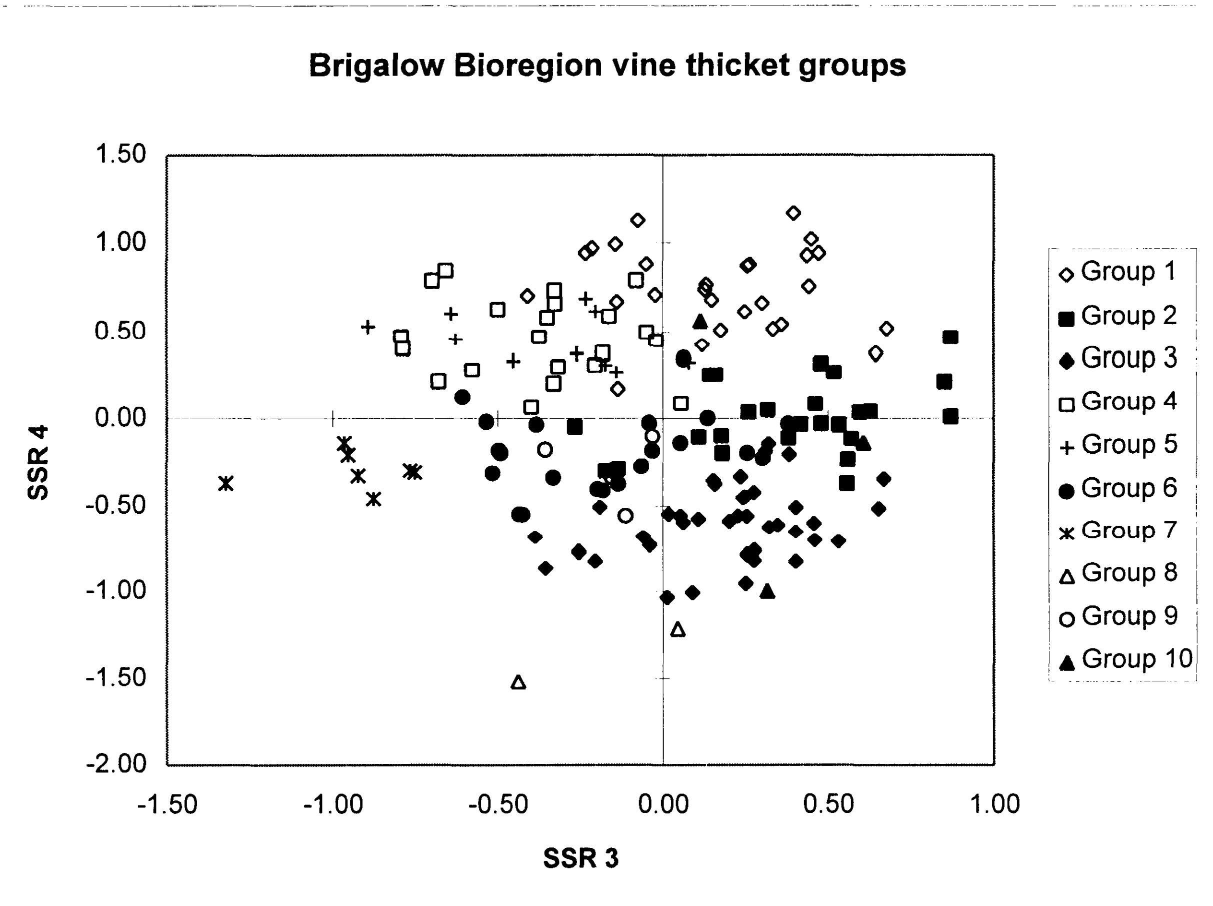


Figure 4.9 (b) Comparison of SSR ordination of bioregional vine thicket community-types (based on species presence/absence data) and vector directions for 35 climatic (BIOCLIM) attributes.

Substitution of SSR 3 for SSR 2 results in a slightly different site array. Group Bg7 is clearly differentiated along axis 3 and there is also a weak separation of the main array, i.e. groups Bg2 and most sites in groups Bg1 and Bg3 from groups Bg4 and Bg5. The most closely correlated attributes with axis 3 are 7 (annual temp. range) and (negatively) 29 (highest period moisture index).

Figure 4.10 displays the means, medians and ranges of values of the 18 climatic attributes for the 10 regional floristic groups. Group means and standard deviations are presented in **Appendix 6**, while significant differences between group means are summarised in **Table 4.9**.

As with the results of the detailed vine thicket survey, most of the vine thicket groups can be differentiated on a range of climatic attributes, with the majority of these differences being highly significant ($P<0.001$). The two southern vine thicket groups (Bg9 and Bg10) cannot be separated on climatic parameters. The considerable geographic overlaps between groups Bg4, 5, 6 and 7 is reflected in the limited number of significant climatic differences. Groups Bg4, 5 and 6 have only minor differences ($P<0.05$) for a limited range of attributes, none of which are common to the three groups.

4.5 Discussion

Floristic presence/absence data from the 75 detailed vine thicket sites have now been subjected to a series of classifications, using both agglomerative and divisive procedures, alone and as part of an expanded data set covering the Brigalow Belt Biogeographic Region. The results for each site are compared in **Table 4.10**.

The agglomerative classifications (Bray-Curtis coefficient with flexible UPGMA clustering) from the detailed survey and bioregional floristic data sets (DS 13 and Bg - see **Table 4.10**) placed 56 of the 75 sites in equivalent groups. There was however some re-structuring of the hierarchy, with group 1 remaining separate to a much higher level in the bioregional classification, group 3 (=Bg4) fusing with the northern vine thickets rather than those of southern Queensland and groups 7 and 8 being linked with group 2 (to form Bg3, see below), rather than remaining a relatively separate entity.

Figure 4.10 Means, medians and ranges of values of 15 climatic attributes for bioregional vine thicket community-types based on classification (B-C/UPGMA clustering of species presence/absence data.

-------TABLES ARE GROUPS (ROWS) BY ATTRIBUTE VALUES------>
L=lower limit.....1=1st Quartile.....M=mean
D=Median.....3=3rd quartile.....U=upper limit
*=more than one symbol at print position

.....Attribute: **(1) Annual Mean Temperature** Cramer value: **0.8554**

```
 15.40        17.50        19.60        21.70       23.80
GRP +---------------+---------------+---------------+---------------+
 1 L--------------------1==*====3----U
 2          L-----------1====DM======3----------U
 3                      L-----1=====*=====3-------U
 4               L--------------------1==M=D==3----U
 5                  L------------------M1D=3---U
 6                      L-----------1==MD=3--U
 7                                  L1=DM=3--U
 9   L-------1=*======*
10          L-1=MD=3U
```

.....Attribute: **(5) Max. Temp. Warmest Period** Cramer value: **0.7980**

```
 25.60        27.77        29.95        32.13       34.30
GRP +---------------+---------------+---------------+---------------+
 1 L-----------------------------1=MD====3-------U
 2          L-------------------------1==*====3-------U
 3                                  L----1=MD3-----U
 4               L------------------1=*===3-U
 5                        L-----1M*-U
 6                           L-1===*=3--------U
 7                               L1D=*-------U
 9                 L1==============M====D==3---U
10                      L-------1===M=====D3U
```

.....Attribute: **(6) Min. Temp. Coldest Period** Cramer value: **0.8265**

```
 0.7000       3.350        6.000        8.650       11.30
GRP +---------------+---------------+---------------+---------------+
 1           L--1===DM===3-------U
 2          L-1=====DM===3-------------------U
 3           L-------1===D====M======3----------------U
 4               L-------------------1======*==========3----U
 5                 L-------------------*=D3----U
 6                     L----1========M====D3----U
 7                                  L-1=DM==3-U
 9 L--1===D*-----------U
10      ++U
```

.....Attribute: **(7) Temperature Annual Range (5-6)** Cramer value: **0.7533**

```
 19.50        22.42        25.35        28.27       31.20
GRP +---------------+---------------+---------------+---------------+
 1           L-----------1=====*=====3-------U
 2             L-------------------------*===D=3-----U
 3            L--------------------1=====M=====D==3-U
 4 L------1===========MD=====3---------------U
 5             L--1D=*-----------U
 6           L---1===D=====M=========3-----------U
 7         L---1==*==3-U
 9                     L------------1=========M=====D=====*
10                                L-----1==M====*
```

.....Attribute: **(10) Mean Temp. Warmest Quarter** Cramer value: **0.8379**

```
 20.10        21.98        23.85        25.73       27.60
GRP +---------------+---------------+---------------+---------------+
 1 L--------------------------1==M=D==3-----U
 2            L-------------------1=====*========3------U
 3                                L------1===*===3--U
 4                L------------------------1=M=D==3----U
 5                          L------------*D3-----U
 6                                L---1DM3-----U
 7                                     L1DM=3--U
 9            L--1=============M==D=====3--U
10                   L------1==M===D3-U
```

.....Attribute: **(11) Mean Temp. Coldest Quarter** Cramer value: **0.8499**

```
 9.200        11.65        14.10        16.55       19.00
GRP +---------------+---------------+---------------+---------------+
 1    L----------------1==MD===3---U
 2            L-----1==D=M======3------------U
 3                  L----1====D==M======3------------U
 4                  L----------------1==M=D====3----U
 5                  L---------------------*=D=3----U
 6                            L----1=====M=D=3---U
 7                                       L1=DM=3--U
 9 L---1=MD==3U
10      *M3U
```

.....Attribute: **(15) Precipitation Seasonality (C of V)** Cramer value: **0.9019**

```
GRP +---------------+---------------+---------------+---------------+
 1             L---------1*=3-------U
 2                  L---1D=*-------U
 3                    L-------1==D=M3---------------U
 4                          L-------1=*=3---------U
 5                              L--------1DM=3-------U
 6                              L------1==*===3------U
 7                                        L-1====MD=3--U
 9 L-----1*=3U
10     L*==M3---U
```

.....Attribute: **(17) Precipitation of Driest Quarter** Cramer value: **0.8447**

```
 38.00        65.50        93.00        120.5       148.0
GRP +---------------+---------------+---------------+---------------+
 1                    L----------1===D=M=====3-----------------U
 2                  L-------1===DM=====3----U
 3  L-----------------1===M===D=3-------U
 4                L---1====DM==3-------U
 5             L---1==MD==3--U
 6            L--1==D*---------U
 7 L1==*3---U
 9                                L---1=D=M=====3---U
10                                L---1M=D*
```

.....Attribute: **(20) Annual Mean Radiation** Cramer value: **0.8394**

```
 17.70       18.48       19.25       20.02      20.80
GRP +----------------+----------------+----------------+----------------+

 1            L----------1=====M=D===3-----U
 2                        L-1==*=3----------U
 3                        L---1======D=M======3---------U
 4                             L-------1===M==D=3-U
 5                                   L--1=*=*
 6                                 L-----1MD=*
 7                                      L-1M=*
 9 L-1================M===D==========*
10                 L-1==*=3-U
```

.....Attribute: **(23) Radiation Seasonality (C of V)** Cramer value: **0.9218**

```
 18.00       21.50       25.00       28.50      32.00
GRP +----------------+----------------+----------------+----------------+

 1      L--------------*=M=====3------U
 2      L---------*M===3---------U
 3   L---1===M=*---------U
 4   L----*M====*
 5   *M---U
 6   *=M==*
 7 *==M=*
 9                            *=========MD====3---U
10                            L--1M*
```

.....Attribute: **(27) Radiation of Coldest Quarter** Cramer value: **0.9035**

```
 10.90       12.27       13.65       15.02      16.40
GRP +----------------+----------------+----------------+----------------+

 1                L-------1=====MD==3---------U
 2                     L------1===*3----------U
 3                          L----1====DM===3--------U
 4                               L---1==*3---U
 5                                   L--1*-U
 6                                  L---1=*=*
 7                                       *M*
 9 L------1======MD========*
10           L-1=*=3-U
```

.....Attribute: **(29) Highest Period Moisture Index** Cramer value: **0.7977**

```
 0.4700      0.6025      0.7350      0.8675     1.000
GRP +----------------+----------------+----------------+----------------+

 1         L---------1======D=M========3-----------------U
 2 L---------1====MD===3----------U
 3 L-------1===D=M====3------------U
 4          L-------------------------1=====*===========3--------U
 5                L----------1============*===============3--U
 6      L---------------1===========D=M===========3----------------U
 7                    L-----1=*=3---------U
 9        L------1====*====3--------U
10            L*
```

.....Attribute: **(31) Moisture Index Seasonality (C of V)** Cramer value: **0.8513**

```
 17.00       32.50       48.00       63.50      79.00
GRP +----------------+----------------+----------------+----------------+

 1 L-----1=D=M===3-------U
 2  L----1====DM=3-------------U
 3    L---------1=D====M===3--------------------------U
 4          L-------1=======*======3------U
 5               L-----------M1*-U
 6              L---------1===M=D=3-----U
 7                          L-1=====MD=====3U
 9        L---1*=*
10       L------1==M====*U
```

.....Attribute: **(33) Mean Moisture Index Lowest Qtr MI** Cramer value: **0.8507**

```
 0.8000E-01  0.1875      0.2950      0.4025     0.5100
GRP +----------------+----------------+----------------+----------------+

 1                L-------------1======MD===3-----------------U
 2            L---------1==D=M=======3----U
 3   L-----------1===M=D=3------------U
 4           L--1====D=M=====3-----------U
 5       L----1*=3-U
 6       L-1DM=3-U
 7 L-1DM=3-U
 9                L----1===MD==*
10                  *=M=3---U
```

.....Attribute: **(34) Mean Moisture Index Warmest Qtr** Cramer value: **0.8339**

```
 0.2600      0.3950      0.5300      0.6650     0.8000
GRP +----------------+----------------+----------------+----------------+

 1                  L------1====DM======3----------U
 2             L---------1=*===3-----U
 3            L------1==MD3----------U
 4                 L----------------1====M=D===3---------U
 5                     L----1=======DM==========3------U
 6               L-----------1===D==M========3----------------U
 7              L------------------*===D3U
 9 L----1==M=D=*
```

Table 4.9 Significance of differences between group means for 35 climatic attributes - groups based on species presence/absence data for Brigalow Belt Biogeographic Region (160 sites).

Groups	Attributes																																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
2 vs 1	1#			1	3		2	3		3		3	1				3	1	3	1			2					3	3	3		3	3	3	3
3 vs 1	3				3	1	2	3	3	3	3	3	1	3	3		3	1	3	3		3	3		3	2	3	3	3	3	3	3	3	3	3
3 vs 2	3				3	2		3	3	3	3			3	3		3		3	2		2	3		3		3	3		3	3		3		3
4 vs 1	3	3	1	2	3	3	3	3	3	3	3		3	3	3	3	3	3	2	3		3	3		3	1	3		3	3	3	2	3	1	3
4 vs 2	3	3		3		3	3		3	1	3	3	3	1	3	3		3		3		3	3		3	3	3	3	3	1	3	3		3	
4 vs 3		3		3	3	3	3		1	1	3	3	3		3	3		3	3	1		3		2		3		3	3		2	3		3	2
5 vs 1	3				3	3		3	3	3	3		3	3	3	3	3	2	3	3	1	3	3	2	3		3		2	3	3	1	3		3
5 vs 2	3	2		3		3	3		3	1	3	1	3	3	3	3	3	3		3	2	3	3		3		3		3	3	3	3	3	3	
5 vs 3		1		3	1	3	3		1		2	3	3		3	3		3		2		3	2				3	3	3		3	3		3	
5 vs 4																					1			3											
6 vs 1	3				3	3		3	3	3	3		2	3	3	1	3		3	3	3	3	3		3		3	3		3	3		3		3
6 vs 2	3	3		3		3	3	3	3	3	3		3	3	3	3	3	3	2	3	3	3	3		3		3		3	3	3	3	3	3	1
6 vs 3	1	2		3		3	3		3		3	2	3	2	3	3		3		3	1	3	3		3		3	3	3		3	3		3	
6 vs 4		1	1		3							1		2			2		3		3			3		2		1		1			3	1	
6 vs 5																																			
7 vs 1	3				3	3	1	3	3	3	3	3		3	3		3		3	3		3	3		3		3	3		3	3		3		3
7 vs 2	3	2		3	2	3	3	3	3	3	3		3	3	3		3		3	3		3	3		3		3		3	3	3	3	3		3
7 vs 3	3	1		3		3	3		3		3		3	3	3		3		3	3		3	3		3		3		3	3	3	3	3	2	1
7 vs 4	3		1		3				3	2	3	3		3	3		3	1	3				1	1	3		2	3		3	3		3	1	3
7 vs 5	1								3		1	1		3	2		3		3						1			1			3		1		3
7 vs 6									3		1			3	3		3		2						1						3				1
9 vs 1	3		3			2	3				3	2	3	3	3	3	2	3	1	3		3	3		3	3	3	1						3	1
9 vs 2	3		2			1		1		3	3		1	3	3	2	3	3	3	3		3	3	1	3	3	3							3	3
9 vs 3	3		1		3	3		3	3	3	3		2	3	3	2	3	3	3	3		3	3	2	3	3	3	1		3		1	2	3	3
9 vs 4	3	3		3		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		3	3		3		3		2	3	1	1		3	3
9 vs 5	3		3	3		3	3	3	3	3	3	1	3	3	3	3	3	3	3	3		3	3	3	3	3	3		2	3	3	1	3	3	3
9 vs 6	3		3	2	2	3	3	3	3	3	3		3	3	3	3	3	3	3	3		3	3	3	3	3	3			3	3		3	3	3
9 vs 7	3	1	3	3	3	3	3	3	3	3	3		3	3	3	3	3	3	3	3		3	3	3	3	2	3			3	3		3	3	3
10 vs 1					1		2					1	2		3	2		3				3	3		3	3	3	1						3	
10 vs 2	1										1			1	3		2	1	3			3	3	1	3	3	3							3	3
10 vs 3	3					3		1	1	3	3			3	3		3	1	3	3		3	3	1	3	3	3							3	3
10 vs 4	3	2		2	1	3	3		3	1	3	2	3	3	3	3	3	3	2	3		3	3		3		3		2			1		3	3
10 vs 5	3		1	1	1	3	3		3	1	3		3	3	3	3	3	3	3	3		3	3	3	3	3	3		2	1	2	1		3	3
10 vs 6	3					3	3	1	3	3	3		3	3	3	3	3	3	3	3		3	3	2	3	3	3			2	2			3	3
10 vs 7	3		1	2		3	3	3	3	3	3		3	3	3	3	3	3	3	3		3	3	2	3	2	3			3	3		3	3	3
10 vs 9																																			

* Group 8 (sites 35 and 43) represents a single locality.

#Significances: 1 = P<0.05, 2 = P<0.01, 3 = P<0.001.

Of the remaining sites, 7 *Macropteranthes leichhardtii* sites which had formed most of a distinct Central Highlands floristic group (group 8, see **Chapter 3**) were included in a much enlarged (geographically) group (Bg3) which also incorporated many non-*Macropteranthes* sites in the northern Brigalow Belt Biogeographic Region. Together with S032 (Dipperu), these *M. leichhardtii* plots also formed a distinct subgroup within group Bg3.

A second group, also of 7 sites, includes the more diverse stands (floristically) from the Injune - Taroom site-group (group 7) from the detailed survey classification. These sites have been placed in an enlarged Auburn site-group (group Bg2, based on detailed survey group 2), while the (less diverse) *Cadellia pentastylis* stands and eastern *Macropteranthes leichhardtii* communities have been included in the broad bioregional group Bg3 (see above).

Of the remaining five sites, S053 probably belongs more with the other *Cadellia pentastylis* stands than with the more diverse and structurally developed Auburn district vine thickets. Sites S060 and S061 (Allies Creek) are transitional both in their geographic position and in floristic composition between the Auburn and Burnett-Moreton site-groups, and could be placed in either group. Site S044 (Dipperu) has been placed with the inland vine thickets (together with S032, dominated by *Macropteranthes leiocaulis*), rather than with the other Nebo district thickets, which are split between bioregional site-groups Bg5 and Bg6.

When the divisive (TWINSPAN) classifications of detailed survey and bioregional data (DS 15 and Tg) are compared, fewer than half the sites (29/75) show agreement, even at the 8-group level (see **Table 4.10**). There are three small groups of sites with equivalent classifications. The largest group (15 sites) comprises mainly *Macropteranthes leichhardtii* - dominated vine thickets. The other groups (6 and 5 sites) are based on south-eastern and central coastal Queensland respectively.

The divisive hierarchies are broadly similar, however, with the first division separating coastal/subcoastal sites from the more inland stands, and the second divisions defining groups on a roughly north/south basis (see **Figures 3.10, 4.5** and **4.6**). The four coastal/subcoastal groups are geographically consistent, comprising south-east Queensland, "Auburn" district , central Queensland and Mackay/Nebo, although with the regional data set , the fourth group is quite diffuse.

Table 4.10 Comparison of site classifications from detailed survey and bioregional vine thicket databases.

		BRAY-CURTIS/UPGMA		TWINSPAN				BRAY-CURTIS/UPGMA		TWINSPAN	
SITE	**DS 7**	**Bg**	**DS 13**	**DS 15**	**Tg**	**SITE**	**DS 7**	**Bg**	**DS 13**	**DS 15**	**Tg**
S001	1	1	1*	3	2	S039	8	3	7	5	6
S002	4	2	2	4	6	S040	8	3	7	5	6
S003	4	2	2	4	6	S041	8	3	8	7	7
S004	4	2	2	4	6	S042	8	3	8	5	7
S005	4	2	2	4	2	S043	8	8	9	8	7
S006	1	2	2	4	2	S044	6	3	4	5	7
S007	8	3	7	5	7	S045	6	6	4	1	6
S008	8	3	7	5	7	S046	3	5	4	1	4
S009	5	2	2	4	6	S047	6	6	4	1	8
S010	5	3	7	6	7	S048	7	7	6	1	9
S011	8	3	8	7	7	S049	5	2	7	4	6
S012	8	3	7	5	6	S050	5	3	7	6	6
S013	8	3	7	5	7	S051	5	3	7	6	6
S014	8	3	7	5	6	S052	5	3	7	5	6
S015	5	2	7	4	6	S053	8	2	5	4	6
S016	5	2	7	4	6	S054	8	3	8	7	7
S017	5	3	7	6	6	S055	8	3	8	7	7
S018	5	3	7	6	6	S056	8	3	7	6	7
S019	4	2	2	4	2	S057	5	2	7	5	6
S020	4	2	2	4	2	S058	5	2	7	4	6
S021	1	1	1	3	1	S059	1	1	1	3	2
S022	2	4	3	2	3	S060	1	2	1	4	6
S023	3	4	3	3	3	S061	1	2	1	4	2
S024	3	4	3	2	3	S062	1	1	1	3	2
S025	3	4	3	2	3	S063	5	3	7	6	6
S026	3	4	3	3	3	S064	4	1	1	4	2
S027	3	4	3	2	3	S065	4	2	2	4	2
S028	3	4	3	2	4	S066	4	2	2	4	2
S029	3	4	3	4	3	S067	3	4	3	2	3
S030	3	6	4	1	4	S068	1	1	1	3	2
S031	6	6	4	1	8	S069	1	1	1	3	2
S032	8	3	8	5	7	S070	1	1	1	3	2
S033	5	2	2	4	3	S071	3	4	3	4	3
S034	8	3	8	7	7	S072	3	4	3	1	3
S035	8	8	9	8	7	S073	3	4	3	5	6
S036	5	2	7	5	6	S074	1	1	1	5	6
S037	5	2	7	5	6	S075	1	1	1	3	1
S038	8	3	7	5	6						

DS = Detailed survey survey: (An) 7 = cover data, trees and shrubs, (An) 13, (An) 15 = presence/absence data, trees, shrubs and vines, single records excluded.

Bg, Tg = Brigalow Belt Biogeographic Region data - presence/absence data, trees, shrubs and vines, single records excluded.

*** Hatched area = agreement between classifications.**

The major difference between the two classifications lies in the definition of the "inland" vine thicket site-groups. With the detailed data set, there are three groups of sites covering the upper Dawson Valley/Central Highlands region, with a small group (2 sites) at Dipperu. With the expanded bioregional data set, the inland vine thickets form three large units, the Central Highlands/upper Dawson (groups 6, 7), the northern Brigalow Belt (groups 8, 9) and the southern Brigalow Belt (groups 10, 11) (see **Figure 4.6**).

Table 4.10 also includes the site classification from the preferred analysis (DS 7) based on quantitative (cover) data from the detailed survey (see **Chapter 3**). Of the 75 detailed sites, 50 are placed in equivalent groups. The major difference is in the placement of the of the detailed survey (DS 7) group 5 sites (upper Dawson Valley). The bioregional classification divides these between (Bg) groups 2 and 3. The sites placed in Bg 3 correspond closely to a subgroup noted within detailed survey group 5, comprising more open, floristically simpler stands, several of which are dominated by ooline (*Cadellia pentastylis*).

These comparisons between the detailed survey and bioregional classifications (DS 7, DS 13 and Bg) suggest that the Springsure district and eastern bonewood communities should be regarded as separate entities and that community-type 5 from the detailed survey classification should be broken into two subgroups, viz. the more open communities with brigalow and/or ooline and the denser, more diverse Injune-Taroom vine thickets. Sites 6 (Cracow) and 60 and 61 (Allies Creek) are more appropriately placed in community-type 2 (Auburn), while sites 30 and 46 (Mt Britten), rather than being considered an outlier of community-type 3 (Central Queeensland), could on overall floristic similarity, be included in community-type 6 (Nebo district).

A revised vine thicket classification is presented in the concluding chapter (**Chapter 7**).

Most of the northern Brigalow Belt site-lists included in the floristic analysis described in this chapter were selected from the database (presence/absence data for tree, shrub and vine species) on 358 vine thicket stands surveyed by Fensham (1995) in northern inland Queensland. The first division of the TWINSPAN classification carried out by Fensham separated northern and southern sites, in contrast to the separation of near-coastal and inland sites in the present study. Subsequent divisions defined a series of geographical subregions in the northern vine thickets which, although overlapping, were relatively discrete (Fensham 1995)

The 30 sites which were common to both data sets were placed in groups 2 (8 sites) and 3 (22 sites) of Fensham's 8-group classification. The TWINSPAN classification undertaken in the present study gave some agreement with Fensham's results, with 8/8 equivalent in group 2. Fensham's group 3 (22) sites however were divided among groups (Tg) 7, 8 and 9 of the present study.

Nix, Stein, McMahon, Tassell and Hodges (1992) undertook an agglomerative classification of a subset (290 sites) of the rainforest data base assembled by Webb and Tracey for their floristic analysis of Australian rainforests (Webb *et al.* 1984). This data set was broadly equivalent to the combined C_1 and C_2 floristic provinces of Webb *et al.* and comprised presence/absence data for tree and shrub species, whereas the regional classification in the present study also included vine species. The classificatory methods used in this study and that of Nix *et al.* were otherwise similar, being based on the Czekanowski coefficient (equivalent to the Bray-Curtis coefficient with binary data) and flexible UPGMA clustering.

The 290 mesotherm sites were classified by Nix *et al.* into 10 floristic groups, with vine thicket (SEVT) sites concentrated in their groups 1 and 2. These groups combined a range of structural forms from SEVT to AMVF and ANVF. Group 1 consisted of 71 sites on predominantly volcanic substrates in coastal and subcoastal districts of Queensland, while group 2. (19 sites) occurred in more inland localities on sediments and volcanic substrates. The characteristic (most frequent) species in each of these groups were (Group 1) *Ficus platypoda, Diospyros geminata, Turraea pubescens, Strychnos axillaris, Sterculia quadrifida,* (Group 2) *Brachychiton rupestris, Ehretia membranifolia, Carissa ovata, Notelaea microcarpa* and *Alectryon diversifolius*. Five subgroups were distinguished in group 1 and two in group 2 (see **Table 4.11**).

The characteristic species for each of the subgroups of Nix *et al.* were matched against the most frequent species in each of the community-types defined in the present study (see **Table 4.4**). Subgroup 1.1 corresponded closely with (bioregional) group Bg5, while subgroup 1.3 was nearest to group Bg4, and subgroup 1.4 was broadly equivalent to group Bg1. Subgroup 2.1 appeared to represent a combination of groups Bg2 and Bg3, while subgroup 2.2 includes Bg9 and southern elements within Bg2 and Bg3. These differences are understandable given the relatively small number of sites (19) in Nix *et al.*'s group 2 compared with the equivalent groups in the bioregional classification.

Table 4.11 Floristic subgroups with eastern Australian dry rainforests (after Nix *et al.* 1992)

Sub-group	No. sites	Structure	Frequent Species	Distribution
1.1	16	SEVT, DVT, (A)MVF	*Pleiogynium timorense, Drypetes deplanchei, Cupaniopsis anacardioides, Alphitonia excelsa, Pouteria sericea, Geijera salicifolia, Ficus platypoda*	Coastal areas from Gladstone to Townsville, then inland to Charters Towers, Mt Garnet and Lakeland Downs.
1.2	7	CNVF, (A)NVF	*Sterculia quadrifida, Mallotus philippensis, Jagera pseudorhus, Cryptocarya triplinervis, Drypetes deplanchei, Cupaniopsis anacardioides, Flindersia schottiana, Pleiogynium timorense, Araucaria cunninghamii*	Similar to 1.1, but in higher rainfall areas.
1.3	11	SEVT/(A)NVF	*Strychnos axillaris, Turraea pubescens, Geijera salicifolia, Diospyros geminata, Sterculia quadrifida, Elattostachys xylocarpa, Drypetes deplanchei, Dendrocnide photinophylla*	Rockhampton region, outliers in Brisbane Valley.
1.4	27	ANVF, AMVF/SEVT	*Drypetes deplanchei, Cleistanthes cunninghamii, Alchornea ilicifolia, Austromyrtus acmenoides, Mallotus phillipensis, Flindersia australis, Araucaria cunninghamii, Premna lignum-vitae, Cryptocarya triplinervis, Carissa ovata, Streblus brunonianus*	South-east Queensland, north-eastern New South Wales.
1.5	10	SEVT, LMNF, AMVF/ANVF	*Austromyrtus bidwillii, Drypetes deplanchei, Dendrocnide photinophylla, Brachychiton australis, Archidendropsis thozetiana, Sterculia quadrifida, Premna lignum-vitae, Ficus virens, Cupaniopsis anacardioides, Cryptocarya triplinervis*	Burnett (Biggenden) district.
2.1	12	SEVT	*Brachychiton rupestris, Croton insularis, Alectryon diversifolius, Ehretia membranifolia, Diospyros humilis, Carissa ovata, Acacia fasciculifera, Citriobatus spinescens, Acalypha eremorum, Brachychiton australis, Backhousia angustifolia.*	Fitzroy and Burnett River basins.
2.2.	5	SEVT	*Notelaea microcarpa, Maytenus cunninghamii, Ehretia membranifolia, Carissa ovata, Alstonia constricta, Alphitonia excelsa, Canthium oleifolium, Apophyllum anomalum, Alectryon diversifolius*	Northern NSW to south Queensland.

Nix *et al.* also undertook an inverse (species X site) analysis of the Webb and Tracey data, but experienced difficulties because of the size of the data set (1453 species X 661 sites). They noted a tendency for the classification to produce a few groups with very large numbers of species and many groups with relatively few species. Similar trends were noted in the inverse analyses carried out on the detailed survey and the bioregional data sets (see sections **3.6.2 and 4.3.2**).

One of the major difficulties in attempting to determine relationships between vine thicket communities and individual climatic factors has been the high degree of correlation amongst the 35 BIOCLIM attributes (see **Table 4.7**) Most attributes were also highly correlated overall with the results of DCA and SSR ordination - the exceptions were isothermality (3), highest period radiation (21), radiation of wettest quarter (24) and radiation of warmest quarter (26). Several attributes however were only moderately correlated with scores for individual axes (8 and 10 for example), and results varied between data sets and also between ordination procedures (see **Table 4.8**).

An alternative approach used for ranking was to sum for each attribute the ratings of levels of significant differences between group means for the bioregional data sets (see **Table 4.9**). On this basis, attribute 15 (coefficient of variation of annual precipitation) was the most significant climatic attribute. It was also highly correlated with the results of DCA ordination (coefficients of 0.88 and 0.80 respectively).

Attributes 11 (mean temperature of the coldest quarter) and 27 (radiation of the coldest quarter) were the next most significant attributes.

These results show a broad agreement with climatic attributes identified as significant by Fensham (1995) (i.e. attribute 15) for northern inland Queensland and Neyland and Brown (1993) (attribute 11) for the eastern Tasmanian rainforests.

Table 4.12 lists the most frequent species in each bioregional (Bg) vine thicket group, together with mean values for attributes 15, 11 and 27.

A major limitation to the use of BIOCLIM data is its spatial resolution., although it has been improved in the recently released version to approximately a 2.5 km X 2.5 km grid. The degree of topographic variation is not as critical as in the wet tropics for example, but many areas, particularly in southern parts of the study area, aspect and position on slope may become significant. At Reinkes Scrub

Table 4.12 Brigalow bioregional site-groups with most frequent species and mean values for major climatic attributes.

Regional Group	Frequent Species	Mean Temp Coldest Quarter	Rainfall Seasonality (C of V)	Radiation of Coldest Quarter
Bg 1 (27)	*Notelaea microcarpa, Austromyrtus bidwillii, Capparis arborea, Carissa ovata, Drypetes deplanchei, Canthium vacciniifolium, Alyxia ruscifolia, Malaisia scandens, Croton insularis, Jasminum simplicifolium* subsp. *australiensis, Secamone elliptica, Denhamia pittosporoides*	12.84	50.67	14.1
Bg 2 (25)	*Carissa ovata, Croton insularis, Brachychiton rupestris, Planchonella cotinifolia* var. *pubescens, Jasminum simplicifolium* subsp. *australiensis, Ehretia membranifolia, Flindersia collina, Parsonsia lanceolata*	13.12	52.24	14.48
Bg 3 (40)	*Carissa ovata, Citriobatus spinescens, Alectryon diversifolius, Planchonella cotinifolia* var. *pubescens, Ehretia membranifolia, Acalypha eremorum, Cissus opaca, Diospyros humilis, Brachychiton rupestris*	14.63	60.8	15.12
Bg 4 (21)	*Strychnos axillaris, Acalypha eremorum, Carissa ovata, Jasminum didymum* subsp. *racemosum, Canthium odoratum, Cissus oblonga, Austromyrtus bidwillii, Turraea pubescens, Diospyros geminata, Glossocarya hemiderma, Murraya ovatifoliolata, Planchonella cotinifolia* var. *pubescens, Drypetes deplanchei, Capparis arborea, Secamone elliptica, Alectryon connatus, Dioscorea transversa, Citrspin, Notelaea microcarpa, Alyxia ruscifolia, Pleiogynium timorense*	15.97	68.67	15.49
Bg 5 (10)	*Jasminum didymum* subsp. *racemosum, Turraea pubescens, Glossocarya hemiderma, Capparis arborea, Diospyros geminata*	16.1	75.4	15.87
Bg 6 (19)	*Polycias elegans, Ficus platypoda, Cupaniopsis anacardioides, Strychnos axillaris, Austromyrtus bidwillii*	16.34	74.47	15.86
Bg 7 (7)	*Ricinocarpos ledifolius, Gyrocarpus americanus, Glossocarya hemiderma, Geijera salicifolia* var. *salicifolia, Capparis lasiantha, Lysiphyllum hookeri, Jasminum didymum* subsp. *racemosum, Strychnos axillaris, Planchonella cotinifolia* var. *pubescens, Carissa ovata, Cissus opaca, Croton phebalioides, Flueggea leucopyrus*	18.14	89	16.26
Bg 9 (6)	*Notelaea microcarpa, Geijera parviflora, Alectryon oleifolius, Pandorea pandorana, Brachychiton populneus*	10.18	25.33	11.97
Bg 10 (2)	*Notelaea microcarpa, Cadellia pentastylis*	10.67	28.33	12.4

(S063), for example, subplots with northerly and southerly aspects respectively were placed in different classificatory group (see **Chapter 3**). Position on slope would influence both the incidence and severity of winter frosts, which may occur throughout the Brigalow Belt. Vine thickets are found more often in mid-slope positions than on flats, but this could be related as much to soil factors as to relative freedom from frost.

Another limitation of modelled climatic data is the lack of a temporal component, namely year - to-year variability (Murphy and Lugo 1986a). Variability in amount of annual rainfall and intensity and timing of wet and dry periods is often considerable, although there do appear to be some cyclic trends apparent in rainfall (see **Figure 4.11**), which are believed to be related to the activity of the Southern Oscillation (Partridge 1994) (**Chapter 3**). Rainfall seasonality (attribute 15), for example, has been shown be associated with significant between group differences in northern Queensland vine thickets (Fensham 1995) as well as in the present study (see **Table 4.9**).

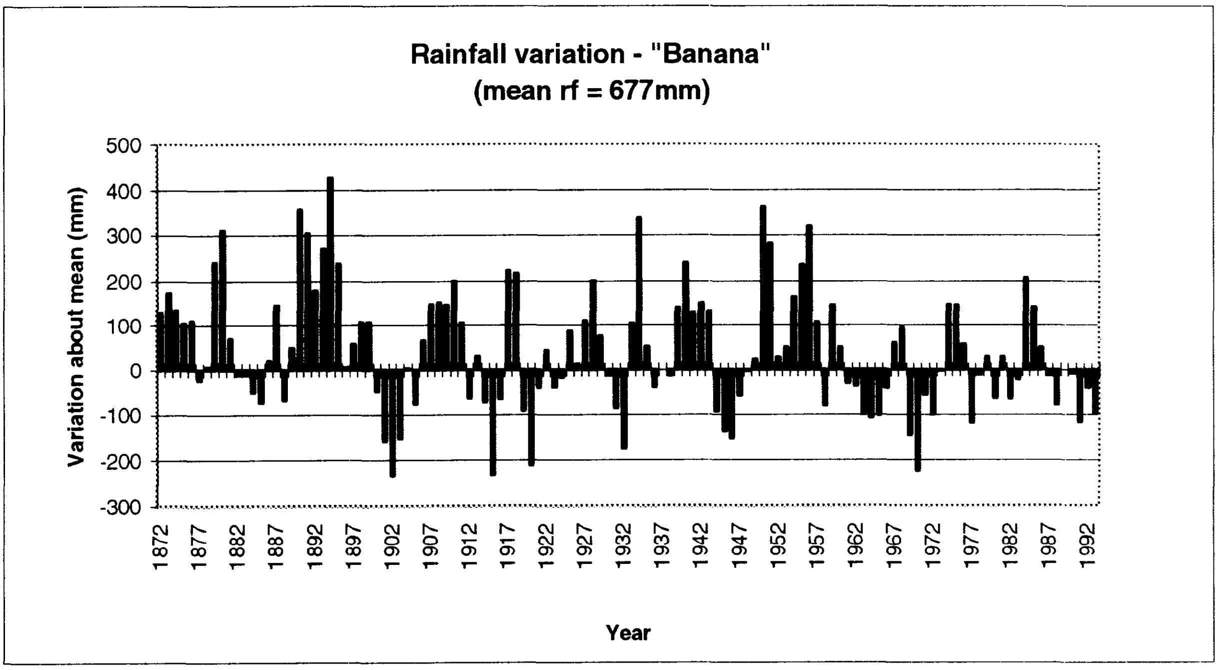


Figure 4.11 Variation in annual rainfall at "Banana", Moura district, central Queensland, 1872-1992 (source Clewett *et al.* 1994).

Murphy and Lugo (1986a) point out that rainfall variability is particularly significant for systems near the threshold levels of water supply. The high levels of mortality that occur in dry years suggest that the extreme years, rather than the average years, may be of most significance in determining overall structure and composition of vine thickets and other dry forest ecosystems. Seasonal effects are discussed further in relation to temporal changes in *Macropteranthes leichhardtii*-dominated vine thickets in **Chapter 6**.