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Quantitative descriptions of native plant communities with potential for use in revegetation at Ranger uranium mine

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Quantitative descriptions of native plant communities with potential for use in revegetation at Ranger uranium mine

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Contents

Figures

Tables

Preface

A draft of this internal report was completed in 1994, following field studies conducted in 1991–93. In 1994, the then Supervising Scientist, Mr Barry Carbon, acting on the advice of a consultancy review team commissioned to review environment protection research in the Alligator Rivers Region (ARR), decided that research on the revegetation of mine sites in the ARR would no longer be carried out by the Environmental Research Institute of the Supervising Scientist (***eriss***). As a consequence, the review, finalisation and release of this report in the Institute's internal report series received low priority. The value of the work contained in the report has recently been recognised following re-prioritisation of rehabilitation research in the region by the Alligator Rivers Region Technical Committee (ARRTC) and has resulted in a decision to produce and release the report in the internal report series.

The old files (electronic and hard copies) for this report were assembled through a combination of conversion, scanning, formatting and extensive checking and editing by Gary Fox with help from Ann Webb. James Boyden restored original data files to the Institute's computer network and file storage system, imported the Paradox files into Microsoft Access and revised the section on 'Data storage' to reflect these changes. Chris Humphrey reviewed and edited the manuscript prior to final production.

In May 2005, the author updated the taxonomy of plants listed in the report. Otherwise, the author was not asked to review the scientific content of the report and the philosophy and conclusions current at the time he prepared the report have been retained.

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Introduction and background

The Commonwealth and the NT Governments have agreed on the conceptual plan for rehabilitation at the Ranger Uranium mine (SSARR 1990). The broad goal of this plan is that:

> Rehabilitation of the Ranger Project Area should aim to establish an environment in the area that reflects to the maximum extent that can reasonably be achieved the environment existing in the adjacent areas of Kakadu National Park without detracting from Park values of adjacent areas.

The major objective for revegetation is:

> to revegetate the disturbed sites of the Ranger Project Area with local native plant species similar in density and abundance to that existing in adjacent areas of Kakadu National Park, in order to form an ecosystem the long term viability of which would not require a maintenance regime significantly different from that appropriate to adjacent areas of the Park.

This goal and objective indicate clearly that planning and assessment of revegetated sites on the Ranger Uranium Mine Project Area should be based on the composition, richness and density of native plant communities in areas adjacent to it. The primary purpose of this study was therefore to obtain quantitative data from undisturbed native plant communities in areas adjacent to the Ranger Uranium mine site that may be considered useful as models for future revegetation strategies and standards.

The concept of site revegetation based on the characteristics of adjacent or pre-existing plant communities has much popular appeal; a clear statement of intent to restore disturbed sites to their previous undisturbed state. However, there is a potential problem in applying this concept to guide revegetation on the Ranger Waste Rock Dump (WRD) - the largest area to be revegetated on the Ranger site. The basis of the problem is that the landform and substrate of the WRD are not related to pre-existing landforms, or to substrates adjacent to it. The WRD is a rocky hill being set on a previously flat terrain. Furthermore it is composed of metamorphic, Cahill-formation schists whereas adjacent substrates belong to a geologically unrelated entity known as the Koolpinyah-surface (Needham et al 1973, Wells 1979). Given these striking geotopographic differences it seemed reasonable to suggest that native vegetation communities immediately adjacent to the WRD might not contain the most appropriate species for revegetating this area. A second objective of the study was therefore to describe undisturbed native vegetation on a range of sites elsewhere in the Alligator Rivers Region where the topography and/or substrates were perceived to be more similar to conditions expected to prevail on the WRD. Comparison of vegetation communities on these sites with those adjacent to the WRD could indicate the degree to which adjacent vegetation might be useful as a model for revegetating the Ranger WRD.

Methods

Site selection

Twenty sites were selected for vegetation description (see table 1). Ten 1-hectare sites were established in well-drained woodlands 'adjacent' to the WRD in the Ranger lease on low, broad ridges of the Koolpinyah surface. These sites were chosen randomly from the 4a and 3c1 land units (Wells 1979). Land units on the Ranger lease characterised by poor drainage or extensive waterlogging in the wet season were specifically excluded from the study. The 10 remaining sites, of up to 3 hectares in area, were located on a range of hill terrains outside the Ranger lease but within the Alligator Rivers Region. Five sites were established on weathered, rocky hills along major roads in Kakadu National Park. These were chosen wholly for their topographic similarity to the Ranger WRD without considering the composition of the parent rock. The final five sites were located on weathered hills composed of Cahill formation schists. These sites were identified as the best natural sites available where both topography and rock type were similar to that expected on the Ranger WRD (Needham et al 1973, Uren 1992).

Sampling procedures

Trees and shrubs

For quantitative description of the trees and shrubs at each site, plants > 1.5m tall and plants < 1.5m tall were sampled independently.

Trees and shrubs > 1.5 m in height

Trees and shrubs > 1.5 m tall were described using 10 randomly placed, 20 m x 20 m quadrats. Species composition, basal area, density and height from each plant > 1.5m tall in each quadrat were recorded. The height of plants up to 5 m tall was measured directly using a 5 m ranging pole while for plants > 5 m tall, height was estimated to the nearest 0.l m either by comparison with the ranging pole or with a clinometer. Basal area was determined from a diameter measurement using a diameter tape. Diameters were recorded at 1.5 m height for plants > 3m tall with single unbranched trunks. For plants < 3m tall the diameter was measured at the base of the plant. For plants > 3 m tall but with major branching below 1.5 m the diameter was taken at the highest point on the trunk below the first branch.

Trees and shrubs < 1.5 m in height

Tree and shrub vegetation < 1.5m tall was described using 20 randomly placed, 5 m x 5 m quadrats. Within each quadrat the number of individuals of each species of tree and shrub < 1.5 m tall was recorded. Plant height and crown cover were also recorded. Height was measured directly from a ranging pole. Crown cover was determined from two crown diameter measurements (Mueller-Dombois & Ellenberg 1974). The first diameter (d_1) measured the longest distance across the crown while the second (d_2), was taken across the crown perpendicular to the first.

$$\text{Crown cover} = ((d_1 + d_2)/4)^2 \pi$$

Herbaceous plants

Due to constraints on staff and time, herbaceous vegetation was evaluated quantitatively at only 13 of the 20 sites (see table 1) and the survey extended over two wet seasons. In the wet season of 1991/1992, Ranger sites 1, 2, 8, 9 and 10, the hill sites, Jabiluka, Spring Peak and

Barramundi, and the schist hills, Fisher and Tin Camp 1 were studied. In the following wet season, 1992/1993, a survey of schist hill sites, Tin Camp 2, 3 and 4 was completed.

At each site herbaceous vegetation was described using 25, 0.71 m x 0.71 m (0.5 m^2) randomly-placed quadrats. All herbaceous plants in each quadrat were harvested and species composition, plant density, height and dry weight biomass were obtained. Individual plant heights were not measured precisely but were tallied within 0.5 m height class intervals. For biomass estimation, only live, aerial plant material was harvested, dead plants being discarded. The harvested material was sorted into species, placed into paper bags and oven dried at 60°C for at least 3 days before being weighed. At each site sampling was repeated at monthly intervals throughout the growing season to capture succession. Sampling began in the month after the first rains of the wet season in Jabiru (usually October or November) and ceased during the following dry season either when the site was burnt or in August.

Data storage and analysis

Data storage

Currently (August 2005) data pertaining to this study are stored in the Oracle file storage system, SSD-Explorer, under the directory named:

SSDx\\Rehabilitation\Ranger\Kym Brennans vegetation surveys\Files\.

This directory also includes files describing the methods used to collect data in a file named "Brennans Methods.zip"

Historically, data appear to have been stored in a number of locations. Data were originally located on the Jabiru server under the directory:

OSS JABIRU\U:\GROUPS\WETLAND\PLANTBIO\DATA\DB\VEGSURVS\

Data have also appeared under a generic directory named "32" (designating the project number for Minesite revegetation projects). In this case, data are stored under the sub-directory named "320701" (after the assigned project number for the vegetation surveys).

Original data were stored as three PARADOX database tables, named HERBDATA.DB, SHRBDATA.DB, and TREEDATA.DB. A fourth lookup table named SITES.DB provides detailed spatial information relating to location and size of associated sampling sites. Another lookup table, Names, provides details on taxonomic names. The database tables have subsequently been imported to ACCESS 2000. The original table names were retained and the relational links between tables re-established. The name of the new Access database is "Kyms vegetation survey data.mdb"

The *TREEDATA* table contains the data for trees and shrubs > 1.5 m, *SHRBDATA* contains the data for trees and shrubs < 1.5 m. and *HERBDATA* contains the data from herbaceous plants.

In each of these database tables the 'OSS Code' column is the species name code. This column can be linked to the 'OSS Code' column in the file *NAMES* to convert the codes to species names. Similarly the 'Site #' column in any of these files can be linked to the 'Site #' column in file SITES to obtain location details of the sites. In some of the data columns, many values may appear as '.00'. This is a display quirk which can be rectified by putting the cursor in that column and using the key sequence 'F10, Image, Format, General' to alter the number of places displayed after the decimal point.

Data analysis

The computer software package PATN (Belbin 1994) was used for multivariate analysis of community data. All classifications and ordinations (SSH) are based on the use of the Bray-Curtis association measure and a flexible UPGMA fusion strategy (beta = 0). For SSH ordinations stress levels of < 0.15 were achieved with 3-dimensional solutions. The data-sets from herbaceous plants and trees/shrubs had to be analysed independently because data pertaining to the herbaceous species were not collected from all the sites.

The herbaceous plant data-set was a sites x species matrix composed of maximum mean monthly biomass data transformed into ranks (see below). Maximum mean monthly biomass provided a view of the total species richness and overall productivity of each site without confounding effects due to seasonal succession.

The tree/shrub data-set was a sites x species matrix composed of stem volume data also transformed into ranks (see below). Stem volume (= density x basal area x height) was used as a surrogate measure of biomass. Neither the density nor the basal area data by themselves were considered ideal for analysis. Density data greatly weights the importance of populations of small dense understorey species while basal area, although adequate in many respects, could be improved by incorporating height.

Prior to analysis the tree and shrub data-sets for the < 1.5m and > 15 m strata were combined.

Stem volume of each tree and shrub > 1.5m = π(stem diameter / 2)^2 h.

Each species mean stem volume per hectare was calculated from the quadrat data at each site.

Stem volumes of trees and shrubs < 1.5 m were calculated similarly, but the stem diameter was estimated from the average crown diameter.

Estimated stem diameter of each tree and shrub < 1.5 m = ((crown d_1 + crown d_2)/2)/ 25

One twenty fifth the average crown diameter was derived by dividing the mean stem diameter from all trees and shrubs 1.5–1.6 m high in the > 1.5m data-set into the mean average crown diameter of all trees and shrubs 1.4–1.5 m high in the < 1.5 m data-set. The value obtained, 22.3, was rounded up to 25 on the assumption that the average stem diameter of a 1.4–1.5 m plant should be smaller than that of a 1.5–1.6 m plant.

With both data-sets in equivalent units they were added together to form a composite sites x species matrix.

Prior to analysis the raw biomass (or stem volume) values in both data matrices were transformed into whole number ranks with a range of 1 to 5 (least biomass to most biomass). The cut points used in these transformations were subjectively, to some extent, iteratively derived, to reflect natural ranks of biomass perceived within and between sites in the field. The transformation scale used for herb biomass was:

5 = >80 g (dry wt)/m^2, **4** = 8–80 g/m^2, **3** = 1.2–8g/m^2, **2** = 0.75–1.2g/m^2, **1** = <0.75g/m^2

In the tree/shrub matrix, because the stem volumes of abundant obligate shrubs were always very much less than the stem volumes of abundant trees, the data of the trees and of obligate shrubs were segregated, transformed independently at different scales, then recombined. The two transformation scales used were:

trees: **5** = >30m^3/ha, **4** = 16–30m^3/ha, **3** = 5–16m^3/ha, **2** = 1–5m^3/ha, **1** = <lm^3/ha

obligate shrubs: 5 = >1.5m^3/ha, **4** = 0.75–1.5m^3/ha, **3** = 0.25–0.75m^3/ha, **2** = 0.1–0.25m^3/ha, **1** = <0.1m^3/ha

Results

Description of the Ranger sites

One hundred and ninety three species (57 trees and shrubs, 136 herbs) were recorded from the 10 sites on the Ranger lease. Species-specific data from each site are provided in: Appendix 1, tree/shrub density; Appendix 2, tree/shrub stem volume; Appendix 3, herb density; and Appendix 4, herb biomass. Individual sites are described in terms of a range of generic community-level attributes in table 2. Overall summaries are provided in: table 3, trees and shrubs < 1.5m; table 4, trees and shrubs > 1.5 m; table 5, herbs; and table 6, generic attributes.

The Ranger sites were quite variable in terms of both tree/shrub and herbaceous species composition. This is evident in both the site classifications (figures la, b) and the ordination diagrams (figures 2a, b.) The difference between site 10 and the other Ranger sites is particularly striking. The dissimilarity value at which site 10 fuses with the other Ranger sites is high (almost 0.6 for tree/shrubs, over 0.5 for herbs) and, at least in the tree/shrub ordination, it is placed distant from the main cluster of sites. The tree/shrub vegetation of site 10 was characterised by the presence of *Acacia hemignosta, Antidesma ghesaembilla, Brachychiton diversifolius***,** *Corymbia* (formerly *Eucalyptus) foelscheana, Eucalyptus tectifica, Ficus opposita, Hakea arborescens* and *Terminalia grandiflora* which were absent from other Ranger sites. Of these *Corymbia foelscheana* and *Eucalyptus tectifica* had relatively high stem volumes. Amongst its herb community, site 10 supported 24 species not found at other Ranger sites.

Several, including *Cleome tetrandra, Heliotropium alcyonium, Merremia guinata, Panicum mindanaense* and *Themeda triandra,* were relatively high biomass species.

The tree/shrub site classification and ordination also indicate that the plant communities at sites 4 and 5 were somewhat different from the others (ie high level of fusion in the classification and outlier-like position on the ordination). Species unique to these sites included *Capparis umbonata***,** *Melaleuca viridiflora, Pandanus spiralis* and *Petalostigma pubescens.* Each of these species is often associated with areas having impeded drainage; becoming seasonally waterlogged (pers. obs.). None of them has a high stem volume at any of the sites but their occurrence may indicate that sites 4 and 5 contain local areas of poor drainage.

Despite the range of differences that existed amongst the various Ranger sites, there were many floristic elements with high constancy. These are now summarised as the overall vegetation 'type' for areas adjacent to the Ranger WRD. At almost all sites *Eucalyptus tetrodonta* was the dominant tree (by stem volume, see table 4). This species occurred with other high volume, high frequency species such as the canopy species, *Eucalyptus miniata, Corymbia porrecta and Corymbia bleeseri,* and mid-storey species, *Xanthostemon paradoxus* and *Acacia mimula.* The midstorey also contained a range of low stem volume, high frequency trees including *Terminalia ferdinandiana, Planchonia careya, Buchanania obovata, Gardenia megasperma, Grevillea decurrens* and *Persoonia falcata*. Only nine species of obligate shrubs were recorded from the understorey, *Petalostigma guadriloculare, Galactia megalophylla, Acacia difficilis, Jasminum molle, Premna acuminata, Antidesma ghesaembilla, Pachyema junceum, Acacia gonocarpa* and *Calytrix achaeta.* Of these only *Petalostigma guadriloeulare* had consistently high biomass across most sites. *Galactia megalophylla* was the only other shrub with a site frequency of > 50%. The overall mean crown cover of shrubs and trees in the < 1.5 m stratum was 18%. The overall average density of trees and shrubs from all strata exceeded 11,000 plants per hectare (about 1.1 plants/m^2).

The herbaceous flora was studied at only five Ranger sites. Each of these was dominated by the tall annual grass *Sorghum brachypodum.* This species accounted for almost 60% of the total seasonal production of herbaceous biomass at each site. A further 20% of the total annual productivity was added by other grasses (22 species). Of these *Heteropogon triticeus* and *Alloteropsis semialata* were 'high biomass' species, but the short grasses, *Schizachrium fragile, Eriachne agrostidea, Eriachne ciliata, Thaumastochloa major, Digitaria gibbosa, Aristida holathera, Brachiaria holosericea, Mnesithea formosa, Sporobolus pulchellus Pseudopogonatherum irritans* and *Yakirra nulla* each had high site frequencies. Forty two percent of the non-grass herbs had site frequencies of at least 60%. *Tephrosia remotiflora* was the only high frequency, 'high' biomass legume. At time of peak growth the average density of herbaceous plants was over 250 plants/m^2 representing a dry weight biomass of about 160 g/m^2. Species richness at this time exceeded 7.5 species/0.5m^2.

The pattern of biomass production throughout the growing season on the Ranger sites is shown in figure 3. At almost all sites the monthly biomass peaked during March when *Sorghum brachypodum* began to flower and seed. Figure 4 shows the relative composition of the biomass during March 1992.

Description of the hill sites

Species-specific data from the 10 hill sites is provided in appendix 1, tree and shrub density; appendix 2, tree and shrub stem volume; appendix 3, herb density; and appendix 4, herb biomass. The hill sites are also described in terms of a range of generic community-level characteristics in table 7. Figure 5a, trees and shrubs, and figure 5b, herbs, show classifications of the sites, while figure 6a, trees and shrubs, and figure 6b, herbs, present ordinations of the same data.

The tree and shrub assemblages on the hills were enormously heterogeneous. This is depicted in the site classification (figure 5a) where the dissimilarity value at which all sites fuse is almost 0.8. Mt Cahill and Tin Camp 3, the two most different sites, with a combined total of 53 species had only one species, *Gardenia megasperma,* in common! A likely cause of the high level of floristic heterogeneity amongst the hill sites is the dissimilarity of their substrates or parent-rock types.

The hill sites encompassed 5 distinct parent-rock types; two schists, two sandstones and a quartzite (see table 1). When the generalised rock type (viz schist, sandstone or quartzite) of each site is overlayed on the species site ordinations (figures 6a, b) the sites appear sorted vertically by rock type, ie sites on schist located at the top of the ordination, sandstone sites below centre and the quartzite site at the bottom. The medians of the ordination scores along ordination axis 2 for trees and shrubs (figure 6a) and ordination axis 1 for herbs (figure 6b) of the sites with similar rock type were compared. The results were significant (trees/shrubs Kruskal-Wallis H=7.36, df=2, P=0.03, herbs Kruskall-Wallis H=5.00, df=1, P=0.026). It was concluded that, for these sites, plant communities on hills were influenced by the change in parent rock (essentially from schist to sandstone).

Although few tree and shrub species were totally restricted to a particular substrate type the assemblages on sandstone and schist had very different dominant species. Three of the most abundant species on sandstone, *Eucalyptus miniata, Eucalyptus tetrodonta* and *Acacia mimula* were rare on schist while *Corymbia foelscheana* and *Eucalyptus tectifica,* frequently dominant on schist, occurred only occasionally on sandstone.

A feature of the distribution patterns of species within the different types of hill substrates was the occurrence of taxa, with relatively high stem volume, restricted to just one site eg

Eucalyptus pruinosa, dominant only at schist site Tin Camp 3, *Eucalyptus phoenicea*, dominant only at sandstone sites Mt Cahill and Spring Peak and *Eucalyptus tintinans* only at the Fisher Hills schist site. Possible reasons for these patterns, related to site-specific soil properties are not dealt with here.

Comparison of a range of generic, community-level attributes showed other distinctions between the tree/shrub flora on schist hills and sandstone hills (table 8). The change from sandstone to schist was associated with statistically significant reductions in number of tree species per site, tree density and overall stem volume. The tree density on the schist sites was significantly reduced throughout all height strata. Schist sites compared to sandstone sites supported significantly lower densities of evergreen species and the legume genera, *Acacia* and *Erythophleum*, were significantly less dense on schists than on sandstone.

The assemblages of herbaceous species on the hills proved to be almost as heterogeneous as the trees and shrubs (figure 5b) and again when the parent-rock type was overlayed on the species site ordination the schist and sandstone sites were clearly segregated (figure 6b). One of the most conspicuous differences between the schist hills and the sandstone hills was the dominant, high biomass grass. All sandstone hills were dominated by *Sorghum brachypodum*, a species not recorded on the schist hills. Conversely, *Chrysopogon fallax* and *Sorghum intrans*, which dominated the four Tin Camp Creek schist sites and Fisher Hills schist site respectively, were absent from sandstone sites. The grass *Sehima nervosum* and sedge *Fimbristylis xyridis*, also moderately high biomass species on the schist sites, did not occur on sandstone. Overall there were 14 herb species with high frequency on sandstone that were absent from schist and 11 widespread species of schists not found on sandstone.

On the basis of the herbaceous assemblages there were virtually no generic community-level differences between sandstone hills and schist hills. The number of species per sample quadrat was significantly higher on schist than sandstone, but overall, species richness on sandstone and schist hill sites were similar (analyses not presented).

Ranger sites compared to the hill sites

Site classifications and ordinations showing the data from the Ranger and hill sites combined are presented in figure 7 (tree/shrub classification), figure 8 (herb classification) and figures 9a.and 9b (tree/shrub and herb ordinations). Each classification was cut at the lowest level of fusion achievable to consolidate the Ranger sites into a single group. This strategy provided a practical benchmark against which other individual sites or other groups of sites could be compared, and resulted in each classification being cut at a five group level. These groups are identified on the ordinations. Two-way classifications of the sites x species matrices are shown in appendix 5 for trees and shrubs, and appendix 6 for herbs, and give the total array of species responses within the realms of this classification strategy.

In the tree/shrub site classification, three hill sites fused with the Ranger sites inside group 1. It was therefore not particularly surprising that nearly all of the tree and shrub species on the Ranger sites were also found in hill situations (table 9).

In the herb site classification, none of the hill sites fused with the Ranger sites at the five group cut level. However, from table 10 there were only a few, mostly low biomass herbaceous species (eg *Portulaca bicolor, Minuria macrorhiza* and *Bulbostylis barbata*) with high affinity to the Ranger sites that were completely absent from all the hills. On the basis of simple floristics it is therefore concluded that nearly all of the lowland species on the Ranger sites can be found growing in hill situations.

A feature of the two site ordinations (figures 9a and 9b) is that the Ranger lowland sites tend to fall to the left of the ordination space while hill sites, although spread vertically, tended to be placed to the right. The median of the axis 1 ordination score for trees and shrubs (figure 9a) and the axis 2 ordination score for herbs (figure 9b) of the Ranger sites was significantly different from that of the hill sites for both data-sets (for trees/shrubs: Kruskall-Wallis H=9.61, df=1, P=0.002, for herbs: Kruskall-Wallis H=8.57, df=1, P=0.003). It was concluded for the sites in this study, that hills could be distinguished from lowlands on the basis of vegetation. In terms of simple floristics it was difficult to identify particular species that consistently differentiated between hills and lowlands. This no doubt reflected the high level of floristic heterogeneity amongst the hill sites. *Sorghum plumosum* though, a moderately widespread, high biomass grass on hills was completely absent from lowland sites. From a more general perspective, however, a number of community-level attributes (tables 11 and 12) did effectively distinguish hill sites from lowland sites. The tree/shrub communities on hills differed from those at Ranger by their higher density of shrubs > 1.5m tall, higher density of trees in the 5–10 m stratum, and lower density of trees > 10 m high. The stem volume of woody leguminous species was significantly lower on hills than in the lowlands. In terms of herbaceous vegetation. the hill sites were separable from the Ranger lowland sites by their less diverse assemblages of non-grass species and lower biomass of annuals.

Ranger sites compared with schist sites

From figure 7, the tree/shrub classification, and figure 8, herb classification, fusion between the four Tin Camp schist sites and the Ranger sites only occurred at the highest level of dissimilarity. In the herb site classification the schist site, Fisher Hills, is grouped with the Tin Camp schist sites. In the tree/shrub classification, the Fisher Hills schist site fuses in group 3 though in ordination space (figure 9a) it is 'located' adjacent the Tin Camp schist sites (in the top half of the ordination diagram) rather than near the Ranger sites. All of this suggests the presence of many non-trivial qualitative and/or quantitative differences between the Ranger sites and the schist sites.

Appendix 5, a two-way classification of trees and shrubs, and appendix 6, two-way classification of herbs, show the overall magnitude of floristic differences between the Ranger sites and the schists sites. Table 9 and table 10 provide summaries, highlighting only those species with high frequency of occurrence or high biomass (or stem volume) at either the Ranger or the schist sites.

For trees and shrubs (table 9), it is clear that most of the species with high affinity to the Ranger sites are those with high stem volume, ie most of the abundant trees and shrubs at Ranger are absent from, or comparatively rare in, woodlands on schist. Similarly, the most abundant species on schists are uncommon at Ranger. Of the small group of species with high frequency at both Ranger and the schist sites, only one, the shrub, *Petalostigma quadriloculare* has high stem volume, but only at the Ranger sites. The two species, *Corymbia dichromophloia* and *Eucalyptus pruinosa*, had very high stem volumes on single schist sites. Neither of these species occurred on the Ranger sites.

Table 10 shows the herbaceous species having high frequency either at Ranger or on the schist sites. The pattern is somewhat similar to that seen for the trees and shrubs. The species with the highest biomass on the Ranger sites, *Sorghum brachypodum*, was absent from the schists, and two high biomass species on schist, *Chrysopogon fallax* and *Sorghum plumosum* had low, or no occurrence at Ranger. The Fisher Hill schist site did not support *Chrysopogon fallax* but was dominated by *Sorghum intrans*, a species also not present on the Ranger sites.

There were several herbaceous species with high frequency amongst the Ranger sites and the schist sites eg *Heteropogon triticeus, Schizachrium fragile, Mnesithea formosa, Alloteropsis semialata* and *Ipomoea graminea.* However, only *Heteropogon triticeus* was noted as having high biomass on both site types.

Tables 11 and 12 compare the Ranger sites and the schist sites in terms of a range of generic community-level attributes. Schist sites differed from the Ranger sites in having fewer tree species > 1.5m per sample quadrat, a lower density of trees > 1.5m and lower overall stem volume (trees+shrubs). The density of trees > 10 m tall was much lower on schist sites than on the Ranger sites. The density of evergreen trees, and the stem volume of leguminous woody species were also each much lower on the schist sites than on the Ranger sites. The schist sites thus supported more open, relatively low stature tree and shrub communities, dominated by deciduous species and lacking the dense *Acacia* understorey of the Ranger sites. These differences suggest that the tree and shrub communities at Ranger and on the schists function quite differently.

With respect to herbs (table 12), very a few generic community-level differences were found. Compared to the Ranger sites, the schist sites supported fewer species of non-grass herbs per site. Although not significant, the difference in biomass of perennial grasses at Ranger and on the schist sites is notable. All the dominant grass species at the Tin Camp schist sites are perennials, while the dominant grass on the Ranger sites is an annual. However, the dominant grass at the Fisher Hills schist site was an annual.

Conclusions

The first of the two main findings from this study was that there are natural plant communities on hills in the region that are very similar floristically to the vegetation in eucalypt woodlands on the Koolpinyah surface on the Ranger lease. From this it follows that a revegetation strategy for an artificially created waste rock hill *could* be based on the floristic characteristics of plant communities at Ranger adjacent to the WRD. However, the plant communities on hills did have several structural characteristic that differed from the Ranger sites and these would need to be acknowledged. However, all of the hill sites with high similarity to Ranger sites were on sandstone substrates and clearly the Ranger waste rock is not sandstone, but schist.

The second main finding was that natural vegetation on schist hills was highly dissimilar, both floristically and structurally, to that occurring on the Ranger sites.

These results add an important dimension to the process of selecting the best long term revegetation strategy for the Ranger WRD. In terms of potential revegetation strategies for the Ranger WRD, the vegetation at Ranger and on the schist hills represent two strikingly different, but highly relevant revegetation models. On the basis of similarity of topography and the characteristics of future soils that might develop on the Ranger WRD, a long term revegetation plan based on plant assemblages from the schist hills might be most appropriate. Under current governmental goals and objectives, however, plans based on assemblages at Ranger would be favoured because they are adjacent to the Ranger WRD. The results of this study thus serve to identify the possibility that the best long term revegetation strategy for the Ranger WRD may not be one that is based on data from plant communities adjacent to it.

Finally however, it is important to emphasise that these conclusions relate entirely to selecting *long term* strategies and standards for revegetation of the Ranger WRD. Initial revegetation strategies, to control erosion and to progressively enrich the site biologically throughout the

early stages of soil development may need to be quite different. These strategies still need to be developed.

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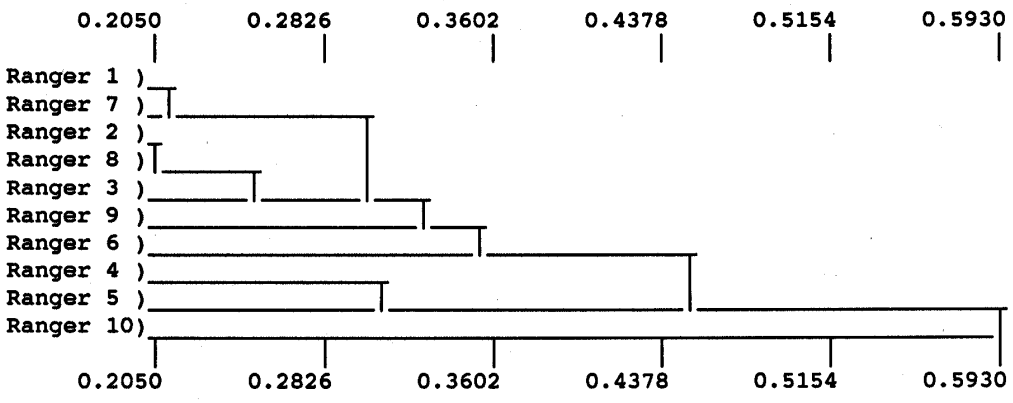
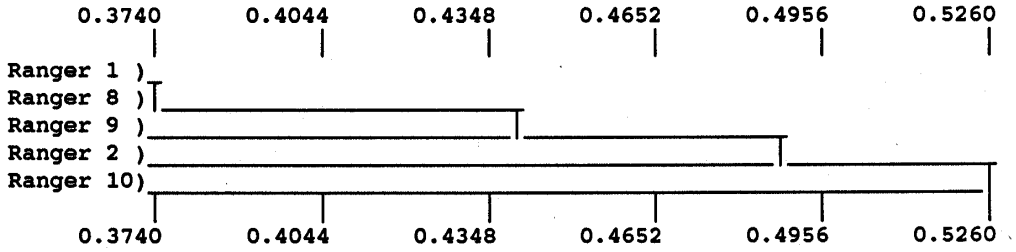


Tree and shrub data = stem volume transformed by linear interpolation

Association measure = Bray-Curtis

Fusion strategy = Flexible UPGMA (Beta = 0)

Figure 1a Classification of Ranger sites, tree and shrub data



Herb data = Dry weight biomass transformed by linear interpolation

Association measure = Bray-Curtis

Fusion strategy = Flexible UPGMA (Beta = 0)

Figure 1b Classification of Ranger sites, herb data

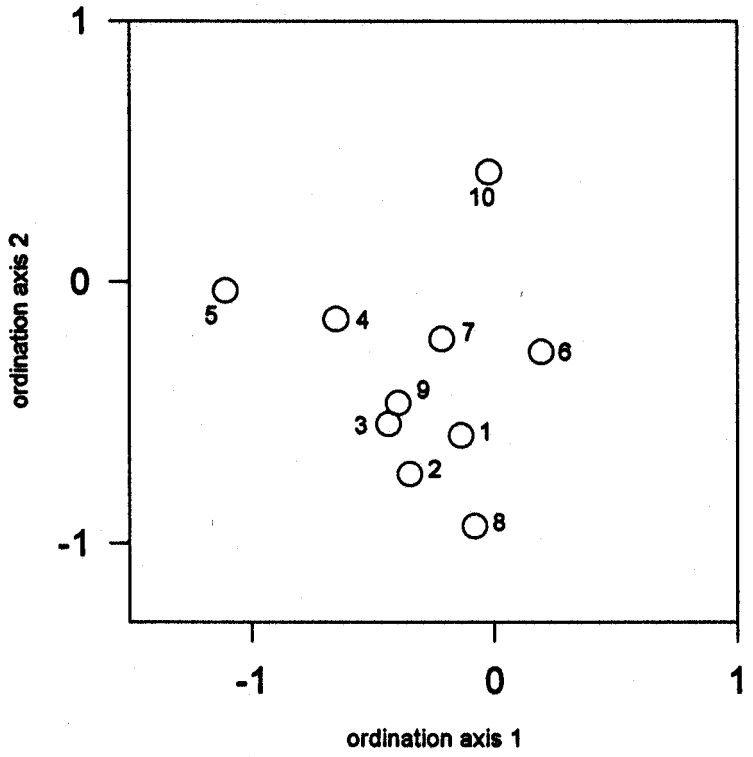


Figure 2a Ordination of Ranger sites: tree and shrub data, axes 1 and 2 of a three dimensional solution shown, stress = 0.13

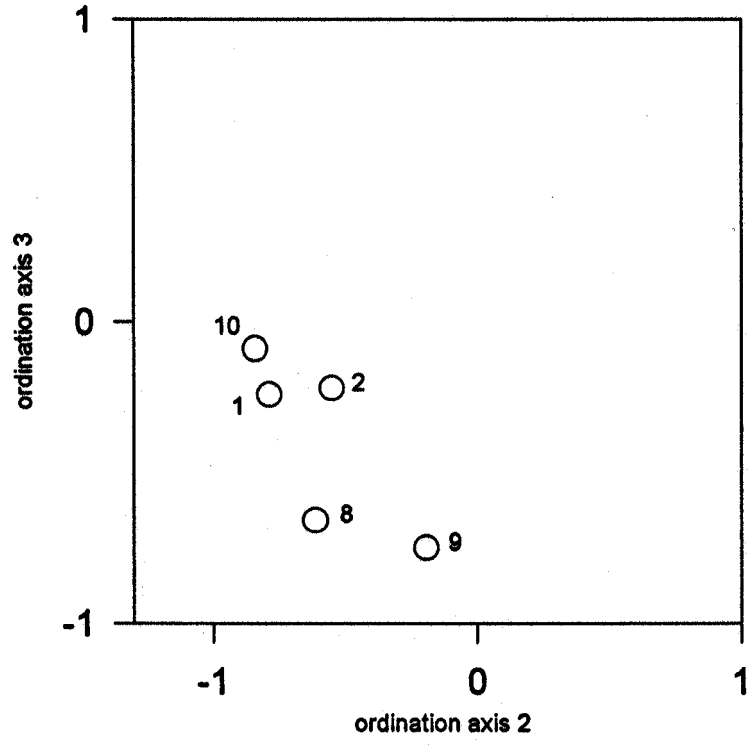


Figure 2b Ordination of Ranger sites: herb data, axes 2 and 3 of a three dimensional solution shown, stress = 0.14

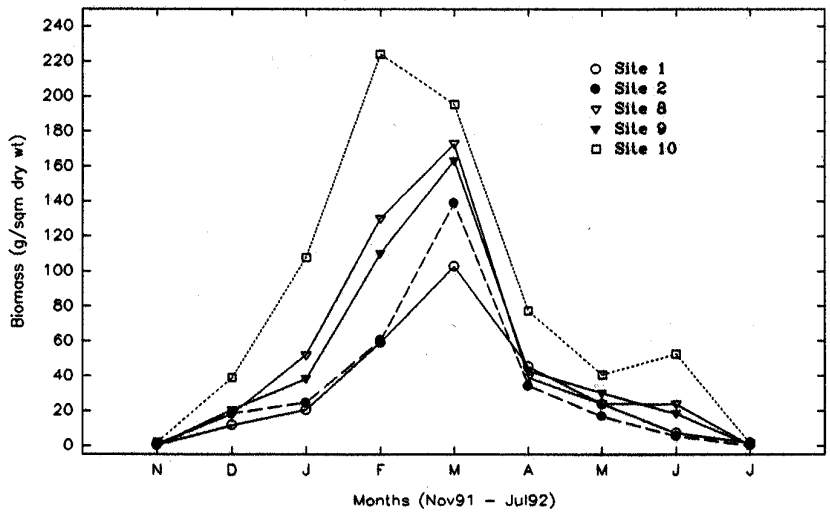


Figure 3 Herbaceous Biomass on Ranger sites

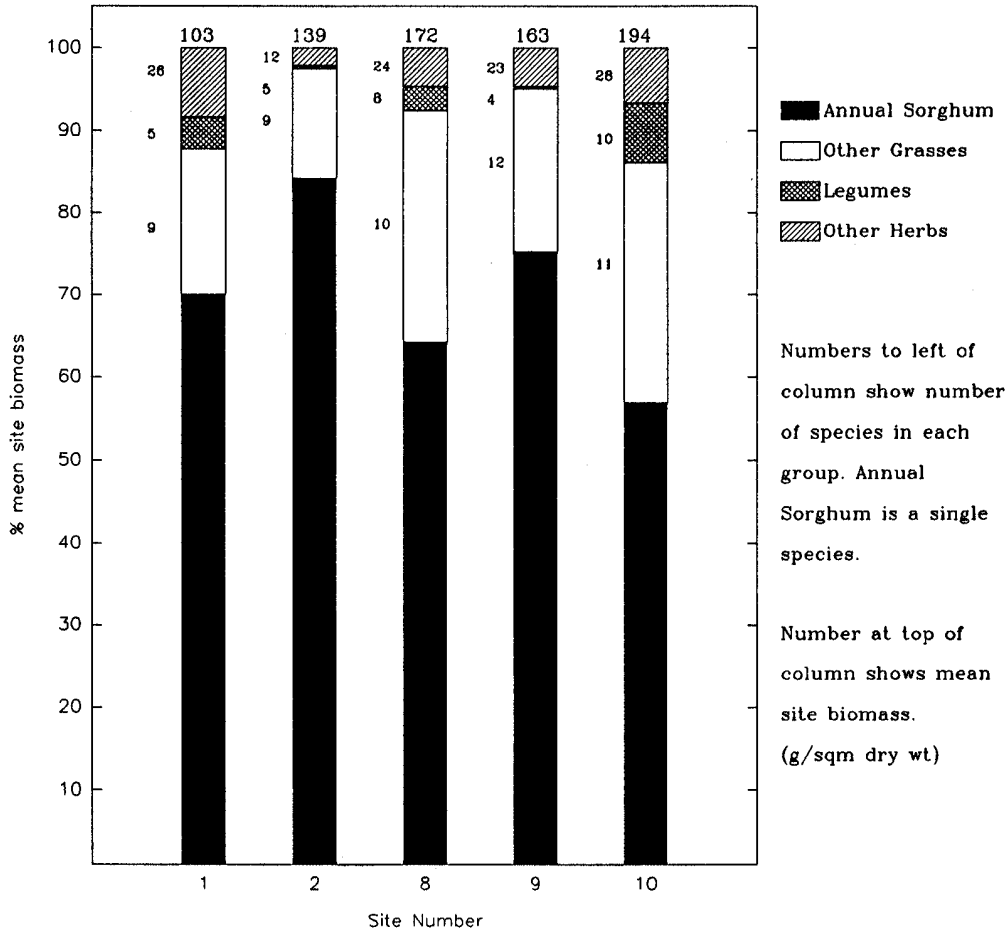


Figure 4 Composition of Herbaceous Biomass on Ranger Sites: March 1992

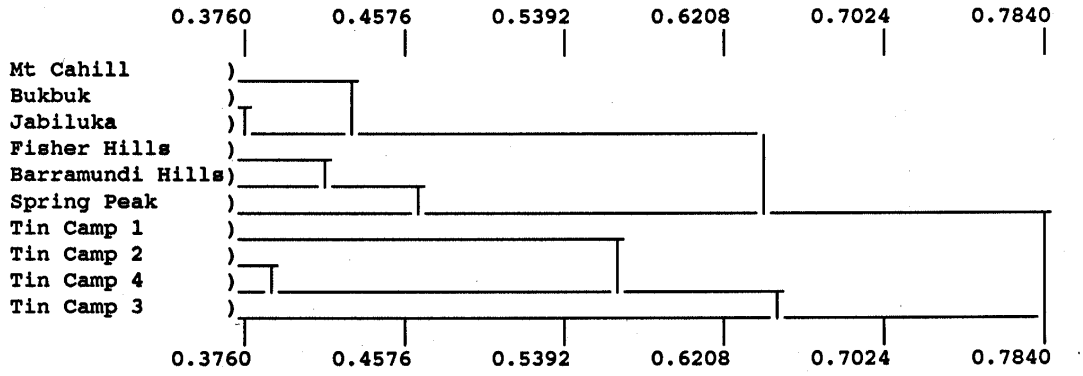


Figure 5a Classification of hill sites: tree and shrub data

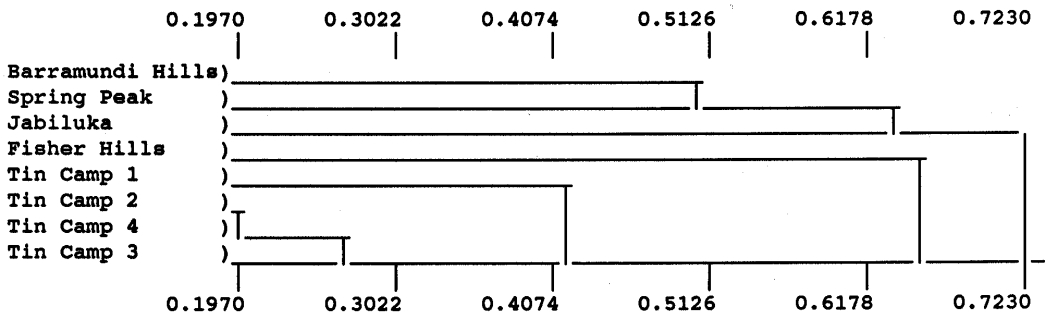


Figure 5b Classification of hill sites: herb data

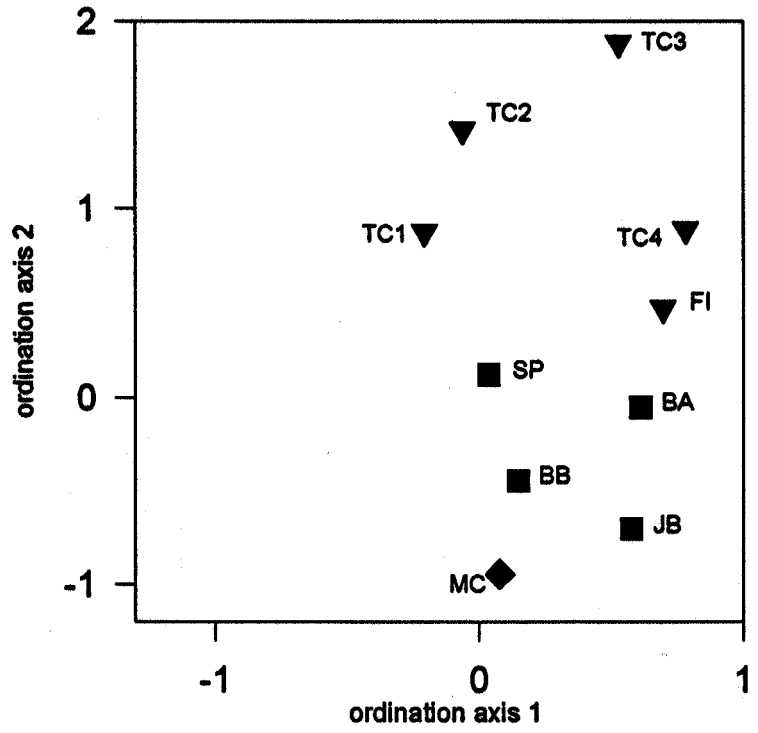


Figure 6a Ordination of hill sites: tree and shrub data. Axes 1 and 2 of three dimensional solution shown, stress = 0.13. Sites with similar rock types have same symbols: Schists = triangle, sandstones = square, quartzite = diamond

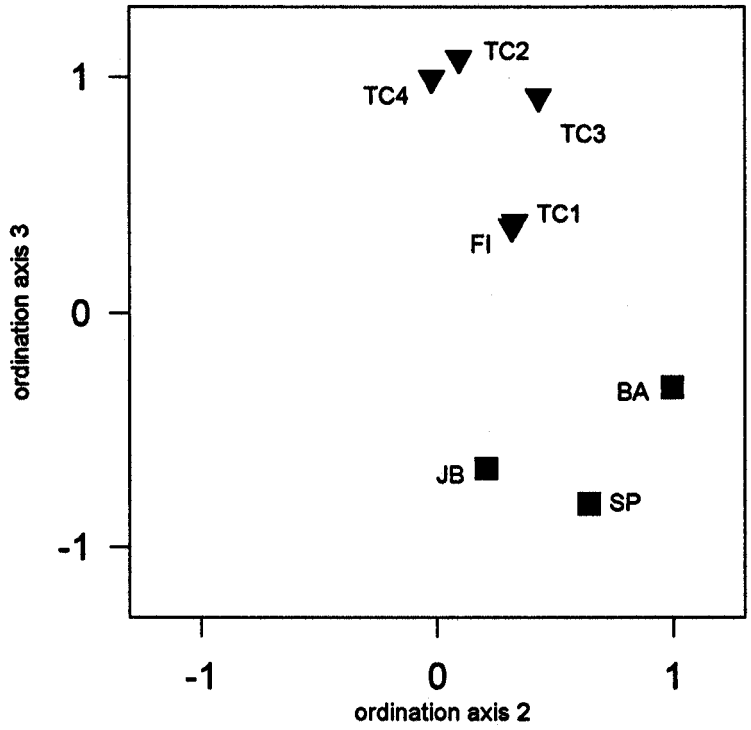
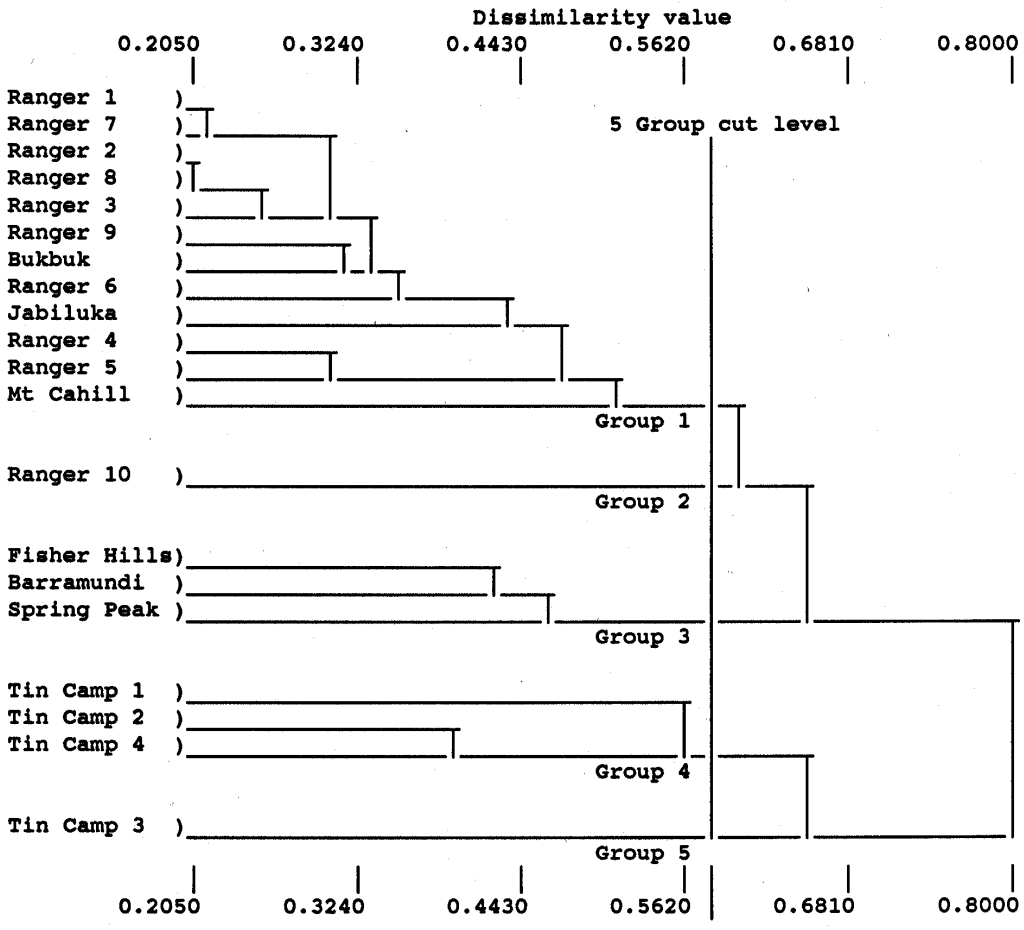


Figure 6b Ordination of hill sites: herb data, Axes 2 and 3 of three dimensional solution shown, stress = 0.14. Sites with similar rock types have same symbols: Schists = triangle, sandstones = square, quartzite = diamond

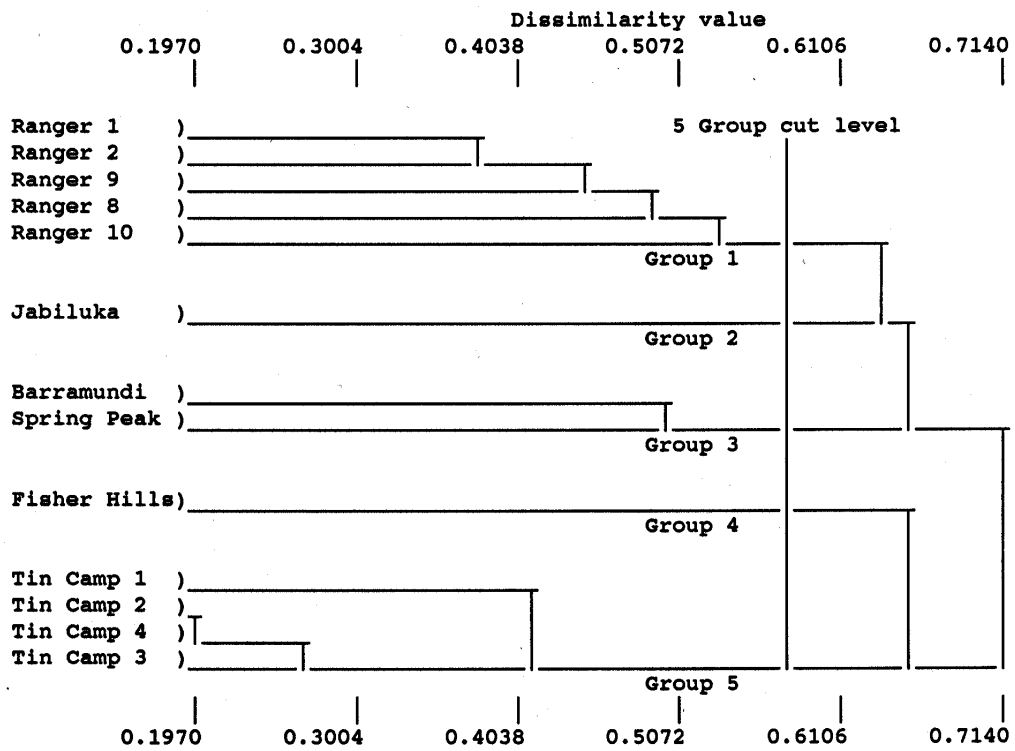


Tree and shrub data = stem volume transformed by linear interpolation

Association measure = Bray-Curtis

Fusion strategy = Flexible UPGMA (Beta = 0)

Figure 7 Site classification: tree and shrub data, showing the 5 group cut level



Herb data = Dry weight biomass transformed by linear interpolation

Association measure = Bray-Curtis

Fusion strategy = Flexible UPGMA (Beta = 0)

Figure 8. Site classification: herbaceous species data, showing the 5 group cut level

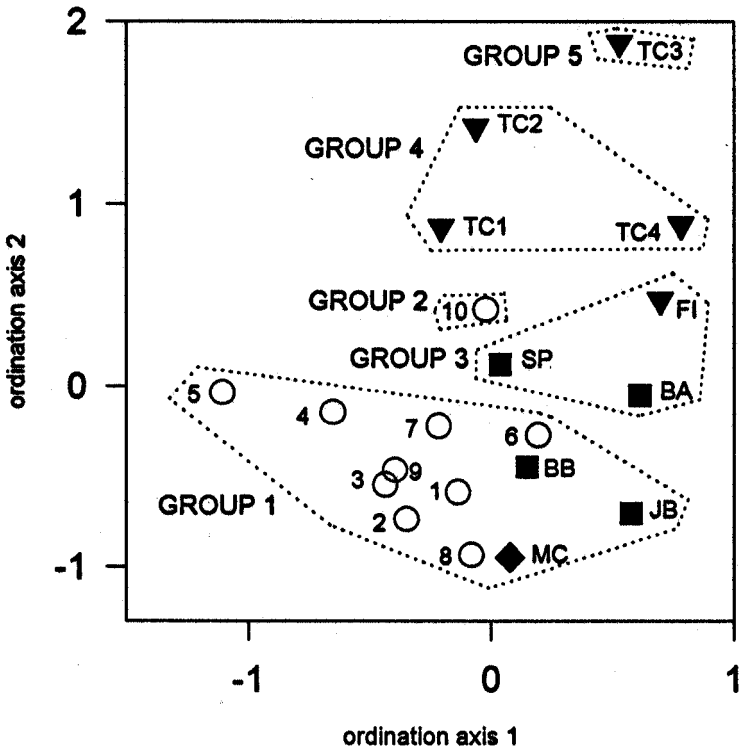


Figure 9a. Ordination of all sites; tree and shrub data, axes 1 and 2 of a three dimensional solution shown, stress = 0.13. Classification groups also shown

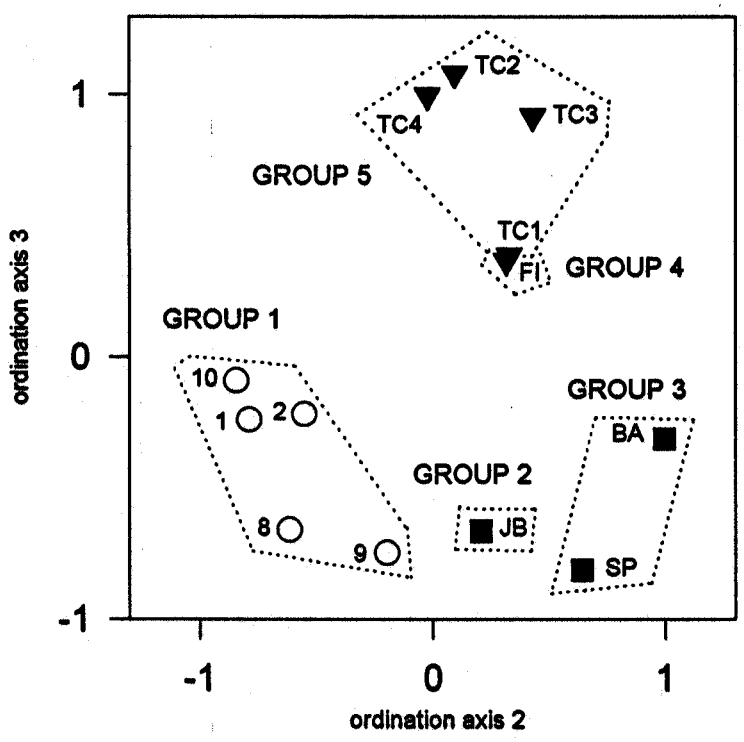


Figure 9b Ordination of all sites; herb data, axes 2 and 3 of a three dimensional solution shown stress = 0.143. Classification groups also shown

Ranger sites have open circles, hill sites with filled symbols.

Hills with similar rock type have the same symbol

Table 1 Location details of vegetation study sites

Site	Text name	Site type	General Location	1:100,000 Map sheet	Grid Reference		Veg Survey	
					East	North	trees	herbs
1	R1	lowland woodland, on Koolpinyah surface	Ranger lease	Cahill: 5472	270,600	8,600,600	x	x
2	R2	lowland woodland, on Koolpinyah surface	Ranger lease	Cahill: 5472	271,900	8,600,000	x	x
3	R3	lowland woodland, on Koolpinyah surface	Ranger lease	Cahill: 5472	271,200	8,598,900	x	
4	R4	lowland woodland, on Koolpinyah surface	Ranger lease	Cahill: 5472	271,500	8,598,200	x	
5	R5	lowland woodland, on Koolpinyah surface	Ranger lease	Cahill: 5472	271,700	8,597,600	x	
6	R6	lowland woodland, on Koolpinyah surface	Ranger lease	Cahill: 5472	271,300	8,596,800	x	
7	R7	lowland woodland, on Koolpinyah surface	Ranger lease	Cahill: 5472	271,200	8,595,200	x	
8	R8	lowland woodland, on Koolpinyah surface	Ranger lease	Cahill: 5472	274,900	8,597,100	x	x
9	R9	lowland woodland, on Koolpinyah surface	Ranger lease	Cahill: 5472	274,900	8,595,600	x	x
10	R10	lowland woodland, on Koolpinyah surface	Ranger lease	Cahill: 5472	275,000	8,594,500	x	x
12	Fl	hill woodland, on Burrell formation schist	Hills near Fisher Airstrip	Stow. 5470	244,700	8,498,500	x	x
13	BA	hill woodland, on Mt Partridge sandstone	Barramundi Hills, Just N Barramundie Gorge turnoff	Mundogie: 5371	218,800	8,537,000	x	x
14	SP	hill woodland, on Mt Partridge sandstone	Spring Peak Range, 13.5km South of Old Darwin Rd	Mundogie: 5371	223,500	8,554,000	x	x
15	MC	hill woodland, on Cahill formation quartzite	Mt Cahill, Mirray lookout area	Cahill: 5472	250,800	8,576,600	x	
16	BB	hill woodland, on Mt Partridge sandstone	Bukbuk. Sth of Arnhem hwy, near Kapalga turnoff	Kapalga: 5372	221,300	8,593,700	x	
17	JB	hill woodland, on Kombolgie sandstone	Lookout Hill, Nth end of Jabiluka outlier	Cahill: 5472	271,700	8,616,700	x	x
18	TC1	hill woodland, on Cahill formation schist	Tin Camp Creek 1	Oenpelli: 5573	309,100	8,627,500	x	x
19	TC2	hill woodland, on Cahill formation schist	Tin Camp Creek 2	Oenpelli: 5573	312,800	8,622,200	x	x
20	TC3	hill woodland, on Cahill formation schist	Tin Camp Creek 3	Oenpelli: 5573	313,300	8,621,500	x	x
22	TC4	hill woodland, on Cahill formation schist	Tin Camp Creek 4	Oenpelli: 5573	313,600	8,622,100	x	x

Table 2 Community characteristics of vegetation at sites on the Ranger lease

				SITES									
Attribute	**Veg Component**	**Stratum**	**Area**	**Ranger 1**	**Ranger 2**	**Ranger 3**	**Ranger 4**	**Ranger 5**	**Ranger 6**	**Ranger 7**	**Ranger 8**	**Ranger 9**	**Ranger 10**
Species / quadrat	Tree + shrub	>1.5m	20 x 20m	7.3 ± 1.6[a]	6.1 ± 1.6	4.8 ± 1.0	5.7 ± 1.3	6.2 ± 2.4	10.5 ± 2.0	5.9 ± 1.8	8.8 ± 1.4	7.1 ± 1.5	10.6 ± 1.2
	Tree + shrub	<1.5m	5 x 5m	6.1 ± 1.6	3.1 ± 1.3	4.9 ± 2.4	5.6 ± 2.7	3.1 ± 1.5	7.5 ±2.2	3.7 ± 1.6	6.6 ± 1.7	5.9 ± 2.0	6.1 ± 2.3
	herbs	all	0.7 x 0.7m	7.1 ± 3.1	5.1 ± 2.2	not done	not done	not done	not done	not done	8.1 ± 3.2	7.8 ± 3.7	11.0 ± 3.7
Species/ site	Tree + shrub	<1.5 + >1.5m	10,20 x 20 + 20, 5 x 5m	21	17	18	25	24	31	26	25	19	33
	herbs	all	225, 0.7 x 0.7m	77	52	not done	riot done	not done	not done	not done	67	62	87
Plant Density	Tree + shrub	>1.5m	0.1 ha	70 ± 33	55 ± 16	45 ± 15	56 ± 21	49 ± 29	195 ± 54	71 ± 37	110 ± 34	107 ± 30	109 ± 34
	Tree + shrub	<1.5m	0.1 ha	648 ± 280	608 ± 258	2344 ± 3497	1080 ± 855	610 ± 508	1434 ± 820	346 ± 240	1018 ± 517	1710 ± 1074	648 ± 277
	herbs[b]	all	1 m^2	248.4 ± 857.7	563.8 ± 1072.8	not done	not done	not done	not done	not done	168.2 ± 104.1	206.4 ± 253.8	238.2 ± 253.2
Basal Area[d]	Tree + shrub	>1.5m	1 ha	8.3 ± 2.9	6.6 ± 1.9	6.3 ± 2.7	5.7 ± 2.0	3.8 ± 2.1	7.2 ± 1.9	6.6 ± 2.1	8.3 ± 3.3	5.6 ± 0 .8	7.6 ± 2.3
%Cr Cov	Tree + shrub	<1.5m	1 ha	17.4 ± 7.6	14.6 ± 5.4	14.4 ± 8.2	10.1 ± 7.4	17.2 ± 15.6	28.6 ± 12.4	12.9 ± 13.7	18.2 ± 7.5	32.2 ± 9.2	15.5 ± 8.2
Biomass[c]	herbs	all	1 m^2	102.8 ± 36.8	138.5 ± 53.8	not done	not done	not done	not done	not done	173.0 ± 68.6	163.3 ± 54.8	218.8 ± 130.2
Stem Volume[e]	Tree + shrub	>1.5m	1 ha	91 ± 41	73 ± 33	71 ± 38	56 ± 22	35 ± 21	70 ± 24	63 ± 18	106 ± 57	56 ± 13	95 ± 38
	Tree + shrub	<1.5m	1 ha	9.1 ± t 4.5	7.5 ± 3.1	6.4 ± 3.5	4.6 ± 3.5	11.8 ± 11.9	14.1 ± 6.9	7.3 ± 8.4	9.3 ± 4.6	15.6 ± 4.8	8.1 ± 5.1

a mean ± std

b maximum mean density recorded from the site in any month during the growing season

c maximum mean biomass (g dry weight) recorded at the site in any month during the growing season

d Basal area in m^2

e Stem volume in m^3

Table 3 Summary of trees and shrubs < 1.5m on the Ranger lease (ordered by stem volume)

Species	Stem Volume[a]	Density[b]	Crown Cover[c]	Site % freq[e]
Petalostigma quadriloculare (EUPHORBIACEAE)	3.808[d]	1946.0	756.685	90
Acacia mimula (MIMOSACEAE)	1.037	932.0	175.079	90
Acacia oncinocarpa (MIMOSACEAE)	1.015	818.0	152.416	50
Xanthostemon paradoxus (MYRTACEAE)	0.547	3802.0	157.824	90
Planchonia careya (LECYTHIDACEAE)	0.408	278.0	81.016	100
Galactia megalophylla (FABACEAE)	0.389	268.0	65.465	60
Corymbia porrecta (MYRTACEAE)	0.372	310.0	61.937	80
Eucalyptus tetrodonta (MYRTACEAE)	0.245	330.0	47.524	100
Acacia difficilis (MIMOSACEAE)	0.181	106.0	25.469	30
Buchanania obovata (ANACARDIACEAE)	0.165	242.0	38.092	100
Erythrophleum chlorostachys (CAESALPINIACEAE)	0.155	60.0	27.973	20
Wrightia saligna (APOCYNACEAE)	0.124	148.0	24.590	60
Jasminum molle (OLEACEAE)	0.107	208.0	28.138	40
Gardenia megasperma (RUBIACEAE)	0.068	100.0	14.279	80
Grewia mesomischa (TILACEAE)	0.063	10.0	9.444	20
Corymbia bleeseri (MYRTACEAE)	0.061	46.0	8.933	30
Terminalia ferdinandiana (COMBRETACEAE)	0.059	78.0	13.200	70
Pandanus spiralis (PANDANACEAE)	0.056	12.0	9.137	10
Corymbia foelscheana (MYRTACEAE)	0.050	58.0	11.300	10
Cochlospermum fraseri ssp. *fraseri* (BIXACEAE)	0.049	30.0	8.254	20
Corymbia latifolia (MYRTACEAE)	0.044	54.0	7.870	30
Brachychiton megaphyllus (STERCULIACEAE)	0.041	34.0	6.555	50
Premna acuminata (VERBENACEAE)	0.037	56.0	5.860	20
Antidesma ghesaembilla (EUPHORBIACEAE)	0.032	60.0	6.555	10
Grevillea mimosoides (PROTEACEAE)	0.031	100.0	7.261	40
Eucalyptus miniata (MYRTACEAE)	0.030	36.0	8.553	60
Corymbia chartacea (MYRTACEAE)	0.028	22.0	5.420	20
Stenocarpus acacioides (PROTEACEAE)	0.028	12.0	3.886	30
Corymbia disjuncta (MYRTACEAE)	0.025	30.0	5.570	30
Livistona humilis (ARECACEAE)	0.024	16.0	6.716	20
Eucalyptus tectifica (MYRTACEAE)	0.020	34.0	5.401	10
Dolichandrone filiformis (BIGNONIACEAE)	0.018	18.0	3.328	50
Pachynema junceum (DILLENIACEAE)	0.012	10.0	2.441	20
Acacia hemignosta (MIMOSACEAE)	0.011	12.0	1.927	10
Terminalia pterocarya (COMBRETACEAE)	0.010	8.0	2.422	30
Melaleuca viridiflora (MYRTACEAE)	0.009	16.0	1.562	10
Persoonia falcata (PROTEACEAE)	0.009	36.0	1.778	60
Grevillea decurrens (PROTEACEAE)	0.008	32.0	2.508	60
Acacia gonocarpa (MIMOSACEAE)	0.005	12.0	1.558	20
Distichostemon arnhemicus (SAPINDACEAE)	0.005	4.0	1.229	10
Pogonolobus reticulatus (RUBIACEAE)	0.005	18.0	1.625	40
Clerodendrum floribundum (VERBENACEAE)	0.005	16.0	1.280	30
Calytrix exstipulata (MYRTACEAE)	0.003	8.0	0.840	10
Capparis umbonata (CAPPARACEAE)	0.001	2.0	0.318	10
Brachychiton diversifolius (STERCULIACEAE)	0.001	4.0	0.353	10
Acacia dimidiata (MIMOSACEAE)	0.001	2.0	0.192	10
Croton arnhemicus (EUPHORBIACEAE)	0.000	2.0	0.192	10
Pouteria arnhemica (SAPOTACEAE)	0.000	4.0	0.098	20
Alphitonia excelsa (RHAMNACEAE)	0.000	4.0	0.098	20
Calytrix achaeta (MYRTACEAE)	0.000	2.0	0.035	10

a Stem volume, m^3/ha; b Density, plants/ha; c Crown cover, m^2/ha; d mean, calculated from 200, 5x5m quadrats;
e site % frequency = % of sites in which the species was recorded (n=10)

Table 4 Summary of trees and shrubs >1.5m on the Ranger lease (ordered by stem volume)

Species	Stem Volume[a]	Density[b]	Basal Area[c]	Site % freq[e]
Eucalyptus tetrodonta (MYRTACEAE)	33.37[d]	130.75	2.489	100
Eucalyptus miniata (MYRTACEAE)	9.575	29.25	0.726	80
Xanthostemon paradoxus (MYRTACEAE)	9.113	116.25	1.076	100
Corymbia porrecta (MYRTACEAE)	5.898	101.75	0.670	90
Corymbia latifolia (MYRTACEAE)	3.012	12.00	0.270	40
Corymbia bleeseri (MYRTACEAE)	2.815	29.00	0.219	70
Acacia mimula (MIMOSACEAE)	1.930	222.50	0.447	90
Corymbia foelscheana (MYRTACEAE)	1.487	18.00	0.149	10
Erythrophleum chlorostachys (CAESALPINIACEAE)	1.149	13.25	0.084	30
Terminalia ferdinandiana (COMBRETACEAE)	0.805	45.25	0.142	100
Eucalyptus tectifica (MYRTACEAE)	0.708	1.75	0.042	10
Corymbia disjuncta (MYRTACEAE)	0.352	22.00	0.056	50
Corymbia chartacea (MYRTACEAE)	0.273	12.25	0.048	20
Brachychiton diversifolius (STERCULIACEAE)	0.250	0.50	0.020	10
Terminalia grandiflora (COMBRETACEAE)	0.236	0.75	0.013	10
Planchonia careya (LECYTHIDACEAE)	0.091	22.25	0.030	60
Cochlospermum fraseri ssp. *fraseri* (BIXACEAE)	0.089	16.25	0.024	30
Buchanania obovata (ANACARDIACEAE)	0.085	11.75	0.024	80
Pouteria arnhemica (SAPOTACEAE)	0.056	3.25	0.008	50
Gardenia megasperma (RUBIACEAE)	0.050	4.25	0.014	80
Grevillea decurrens (PROTEACEAE)	0.047	10.50	0.017	90
Brachychiton megaphyllus (STERCULIACEAE)	0.033	8.25	.010	40
Terminalia pterocarya (COMBRETACEAE)	0.026	2.00	0.006	10
Calytrix exstipulata (MYRTACEAE)	0.025	2.75	0.008	30
Melaleuca viridiflora (MYRTACEAE)	0.025	1.00	0.004	20
Pandanus spiralis (PANDANACEAE)	0.021	0.50	0.008	10
Acacia oncinocarpa (MIMOSACEAE)	0.015	2.75	0.006	30
Ficus aculeata (MORACEAE)	0.011	0.75	0.002	10
Calytrix achaeta (MYRTACEAE)	0.009	0.50	0.002	10
Acacia hemignosta (MIMOSACEAE)	0.009	2.00	0.003	10
Persoonia falcata (PROTEACEAE)	0.009	3.25	0.003	70
Livistona humilis (ARECACEAE)	0.009	0.50	0.003	20
Acacia difficilis (MIMOSACEAE)	0.005	2.00	0.002	20
Acacia dimidiata (MIMOSACEAE)	0.005	0.75	0.001	20
Dolichandrone filiformis (BIGNONIACEAE)	0.004	3.50	0.002	40
Wrightia saligna (APOCYNACEAE)	0.004	2.00	0.002	20
Grevillea mimosoides (PROTEACEAE)	0.004	2.75	0.001	10
Stenocarpus acacioides (PROTEACEAE)	0.003	1.50	0.001	20
Denhamia obscura (CELASTRACEAE)	0.002	0.50	0.000	10

Species	**Stem Volume[a]**	**Density[b]**	**Basal Area[c]**	**Site % freq[e]**
Acacia lamprocarpa (MIMOSACEAE)	0.001	0.50	0.000	20
Vitex glabrata (VERBENACEAE)[a]	0.001	0.50	0.000	10
Capparis umbonata (CAPPARACEAE)	0.001	0.75	0.001	20
Hakea arborescens (PROTEACEAE)	0.001	0.75	0.000	10
Premna acuminata (VERBENACEAE)	0.001	1.50	0.000	10
Grewia mesomischa (TILACEAE)	0.000	2.50	0.000	20
Petalostigma pubescens (EUPHORBIACEAE)	0.000	0.25	0.000	10

a Stem volume, m^3/ha

b Density, plants/ha

c Basal Area, m^2/ha

d mean, calculated from 100, 20x20m quadrats

e Site % frequency = % of sites in which the species was recorded (n=10)

Table 5 Summary of herbaceous vegetation on the Ranger lease

Species	Biomass[a]	Density[b]	Site % freq[e]
Sorghum brachypodum (POACEAE)	106.583[c]	97.74[d]	100
Heteropogon triticeus (POACEAE)	19.549	2.27	100
Alloteropsis semialata (POACEAE)	7.786	1.65	100
Ampelocissus acetosa (VITACEAE)	6.209	0.10	60
Themeda triandra (POACEAE)	3.948	1.10	20
Galactia tenuiflora (FABACEAE)	3.523	0.91	60
Tephrosia remotiflora (FABACEAE)	2.992	2.43	100
Eriachne obtusa (POACEAE)	2.799	1.01	40
Merremia quinata (CONVOLVULACEAE)	2.679	0.24	20
Spermacoce aequabilis (RUBIACEAE)	2.282	26.82	100
Schizachyrium fragile (POACEAE)	1.955	76.94	100
Calandrinia uniflora (PORTULACACEAE)	1.912	17.65	60
Arthrostylis aphylla (CYPERACEAE)	1.626	1.58	100
Eriachne agrostidea (POACEAE)	1.323	56.42	60
Aristida superpendens (POACEAE)	1.081	0.51	20
Eriachne ciliata (POACEAE)	1.032	24.54	80
Wedelia cunninghamii (ASTERACEAE)	1.004	0.08	20
Helicteres sp. Darwin (STERCULIACEAE)	0.938	0.18	60
Flemingia parviflora (FABACEAE)	0.917	1.02	60
Spermacoce stenophylla (RUBIACEAE)	0.844	5.15	40
Thaumastochloa major (POACEAE)	0.803	6.61	100
Eriachne basedowii (POACEAE)	0.802	0.06	20
Stemona australiana (STEMONACEAE)	0.763	0.03	40
Sehima nervosum (POACEAE)	0.664	0.08	20
Chrysopogon fallax (POACEAE)	0.628	0.22	40
Commelina ensifolia (COMMELINACEAE)	0.603	0.67	80
Panicum mindanaense (POACEAE)	0.594	4.35	20
Pachynema sphenandrum (DILLENIACEAE)	0.549	0.27	80
Mitrasacme connata (LOGANIACEAE)	0.539	1.10	80
Spermacoce breviflora (RUBIACEAE)	0.523	0.94	20
Mnesithea rottboellioides (POACEAE)	0.517	0.11	20
Waltheria indica (STERCULIACEAE)	0.509	0.40	80
Polycarpaea violacea (CARYOPHYLLACEAE)	0.503	3.66	60
Minuria macrorhiza (ASTERACEAE)	0.497	0.26	80
Gomphrena canescens (AMARANTHACEAE)	0.456	0.66	40
Bonamia brevifolia (CONVOLVULACEAE)	0.448	0.14	40
Digitaria gibbosa (POACEAE)	0.439	9.12	100
Fimbristylis caloptera (CYPERACEAE)	0.438	16.86	80
Scleria annularis (CYPERACEAE)	0.429	0.48	80
Haemodorum coccineum (HAEMODORACEAE)	0.419	0.34	40

Species	Biomass[a]	Density[b]	Site % freq[e]
Euphorbia schizolepis (EUPHORBIACEAE)	0.391	0.06	20
Aristida holathera var. *holathera* (POACEAE)	0.383	0.75	60
Sauropus stenocladus ssp *stenocladus* (EUPHORBIACEAE)	0.326	0.11	20
Ipomoea diversifolia (CONVOLVULACEAE)	0.308	0.30	40
Tephrosia reticulata (FABACEAE)	0.289	0.03	20
Xyris complanata (XYRIDACEAE)	0.250	0.10	20
Kailarsenia suffruticosa (RUBIACEAE)	0.229	0.06	60
Murdannia graminea (COMMELINACEAE)	0.221	0.83	100
Gomphrena diffusa (AMARANTHACEAE)	0.220	2.72	40
Lomandra tropica (XANTHORRHOEACEAE)	0.207	0.05	40
Portulaca bicolor var. bicolor (PORTULACACEAE)	0.204	15.10	100
Eriachne semiciliata (POACEAE)	0.195	7.33	20
Fimbristylis schultzii (CYPERACEAE)	0.184	4.35	100
Drosera petiolaris (DROSERACEAE)	0.179	0.50	80
Evolvulus alsinoides (CONVOLVULACEAE)	0.175	0.26	80
Heliotropium alcyonium (BORAGINACEAE)	0.169	5.55	20
Stackhousia intermedia (STACKHOUSIACEAE)	0.169	0.91	100
Crotalaria brevis (FABACEAE)	0.163	0.54	80
Cheilanthes nitida (ADIANTACEAE)	0.150	1.70	60
Buchnera linearis (SCROPHULARIACEAE)	0.147	0.32	80
Cartonema spicatum (COMMELINACEAE)	0.144	0.16	80
Bonamia pannosa (CONVOLVULACEAE)	0.139	0.06	60
Alysicarpus schomburgkii (FABACEAE)	0.136	1.26	100
Heliotropium ventricosum (BORAGINACEAE)	0.130	5.52	80
Desmodium pycnotrichum (FABACEAE)	0.130	1.46	60
Sauropus stenocladus ssp *stenocladus* (EUPHORBIACEAE)	0.126	0.11	60
Crotalaria medicaginea (FABACEAE)	0.117	1.23	100
Desmodium pulleni (FABACEAE)	0.114	0.40	20
Brachiaria holosericea (POACEAE)	0.110	2.61	100
Sauropus brunonis (EUPHORBIACEAE)	0.104	0.10	20
Chlorophytum laxum (LILIACEAE)	0.102	0.38	100
Cleome tetrandra var. *tetrandra* (CAPPARACEAE)	0.099	2.45	20
Bulbostylis barbata (CYPERACEAE)	0.095	2.91	80
Brunoniella linearifolia (ACANTHACEAE)	0.093	0.46	60
Curculigo ensifolia var. *ensifolia* (LILIACEAE)	0.092	0.26	20
Marsdenia trinervis (ASCLEPIADACEAE)	0.088	0.02	20
Ipomoea graminea (CONVOLVULACEAE)	0.088	0.06	40
Goodenia holtzeana (GOODENIACEAE)	0.085	0.69	80
Desmodium brownii (FABACEAE)	0.084	1.86	100
Yakirra nulla (POACEAE)	0.082	0.50	60
Cayratia trifolia (VITACEAE)	0.076	0.03	20

Species	Biomass[a]	Density[b]	Site % freq[e]
Polycarpaea holtzei (CARYOPHYLLACEAE)	0.070	5.34	100
Mnesithea formosa (POACEAE)	0.070	0.82	100
Thecanthes punicea (THYMELAEACEAE)	0.064	0.64	80
Fimbristylis cinnamometorum (CYPERACEAE)	0063	0.29	20
Cassytha aurea (LAURACEAE)	0.061	0.02	20
Goodenia leiosperma (GOODENIACEAE)	0.060	0.86	40
Indigofera linifolia (FABACEAE)	0.055	0.72	20
Uraria lagopodiodes (FABACEAE)	0.051	0.02	20
Polygala triflora (POLYGALACEAE)	0.051	0.78	80
Sebastiania chamaelea (EUPHORBIACEAE)	0.049	0.03	20
Haemodorum brevicaule (HAEMODORACEAE)	0.049	0.05	20
Ptilotus corymbosus (AMARANTHACEAE)	0.048	0.45	60
Sporobolus pulchellus (POACEAE)	0.045	1.81	60
Ipomoea abrupta (CONVOLVULACEAE)	0.044	0.03	20
Polygala orbicularis (POLYGALACEAE)	0.043	0.58	40
Tacca leontopetaloides (TACCACEAE)	0.042	0.08	40
Euphorbia schultzii (EUPHORBIACEAE)	0.042	0.86	100
Fimbristylis densa (CYPERACEAE)	0.038	0.70	40
Zornia prostrata var. *prostrata* (FABACEAE)	0.033	0.10	40
Pseudopogonatherum irritans (POACEAE)	0.033	1.92	60
Yakirra pauciflora (POACEAE)	0.033	0.58	80
Tribulopis pentandra (ZYGOPHYLLACEAE)	0.028	0.78	40
Eulalia annua (POACEAE)	0.026	1.18	20
Goodenia coronopifolia (GOODENIACEAE)	0.025	0.26	40
Fimbristylis oxystachya (CYPERACEAE)	0.024	0.03	20
Polycarpaea longiflora (CARYOPHYLLACEAE)	0.021	0.22	40
Polygala sp.Cahill (POLYGALACEAE)	0.020	0.19	80
Fimbristylis pterygosperma (CYPERACEAE)	0.018	0.19	20
Vigna lanceolata (FABACEAE)	0.016	0.08	60
Tephrosia sp. 4 (FABACEAE)	0.013	0.02	20
Xenostegia tridentata (CONVOLVULACEAE)	0.013	0.06	20
Desmodium glareosum (FABACEAE)	0.012	0.46	40
Typhonium cochleare (ARACEAE)	0.011	0.02	20
Hybanthus enneaspermus ssp. *enneaspermus* (VIOLACEAE)	0.011	0.03	20
Sauropus paucifolius (EUPHORBIACEAE)	0.009	0.03	40
Ptilotus distans (AMARANTHACEAE)	0.009	0.03	20
Cartonema parviflorum (COMMELINACEAE)	0.008	0.01	20
Gonocarpus leptothecus (HALORAGACEAE)	0.008	0.05	20
Crotalaria montana (FABACEAE)	0.007	0.10	40
Stylidium leptorrhizum (STYLIDIACEAE)	0.007	0.22	60
Mitrasacme exserta (LOGANIACEAE)	0.007	0.10	20

Species	Biomass[a]	Density[b]	Site % freq[e]
Trianthema rhynchocalyptra (AIZOACEAE))	0.006	0.03	20
Marsdenia annae (ASCLEPIADACEAE)	0.005	0.13	40
Marsdenia viridiflora (ASCLEPIADACEAE)	0.005	0.03	20
Scleria novae-hollandiae (CYPERACEAE)	0.005	0.02	20
Chamaecrista mimosoides (CAESALPINIACEAE)	0.005	0.03	20
Fimbristylis pachyptera (CYPERACEAE)	0.004	0.10	20
Striga curviflora (SCROPHULARIACEAE)	0.004	0.03	20
Heliotropium foliatum (BORAGINACEAE)	0.004	0.03	20
Aristolochia holtzei (ARISTOLOCHIACEAE)	0.004	0.06	60
Setaria apiculata (POACEAE)	0.002	0.03	20
Schizachyrium crinizonatum (POACEAE)	0.002	0.08	20
Iphigenia indica (LILIACEAE)	0.001	0.02	20
Nervillia holochila (ORCHIDACEAE)	0.001	0.02	20
Rhynchospora longisetis (CYPERACEAE)	0.000	0.02	20

a Biomass, g dry weight/m^2

b Density, plants/m^2

c mean of max monthly biomass recorded for the species at each of 5 sites (Ranger 1, 2, 8, 9, 10).

d mean of max monthly density recorded for the species at each of 5 sites (Ranger 1, 2, 8, 9, 10).

e site % frequency = % of sites in which the species was recorded (n=5)

Table 6 Summary of vegetation data from sites on the Ranger lease

Attribute	veg component	quadrats (n)	reference area	Mean ± std or total
species / quadrat	trees & shrubs > 1.5m	n=100	20 x 20m	7.3 ± 2.5
	trees & shrubs < 1.5m	n=200	5 x 5m	5.3 ± 2.4
	herbaceous plants[a]	n=125	0.71 x 0.71m	7.6 ± 3.9
species / site	trees & shrubs > 1.5m	n=10	10,20 x 20m	17.0 ± 5.0
	trees & shrubs < 1.5m	n=10	20,5 x5 m	19.1 ± 4.5
	herbaceous plants[a]	n=5	25,0.71 x 0.71 m	44.4 ± 9.4
total species	trees & shrubs > 1.5m	n=1	100, 20 x 20m	46
	trees & shrubs < 1.5m	n=1	200, 5 x 5m	50
	trees & shrubs <1.5m+>1.5m	n=1	100, 20 x 20m + 200, 5 x 5m	57
	herbaceous plants	n=1	1125, 0.7 x 0.7m	136
density	trees & shrubs > 1.5m	n=100	1ha	867 ± 532
	trees & shrubs < 1.5m	n=200	1 ha	10448 ± 13556
	herbaceous plants[a]	n=125	1 m^2	257.9 ± 518.7
basal area (m^2)	trees & shrubs > 1.5m	n=100	1 ha	6.75 ± 2.5
crown cover (m^2)	trees & shrubs < 1.5m	n=200	1 ha	1812 ± 1180
stem volume (m^3)	trees & shrubs > 1.5m	n=100	1 ha	71.5 ± 37.5
	trees & shrubs < 1.5m	n=200	1ha	9.4 ± 6.9
biomass (g dry wt)	herbaceous plants[a]	n=125	1 m^2	159.2 ± 84.1

[a] derived from data from the month of maximum biomass at each site

Table 7 Community characteristics of vegetation on the hill sites

				SITES									
Attribute	**Veg Component**	**Stratum**	**Area**	**Barra Hills**	**Spring Peak**	**Mt Cahill**	**Bukbuk**	**Jabiluka**	**Fisher Hills**	**Tin Camp 1**	**Tin Camp 2**	**Tin Camp 3**	**Tin Camp 4**
Species/ quadrat	Tree + shrub	>1.5m	20 x 20m	7.2 ± 1.1[a]	6.7 ± 2.3	9.8 ± 3.7	12.4 ± 1.3	10.9 ± 1.4	6.0 ± 2.1	6.6 ± 2.7	3.7 ± 1.3	2.9 ± 1.1	4.8 ± 1.7
	Tree + shrub	<1.5m	5 x 5m	5.5 ± 1.2	6.4 ± 2.2	7.6 ± 1.5	7.2 ± 2.1	7.8 ± 2.1	4.7 ± 1.3	5.2 ± 2.1	4.4 ± 1.4	1.2 ± 0.9	3.7 ± 1.6
	herbs	all	0.7 x 0.7m	6.4 ± 4.2	4.0 ± 2.0	not done	not done	6.7 ± 2.3	7.2 t 2.0	13.0 ± 4.6	8.6 ± 2.1	9.8 ± 3.0	10.4 ± 2.4
Species / site	Tree + shrub	<1.5 + >1.5m	10,20(20 + 20, 5 x 5m	24	37	42	25	42	19	27	13	11	18
	herbs[b]	all	225, 0.7 x 0.7m	60	43	not done	not done	47	35	64	39	48	44
Plant	Tree + shrub	>1.5m	0.1 ha	78 ± 30	74 ± 39	110 ± 49	266 t 106	102 ± 40	84 ± 65	66 ± 46	50 ± 13	28 ± 7	33 ± 9
Density	Tree + shrub	<1.5m	0.1 ha	1648 ± 695	1776 ± 1134	1240 ± 481	1300 t 575	1262 ± 468	1972 t 1061	614 t 414	776 ± 382	128 t 126	424 ± 241
	herbs[b]	all	1 m^2	156.2 ± 316.9	109.4 ± 105.2	not done	not done	109.3 ± 84.9	636.4 t 310.1	474.7 t 303.9	160.0 ± 142.3	124.4 t 57.7	134.8 t 79.2
Basal Area[d]	Tree + shrub	>1.5m	1 ha	10.9 ± 3.1	11.1 ± 3.3	12.5 ± 3.7	11.3 ± 2.8	10.9 ± 3.7	6.5 t 2.7	4.0 t 1.1	3.4 ± 1.4	4.8 ± 1.3	4.1 ± 1.4
% Cr Cov	Tree + shrub	<1.5m	1 ha	15.1 ± 7.2	22.1 ± 20.1	25.6 ± 6.4	27.8 ± 12.2	19.8 ± 9.9	17.5 ± 9.8	5.2 t 4.0	7.6 ± 4.1	0.7 ± 0.6	3.2 ± 2.2
Biomass[c]	herbs	all	1 m^2	108.9 ±85.6	88.2 ± 54.6	not done	not done	151.9 ±78.4	167.1 ±62.3	118.5 ±35.1	146 ± 41.5	173.5 ±38.5	155.8 ±38.0
Stem	tree + shrub	>1.5m	1 ha	84 ± 23	91 ± 35	104 ± 32	77 ± 27	127 ± 64	47 ± 19	27 ± 9	24 ± 12	35 ± 11	31 t 14
Volume[e]	tree + shrub	<1.5m	1 ha	4.5 ± 2.5	7.1 ± 8.2	12.8 ± 3.8	12.1 ± 5.3	8.0 ± 5.1	5.7 ± 4.4	1.8 ±1.8	2.5 ± 1.6	0.2 ± 0.2	1.3 ± 1.2

[a] mean ± std

[b] maximum mean density recorded from the site in any month during the growing season

[c] maximum mean biomass (g dry weight) recorded at the site in any month during the growing season

[d] Basal area in m^2,

[e] Stem volume in m^3

Table 8 Comparison between sandstone sites and schist sites for a range of tree and shrub community attributes

				Sandstone sites (n=5)	Schist sites (n=5)	
Attribute	Veg component	Stratum	Condition	mean	mean	Kr-Wall[a]
					17.6*	4.84
	shrubs	all	per site	8.8	5.0	1.89
					12.6**	6.82
					4.8**	6.82
					4.5**	6.82
	shrub	>1.5m	per 20 x 20 quadrat	0.5	0.3	1.10
					3.8**	6.82
					2.2**	6.86
	shrub	<1.5m	per 5 x 5 quadrat	2.5	1.6	2.46
					20 9*	4.81
	shrub	>1.5m	per 20 x 20 quadrat	2.6	2.9	0.27
					18.0**	6.82
	tree+shrub	<1.5m	per 5 x 5 quadrat	36.1	19.6	2.45
	shrub	<1.5m	per 5 x 5 quadrat	21.5	10.2	3.15
	tree	<15m	per 5 x 5 quadrat	14.5	9.3	1.84
					10.4*	4.81
					7.1**	6.82
					0.4**	6.88
					3.0**	6.81
	deciduous tree	>1.5m	per 20 x 20 quadrat	16.1	15.0	0.01
					0.18**	7.03
					34.9	6.81
					0.11**	6.86

Sandstone sites = Spring Peak, Barramundi, Bukbuk, Mt Cahill, Jabiluka;Schist sites = Fisher Hills, Tin Camp 1 - 4.

[a] non-parametric Kruskal - Wallis statistic

[b] Leguminous species in Families Caesalpiniaceae, Fabaceae or Mimosaceae

* significantly different from mean of sandstone sites; 0.01 <P<0 05

** significantly different from mean of sandstone; 0.001<P<0.01

Table 9 Trees and shrubs with high constancy or high stem volume at the Ranger sites, hill sites or schist sites

Species (lifeform)	**Ranger % site freq**	**All Hills % site freq**	**Schist % site freq**
a. Species with high affinity to the Ranger sites and low affinity to the schist sites			
Eucalyptus tetrodonta (TR)	100	60	0
Acacia mimula (TR)	90	50	0
Corymbia porrecta (TR)	90	30	0
Persoonia falcata (TR)	90	20	0
Corymbia bleeseri (TR)	70	30	0
Wrightia saligna (TR)	60	50	0
Acacia oncinocarpa (SH)	60	30	0
Xanthostemon paradoxus (TR)	100	50	20
Planchonia careya (TR)	100	50	20
Eucalyptus miniata (TR)	80	50	20
b. Species with high affinity to the schist sites and low affinity to the Ranger sites			
Corymbia foelscheana (TR)	10	0	100
Eucalyptus tectifica (TR)	10	70	100
Cochlospermum fraseri (TR)	30	90	100
Calytrix achaeta (SH)	20	60	80
Acacia hemignosta (TR)	10	0	60
Hakea arborescens (TR)	10	0	60
Pachynema hooglandi (SH)	0	20	60
c. Species widespread across the Ranger sites and the schist sites			
Petalostigma quadriloculare (SH)	90	70	40
Terminalia ferdinandiana (TR)	100	70	40
Gardenia megasperma (TR)	90	100	100
Buchanania obovata (TR)	100	80	60
Grevillea decurrens (TR)	90	90	80
Brachychiton megaphyllus (TR)	60	60	40
Erythrophleum chlorostachys (TR)	30	80	60
d Species with low constancy but with high stem volume (biomass class 4 or 5) at particular sites	occurrence	occurrence	
Corymbia dichromophloia (TR)		**BA**, SP, **FI**	
Acacia oncinocarpa (SH)	**R5**		
Corymbia chartacea (TR)		BK, MC	
Eucalyptus pruinosa (TR)		**TC3**	
Eucalyptus phoenicea (TR)		MC, **SP**	

Ranger Sites = Ranger 1 - 10

Hills sites = Bukbuk, Jabiluka, Mt Cahill, Fisher Hills, Barramundi, Spring Peak, Tin Camp I - 4

Schist sites=Fisher Hills, Tin Camp 1 - 4

Lifeform Codes: SH= shrub, TR=tree

***Species* in bold** = with very high biomass throughout the group (biomass class 5),

Species underlined= with high biomass throughout the group (biomass classes 4 & 3)

Species not in bold, not underlined= with relatively low biomass thoughout the group (biomass class < 3)

Table 10 Herbaceous plants with high constancy or high biomass on the Ranger sites, the hill sites or the Schist Hills

Species (lifeform)	**Ranger % site freq**	**All hills % site freq**	**Schist % site freq**
a. Species with high affinity to Ranger sites.			
Portulacca bicolor (FO)	100	0	0
Arthrostylis aphylla (SE)	100	25	0
Sorghum brachypodum (GR)	100	38	0
Crotalaria medicaginea (FO)	100	13	20
Fimbristylis schultzii (SE)	100	13	20
Polycarpaea holtzei (FO)	100	13	20
Thaumastochloa major (GR)	100	25	20
Spermacoce aequabilis (FO)	100	38	20
Tephrosia remotiflora (FO)	100	38	20
Minuria macrorhiza	80	0	0
Bulbostylis barbata	80	0	0
Yakirra pauciflora	80	0	0
Mitrasacme pauciflora	80	0	0
Fimbristylis caloptera	80	0	0
Crotalaria brevis	80	0	0
Polygala triflora (FO)	80	25	0
Commelina ensifolia (FO)	80	13	0
Scleria annularis (SE)	80	13	0
Waltheria indica (FO)	80	13	0
Evolvulus alsinoides	80	13	20
Eriachne ciliata (GR)	80	38	20
Polygala sp. Cahill (FO)	80	38	20
Desmodium pycnotrichum (FO)	60	25	0
Aristida holathera (GR)	60	38	20
Vigna lanceolata (VN)	60	38	20
b. Species with high affiinity for the schist sites.			
Sorghum plumosum (GR)	0	75	100
Fimbristylis xyridis (SE)	0	63	100
Fimbristylis pterigosperma (SE)	20	63	100
Sehima nervosum (GR)	20	63	100
Haemodorum parviflorum (FO)	0	50	80
Indigofera parviflora (FO)	0	50	80
Polygala longiflora (FO)	0	50	80
Tephrosia leptoclada (FO)	0	50	80
Goodenia armstrongii (FO)	0	75	80
Polygala arvensis (FO)	0	63	80

Species (lifeform)	**Ranger** **% site freq**	**All hills** **% site freq**	**Schist** **% site freq**
Rhynchospora longisetis (SE)	0	20	80
Chamaecrista mimosoides (FO)	20	88	80
Uraria lagopodiodes (FO)	20	50	80
Fimbrisylis cinnamometorum (SE)	20	63	80
Chrysopogon fallax (GR)	40	50	80
Spermacoce leptoloba (FO)	0	38	60
Mitrasacme nudicaulis (FO)	0	38	60
c. Species with high occurrence at both Ranger and the schist sites.	**Ranger**	**All Hills**	**Schist**
Heteropogon triticeus (GR)	100	100	100
Schizachrium fragile (GR)	100	100	100
Chlorophytum laxum (FO)	100	88	100
Mnesithea formosa (GR)	100	88	100
Digitaria gibbosa (GR)	100	88	80
Murdannia graminea (FO)	100	88	80
Alloteropsis semialata (GR)	100	75	60
Euphorbia schultzii (FO)	100	63	40
Alysicarpus glumaceus (FO)	100	75	80
Desmodium brownii (FO)	100	so	40
Stackhousia intermedia (FO)	100	63	80
Brachiaria holosericea (GR)	100	50	60
Cartonema spicata (FO)	80	88	80
Drosera petiolaris (FO)	80	88	100
Heliotropium ventricosum (FO)	80	88	100
Pachynema sphenandrum (FO)	80	50	40
Thecanthes punicea (FO)	80	50	40
Crotalaria montana (FO)	40	88	80
Ipomea graminea (VN)	40	88	80
Buchnera linearis (FO)	80	50	80
Goodenia holtzei	80	25	40
Eriachne obtusa (GR)	40	75	80
Pseudopogonatherum irritans (GR)	60	50	80
d. Species with low constancy but with high biomass (biomass class 4 or 5) at particular sites	**occurrence**	**occurrence**	
Merremia quinata	R10		
Themeda triandra	R10		
Ampelocissus acetosa	R10		
Eriachne avenacea		FI	
Calandrinia uniflora	R2		
Galactia tenuiflora	R10		

Species (lifeform)	Ranger % site freq	All hills % site freq	Schist % site freq
Desmodium glareosum.		FI	
Eulalia mackinlayi		BA	
Helicteres dentata var. *dentata*		SP	
Sorghum intrans		FI	
Triodia procera		BA	

Ranger Sites= Ranger 1, Ranger 2, Ranger 8, Ranger 9, Ranger 10,

All Hills=Jabiluka, Barramundi, Spring Peak, Fisher Hills, Tin Camp 1, Tin Camp 2, Tin Camp 3, Tin Camp 4

Schist hills=Tin Camp 1, Tin Camp 2, Tin Camp 3, Tin Camp 4

Lifeform Codes: FO = forb, GR= grass, SE= sedge, VN= vine

***Species* in bold** = with very high biomass throughout the group (biomass class 5),

Species underlined= with high biomass throughout the group (biomass classes 4 & 3)

Species not in bold, not underlined= with relatively low biomass thoughout the group (biomass class < 3)

Table 11 Comparison between Ranger sites and hill and schist sites for a range of tree and shrub community attributes

				Ranger sites n=10	All hills n=10		Schist sites n=5	
Attribute	Veg component	Stratum	Condition	mean	mean	Kr-Wall[a]	mean	Kr - Wall
species richness	all	all	per site	23.9	25.8	0.036	17.6	2.55
	shrubs	all	per site	4.5	6.9	1.45	5.0	0.064
	trees	all	per site	18.4	18.9	0.006	12.6	3.39
				7 3	7.1	0.036	4.8*	4.09
				7.1	6 7	0.71	4 5*	5.16
	shrub	>1.5m	per 20 x 20 quadrat	0.23	0.39	0.91	0.3	0.015
	tree + shrub	<0.5m	per 5 x 5 quadrat	5.3	5.3	0.07	3.8	2.35
	tree	<1.5m	per 5 x 5 quadrat	3.8	3.2	0.69	2.2	3.16
	shrub	<1.5m	per 5 x 5 quadrat	1.4	2.1	1.66	1.6	0.13
density	tree + shrub	>1.5m	per 20 x 20 quadrat	34.7	35.7	0.013	20.9	2.53
					2.7**	7.06	2.9	1.53
				34.2	32.9	0.82	18 0*	4.34
	tree + shrub	<15m	per 5 x 5 quadrat	26.1	27.8	0.21	19.6	0.73
	shrub	<1.5m	per 5 x 5 quadrat	8.7	15.9	2.28	10.2	0.13
	tree	<1.5m	per 5 x 5 quadrat	17.3	11.9	0.37	9.3	1.5
	tree	1.5 - 5m	per 20 x 20 quadrat	23.4	20.5	0.69	10.4	3.37
					10.8*	5.49	7.1	0.96
					1 6**	8.69	0.4**	9.39
				22.6	17.3	2.64	3.0**	9.39
	deciduous tree	>1.5m	per 20 x 20 quadrat	11.6	15.6	2.53	15.0	2.18
				0.26	0.32	0.37	0.18*	4.37
				81.0	70.2	0.36	34.9	8.64
					0.96*	5.32	0 11**	7.95

Ranger sites = Ranger 1-10, All Hills = Fisher Hills, Spring Peak, Barramundi, Bukbuk, Mt Cahill, Jabiluka, Tin Camp 1 - 4

Schist sites = Fisher Hills, Tin Camp 1 - 4.

[a] non - parametric Kruskal - Wallis statistic; [b] Leguminous species in Families Caesalpiniaceae, Fabaceae or Mimosaceae

* significantly different from mean of Ranger sites at 0.01 <P<0.05; * * significantly different from mean of Ranger sites at 0.001 <P<0.01

Table 12 Comparison between Ranger sites and hill and schist sites for a range of herb community characteristics

			Ranger sites (n=5)	All hills (n=8)		Schist sites (n=5)	
Attribute	Veg component	Condition	mean	mean	Kr - Wall[a]	mean	Kr - Wall
				48.0**	6.94	46.2*	5.77
	all	per 0.7 x 0.7m quadrat	7.6	7.7	0.00	9.0	1.32
	grasses	per site	16.4	12.4	3.12	12.6	1.85
				35.6**	6.98	33 6*	5.77
biomass	all	g dry wt / m^2	159.2	137.0	1.05	149.4	0.27
	grasses	g dry wt / m^2	143.2	123.5	1.55	136.6	0.71
	Non - grasses	g dry wt / m^2	16.0	13.2	0.13	12.4	0.01
				54.2*	4.2	47.4	2.45
	all perennials	g dry wt / m^2	45.2	82.4	1.73	101.4	3.15
	legumes[b]	g dry wt / m^2	108.2	64.0	0.53	61.2	0.53

Ranger sites = Ranger 1,2,8,9,10, All Hills = Fisher Hills, Spring Peak, Barramundi, Jabiluka, Tin Camp 1 - 4

Schist sites = Fisher Hills, Tin Camp 1 - 4.

[a] non-parametric Kruskal - Wallis statistic

b Leguminous species in Families Caesalpiniaceae, Fabaceae or Mimosaceae

* significantly different from mean of Ranger sites at 0.01<P<0 05

** significantly different from mean of Ranger sites at 0.001<P<0.01

Appendices

Appendix 1 Density[a] of trees and shrubs at each site

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Acacia lamprocarpa (MIMOSACEAE)[b]						0.2[c] *0*[d]				0.2 *0*										
Acacia conspersa (MIMOSACEAE)																10 *60*				
Acacia difficilis (MIMOSACEAE)			6 *100*	56 *100*	45 *96.7*			0.5 *0*						22 *87.9*			0.2 *0*			
Acacia dimidiata (MIMOSACEAE)	0.2 *0*				2 *80*											2 *100*				
Acacia gonacarpa (MIMOSACEAE)		2 *100*						10 *100*									8 *100*			
Acacia hemignosta (MIMOSACEAE)										14 *85.7*								12 *100*	2 *80*	4 *100*
Acacia humifusa (MIMOSACEAE)													30 *100*	68 *100*						
Acacia latescens (MIMOSACEAE)														57 *94.3*		3 *61.5*				
Acacia mimula (MIMOSACEAE)	110 *80*	210 *87.5*	148 *91.9*	104 *90.4*	24 *72.7*	100 *41.9*	107 *69.3*	177 *82.3*	173 *86.7*			345 *87.6*	4 *94.1*	26 *69.2*	153 *82.4*	51 *73.8*				
Acacia multisiliqua (MIMOSACEAE)														0.5 *0*						
Acacia oncinocarpa (MIMOSACEAE)	0.2 *0*	2 *100*		458 *100*	342 *99.5*		13 *94.1*	6 *100*						1 *0*	5 *72.7*	2 *0*				
Acacia praelongata (MIMOSACEAE)													0.2 *0*							
Acacia sublanata (MIMOSACEAE)												2 *100*								
Acacia umbellata (MIMOSACEAE)																	0.2 *0*			

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Alphitonia excelsa (RHAMNACEAE)	2 *100*						2 *100*						66 *100*			16 *98.5*				
Antidesma ghesaembilla (EUPHORBIACEAE)										60 *100*							2 *88.9*			
Boronia lanuginose (RUTACEAE)												4		 *100*						
Brachychiton diversifolius (STERCULIACEAE)								4		 *88.9*							2 *86.9*			
Brachychiton megaphyllus (STERCULIACEAE)			4 *100*	2 *100*		14 *72.7*	1 *0*	4 *94.1*		17 *81.2*		2 *100*	0.7 *0*	2 *100*	3 *0*		2 *100*			0.2 *0*
Buchanania obovata (ANACARDIACEAE)	27 *87.3*	12 *98*	16 *100*	33 *97.7*	4.5 *88.9*	24 *92.6*	17 *92.8*	28 *100*	14 *98.2*	77 *95.5*		4 *100*	4 *100*	22 *97.8*	13 *92.3*	63 *91.7*	28 *93.7*	5 *84.2*		77 *96.1*
Calytrix achaeta (MYRTACEAE)							0.5 *0*		2 *100*		293 *92.7*	38 *78.4*	12 *80*				75 *85*	31 *97.6*	2 *0*	
Calytrix *exstipulata* (MYRTACEAE)				10 *82.1*		0.7 *0*		0.2 *0*					8 *51.6*						0.2 *0*	
Psydrax attenuate (RUBIACEAE)													20 *100*							
Capparis umbonata (CAPPARACEAE)				2 *100*	0.2 *0*					0.5 *0*										
Clerodendrum floribundum (VERBENACEAE)			4 *100*			4 *100*		8 *100*						0.2 *0*		2 *100*				
Cochlospermum fraseri ssp. *fraseri* (BIXACEAE)						2 *88.9*	0.5 *0*			43 *64.4*	3 *0*	11 *55.8*	12 *85.1*		21 *66.7*	0.2 *0*	25 *47.5*	3 *66.7*	2 *88.9*	24 *98*
Croton amhemicus (EUPHORBIACEAE)								2 *100*				4 *88.9*		8 *72.7*	14 *69*	1 *0*				
Denhamia obscura (CELASTRACEAE)								0.5 *0*				2		 *100*						
Distichostemon amhemicus (SAPINDACEAE)				4				 *100*												

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Dolichandrone filiformis (BIGNONIACEAE)	6 *96*		2 *100*	2 *88.9*	0.5 *0*	8 *70.6*	2 *100*									16 *97*			4 *88.9*	
Erythrophleum chlorostachys (CAESALPINIACEAE)						19 *84.2*	1 *0*			52 *83.4*	80 *67.5*	201 *89.4*	416 *95.6*	22 *90.9*	41 *77.6*	50 *92.5*	10 *82.1*			0.2 *0*
Erythroxylum ellipticum (ERYTHROXYLACEAE)											0.2 *0*		0.5 *0*				20 *98.8*			
Corymbia bleeseri (MYRTACEAE)	0.2 *0*	2 *0*		10 *61.5*	0.7 *0*		0.7 *0*	11 *71.7*	50 *64*					19 *82.1*	6 *69.6*	4 *47.1*				
Corymbia chartacea (MYRTACEAE)								4 *47.1*	30 *66.7*					31 *71.5*	97 *68*	33 *79.4*	18 *54.8*			
Corymbia disjuncta (MYRTACEAE)				0.2 *0*	2 *80*	13 *62.7*			27 *74.8*	10 *0*		6		4 *88.9*	98 *75.5*		52 *96.6*	6 *100*		
Corymbia dichromophloia (MYRTACEAE)											604 *96.9*	112 *90.9*	102 *90.4*							
Corymbia dunlopiana (MYRTACEAE)											0.2 *0*		4 *50*							
Corymbia foelscheana (MYRTACEAE)										76 *76.3*							0.2 *0*	161 *82.2*	5 *38.1*	81 *88.9*
Corymbia latifolia (MYRTACEAE)			10 *78*		22 *71.1*		0.25 *0*			33 *90.9*										
Eucalyptus miniata (MYRTACEAE)	13 *76.9*	5 *0*	8 *51.6*	4.5 *88.9*		5 *84.2*	2 *0*	14 *28.6*	15 *67.8*			3 *0*		10 *40*	7 *59.3*	17 *69.6*				2 *80*
Corymbia oocarpa (MYRTACEAE)																7	1 *0*			 *88.9*
Corymbia papillosa (MYRTACEAE)																				0.2 *0*
Eucalyptus phoenicea (MYRTACEAE)													10 *41*	34 *41.5*						
Corymbia polysciada (MYRTACEAE)											0.2 *0*	0.5 *0*	0.2 *0*							1 *0*

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Corymbia porrecta (MYRTACEAE)	27 *74.8*	23 *70.3*	91 *85.7*	38 *83.1*	0.5 *0*	135 *69.6*	23 *70.3*	70 *71.7*	5 *84.2*					16 *72.7*	42 *86.2*	57 *91.6*				
Eucalyptus pruinosa (MYRTACEAE)																			83 *76.9*	
Eucalyptus tectifica (MYRTACEAE)										36 *95.1*	1 *0*		1 *0*		0.7 *0*		120 *83.5*	199 *88.6*	0.2 *0*	129 *91.5*
Eucalyptus tetrodonta (MYRTACEAE)	63 *79.4*	10 *40*	38 *79.5*	38 *57.5*	36 *67.1*	60 *69.7*	21 *56.5*	82 *77.8*	42 *70.6*	70 *74.6*		0.7 *0*	1 *0*	141 *81*	94 *78.7*	190 *86.1*	0.5 *0*			
Eucalyptus tintinnans (MYRTACEAE)											6 *61.5*									
Exocarpos latifolius (SANTALACEAE)																0.2 *0*				
Ficus aculeata (MORACEAE)										0.7 *0*										0.2 *0*
Galactia megalophylla (FABACEAE)	58 *100*			24 *100*	2 *100*	126 *100*	50 *100*		8 *100*		28 *100*							20 *100*		30 *100*
Gardenia megasperma (RUBIACEAE)	21 *96.4*	0.7 *0*	6 *96*	20 *98.8*	7 *88.9*	13 *94.1*	6 *100*	20 *97.6*	10 *97.6*		8 *75*	14 *96.6*	4 *88.9*	3 *72.7*	7 *57.1*	10 *78*	1 *0*	2 *80*	0.2 *0*	0.5 *0*
Grevillea decurrens (PROTEACEAE)	6 *33.3*	3 *61.5*	4 *94.1*	5 *72.7*	0.5 *0*	0.5 *0*	19 *94.7*		3 *66.7*	0.5 *0*	5 *36.4*	28 *78.6*	0.7 *0*	2 *80*	14 *82.8*	38 *93.5*	9 *91.4*	4 *53.3*		35 *85.7*
Grevillea dryandri (PROTEACEAE)														56 *100*						
Grevillea goodii (PROTEACEAE)																	12 *100*			
Grevillea heliosperma (PROTEACEAE)														0.2 *0*						
Grevillea mimosoides (PROTEACEAE)	22 *100*					22 *100*	10 *100*			49 *94.4*	4 *88.9*									
Grewia mesomischa (TILACEAE)						8 *72.7*				4 *94.1*										

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Hakea arborescens (PROTEACEAE)										0.7 *0*								48 *92.1*	7 *82.8*	9 *91.4*
Helicteres cana (STERCULIACEAE)																				16 *100*
Hibbertia dealbata (DILLENIACEAE)														144 *100*		70 *100*				
Hibbertia lepidota (DILLENIACEAE)												6		 *100*						
Hibbertia sp. Softly hairy (DILLENIACEAE)																16 *100*				
Indigofera saxicola (FABACEAE)											116 *100*		62 *100*	26 *99*			72 *100*			
Jacksonia dilatata (FABACEAE)														3		 *0*				
Jasminum molle (OLEACEAE)			74 *100*			42 *100*		4 *100*		88 *100*				38 *100*		22 *100*				
Livistona humilis (ARECACEAE)						2 *100*			14 *98.2*	0.2 *0*		8 *23.5*	8 *48.5*	22 *44.9*	5 *76.2*	0.2 *0*				
Livistona inermis (ARECACEAE)															243 *61.7*	3 *72.7*				
Melaleuca viridiflora (MYRTACEAE)				0.2 *0*	17 *95.5*															
Owenia vernicosa (MELIACEAE)													2 *100*	2 *0*		44 *91.4*				
Pachynema hooglandii (DILLENIACEAE)																94 *100*	52 *100*	60 *100*		40 *100*
Pachynema junceum (DILLENIACEAE)					6 *100*		4 *100*						32 *100*	22 *100*						
Pandanus spiralis (PANDANACEAE)					0.5 *0*					12 *100*										

	SITES																			
Species	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
(RUBIACEAE)														*0*		*0*				
Persoonia falcata (PROTEACEAE)	0.7 *0*	6 *96*	4 *100*	18 *97.3*		2 *80*	4 *100*	3 *72.7*	0.2 *0*	0.2 *0*				2 *100*		8 *77.4*				
Petalostigma pubescens (EUPHORBIACEAE)					0.25 *0*															
Petalostigma quadriloculare (EUPHORBIACEAE)	188 *100*	344 *100*	172 *100*	46 *100*		354 *100*	92 *100*	308 *100*	388 *100*	54 *100*	700 *100*	1000 *100*	734 *100*	460 *100*	494 *100*	444 *100*	160 *100*			
Phyllanthus grandisepalus (EUPHORBIACEAE)													4 *100*	36 *100*						
Pityrodia quadrangulata (VERBENACEAE)												2		*100*						
Pouteria arnhemica (SAPOTACEAE)		0.2 *0*				2 *80*	0.5 *0*	3 *57.1*		0.5 *0*		0.2 *0*			3 *57.1*	1 *0*				
Planchonia careya (LECYTHIDACEAE)	96 *100*	32 *100*	12 *100*	16 *100*	6 *92.3*	73 *81.6*	12 *98*	20 *90*	12 *96*	19 *71.8*			2 *100*	6 *96*	32 *100*	16 *100*	0.2 *0*			
Pogonolobus reticulatus (RUBIACEAE)	4 *100*			6 *100*		6 *100*				2 *100*		0.75 *0*		2 *100*	20 *100*					
Premna acuminata (VERBENACEAE)						55.5 *97.3*				2 *100*										
Senna leptoclada (CAESALPINIACEAE)																18 *100*				
Stenrocarpus acacioides (PROTEACEAE)						5.25 *76.2*		6.25 *96*		2 *100*			0.25 *0*	14.5 *96.6*		0.25 *0*				
Syzygium eucalyptoides ssp. *eucalyptoides* (MYRTACEAE)																3.5 *57.1*				
Tephrosia filipes (FABACEAE)													8 *100*							
Tephrosia nematophylla (FABACEAE)																		276 *100*	48 *100*	

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Tephrosia polyzyga (FABACEAE)											36 *100*	184 *100*	42 *100*							
Tephrosia savannicola (FABACEAE)																4 *100*				
Tephrosia spechtii (FABACEAE)													106 *100*							
Tephrosia sp *carriemichelliae* (FABACEAE)											4 *100*									
Terminalia canescens (COMBRETACEAE)												3 *0*	17 *94.1*							
Terminalia carpenrtariae (COMBRETACEAE)													12 *85.1*	5 *76.2*		2 *100*				
Terminalia ferdinandiana (COMBRETACEAE)	24 *67.4*	1 *0*	5 *80*	2 *80*	2 *0*	20 *19.5*	3 *61.5*	51 *86.7*	7 *85.7*	7 *0*	0.2 *0*	18 *87.7*	5 *80*	2 *0*	34 *63.8*	19 *62.3*	4 *53.3*			
Terminalia grandiflora (COMBRETACEAE)										0.7 *0*										
Termninalia latipes (COMBRETACEAE)																3 *61.5*				
Terminalia pterocarya (COMBRETACEAE)				2 *100*	2 *0*	2 *100*			4 *100*								4 *88.9*			
Triumfetta sp. (TILACEAE)													2 *100*							
Vitex glabrata (VERBENACEAE)						0.5 *0*											0.2 *0*			
Wrightia saligna (APOCYNACEAE)	10 *100*	4 *100*		73 *98.6*	59 *98.3*		2 *100*			2 *100*		10 *100*	46 *100*	6 *100*	0.2 *0*	26 *100*				
Xanthostemon paradoxus (MYRTACEAE)	39 *81.5*	5 *0*	1785 *99.7*	164 *92.5*	75 *87.7*	508 *95.7*	23 *52.7*	290 *95.7*	1011 *97.3*	17 *70.6*	165 *97*	37 *90.7*	71 *76.1*		117 *89.1*	0.5 *0*				

Site Codes: RI - R10= Ranger 1 - Ranger 10, FI= Fisher Hills, BA= Barramundi, SP= Spring Peak, MC= Mt Cahill, BB= Bukbuk, JB= Jabiluka, TC 1 -- TC4= Tin Camp 1 - Tin Camp 4.

[a] Density = plants / 0.1 ha [b] Family name [c] mean, composed of mean from >1.5m stratum (n=10) + mean from < 1.5m stratum (n=20)

[d] values in *italics* = percent of density in < 1.5m stratum

Appendix 2 Stem volumes[a] of trees and shrubs at each site

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**RS**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Acacia lamprocarpa (MIMOSACEAE)[b]						.004[c]				0.008										
Acacia conspersa (MIMOSACEAE)																0.943				
Acacia difficilis (MIMOSACEAE)			0.019	0.245	1.57			0.031						0.215			0.003			
Acacia dimidiata (MIMOSACEAE)	0.043				0.009											0.007				
Acacia gonacarpa (MIMOSACEAE)		0.005						0.046									0.067			
Acacia hemignosta (MIMOSACEAE)										0.201								0.044	0.144	0.002
Acacia humifusa (MIMOSACEAE)													0.019	0.041						
Acacia latescens (MIMOSACEAE)														1.17		0.489				
Acacia mimula (MIMOSACEAE)	3.62	5.48	3.04	1.13	0.903	4.17	2.96	4.20	4.14			1.15	0.055	1.97	3.81	1.39				
Acacia multisiliqua (MIMOSACEAE)														0.009						
Acacia oncinocarpa (MIMOSACEAE)	0.037	0.001		2.11	7.94		0.209	0.005						0.060	0.064	0.011				
Acacia praelongata (MIMOSACEAE)													0.060							
Acacia sublanata (MIMOSACEAE)												0.004								
Acacia umbellata (MIMOSACEAE)																	0.015			
Alphitonia excelsa (RHAMNACEAE)	0.000						0.001						0.120			0.091				

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**RS**	**R6**	**R7**	**R8**	**R9**	**R10**	**Fl**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Antidesma ghesaembilla (EUPHORBIACEAE)										0.316							0.004			
Boronia lanuginose (RUTACEAE)														0.007						
Brachychiton diversifolius (STERCULIACEAE)										2.51							0.284			
Brachychiton megaphyllus (STERCULIACEAE)			0.002	0.010		0.273	0.012	0.005		0.435		0.043	0.095	0.014	0.077		0.001			0.015
Buchanania obovata (ANACARDIACEAE)	0.300	0.171	0.043	0.240	0.217	0.089	0.261	0.041	0.100	1.04		0.004	0.003	0.154	0.437	15.4	1.31	0.304		1.50
Calytrix achaeta (MYRTACEAE)							0.093		0.000		1.58	0.859	0.056				0.743	0.185	0.094	
Calytrix *exstipulata* (MYRTACEAE)				0.281		0.005		0.002					0.246						0.079	
psydrax attenuate (RUBIACEAE)													0.036							
Capparis umbonata (CAPPARACEAE)				0.012	0.001					0.009										
Clerodendrum floribundum (VERBENACEAE)			0.010			0.016		0.019						0.001		0.001				
Cochlospermum fraseri ssp. *fraseri* (BIXACEAE)						0.055	0.017			1.30	0.471	0.403	0.170		0.325	0.006	0.816	0.093	0.002	0.066
Croton amhemicus (EUPHORBIACEAE)								0.004				0.057		0.538	0.121	0.034				
Denhamia obscura (CELASTRACEAE)								0.017						0.034						
Distichostemon amhemicus (SAPINDACEAE)								0.048												
Dolichandrone filiformis (BIGNONIACEAE)	0.022		0.010	0.018	0.005	0.112	0.051									0.155			0.168	

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**RS**	**R6**	**R7**	**R8**	**R9**	**R10**	**Fl**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Erythrophleum chlorostachys (CAESALPINIACEAE)						0.396	0.084			12.5	3.93	17.	15.9	0.666	3.36	4.34	1.91			0.021
Erythroxylum ellipticum (ERYTHROXYLACEAE)											0.122		0.036				0.009			
Corymbia bleeseri (MYRTACEAE)	0.008	4.37		4.84	0.011		6.40	4.26	8.84					5.65	1.12	0.100				
Corymbia chartacea (MYRTACEAE)								0.528	2.48					16.3	23.3	3.85	2.86			
Corymbia disjuncta (MYRTACEAE)				0.014	0.015	0.201			2.44	1.08		0.587		0.243	3.63		2.53	0.024		
Corymbia dichromophloia (MYRTACEAE)											32.8	49.2	22.5							
Corymbia dunlopiana (MYRTACEAE)											0.002		1.45							
Corymbia foelscheana (MYRTACEAE)										15.3							1.10	8.34	2.67	11.1
Corymbia latifolia (MYRTACEAE)			11.7		12.3		0.242			6.21										
Eucalyptus miniata (MYRTACEAE)	15.4	28.4	19.1	0.167		3.90	0.139	21.5	7.18			6.99		10.6	4.75	12.6				1.29
Corymbia oocarpa (MYRTACEAE)																	0.439			3.69
Corymbia papillosa (MYRTACEAE)																				0.075
Eucalyptus phoenicea (MYRTACEAE)													33.4	36.1						
Corymbia polysciada (MYRTACEAE)											0.950	0.978	0.485							3.13
Corymbia porrecta (MYRTACEAE)	7.08	8.18	6.46	4.37	0.569	19.7	6.41	9.71	0.181					1.91	5.51	6.33				

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**RS**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Eucalyptus pruinosa (MYRTACEAE)																			31.7	
Eucalyptus tectifica (MYRTACEAE)										7.27	1.60		8.87		0.049		14.5	14.5	0.010	10.0
Eucalyptus tetrodonta (MYRTACEAE)	52.4	15.0	24.9	29.8	14.5	40.5	26.	61.7	27.5	43.4		2.64	1.49	28.9	18.5	77.3	0.633			
Eucalyptus tintinnans (MYRTACEAE)											4.96									
Exocarpos latifolius (SANTALACEAE)																0.001				
Ficus aculeata (MORACEAE)										0.107										0.012
Galactia megalophylla (FABACEAE)	1.36			0.192	0.021	1.03	1.18		0.085		0.013							0.011		0.126
Gardenia megasperma (RUBIACEAE)	0.397	0.076	0.013	0.101	0.178	0.197	0.093	0.079	0.046		0.526	0.058	0.018	0.123	0.116	0.145	0.298	0.029	0.013	0.037
Grevillea decurrens (PROTEACEAE)	0.180	0.050	0.031	0.087	0.013	0.032	0.119		0.036	0.005	0209	0.361	0.020	0.014	0.221	0.220	0.017	0.059		0.337
Grevillea dryandri (PROTEACEAE)														0.108						
Grevillea goodii (PROTEACEAE)																	0.107			
Grevillea heliosperma (PROTEACEAE)														0.390						
Grevillea mimosoides (PROTEACEAE)	0.120					0.042	0.015			0.172	0.059									
Grewia mesomischa (TILACEAE)						0.451				0.181										
Hakea arborescens (PROTEACEAE)										0.008								1.50	0.191	0.326

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**RS**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Helicteres cana (STERCULIACEAE)																				0.052
Hibbertia dealbata (DILLENIACEAE)														0.598		0.102				
Hibbertia lepidota (DILLENIACEAE)														0.012						
Hibbertia sp. Softly hairy (DILLENIACEAE)																0.017				
Indigofera saxicola (FABACEAE)											0.174		0.157	0.414			0.202			
Jacksonia dilatata (FABACEAE)																0.441				
Jasminum molle (OLEACEAE)			0.083			0.038		0.002		0.944				0.053		0.017				
Livistona humilis (ARECACEAE)						0.032			0.263	0.033		1.03	0.809	1.99	0.258	0.050				
Livistona inermis (ARECACEAE)															8.13	0.189				
Melaleuca viridiflora (MYRTACEAE)				0.102	0.235															
Owenia vernicosa (MELIACEAE)													0.006	0.381		1.66				
Pachynema hooglandii (DILLENIACEAE)																0.596	0.146	0.197		0.420
Pachynema junceum (DILLENIACEAE)					0.051		0.073						0.165	0.126						
Pandanus spiralis (PANDANACEAE)					0.208					0.557										
Pavetta brownii (RUBIACEAE)														0.048		0.011				

	SITES																		
Species	**R1**	**R2**	**R3**	**R4**	**RS**	**R6**	**R7**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Persoonia falcata (PROTEACEAE)	0.018	0.040	0.003	0.025		0.008	0.006	0.058	0.017	0.002				0.016		0.118				
Petalostigma pubescens (EUPHORBIACEAE)					0.003															
Petalostigma quadriloculare (EUPHORBIACEAE)	4.96	5.05	2.32	0.573		7.70	3.39	4.45	8.89	0.711	2.30	1.99	3.57	6.79	3.95	4.80	0.271			
Phyllanthus grandisepalus (EUPHORBIACEAE)													0.001	0.071						
Pityrodia quadrangulata (VERBENACEAE)														0.006						
Pouteria arnhemica (SAPOTACEAE)		0.190				0.019	0.340	0.012		0.003		0.055			0.513	0.552				
Planchonia careya (LECYTHIDACEAE)	1.28	0.148	0.166	0.026	0.295	1.56	0.246	0.452	0.103	0.706			0.019	0.168	0.207	0.137	0.014			
Pogonolobus reticulatus (RUBIACEAE)	0.009			0.024		0.006				0.006		0.056		0.018	0.041					
Premna acuminata (VERBENACEAE)						0.366				0.014										
Senna leptoclada (CAESALPINIACEAE)																0.016				
Stenrocarpus acacioides (PROTEACEAE)						0.186		0.118		0.003			0.181	0.261		0.007				
Syzygium eucalyptoides ssp. *eucalyptoides* (MYRTACEAE)																0.102				
Tephrosia filipes (FABACEAE)													0.027							
Tephrosia nematophylla (FABACEAE)																		0.767	0.040	
Tephrosia polyzyga (FABACEAE)											0.113	0.326	0.072							

	SITES																			
Species	**R1**	**R2**	**R3**	**R4**	**RS**	**R6**	**R7**	**R8**	**R9**	**R10**	**Fl**	**BA**	**SP**	**MC**	**BB**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Tephrosia savannicola (FABACEAE)																0.000				
Tephrosia spechtii (FABACEAE)													0.424							
Tephrosia sp *carriemichelliae* (FABACEAE)											0.006									
Terminalia canescens (COMBRETACEAE)												0.570	1.09							
Terminalia carpenrtariae (COMBRETACEAE)													0.822	0.558		0.000				
Terminalia ferdinandiana (COMBRETACEAE)	2.16	0.218	0.205	0.773	0.284	1.04	0.171	1.26	0.166	2.34	0.006	0.899	0.110	0.326	2.58	1.30	0.698			
Terminalia grandiflora (COMBRETACEAE)										2.36										
Termninalia latipes (COMBRETACEAE)																0.016				
Terminalia pterocarya (COMBRETACEAE)				0.007	0.264	0.007											0.011			
Triumfetta sp. (TILACEAE)													0.004							
Vitex glabrata (VERBENACEAE)						0.010											0.010			
Wrightia saligna (APOCYNACEAE)	0.006	0.004		0.164	0.969		0.131			0.001		0.010	0.048	0.016	0.004	0.055				
Xanthostemon paradoxus (MYRTACEAE)	10.0	12.8	9.07	15.4	6.42	2.10	21.2	6.94	8.85	3.61	3.06	3.07	5.55		7.40	.915				

Site Codes: R 1 - R10= Ranger 1 - Ranger 10, F1= Fisher Hills, BA= Barramundi, SP= Spring Peak, MC= Mt Cahill, BB= Bukbuk JB= Jabiluka, TC 1 -- TC4= Tin Camp 1 - Tin Camp 4

[a] Stem volume in m^3/ ha

[b] Family name

[c] mean, composed of mean from >1.5m stratum (n=10) + mean from < 1.5m stratum (n=20)

Appendix 3 Density[a] of herbaceous species at each site

Species	R1	R2	R8	R9	R10	FI	BA	SP	JB	TCI	TC2	TC3	TC4
Alloteropsis semialata (POACEAE)[b]	4.24[c]	0.32	0.96	1.76	0.96	0.08	0.8	0.08	0.56	0.64		0.08	
Alysicarpus schomburgkii (FABACEAE)	3.6	0.08	.24	0.08	2.32			0.24	0.08	2.72	0.4	0.4	0.32
Ampelocissus acetosa (VITACEAE)	0.08		0.08		0.32					0.08			0.08
Aristida holathera var. *holathera* (POACEAE)	2.16		0.32		1.28		5.36	0.32	1.12	1.76			
Aristida superpendens (POACEAE)				2.56			0.64	0.32					
Aristolochia holtzei (ARISTOLOCHIACEAE)	0.08		0.08		0.16								
Arthrostylis aphylla (CYPERACEAE)	1.92	0.24	0.48	5.12	0.16		0.08						
Bonamia brevifolia (CONVOLVULACEAE)		0.08		0.64			0.08	0.08					
Bonamia pannosa (CONVOLVULACEAE)	0.08	0.08			0.16								
Spermacoce breviflora (RUBIACEAE)	4.72						14.4						
Borreria stenophylla (RUBIACEAE)			0.08		25.68								
Spermacoce leptoloba (RUBIACEAE)						4.0	26.96				0.56	0.24	2.56
Spermacoce aequabilis (RUBIACEAE)	9.36	45.2	21.68	46.0	11.84		75.6	4.88		22.0			
Spermacoce erectiloba (RUBIACEAE)						16.56			9.76				
Brachiaria holosericea (POACEAE)	0.96	2.0	1.36	7.12	1.6	0.56			1.68	33.36		4.32	
Brunoniella linearifolia (ACANTHACEAE)	0.24		0.96		1.12				0.08		0.08	0.08	0.08
Buchnera linearis (SCROPHULARIACEAE)	0.16		0.08	0.48	0.88					0.48	1.2	1.84	1.92
Bulbostylis barbata (CYPERACEAE)		1.6	5.04	2.24	5.68								
Calandrinia uniflora (PORTULACACEAE)	6.88	77.76			3.6								
Cartonema parviflorum (COMMELINACEAE)	0.08												
Cartonema spicatum (COMMELINACEAE)	0.4	.08	0.16		0.16		1.84	0.08	0.32	1.52	0.24	0.72	0.08
Cassytha aurea (LAURACEAE)		0.08											
Cayratia trifolia (VITACEAE)					0.16								
Chamaecrista mimosoides CAESALPINIACEAE)	0.16					0.08	0.08	1.28	0.16	0.08		0.08	0.16
Cheilanthes fragillima (ADIANTACEAE)							2.16	0.08					
Cheilanthes hirsuta (ADIANTACEAE)										3.04			
Cheilanthes nitida (ADIANTACEAE)	0.08		0.96	7.44									
Cheilanthes praetermissa (ADIANTACEAE)								0.24					
Chlorophytum laxum (LILIACEAE)	0.16	0.08	064	0.8	0.24	0.24	1.68	.08		0.16	0.08	0.4	0.32

Species	R1	R2	R8	R9	R10	FI	BA	SP	JB	TCI	TC2	TC3	TC4
Chrysopogon fallax (POACEAE)	0.08				1.04					5.92	22.08	30.72	19.52
Cleome tetrandra var. *tetrandra* (CAPPARACEAE)					12.24								
Commelina ensifolia (COMMELINACEAE)	0.4	0.32	0.72		1.92			1.12					
Crotalaria brevis (FABACEAE)	0.72		0.64	1.2	0.16								
Crotalaria medicaginea(FABACEAE)	1.04	1.12	0.72	0.24	3.04					0.08			
Crotalaria montana (FABACEAE)		0.08			0.4	0.4	0.96	1.04	0.08	0.32		0.64	0.56
Curculigo ensifolia var. *ensifolia* (LILIACEAE)					1.28		0.08				0.08		
Cyperus sporobolus (CYPERACEAE)									1.84				
Desmodium brownii (FABACEAE)	2.8	.16	4.24	1.44	0.64	0.08	2.4	1.76		1.92			
Desmodium pycnotrichum (FABACEAE)	0.72		1.52		5.04			2.96	0.08				
Desmodium triflora (FABACEAE)					2.0		0.4			1.12			0.48
Desmodium eriocephala (FABACEAE)	1.36	0.96				346.72							
Digitaria gibbosa (POACEAE)	3.28	5.6	4.08	20.24	12.4	31.84	0.96	0.32	7.6	6.32		0.64	0.24
Drosera petiolaris (DROSERACEAE)	0.72	0.24		1.36	0.16	0.8	1.04	0.08		4.0	0.96	3.84	4.88
Dunbaria singuliflora (FABACEAE)							0.08						
Eragrostis sp. (POACEAE)							0.08						
Eragrostis cumingii (POACEAE)							0.08						
Eriachne agrostidea (POACEAE)		280.4	0.08	1.6		10.24							
Eriachne avenacea (POACEAE)						6.16		0.64		1.28			
Eriachne basedowii (POACEAE)				0.32									
Eriachne ciliata (POACEAE)	16.8	76.0	0.16	29.76		50.08	52.0		0.56				
Eriachne obtusa (POACEAE)		4.08		0.96		0.72	2.88		2.88	2.88		1.2	1.52
Eriachne schultziana (POACEAE)										0.32			
Eriachne semiciliata (POACEAE)				36.64									
Eriachne sulcata (POACEAE)						0.24							
Eulalia annua (POACEAE)			5.92										
Eulalia mackinlayi (POACEAE)							1.28						
Euphorbia muelleri (EUPHORBIACEAE)							0.32						
Euphorbia schizolepis (EUPHORBIACEAE)					0.32								
Euphorbia schultzii (EUPHORBIACEAE)	1.36	0.8	0.4	0.32	1.44		0.16	0.16	0.16	0.72		0.32	
Euphorbia vachellii (EUPHORBIACEAE)											0.32		0.48

Species	R1	R2	R8	R9	R10	FI	BA	SP	JB	TCI	TC2	TC3	TC4
Evolvulus alsinoides (CONVOLVULACEAE)	0.16		0.32	0.4	0.4					0.16			
Fimbristylis caloptera (CYPERACEAE)	2.48	69.36	0.08		12.4								
Fimbristylis cinnamometorum (CYPERACEAE)	1.44						8.4			1.84	0.08	0.24	1.76
Fimbristylis densa (CYPERACEAE)	2.0			1.52									
Fimbristylis macrantha (CYPERACEAE)							0.32	0.4	1.04				
Fimbristylis oxystachya (CYPERACEAE)					0.16								
Fimbristylis pachyptera (CYPERACEAE)				0.48		0.72	0.08			0.72			
Fimbristylis pterygosperma (CYPERACEAE)				0.96		10.72				7.2	18.4	5.84	23.52
Fimbristylis schultzii (CYPERACEAE)	13.28	1.68	4.48	2.32		3.36							
Fimbristylis sp. Latz sp B (CYPERACEAE)							10.4						
Fimbristylis xyridis (CYPERACEAE)						8.56				4.16	2.24	2.32	2.32
Flemingia parviflora (FABACEAE)			1.76	0.4	2.96								
Galactia sp. (FABACEAE)								0.64					
Galactia tenuiflora (FABACEAE)		0.24	1.04		3.28				1.44	0.16			
Gomphrena canescens (AMARANTHACEAE)	1.92	1.36											
Gomphrena diffusa (AMARANTHACEAE)	11.92				1.68								
Gonocarpus leptothecus (HALORAGACEAE)				0.24									
Goodenia armstrongiana (GOODENIACEAE)							1.6	0.16		2.4	1.12	2.0	0.96
Goodenia coronopifolia (GOODENIACEAE)	0.16			1.12			1.36	0.96		0.48			
Goodenia holtzeana (GOODENIACEAE)	0.8	0.24		2.24	0.16					0.88			0.32
Goodenia janamba (GOODENIACEAE)							1.52						
Goodenia leiosperma (GOODENIACEAE)			0.96		3.36								
Marsdenia trinervis (ASCLEPIADACEAE)					0.08								
Haemodorum brevicaule (HAEMODORACEAE)	0.24						1.68	0.24	0.72	0.08			
Haemodorum coccineum (HAEMODORACEAE)	1.6		0.08			0.48			0.32				
Haemodorum parviflorum (HAEMODORACEAE)										0.48	0.08	0.96	0.24
Helicteres dentata var. *dendata* (STERCULIACEAE)							0.24	0.56					
Helicteres sp. Darwin (STERCULIACEAE)			0.16	0.32	0.4								
Heliotropium alcyonium (BORAGINACEAE)					27.76								
Heliotropium foliatum (BORAGINACEAE)					0.16				5.76				
Heliotropium ventricosum (BORAGINACEAE)	0.56		2.16	0.72	24.16	0.72	0.24	0.24		5.68	0.56	2.0	2.16

Species	R1	R2	R8	R9	R10	FI	BA	SP	JB	TCI	TC2	TC3	TC4
Unknown herb species							1.76		0.16				
Heteropogon contortus (POACEAE)												0.16	
Heteropogon triticeus (POACEAE)	1.28	0.56	4.16	1.28	4.08	0.16	0.16	0.4	3.12	3.04	1.84	0.48	3.76
Hybanthus enneaspermus ssp. *enneaspermus* (VIOLACEAE)	0.16												
Indigofera linifolia (FABACEAE)					3.6					0.08		0.16	
Indigofera parviflora (FABACEAE)										0.16	0.08	0.08	1.36
Iphigenia indica (LILIACEAE)				0.08			0.08					0.08	
Ipmoea abrupta (CONVOLVULACEAE)					0.16								
Ipmoea diversifolia (CONVOLVULACEAE)			1.2		0.32								
Ipmoea graminea (CONVOLVULACEAE)		0.16		0.16			0.24	0.32	0.16	0.8	0.72	1.12	0.88
Kailarsenia suffruticosa (RUBIACEAE)			0.16	0.08	0.08				0.08	0.16	0.08		0.08
Lomandra tropica (XANTHORRHOEACEAE)	0.16	0.08					0.24		0.8				
Marsdenia annae (ASCLEPIADACEAE)	0.08			0.56									
Marsdenia viridiflora (ASCLEPIADACEAE)					0.16								
Merremia quinata (CONVOLVULACEAE)					1.2								
Minuria macrorhiza (ASTERACEAE)	0.48	0.32	0.16		0.32								
Mitrasacme connata (LOGANIACEAE)	0.56	0.72	1.36	2.88									
Mitrasacme exserta (LOGANIACEAE)				0.48									
Mitrasacme glaucescens (LOGANIACEAE)							0.16						
Mitrasacme latiflora (LOGANIACEAE)							0.88						
Mitrasacme nudicaulis (LOGANIACEAE)											0.4	0.08	0.48
Mnesithea formosa (POACEAE)	0.16	0.88	1.6	0.08	1.36	8.96	5.52	0.32		15.52	46.48	10.32	49.92
Mnesithea rottboellioides (POACEAE)					0.56								
Murdannia graminea (COMMELINACEAE)	0.64	2.16	0.08	0.88	0.4		4.0	2.96	0.48	1.28	1.92	1.84	0.32
Neptunia gracilis (MIMOSACEAE)													0.16
Nervilia holochila (ORCHIDACEAE)					0.08								
Oldenlandia laceyi (RUBIACEAE)												1.2	
Pachynema sphenandrum (DILLENIACEAE)	0.48		0.48	0.32	0.08	0.16	0.4	0.08		0.16			
Panicum mindanaense (POACEAE)					21.76					0.56		0.24	
Patersonia macrantha (IRIDACEAE)									0.32				

Species	R1	R2	R8	R9	R10	FI	BA	SP	JB	TCI	TC2	TC3	TC4
Phyllanthus eutaxioides (EUPHORBIACEAE)										2.0			
Phyllanthus virgatus (EUPHORBIACEAE)							0.56	0.08		0.48			
Polycarpaea holtzei (CARYOPHYLLACEAE)	0.72	22.88	0.16	0.16	2.8	0.32							
Polycarpaea longiflora (CARYOPHYLLACEAE)				0.08	1.04								
Polycarpaea violacea (CARYOPHYLLACEAE)	1.2	16.24			0.88								
Polygala longifolia (POLYGALACEAE)										0.08	0.16	0.16	0.24
Polygala orbicularis (POLYGALACEAE)			0.16		2.72		0.4			0.4			
Polygala triflora (POLYGALACEAE)	0.48		0.88	0.4	2.16			0.32	0.08				
Polygala eriocephala (POLYGALACEAE)											0.08	0.56	
Polygala arvensis (POLYGALACEAE)								0.24		1.52	0.8	1.2	1.36
Polygala sp. Cahill (POLYGALACEAE)	0.16	0.24	0.16	0.4			0.08	0.08		0.32			
Poranthera microphylla (EUPHORBIACEAE)								1.44					
Portulaca bicolor var. *bicolor* (PORTULACACEAE)	8.96	62.0	1.2	0.48	2.88								
Pseudopogonatherum irritans (POACEAE)	1.04		2.16	6.4						78.24	8.32	3.28	5.28
Ptilotus corymbosus (AMARANTHACEAE)	1.92		0.16		0.16								
Ptilotus distans (AMARANTHACEAE)	0.08				0.08				0.24				
Rhynchospora sp. (CYPERACEAE)						1.84							
Rhynchospora longisetis (CYPERACEAE)	0.08									2.0	14.88	11.92	2.64
Sauropus brunonis (EUPHORBIACEAE)			0.48						0.56				
Sauropus ditassoides (EUPHORBIACEAE)								0.08	0.48	0.16			
Sauropus paucifolius (EUPHORBIACEAE)				0.16					0.24				
Sauropus stenocladus ssp *stenocladus* (EUPHORBIACEAE)	0.24	0.16	0.56	0.16			0.56				0.24	0.08	0.32
Sauropus glaucus (EUPHORBIACEAE)						0.16	0.16						
Schizachyrium crinizonatum (POACEAE)	0.4												
Schizachyrium fragile (POACEAE)	190.0	130.72	19.6	1.6	42.8	43.36	5.36	0.56	2.16	358.24	60.8	35.76	19.52
Schizachyrium pseudeulalia (POACEAE)												0.08	
Scleria annularis (CYPERACEAE)	0.16		0.16	0.4	1.68				0.08				
Scleria novae hollandiae (CYPERACEAE)		0.08											
Scleria sphacelata (CYPERACEAE)							0.4						
Sebastiania chamaelea (EUPHORBIACEAE)					0.16				0.8	0.08			

Species	**R1**	**R2**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**JB**	**TCI**	**TC2**	**TC3**	**TC4**
Sehima nervosum (POACEAE)					0.4	0.16				0.4	5.28	2.08	2.0
Senna heptanthera (CAESALPINIACEAE)										0.16			
Senna oligoclada (CAESALPINIACEAE)							0.32	0.4					
Setaria apiculata (POACEAE)			0.16						0.24				
Sorghum brachypodum (POACEAE)	71.2	148.1	96.48	86.72	86.16		5.92	104.1	97.2				
Sorghum intrans (POACEAE)						170.9							
Sorghum plumosum var. *plumosum* (POACEAE)						2.88	7.6			3.6	1.84	0.24	2.48
Sporobolus pulchellus (POACEAE)	0.56		0.72	7.76						4.32			
Stackhousia intermedia (STACKHOUSIACEAE)	0.96	0.32	2.0	1.2	0.08			0.16		0.08	2.0	11.36	1.36
Stemona australiana (STEMONACEAE)			0.08		0.08								
Stemona prostrata (STEMONACEAE)									0.08				
Striga curviflora (SCROPHULARIACEAE)					0.16								
Stylidium rotundifolium (STYLIDIACEAE)												9.12	
Stylidium leptorrhizum (STYLIDIACEAE)	0.16		0.64	0.32							0.4		1.84
Tacca leontopetaloides (TACCACEAE)			0.24		0.16				0.08				
Tephrosia leptoclada (FABACEAE)										0.32	0.48	1.28	1.04
Tephrosia remotiflora (FABACEAE)	2.4	0.4	2.08	0.56	6.72	12.56	0.08	1.84					
Tephrosia reticulata (FABACEAE)				0.16									
Tephrosia sp. 4 (FABACEAE)	0.08												
Thaumastochloa major (POACEAE)	3.36	1.28	15.6	12.56	0.24				0.88	0.24			
Thecanthes punicea (THYMELAEACEAE)	0.32	0.16	1.76	0.96				0.56	0.08		0.08		0.24
Themeda triandra (POACEAE)					5.52								
Thysanotus banksii(LILIACE)											0.18	0.24	
Trianthema rhynchocalyptra (AIZOACEAE))		0.16											
Tribulopsis pentandra (ZYGOPHYLLACEAE)		0.24			3.68	0.56							
Triodia procera (POACEAE)							1.52		0.08				
Typhonium cochleare (ARACEAE)					0.08								
Typhonium russell smithii (ARACEAE)												0.08	0.24
Uraria lagopodiodes (FABACEAE)					0.08		0.08		0.16	0.08	0.64	0.16	0.72
Vigna lanceolata (FABACEAE)	0.16		0.08		0.16	0.24	0.24		0.24				
Waltheria indica (STERCULIACEAE)	0.24	0.08	0.16		1.52				0.08				

Species	R1	R2	R8	R9	R10	FI	BA	SP	JB	TCI	TC2	TC3	TC4
Wedelia cunninghamii (ASTERACEAE)					0.4								
Xenostegia tridentate(CONVOLVULACEAE)					0.32				3.92	0.32			
Xyris complanata (XYRIDACEAE)	0.48												
Yakirra nulla (POACEAE)	0.16		0.64	1.68						0.08			
Yakirra pauciflora (POACEAE)	0.16	1.28	0.24		1.2								
Zornia chaetophora (FABACEAE)											0.16		
Zornia prostrata var. *prostrata* (FABACEAE)	0.32	0.16											_

Site Codes: RI - R10= Ranger 1 - Ranger 10, FI= Fisher Hills, BA= Barramundi, SP - Spring Peak, JB=Jabiluka, TCI - TC4= Tin Camp 1 - Tin Camp 4

[a] maximum mean density (number of plants / m^2) recorded at the site in any month during the growing season

[b] Family name

[c] Mean, derived from 25, 0.5m^2 sample quadrats

Appendix 4 Biomass[a] of herbaceous species at each site

	SITES												
Species	**R1**	**R2**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**JB**	**TC1**	**TC2**	**TC3**	**TC4**
Alloteropsis semialata (POACEAE)[b]	11.91[c]	0.706	3.706	11.026	11.575	2.384	3.828	0.730	0.956	9.160		0.46	
Alysicarpus schomburgkii (FABACEAE)	0.27	0.002	0.066	0.001	0.333			0.045	0.004	0.113	0.154	0.103	0.568
Ampelocissus acetosa (VITACEAE)	1.36		6.99		22.68					0.009			2.58
Aristida holathera var. *holathera* (POACEAE)	0.62		0.32		0.97		4.57	1.42	1.521	1.78			
Aristida superpendens (POACEAE)				5.40			1.79	0.86					
Aristolochia holtzei (ARISTOLOCHIACEAE)	0.003		0.01		0.005								
Arthrostylis aphylla (CYPERACEAE)	2.44	0.21	0.81	4.60	0.07		0.04	1.19					
Bonamia brevifolia (CONVOLVULACEAE)		0.009		2.23			0.04	0.54					
Bonamia pannosa (CONVOLVULACEAE)	0.18	0.02			0.49								
Spermacoce breviflora (RUBIACEAE)	2.61						1.48						
Spermacoce stenophylla (RUBIACEAE)			0.11		4.10								
Spermacoce leptoloba (RUBIACEAE)						0.20	1.3				0.13	0.04	3.32
Spermacoce aequabilis (RUBIACEAE)	0.37	1.85	2.9	5.96	0.30		2.17	0.23		2.56			
Spermacoce erectiloba (RUBIACEAE)						1.20			1.43				
Urochloa holosericea (POACEAE)	0.02	0.03	0.15	0.25	0.08	0.06			0.13	1.86		0.28	
Brunoniella linearifolia (ACANTHACEAE)	0.04		0.19		0.23				0.001		0.02	0.03	0.01
Buchnera linearis (SCROPHULARIACEAE)	0.02		0.00	0.21	0.49					0.18	0.18	6.99	0.27
Bulbostylis barbata (CYPERACEAE)		0.05	0.15	0.11	0.14								
Calandrinia uniflora (PORTULACACEAE)	1.09	8.29			0.17								
Cartonema parviflorum (COMMELINACEAE)	0.04												
Cartonema spicatum (COMMELINACEAE)	0.28	0.05	0.08		0.28		1.04	0.12	0.42	0.71	0.01	0.12	0.06
Cassytha aurea (LAURACEAE)		0.30											
Cayratia trifolia (VITACEAE)					0.38								
Chamaecrista mimosoides (CAESALPINIACEAE)	0.02					0.004	0.01	0.26	0.01	0.006		0.06	0.04
Cheilanthes fragillima (ADIANTACEAE)							1.20	0.03					
Cheilanthes hirsuta (ADIANTACEAE)										0.52			
Cheilanthes nitida (ADIANTACEAE)	0.01		0.16	0.57									
Cheilanthes praetermissa (ADIANTACEAE)								0.06					
Chlorophytum laxum (LILIACEAE)	0.15	0.005	0.22	0.07	0.06	0.14	0.08	0.006		0.02	0.03	0.07	0.16

	SITES												
Species	**R1**	**R2**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**JB**	**TC1**	**TC2**	**TC3**	**TC4**
Chrysopogon fallax (POACEAE)	0.11				3.02					37.6	87.3	158.5	99.1
Cleome tetrandra var. *tetrandra* (CAPPARACEAE)					0.49								
Commelina ensifolia (COMMELINACEAE)	0.11	0.29	1.39		1.21				1.15				
Crotalaria brevis (FABACEAE)	0.39		0.13	0.27	0.005								
Crotalaria medicaginea (FABACEAE)	0.19	0.20	0.02	0.002	0.15					0.01			
Crotalaria montana (FABACEAE)		0.003			0.03	0.03	0.27	0.22	0.01	0.02		0.12	0.09
Curculigo ensifolia var. *ensifolia* (LILIACEAE)					0.46		0.03				0.05		
Cyperus sporobolus (CYPERACEAE)									0.84				
Desmodium brownii (FABACEAE)	0.06	0.003	0.20	0.13	0.01	0.01	0.33	0.17		0.16			
Desmodium pycnotrichum (FABACEAE)	0.006		0.05		0.59			029	0.007				
Desmodium pulleni (FABACEAE)					0.57		0.25			0.05			0.12
Desmodium glareosum (FABACEAE)	0.05	0.01				14.4							
Digitaria gibbosa (POACEAE)	0.08	0.22	0.33	1.15	0.40	1.36	0.06	0.01	0.65	0.41		0.06	0.01
Drosera petiolaris (DROSERACEAE)	0.32	0.07		0.36	0.12	0.14	0.23	0.07		1.34	0.08	0.39	0.84
Dunbaria singuliflora (FABACEAE)							0.22						
Eragrostis sp. (POACEAE)							0.72						
Eragrostis cumingii (POACEAE)							0.17						
Eriachne agrostidea (POACEAE)		6.48	0.01	0.11		1.35							
Eriachne avenacea (POACEAE)						20.3		0.79		0.53			
Eriachne basedowii (POACEAE)				4.01									
Eriachne ciliata (POACEAE)	0.36	2.64	0.05	2.09		2.89	0.46		0.02				
Eriachne obtusa (POACEAE)		10.8		3.17		1.43	9.27		14.47	4.08		0.92	2.07
Eriachne schultziana (POACEAE)										1.13			
Eriachne semiciliata (POACEAE)				0.97									
Eriachne sulcata (POACEAE)						7.09							
Eulalia annua (POACEAE)			0.13										
Eulalia mackinlayi (POACEAE)							13.27						
Euphorbia muelleri (EUPHORBIACEAE)							.25						
Euphorbia schizolepis (EUPHORBIACEAE)					1.957								
Euphorbia schultzii (EUPHORBIACEAE)	0.06	0.02	0.02	0.03	0.06		0.07	0.01	0.006	0.12		0.03	

	SITES												
Species	**R1**	**R2**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**JB**	**TC1**	**TC2**	**TC3**	**TC4**
Euphorbia vachellii (EUPHORBIACEAE)											0.22		0.33
Evolvulus alsinoides(CONVOLVULACEAE)	0.56		0.03	0.07	0.20					0.03			
Fimbristylis caloptera (CYPERACEAE)	0.14	0.62	0.01		1.41								
Fimbristylis cinnamometorum (CYPERACEAE)	0.31						2.10			0.41	0.04	017	0.09
Fimbristylis densa (CYPERACEAE)	0.08			0.10									
Fimbristylis macrantha (CYPERACEAE)							1.47	0.99	2.76				
Fimbristylis oxystachya (CYPERACEAE)					0.11								
Fimbristylis pachyptera (CYPERACEAE)				0.02		0.09	0.11			0.64			
Fimbristylis pterygosperma (CYPERACEAE)				0.08		0.40				1.46	3.40	1.93	2.01
Fimbristylis schultzii (CYPERACEAE)	0.34	0.08	0.33	0.15	0.001	0.09							
Fimbristylis sp. Latz spB (CYPERACEAE)							0.31						
Fimbristylis xyridis (CYPERACEAE)						0.26				1.21	1.04	2.02	0.45
Flemingia parviflora (FABACEAE)			2.48	0.02	2.06								
Galactia sp. (FABACEAE)								4.03					
Galactia tenuiflora (FABACEAE)		0.56	5.85		11.19				7.70	1.68			
Gomphrena canescens (AMARANTHACEAE)	2.02	0.25											
Gomphrena diffusa (AMARANTHACEAE)	1.03				0.06								
Gonocarpus leptothecus (HALORAGACEAE)				0.03									
Goodenia armstrongiana (GOODENIACEAE)							0.26	0.01		0.29	0.06	0.20	0.05
Goodenia coronopifolia (GOODENIACEAE)	0.02			0.10			0.39	0.24		0.05			
Goodenia holtzeana (GOODENIACEAE)	0.09	0.01		0.28	0.03					0.01			0.22
Goodenia janamba (GOODENIACEAE)							0.49						
Goodenia leiosperma (GOODENIACEAE)			0.10		0.19								
Marsdenia trinervis (ASCLEPIADACEAE)					0.43								
Haemodorum brevicaule (HAEMODORACEAE)	0.24						0.67	0.98	2.30	0.01			
Haemodorum coccineum (HAEMODORACEAE)	1.39		0.70			0.65			1.07				
Haemodorum parviflorum (HAEMODORACEAE)										0.18	0.07	0.33	0.15
Helicteres dentata var. *dendata* (STERCULIACEAE)							2.44	9.15					
Helicteres sp. Darwin (STERCULIACEAE)			1.49	1.36	1.83								
Heliotropium alcyonium (BORAGINACEAE)					0.84								

	SITES												
Species	**R1**	**R2**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**JB**	**TC1**	**TC2**	**TC3**	**TC4**
Heliotropium foliatum (BORAGINACEAE)					0.02				0.36				
Heliotropium ventricosum (BORAGINACEAE)	0.01		0.23	0.03	0.37	0.08	0.01	0.01		0.47	0.03	0.19	0.13
Herb sp							0.16		0.006				
Heteropogon contortus (POACEAE)												4.10	
Heteropogon triticeus (POACEAE)	9.95	5.09	40.8	10.0	31.7	0.55	1.47	1.20	31.12	20.81	18.91	6.59	21.32
Hybanthus enneaspermus ssp. *enneaspermus* (VIOLACEAE)	0.05												
Indigofera linifolia (FABACEAE)					0.274					0.003		0.01	
Indigofera parviflora (FABACEAE)										0.02	0.007	0.015	0.54
Iphigenia indica (LILIACEAE)				0.00			0.01					0.01	
Ipmoea abrupta (CONVOLVULACEAE)					0.21								
Ipmoea diversifolia (CONVOLVULACEAE)			1.11		0.42								
Ipmoea graminea (CONVOLVULACEAE)		0.28		0.15			0.34	0.20	0.15	1.58	1.24	1.57	1.95
Kailarsenia suffruticosa (RUBIACEAE)			0.74	0.28	0.11				0.58	0.66	0.49		0.23
Lomandra tropica (XANTHORRHOEACEAE)	0.88	0.147					0.33		7.06				
Marsdenia annae (ASCLEPIADACEAE)	0.007			0.02									
Marsdenia viridiflora (ASCLEPIADACEAE)					0.02								
Merremia quinata (CONVOLVULACEAE)					13.39								
Minuria macrorhiza (ASTERACEAE)	1.27	0.91	0.09		0.20								
Mitrasacme connata (LOGANIACEAE)	0.12	0.21	0.12	2.24									
Mitrasacme exserta (LOGANIACEAE)				0.03									
Mitrasacme glaucescens (LOGANIACEAE)							0.00						
Mitrasacme latiflora (LOGANIACEAE)							0.08						
Mitrasacme nudicaulis (LOGANIACEAE)											0.009	0.005	0.03
Mnesithea formosa (POACEAE)	0.02	0.05	0.18	0.00	0.08	1.24	0.32	0.10		2.68	5.69	2.03	8.53
Mnesithea rottboellioides (POACEAE)					2.58								
Murdannia graminea (COMMELINACEAE)	0.41	0.21	0.04	0.07	0.38		0.46	0.81	0.07	0.13	0.25	0.16	0.05
Neptunia gracilis (MIMOSACEAE)													0.09
Nervilia holochila (ORCHIDACEAE)					0.004								
Oldenlandia laceyi (RUBIACEAE)												0.01	

	SITES												
Species	**R1**	**R2**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**JB**	**TC1**	**TC2**	**TC3**	**TC4**
Pachynema sphenandrum (DILLENIACEAE)	0.45		0.60	0.29	1.39	0.38	0.83	0.08		0.08			
Panicum mindanaense (POACEAE)					2.97					0.13		0.03	
Patersonia macrantha (IRIDACEAE)									2.14				
Phyllanthus eutaxioides (EUPHORBIACEAE)										0.92			
Phyllanthus virgatus (EUPHORBIACEAE)							0.24	0.10		0.09			
Polycarpaea holtzei (CARYOPHYLLACEAE)	0.07	0.18	0.002	0.009	0.08	0.01							
Polycarpaea longiflora (CARYOPHYLLACEAE)				0.01	0.09								
Polycarpaea violacea (CARYOPHYLLACEAE)	0.11	2.35			0.04								
Polygala longifolia (POLYGALACEAE)										0.01	0.01	0.002	0.02
Polygala orbicularis (POLYGALACEAE)			0.004		0.21		0.02			0.03			
Polygala triflora (POLYGALACEAE)	0.06		0.07	0.03	0.08			0.17	0.006				
Polygala eriocephala (POLYGALACEAE)											0.03	0.11	
Polygala arvensis (POLYGALACEAE)								0.02		0.03	0.08	0.18	0.13
Polygala sp. Cahill (POLYGALACEAE)	0.03	0.02	0.02	0.02			0.007	0.006		0.007			
Poranthera microphylla (EUPHORBIACEAE)								0.01					
Portulaca bicolor var. *bicolor* (PORTULACACEAE)	0.27	0.62	0.02	0.01	0.08								
Pseudopogonatherum irritans (POACEAE)	0.01		0.11	0.04						6.08	0.70	0.20	0.38
Ptilotus corymbosus (AMARANTHACEAE)	0.19		0.02		0.02								
Ptilotus distans (AMARANTHACEAE)	0.02				0.02				0.22				
Rhynchospora sp. (CYPERACEAE)						0.05							
Rhynchospora longisetis (CYPERACEAE)	0.002									0.46	2.48	1.10	0.65
Sauropus brunonis (EUPHORBIACEAE)			0.51						0.67				
Sauropus ditassoides (EUPHORBIACEAE)								0.02	1.37	0.03			
Sauropus paucifolius (EUPHORBIACEAE)				0.04					0.04				
Sauropus stenocladus ssp *stenocladus* (EUPHORBIACEAE)	0.19	0.22	1.62	0.20			0.35				0.31	0.006	1.51
Sauropus glaucus (EUPHORBIACEAE)						0.53	0.43						
Schizachyrium crinizonatum (POACEAE)	0.01												
Schizachyrium fragile (POACEAE)	6.32	1.87	1.07	0.14	0.36	1.65	0.06	0.04	0.24	37.0	3.06	4.37	1.23
Schizachyrium pseudeulalia (POACEAE)												0.14	
Scleria annularis (CYPERACEAE)	0.58		0.40	0.07	1.08				0.027				

	SITES												
Species	**R1**	**R2**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**JB**	**TC1**	**TC2**	**TC3**	**TC4**
Scleria novae hollandiae (CYPERACEAE)		0.02											
Scleria sphacelata (CYPERACEAE)							0.80						
Sebastiania chamaelea (EUPHORBIACEAE)					0.24				0.36	0.29			
Sehima nervosum (POACEAE)					3.32	4.20				1.77	26.1	10.3	6.63
Senna heptanthera (CAESALPINIACEAE)										0.27			
Senna oligoclada (CAESALPINIACEAE)							0.42	0.08					
Setaria apiculata (POACEAE)			0.01						0.077				
Sorghum brachypodum (POACEAE)	71.8	116.9	110.5	122.9	110.5		18.9	71.3	95.8				
Sorghum intrans (POACEAE)						111.7							_ -
Sorghum plumosum var. *plumosum* (POACEAE)						19.6	39.6			22.0	16.8	2.6	15.4
Sporobolus pulchellus (POACEAE)	0.02		0.05	0.15						0.49			
Stackhousia intermedia (STACKHOUSIACEAE)	0.10	0.09	0.40	0.24	0.001			0.05		0.09	0.17	1.42	0.12
Stemona australiana (STEMONACEAE)			0.01		3.80								
Stemona prostrata (STEMONACEAE)									0.21				
Striga curviflora (SCROPHULARIACEAE)					0.02								
Stylidium rotundifolium (STYLIDIACEAE)												0.06	
Stylidium leptorrhizum (STYLIDIACEAE)	0.006		0.02	0.007							0.009		0.05
Tacca leontopetaloides (TACCACEAE)			0.14		0.06				0.01				
Tephrosia leptoclada (FABACEAE)										0.12	0.38	0.65	0.77
Tephrosia remotiflora (FABACEAE)	6.64	0.53	0.87	0.31	6.60	1.11	0.18	1.18					
Tephrosia reticulata (FABACEAE)				1.44									
Tephrosia sp. 4 (FABACEAE)	0.06												
Thaumastochloa major (POACEAE)	0.25	0.04	3.10	0.59	0.01				0.17	0.02			
Thecanthes punicea (THYMELAEACEAE)	0.04	0.01	0.12	0.12				0.08	0.02		0.004		0.01
Themeda triandra (POACEAE)					19.7								
Thysanotus banksii(LILIACEAE)											0.04	0.06	
Trianthema rhynchocalyptra (AIZOACEAE))		0.02											
Tribulopsis pentandra (ZYGOPHYLLACEAE)		0.02			0.10	0.06							
Triodia procera (POACEAE)							39.5		0.60				
Typhonium cochleare (ARACEAE)					0.05								
Typhonium russell smithii (ARACEAE)												0.008	0.02

	SITES												
Species	**R1**	**R2**	**R8**	**R9**	**R10**	**FI**	**BA**	**SP**	**JB**	**TC1**	**TC2**	**TC3**	**TC4**
Uraria lagopodiodes (FABACEAE)					0.25		0.13		0.30	0.45	0.96	0.25	1.19
Vigna lanceolata (FABACEAE)	0.02		0.02		0.03	0.01	0.05		0.01				
Waltheria indica (STERCULIACEAE)	0.99	0.29	0.43		0.82				0.22				
Wedelia cunninghamii (ASTERACEAE)					5.02								
Xenostegia tridentate (CONVOLVULACEAE)					0.06				0.32	0.07			
Xyris complanata (XYRIDACEAE)	1.24												
Yakirra nulla (POACEAE)	0.01		0.05	0.34						0.05			
Yakirra pauciflora (POACEAE)	0.02	0.05	0.03		0.05								
Zornia chaetophora (FABACEAE)											0.06		
Zornia prostrata var. *prostrata* (FABACEAE)	0.15	0.01											
Total biomass production of site	**132.06**	**164.18**	**193.01**	**185.04**	**277.06**								

Site Codes: R1 – R10 - Ranger 1 - Ranger 10, FI = Fisher Hills, BA = Barramundi, SP = Spring Peak, JB = Jabiluka, TC 1 - TC4 = Tin Camp 1 - Tin Camp 4

[a] maximum mean biomass (g dry weight / m^2) recorded at the site in any month during the growing season

[b] Family name

[c] Mean, derived from 25, 0.5m^2 sample quadrats

Appendix 5 Two-way classification of sites and species for tree and shrub vegetation

	Sites																			
Species(life form)	**R01**	**R07**	**R02**	**R08**	**R03**	**R09**	**Buk**	**R06**	**Jab**	**R04**	**R05**	**Cah**	**R10**	**Fis**	**Bar**	**Spk**	**TC1**	**TC2**	**TC4**	**TC3**
Triumfetta sp. (SH)																+				
*Acacia praelongata (*TR)																+				
Psydrax attenuatum (TR)																+				
Tephrosia spechtii (SH)																+				
Tephrosia filipes (SH)																+				
Terminalia canescens (TR)															+	+				
***Corymbia dichromophloia* (TR)**														5	5	4				
Tephrosia polyzyga (SH)														+	+	+				
Corymbia dunlopiana (TR)														+		+				
Corymbia polysciada (TR)														+	+	+			+	
Erythroxylum ellipticum (TR)														+		+	+			
Indigofera saxicola (SH)												+		+		+	+			
Acacia sublanata (SH)															+					
Eucalyptus tintinans (TR)														+						
Tephrosia sp.*carriemichelliae* (SH)														+						
***Corymbia porrecta* (TR)**	3	3	3	3	3	+	3	4	3	+	+	+		3				+		
***Corymbia bleeseri* (TR)**	+	3	+	+		3	+		+	+	+	3								
***Acacia oncinocarpa* (SH)**	+	+	+	+			+		+	3	5	+								
Persoonia falcata (TR)	+	+	+	+	+	+		+	+	+		+	+							
***Eucalyptus miniata* (TR)**	3	+	4	4	4	3	+	+	3	+		3			3				+	
Acacia mimula (TR)	+	+	+	+	+	+	+	+	+	+	+	+			+	+				
Dolichandrone filiformis (TR)	+	+			+			+	+	+	+									+
***Eucalyptus tetrodonta* (TR)**	5	4	3	5	4	4	4	5	5	4	3	4	5		+	+	+			
Planchonia careya (TR)	+	+	+	+	+	+	+	+	+	+	+	+	+			+	+			
Terminalia ferdinandiana (TR)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+			
***Petalostigma quadriloculare* (SH)**	4	4	4	4	3	5	4	5	4	+		5	+	3	4	4	+			
***Xanthostemon paradoxus* (TR)**	3	4	3	3	3	3	3	+	+	3	3		+	+	+	3				
***Buchanania obovata* (TR)**	+	+	+	+	+	+	+	+	3	+	+	+	+		+	+	+	+	+	
Grevillea decurrens (TR)	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Gardenia megasperma (TR)	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+
Wrightia saligna (TR)	+	+	+				+		+	+	+	+	+		+	+				
Corymbia disjuncta (TR)						+	+	+		+	+	+	+		+		+	+		
Brachychiton megaphyllus (TR)		+		+	+		+	+		+		+	+		+	+	+		+	
Pogonolobus reticulatus (TR)	+						+	+		+		+	+		+					
Pouteria arnhemica (TR)		+	+	+			+	+	+				+		+					
Livistona humilis (TR)						+	+	+	+			+	+		+	+				
Jasminum molle (SH)				+	+			+	+			+	+							
Stenocarpus acacioides (TR)				+				+	+			+	+			+				
Croton arnhemicus (TR)				+			+		+			3			+					
Clerodendrum floribundum (TR)				+	+			+	+			+								
***Corymbia chartacea* (TR)**				+		+	4		+			4					+			
***Eucalyptus tectifica* (TR)**							+						3	+		3	3	3	3	+
***Calytrix achaeta* (SH)**		+				+								4	3	+	3	+		+
***Erythrophleum chlorostachys* (TR)**		+					+	4	+			+	3	+	+	3	+		+	
Cochlospermum fraseri (TR)		+					+	+	+				+	+	+	+	+	+	+	+
Calytrix exstipulata (SH)				+				+		+						+				+
***Galactia megalophylla* (SH)**	3	3				+		3		+	+			+				+		
Grevillea mimosoides (TR)	+	+						+					+	+						
Pachnema hooglandii (SH)									+								+	+	+	

Terminalia pterocarya (TR)					+		+		+	+					+				
***Acacia difficilis* (SH)**			+	+					+	3	+				+				
Acacia gonocarpa (SH)		+	+												+				
Distichostemon arnhemicus (SH)			+																
Melaleuca viridiflora (TR)									+	+									
Petalostigma pubescens (TR)										+									
***Eucalyptus latifolia* (TR)**	+			3						3		3							
Pandanus spiralis (TR)										+		+							
Capparis umbonata (TR)									+	+		+							
Terminalia grandiflora (TR)												+							
Acacia lamprocarpa (TR)							+					+							
Grewia mesomischa. (SH)							+					+							
Premna acuminata (SH)							+					+							
Acacia hemignosta (TR)												+				+	+	+	
Hakea arborescens (TR)												+				+	+	+	
Corymbia foelscheana (TR)												3			+	3	3	+	
Ficus aculeata (TR)												+					+		
***Eucalyptus pruinosa* (TR)**																+		5	
Tephrosia nematophylla (SH)																+		+	
Helicteres cana (SH)																	+		
Corymbia papillosa (TR)																	+		
Acacia umbellata (SH)															+				
Grevillea goodii (SH)															+				
Corymbia oocarpa (TR)															+		+		
Brachychiton diversifolius (TR)												+			+				
Antidesma ghesaembilla (SH)												+			+				
Vitex glabrata (TR)							+								+				
Grevillea heliosperma (TR)											+								
Acacia multisiliqua (SH)											+								
Grevillea dryandri (SH)											+								
Boronia lanuginose (SH)											+								
Pityrodia quadrangulata (SH)											+								
Hibbertia lepidota (SH)											+								
Denhamia obscura (TR)				+							+								
Terminalia carpentariae (TR)									+		+			+					
Owenia vernicosa (TR)									+		+			+					
Phyllanthus grandisepalus (SH)											+			+					
Acacia humifusa (SH)											+			+					
***Eucalyptus phoenicea* (TR)**											5			5					
Pachnema junceum (SH)		+								+	+			+					
Alphitonia excelsa TR	+	+							+					+					
Senna leptoclada (SH)									+										
Terminalia latipes (TR)									+										
***Jacksonia dilatata* (SH)**									3										
Acacia conspersa (TR)									+										
Exocarpus latifolius (TR)									+										
Tephrosia savannicola (SH)									+										
Syzygium eucalyptoides (TR)									+										
Hibbertia sp. Softly hairy (SH)									+										
***Livistona inermis* (TR)**						3			+										
Acacia dimidiata (TR)	+								+		+								
Hibbertia dealbata (SH)									+			+							
Acacia latescens (TR)									+			+							
Pavetta brownii (TR)									+			+							

Lifeform codes: SH = shrub, = TR= tree; **Stem volume class codes**: For trees: 5= >30m^3/ha; 4= 16-30m^3/ha; 3= 5-16m^3/ha; += <5m^3/ha; For shrubs: 5= >6.0m^3/ha; 4= 3.0 - 6.0m^3/ha; 3= 1.0 - 3.0m^3/ha; += <1.0m^3/ha

Appendix 6 Two-way classification of sites and species for tree and herbaceous vegetation

	Sites												
Species(life form)	R01	R08	R09	R02	R10	Jab	Bar	SPk	Fis	TC1	TC2	TC4	TC3
Cleome tetrandra (FO)					+								
Typhonium cochleare (FO)					+								
Ipomea abrupta (VN)					+								
Marsdenia viridiflora (VN)					+								
***Wedelia cunninghamii* (FO)**					3								
***Merremia quinata* (VN)**					4								
Fimbristylis oxystachya (SE)					+								
Nervillea holochila (FO)					+								
***Mnesithea rottboellioides* (GR)**					3								
***Themeda triandra* (GR)**					4								
Striga curviflora (FO)					+								
Cayratia trifoliata (VN)					+								
***Euphorbia schizolepis* (FO)**					3								
Marsdenia trinervis (FO)					+								
Heliotropium alcyonium (FO)					+								
Desmodium pulleni (FO)					+		+			+		+	
Polygala orbicularis (FO)		+			+		+			+			
Curculigo ensifolia (FO)					+		+				+		
***Panicum mindanaense* (GR)**					3					+			+
Indigofera linifolia (FO)					+					+			+
Uraria lagopodiodes (FO)					+					+	+	+	+
***Sehima nervosum* (GR)**					3				3	3	4	3	4
***Chrysopogon fallax* (GR)**	+				3					4	5	5	5
Goodenia holtzei (FO)	+		+	+	+					+		+	
Evolulus alsinoides (FO)	+	+	+		+					+			
Crotalaria medicaginea (FO)	+	+	+	+	+					+			
***Thaumastochloa major* (GR)**	+	3	+	+	+	+				+			
***Ampelocissus acetosa* (VN)**	3	3			4					+		3	
Sporobolus pulchellus (GR)	+	+	+							+			
Yakirra nulla (GR)	+	+	+							+			
***Arthrostyiis aphylla* (SE)**	3	+	3	+	+		+	+					
***Tephrosia remotiflora* (FO)**	3	+	+	+	3		+	+	+				
***Sorghum brachypodum* (GR)**	4	5	5	5	5	5	4	4					
Desmodium brownii (FO)	+	+	+	+	+		+	+	+	+			
***Spermacoce aequabilis* (FO)**	+	3	3	3	+		3	+		3			
Pachynema sphenandrum (FO)	+	+	+		3		+	+	+	+			
Eriachne ciliata (GR)	+	+	3	3		+	+		3				
Polygala sp. Cahill (FO)	+	+	+	+			+	+		+			
Vigna lanceolata (VN)	+	+			+	+	+		+				
***Aristida holathera* (GR)**	+	+			+	3	3	3		3			
***Schizachrium fragile* (GR)**	3	+	+	3	+	+	+	+	3	4	3	3	3
***Heteropogon triticeus* (GR)**	4	4	4	3	4	4	3	3	+	4	4	4	3
Murdannia graminea (FO)	+	+	+	+	+	+	+	+		+	+	+	+
***Digitaria gibbosa* (GR)**	+	+	+	+	+	+	+	+	3	+		+	+
Cartonema spicata (FO)	+	+		+	+	+	+	+		+	+	+	+
***Drosera petiolaris* (FO)**	+		+	+	+		+	+	+	3	+	+	+
Heliotropium ventricosum (FO)	+	+	+		+		+	+	+	+	+	+	+
Chlorophytum laxum (FO)	+	+	+	+	+		+	+	+	+	+	+	+
***Mnesithea formosa* (GR)**	+	+	+	+	+		+	+	3	3	3	4	3
Alysicarpus schomburgkii (FO)	+	+	+	+	+	+		+		+	+	+	+
***Stackhousia intermedia* (FO)**	+	+	+	+	+			+		+	+	+	3

	Sites												
Species(life form)	**R01**	**R08**	**R09**	**R02**	**R10**	**Jab**	**Bar**	**SPk**	**Fis**	**TC1**	**TC2**	**TC4**	**TC3**
Euphorbia schultzii (FO)	+	+	+	+	+	+	+	+		+			+
***Alloteropsis semialata* (GR)**	4	3	4	+	4	+	3	+	3	4			+
***Brachiaria holosericea* (GR)**	+	+	+	+	+	+			+	3			+
Chamaecrista mimosoides (FO)	+					+	+	+	+	+		+	+
***Ipomea graminea* (VN)**			+	+		+	+	+		3	3	3	3
***Eriachne obtusa* (GR)**			3	4		4	4		3	3		3	+
Crotalaria montana (FO)				+	+	+	+	+	+	+		+	+
***Pseudopogonatherum irritans* (GR)**	+	+	+							3	+	+	+
***Buchnera linearis* (FO)**	+	+	+		+					3	+	+	+
Stylidium leptorrhizum (FO)	+	+	+								+	+	
Kailarsenia suffruticosa (FO)		+	+		+	+				+	+	+	
Brunoniella linearis (FO)	+	+			+	+					+	+	+
Thecanthes punicea (FO)	+	+	+	+		+		+			+	+	
***Sauropus stenocladus* ssp *stenocladus* (FO)**	+		+	+			+				+	3	+
***Spermacoce breviflora* (FO)**	3						3						
***Lomandra tropica* (FO)**	+			+		3	+						
***Haemodorum brevicaule* (FO)**	+					3	+	+		+			
Goodenia coronopiifolia (FO)	+		+				+	+		+			
***Bonamia brevfolia* (FO)**			3	+			+	+					
***Aristida superpendens* (GR)**			3				3	+					
Fimbristylis pachyptera (SE)			+				+		+	+			
Iphigenia indica (FO)			+				+						+
***Eriachne avenacea* (GR)**								+	4	+			
Phyllanthus virgatus (FO)							+	+		+			
***Sauropus ditassoides* (FO)**						3		+		+			
Calandrinia uniflora (FO)	+			4	+								
***Polycarpea violacea* (FO)**	+			3	+								
Bonamia pannosa (FO)	+			+	+								
Ptilotus corymbosa (FO)	+	+			+								
Aristolochia holtzei (FO)	+	+			+								
Gomphrena diffusa (FO)	+				+								
***Minuria macrorhiza* (FO)**	3	+		+	+								
Yakirra pauciflora (GR)	+	+		+	+								
***Fimbristylis caloptera* (SE)**	+	+		+	3								
Bulbostylis barbata (SE)		+	+	+	+								
Portulaca bicolor (FO)	+	+	+	+	+								
Crotalaria brevis (FO)	+	+	+		+								
Polycarpea holtzei (FO)	+	+	+	+	+				+				
Fimbristylis schultzlii (SE)	+	+	+	+	+				+				
***Commelina ensifolia* (FO)**	+	3		+	3	+							
Waltheria indica (FO)	+	+		+	+	+							
Scleria annularis (SE)	+	+	+		+	+							
Desmodium pycnotrichum (FO)	+	+			+	+		+					
Polygala triflora (FO)	+	+	+		+	+		+					
***Galactia tenufolia* (VN)**		3		+	4	3				3			
***Borreria exserta* (FO)**		+			3								
Ipomea diversifolia (VN)		+			+								
Goodenia leiosperma (FO)		+			+								
***Stemona australiana* (VN)**		+			3								
Polycarpea longiflora (FO)			+		+								
***Flemingia parviflora* (FO)**		3	+		3								
Helicteres dentata var *dentata*. (FO)		3	3		3								
Ptilotus distans (FO)	+				+	+							

	Sites											
Species(life form)	**R01**	**R08**	**R09**	**R02**	**R10**	**Jab**	**Bar**	**SPk**	**Fis**	**TC1**	**TC2**	**TC4**	**TC3**
Tacca leontopetaloides (FO)		+			+	+							
Heliotropium foliatum (FO)					+	+							
Xenostegia tridentata (VN)					+	+				+			
Sebastiana chamaelea (FO)					+	+				+			
Tribulopsis pentandra FO				+	+				+				
Eriachne sp. (GR)			+										
Tephrosia reticulata (FO)			3										
Gonocarpus leptothecus (FO)			+										
Eriachne basedowii (GR)			3										
Mitrasacme exserta (FO)			+										
Trianthema rhynchocalyptera (FO)				+									
Scleria novaehollandiae (SE)				+									
Cassytha aurea (VN)				+									
Gomphrena canescens (FO)	3			+									
Zornia prostrata ssp *prostrata* (VN)	+			+									
Desmodium glareosum (FO)	+			+					4				
Fimbristylis densa (SE)	+		+										
Marsdenia annae (VN)	+		+										
Mitrasacme connata (FO)	+	+	3	+									
Cheilanthes nitida (FN)	+	+	+										
Haemodorum coccineum (FO)	3	+				+			+				
Eriachne agrostoides (GR)		+	+	3					3				
Cartonema parviflora (FO)	+												
Hybanthus enneaspermus (FO)	+												
Xyris complanata (FO)	3												
Schizachrium crinozonatum (GR)	+												
Tephrosia sp. (FO)	+												
Eulalia annua (GR)		+											
Sauropus sp. 2 (FO)		3											
Sauropus brunonis (FO)		+				+							
Setaria apiculata (GR)		+				+							
Sauropus pauciflora (FO)			+			+							
Eragrostis cumingii (GR)							+						
Eragrostis sp. (GR)							+						
Goodenia janamba (FO)							+						
Dunbaria singuliflora (VN)							+						
Eulalia mackinlayi (GR)							4						
Scleria sphacelata (SE)							+						
Euphorbia muelleri (FO)							+						
Mitrasacme glaucescens (FO)							+						
Mitrasacme latiflora (FO)							+						
Fimbristylis sp. (SE)							+						
Poranthera microphylla (FO)								+					
Cheilanthes praetermissa (FN)								+					
Galactia sp. (VN)								3					
Cheilanthes fragillima (FN)							3	+					
Senna oligoclada (FO)							+	+					
Helicteres dentata var *dentata* (FO)							3	4					
Spermacoce leptoloba (FO)							3		+				
Sauropus sp. 20 (FO)							+		+				
Rhynchospora sp. (SE)									+				
***Eriachne sulcata* (GR)**									3				
***Sorghum intrans* (GR)**									5				

	Sites											
Species(life form)	**R01**	**R08**	**R09**	**R02**	**R10**	**Jab**	**Bar**	**SPk**	**Fis**	**TC1**	**TC2**	**TC4**	**TC3**
***Fimbristylis macrantha* (SE)**						3	3	+					
Uraria lagopodiodes (FO)						+	+						
***Triodia procera* (GR)**						+	4						
Unknown herb species (FO)						+	+						
***Patersonia macrantha* (FO)**						3							
Cyperus sporobolus (SE)						+							
Stemona prostrata (VN)						+							
***Spermacoce erectiloba* (FO)**						3			3				
Eriachne schultziana (GR)										+			
Cheilanthes hirsuta (FN)										+			
Senna heptanthera (FO)										+			
Phyllanthus sp. (FO)										+			
Euphorbia vachelli (FO)											+	+	
Neptunia gracilis (FO)												+	
Zornia chaetophora (FO)											+		
Typhonium russell-smithii (FO)												+	+
Mitrasacme nudicaulis (FO)											+	+	+
***Spermacoce leptoloba* (FO)**											+	3	+
Thysanotus banksii (FO)											+		+
Polygala eriocephala (FO)											+		+
***Heteropogon contortus* (GR)**													3
Stylidium rotundifolium (FO)													+
Schizachrium pseudeulalia (GR)													+
Oldenlandia laceyi (FO)													+
***Fimbristylis cinnamometorum* (SE)**	+						3			+	+	+	+
***Rhynchospora longisetis* (SE)**	+									+	3	+	+
***Fimbristylis pterigosperma* (SE)**			+						+	3	3	3	3
Goodenia armstrongii (FO)							+	+		+	+	+	+
***Sorghum plumosum* (GR)**													
***Fimbristylis xyridis* (SE)**													
Polygala arvensis (FO)													
Haemodorum parviflorum (FO)													
Polygala longiflora (FO)													
Indigofera parviflora (FO)													
Tephrosia leptoclada (FO)													

Lifeform codes: FO = forb, FN = fern, GR = grass, SE = sedge, VN = vine

Biomass codes: 5 = >80g (dry wt)/m^2, 4 = 8 – 80g/m^2, 3 = 1.2 – 8g/m^2, + = <1.2g/m^2