Lose the plot: cost-effective survey of the Peak Range, central Queensland.

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Abstract: The Peak Range (22˚ 28' S; 147˚ 53' E) is an archipelago of rocky peaks set in grassy basalt rolling-plains, east of Clermont in central Queensland. This report describes the flora and vegetation based on surveys of 26 peaks. The survey recorded all plant species encountered on traverses of distinct habitat zones, which included the 'matrix' adjacent to each peak. The method involved effort comparable to a general flora survey but provided sufficient information to also describe floristic association among peaks, broad habitat types, and contrast vegetation on the peaks with the surrounding landscape matrix.

The flora of the Peak Range includes at least 507 native vascular plant species, representing 84 plant families. Exotic species are relatively few, with 36 species recorded, but can be quite prominent in some situations. The most abundant exotic plants are the grass *Melinis repens* and the forb *Bidens bipinnata*. Plant distribution patterns among peaks suggest three primary groups related to position within the range and geology. The Peak Range makes a substantial contribution to the botanical diversity of its region and harbours several endemic plants among a flora clearly distinct from that of the surrounding terrain. The distinctiveness of the range's flora is due to two habitat components: dry rainforest patches reliant upon fire protection afforded by cliffs and scree, and; rocky summits and hillsides supporting xeric shrublands. Plants endemic to the Peak Range are mainly associated with the latter of these habitats.

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Introduction

Massive rocky outcrops frequently harbour an interesting and unusual flora (Porembski and Barthlott 2000). Australian rock outcrops are depauperate in specialised succulent life-forms that have diversified on outcrops in other regions (Hopper *et al*. 1997, Clarke 2002a), but diversification has occurred among scleromorphic shrubs and herbs (Hunter 2003). Limited soil development and low water-holding capacity makes rock outcrops relatively arid environs. Rocky outcrops can provide sharp environmental contrasts with the landscape around them, which makes them interesting models by which to understand factors that control vegetation composition.

Knowledge of the unusual flora of rock outcrops is based mainly on flora surveys and the specimens and subsequent taxonomic descriptions that are their main products. Such knowledge allows regional or broader-scale accounts of biogeographic pattern and endemism (eg. Batianoff *et al*. 1991, Hopper *et al*. 1997). However, more detailed phytosociological and ecological studies of rock outcrop vegetation have generally been based on plot-based surveys (eg. Kirkpatrick *et al*. 1988, Gibson *et al*. 1992, Hunter and Clarke 1998), which require far greater investment of time and resources than flora surveys but yield more detailed insights into patterns and processes. This study attempts to steer a course between these two sampling strategies, to glean some information on pattern and process more typical of plot-based surveys using a plot-free, traverse-survey technique comparable to flora survey in its demand on resources.

Primarily, we provide a descriptive study of the vegetation of an archipelago of prominent rocky peaks set in grassy rolling basalt-plains in semi-arid central Queensland, the Peak Range. Similarities and differences between vegetation of the peaks and surrounding plains are described, and floristic patterns are analysed among peaks and also for habitats within peaks. The ecological processes underlying these patterns are discussed.

Methods

Study area

The Peak Range forms a north-west orientated chain of peaks 66 km from the northern-most Mt Castor (22˚28' S 147˚53' E) to the southern-most The Woolbale (22˚55' S, 148˚17' E) (Figure 1). The nearby town of Clermont receives an annual average of 660 mm rainfall, concentrated in the summer

months, and has annual mean maximum and minimum temperatures of 29.7˚C and 15.0˚C (Australian Bureau of Meteorology 2007).

The Peak Range and the surrounding fertile basalt plains are artefacts of volcanic activity from about 32 to 29 million years ago in the Tertiary period (Willmott 2006). The peaks include steep-sided plugs from volcanic vents, massive thrust domes produced by magma intrusions, and steep-sided basalt hills that are remnants of much-eroded Tertiary lava flows. Figure 2 provides photographs of some Peak Range landscapes.

The Peak Range includes two distinct clusters of plugs and domes of hard, light-coloured trachyte and rhyolite, one at each end of the range (Figure 1). The southern cluster includes the tallest peak in the range, Scotts Peak, which rises from its base at about 420 m ASL to an altitude of 854 m ASL. The middle section of the Peak Range consists of a series of steep-sided basalt hills, including the mesa-shaped Lords Table Mountain, capped by an erosion resistant layer of trachyandesite or trachyte, overlaying layers of basalt (Willmott 2006). Lords Table Mountain's slopes support the largest area of dry rainforest (semi-evergreen vine-thicket) in the Peak Range, and the 30 m cliffs that surround the mountain's top keep the summit plateau beyond the reach of domestic stock. The grassland vegetation on the plateau has been described (Fensham and Holman 1998) and is recognised as a unique regional ecosystem (11.8.10) within Queensland's state-wide land classification scheme (Sattler and Williams 1999).

Parts of the Peak Range are protected within the Peak Range National Park which has four disjointed sections that cover a total of 2500 ha; Wolfang Peak (172 ha), Gemini Mountains (787 ha), Lords Table (784 ha) and Eastern Peak (761 ha).

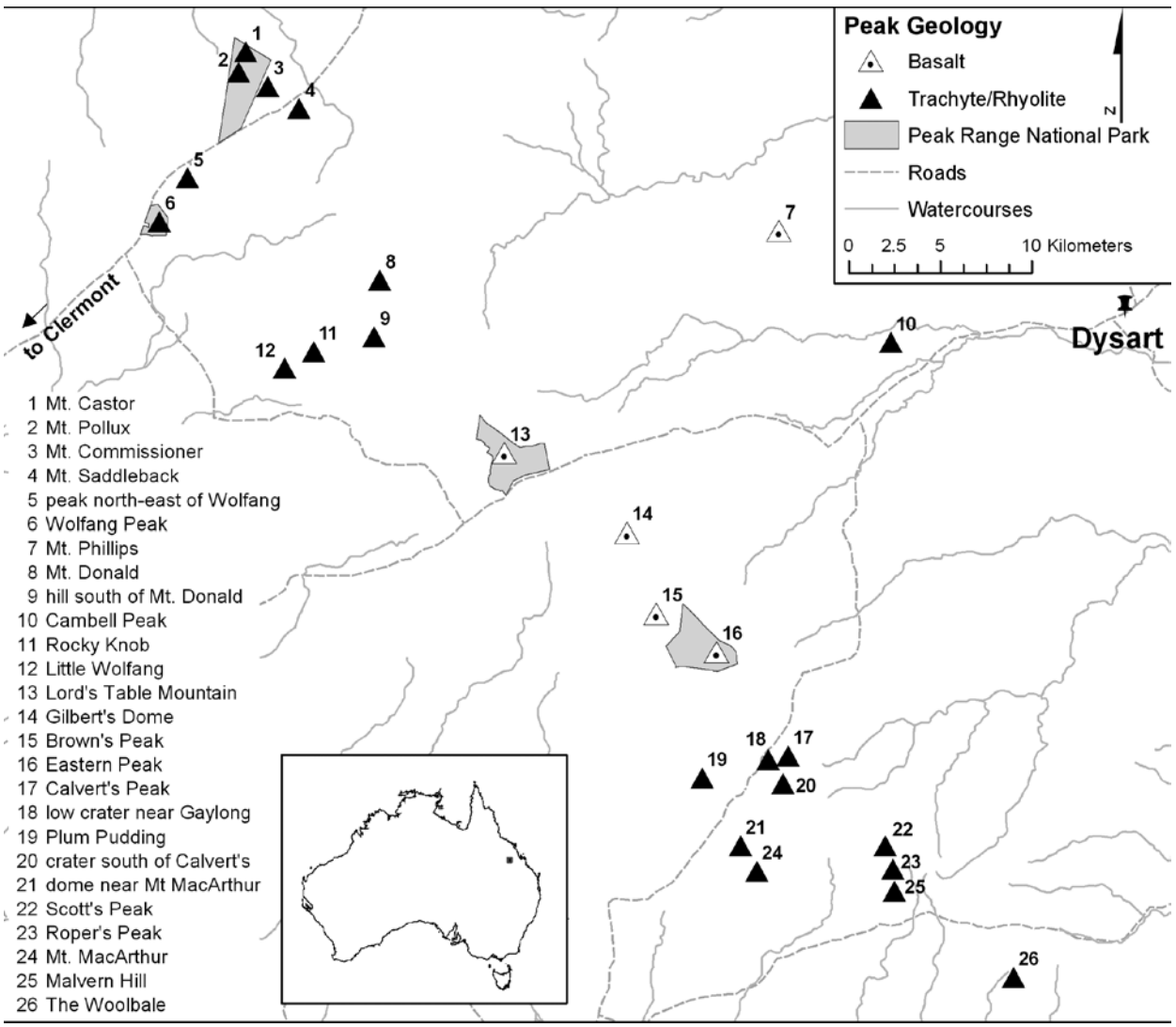

Fig. 1. A map showing the Peak Range National Park and the twenty-six features of the Peak Range included in this study. Symbols differentiate basalt hills from outcrops of trachyte or rhyolite.

Flora data and surveys

Vegetation surveys were undertaken in February and June 2006 and involved making full floristic lists for distinct habitat zones such as skeletal outcrop and soiled lower slopes. A list of species growing on the plain adjacent to each peak was also compiled. Voucher specimens are lodged at the Queensland Herbarium and nomenclature follows Bostock and Holland (2007).

Analysis

Analysis of plant distributions was undertaken at two scales: whole peaks (n = 26); and, individual habitats (n = 69). Flora data for the whole peak scale included 2006 survey data as well as records from the Queensland Herbarium's specimen database (HERBRECS), and previous survey's of Lords Table Mountain (Fensham 1995, Fensham & Holman 1998). A dissimilarity measure based on presence-absence data was calculated using Bray-Curtis Index. Classifications (UPGMA with Beta = -0.1) were run in PATN 3.0. The groups identified in the classification were further assessed in PRIMER 5.1 using ordination (NMDS) to visualise inter-relationships, SIMPER to assess the contributions of individual species to dissimilarity between groups of peaks or habitats, and ANOSIM to assess the robustness of the groups.

Average species richness and percentages of species in life-form classes were compared between habitat groups using Kruskal-Wallis tests with Wilcoxon rank-sum tests for subsequent pair-wise comparisons where overall differences were significant.

Nestedness in the distributions of species across peaks was assessed using 'The nestedness temperature calculator' of Atmar and Patterson (1995). In a strongly nested system the most hospitable habitat units (peaks in this case) harbour more species, especially uncommon species, whereas the least hospitable harbour a small subset of common species. The program ranks peaks from most to least hospitable and species from most stable (least likely to go extinct) to most tenuous in the system (Atmar and Patterson 1993). Stable species tend to be common or associated with hospitable peaks. The 'calculator' uses randomisation to estimate the probability of the degree of nestedness observed in a dataset occurring by chance.

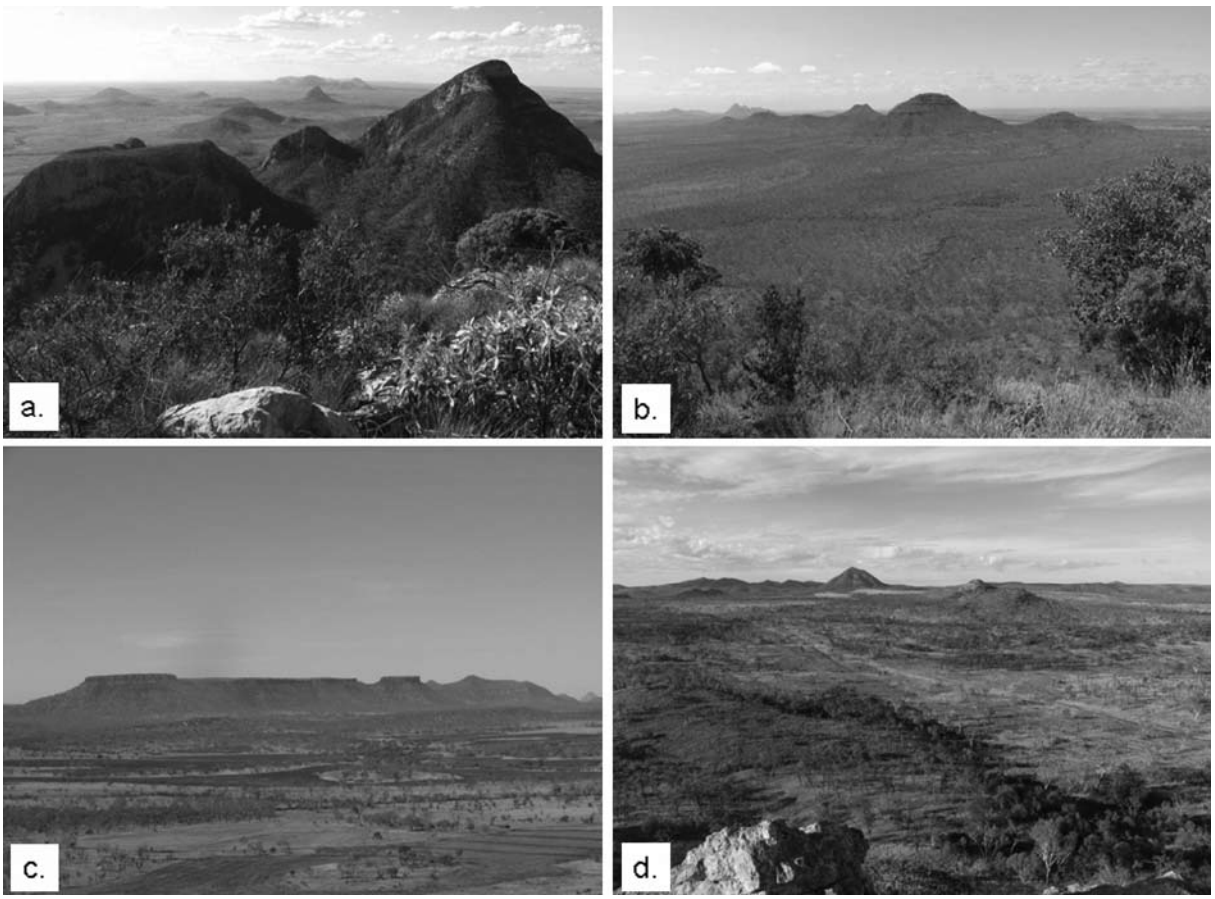

Fig. 2. Some Peak Range landscapes: **a.** southern section, looking north from Ropers Peak toward Scotts Peak, note the low profile thrust domes in the upper central section of the photograph; **b.** central section with steep-sided basalt hills, looking south from the top of Gilberts Dome to Browns Peak (centre top) and Eastern Peak (behind and left of Browns Peak); **c.** central section, Lords Table looking south from Little Wolfang; **d.** northern section of the range looking north-east from Little Wolfang past Rocky Knob (centre right) to Mt Donald (centre left).

Results

The flora of the Peak Range includes at least 507 native vascular plant species, representing 84 plant families. Exotic plants added a further 36 species and two additional families. A complete list is provided as an Appendix.

Table 1 provides details of plants endemic to the Peak Range as well as those listed as rare or threatened under Queensland's *Nature Conservation Act 1992* (NCA). They occur across the length of the range, and on both basalt and on trachyte/rhyolite peaks. The endemic *Acacia* species and *Plectranthus* species are all associated with very rocky habitats. Another endemic, *Trioncinia patens,* occurs on the lower slopes of three peaks.

Some plant populations on the Peak Range represent substantial range outliers. For example, *Cyperus cunninghamii* subsp. *cunninghamii* occurs atop Mt Castor but the nearest known population is over 800 km to the west near Cloncurry. *Prostanthera lithospermoides* occurs on Mt Donald but its nearest known population is 300 km to the south in the Carnarvon Ranges. Such outliers also tend to be associated with rocky habitats in the Peak Range.

Patterns among peaks

Analysis of plant distributions at the peak-scale, suggests a primary split based on geography rather than geology, between the peaks south from Calverts Peak and those further north (Figure 3, Groups A&B vs. C&D). The only exception was Mt Donald, which is in the northern part of the range but was placed in Group C among peaks from the south. Within the northern section the basalt hills (Group A) were differentiated from the trachyte/rhyolite peaks and domes (Group B). In the south, the major peaks (Group C) were differentiated from lower profile thrust domes which tend to support less variable vegetation (Group D), mainly very open woodlands of yellow-jackets (*Corymbia leichhardtii* and *Corymbia peltata*) with a sparse grassy understorey on shallow stony soil with patches of rock pavement.

Assessment of nestedness across the 26 peaks indicated a strongly non-random arrangement of species across peaks. However, there was also ample evidence for idiosyncratic species distributions, which indicate complex rather than strongly nested patterns. The rank of each peak from most to least hospitable is provided in Figure 3. The three most hospitable peaks were Lords Table Mountain, Mt Castor

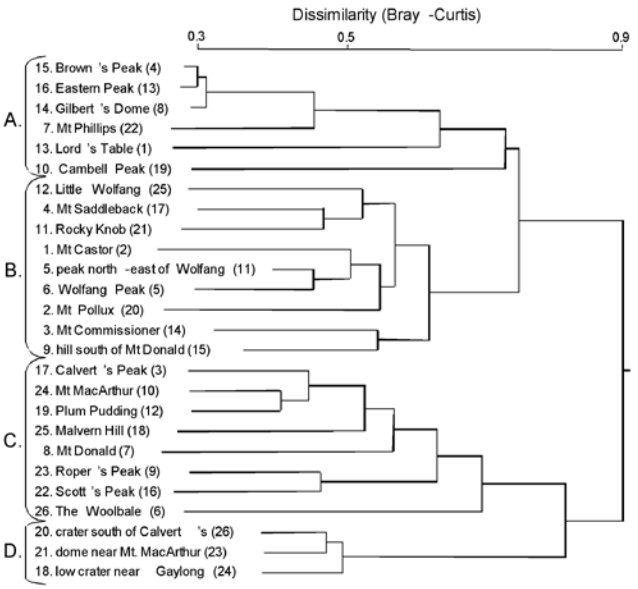

Fig. 3. A dendrogram showing relationships between 26 features of the Peak Range based on plant species presence and absence. Four main groups of peaks are identified by letters and brackets on the left of the diagram. The 'hospitability' rank for each feature, based on nestedness, is provided after its name in brackets. The classification method was flexible UPGMA (Beta = -0.10) on a Bray & Curtis dissimilarity matrix.

Table 1. Endemic and listed threatened plants of the Peak Range.

Species	NCA status	EPBC status	Endemicity	Peaks (key in fig. 1)
Acacia arbiana	Rare	-	endemic	4, 12, 17, 18, 19, 22, 23, 26
Acacia sp. (D.W. Butler 98)	-	-	endemic	1, 2
Acacia sp. (D.W. Butler+ 178)	-	-	probable endemic	8
Bertya pedicellata	Rare	-	not endemic	1, 4, 6, 8, 11, 17, 22, 23, 26
Cerbera dumicola	Rare		not endemic	26
Dichanthium queenslandicum	Vulnerable	Vulnerable	not endemic	matrix only
Persoonia amaliae	Rare	-	not endemic	23
Plectranthus actites	-	-	endemic	13
Plectranthus sp. (R.J. Fensham RJF5424)	-	-	probable endemic	26
Plectranthus sp. (D.W. Butler 179)	-	-	probable endemic	8
Trioncinia patens	-	-	endemic	1, 15, 16

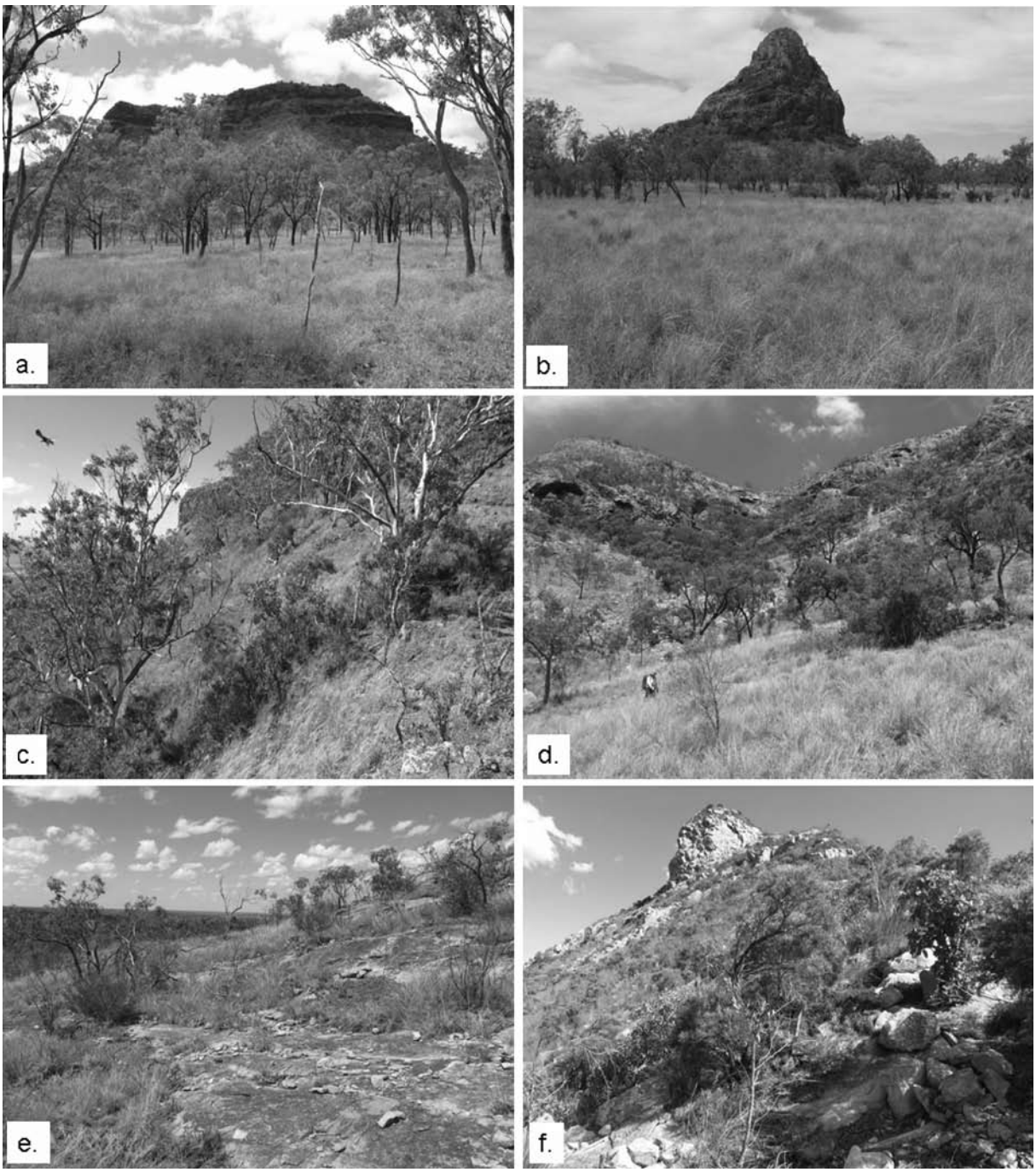

Fig. 4. Photographs of examples of three broad Habitats identified for the Peak Range. a. Habitat 1, grassy *Eucalyptus orgadophila, E. crebra* and *C. erythrophloia* woodland north of Gilberts Dome; b. Habitat 1, grassland and grassy *Eucalyptus orgadophila* woodland north of Wolfang Peak; c. Habitat 2, grassy *Eucalyptus orgadophila* woodland with patchy rainforest shrubs on the steep basaltic slopes of Browns Peak; d. Habitat 2, a mosaic of grassy *Corymbia trachyphloia* woodland, rainforest patches (eg. centre left), and rocky shrubland with spinifex on Mt Pollux; e. Habitat 3, rocky shrubland with low *Eucalyptus exserta* and *Acacia arbiana* on The Woolbale; f. Habitat 3, rocky shrubland atop Ropers Peak.

and Calverts Peak. Between them these three peaks support nearly 70% of the native plants recorded from the peaks.

Lords Table Mountain supports more than twice as many plant species as any other peak and has the greatest concentration of species restricted to one peak, most of which are associated with the extensive dry rainforest on its slopes. However, it also has an endemic plant (*Plectranthus actites*) and the ecosystem on its summit is considered unique in the region. Steep-sided basalt hills like Lords Table Mountain were relatively prominent at the most hospitable end of the nestedness analysis, comprising two of the first four positions, and three of the top eight. The three low domes identified as group D in the classification were identified as the least hospitable parts of the range. Their classification as a separate group is best explained by their depauperate floras, which are a subset of the vegetation of peaks in group C.

Patterns among habitat units on and around the peaks

Drilling down beneath the peak-scale, to assess similarities between the geomorphic habitat units discriminated during the surveys, suggested three primary Habitats:

Habitat 1. Grassy woodlands surrounding most peaks;
Habitat 2. A mixture of dry rainforest elements and grassy woodland, and;
Habitat 3. Rocky shrublands and low woodlands, mainly on upper slopes and summits of trachyte peaks.

Photographs of examples of each of the Habitats appear as Figure 4. The vegetation samples classified together as Habitat 1 included all of those of basalt context adjacent to peaks (Figure 5). This shows that vegetation on basalt adjacent to the peaks is consistently distinguishable from that on the peaks (Habitats 1 & 2). The vegetation in Habitat 1 was typically grassy eucalypt woodland (mainly *Eucalyptus orgadophila, Eucalyptus crebra* and *Corymbia erythrophloia*) and the landform was typically undulating basalt plain. Common grasses include *Heteropogon contortus, Bothriochloa ewartiana, Aristida latifolia, Themeda triandra* and *Dichanthium sericeum*; all of which were much less frequent in Habitats 2 and 3 (Table 2). A few samples from the peaks were also classified into Habitat 1, but they were all grassy woodlands of *Eucalyptus crebra* and occurred on the toe-slopes of The Woolbale, Rocky Knob and Mt Castor.

Habitat 2 occurred on most of the peaks in the northern part of the range, the basalt hills from the central section, and the lower slopes of some of the southern trachyte/rhyolite peaks. Many of the species that differentiate Habitat 2 are associated with dry rainforests in the region (Table 2). Running the habitat classification after excluding species with high fidelity to rainforests produced limited change in classification at the three-group level, and suggests there are other differences. The main change was for the basalt hills, which were classified among the context sites in Habitat 1 when rainforest species were removed.

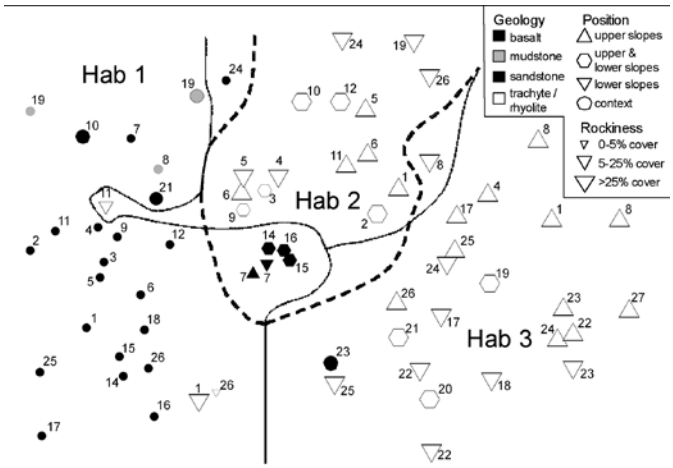

Fig. 5. Two-dimensional ordination (NMDS) of Bray-Curtis similarity in native flora, for habitats across the Peak Range. Symbols differentiates geology (shading), position on peaks (shape), and rockiness (size). Labels identify peaks according to the key provided in Figure 1. Lines differentiate three habitat groups identified by classification (UPGMA) based on all native plants (solid and dashed lines) or based on natives other than rainforest plants (solid and fine-dotted lines).

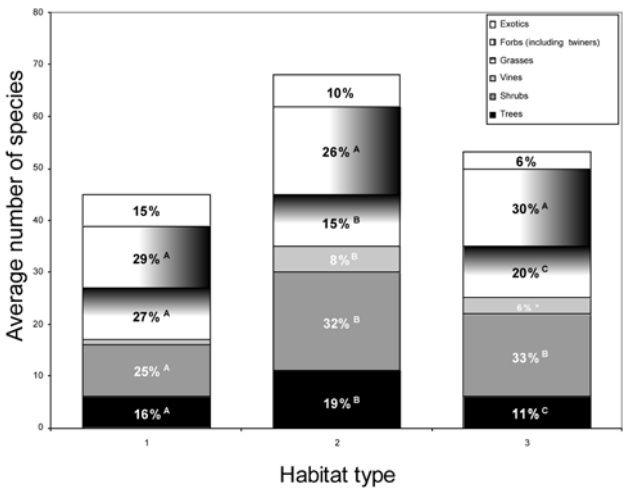

Fig. 6. Average plant species richness by life-form for three Habitats in the Peak Range. Standard Errors for the mean of total native species richness were 2.2, 5.4 and 3.1 for Habitats 1, 2 and 3 respectively. Labels are percentages of native species richness for life-form; superscript "A", "B" and "C" denote significant pairwise differences between habitats (Wilcoxon rank-sum tests) where Kruskal-Wallis tests suggested significant differences across all habitats.

Habitat 2 is a fine scale mosaic of at least two or three distinct plant communities; including grassy woodlands, dry rainforest patches, and shrublands or low woodlands on lithosols. The grassy woodlands in Habitat 2 are most similar to Habitat 1, but there are clear compositional differences. Moving from Habitat 1 to 2 is associated with declining frequency for grassy woodland species such as *Dichanthium sericeum*, *Bothriochloa ewartiana*, *Brunoniella australis* and *Atalaya hemiglauca* and increasing frequency of other plants common in grassy woodlands on the peaks, such as *Cymbopogon queenslandicus* and *Hibiscus sturtii* (Table 2). Likewise, Habitats 2 and 3 share many frequent species but there is a suite of species that differentiates them. Those whose presence indicates Habitat 2 are most common in grassy woodlands (e.g. *Themeda triandra* and *Melhania oblongifolia*) or associated with rainforest patches (e.g. *Alectryon connatus* and *Bridelia leichhardtii*), and those that indicate Habitat 3 are most common in rocky shrublands and open woodlands (e.g. *Acacia julifera* and *Cleistochloa subjuncea*).

At the other end of the spectrum, the samples classified into Habitat 3 included the upper slopes of all of the southern trachyte/rhyolite peaks and of some of the larger such peaks in the north of the range (Mt Donald, Mt Castor and Mt Saddleback). Lower slopes of most of the southern trachyte/rhyolite peaks were also included in this Habitat, but were placed close together on the ordination suggesting some subtle differences with the upper slopes. The vegetation in Habitat 3 was typically mid-dense to dense shrubland, most commonly dominated by *Acacia julifera* subsp. *curvinervia, Dodonaea lanceolata* subsp. *subsessilifolia, Leptospermum lamellatum* and *Xanthorrhoea johnsonii,* with emergent low trees, commonly *Corymbia trachyphloia, Eucalyptus exserta* or *Eucalyptus crebra*. The herbs in Habitat 3 were quite distinct from those in the other two Habitats. Frequent species with the highest fidelity included *Scleria sphacelata, Cheilanthes sieberi, Digitaria breviglumis, Cleistochloa subjuncea, Arundinella nepalensis* and *Triodia pungens*.

In terms of total flora, the peaks supported many more species that were not recorded in the surrounding habitat-matrix than vice-versa. Of 418 species (29 exotic) encountered in the surveys, 192 of them were recorded only on peaks; whereas, only 40 species (five exotic) were recorded adjacent to peaks but not on them. The same pattern occurred for families, with 22 families recorded on the peaks but not the matrix, and only four families found in the matrix unrecorded on the peaks. Families with the most species were very similar on both the peaks and the surrounding landscape. The seven most speciose families in both were Poaceae, Fabaceae, Asteraceae, Mimosaceae, Euphorbiaceae, Myrtaceae and Malvaceae, but their order varied slightly. At the family level the greatest change from the matrix onto the peaks was increasing richness among Cyperaceae, Lamiaceae and Adiantaceae, and the addition of a suite of families represented by one or two rainforest species.

Habitat samples on the peaks had much greater average plant species richness than those adjacent to the peaks (Habitat 2&3 >> Habitat 1, $p = 0.0005$, Figure 6). Within Habitat 2, the habitat samples from steep-sided basalt peaks had much higher average richness than those from trachyte/rhyolite peaks (87 vs. 53 species).

Exotic plants account for only 7% of the flora in the Peak Range. The most abundant is red natal grass, *Melinis repens*. It is the only weed that is abundant on the shallow soils that support the most unique components of the Peak Range's flora. It was the dominant grass on rocky parts of many peaks, particularly in the southern part of the range (peaks in Groups 3&4). Generally the weediness of the flora was greatest off the peaks, equivalent to 15% of the native flora in Habitat 1, and declined with increasing rockiness to about 5% of the number of native species in Habitat 3. Several weed species were associated with shadier, fire-protected pockets most prevalent in Habitat 2, including *Bidens bipinnata, Opuntia tomentosa* and *Solanum seaforthianum*. Buffel grass, *Pennisetum ciliare*, was frequent around the peaks and in Habitat 2, but was rarely dominant. Mt Lowe, in the southern part of the range is completely infested by buffel grass. It was excluded from the analyses in this report because of its weediness.

The three Habitats differ considerably in terms of plant life-forms. The main difference is that the vegetation on the peaks supports many more woody plant species than the vegetation around them. Trees, shrubs and vines all accounted for a much larger proportion of the total flora in the two Habitats on the peaks (Figure 6).

Discussion

The Peak Range is typical of Australian outcrop archipelagos in sharing considerable similarity with the surrounding matrix at the family level, but exhibiting some marked contrasts at the species level (Clarke 2002a). Other similarities with Australian rock outcrop systems include: a lack of highly specialised, often succulent, plant life forms found on some outcrops internationally (Porembski and Barthlot 2000); the presence of resurrection ferns in the genus *Cheilanthes*; the presence of a small number of succulent species uncommon in the surrounding matrix (e.g. *Portulaca bicolor* and *Hoya australis*); the presence of several endemic species restricted to the rock outcrops and; the presence of several plant populations well beyond the core of their geographic range (Hopper *et al*. 1997, Clarke 2002a).

The Peak Range contributes significantly to botanical diversity in its region because overlap between the species found on peaks and in the surrounding basaltic landscape is strongly asymmetric, and because the floras of the peaks are richer than on adjacent landforms. This level of distinctness between the flora of a set of rocky habitat islands and the surrounding matrix is perhaps unusually high for Australian

Table 2. Frequencies in Peak Range habitat groups of species that distinguish the habitat groups. Shaded cells indicate pairwise habitat comparisons for which each species was among the strongest contributors to dissimilarity, with black cells showing increasing frequency upslope and grey indicating decreasing frequency.

Species	1 vs. 2	1 vs. 3	2 vs. 3	% Hab 1	% Hab 2	% Hab 3
Alphitonia excelsa				15	90	96
Heteropogon contortus				88	65	26
Scleria sphacelata				0	30	87
Pandorea pandorana				27	85	43
Ehretia membranifolia				54	80	4
Brachychiton australis				15	80	26
Alectryon connatus				8	80	13
Bridelia leichhardtii				0	80	9
Cheilanthes sieberi/nudiuscula				0	25	78
Erythroxylum australe				50	75	43
Carissa ovata				50	75	13
Ficus rubiginosa				0	75	26
Digitaria breviglumis				0	25	74
Enneapogon lindleyanus				73	55	35
Atalaya hemiglauca				73	25	4
Bothriochloa ewartiana				73	25	0
Alstonia constricta				38	70	48
Cleistochloa subjuncea				0	10	70
Brunoniella australis				69	40	35
Themeda triandra				65	50	26
Maytenus disperma				4	60	65
Jasminum didymum				35	65	22
Secamone elliptica				15	65	26
Dichanthium sericeum				65	25	0
Croton phebalioides				12	65	4
Acacia julifera subsp. *curvinervia*				0	0	65
Corymbia trachyphloia				0	20	61
Arundinella nepalensis				0	0	61
Dodonaea lanceolata var. *subsessilifolia*				0	0	61
Xanthorrhoea johnsonii				0	0	61
Amaranthus mitchellii/interputus				27	60	30
Alyxia ruscifolia				0	60	43
Ancistrachne uncinulata				12	60	13
Ficus opposita				4	60	17
Melhania oblongifolia				58	50	9
Corymbia erythrophloia				58	45	0
Aristida latifolia				58	5	4
Cyanthillium cinereum				15	35	57
Panicum effusum				12	30	57
Leptospermum lamellatum				0	30	57
Cymbopogon queenslandicus				12	55	52
Psydrax johnsonii				15	55	43
Hibiscus sturtii				4	55	43
Abutilon spp.				19	55	0
Drypetes deplanchei				0	55	17
Plumbago zeylanica				4	55	9
Aristida ramosa				54	50	4
Psydrax saligna				4	25	52
Eucalyptus exserta				0	10	52
Eucalyptus crebra				50	40	48
Capparis lasiantha				38	50	4
Trema tomentosa				0	50	26

outcrop archipelagos, especially given its quite low rainfall. Generally, the overlap between floras on rock outcrops and the surrounding matrix increases as rainfall decreases (Hopper *et al*. 1997, McGann 2002). Clarke (2002b) found granite outcrops in the New England Tableland bioregion in eastern Australia, with rainfall between 750 mm and 1250 mm per annum, shared more species with their forest surrounds than vice versa; the opposite of the pattern found in the Peak Range. The geological contrast between the outcrops and matrix in the Peak Range are more substantial than in the granite system reported on by Clarke (2002b), however even the basalt peaks in this study were distinct from their surrounds, confirming that landform is itself important to the distinctiveness of the vegetation on the peaks (Clarke 2002a).

Species that were recorded only on the peaks and not on the surrounding plains fall into two broad classes; species associated with shrublands and low open woodlands on rock pavements and lithosols, and species associated with dry rainforest in fire protected pockets associated with cliffs and scree on the peaks. These two groups strongly influenced vegetation similarity between peaks. Both groups are highly dissimilar at the generic level to the flora of the basaltic terrain around the peaks, and the dry rainforest plants make the flora of Habitat 2 quite distinct at the plant family level.

The endemic plants of the Peak Range are mainly associated with rocky terrain. This is the case for *Acacia arbiana,* and *Plectranthus actites* as well as the un-named *Acacia* from Gemini Peaks, the potentially new *Acacia* from Mt Donald and the two potentially new *Plectranthus* species from The Woolbale and Mt Donald. This substantial list, to which *Trioncinia patens* must also be added, highlights the importance of the Peak Range to regional botanical diversity, but this importance is also clear in the whole flora.

The much greater species richness of the peaks compared to the matrix is most likely because of greater fine-scale habitat diversity on the peaks, due to the influence of geomorphic variation (slopes, summits, cliff-breaks, and rock-slabs) on key physical processes such as water movement, soil development and fire behaviour.

Much of the marked increase in woody plants between the matrix and the peaks is probably related to fire protection, especially for Habitat 2 with its characteristic component of plants associated with dry rainforest. Protection from high fire frequency, provided in the Peak Range by rocky outcrops, gullies and scree-slopes, is key habitat-component for dry rainforest plants in Central Queensland (Fensham 1995). The shrubby vegetation associated with rocky and shallow soils in Habitat 3 typically includes fewer trees than Habitat 2 does, but still supports many more woody species than the vegetation surrounding the peaks in Habitat 1. Shrubs are often prominent on shallow soils associated with rock outcrops in Australia (Clarke 2002a), probably because the soils are too shallow and freely draining to support trees. The trees that do occur in Habitat 3 (*Eucalyptus exserta* and *Corymbia trachyphloia*) also often occur on shallow well-drained soils in sandstone landscapes.

The connection between the flora of sandstone landscapes and the southern trachyte peaks, predominant in Habitat 3, is particularly clear on Scotts and Ropers Peaks, which have a skirt of sandstone around their base and support several species more typically found on sandstone, including *Acacia gnidium, Dampiera discolor, Lysicarpus angustifolius, Persoonia amaliae* and *Prostanthera leichhardtii*. Other sandstone-associated scleromorphic species occur more broadly across the Peak Range, generally on the upper slopes and shallow rocky soils, such as *Cleistochloa subjuncea, Corymbia trachyphloia, Leptospermum lamellatum, Triodia pungens* and *Xanthorrhoea johnsonii*. Whether this connection with the region's sandstone flora has more to do with water and freely draining soils, or rock type and lower pH and nutrient status, is an interesting but open question. The association of Habitat 3 with the run-off areas on upper slopes suggests that drainage is perhaps the key feature, but drought and soil nutrition are clearly not mutually exclusive factors and weighing their relative importance will be difficult. Our impression is that beyond a weak association between substantial rainforest development and south and easterly aspects (in run-on topographic positions), there does not appear to be a strong effect of aspect on vegetation in the Peak Range.

Consequences for conservation and management

The Peak Range contains at least three, quite distinct botanic and geographic sections: the northern and southern trachyte features and the central basalt hills. The current extent of the Peak Range National Park covers sections of the northern trachyte/rhyolite peaks and the central basalt hills, including many of the peaks highlighted as most hospitable to plant diversity in the Peak Range by analysis of nestedness. However, the National Park does not include any part of the southern end of the range, which appears to be its most distinctive section. Consideration may be given to adding some of the southern peaks to the Peak Range National Park, however the Peak's generally rocky and steep geomorphology lends most of them considerable protection from grazing and there are no threats that would obviously be alleviated by placing the peaks within a conservation reserve.

The best conservation strategy is likely to revolve around working with landholders to manage threats. Buffel grass probably represents the greatest potential threat to the native vegetation of the Peak Range, particularly to fire-sensitive dry rainforest species. Buffel grass seems to be implicated in a grass-fire cycle (D'Antonio and Vitousek 1992). The growth potential of buffel grass seems to increase the susceptibility of dry rainforest to incursion by fire (sensu Panton 1993). It is difficult to envisage effective control of *Melinis repens*, given its wind-dispersal and the extent of the infestation.

Feral animals currently seem to pose little threat. We saw only limited sign of pigs and the range is remarkable in the absence of feral goats that plague so many other rocky habitats in semi-arid Australia.

Cattle grazing may be an issue for *Trioncinia patens*, which is arguably the most threatened plant species in the Peak Range. Two of the three known populations of *Trioncinia patens* occur within the Peak Range NP (Holland and Butler 2007). *Trioncinia retroflexa,* the closest relative of *Trioncinia patens*, is highly sensitive to continuous grazing (Fensham *et al*. 2002). Two of the populations of *Trioncinia patens* are currently exposed to low levels of grazing at the base of Browns and Eastern Peaks. Intensification of grazing in these areas should be avoided, particularly during the summer when the species flowers and seeds.

Methodological considerations

The traverse-survey method employed in this study provided sufficient information to describe relationships among peaks, identify broad habitat types, and identify differences between the vegetation of the peaks and that of the surrounding landscape matrix. The main short-coming of the method concerns resolution of the habitat units, particularly in Habitat 2 which clearly included several quite distinct vegetation classes that would perhaps have been discriminated using plot based survey techniques. However, a plot-based survey would have to have been extensive to overcome this problem, especially with random plot placement. A very substantial advantage with our technique is that comprehensive survey data, including information on rare species, is attainable with a reasonable effort: in this case, survey of 25 separate peaks in 12 days field work.

In Australia, 'plotless' vegetation surveys have most widely been used in rainforest. For example, the seminal work of Webb, Tracey and Williams (1984) as well as that of Russell-Smith (1991) and Fensham (1995), were all based on plotless inventories. The technique is also well suited to rock outcrop surveys, not least because the patchy nature of rock-outcrop vegetation, including large areas of bare rock, can be problematic for plot based surveys. Another important feature of the survey technique employed here, which is recommended for any survey of poorly known rock outcrop vegetation, is including the 'matrix' in the survey, enabling comparisons across outcrop boundaries.

Conclusions

The Peak Range harbours several endemic plants among a diverse flora which is clearly distinct from that of the surrounding terrain. The distinctiveness of the range's flora is due to two habitat components: dry rainforest patches reliant upon fire protection afforded by the peaks, and a scleromorphic flora associated with shallow soils and rock pavements. The endemic species of the Peak Range are mainly associated with the latter of these, which lends them considerable natural protection from potential threats, including fire and grazing.

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Appendix – Plants of the Peak Range. Names of exotic species are preceded by '*'. Life form codes are f – forb, g – grass, s – shrub, t – tree, v – vine, w - twiner. '(rf)' indicates 'rainforest species'. The remaining columns detail numbers of records from various sources: 'n Peaks' is the number of Peaks from which a taxon is known (from any of the sources used); 'n Context' is the number of context sites in which each taxa was encountered in this survey; 'Fensham & Holman' indicates those species recorded from Lord's Table Mountain in the surveys of Fensham and Holman (1998); 'Fensham's Dry RF' indicates species recorded from dry rainforest on Lords Table Mountain in the survey by Fensham (1995); 'HERBRECS' is the number of specimen records from peaks in the Peak Range held at the Queensland Herbarium prior to this survey. Nomenclature after Bostock and Holland (2007).

	Life form	n Peaks	n Context	Fensham & Holman	Fensham's Dry RF	HERBRECS
Angiosperms						
Acanthaceae						
Brunoniella australis	f	19	16	1	-	-
Pseuderanthemum variabile	f	8	1	1	1	2
Rostellularia adscendens	f	6	4	-	-	-
Aizoaceae						
Zaleya galericulata	f	2	5	-	-	-
Amaranthaceae						
Achyranthes aspera	f	12	6	1	-	-
Alternanthera denticulata	f	2	-	1	-	1
Alternanthera nana	f	7	-	1	-	1
Amaranthus mitchellii and/or *A. interruptus*	f	20	6	-	-	-
Deeringia amaranthoides	f	4	-	-	1	-
Nyssanthes erecta	f	1	4	-	-	-
Anacardiaceae						
Euroschinus falcatus var. *angustifolius*	t (rf)	19	-	1	1	2
Apiaceae						
Platysace valida	s	8	-	-	-	-
Apocynaceae						
Alstonia constricta	t	28	9	1	1	-
Alyxia ruscifolia	s (rf)	26	-	1	1	2
Carissa ovata	s	20	12	1	1	-
Cerbera dumicola	t	1	-	-	-	-
Parsonsia lanceolata	v	13	3	1	1	-
Parsonsia plaesiophylla	v (rf)	13	-	1	1	1
Parsonsia rotata	v (rf)	1	-	-	-	1
Araliaceae						
Polyscias elegans	t (rf)	9	-	1	1	1
Asclepiadaceae						
**Gomphocarpus physocarpus*	f	-	-	-	-	-

	Life form	n Peaks	n Context	Fensham & Holman	Fensham's Dry RF	HERBRECS
Hoya australis	v	10	-	1	1	-
Marsdenia microlepis	v	20	3	1	-	1
Marsdenia pleiadenia	v (rf)	2	1	-	1	-
Marsdenia viridiflora subsp. *viridiflora*	v	2	1	1	-	-
Sarcostemma viminale subsp. *brunonianum*	s	5	-	-	-	-
Secamone elliptica	v	23	3	1	1	1
Tylophora erecta	s	3	-	-	-	-
Asteraceae						
Acmella grandiflora var. *brachyglossa*	f	2	-	1	-	1
**Bidens bipinnata*	f	-	3	1	-	1
Brachyscome microcarpa	f	2	-	1	-	1
Calotis cuneata	f	-	2	-	-	-
Calotis lappulacea	f	3	2	-	-	1
Cassinia laevis	s	4	-	-	-	-
Chrysocephalum apiculatum	f	2	-	1	-	1
**Conyza aegyptiaca*	f	-	-	-	-	-
**Conyza bonariensis*	f	-	-	-	-	-
Cyanthillium cinereum	f	21	4	1	-	-
**Emilia sonchifolia*	f	-	1	-	-	-
Epaltes australis	f	2	-	1	-	1
Glossocardia bidens	f	2	-	1	-	1
Gynura drymophila	f	1	-	-	-	-
Olearia canescens	s	1	-	-	-	-
**Parthenium hysterophorus*	f	-	19	1	-	-
Peripleura bicolor	f	4	1	-	-	-
Peripleura diffusa	f	1	-	-	-	-
Peripleura hispidula	f	12	6	1	-	1
Pluchea dentex	f	1	1	-	-	-
Pseudognaphalium luteoalbum	f	1	-	-	-	1
Pterocaulon redolens	f	1	-	-	-	1
Pterocaulon serrulatum var. *serrulatum*	f	5	-	-	-	-
Pterocaulon sphacelatum	f	8	-	1	-	1
**Schkuhria pinnata*	f	-	1	1	-	1
Senecio bathurstianus	f	1	-	-	-	-
Senecio brigalowensis	f	1	-	-	-	1
Sigesbeckia fugax	f	2	-	-	-	-
Sigesbeckia orientalis	f	8	-	1	-	1
**Sonchus oleraceus*	f	-	-	-	-	1
**Tagetes minuta*	f	-	-	1	-	1
**Tridax procumbens*	f	-	-	-	-	1
Trioncinia patens	f	1	2	-	-	1
Vittadinia pterochaeta	f	2	-	1	-	1
Vittadinia sulcata	f	2	-	1	-	1
Wedelia spilanthoides	f	4	2	-	-	-
Xerochrysum bracteatum	f	16	4	1	-	3
**Zinnia peruviana*	f	-	1	-	-	-
Bignoniaceae						
Pandorea pandorana	v	30	5	1	-	-
Boraginaceae		-	-	-	-	-
Ehretia membranifolia	s	20	12	-	-	1
**Heliotropium amplexicaule*	f	-	-	-	-	-
Heliotropium brachygyne	f	2	-	1	-	1
Trichodesma zeylanicum	f	4	2	-	-	1
Cactaceae						
**Opuntia stricta*	s	-	-	1	-	-
**Opuntia tomentosa*	s	-	9	1	1	-
Caesalpiniaceae						
Cassia brewsteri	s	10	8	-	-	-
Chamaecrista absus var. *absus*	f	6	3	1	-	1
Chamaecrista mimosoides	f	2	-	1	-	1
Chamaecrista nomame	f	1	-	-	-	-
Lysiphyllum carronii	t	2	5	-	-	-
Senna aciphylla	s	4	1	-	-	1
Senna barclayana	s	2	-	-	-	-
Senna gaudichaudii	s	2	-	-	-	1
Senna artemisioides nothosubsp. *coriacea* (formerly *Senna nemophila*)	s	-	1	-	-	-
Senna surattensis subsp. *retusa*	s	1	-	1	-	-
Campanulaceae						
Isotoma axillaris	f	1	-	-	-	1
Lobelia quadrangularis	f	2	-	1	-	1
Wahlenbergia gracilis	f	9	-	1	-	1
Capparaceae						
Apophyllum anomalum	s	-	3	-	-	-
Capparis arborea	s (rf)	1	-	1	-	-
Capparis canescens	s	12	8	-	-	-
Capparis lasiantha	w	12	9	-	-	-
Capparis loranthifolia	s (rf)	7	1	-	-	1
Capparis mitchellii	s	-	1	-	-	-
Cleome viscosa	f	16	6	-	-	-
Caryophyllaceae						
Polycarpaea corymbosa	f	5	-	-	-	-
Polycarpaea spirostylis	f	2	-	-	-	1
Celastraceae						
Denhamia oleaster.	s	11	10	-	1	-
Elaeodendron australe	s	5	1	-	1	1
Maytenus cunninghamii	s	12	12	-	-	1
Maytenus disperma	s	29	2	1	1	1
Chenopodiaceae						
Atriplex muelleri	f	1	1	-	1	-
Chenopodium pumilio	f	1	-	-	-	-

	Life form	n Peaks	n Context	Fensham & Holman	Fensham's Dry RF	HERBRECS
Einadia hastata	f	4	-	-	-	-
Einadia nutans	f	10	2	-	-	-
Salsola kali	f	1	13	-	-	-
Sclerolaena anisacanthoides	f	-	2	-	-	-
Sclerolaena bicornis	f	-	3	-	-	-
Sclerolaena muricata	f	-	3	-	-	-
Clusiaceae						
Hypericum gramineum	f	1	-	-	-	-
Hypericum japonicum	f	1	-	1	-	-
Colchicaceae						
Iphigenia indica	f	2	-	1	-	1
Combretaceae						
Terminalia oblongata	s	1	7	-	-	1
Commelinaceae						
Commelina ensifolia	f	21	2	1	-	-
Murdannia graminea	f	1	-	-	-	-
Convolvulaceae						
Dichondra repens	f	1	-	1	-	-
Evolvulus alsinoides	f	18	5	1	-	-
Ipomoea brownii	w	6	2	-	-	-
Ipomoea calobra	w	2	-	-	-	-
Ipomoea gracilis	w	1	-	-	-	-
Ipomoea plebeia	w	4	2	1	-	-
Ipomoea polymorpha	w	2	-	1	-	1
Jacquemontia paniculata	f	5	6	-	-	1
Polymeria pusilla	f	-	1	-	-	-
Crassulaceae						
**Bryophyllum delagoense*	f	-	-	1	1	2
Cucurbitaceae						
Cucumis melo	w	1	-	-	-	-
Mukia maderaspatana	w	2	-	-	-	-
Sicyos australis	w (rf)	3	-	-	-	-
Cyperaceae						
Bulbostylis barbata	f	2	-	-	-	-
Cyperus bifax	f	1	2	1	-	-
Cyperus concinnus	f	2	-	1	-	1
Cyperus cunninghamii subsp. *cunninghamii*	f	1	-	-	-	-
Cyperus dietrichiae var. *dietrichiae*	f	1	-	-	-	1
Cyperus difformis	f	1	-	1	-	-
Cyperus fulvus	f	8	-	1	-	1
Cyperus gracilis	f	5	1	1	1	1
Cyperus leiocaulon	f	3	-	-	-	-
Cyperus microcephalus subsp. *microcephalus*	f	9	-	-	-	-
Cyperus squarrosus	f	2	-	1	-	1
Fimbristylis dichotoma	f	15	-	1	-	-
Lipocarpha microcephala	f	2	-	1	-	1
Schoenus vaginatus	f	2	-	-	-	-
Scleria mackaviensis	f	10	2	1	1	-
Scleria sphacelata	f	27	1	-	-	2
Dilleniaceae						
Hibbertia stricta	f	5	-	-	-	-
Droseraceae						
Drosera indica	f	1	-	1	-	-
Ebenaceae						
Diospyros humilis	t (rf)	13	2	1	1	1
Erythroxylaceae						
Erythroxylum australe	s	30	10	1	-	2
Euphorbiaceae						
Acalypha eremorum	s (rf)	9	2	1	1	1
Bertya pedicellata	s	22	-	-	-	7
Beyeria viscosa var. *obovata*	s	3	-	-	-	-
Breynia oblongifolia	s	14	-	1	1	-
Bridelia leichhardtii	t (rf)	20	-	1	1	-
Chamaesyce biconvexa	f	1	-	-	-	1
Chamaesyce coghlanii	f	2	7	-	-	-
Chamaesyce dallachyana	f	2	-	-	-	-
Chamaesyce drummondii	f	1	-	1	-	-
**Chamaesyce hirta*	f	-	-	-	-	-
**Chamaesyce hyssopifolia*	f	-	-	-	-	-
Chamaesyce mitchelliana	f	2	-	-	-	-
Croton phebalioides	s (rf)	17	3	-	1	2
Drypetes deplanchei	t (rf)	20	-	1	1	3
Euphorbia tannensis subsp. *eremophila*	f	3	-	1	-	1
Flueggea leucopyrus	s (rf)	14	12	1	-	2
Leptopus decaisnei var. *decaisnei*	f	-	1	-	-	-
Monotaxis macrophylla	f	1	-	-	-	-
Petalostigma pubescens	t	5	4	-	-	-
Phyllanthus maderaspatensis	f	2	4	-	-	1
Phyllanthus virgatus	f	15	7	1	-	1
Poranthera microphylla	f	1	-	1	-	-
Sauropus trachyspermus	f	-	1	-	-	-
Fabaceae						
Aeschynomene brevifolia	f	1	-	-	-	-
Alysicarpus muelleri	f	-	1	-	-	-
Cajanus reticulatus var. *reticulatus*	w	2	1	-	-	-
Canavalia papuana	w	1	-	-	-	-
Crotalaria brevis	f	1	-	-	-	-
**Crotalaria incana* subsp. *incana*	f	-	3	1	-	1
**Crotalaria juncea*	f	-	1	1	-	-
Crotalaria medicaginea var. *medicaginea*	f	-	1	-	-	-

	Life form	n Peaks	n Context	Fensham & Holman	Fensham's Dry RF	HERBRECS
Crotalaria montana	f	1	-	-	-	1
Daviesia filipes	s	3	-	-	-	-
Desmodium brachypodum	w	3	2	-	-	-
Desmodium campylocaulon	w	-	2	-	-	-
Desmodium gunnii	w	1	-	1	-	-
Desmodium rhytidophyllum	w	5	-	1	-	1
Desmodium varians	w	2	-	1	-	-
Erythrina vespertilio	t	7	3	-	-	-
Galactia sp. indet.	w	1	-	-	-	1
Galactia tenuiflora	w	13	9	1	-	-
Gastrolobium grandiflorum	f	1	-	-	-	1
Glycine latifolia	w	-	2	-	-	-
Glycine tabacina	w	2	-	1	-	1
Glycine tomentella	w	2	-	1	-	1
Hardenbergia perbrevidens	w	6	-	-	-	1
Hovea longipes	s	14	1	-	-	1
Hovea tholiformis	s	1	-	-	-	-
Indigastrum parviflorum	f	2	-	1	-	1
Indigofera australis	s	12	4	-	-	-
Indigofera brevidens	s	12	1	-	-	1
Indigofera colutea	s	1	1	-	-	-
Indigofera hirsuta	s	4	-	1	-	1
Indigofera linifolia	s	5	6	-	-	-
Indigofera linnaei	s	3	2	1	-	-
Indigofera pratensis	s	4	3	-	-	-
Indigofera sp. indet.	s	-	1	-	-	-
Jacksonia scoparia	s	3	-	-	-	-
**Macroptilium lathyroides*	w	-	1	-	-	-
Rhynchosia minima	w	8	10	1	-	-
**Stylosanthes scabra*	f	-	-	-	-	-
Tephrosia astragaloides	s	1	-	-	-	-
Tephrosia barbatula	s	2	1	-	-	-
Tephrosia filipes subsp. *filipes*	s	2	-	1	-	1
Tephrosia sp. (Ilfracombe R.D.Law AQ238393)	s	1	-	-	-	-
Tephrosia sp. (Miriam Vale E.J.Thompson+ MIR33)	s	1	-	-	-	1
Vigna lanceolata	w	2	-	-	-	-
Vigna radiata	w	2	2	-	-	1
Zornia muriculata subsp. *muriculata*	f	2	-	1	-	1
Goodeniaceae						
Dampiera discolor	f	7	1	-	-	1
Goodenia grandiflora	f	5	-	1	-	2
Goodenia rotundifolia	f	5	-	-	-	-
Haloragaceae						
Gonocarpus teucrioides	f	3	-	-	-	-
Hemerocallidaceae						
Dianella brevipedunculata	f	1	-	-	-	-
Dianella caerulea	f	6	-	1	-	1
Dianella longifolia	f	7	1	-	-	-
Dianella nervosa	f	1	-	-	-	1
Tricoryne elatior	f	4	-	1	-	1
Hypoxidaceae						
Hypoxis arillacea	f	1	-	-	-	1
Hypoxis hygrometrica var. *villosisepala*	f	2	-	1	-	1
Juncaceae						
Juncus aridicola	f	2	-	1	-	1
Lamiaceae						
Anisomeles malabarica	f	2	-	-	-	2
Clerodendrum floribundum	s	12	4	1	-	1
Mentha grandiflora	f	9	1	-	-	-
Plectranthus actites	f	4	-	1	1	2
Plectranthus graveolens	f	11	-	-	-	1
Plectranthus parviflorus	f	1	-	-	-	1
Plectranthus sp. nov. 1?	f	1	-	-	-	-
Plectranthus sp. nov. 2?	f	1	-	-	-	-
Prostanthera leichhardtii	s	5	1	-	-	2
Prostanthera lithospermoides	s	2	-	-	-	-
Spartothamnella juncea	s	2	-	-	-	-
Lauraceae						
Cassytha pubescens	f	-	1	-	-	-
Laxmanniaceae						
Eustrephus latifolius	w	14	5	1	-	1
Lomandra filiformis	f	2	-	-	-	-
Lomandra longifolia	f	11	2	1	-	1
Lomandra multiflora subsp. *multiflora*	f	1	-	-	-	-
Loranthaceae						
Amyema villiflora	f	1	-	-	-	1
Lythraceae						
Ammannia multiflora	f	2	-	1	-	1
Rotala mexicana	f	2	-	1	-	1
Malvaceae						
Abelmoschus ficulneus	f	-	1	-	-	-
Abutilon auritum and/or *A.. leucopetalum* and/or *A. micropetalum* and/or *A. nobile*	f	14	8	-	1	4
Abutilon otocarpum	f	7	1	-	-	-
Abutilon oxycarpum	f	8	3	1	-	1
Gossypium australe	f	2	2	-	-	-
Hibiscus heterophyllus	s	10	-	-	-	-
Hibiscus meraukensis	s	2	-	-	-	-
Hibiscus sturtii	s	22	2	1	-	1
Hibiscus trionum var. *vesicarius*	f	2	4	1	-	-

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Hibiscus vitifolius	s	1	-	-	-	-
**Malvastrum americanum*	f	-	17	1	-	-
Sida atherophora	f	3	2	-	-	-
Sida fibulifera	f	2	4	-	-	-
Sida sp. (cf *S. cunninghamii*)	f	4	2	-	-	-
Sida sp. (Greenvale R.J.Fensham 1150)	f	6	1	-	-	1
**Sida spinosa*	f	-	15	1	-	-
Sida subspicata	f	6	3	1	-	-
Meliaceae						
Melia azedarach	t	9	-	1	1	2
Owenia acidula	t	4	11	-	-	-
Turraea pubescens	t (rf)	10	3	-	1	-
Menispermaceae						
Pleogyne australis	v (rf)	1	1	-	-	-
Stephania japonica	v	2	-	-	1	-
Tinospora smilacina	v	6	-	1	-	-
Mimosaceae						
Acacia amblygona	s	4	-	-	-	1
Acacia aprepta	s	1	-	-	-	-
Acacia arbiana	s	15	-	-	-	5
Acacia bancroftiorum	s	5	1	-	-	-
Acacia bidwillii	s	2	8	-	-	-
Acacia burdekensis	s	1	-	-	-	-
Acacia cretata	s	4	1	-	-	1
Acacia decora	s	7	5	1	-	1
Acacia excelsa	t	3	4	-	-	-
**Acacia farnesiana*	s	-	7	-	-	-
Acacia gnidium	s	7	-	-	-	3
Acacia harpophylla	t	-	6	-	-	-
Acacia julifera subsp. *curvinervia*	s	15	1	-	-	1
Acacia juncifolia	s	2	-	-	-	-
Acacia leiocalyx	s	-	1	-	-	-
Acacia macradenia	s	5	-	-	-	-
**Acacia nilotica*	t	-	1	-	-	-
Acacia rhodoxylon	t	1	1	-	-	-
Acacia salicina	t	8	4	-	-	-
Acacia shirleyi	t	-	1	-	-	-
Acacia sp. (Gemini Peaks)	s	2	-	-	-	-
Acacia sp. (Mt Donald)	s	2	-	-	-	-
Albizia canescens	t	1	-	-	-	-
Archidendropsis basaltica	s	4	5	-	-	-
Archidendropsis thozetiana	t	2	-	-	-	-
Neptunia gracilis	f	1	9	1	-	-
Moraceae						
Ficus obliqua	t (rf)	4	-	1	-	-
Ficus opposita	s	21	1	1	1	3
Ficus rubiginosa	t	25	-	-	1	3
Ficus virens	t (rf)	2	-	1	1	-
Trophis scandens	v (rf)	1	-	-	-	-
Myoporaceae						
Eremophila deserti	s	1	1	-	-	-
Eremophila longifolia	s	1	-	-	-	-
Eremophila mitchellii	s	1	7	-	-	-
Myoporum acuminatum	s	1	1	-	-	-
Myrsinaceae						
Myrsine variabilis	s	6	-	-	1	-
Myrtaceae						
Callistemon sp. (Ropers Peak P.I.Forster PIF7208)	s	12	-	1	-	3
Corymbia citriodora	t	1	-	-	-	-
Corymbia clarksoniana	t	3	-	-	-	-
Corymbia dallachiana	t	8	7	-	-	-
Corymbia erythrophloia	t	10	14	-	-	-
Corymbia leichhardtii	t	10	1	-	-	-
Corymbia peltata	t	5	-	-	-	-
Corymbia tessellaris	t	-	1	-	-	-
Corymbia trachyphloia	t	20	-	-	-	2
Eucalyptus apothalassica	t	4	-	-	-	-
Eucalyptus crebra	t	20	12	-	-	-
Eucalyptus exserta	t	16	-	1	-	1
Eucalyptus melanophloia	t	2	3	-	-	-
Eucalyptus microcarpa	t	2	-	1	-	1
Eucalyptus moluccana	t	1	-	-	-	1
Eucalyptus orgadophila	t	9	12	-	-	2
Eucalyptus populnea	t	-	-	-	-	-
Gossia bidwillii	t (rf)	3	-	1	-	1
Leptospermum lamellatum	s	19	-	-	-	-
Leptospermum neglectum	s	9	-	-	-	-
Lysicarpus angustifolius	t	5	1	-	-	-
Melaleuca bracteata	t	1	1	-	-	-
Nyctaginaceae						
Boerhavia sp. indet.	f	9	10	-	-	-
Oleaceae						
Jasminum didymum	v	18	9	-	-	-
Jasminum simplicifolium	v	18	2	1	1	-
Notelaea microcarpa	s	17	4	1	1	1
Orchidaceae						
Cymbidium canaliculatum	f	2	-	-	-	-
Dockrillia bowmanii	f (rf)	3	-	1	1	1
Sarcochilus ceciliae	f	1	-	-	1	-
Oxalidaceae						
**Oxalis corniculata*	f	1	-	1	-	-
Oxalis sp. indet.	f	13	2	-	-	-
Passifloraceae						
Passiflora aurantia	v	5	-	-	-	-

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Pedaliaceae						
Josephinia eugeniae	f	-	2	-	-	-
Piperaceae						
Peperomia blanda var. *floribunda*	f	2	-	-	1	1
Pittosporaceae						
Bursaria incana	s	6	7	-	-	-
Hymenosporum flavum	t (rf)	1	-	-	-	-
Pittosporum spinescens	s	9	10	1	1	-
Plumbaginaceae						
Plumbago zeylanica	f	14	-	-	-	-
Poaceae						
Alloteropsis cimicina	g	6	1	1	-	1
Ancistrachne uncinulata	g	17	3	1	1	-
Aristida benthamii var. *benthamii*	g	7	-	-	-	-
Aristida calycina	g	6	-	1	-	1
Aristida holathera	g	2	-	-	-	1
Aristida ingrata	g	1	-	-	-	1
Aristida jerichoensis	g	2	-	-	-	-
Aristida latifolia	g	3	15	1	-	-
Aristida lazaridis	g	4	4	1	-	1
Aristida leptopoda	g	2	7	1	-	-
Aristida muricata	g	2	-	1	-	1
Aristida personata	g	5	1	-	-	-
Aristida queenslandica	g	16	3	1	-	1
Aristida ramosa	g	14	13	1	-	1
Aristida spuria	g	3	-	1	-	1
Arundinella nepalensis	g	13	1	-	-	-
Astrebla elymoides	g	-	3	-	-	-
Astrebla lappacea	g	1	3	-	-	1
Bothriochloa bladhii	g	1	3	1	-	-
Bothriochloa decipiens var. *cloncurrensis*	g	1	1	-	-	-
Bothriochloa decipiens var. *decipiens*	g	3	-	1	-	1
Bothriochloa erianthoides	g	-	1	-	-	-
Bothriochloa ewartiana	g	8	17	1	-	-
**Bothriochloa pertusa*	g	-	1	-	-	-
Brachyachne convergens	g	-	3	-	-	-
Chloris divaricata	g	2	1	1	-	1
Chloris ventricosa	g	2	4	-	-	-
**Chloris virgata*	g	-	2	-	-	-
Chrysopogon fallax	g	3	-	1	-	-
Cleistochloa subjuncea	g	17	1	-	-	-
Cymbopogon bombycinus	g	18	3	-	-	-
Cymbopogon obtectus	g	3	-	1	-	2
Cymbopogon queenslandicus	g	25	3	1	-	1
Cymbopogon refractus	g	8	1	1	-	-
Dactyloctenium radulans	g	1	3	-	-	-
Dichanthium queenslandicum	g	-	2	-	-	-
Dichanthium sericeum	g	9	16	1	-	2
Dichanthium tenue	g	1	-	-	-	-
Digitaria breviglumis	g	21	1	-	-	-
Digitaria brownii	g	6	-	1	-	2
Digitaria diffusa	g	1	-	-	-	1
Digitaria divaricatissima	g	2	1	1	-	-
Digitaria minima	g	1	-	-	-	1
Digitaria parviflora	g	1	-	-	-	-
Enneapogon gracilis	g	7	11	1	-	2
Enneapogon lindleyanus	g	22	17	1	-	1
Enneapogon pallidus	g	2	-	-	-	-
Enneapogon polyphyllus	g	5	5	-	-	1
Enteropogon acicularis	g	-	4	-	-	-
Enteropogon ramosus	g	5	6	-	-	-
Enteropogon unispiceus	g	1	-	-	-	-
Entolasia stricta	g	1	-	-	-	-
Eragrostis brownii	g	1	-	-	-	-
Eragrostis elongata	g	5	-	1	-	1
Eragrostis lacunaria	g	1	-	-	-	-
Eragrostis leptostachya	g	2	1	-	-	-
Eragrostis megalosperma	g	6	3	-	-	-
Eragrostis sororia	g	5	-	1	-	1
Eremochloa bimaculata	g	-	1	-	-	-
Eriachne mucronata	g	18	1	1	-	2
Eriachne pallescens	g	1	-	-	-	-
Eriochloa crebra	g	4	4	-	-	-
Eriochloa procera	g	8	6	1	-	1
Eriochloa pseudoacrotricha	g	1	-	-	-	-
Eulalia aurea	g	2	1	1	-	-
Heteropogon contortus	g	22	21	1	-	-
Iseilema vaginiflorum	g	2	4	1	-	-
Leptochloa decipiens	g	16	2	1	-	1
**Megathyrsus maximus*	g	-	2	-	-	-
**Melinis repens*	g	-	15	1	-	-
Microlaena stipoides var. *stipoides*	g	2	-	1	-	1
**Moorochloa eruciformis*	g	-	3	-	-	-
Ophiuros exaltatus	g	-	1	-	-	-
Oplismenus aemulus	g	2	-	1	1	-
Panicum decompositum	g	4	9	1	-	1
Panicum effusum	g	20	3	1	-	-
Panicum queenslandicum	g	3	2	1	-	-
Paspalidium albovillosum	g	6	-	-	-	-
Paspalidium caespitosum	g	1	3	-	-	-
Paspalidium constrictum	g	6	2	1	-	1
Paspalidium distans	g	1	-	-	-	-
Paspalidium globoideum	g	-	3	-	-	-

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Paspalidium gracile	g	16	1	-	-	1
**Pennisetum ciliare*	g	-	18	-	-	-
Perotis rara	g	4	1	-	-	-
Sarga leiocladum	g	3	1	1	-	-
Setaria australiensis	g	1	-	-	-	-
Setaria paspalidioides	g	1	-	-	-	-
Setaria surgens	g	5	2	-	-	-
Sporobolus actinocladus	g	-	1	-	-	-
Sporobolus caroli	g	-	3	-	-	-
Sporobolus elongatus	g	2	-	1	-	1
Thellungia advena	g	1	5	-	-	-
Themeda triandra	g	18	16	1	-	-
Tragus australianus	g	5	8	1	-	-
Triodia mitchellii	g	5	-	-	-	1
Triodia pungens	g	10	1	-	-	-
Tripogon loliiformis	g	4	-	1	-	-
Urochloa foliosa	g	2	-	1	-	1
Urochloa gilesii	g	2	-	-	-	1
Urochloa holosericea	g	4	-	1	-	1
**Urochloa mosambicensis*	g	-	-	-	-	-
**Urochloa panicoides*	g	-	2	-	-	-
Urochloa pubigera	g	7	2	-	-	-
Polygalaceae						
Polygala linariifolia	f	2	-	1	-	1
Polygala sp. (Emerald R.W.Johnson 1322)	f	-	2	-	-	-
Portulacaceae						
Grahamia australiana	f	4	-	1	-	1
Portulaca australis	f	1	-	-	-	1
Portulaca bicolor	f	10	-	1	-	1
Portulaca filifolia	f	1	-	1	-	-
**Portulaca oleracea*	f	-	9	-	-	-
**Portulaca pilosa*	f	-	-	-	-	-
Proteaceae						
Grevillea parallela	t	1	-	-	-	-
Grevillea striata	t	3	6	-	-	-
Hakea lorea	s	7	1	1	-	-
Persoonia amaliae	s	1	1	-	-	1
Persoonia falcata	s	3	-	-	-	1
Ranunculaceae						
Clematis pickeringii	v	1	-	-	-	-
Rhamnaceae						
Alphitonia excelsa	s	41	4	1	-	-
Ventilago viminalis	t	4	4	-	-	-
Rubiaceae						
Antirhea putaminosa	s (rf)	4	-	-	1	2
Larsenaikia ochreata	s	3	2	-	-	-
Oldenlandia coerulescens	f	1	-	1	-	-
Oldenlandia galioides	f	1	-	1	-	-
Oldenlandia mitrasacmoides	f	3	-	1	-	1
Pavetta australiensis	s (rf)	3	-	-	1	-
Pogonolobus reticulatus	s	3	1	-	-	-
Pomax umbellata	f	5	-	-	-	-
Psychotria daphnoides	s (rf)	5	-	-	-	1
Psychotria daphnoides var. *angustifolia*	s (rf)	5	-	-	1	-
Psydrax forsteri	s	3	-	1	-	2
Psydrax johnsonii	s	23	4	-	-	2
Psydrax odorata	s	2	-	1	-	-
Psydrax oleifolia	s	6	5	-	1	-
Psydrax saligna	s	17	1	-	-	-
Spermacoce sp. indet.	f	15	6	1	-	1
Spermacoce brachystema	f	15	6	-	-	1
Triflorensia ixoroides	s (rf)	4	-	-	-	1
Rutaceae						
Acronychia laevis	s (rf)	4	-	1	1	1
Flindersia dissosperma	s	-	2	-	-	-
Geijera parviflora	s	8	7	-	-	-
Geijera salicifolia	s (rf)	8	1	1	-	-
Murraya ovatifoliolata	s (rf)	4	-	-	-	1
Phebalium glandulosum subsp. *glandulosum*	s	12	-	1	-	3
Zieria aspalathoides	s	7	-	-	-	2
Zieria cytisoides	s	3	-	-	-	2
Santalaceae						
Exocarpos latifolius	s	3	1	1	-	-
Santalum lanceolatum	s	5	5	-	-	-
Sapindaceae						
Alectryon connatus	t (rf)	21	2	1	-	1
Alectryon diversifolius	s	4	6	-	-	-
Alectryon oleifolius	s	1	7	-	-	-
Atalaya hemiglauca	t	7	17	-	-	-
Cupaniopsis anacardioides	t (rf)	13	1	-	1	1
Dodonaea filifolia	s	10	-	-	-	1
Dodonaea lanceolata var. *subsessilifolia*	s	14	-	-	-	-
Dodonaea stenophylla	s	3	-	-	-	2
Dodonaea viscosa subsp. *spatulata*	s	13	8	1	-	-
Elattostachys xylocarpa	t (rf)	1	-	-	1	-
Sapotaceae						
Pouteria cotinifolia var. *pubescens*	s (rf)	4	-	1	1	-
Scrophulariaceae						
Stemodia glabella	f	2	-	1	-	1
Solanaceae						
Datura leichhardtii	f	-	1	-	-	-
Nicotiana forsteri	f	2	-	-	-	1

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Solanum ellipticum	f	19	2	1	-	1
Solanum esuriale	f	1	-	-	-	-
**Solanum lycopersicum*	f	1				
Solanum opacum	f	1	-	-	-	1
Solanum parvifolium	f	1	1	-	-	-
**Solanum seaforthianum*	f	-	1	-	-	1
Stackhousiaceae						
Stackhousia intermedia	f	1	-	-	-	-
Sterculiaceae						
Brachychiton australis	t	25	4	1	1	1
Brachychiton populneus	t	6	1	1	-	-
Brachychiton rupestris	t	4	3	1	1	-
Keraudrenia lanceolata	s	1	-	-	-	-
Melhania oblongifolia	f	12	15	-	-	-
Seringia corollata	s	3	-	-	-	-
Waltheria indica	f	9	6	-	-	-
Tiliaceae						
Corchorus trilocularis	f	3	6	-	-	-
Grewia latifolia	s	15	11	1	-	1
Ulmaceae						
Celtis paniculata	t (rf)	8	-	-	1	-
Trema tomentosa	s	16	-	-	-	-
Urticaceae						
Dendrocnide photinophylla	t (rf)	1	-	-	1	-
Pipturus argenteus	s (rf)	1	-	-	1	-
Verbenaceae						
Verbena macrostachya	f	1	-	-	-	-
Violaceae						
Hybanthus enneaspermus	f	4	4	-	-	1
Hybanthus stellarioides	f	2	-	1	-	1
Vitaceae						
Cayratia clematidea	v	9	-	1	-	-
Cissus oblonga	v (rf)	9	-	1	1	1
Cissus opaca	v	13	1	1	1	1
Cissus reniformis	v (rf)	2	-	-	-	-
Xanthorrhoeaceae						
Xanthorrhoea johnsonii	s	14	-	-	-	-
Zygophyllaceae						
Tribulus micrococcus	f	1	2	-	-	-

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Pteridophytes						
Adiantaceae						
Adiantum hispidulum	f	4	-	-	1	1
Cheilanthes distans	f	17	-	1	1	1
Cheilanthes sieberi and/or *Cheilanthes nudiuscula*	f	25	-	1	-	1
Doryopteris concolor	f	1	-	1	-	-
Isoetaceae						
Isoetes muelleri	f	2	-	1	-	1
Ophioglossaceae						
Ophioglossum gramineum	f	1	-	1	-	-
Ophioglossum lusitanicum	f	1	-	-	-	-
Polypodiaceae						
Platycerium veitchii	f	3	-	-	1	-
Pyrrosia rupestris	f (rf)	2	-	-	1	1
Bryophytes						
Ptychomitriaceae						
Ptychomitrium australe	f	2	-	-	-	2