Rainforest stands between Barrington Tops and the Hunter River, New South Wales

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Turner, J.C.[1] & Vernon, S.L.[2] ([1]21 Tyrrell St, Newcastle, NSW, Australia 2300; [2]Hunter Catchment Management Trust, High St, Maitland, NSW, Australia, 2315) 1994. Rainforest stands between Barrington Tops and the Hunter River, New South Wales. Cunninghamia *3(3): 465–514.* The environmental settings and floristic compositions of 46 rainforest stands are examined. The stands, of total area about 850 ha, were selected from some 3 700 km^2 of foothill country north of the Hunter River towards the southern scarp of Barrington Tops. The surveyed stands (median area: 15 ha) have characteristics typical of the dry rainforest sub-formation: several emergents (*Ficus* spp. and *Brachychiton discolor*), rich tree and woody climber components, relatively small numbers of shrub, fern and epiphyte species, and a sparse ground stratum. They contain about 200 species, excluding grasses, sedges and eucalypts. The stands form a fairly homogeneous group, with relatively little compositional change evident across the survey area. The three most abundant and widespread tree species are (in decreasing order) *Streblus brunonianus*, *Mallotus philippensis* and *Capparis arborea*. This is the southernmost occurrence of such a large area of floristically and structurally well-developed dry rainforest. No rare or threatened plant species are known to be present, but 11 rainforest species are thought to reach their southern limits in the survey area. With one exception, the stands are in private ownership, with no legal protection from disturbance. Their current conservation status is therefore very unsatisfactory.

Introduction

Much of the remaining rainforest in NSW is now in National Parks and Nature Reserves, where it is fully protected, or in State Forests, where present policy gives most of it some protection. However, a large number of smaller stands lie outside such protection and most of them have not yet been systematically examined.

In the Hunter Valley, because of the particular patterns of rainfall, landforms and lithology, most of the remaining rainforest lies between Barrington Tops and the Hunter River (Figure 1), as did most rainforest before European settlement. All of the northern section of this tract is in the Barrington Tops National Park and in State Forests. The rainforest stands in these locations are not threatened by human activity and are relatively well known botanically (e.g. Fraser and Vickery, 1938; Bowden and Turner, 1976; Turner, 1976; Floyd, 1990). However, the lower and more southerly parts are largely in private hands and contain several hundred rainforest stands, many of them still in good condition, whose structure and composition are complementary to those of the stands in the immediate Barrington Tops area. These surviving stands are generally conspicuous in the foothill landscapes, especially because past clearing practices have often left a stand mostly untouched while the surrounding eucalypt forest has been wholly or partially removed. Although many stands have escaped wholesale clearing up to the present day, they are exposed to disturbance by cattle, fire, the invasion of weeds, and such activities as timber-getting and track construction.

Four rainforest sub-formations occur in this part of the Hunter Valley: cool temperate, warm temperate, sub-tropical and dry (Williams, Harden & McDonald 1984, pp. 6–7). Cool temperate rainforest, above about 900 m altitude, warm temperate rainforest, immediately below 900 m, and sub-tropical rainforest in the valley floors close to the southern scarp of Barrington Tops, are almost wholly contained within the National Park and State Forests. Further south, recent examination of a few of the foothill stands mentioned above (Floyd 1983a; Vernon 1985) showed that they consist predominantly of dry rainforest, with some internal gradation towards sub-tropical rainforest.

This paper reports the results of an examination of the floristic composition and other characteristics of a sample of rainforest stands north of the Hunter River to the southern boundaries of the publicly-owned land close to Barrington Tops. The eastern boundary of the overall study area is the eastern edge of the Williams River drainage basin, and the western boundary is the western edge of the Foy Brook basin

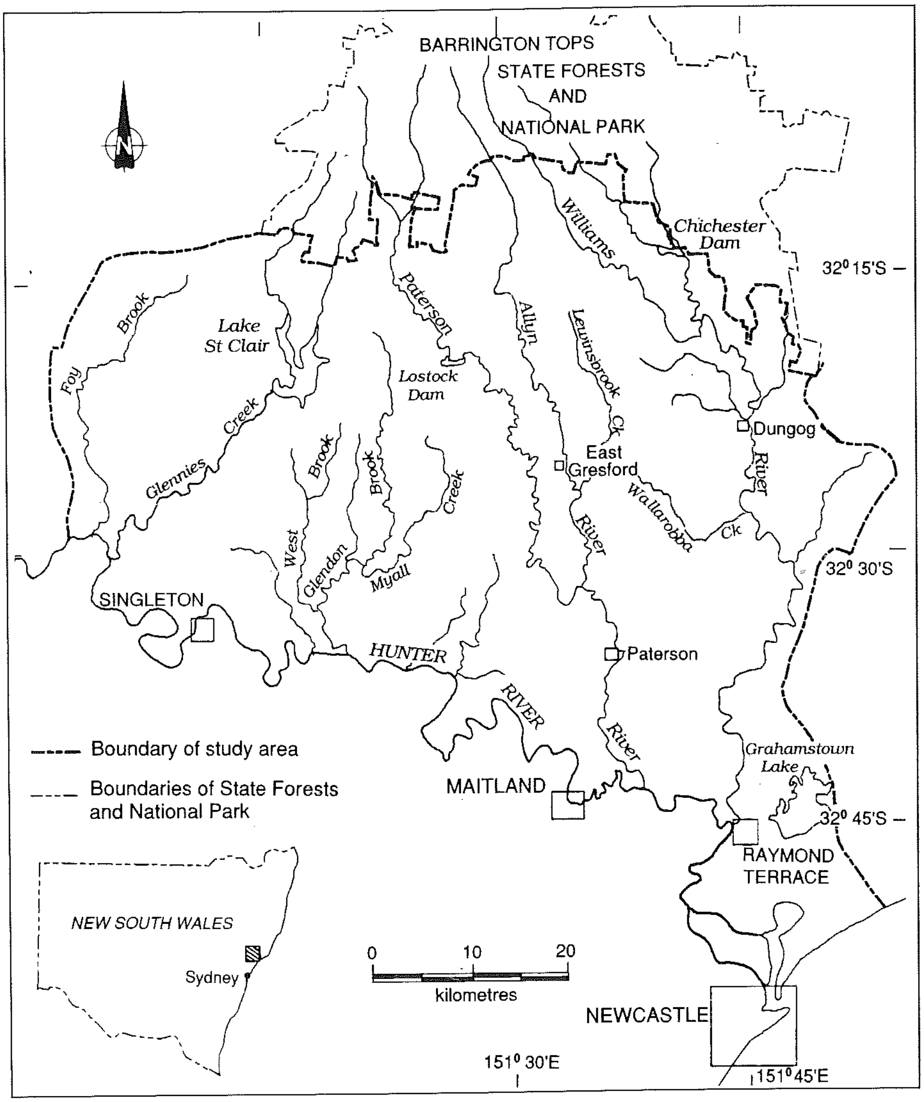

Figure 1. Map of the study area. The southern boundary is the channel of the Hunter River.

(Figure 1). The study area covers about 3 700 km^2 and includes the small towns of Dungog, Gresford and Paterson. The material in this paper is taken from a more extensive, unpublished report prepared under a National Estate grant (Turner and Vernon 1990).

Physical Setting

Drainage and relief

The major streams of the study area (Williams, Allyn and Paterson Rivers) have their beginnings on or close to the southern scarp of Barrington Tops, and their valleys radiate away from it towards the Hunter River. Even such shorter and lesser streams as Glendon Brook, Glennies Creek and Foy Brook are a part of this radiating pattern (Figure 1). Most of the study area lies below 500 m. In this foothill country, the higher land occurs as ridges between the river valleys. Typically, local relief (the difference in elevation between a main valley floor and the nearest basin divide) is 200 m to 300 m. The floors of the main valleys are generally broad and open.

Rainfall

The isohyet map of Figure 2 has been drawn from annual averages (Bureau of Meteorology data) for some sixty of the stations contained in the atlas assembled by Bridgman (1984). The data are so sparse across the whole area that we have not felt

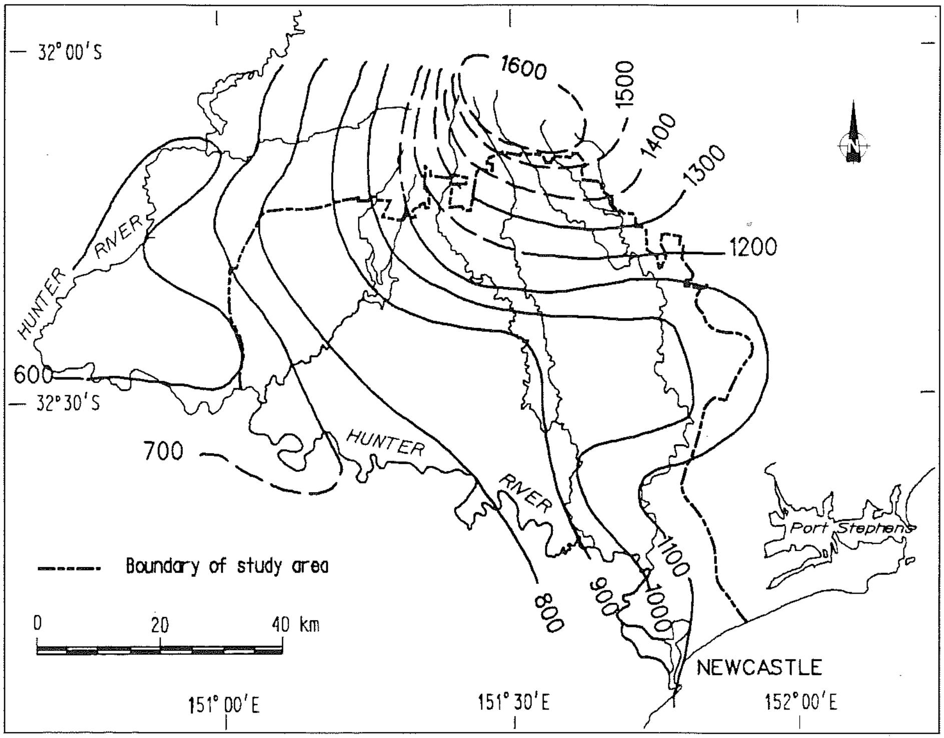

Figure 2. Isohyet map of the study area and vicinity. Smoothed isolines of average annual rainfall in mm.

justified in drawing other than highly-smoothed isolines. Locally, one would expect to find a far from smooth pattern because of aspect and topographic influences. Thus, Figure 2 is only a generalised picture of the annual average rainfall of the area. It probably presents an underestimate of actual rainfall on the higher parts of the foothill country on those parts where most of the remaining rainforest stands occur. Regionally, annual rainfall is positively correlated both with closeness to the coastline and with altitude. Across most of the study area the isohyets lie in a south-east to north-west direction.

Geology and soils

Almost all the rocks in the study area are of Devonian and Carboniferous age, many of them very resistant to weathering. Galloway (1963) has given a brief geological description of the Hunter Valley, including the study area.

Both Galloway (1963) and van de Graaff (1963) point out that the soils found on the more resistant rocks are usually skeletal. A small amount of analytical information is available for such soils. One of us (Vernon 1985) has reported on some characteristics of the top 10 cm of the soils she found in four rainforest stands (coded here as C1, C3, W1 and W2). These stands span most of the southerly part of the survey area, in a south-east to north-west sequence. The soils were relatively coarse in texture (ranging from silty loams to loamy sands) and slightly-to-strongly acid. They contained about 10% organic matter and their total phosphorus concentrations were no more than moderate (mean values 0.042% to 0.061%). These four stands occur on acid-to-intermediate vulcanogenic rocks such as rhyodacites, parent materials typical of the range of parent materials underlying the stands examined in detail in this present survey. We expect therefore that the soils of most of the surveyed stands will be very free-draining and of low-to-moderate chemical fertility and water-retaining capacity.

Land systems and landforms

Land systems are 'areas with (their) own characteristic (and recurring) combination of landforms, soils and vegetation' (Story et al.). Stands were assigned to the land systems used in the CSIRO survey of the Hunter Valley (Story et al. 1963), and based on their 1:250 000 land system map sheet. Abbreviated descriptions of the relevant landforms are given below.

Cranky Corner	Extremely steep massive mountains, hills, escarpments [and] deep ravines with rubbly slopes and cliffs, up to [60 m] high.
Mt Butterwicki	• Very steep ridges with narrow crests dissected by closely-spaced ravines giving extremely broken topography; much outcrop; liable to slumping.
	• Massive hills with extensive cliffs and much surface rubble.
	• Deep narrow valley heads, generally facing south, bounded by cliffs or very steep slopes; much surface rubble.
Mt Royal	Fairly steep to very steep ridges with broadly rounded summits or narrow crests; slopes dissected by closely-spaced ravines.
Rainforest	• Steep ridges with narrow uneven crests; slopes with closely-spaced deep ravines or with cliffs and bluffs [3–60 m] high.
	• Basalt screes and cliffs.
Wallaroo	Moderately steep rounded hills [15–100 m] high; lower slopes of major valleys in more rugged areas; broad structural benches andplateaus fringed by cliffs and bluffs up to [15 m] high.

Methods

Air reconnaissance

We decided that systematic low-level aerial reconnaissance, with a colour photographic record, would provide the most effective basis for selecting stands for ground visits. Standard black-and-white stereo aerial photographs were used to supplement the information gained from these light-plane flights where required. Eleven reconnaissance flights were made in Cessna aircraft, covering the whole study area. The flight path was usually 300–500 m above local terrain. At these elevations, a lens of 50 mm focal length on a 35 mm camera gave satisfactory cover of most rainforest stands.

Ground survey

Criteria used in the selection process were size, relative freedom from human-induced disturbance, representative location within the survey area, physical accessibility, and the granting of permission for entry from the land-owner.

We accepted as a working assumption that the larger a stand, the richer in plant species and the more fully developed structurally it was likely to be. In addition, freedom from at least gross disturbance was a self-evident requirement — this was a characteristic which, it was found, could be assessed satisfactorily from direct observation on light-plane flights and from the resulting colour transparencies. Concerning location, we felt that, as well as there being a requirement for breadth of sampling (i.e. across the whole survey area), there was a need for increased intensity of sampling in areas where stands were relatively large and frequent.

Physical difficulty of access prevented visits to a few remote stands, such as some in the upper parts of the valleys of Glendon Brook and the Paterson River (immediately south of State Forest boundaries). In four cases land-owners either refused or showed marked reluctance to allow a visit. As far as possible, nearby stands of similar size were inspected instead. In the event, 42 stands were examined. In addition, some of the data collected by Vernon (1985) for another four stands have been incorporated into our results.

Within each stand an extended route (usually doubling back and forth) was chosen in order to sample as fully as reasonably possible the range of habitats present, having regard to such influences as local topography and aspect. We aimed to complete the inspection of each smaller stand within a day. However, it took two or three days to examine some of the larger stands. For each stand, the presence and relative abundance of individual species were recorded. Four categories of relative abundance were recognised: very common (VC), common (C), occasional (O) and rare (R). These qualitative abundances were assessed by the same person (SV) for every stand but one (Rosewood Gully, C2), with the aim of achieving as much inter-stand consistency as reasonably possible.

The survey area was divided into three sectors, Eastern (E), Central (C) and Western (W), and the surveyed stands in each sector were numbered in sequence from south to north. Thus each stand has been coded by a letter and a number, e.g. C12. The boundaries between sectors were arbitrarily placed along two of the major streams, the Allyn-Paterson River and Glennies Creek (Figure 3). In a few cases (E4, E5, E11, E17, C14), where two or three small stands were close together and could be inspected as a group during one or at most two visits, they have been given a single code designation.

Rock specimens were collected at most stands. Later they were examined and classified by Dr L.N. Morris of the Geology Department, University of Newcastle.

Landscape data

Area

An outline of each stand was drawn on its 1:25 000 topographic map sheet, using for guidance all the available sources of information: black-and-white aerial photographs (with stereo cover), low-level aerial oblique colour transparencies, our ground-survey records, and the pattern of local drainage and contour lines revealed on the map itself. The area of the stand outline was then determined by tracing it on to graph paper and counting the enclosed number of unit squares.

In most cases, the size of the stand had been reduced by past human disturbance. It is now difficult or impossible to estimate where these edges may have stood before settlement. As mapped, however, the stands consist very largely of rainforest still structurally intact. Particularly at the down-stream margins of many stands, there are clear signs of recent and continuing disturbance: broken canopy, lack of normal vertical structure, weed invasion, livestock incursions. Care was taken to try to exclude such areas from the mapped stand outlines.

Eucalypts occur intermingled with rainforest species in many stands — sometimes singly, sometimes in patches, and almost always towards the edges of stands. Mapping is always difficult in such circumstances. Here, we have included single eucalypt trees and very small groups within the stand outline, but have excluded larger groups. The latter commonly occur on ridge lines within the general confines of the larger stands and they are present, for instance, in the Tabbil Creek stand, E10. Very commonly they have a rainforest understorey.

Rainfall

To obtain an estimate of the average annual rainfall of each stand, linear interpolation was applied between the smoothed isohyets shown in Figure 2. No adjustment was attempted for local topographic patterns, although it was recognised that all the stands examined were in upland sites, commonly with southern or eastern exposures, while most of the measuring stations were on the relatively open floors of the major valleys, kilometres or tens of kilometres away.

Altitudes and altitudinal spans

From the outline of each stand drawn on to its 1:25 000 map sheet, the altitudes of the highest and lowest boundaries were read off to the nearest 10 m. The mid-point of these extreme values was then taken as a mean value for the altitude of the stand. The altitudinal span of a stand was taken as the difference between the two extreme values.

Aspect and slope

A subjective assessment of the predominant aspect of each stand was made by inspection of the stand outline drawn on the appropriate 1:25 000 map sheet. The 16-point compass scale was used as the basis of this assessment.

A measure of the overall slope above horizontal of each stand was obtained by measuring, on the 1:25 000 map sheet, the straight-line distance between the highest

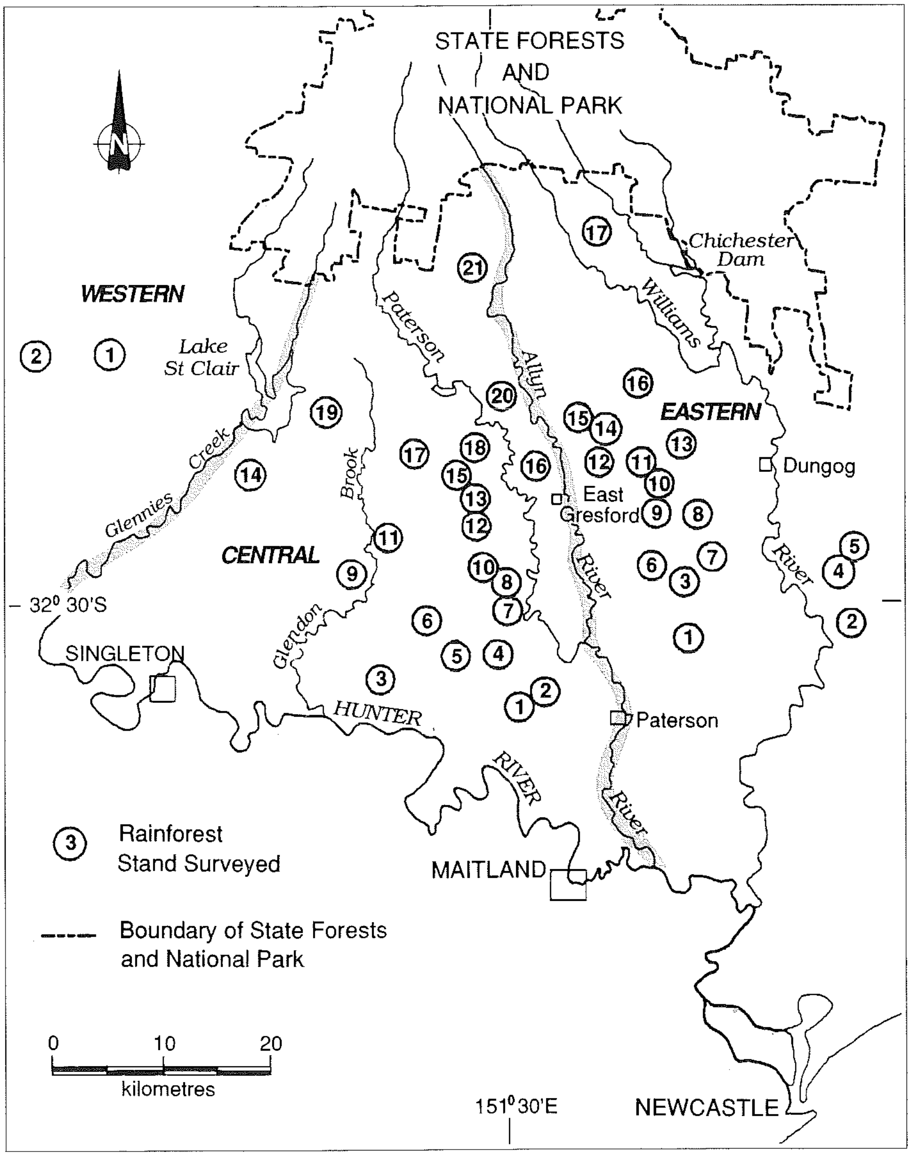

Figure 3. Distribution map of the surveyed stands: Eastern, Central and Western sectors.

and lowest points in the stand (points of known altitude — see earlier) and applying the arctangent relationship to find the angle.

Plant data

Compilation of species lists

Lists of the plants found in the surveyed stands are presented in Appendixes 2 and 3. For some stands occurring very close together, only composite species lists were prepared. Appendix 1 (see further mention in Results) therefore describes more stands than are apparent in the columns of Appendixes 2 and 3 (see Notes with these two Appendixes). Plant names have been checked against Harden (1990, 1991, 1992) and against Beadle (1971–1987) where appropriate.

The distinction between shrubs and small trees is traditionally made on the basis of both height and form. Specht (1970) for instance defines a shrub as 'a woody plant less than 8 m tall, frequently with many stems arising at or near the base'. In rainforest, however, our observations indicate that most small free-standing woody plants are not multi-stemmed, so it is necessary to draw a dividing line, arbitrarily, on a size criterion alone. We prefer to base the decision on the easily-measured or estimated property of stem circumference at breast height (1.4 m), following the definition: 'a shrub species is a population of woody plants whose members do not consistently attain, at maturity, a stem circumference at breast height greater than 10 cm'. On this criterion, most of the woody plants in question are defined as (small) trees and accordingly our species list for shrubs (Appendixes 2 and 3) is quite short.

We have followed the practice of Floyd (1983a) and have not included eucalypt species in the rainforest species lists. Eucalypts almost invariably occur only near the edges of these dry rainforest stands. *Casuarina cunninghamiana* occurs along some of the larger streams running through stands (e.g. along Webbers Creek in the Moonabung Falls stand, C1). It can be thought of as occupying an internal edge habitat. Two *Melaleuca* species, *M. quinquenervia* and *M. styphelioides*, occur through the stands — the latter species is quite common. In contrast to the eucalypts, these three species have been included on the lists. Eucalypts generally cannot regenerate under a rainforest canopy, so their presence in a stand (perhaps initially due to an incursion by fire) is essentially fortuitous and for a single generation. On the other hand, as far as we know, the *Casuarina* and *Melaleuca* species are stable in their present positions and are able to persist indefinitely.

It is inevitable that some species actually present in an individual stand will not be detected. A species missed in one stand, however, is likely to have been noted in one or more other stands (unless it is of very restricted distribution) — more confidence can be placed on the overall occurrence list than on the presence list for any individual stand. It should be noted too that different weights are necessary when one considers presences compared with absences. A recorded presence is unambiguous but an indicated absence is less clear-cut in its meaning — it may truly be an absence, or it may cover a failure to detect a presence.

We have some data on the effectiveness of sampling of stands. They concern stand C1, Moonabung Falls. In 1982 this stand was surveyed by Floyd (1983a), using very much the same method as we used with other stands: a more-or-less systematic walk through the stand, noting presences. In 1985, detailed plot-work was carried out in the same stand by Vernon, who examined 27 plots each of area 200 m^2, placed systematically throughout the stand. In Table 1 we compare the results of the two examinations by way of listing the numbers of species detected in the structural groups. Our general expectation is confirmed that a reconnaissance survey tends to yield fewer recorded presences than the results of detailed plot-work across the stand.

Three other stands (Sandy Waterholes, C3; Foy Brook, W1; and Cedar Creek, W2) were also examined in detail by Vernon (1985). As well, another three of the stands surveyed by us had also been surveyed earlier by Floyd (ibid.) in the same way as his examination of Moonabung Falls. For these stands (Mirari Ck, E6; Pilchers Mountain, E8; and Tabbil Ck, E10) the two presence lists have been combined. Thus, the surveyed stands have been subjected to a range of sampling intensities, and the comprehensiveness of their species lists is likely to vary accordingly.

Cluster analysis of the stands

A polythetic agglomerative classification procedure was applied to the stand-by-stand tree species-presence data. In the so-called 'flexible fusion' strategy (described in Williams, 1976), the relative amount of space contraction–dilation allowed in the clustering process is termed the beta value. A small negative beta value has commonly been found to be optimal in obtaining sought-after sharpening of distinctions between nearby clusters. Commonly, a beta value of –0.25 is used. Here, we used SAS Statistics software, procedure CLUSTER (METHOD = FLEXIBLE, beta = –0.25), followed by procedure TREE, which prints a dendrogram as well as the fusion history of the agglomerative steps.

Included in the analysis was the species list termed Wg (Appendix 2), for those rainforest species occurring generally in the Western sector, often as single trees or in very small groups. For present purposes, the Wg list will be termed a 'stand'. The final data matrix contained 44 stands and 85 tree species. A few species were not included because of their low inter-stand frequencies — only one or two occurrences in the 44 stands.

Results

a) The stands in their landscapes

Location

Locational and other information about the stands is presented in Appendix 1. Most of the surveyed stands are concentrated in the stretch of country from Dungog west–south-west towards Singleton. We consider that this pattern mirrors with fair accuracy the density of distribution of stands as a whole, particularly of the larger ones. Stands are small and infrequent in the western part of the survey area. Here, species of undoubted rainforest affinity occur, but in very small groups or, commonly, as isolated individuals. These species, tolerant of relatively dry habitats, will be referred to again later. The scale of their distribution patterns in the west (where the term 'stand' is frequently no longer appropriate to describe their form of occurrence) makes for difficulties in any attempted comparison with stands in the east, which usually are coherent and well-defined, and may be quite large.

Table 1. Comparison of observed species numbers between a reconnaissance survey (Floyd, 1983a) and systematic plot work (Vernon 1985) at Moonabung Falls (stand C1)

Structural group	Numbers of native species		
	from a single reconnaissance visit	from plot work	reconnaissance / detailed plot work %
Trees and shrubs	46	67	69
Herbs	8	10	80
Climbers*	17	13	131
Epiphytes and Lithophytes	6	6	100
Overall	77	96	80

* Chalmers and Turner (1994 in press) found 26 species of climbers in this stand. Their expanded list has not been applied to this present report.

Area

The frequency distribution and some statistics of the areas of surveyed stands are set out in Table 2. The frequency distribution is strongly skewed towards larger stands. Mean areas were also calculated separately for the 20 stands in the eastern sector and for the 26 stands in the central and western sectors. As expected, the mean size of the eastern-sector stands (22.6 ha) is markedly higher than that for the stands of the other two sectors (15.8 ha).

Rainfall

For the 46 rainforest stands examined, estimated average annual rainfall values range from 750 mm to 1 400 mm, with most stands in the 800–1 000 mm range (Table 3).

Topographic types and land systems

Our observations suggested that the topographic situations in which stands occurred could be assigned to the following general types.

Down-stream valley site

A down-stream valley stand occurs in a side valley usually well removed (typically kilometers) from the extreme headwater tract of its tributary valley. The presence of the stand is associated with a local topographic feature providing sheltered habitats, perhaps a gorge, e.g. stand C1 below Moonibung Falls.

Gully-head amphitheatre

In some cases there are amphitheatre-like hollows at the extreme heads of streams. These hollows, usually with very uneven and scree-covered floors, provide sheltered

Table 2. Frequency distribution and statistics of the areas of surveyed stands

	Area class (ha)					
	0–9	**10–19**	**20–29**	**30–39**	**40–49**	**≥50**
Number of stands (Total = 46)	15	16	8	3	1	3

Mean	= 18.7 ha	**Median**	= 15.5 ha
Standard deviation	= ± 17.0 ha	**Range**	= 1.5–84 ha

Table 3. Frequency distribution and statistics of the estimated average annual rainfall of surveyed stands

	Rainfall class (mm/year)							
	700–799	**800–899**	**900–999**	**1000–1099**	**1100–1199**	**1200–1299**	**1300–1399**	**1400–1499**
Number of stands (Total = 46)	2	17	15	9	1	1	0	1

Mean	= 930 mm	**Median**	= 900 mm
Standard deviation	= ± 110 mm	**Range**	= 750–1400 mm
Mean of eastern-sector stands	= 1005 mm	**Mean of central- and western-sector stands**	= 880 mm

habitats and often contain rainforest stands. An example is the Pilchers Mountain stand, E8.

Single and multiple gully-heads

At the extreme heads of streams ('gullies' at that stage) rainforest stands often occur. Depending on the local pattern of drainage and topography, a stand may be relatively small and occupy a single gully head, which may have minor tributaries within the stand (e.g. Bingleburra, stand E12), or it may connect across several neighbouring gullies (e.g. Wallarobba Range: NE section, stand E13). In both cases, the stand is often roughly triangular in overall outline, with apex down-slope where a consolidated stream finally emerges.

Weakly-gullied rocky slopes

Some stands occur on very rocky slopes where drainage lines and channels are not strongly developed. In these cases, the stand may be largely underlain by scree and there may be low cliffs immediately above (e.g. the Lees Mountain stand, C7). The presence of rainforest plants may be encouraged on some substrates of fragmented rock because relatively more of the infiltrated rain water is likely to be available to plants than in non-rocky soils. There may also be additional water from run-off from cliffs.

A combined frequency table has been drawn up for all surveyed stands in terms of the land systems and topographic types to which they can be assigned (Table 4). Stands occur on five land systems — they are particularly common on Cranky Corner and Mt Butterwicki, both of which are notable for rugged landscapes. As regards the five defined topographic types, gully heads, both single and multiple, are by far the most common sites for the occurrence of the surveyed stands.

Altitudes and altitudinal spans

The frequency distributions and some statistics of the altitudes and altitudinal spans of the surveyed stands are set out in Tables 5 and 6 respectively. These two frequency distributions, unlike those for stand area and average annual rainfall, are more or less symmetrical in shape, with the modal class centrally placed.

Table 4. Frequency distributions of stands with respect to land systems and topographic types

		Land System					
		Cranky Corner	Mt Butterwicki	Mt Royal	Rainforest	Wallaroo	Total
Topographic type	Down-stream valley site	5	4				9
	Gully-head amphitheatre		4			3	7
	Multiple gully-heads	4	8	1	1		14
	Single gully-heads	5	5			2	13
	Weakly-gullied rocky slopes	1	1			2	4
	Total	15	22	1	1	7	46

Aspect and slope

A combined frequency table for aspect and slope of all surveyed stands is presented in Table 7, together with some relevant statistics. The reader will appreciate the gross approximation involved in the selection of a single direction to represent the diverse array of aspects encompassed in a stand, particularly a large one. Most of the stands have predominant aspects lying from E through SE to SSW.

Lithological background

The rock specimens collected were all of Carboniferous age. They were derived almost entirely from volcanic activity, being either lavas of an acid or intermediate type, or sedimentary rocks (mostly fine-grained tuffs) derived from similar igneous rocks. In these latter cases, the sedimentation seems generally to have occurred in terrestrial environments (L.N. Morris, pers. comm.).

From these findings, it cannot be expected that the fertility of the associated soils will be any higher than low-to-moderate. It seems likely that the surface-soil analytical results for four of the stands (C1, C3, W1, W2; Vernon, 1985) mentioned earlier will be of broad applicability across the surveyed stands. The presence of some ooliths at two of the stands (E2 and E9) suggests that at least some of the soils under these particular stands will be enriched in calcium.

Only one rock specimen was collected from most of the stands. Inevitably some stands, particularly the larger ones, will possess a lithological heterogeneity not revealed in our results. However, even if the sampling had been exhaustive, there would be no reason to expect conclusions about general soil fertility levels different from those set out above.

The modal stand

A number of physical features of the surveyed stands have been described. In Table 8 we summarise the modal characteristics of stands. For those characteristics where a numerical scale is employed, the specific bounds of the modal classes shown in the

Table 5. Frequency distribution and statistics of the mid-point altitudes of the surveyed stands

		Altitude class (m)			
		1–99	100–199	200–299	300–399
Number of stands (Total = 46)		3	9	22	12
Mean	= 242 m	**Median**	= 245 m		
Standard deviation	= ± 77 m	**Range**	= 90–380 m		

Table 6. Frequency distribution and statistics of the altitudinal span of the surveyed stands

	Altitude-span class (m)					
	50–99	100–149	150–199	200–249	250–299	300–349
Number of stands (Total = 46)	7	10	16	8	4	1
Mean	= 163 m		**Median**	= 160 m		
Standard deviation	= ± 64 m		**Range**	= 50–310 m		

table have been arbitrarily chosen — no great significance or exactitude should be read into the selected limits. The means and medians lie within the respective modal classes, or close to them.

Results

b) The rainforest vegetation

Rainforest structural types

The surveyed stands are examples of dry rainforest. Williams et al. (1984) provide a description of this rainforest type, which they recognise as one of the four sub-formations of rainforest occurring in NSW. Characteristics important in distinguishing dry rainforest from the other sub-formations are listed below in Table 9.

There is no single structural or floristic feature which uniquely distinguishes dry rainforest from the other sub-formations. Each sub-formation grades continuously into one or more of the others. Dry rainforest, for instance, may grade into sub-tropical rainforest along a moisture-supply gradient (in circumstances where temperature is more-or-less constant) or into warm-temperate rainforest along combined moisture and temperature gradients (increasing moisture and decreasing temperature). The sense of continuity between the sub-formations is reinforced by the fact that some species show a very wide environmental tolerance, occurring in three or even in all four sub-formations.

Table 7. Frequency distributions and statistics of stands with respect to predominant aspect and overall slope inclination

Predominant		**Slope-inclination class (°)**			**Totals**
aspect	**5–9**	**10–14**	**15–19**	**20–24**	
N		1	1	2	
NNE		1		1	
NE	1			1	2
ENE		1			1
E	1	2	2		5
ESE		1	1	1	3
SE	3	5	4	1	13
SSE		2	1		3
S	4	1	3	1	9
SSW	2	1	1		4
SW			1		1
WSW			1		1
W					0
WNW		1			1
NW		1		1	
NNW					0
Totals	11	17	14	4	46

SLOPE INCLINATION

Mean	= 13.2°	**Median**	= 13°
Standard deviation	= ± 4.6°	**Range**	= 5°–24°

ASPECT

Mode	= south-east	**Median**	= south-east

Vernon (1985) assessed the four stands which she was studying in terms of the classification system of Webb (1978). She concluded that they could be regarded as examples both of dry rainforest and of simple notophyll low vine forest (Webb terminology), and we think that these terms can be applied to all the stands in the present survey. Even stand E17, Chichester Gap, which is close to the southern scarp of Barrington Tops and is relatively high (mid-point 375 m in altitude) and wet (1 400 mm estimated average annual rainfall), still fits most of the characteristics for dry rainforest (Table 9). All of these stands, however, possess some characteristics linking them to the sub-tropical and/or warm temperate rainforest sub-formations. This is especially so with those (larger) stands occupying a wide range of topographically-determined habitats. Here, in the most sheltered habitats, for instance, the forest may approach, locally, sub-tropical rainforest in its structure and floristics. Later we examine further the notion of the mixed nature of the surveyed stands.

Species frequencies and abundances

Inter-stand frequencies

The inter-stand frequency of a species is defined here as the percentage of all those stands under study in which the species was observed. It provides a measure of the relative degree of spread of a species across the surveyed stands, and gives no indication at all of the intra-stand abundances of that species. The term *frequency* in plant ecology normally applies to the percentage presence of a species across a number of plots, all of the same size. Our surveyed stands (by analogy, to be thought of as 'plots') range widely in area, so there can only be a broad qualitative similarity between these two frequency terms. To provide an indication of variation in inter-stand frequencies *within* the surveyed area, values have also been calculated separately for the eastern-sector stands and for the central- and western-sector stands combined. Table 10 summarises some of the variability in inter-stand frequency. Species have been included in the Table if their inter-stand frequencies in E and in C + W stands differ by twenty or more percentage points. This figure is an arbitrary choice — it is meant to signify a marked difference unlikely to be due to chance alone.

More species show a large inter-stand frequency decline in the east-to-west direction than show such a decline in the opposite direction. This trend is particularly strong for vines and epiphytes/lithophytes. This supports the expectation that many rainforest species will become less frequent as the distance from the coast increases, mainly for reasons of diminished moisture supply, but also connected with reduced

Table 8. The modal stand amongst the forty-six surveyed

Characteristic	Modal class
Area	10–19 ha
Average annual rainfall	800–899 mm
Land system	Mt Butterwicki
Topographic type	Multiple gully heads
Altitude	200–299 m
Altitudinal span	150–199 m
Predominant aspect	South-east
Overall slope inclination	10–14°
Underlying rock type	Fine-grained tuffs derived from acid volcanics
Geological age	Carboniferous

Table 9. Prime distinguishing features of dry rainforest (after Williams et al., 1984)

Trees
- A more-or-less continuous canopy stratum, above it a discontinuous stratum ('emergents').
- A discontinuous small-tree stratum.
- A rich array of species.
- Leaf-sized, small, mainly microphyll.

Climbers
- Large woody climbers are common and diverse.

Epiphytes
- Large epiphytes may be either rare or common, but there are few species.

Special features
- Mosses and ground ferns rare, no tree-ferns, prickly shrubs common.

Habitat
- Warm areas with fairly low average annual rainfall (600–1100 mm).

Floristics
- A small number of emergent species occur; they include the lace-bark tree, *Brachychiton discolor.*
- The canopy and small-tree strata are often dominated by species of a few families, particularly (in the Hunter Valley) Euphorbiaceae and Sapindaceae.

chances of arrival and establishment of disseminules at individual stands (the past supply of disseminules being assumed to be at a maximum close to the coast at a time-scale of centuries, millenia and longer).

Abundances and inter-stand frequencies considered together

Centrally important features of forest vegetation are the floristic composition of the tree strata and the relative abundances of the species, especially in the main canopy layer. In Table 11 attention is concentrated on those tree species assessed as abundant (VC or C) in most of the stands. The twelve most successful species in this sense are arranged in the Table in decreasing order of inter-stand frequency. Some of these trees do not normally reach the canopy stratum of the forest. Information from Floyd (1989) on tree heights is presented in the right hand column of the Table. In the Hunter Valley, *Cleistanthus cunninghamii, Croton verreauxii,* and *Claoxylon australe* are not tall enough to be counted as members of the canopy stratum. The eight other species in the list can be included as well, although some of them, such as *Streblus brunonianus* and *Elattostachys nervosa*, often reach only the lower part of the canopy. In terms of its consistently high abundance, *Streblus* is clearly in a class by itself. Further down the list, there are large gaps in inter-stand frequency (in the VC + C column) below *Capparis arborea* and below *Croton verreauxii.*

The three species most often noted as emergents in the stands examined are also listed in Table 11: *Brachychiton discolor, Ficus macrophylla* and *F. superba* var. *henneana.* It is a characteristic of the emergents that they are rarely present in large numbers in a stand — examination of Table 11 shows that their (O + R) inter-stand frequencies are much greater than their (VC + C) inter-stand frequencies.

Table 10. List of those species showing large (≥ 20%) inter-stand frequency differences between E and C + W sectors

E>> (C + W)	(C+ W) >> E
Trees (total spp = 95)	
Alangium villosum	*Scolopia braunii*
Actephila lindleyi	*Toona australia*
Citronella moorei	*Austromyrtus acmenioides*
Pennantia cunninghamii	*Backhousia myrtifolia*
Backhousia sciadophora	*Pittosporum undulatum*
Melicope micrococca	*Podocarpus elatus*
Elattostachys nervosa	*Sarcomelicope simplicifolia*
Celtis paniculata	
Dendrocnide photinophylla	
(n = 9)	(n = 7)
Shrubs (total spp = 17)	
Pittosporum revolutum	
Spartothamnella juncea	
**Lantana camara*	
(n = 3)	
Herbs (total spp = 25)	
Alocasia macrorrhizos	*Pseuderanthemum variabile*
Gymnostachys anceps	*Plectranthus parviflorus*
Lastreopsis microsora	*Viola hederacea*
Pollia crispata	
(n = 4)	(n = 3)
Climbers (total spp = 40)	
Parsonsia velutina	*Passiflora herbertiana*
Gymnema pleiadenium	
**Delairea odorata*	
Pandorea pandorana	
Diosscorea transversa	
Austrosteenisia blackii	
Stephania japonica	
**Passiflora subpeltata*	
Piper novae-hollandiae	
Morinda acutifolia	
(n = 10)	(n = 1)
Epiphytes/lithophyytes (total spp = 23)	
Asplenium attenuatum	
Asplenium australasicum	
Dendrobium speciosum	
Dendrobium teretifolium	
Peperomia leptostachya	
Platycerium sperbum	
(n = 6)	(n = 0)

Notes. Eastern sector (E) : 18 stands; Central (C) and Western (W) sectors : 25 stands. (A total of 43 stands; reduced from the 46 stands of Appendix 1 because of some consolidation of species lists — see notes accompanying Appendixes 2 and 3.) - Within each structural category, the genera are arranged in the same (family-ordered) sequence as that in which they occur in Appendixes 2 and 3. – * denotes a naturalised species.

Attention has been given so far to those tree species which are both most frequent across stands and most abundant within stands. The situation in the other structural groups must now be briefly examined. Table 12 lists in decreasing order, in the same way as Table 11, those species with the highest inter-stand frequencies in each group. The results provide agreement with that part of the description of dry rainforest set out in Table 9 concerning the general sparseness of Herb (mostly ferns) and

Table 11. Most frequent and abundant tree species

Species	Inter-stand frequencies (%) in the following intra-stand abundance categories:* VC+C	O+R	Total	Tree height (m) (Floyd 1989)
Trees with the highest VC + C frequencies				
Streblus brunonianus	98	2	100	30
Mallotus philippensis	84	14	98	25
Capparis arborea	81	19	100	10
Baloghia inophylla	65	35	100	25
Olea paniculata	60	28	100	30
Dendrocnide excelsa	58	35	93	40
Cleistanthus cunninghamii	53	28	81	9
Drypetes australasica	53	21	74	25
Croton verreauxii	49	51	100	20
Elattostachys nervosa	33	51	84	30
Claoxylon australe	32	63	95	9
Geijera salicifolia var. *latifolia*	26	67	93	30
Trees often present as emergents				
Brachychiton discolor	11	77	88	30
Ficus macrophylla	2	56	58	50
Ficus superba var. *henneana*	0	65	65	35

* Abundance information drawn from the full range of data (43 stands) set out in Appendixes 2 and 3.
VC : Very common, C : Common, O : Occasional, R : Rare, very infrequent

Epiphyte/Lithophyte groups. Here too the same comment can be applied to the Shrub group. In all three groups, for almost all the small number of species involved, there are few stands where abundances are high. In contrast, the success of the Climber group is apparent, particularly large woody climbers. All of the eight listed climbers are woody and of them only *Legnephora moorei* does not attain large stem diameters.

So far those species have been emphasised which are both frequent and abundant. Obviously, other categories could also be considered. We shall look briefly at only one group: tree species of high inter-stand frequency but of consistently low abundance. Table 13 is organised in a way similar to Table 11 — it lists, in decreasing order, the 16 tree species with the highest inter-stand frequencies of O and R abundances.

This information serves to point up the richness of the tree flora in the dry rainforest of the Hunter Valley. These sixteen species take us down to a frequency of 70%, still relatively high — there are many other species as well with lower frequencies. The listed species range from tall trees down almost to shrubs — as a group, they are most important in helping to fill the top three strata of the forest with populations successful in terms of their spread amongst stands but rarely large locally.

To emphasise the point that some tree species seem never to be abundant in individual stands, Table 13 lists separately (with some repetition from the main part of the Table) those six species having, at the same time, the highest O and R frequencies and zero frequencies in the VC + C abundance categories.

Table 12. Shrub, herb, climber and epiphyte/lithophyte species with the highest inter-stand frequencies and high intra-stand abundances

Species	Inter-stand frequencies (%s) in the following intra-stand abundance categories:*		
	VC + C	O + R	Total
Shrubs with the highest VC + C frequencies			
Citriobatus pauciflorus	97	0	97
*Lantana camara***	63	14	77
Abutilon oxycarpum	14	58	72
Herbs with the highest VC + C frequencies			
Adiantum formosum	56	37	93
Pellaea falcata var. *falcata*	42	56	98
Doodia aspera	38	57	95
Adiantum aethiopicum	29	67	96
Pellaea falcata var. *nana*	19	71	90
Climbers with the highest VC + C frequencies			
Cissus antarctica	98	2	100
Parsonsia straminea	77	23	100
Tetrastigma nitens	77	23	100
Austrosteenisia blackii	56	12	68
Legnephora moorei	47	47	94
Pandorea pandorana	35	65	100
Malaisia scandens	30	56	86
Jasminum volubile	30	42	72
Epiphytes and Lithophytes with the highest VC + C frequencies			
Pyrrosia confluens	38	60	98
Dendrobium speciosum	7	64	71
Asplenium australasicum	5	40	45

* Abundance information as for Table 11.
** An introduced species, now naturalised.

Species numbers in individual stands

Table 14 presents total observed species numbers as well as statistics of numbers of species per stand for each of the structural groups. Some comparable data from other Hunter Region rainforest studies are also included. The figures serve to emphasise once again the richness of these dry rainforest stands in woody plants, especially trees and vines, in agreement with the broad description given in Table 9. The stands of warm-temperate rainforest studied by Gambrill (1986) occur on the south-western margin of the Hunter Valley and are notably poor in species.

Within a particular region, what measures might be used to predict the floristic richness of individual stands? It is reasonable to expect that stand area (as a crude measure of relative habitat diversity) will be positively associated with species numbers. Another stand characteristic which might also be expected to be directly related to habitat diversity is altitudinal span. Assuming that the coastal belt of the

Table 13. Tree species with high inter-stand frequencies and low intra-stand abundances

Species	Inter-stand frequencies (%s) in the following intra-stand abundance categories:*			Tree height (m) (Floyd, 1989)
	O+R	VC+C	Total	
Trees with the highest O + R frequencies				
Hibiscus heterophyllus	91	9	100	6
Notelaea longifolia	91	7	97	9
Clerodendrum tomentosum	88	2	91	15
Cassine australis	86	9	95	8–9
Scolopia braunii	81	0	81	25
Alphitonia excelsa	79	5	84	35
Alectryon subcinereus	79	14	93	18
Elaeocarpus obovatus	77	9	86	45
Toona ciliata	74	5	79	45
Pararchidendron pruinosum	74	0	74	15
Diploglottis australis	74	12	86	35
Ficus rubiginosa	72	5	77	30
Diospyros australis	70	16	88	20
Dysoxylum fraserianum	70	16	86	55
Hymenosporum flavum	70	2	72	20
Melicope micrococca	70	0	70	35
Trees with the highest O + R frequencies and with zero VC + C frequencies				
Scolopia braunii	81	0	81	25
Pararchidendron pruinosum	74	0	74	15
Melicope micrococca	70	0	70	25
Guioa semiglauca	67	0	67	18
Polyscias elegans	67	0	67	30
Wilkiea heugeliana	58	0	58	8

* Abundance information as for Table 11.
VC : Very common, C : Common, O : Occasional, R : Rare, very infrequent

Hunter Valley has been the main local source of lowland rainforest species over long periods (kept supplied by northward and southward migrations along the east coast of the continent), then the distance of a stand from the coast may be an inverse measure of the relative accessibility of that stand to disseminules. Present average annual rainfall is an environmental variable which may have both direct (moisture supply to individual plants) and indirect (an influence on stand size and hence on habitat diversity) effects.

These considerations provide no more than a very rough basis for a search for possible associations between species numbers and landscape variables of various kinds. The complexity of the situation derives in part from unknown but continuing influences of climatic regimes of the past. Product-moment correlation coefficients have been calculated in turn between species numbers per stand in the various structural groups and the variables mentioned above. Another variable has also been incorporated: the overall slope angle of individual stands (Table 15).

Three or more correlation coefficients designated as significantly different from zero occur for each of the stand characteristics, area, slope angle and altitudinal span

Table 14. Species* numbers in the surveyed stands of dry rainforest and other rainforest types in the Hunter region

	Structural Group					
	Trees	**Shrubs**	**Herbs**	**Climbers**	**Epiphytes/ Lithophytes**	**Total**
The present survey						
Total spp numbers across all surveyed stands	95	13	25	37	23	193
Total spp numbers in the Eastern stands	88	11	24	37	20	180
Total spp numbers in the Central and Western stands combined	88	12	25	33	18	176
Range	32–71	3–9	6–20	9–32	1–16	64–144
Median	45	5	12.5	19	6	88
Mean	47.4	5.4	12.2	18.9	6.4	90.6
Standard deviation (±)	8.7	1.5	3.3	4.3	3.4	17.6
Coefficient variation (%)	18	28	27	23	53	19
Numbers of stands included	43	43	42	43	42	42
Other local studies						
Total spp numbers across all surveyed stands:						
• Liverpool Ra: warm-temperate rainforest (Fisher 1980)	35	16	26	20	12	109
• Wollemi basalt caps: warm-temperate rainforest (Gambrill 1986)	9	7	ND	6	ND	ND

* Only native species (but not eucalypts, grasses or sedges) included.
ND : Not determined

against species numbers. The strongest and most numerous of these associations occur in the case of stand area: all the plant structural groups except herbs are involved. The association between species numbers and slope angle is not as strong and is negative: the steeper a stand, the fewer species it tends to have, especially trees. The association between species numbers and altitudinal span is a positive one but it occurs only with the subsidiary structural groups, not trees. Contrary to our expectation, distance from the coast has no pronounced association with species numbers, and for average annual rainfall there is only one significant association (with climbers).

The basic assumptions of normality of variate distribution and randomness of sample selection should apply to the data on which Table 15 is based just as in any other

Table 15. Product-moment correlation coefficients between species numbers in stands of dry rainforest and some physical characteristics of stands

Stand Characteristics	Structural Group (Species numbers per stand)							
	Trees	Shrubs	Herbs	Climbers	Epiphytes/ Lithophytes	Trees+ shrubs	Trees+ shrubs+ vines	Total
Altitudinal span	0.111	0.367*	0.365*	0.331*	0.222	0.167	0.240	0.268
Area	0.500**	0.298*	0.295	0.390**	0.595**	0.522**	0.525**	0.537**
Average annual rainfall	0.012	0.013	0.258	0.358*	0.190	0.013	0.135	0.176
Distance from coastline	-0.086	0.135	0.030	-0.225	-0.275	-0.058	-0.122	-0.145
Slope angle	-0.399**	0.074	-0.366*	-0.185	-0.338*	-0.365*	-0.337*	-0.380*
Sample size	43	43	42	43	42	43	43	42

* Correlation coefficient significantly different from 0, $p \leq 0.05$. ** Correlation coefficient significantly different from 0, $p \leq 0.01$.

significance testing of a parametric type. In fact, however, both assumptions must be regarded as being no more than roughly fulfilled in the present case (a common feature of field ecological analysis), and interpretation of results should accordingly be very conservative. The reader will recall also that the data themselves have some uncertainties: it was pointed out earlier that the species numbers are very likely to be under-estimates, and under-estimates in varying degrees, of the true values (see Table 1). The stand measures employed are probably no better than crude surrogates for the critical (but unknown-in-detail) environmental and historical controls.

Two of the stands, Mirari Creek (C6) and Pilchers Mountain (C8), are particularly rich in species. The species lists for both stands (Appendix 2) are composites of visits by Floyd (1983a) and by Vernon in this present survey. However, we are of the opinion that, despite this double sampling, the observed richness is real compared with other stands. Both of them lie on the Wallarobba Range, near the eastern side of the survey area, and each seems to have a considerable amount of internal heterogeneity of topography. However, neither is unique in this respect and we are unable to offer a convincing explanation of their extreme richness.

Distribution patterns of individual species

Species at their southern limits

Eleven rainforest species — five trees, one herb and five climbers — are considered to be at their southern limits within the survey area (Table 16). Our survey has changed only slightly, and then not for all of the listed species, the limits established by Floyd (1983a, 1989). The new limits should be regarded as no more than provisional — continuing reconnaissance frequently leads to expansion of the known ranges of plants.

The latitudinal span of the known southern limits of these eleven species is about 16.5 minutes or 30.5 km, extending from Tabbil Ck (Stand E10, at 32° 24.7' S) to Comerfords Hill (at 32° 41.2' S — centre of stand: grid reference 654 825, Maitland 1:25 000 map sheet).

The distributions of selected species across the surveyed stands

It is feasible here to plot the observed distribution of only a small number of the species encountered in the survey. The distribution patterns of the three emergents having the highest inter-stand frequencies (*Brachychiton discolor*, *Ficus macrophylla* and *F. superba* var. *henneana*) are presented in Figure 4. Within the survey area, *Brachychiton discolor* is at its known southern limit. Included in Figure 5 is another southern-limit species, *Backhousia sciadophora*. Figure 5 also shows the patterns of occurrence of a further two trees of restricted local distribution (*Canthium copmosmoides* and *Podocarpus elatus*) and also of the locally-widespread weed, *Lantana camara*.

The three emergents mapped in Figure 4 are fairly consistently absent from the peripheral stands of those examined in the survey area. In two stands, E17 on the northern side and C2 on the southern side, none of the emergents was seen, and in other peripheral stands, only one of the three species was noted. We consider that the presence of emergents is an indication of dry rainforest in the Hunter Valley in its most mature and complex form. Those peripheral stands without emergents usually

Table 16. Species with known southern limits in the dry rainforest stands of the survey area

Species	Southern limits previously observed	New limit
Trees		
Backhousia sciadophora	Mirari Ck, Mt Ararat (E6) (Floyd 1989)	Mt Douglas (E1)
*Brachychiton discolor**	Paterson (probably Moonabung Falls) (Floyd 1989)	Kilfoyles Ck
*Cleistanthus cunninghamii**	Moonabung Falls (C1) (Floyd 1989)	Comerfords Hill
Dysoxylum rufum	Bulahdelah and Williams R (Floyd 1989)	Tabbil Ck (E10)
Elattostachys nervosa	Paterson (probably Moonabung Falls) (Floyd 1989)	Moonabung Falls (C1)
Herbs		
Tripladenia cunninghamii (=*Kreysigia multiflora*)	Bulahdelah (Rotherham et al. 1975)	Rosewood Gully (C2)
Climbers		
Cayratia eurynema	Pilchers Mountain (E8) (Floyd 1983a)	(Not observed in present survey)
*Gymnema pleiadenium**	Pilchers Mountain (E8) (Floyd, 1983a)	Moonabung Falls (Chalmers & Turner, 1994)
*Marsdenia suberosa**	Mirari Ck, Mt. Ararat (E6) (Floyd 1983a)	Comerfords Hill
Morinda acutifolia	Moonabung Falls (C1) (Floyd 1983a)	Moonabung Falls (C1)
Parsonsia velutina	Moonabung Falls (C1) (Floyd 1983a)	Moonabung Falls (C1)

* Limits determined since the survey was completed. The Kilfoyles Ck stand is 4 km south-west of Moonabung Falls. Comerfords Hill is a bluff on the northern bank of the Hunter River, about 11 km south–south-east of Moonabung Falls.

possess other characteristics of dry rainforest, of course, such as an abundance of woody climbers of certain species and an array of many of the typical tree species. It is of interest that even the two most westerly stands, W1 and W2, are not without one of the three emergents referred to in Figure 4, *Ficus superba* var. *henneana* in this case.

Two tree species showing marked tendencies to east-west localised distributions are *Podocarpus elatus* and *Backhousia sciadophora* (Figure 5). *Podocarpus elatus* was observed only in the Central sector and *B. sciadophora* only in the Eastern sector, mainly on the

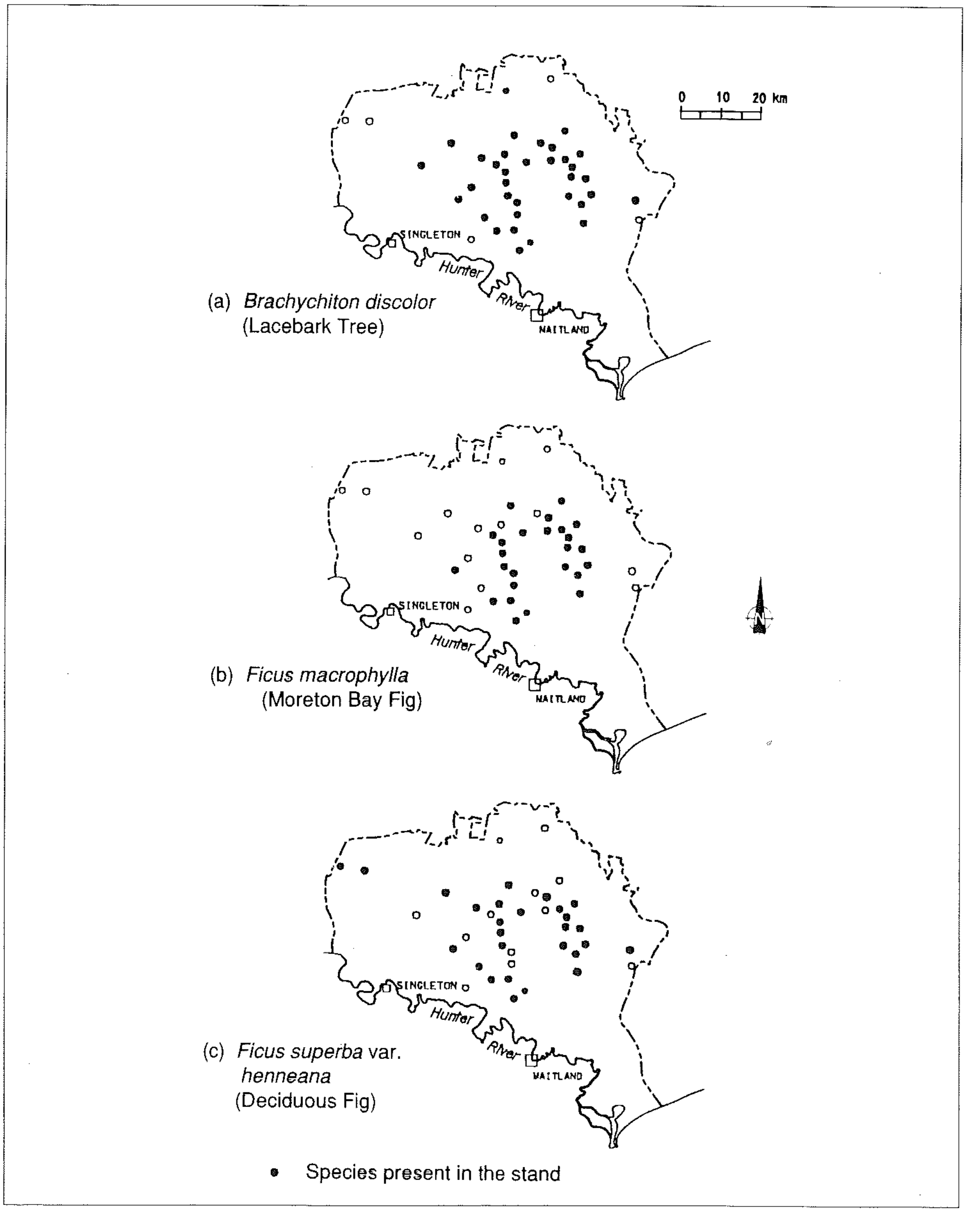

Figure 4. Maps of the observed occurrence of three emergent tree species amongst the surveyed stands. Because of the scale used, it has been judged necessary to merge some closely contiguous stands.

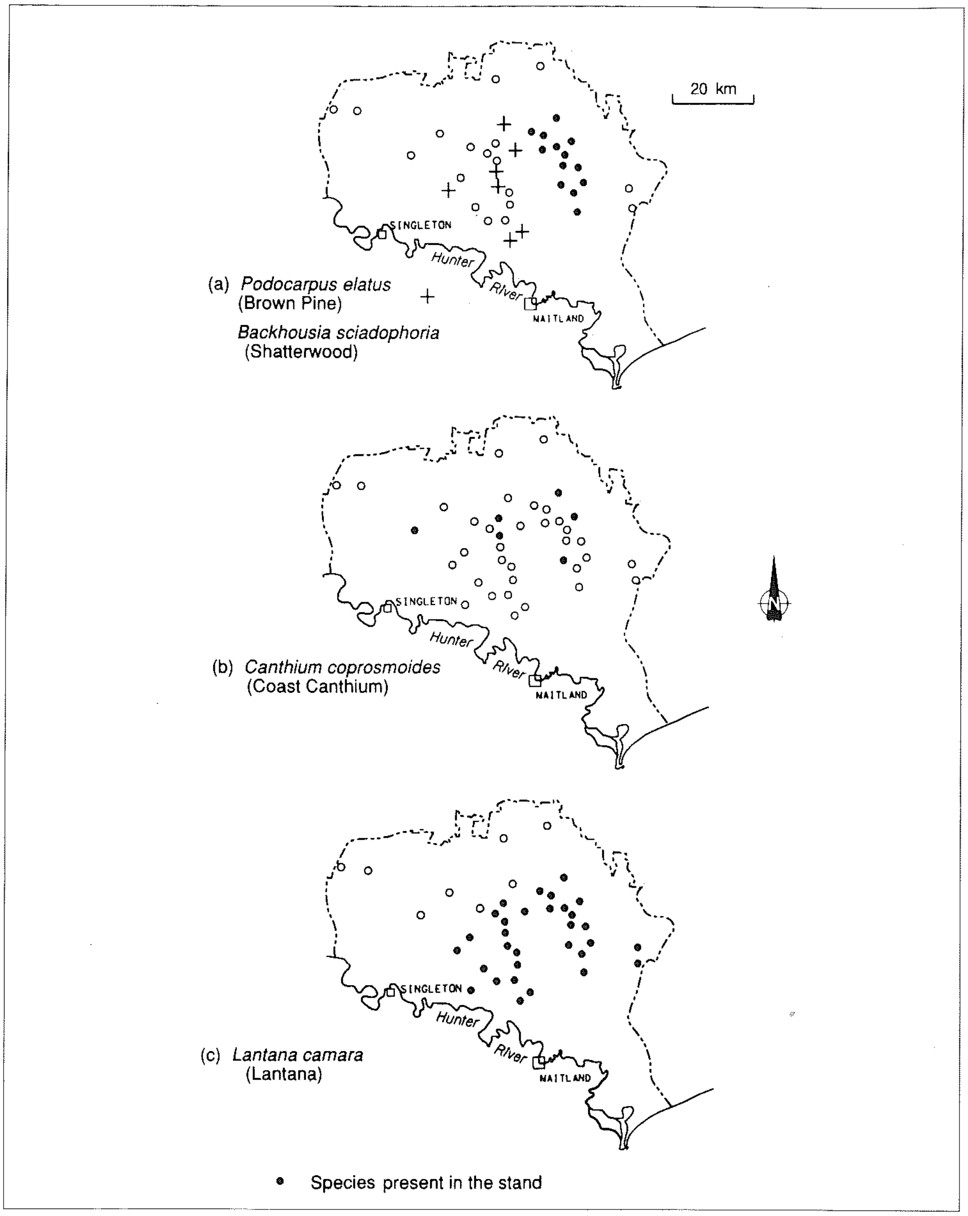

Figure 5. Maps of the observed occurrence of three tree species and the shrub/scrambler, *Lantana camara*, amongst the surveyed stands. Because of the scale used, some closely contiguous stands have been merged.

Wallarobba Range. In contrast, *Canthium coprosmoides* occurs in both Eastern and Central sectors, seemingly becoming more restricted in its distribution towards the west. The westernmost stand in which it was seen, C18, is 63 km from the nearest coast, unexpectedly far given the tree's common name of Coast Canthium and its usually-recorded distribution (Floyd 1989) in near-coastal sites.

The weed *Lantana camara* is widespread as well as abundant in Eastern and Central stands (Figure 5), but clearly there are limitations to its occurrence to the north and west. To the north (stands E17 and C21), low temperatures are most likely limiting, to the west moisture supply is probably critical. There is a possibility too that the species has not yet fully occupied its potential range here and that it may still be moving, albeit slowly, to north and/or west. However, this idea must be considered unlikely given the species' long presence in NSW and its proven mobility in other coastal areas.

Broad-scale occurrences in rainforest types of the listed tree species

Vernon (1985) tried to distinguish between those tree species unmistakably of dry rainforest and those of sub-tropical rainforest. She found that there was by no means complete agreement between the authorities, Floyd (1960–1982, 1983a & b, 1984) and Williams (1975–1980, 1982), as to which was which. She commented on page 57:

> The criteria for classifying species in this way appear to be vague and are based largely on the experience of both Floyd and Williams ... There are as yet no objective guidelines by which to decide whether a species can more appropriately be classed as subtropical or dry. Therefore attempts to identify gradations from one rainforest subform to another, both within each study stand and from one stand to another, will necessarily be somewhat arbitrary and subjective.

We decided to use Floyd (1989) as the latest authority, to examine the broad-scale occurrence across the various rainforest types of the tree species observed in our survey (Table 17). We have combined some of Floyd's categories of individual rainforest types. Ninety-one tree species are included. Of those listed in Appendixes 2 and 3, the following were excluded:

1. those whose main occurrences are not in rainforest (*Brachychiton populneus, Casuarina cunninghamiana, Melaleuca quinquenervia* and *M. styphelioides*)

2. those with some claim to being of rainforest affinity (ecologically and/or taxonomically) but which are not dealt with in Floyd's book (*Geijera parviflora, Hymenanthera dentata* and *Notelaea microcarpa* var. *microcarpa*).

Based on Floyd's assessment, more than half of the tree species referred to in Table 17 are wide-ranging in their occurrence in rainforest in NSW. Their cosmopolitan presence does not impose any distinctive character on the stands examined. However, also present are twenty-three species whose main occurrences are in dry rainforest, and it is these which firmly place the surveyed stands in the dry rainforest category. Numbers in the remaining groups are small and show only a minor presence of sub-tropical- and warm temperate-favouring species. Nevertheless, although the modal class of average annual rainfall of these stands is only 800–899 mm, the tree floral list covers a wide range of preferred rainforest types — it is a very mixed assemblage, missing only species which prefer cool temperate rainforest. As a confirmation of the prevailing dry rainforest character of the stands, all of the twelve most abundant and frequent tree species of the survey (Table 11) occur in the left-hand half of Table 17, i.e. the 'dry and wide-ranging' side.

Cluster analysis of the stands

A dendrogram showing fusion sequences is set out in Figure 6. Only the final fourteen groupings have been retained for the figure — examination of smaller clusters did not yield any noticeable increase in interpretability in ecological or geographical terms.

Table 17. Assignment of the observed rainforest tree species to the broad rainforest types recognised by Floyd (1989)

GROUPINGS OF RAINFOREST TYPES

Dry Rf alone	Dry Rf ± Littoral Rf ± Riverine Rf	Wide-ranging across all or most types	Sub-tropical Rf and Dry RF ± Littoral Rf ± Riverine Rf	Sub-tropical Rf ± Gully Rf ± ± Littoral Rf Riverine Rf	Sub-tropical Rf and Warm-temperate Rf ± Riverine Rf	Warm-temperate Rf ± Littoral Rf	Riverine Rf and/or Rf margins
NUMBER OF SPECIES (Total: 91)							
11	12	50	3	5	6	2	2
*Croton verreauxii**	*Capparis arborea**	(The top 12 spp. of 50 spp.)	*Dendrocnide excelsa**	*Dysoxylum fraserianum*	*Toona ciliata*	*Cryptocarya microneura*	*Glochidion ferdinandi*
Brachychiton discolor	*Hibiscus heterophyllus*	*Streblus brunonianus**	*Sarcomelicope simplicifolia*	*Daphnandra micrantha*	*Citronella moorei*	*Stenocarpus salignus*	*Tristaniopsis laurina*
*Cleistanthus cunninghamii**	*Cassine australis*	*Baloghia inophylla**	*Ehretia acuminata*	*Brachychiton acerifolius*	*Pennantia cunninghamii*		
Ficus rubiginosa	*Alectryon subcinereus*	*Mallotus philippensis**		*Podocarpus elatus*	*Emmenosperma alphitonioides*		
Austromyrtus acmenoides	*Olea paniculata**	*Notelaea longifolia*		*Symplocos thwaitesii*	*Rapanea howittiana*		
Backhousia sciadophora	*Drypetes australasica**	*Claoxylon australe**			*Cinnamomum oliveri*		
Alchornea ilicifolia	*Rhysotoechia bifoliolata*	*Geijera salicifolia**					
Croton insularis	*Melia azedarach*	*Clerodendrum tomentosum*					
Maytenus sylvestris	*Ficus superba*	*Diospyros australis*					
Codonocarpus attenuatus	*Canthium coprosmoides*	*Planchonella australis*					
Canthium odoratum	*Myoporum acuminatum*	*Diploglottis australis*					
	Ficus fraseri	*Elaeocarpus obovatus*					
		*Elattostachys nervosa**					

* The 12 most abundant and frequent species, as listed in Table 11.

Table 18. Stand characteristics of some of the clusters delineated in Figure 6

Cluster (refer to Figure 6)	Number of stands	Area of stand (ha)		Number of tree species/stand	
		Mean	±Standard deviation	Mean	±Standard deviation
Western stands*	5	10.6	±6.9	42.6	±3.6
Northerly stands and rich and large stands	12	32.2	±19.6	56.8	±9.1
Mostly Central sector stands	13	16.2	±15.5	42.9	±4.8
Mostly Eastern sector stands	13	15.8	±15.4	45.2	±5.2

* Exclusive of Wg data, for which there is no single stand area.

Of the two large groups defined before the final fusion, the one on the left side consists of more readily interpretable sub-groups than that on the right side. The six most westerly of the stands are clearly separated from all others in terms of floristic similarity. Then, the most northerly stands occur together but are close to what we term 'rich (in tree species) and large (in area)' stands. The reason why these latter two sub-groups should be closely similar is not clear to us.

On the right side of the dendrogram, we can detect only what seems to be a trend, rather than a clear-cut demarcation of stands with particular characteristics within the sub-groups. The sub-groups on the left consist of more Central sector stands than Eastern (eight to five), while the tendency is exactly reversed in the sub-groups on the right. A look at some stand characteristics across sub-groups of the dendrogram (Table 18) shows that there are no great differences between those on the right side but that the stands of the 'rich and large' sub-group (combined with the three northerly stands) are markedly richer and larger on average than the stands of other sub-groups.

Overall, this analysis, as far as it has been taken, indicates that most stands in the Central and Eastern sectors form a large group which is not readily differentiated into sub-groups on ecological or geographical bases. The stands separated in floristic similarity from this large group are those which occur on the western and northern peripheries of the surveyed area and some of those which are richest in tree species and relatively large in area.

Results

c) Human influences

General observations on disturbance

There seems to be no broad-scale clearing — nor timber-getting — going on any longer in the rainforest stands of the survey area. However, many cases were seen where rainforest has been damaged by track-making activities. Sometimes, too, the best or only remaining eucalypt stems (used for fence posts) remaining on a property are at the edges of rainforest stands and logging tracks may be put in without thought to damage being done to the stand itself.

Another way in which direct damage can occur is as a result of epiphyte collection. The edges of some of the surveyed stands seem to be particularly prone to this kind

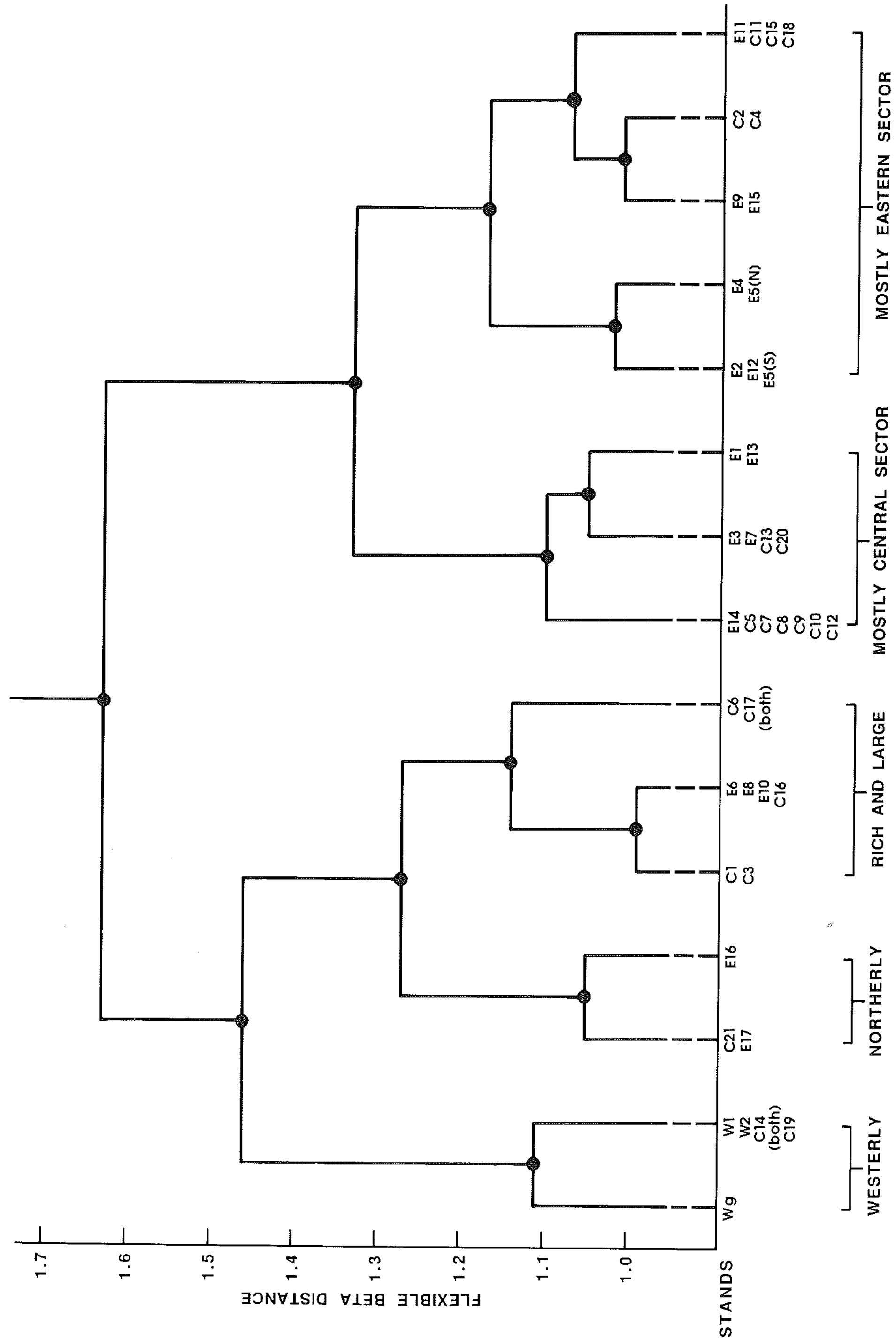

Figure 6. Dendrogram of groups of stands resulting from flexible-beta clustering procedure. Beta = −0.25.

of disturbance, probably because of their closeness to one or other public roads. In a few cases, trees were seen (particularly *Dendrocnide excelsa*, Giant Stinging Tree) which had probably been felled for their load of epiphytes.

Fires are often lit in hill pastures in this area, particularly in early spring, to encourage the rapid growth of new grass. Such fires seldom or never penetrate to the central parts of rainforest stands — however, by burning up to the edges of stands, they may cause the death of many rainforest seedlings and saplings. It is possible that the changed fire regime since white settlement has on balance been more damaging to rainforest edges than the pre-settlement regime.

Cattle seem not to browse on most rainforest plants — at least on those older than saplings — but they trample soils and plants, particularly at the edges of stands. Cattle tend to use the edges of stands for shelter — in a small stand, this may mean that no part of the stand is free of the disturbance resulting from trampling and the concentration of droppings.

Finally, there is the presence of the weed *Lantana camara* in and around most of the stands in the eastern half of the survey area (it occurred in three-quarters of the surveyed stands). The light requirements of *Lantana* are such that it is most successful around the edges of stands and below canopy gaps. The danger from such a vigorous competitor is that, over decades and longer, it will begin to diminish seriously the regeneration success of native species, especially of the rarer ones. Its long-term effect may well be to reduce the diversity of individual stands, and perhaps even to cause some local extinctions of rainforest species.

The condition of stand margins

Past forest-clearing activities have turned most of the survey area into a grassland in which scattered eucalypt trees remain. In this altered landscape, the margins of many rainforest stands now abut directly on to pasture. A stand margin in this situation must be regarded as being more at risk from potential disturbance than one where a belt of open-forest remains to act as a buffer. All of the surveyed stands were examined from this point of view, using both the sketch maps prepared at the time of ground survey and colour transparencies from plane flights. A sequence of five categories of relative 'protection' of stand margins by eucalypts was defined and each of the forty-six stands was assigned to a category (Table 19).

This examination indicates that most of the surveyed stands still have at least some contact at their margins with remnants of eucalypt-dominated open-forest. Indeed, most stands have fairly substantial buffer zones of eucalypts. There is a need for study of the whole subject of the pattern and condition of fragments of open and closed forests in this area in relation to effective plant and animal conservation.

Discussion

Botanical features

The surveyed stands form a fairly homogeneous unit within the dry rainforest subformation. Cluster analysis showed that there is some tendency to differentiation, especially on the western and northern peripheries of the survey area — however, it seems not to be strongly pronounced.

The total area of the forty-six surveyed stands is some 850 ha, with a median stand area of 15 ha. Some hundreds of other stands were not examined. This broad sweep

Table 19. Summary of extent of occupation by eucalypts of the margins of the surveyed rainforest stands

Eucalypt occupation of stand margins*	% of Stands in each category			
Stands	Eastern Sector	Central Sector	Western Sector	All stands
(1) None	0	8	0	4
(2) Narrow eucalypt fringe along < half of periphery	30	12	50	22
(3) Narrow eucalypt fringe along ≥ half of periphery	15	17	50	17
(4) Substantial eucalypt stand along < half of periphery	25	33	0	28
(5) Substantial eucalypt stand along ≥ half of periphery	30	29	0	28
	100	99	100	99
Total number of rainforest stands assessed	20	24	2	46

* Further description of the categories:
(1) No more than occasional isolated mature eucalypts on stand margin.
(2) and (3) Continuous fringe of mature eucalypts, but no more than 25 m wide.
(4) and (5) There is an adjoining mature eucalypt stand which is at least 100 m wide and which has an area of at least 1 ha. There may or may not be, as well, fringing eucalypts of categories (2) or (3).

of stands in the Hunter Valley is the southernmost occurrence in Australia of a substantial area of floristically and structurally well-developed dry rainforest. There are elements of this rainforest type as far south as the South Coast of NSW, but they are much attenuated in extent, composition and complexity compared with the stands in the Hunter Valley. An illustration of this attenuation can be found in the southern limits of some of the tree species important in Hunter Valley stands. Those five 'abundant and frequent' trees identified in Table 17 as being known to be predominantly dry rainforest species (i.e. from the two columns at the left hand side of that table), are important in imposing a dry rainforest identity on the stands in the Hunter Valley (as well as on stands further north). Of these species, only *Croton verreauxii* has its southern limit outside the Hunter Valley. Together with *Brachychiton discolor*, also a dry rainforest species and the emergent tree with the highest inter-stand frequency in the surveyed stands, the other species have their limits within the survey area or immediately to the south of it (Floyd 1989).

Conservation considerations

None of the species listed in Appendixes 2 and 3 is on the rare or threatened plants list of Briggs and Leigh (1988). The main concern in conservation terms is that as many stands as possible in the survey area should remain structurally and floristically intact in the long term. At present the prognosis is not favourable because almost all the surveyed stands are on freehold land. The main exception is a part of Stand E8, Pilchers Mountain, which is a Crown Reserve for Recreation and which has already been recommended for Nature Reserve status by Floyd (1983a). From his limited survey, Floyd also recommended as worthy of conservation the Moonabung Falls (C1) and Cabbage Brush Creek stands (the latter is 4.5 km north-north-west of Moonabung Falls). Clearly, many other stands are worthy of protection and the current conservation status of the remaining rainforest across the survey area is highly unsatisfactory.

Fortunately, however, there is a clearly discernible trend amongst land-owners for the development of a sense of long-term care for the welfare of their land. Many of the owners encountered during the survey expressed great interest in the stands under survey. We believe that lack of specialised knowledge and advice, as well as a lack of financial incentive from governments, often inhibits conservation action by landowners. The recent growth of the Land Care movement is a welcome development from this point of view.

Within the survey area at present, the situation pertaining to the care of eucalypt-dominated open-forest is as unsatisfactory as that for dry rainforest. An ecologically-attractive possibility would be the planned conservation of tracts containing the two vegetation types in contact with each other, each in good condition. The notion of the value of a eucalypt forest buffer around the margin of a rainforest stand was raised earlier. Clearly, the idea could be extended so that appropriately-located examples of foothill eucalypt forest could be conserved in their own right. The preservation of a network of side-by-side residual stands of the two forest types across a broad sweep of country is an ideal to aim at.

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Appendix 1. Information about the stands: location and some physical features

EASTERN SECTOR

Code designation	Stand name	Map sheet (1: 25 000) and grid reference	Area of stand (ha)	Altitudes of upper and lower margins (m)	Topographic type
E1	Mt Douglas	Paterson, 748 992	6	130–240	Down-stream valley site
E2	Glen Martin	Clarence Town, 909 004	2.5	50–140	Single gully-head
E3	Stony Creek, Wallarobba	Gresford, 750 043	17	100–210	Weakly-gullied rocky slopes
E4	Three Brothers: North Face	Dungog, E Stand: 893 040 W Stand: 895 040	E Stand: 4 W Stand:	110–170 80–160	Both stands: gully-head amphitheatres
E5	Three Brothers: Small Hill to North	Dungog, N Stand: 898 049 S Stand: 898 046	N Stand: 2 S Stand: 3	110–210 60–120	N Stand: gully-head amphitheatre S Stand: single gully-head
E6	Mirari Creek, Mt Ararat	Gresford, 725 055	19	100–240	Down-stream valley site
E7	Wallaringa Rd	Gresford, 771 071	8	180–230	Weakly-gullied rocky slopes
E8	Pilchers Mountain	Gresford, 765 100	32	230–350	Gully-head amphitheatre
E9	Coxs Gully	Gresford, 735 109	40	170–250	Down-stream valley site
E10	Tabbil Creek	Gresford, 737 131	84	170–430	Multiple gully-heads
E11	Wallarobba Range: West Side	Gresford, 734 143 (point central to both stands)	N Stand: 28 S Stand:	120–360 120–320	Both stands: multiple gully-
E12	Bingleburra	Gresford, 676 145	9	90–230	Single gully-head
E13	Wallarobba Range: NE Section	Gresford, 741 155	67	150–310	Multiple gully-heads
E14	Lewinsbrook	Gresford, 675 171 (at junction of Gresford and Allynbrook sheets)	21	120–330	Single gully-head
E15	Dog Trap Creek	Allynbrook, 668 175	19	130–370	Single gully-head
E16	Brandy Creek	Allynbrook, 706 219	23	170–370	Multiple gully-heads
E17	Chichester Gap	Chichester, 678 346	38	220–530	Multiple gully-heads

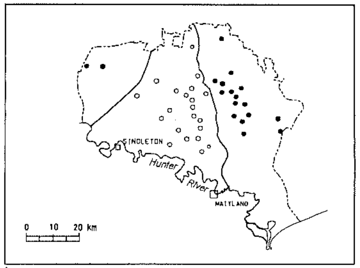
CENTRAL SECTOR

C1	Moonabung Falls	Paterson, 608 929	25	50–130	Down-stream valley site
C2	Rosewood Gully	Paterson, 641 944	4.5	110–170	Down-stream valley site

CENTRAL SECTOR (continued)

Code designation	Stand name	Map sheet (1: 25 000) and grid reference	Area of stand (ha)	Altitudes of upper and lower margins (m)	Topographic type
C3	Sandy Waterholes Creek	Elderslie, 474 962	16	190–380	Multiple gully-heads
C4	The Valley	Elderslie, 587 976	20	160–330	Single gully-head
C5	Lambs Valley	Elderslie, 553 986	6	130–300	Single gully-head
C6	Billy Brook	Elderslie, 519 985	23	120–310	Multiple gully-heads
C7	Lees Mountain	Paterson, 471 017 (also partly on Elderslie)	11	120–310	Weakly-gullied rocky slopes
C8	Summerhill Rd: N end	Ingar, 581 038	11	110–320	Down-stream valley site
C9	Mirannie Mtn: SE side	Ingar, 452 047	13	170–390	Single gully-head
C10	Mt Tyraman	Ingar, 568 052	4.5	190–360	Down-stream valley site
C11	Oakvale	Ingar, 488 079	14	140–300	Single gully-head
C12	Dark Hole	Ingar, 561 100	17	140–390	Gully-head amphitheatre
C13	Harris Creek	Ingar, 565 115	19	150–340	Gully-head amphitheatre
C14	Mt Dyrring	Ingar S Stand: 358 126 Cent. Stand: 364 132 N Stand: 368 134	S Stand: 5 C Stand: 7.5 N Stand: 3.5	240–400 210–400 230–380	S Stand: multiple gully-head C Stand multiple gully-head N Stand single gully-head
C15	Fenwicks Creek	Ingar, 547 137	16	200–300	Single gully-head
C16	Coulston	Gresford, 619 146	59	110–370	Multiple gully-heads
C17	Upper Myall Creek	Ingar, W Stand: 517 148 E Stand: 528 146	W Stand: 35 E Stand: 14	270–420 250–390	W Stand: gully-heads E Stand: single gully-head
18	Dry Creek	Ingar, 558 152	15	135–240	Down-stream valley site
C19	Breakneck	Carrowbrook, 417 181	22	270–500	Multiple gully-heads
C20	Mt Razorback	Allynbrook, 588 204 (also partly on Carrowbrook sheet)	10	270–420	Weakly-gullied rocky slopes
C21	Masseys Creek	Carrabolla, 568 314	19	200–490	Multiple gully heads
WESTERN SECTOR					
W1	Foy Brook	Dawsons Hill, 228 230	15	250–410	Down-stream valley site
W2	Cedar Creek	Dawsons Hill, 143 244	5	325–430	Gully-head amphitheatre

Appendix 2
Eastern and western sectors: list of species observed in the stands under examination



Notes

- For locality and other information about the individual stands, see Appendix 1.
- Estimates of relative abundance are presented using the following code:
  VC Very common
  C Common
  O Occasional
  R Rare, Very infrequent.
- Taxa are arranged alphabetically at family, generic and specific levels within
- the structural categories of Trees, Shrubs, Herbs, Climbers and Epiphytes–Lithophytes.
- * indicates an introduced species, now naturalised.The stands E5(S) and E5(N) occur very close together. They are identified according to their relative north-south locations. Both E4 and E11 also represent pairs of stands but only a combined species list was obtained for each.
- The final column, Wg, is a general list of those rainforest-related species in the western sector observed to occur singly, in small groups and in small stands. No Herb or Epiphyte–Lithophyte presence lists were obtained for Wg.
- *Arthropteris tenella* and *Microsorium scandens*, usually regarded as epiphytes (e.g. Beadle, 1971), have been placed here in the structural category of Climbers.

EASTERN AND WESTERN SECTORS

RAINFOREST STANDS

		E1	E2	E3	E4	E5 S	E5 N	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	W1	W2	Wg
TREES																						
Alangiaceae	*Alangium villosum*		C	R	O	R	R	R		C	O	O	O		R		R	C				
Anacardiaceae	*Euroschinus falcata*							R		O	R	R			R							R
Araliaceae	*Polyscias elegans*			O	O		O	R	R	O	R	R		R		R	R	R	R	R	O	R
Boraginaceae	*Ehretia acuminata*		R		R		R	O		O	R	R	R			O	O	C	C	R	O	
Capparaceae	*Capparis arborea*	C	C	C	VC	VC	VC	VC	C	C	C	C	C	R	C	VC	C	VC	O	VC	VC	
Celastraceae	*Cassine australis* var. *australis*	R	R	R	C	C	O	O	R	R	R	R	R	R		R	R	R	O	O	O	O
	Maytenus silvestris		R					O				R										O

Appendix 2. (continued)

RAINFOREST STANDS

EASTERN AND WESTERN SECTORS

		E1	E2	E3	E4	E5 S	E5 N	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	W1	W2	Wg
Ebenaceae	*Diospyros australis*	O	C	R	O	O	O	O		O	O	O	O	R	O	O	C	C		C	O	O
	D. pentamera	C		R				O	O	O	O	O	O		O	O			R		O	
Elaeocarpaceae	*Elaeocarpus obovatus*	R	R		O	O		O	O	R	R	O		O	R	R	R	O	R	O	O	C
	Sloanea australis								R	R								C				
Euphorbiaceae	*Actephila lindleyi*		O					O		VC	C	C	O		C	O						
	Alchornea ilicifolia	O		O		O		O	O	O	O	O	O	O	O	O	C	O			C	O
	Baloghia inophylla	O	VC	O	C	C	C	VC		VC		C	O	O	O	O	R	C	C	C	C	R
	Claoxylon australe	O	C	O	O	O	R	C	C	O	C	C	O	O	C	C	O	O	C	C	VC	R
	Cleistanthus cunninghamii	O	O	R	O	O	R	C	O	O	O	VC	VC	C	VC	O	O					
	Croton insularis							O	O			O	R		R		O	R				
	C. verreauxii	O	O	O	C	VC	R	C		O	VC	O	O	O	O	O	C	VC	O	O		O
	Drypetes australasica	C	C	VC	C		O	VC		C	R	O	O	O	O	C	O	C			O	
	Glochidion ferdinandi					C			O	R	O	R										O
	Mallotus philippensis	C	VC	VC	C		C	O		C		C	VC	VC	C	VC	VC	VC	O	VC		O
	Omalanthus populifolius	R				C			C	R	C							R		R	VC	O
									VC		VC											
Eupomatiaceae	*Eupomatia laurina*				R			R		R												
Flacourtiaceae	*Scolopia braunii*	R		R	O	O	R	O	R	R		R				R		R	O	R	O	O
Gyrostemonaceae	*Codonocarpus attenuatus*											O										
Icacinaceae	*Citronella moorei*				C		R	R		R	R		R					O	R			
	Pennantia cunninghamii		R					R		O	R								O			

Appendix 2. (continued)

Lauraceae	*Cinnamomum oliveri*		R					R														
	Cryptocarya microneura				R			O	R	R							R					
	C. obovata							R			R	R						R	R			
	Litsea reticulata									R					R							
	Neolitsea dealbata		O					O										C	C		R	
Malvaceae	*Hibiscus heterophyllus*	O	O	R	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	C	O
Meliaceae	*Dysoxylum fraserianum*		VC	C	C		O	O	O	C	O	O	O	O	O	R	O	O	C	O	O	
	D. rufum											O										
	Melia azedarach	O		O	O			O		O		O	O		O	O	C	C	O	R	R	O
	Synoum glandulosum								O		R											
	Toona australis		R	R			R	O	R	O	R	R	R			R		C	O	O	O	O
Mimosaceae	*Pararchidendron pruinosum*		O		O	O		R	R	O		R	R	O	R	R		R	O	O	O	
Monimiaceae	*Daphnandra micrantha*		C		O	O	R	C	R	O	O	O	R	R		R	C	O	O	C	R	
	Wilkiea huegeliana		O	R	O	O	R	O		O		R	R	R				R	O			
Moraceae	*Ficus coronata*	C	O		R			C		O	C	O	O		R		O	C	C	O		O
	F. fraseri				O		R															
	F. macrophylla	O		O				R	O	C	O	O	O	R	O	O		R				
	F. obliqua							R		R												
	F. rubiginosa	R	R	O	O	O	O	O		O		R		R			R			O		O
	F. superba var. *henneana*	O		O	O		O	R	C	O		R	O		R	R				O	R	R
	Streblus brunonianus	C	VC	C	VC	VC	VC	VC	R VC	C	R VC	C	VC	VC	VC	C	VC	C	VC	VC	VC	C
Myoporaceae	*Myoporum acuminatum*											R										
Myrsinaceae	*Rapanea howittiana*																R					
	R. variabilis		R		O	O	R	R		R		R	R	R					R			C

Appendix 2. (continued)

Myrtaceae	*Acmena smithii*							O		R								R	O			
	Austromyrtus acmenoides	R	R			O		O					R		R			R				
	Backhousia myrtifolia		O			V				R		R	O	R		R	O			R	R	O
	B. sciadophora	C		VC		C		C	O	O	C	C	C	VC	C	VC	V	VC				
	Lophostemon confertus		O														C					
	Melaleuca quinquenervia											R										
	M. styphelioides		O	R			R	O		R	R	O	O			R				R	R	
	Rhodamnia rubescens		O			O		O	O	R		R	R				O	R	O	R	R	
	Syzygium australe		R					O		R	R	R	R	R			R	O	O	O	R	
																	O					
Oleaceae	*Notelaea longifolia*		O	O	O	O	O	R	O	R	R	O	O	O	O	O	C	O	R	O	O	C
	N. microcarpa var. *microcarpa*		O				O	O														C
	N. venosa	C	R	C	VC	C	VC	C		C	O	O	R	C		C	O			VC	C	O
	Olea paniculata								C													
Pittosporaceae	*Hymenosporum flavum*		R	R			O	O		R	R	R	R		R	R		O	O	O	R	C
	Pittosporum undulatum	O						O		O	R		R				O	R		C	C	C
Proteaceae	*Stenocarpus salignus*			R				R		O		R						O			R	
Rhamnaceae	*Alphitonia excelsa*	R	R	R	R	R	R	O	O	R	R	O	R	R		R	O		R	R	O	R
	Emmenosperma alphitonioides									R					R							R
Rubiaceae	*Canthium coprosmoides*							R							R			R				
	C. odoratum																					O
Rutaceae	*Acronychia oblongifolia*							R										R				
	Geijera salicifolia var. *latifolia*	O		O	C			O	C	O	O	O	R	O	O	O	O		R	O	O	O
	G. parviflora						R															O
	Melicope micrococca		O	R	R	O	O	R	R	R		R	R	R		R	R	O	R	R	O	R
	Sarcomelicope simplicifolia	R		O	R			R	O	O			O	R	O	R			R	C	C	

Appendix 2. (continued)

Sapindaceae	*Alectryon subcinereus*	O	R	R	C	O	O	R	O	R		R	R	O	R	C	O	O	O	C	C	C
	A. tomentosus	O		C						R	R	O	R	O	R	O						
	Diploglottis australis	R	C	R	C		R	O	O	O	R	O	O	O	R	R	R	O	C	R	O	R
	Elattostachys nervosa	O	O	R	O	O	C	VC	R	C	O	C	C	C	C	C	R	VC	C			
	Guioa semiglauca		R		O		O	R	O	R		R	R					O	O	R	R	R
	Mischocarpus australis							O		O	R	O	R	R	R	O			O			
	Rhysotoechia bifoliolata		R	C	C	C	VC	O	R	O	R	R	R	R	R	O	R					
									C		R											
Sapotaceae	*Planchonella australis*	R	O	O	O	O	O	O		O	O	O	O	R	O	O	R	O	VC			
Sterculiaceae	*Brachychiton acerifolius*	O		R					O		R	R			O		R			R	R	
	B. discolor	O		O			R	O		O	O	O	O	C	O	C	R	O		C	O	
	B. populneus		R		R		R		O							R				O		C
	Commersonia fraseri				R			R		O								R			R	
Ulmaceae	*Celtis paniculata*	O		C					C	C		O		C				R				
Urticaceae	*Dendrocnide excelsa*	C	C	O				VC	C	C	O	C	C	C	C	VC	C	C	C	C	VC	O
	D. photinophylla	C		C				O	C	R	R	O	C	C	O	C	O	R				
Verbenaceae	*Clerodendrum tomentosum*	R		O	O	O	O	O	O	O	O	O	R	R	R	O	O	R	R	O	C	O
Violaceae	*Hymenanthera dentata*																			O	O	O
SHRUBS																						
Amaranthaceae	*Deeringia amaranthoides*			O				O		R		R				O	R	O				R
	Nyssanthes diffusa									R	R	O				O	O	O				
Caesalpiniaceae*	*Senna floribunda*			R						R			R	O								
Caprifoliaceae	*Sambucus australasica*	R			O		O	R		R	R		R		R	R		R		O	O	
Euphorbiaceae	*Breynia oblongifolia*	R	O		O	O	O	R		R	R		R	O	R	R	O	O	R	O	O	C
Malvaceae	*Abutilon oxycarpum*	O		C				R	O	R	R	O	O	C	O	O	O	O				

Appendix 2. (continued)

Pittosporaceae	*Citriobatus pauciflorus*	V	VC		VC	C	C	VC	V	VC	V	VC	VC	VC	VC	VC	V	VC	C	VC	C	O
	Pittosporum revolutum	C	O		O	O	C	O	C	R	C		O	R	O	R	C			O	R	O
		R							O								O					
Solanaceae	*Solanum aviculare*																	O		O		O
	* *S. mauritianum*											R										
	* *S. pseudocapsicum*																	O				
	S. stelligerum	R	O	O	O	R	R	O		R	R	C	O	O	O	O	O	O	O	O	O	O
Verbenaceae	* *Lantana camara*	V	O	VC	C	C	O	VC	V	C	C	O	C	C	C	C	C	C				
	Spartothamnella juncea	C							C		R	R			R	O	R					C
Winteraceae	*Tasmannia insipida*																		R			
HERBS																						
Acanthaceae	*Pseuderanthemum variabile*				O	R	O					R	R	O								—
Adiantaceae	*Adiantum aethiopicum*	O	O		O	O	R	C	O	R	O	O	O	O	R	C	O	O	O	C	O	—
	A. formosum	O	C		C	O		C		O		C	C	C	O	VC	V	O	VC	C	O	—
	A. hispidulum	R	R		O	R	R	O	O	R	C	O	O	O	O	O	C	R	C	R		—
	A. silvaticum							R		R	O.		R				O	R				—
	Pellaea falcata var. *falcata*	R	C	C	O	C		C	R	O		O	R	O	O	C		O	C	C	C	—
	P. falcata var. *nana*	O	O	C				O		C	R	C	O	O	O	O	O	C	O	O	O	—
	P. paradoxa	O	C	O	O	C	O	O	O	O	C	R	R	R	R	R	C	R				—
									C		O											
									O		O											
Araceae	*Alocasia macrorrhiza*							C		R						R		R	O			—
	Gymnostachys anceps		R	O	O	O	O	C	O	O									O			—
Aspidiaceae	*Lastreopsis decomposita*		O					O					O	O	O	O		VC				—
	L. microsora		C			O		R		O	O	O				O	O	O	C			—
Athyriaceae	*Diplazium australe*		O							O						O		O	O			—
Blechnaceae	*Doodia aspera*	R	C		C	C	O	O	O	O	O	O	O	R	R	O	C	O	C	O	R	—

Appendix 2. (continued)

Commelinaceae	*Aneilema acuminatum*		O	R				R		R	R	R		O	R	O	O	O	O			—
	Pollia crispata		R					R		R	R								O			—
Lamiaceae	*Plectranthus parviflorus*							O		R	R			R		R						—
Liliaceae	*Dianella caerulea*							C														—
Pteridaceae	*Pteris tremula*		C					O		O	O	O	O	R	O		O	O	VC	O	O	—
	P. umbrosa		O							R	C	O										—
Thelypteridaceae	*Christella dentata*							R														—
Urticaceae	*Urtica incisa*											R				R			C			—
Violaceae	*Viola hederacea*		O										R	R			R					—
Xanthorrhoeaceae	*Lomandra longifolia*	R	C	O	O		R	C		O	O	O	O	R	O		R	O	O			C
CLIMBERS																						
Apocynaceae	*Parsonsia straminea*	C	C	C	C	O	O	C	C	C	C	O	C	C	C	C	O	C	O	O	O	C
	P. velutina			R	O	O	R	C	R	O	R	R	R	R		R		R	R			
Asclepiadaceae	*Gymnema pleiadenium*			O			C	O	R	R	R				O							
	Marsdenia flavescens	R	R					C			O	R	O	O	O	C	R	O	O			
	M. rostrata		O					O					O		O	C	R		O			O
	M. lloydii	O	C		C		O	R	C	O	O	O		R	O							
Asteraceae *	*Delairea odorata*											R			R	R	C	C				
Bignoniaceae	*Pandorea pandorana*	O	C	R	O	O	R	O	O	O	R	O	O	R	R	C	VC	VC	C	O	O	C
Celastraceae	*Celastrus australis*						O	O		R								R				O
	C. subspicata		R							O		R	R			O	O					
Cunoniaceae	*Aphanopetalum resinosum*		O	O	C	C	C	O	C	O					R	O	O	R	O			C
Davalliaceae	*Arthropteris tenella*		VC		O	O	O	C	R	C	O	O	O	R	O			O	C	R		
Dioscoreaceae	*Dioscorea transversa*	R	O	R	O	O	O	O	R	R	O	O	O	O	O	O	O	O	O	O	O	
Fabaceae	*Austrosteenisia blackii*	VC	VC	C	O	O	VC	VC	C	C	VC	VC	VC	VC	VC	VC	C	C	C			

Appendix 2. (continued)

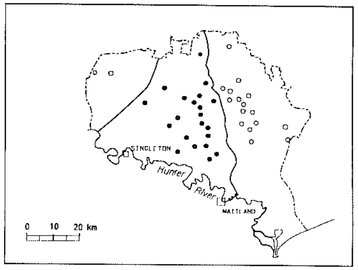
Menispermaceae	*Legnephora moorei*	R	VC	C	O	O	O	C	C	C	C	C	C	C	VC	O	C	C	O			
	Sarcopetalum harveyanum							R		R	R											
	Stephania japonica		R			R		R		R			O			R	O	O	O			
Moraceae	*Maclura cochinchinensis*		O	O	O	O	O	O	O	O	R	O	R	O	R	R	O	O	O	O	O	O
	Malaisia scandens	O	C	O	O	C	C	VC	C	C	O	O	O	O				R	R	O	C	
Myrsinaceae	*Embelia australiana*	C			O			C	O	O		R	O	O	O		R	R	O			
Oleaceae	*Jasminum volubile*	O		VC	VC	VC	VC	O	VC	C	O	C	R	O	O	C						O
Passifloraceae *	*Passiflora edulis*																	R				
	P. herbertiana											O						R			R	
*	*P. subpeltata*						R	R		R				O	R	R		R				
Piperaceae	*Piper novae-hollandiae*							O		O	R	R							R			
Polypodiaceae	*Microsorium scandens*							O		C												
Ranunculaceae	*Clematis glycinoides*							O		R		R						R				
Rosaceae	*Rubus hillii*																	O				
	R. moorei		R					R					R	R				R			O	
Rubiaceae	*Morinda acutifolia*				R			C	O	O	R	O		R								
	M. jasminoides						O	O		C	R	C	O	C	O	O			O		R	
Smilacaceae	*Eustrephus latifolius*		O	R	O	O	O	R	R		R	O	O	O	R	O	R	O	R			C
	Geitonoplesium cymosum			R					R	R												
	Ripogonum album		R					O		R									O			
	Smilax australis		O		O		R	O		R		R	R			R	R	O	O		C	
Vitaceae	*Cayratia clematidea*	O						R		R	O	R	R	O	R	C	R	O	O			
	C. eurynema									O												
	Cissus antarctica	VC	C	C	C	C	C	VC	C	C	VC	VC	VC	VC	C	VC	VC	VC	VC	C	C	C
	C. hypoglauca		R		R			R			R						R	R		R		O
	Tetrastigma nitens	O	C	C	C	C	C	C	O	C	O	O	C	C	O	C	C	C	O	C	VC	

Appendix 2. (continued)

EPIPHYTES and LITHOPHYTES																						
Aspleniaceae	*Asplenium attenuatum*							O		R	O	O	O		O	R	R	R				—
	A. australasicum	R	O		R	R		C		O		O	R		R			R	C			—
	A. polyodon							R			O											—
Davalliaceae	*Davallia pyxidata*									R												—
Orchidaceae	*Cymbidium suave*									R												—
	Dendrobium gracilicaule	O		R				C	R	O	O	O	R			R		R				—
	D. linguiforme	R		R			O	R	R	R												—
	D. schoeninum											O					O	R				—
	D. speciosum	R	R	R	O	O	C	C	O	C	R	O	O		O	O		O	R	R	R	—
	D. teretifolium			R				R			O	R	R	R	R	R						—
	Liparis sp.									R	R											—
	Plectorrhiza tridentata																					—
	Rhinerrhiza divitiflora									R	R	R										—
	Sacrochilus falcatus			R				O		O	O	O	O		O	R	R	O	R			—
Piperaceae	*Peperomia leptostachya*	R					O	C	O	R	O	C	R	O	R	R	O	R				—
	P. tetraphylla							C	O	O												—
Polypodiaceae	*Dictymia brownii*						O	C		R	O	R			R				R			—
	Platycerium bifurcatum	R	R			R	O	O		O		R			O		R	O	O			—
	P. superbum	R						C		O		O	O	R	O				R			—
	Pyrrosia confluens	O	O	O	C	C	C	VC	O	O	O	C	O	R	C	C	O	O	O	O	O	—
											C											

APPENDIX 3

Central sector: list of species observed in the stands under examination



Notes

- For locality and other information about the individual stands, see Appendix 1.
- Estimates of relative abundance are presented using the following code:
  VC Very common
  C Common
  O Occasional
  R Rare, Very infrequent.
- Taxa are arranged alphabetically at family, generic and specific levels within the structural categories of Trees, Shrubs, Herbs, Climbers and Epiphytes–Lithophytes.
- * Indicates an introduced species, now naturalised.
- The three stands C14(S), C14(C) and C14(N) occur close together. They are identified according to their relative south-central-north locations. Here, only two species lists are presented: under C14(S), a combined list for C14(S) and C14(C) (separate lists not having been made when the field-work was done), and under C14(N) a list for that stand alone.
- The stands C17(W) and C17(E) occur close together. They are identified according to their relative west-east locations.
- The Herb and Epiphyte–Lithophyte presence lists for stand C2 are incomplete.
- *Arthropteris tenella* and *Microsorium scandens*, usually regarded as epiphytes (e.g. Beadle, 1971), have been placed here in the structural category of Climbers.

CENTRAL SECTOR — **RAINFOREST STANDS**

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14 S	C14 N	C15	C16	C17 W	C17 E	C18	C19	C20	C21
TREES																								
Alangiaceae	*Alangium villosum*		R		R									R			O	O	R				O	O
Anacardiaceae	*Euroschinus falcata*	R	R	R																				
Araliaceae	*Polyscias elegans*	R	R	O		O	O			R	R		O	R	R		R	O	O	R				
Boraginaceae	*Ehretia acuminata*	R		O		O	C		R		O		R	R	O	O	R	R	O	R	R		O	C
Capparaceae	*Capparis arborea*	VC	C	VC	O	C	VC	C	C	O	C	O	C	O	VC	VC	O	C	C	C	C	C	C	O
Casuarinaceae	*Casuarina cunninghamiana*	R																	R					

CENTRAL SECTOR — **RAINFOREST STANDS**

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14 S	C14 N	C15	C16	C17 W	C17 E	C18	C19	C20	C21
Celastraceae	*Cassine australis* var. *australis*	O	O	O	O	O	R	R	R		R	O	O	R	O	O	O	O	C	O	O	C	R	R
	Maytenus silvestris		O																					

Appendix 3. (continued)

Ebenaceae	*Diospyros australis*	O	C	O	O	O		R	R	O	O	O	R		R	O	C	R	O	R	C	O		C
	D. pentamera	O		O	R		O	R		R		R	C				O	C		O		O	O	
						O					C								O					
Elaeocarpaceae	*Elaeocarpus obovatus*	O		C		R	O		R	O	C	O	O	O	O	O	O	O	O	O	R	O	C	C
	Sloanea australis																							R
Euphorbiaceae	*Actephila lindleyi*	R		C	R						R							O						
	Alchornea ilicifolia	C	C	O	C	O	C	O	O	C	O	O	O		C	O	O	O			O	O	R	
	Baloghia inophylla	C	C	C	VC		V		C	R		C	O	O	VC	C	C	C	C	O	R	C	O	R
	Claoxylon australe	O	C	V	C	C	C	R	O		C		O	R	C	O	O	O	O	O	O	O	C	O
	Cleistanthus	C	C	C	C	R	C	O	VC	VC	O	O	V	VC			VC	VC		VC	C		VC	
	cunninghamii	R		C		C	V					R	C					R	O					
	Croton insularis	C	VC	R	O		C	V	O	C	V	C		O	VC	C	C	O		C	C	V	O	C
	C. verreauxii	V	VC	V	VC	O	R	C	C	C	C	C	O	R			O	O				C		
	Drypetes australasica	C	C	C			V	O	R				C						C		R			
	Glochidion ferdinandi		C	V	VC	V	C		VC	VC	C	VC	R	VC	C	V	VC	O		O	C		VC	O
	Mallotus philippensis	V		C		C	C	C			C		C			C						O		R
	Omalanthus populifolius	C		R				C																
				V		V	C	R			C								R					
				C		C	R	V																
						R		C																
Eupomatiaceae	*Eupomatia laurina*				O		R						R	O				R	R	R			R	O
Flacourtiaceae	*Scolopia braunii*	O	O	O		O	O	O	R		O	O	O	O	R	O	C	O	O	O	O	R	R	R
Icacinaceae	*Citronella moorei*			R			R										R		R	R			R	
	Pennantia cunninghamii																						R	O
Lauraceae	*Cryptocarya glaucescens*																							R
	C. microneura	R		O			R												O	R		O		O
	C. obovata				R								R					R						
	Litsea reticulata																						R	
	Neolitsea dealbata														R				R					VC
Malvaceae	*Hibiscus heterophyllus*	O	C	V	O	R	O	O	O	O	O	O	O	O	O	O	O	O	C	O	O	O	O	O
				C																				
Meliaceae	*Dysoxylum fraserianum*	O	O	O	O	O	O		O			O	R	O	O	O	C	R	O	O		O	O	C
	Melia azedarach	O			R			O	R		R	R	R	R			O	O			C		O	O
	Synoum glandulosum	O																						
	Toona australis	R		R	R		O		R	R	O	R	R		O	O	R	R			O	O	R	C
						R		R											O					
Mimosaceae	*Pararchidendron*	O		O		R	R	R	O		O	R	R		R	O		R	R	R	R	R	R	
	pruinosum																							
Monimiaceae	*Daphnandra micrantha*	O	R	O	O		O							R	C	C	R	R	O	R		R	R	VC
	Wilkiea huegeliana	O		O	R		R					R			R	R	R	R			R	O		R
																			O					

Appendix 3. (continued)

Moraceae	*Ficus coronata*; *F. macrophylla*; *F. rubiginosa*; *F. superba* var. *henneana*; *Streblus brunonianus*	O O R R V C	C O O O VC	R R V C	C O R R VC	O O O R V C	O R R V C	O R V C	O R R VC	O O R VC	R O O V C	R O VC	O O R V C	R C R VC	C O VC	C R V C	O	R O R O VC	C R V C	R VC	O R R VC	O O R V C	O O R VC	O R O
Myoporaceae	*Myoporum acuminatum*																							
Myrsinaceae	*Rapanea howittiana*; *R. variabilis*	O	C O	R R		R			R	R	R	R	R				R		R R		R	R		R
Myrtaceae	*Acmena smithii*; *Austromyrtus acmenoides*; *Backhousia myrtifolia*; *B. sciadophora*; *Melaleuca quinquenervia*; *M. styphelioides*; *Rhodamnia rubescens*; *Syzygium australe*; *Tristaniopsis laurina*	R R R O O R	VC C	R R R O R O	O O O	O O	R O R	O	R O R O	O O	O O R	C O	R O C O	O	R O O R O	R O O	O C O R	O O R O	R O C O O C	R C O R	R R C R R	O C R R C O C	R R O O	O R R R O O
Oleaceae	*Notelaea longifolia*; *Olea paniculata*	O C	C VC	C O	R C	O C	O C	R C	R C	O O	O C	O C	O C	O C	O C	O C	O C	O O	O R	R	O O	O O	R O	R
Pittosporaceae	*Hymenosporum flavum*; *Pittosporum undulatum*	R	O C	O R	R	R	O			O O	R	R R	R		C R	O O	R R	R	O R	O	O R	O R	R R	R O
Podocarpaceae	*Podocarpus elatus*	R	R							R	R		R					R					R	
Proteaceae	*Stenocarpus salignus*			C								R					R		R					R
Rhamnaceae	*Alphitonia excelsa*; *Emmenosperma alphitonioides*	R R	O	O	O	R	R	R				R	R		R	R	C	O	R	R	C	O	R	R
Rubiaceae	*Canthium coprosmoides*														R		O				R			
Rutaceae	*Acronychia oblongifolia*; *Geijera salicifolia* var. *latifolia*; *Melicope micrococca*; *Sarcomelicope simplicifolia*	R C O C	R R R	O C R O	O R C	O O	C R	C O	O R	O C	O O	C R R	C R	O R O	O C	R O	O R C	C R O	R O O R	C O R	C O R	O R C	O R O	R R O

Appendix 3. (continued)

Sapindaceae	*Alectryon subcinereus*	O		O		O	O	O	O	O	O	C	O	O	R	R	O	O	O	O	C	O	O	O
	A. tomentosus	O							O	R		O	C	O				R		R	O		R	
	Diploglottis australis	R	O	O	O	O	C	C			O	R			C	O	O	O		R	R	O	O	O
	Elattostachys nervosa	C	C	C	O		O		R			O	O	O			O	C	O	O	R		O	
	Guioa semiglauca	O	R	O	R	R	O	R			R	R	R	R	O		R			R		R	R	R
	Mischocarpus australis	O	R	O		R	O				O		O					O	R	C		C		O
	Rhysotoechia bifoliolata	C		C	O		R		R	O		R	R	O			O	C	O				O	
						R		R			R													
						R					R								C					
											R								R					
Sapotaceae	*Planchonella australis*	C	O	C	C		C	R	O	O	O	R	O		O	O	O	C	C	O	C	O	C	O
Sterculiaceae	*Brachychiton acerifolius*			R		R	O								R			R				O		
	B. discolor	C	O		O	O	R	R	O	O	O	O	O	R	O	O	O	O	O	R	O	R	C	R
	B. populneus	R		O																				
	Commersonia fraseri											O										R		R
Symplocaceae	*Symplocos thwaitesii*																		R	R				
Ulmaceae	*Celtis paniculata*																	R						
Urticaceae	*Dendrocnide excelsa*	O	O	O	C	O	V	C	C	C	O	R	O	O	O	C	O	C	O	C	C	O	C	O
	D. photinophylla	C	O	R			C	C	O	C		O	O	R			O	O						
							R				R													
Verbenaceae	*Clerodendrum tomentosum*	O		O	O	R	R	O	R	R		O	O	R	O	R	R		O	O	O	O	O	R
SHRUBS																								
Amaranthaceae	*Deeringia*						O			R	R				O	R			R			R		
	amaranthoides						R			R	R											R		
	Nyssanthes diffusa																							
Araliaceae	*Astrotricha latifolia*																	R						
Caesalpiniaceae*	*Senna floribunda*	O							R															
Caprifoliaceae	*Sambucus australasica*			R			R	O								R		R	O			O	O	R
	Breynia oblongifolia	O	C	O	O	R	R	O	O	O	R	O	O	R	O	R	R	R	R	R	R	R		R
Euphorbiaceae																								
Malvaceae	*Abutilon oxycarpum*		O			O	R	C	O	C	O	C	C	O	O	O	O	O		O	O	R	O	
Pittosporaceae	*Citriobatus pauciflorus*	V	VC	V	VC	V	V	V	VC	VC	V	C	V	C	VC	V	VC	VC	V	VC	VC	V	VC	VC
	Pittosporum revolutum	C	O	C		C	C	C			C	O	C			C			C		O	C		O
				R							O											O		
Solanaceae	*Solanum aviculare*							R					R				R		R					
	S. stelligerum	O		O	R	R	R	C	R	O	O	O	O	R	O	O	O	O	O	O	O	O	C	O
Verbenaceae *	*Lantana camara*	V	VC	V	VC	C	O	V	C	VC	O	C	C	VC			O	C			VC			
	Spartothamnella juncea	C		C				C		R														

Appendix 3. (continued)

Zamiaceae	*Macrozamia* sp.										O													
HERBS																								
Acanthaceae	*Pseuderanthemum variabile*		—		R		R		O	R	R	O			O	R		R	O	O		R	O	
Adiantaceae	*Adiantum aethiopicum*	C	—	O	O	C	O	O	C	C	C	C	C	C	O	O	R	O	O		C	O	R	O
	A. formosum	O	C	C	C	O	V		O	O	C	R	O		VC	C	C	C		C	O	C	O	C
	A. hispidulum	O	C	R	O		C	R	O	R	O	O	C	R	C	C		R	V	O	R	C	R	O
	A. silvaticum		—			C	R	O				O		R					C	O		R		
	Pellaea falcata var.	C	C	C	VC	R			R	R		O	R	C	C	C	C	R	O	O	C	O	R	O
	falcata	O	—	O	O	O	O		O	R	O	O	O	R	O	O	R	C		R	O	O	R	O
	P. falcata var. *nana*	C	O	C	O		R	O	R	C		R	O	R			O	R			O	R	O	R
	P. paradoxa					C	O				O								O					
						O																		
								O			O								R					
																			R					
Araceae	*Alocasia macrorrhiza*		—																R					R
	Gymnostachys anceps	O	—				O								R	R						R		R
Aspidiaceae	*Lastreopsis decomposita*		—												R			O	V	C				O
	L. microsora		—				O			R	O				C	O		R	C			O		O
Athyriaceae	*Diplazium australe*		—				O								R							R		R
Blechnaceae	*Doodia aspera*	O	—	C	C	O	C		O	O	C	O	C	O	C	O	C	O	O	C	VC	V C	R	C
Commelinaceae	*Aneilema acuminatum*		—			O	R		C	R		O	O		R	R	O		O	O	C	R		
	Pollia crispata		—																R					
Lamiaceae	*Plectranthus parviflorus*		—		R			R	R	R	R	R	O					R	O	O	O		R	
Liliaceae	*Dianella caerulea*		—						R															
	Tripladenia cunninghamii		R																					
Pteridaceae	*Pteris tremula*	R	—	R	O	R		R	R			O	O	O	R		O	O	O	O	O		O	O
	P. umbrosa		—		O														R	R			O	VC
Thelypteridaceae	*Christella dentata*		—																R					
Urticaceae	*Urtica incisa*		—				O			R														
Violaceae	*Viola hederacea*		—			R	O	R	O	O	R	R	R				O			O	C	O	O	
Xanthorrhoeaceae	*Lomandra longifolia*	O	C	C	O	R	O		R		O	O	R	R	C	O	O	O	O	O	R	O	R	O

Appendix 3. (continued)

CLIMBERS

Apocynaceae	*Parsonsia straminea*	C	C	O	C	V	V	C	C	C	C	C	C	C	C	C	VC	C	V	VC	O	C	O	C
	P. velutina	R		R	R	C	C				C				O	O		R	C					O
							O												R					
Asclepiadaceae	*Gymnema pleiadenium*										O				R			R						O
	Marsdenia flavescens		C		O	O	O		O	O			C		VC	C		O	O	VC	O	C		C
	M. rostrata						O				C				O	O						O	C	C
	M. lloydii				O			O	R	C		O	C	O				O			R			
											O								O					
Asteraceae *	*Delairea odorata*																						O	
Bignoniaceae	*Pandorea pandorana*	O	C	O	O	O	V	O	O	VC	O	C	O	O	VC	V	O	C	O	C	O	V	O	VC
							C									C						C		
Celastraceae	*Celastrus australis*											R												
	C. subspicata				R	R			O						O	O	R					C		O
Cunoniaceae	*Aphanopetalum resinosum*		R	R		O	O		R	O	O	O	O	R	O	C		R	O	R	O	V	R	O
																						C		
Davalliaceae	*Arthropteris tenella*	R	C	O	C	C	O		O	R	O	R	O	C	O	O	O	C	O	O	R	O	O	O
Dioscoreaceae	*Dioscorea transversa*					O	O		O	R	O	O		O	C	C		O	O	O	R	C	O	C
Fabaceae	*Austrosteenisia blackii*	C	VC			O	C	C	VC		R			O				VC			VC		VC	
Menisperma-ceae	*Legnephora moorei*	O	R	O	O	O	C	O	O	O	O	O	O	C	O	C	C	C	R		O	C	C	C
	Sarcopetalum			O			R			R								R				R		
	harveyanum							R				R	R						O			R		O
	Stephania japonica					O																		
Moraceae	*Maclura cochinchinensis*	O	O	O	C	C	O	C	O	O	O	R	C	O	O	O	O	O	O	O	C	O	O	O
	Malaisia scandens	O	O	O	C	R	V	O	O			O	O	O	O		C	C		O	R		C	R
							C				O								C					
Myrsinaceae	*Embelia australiana*	O		C	C	O		R		R	R	O	R		O	O	O	O	C	O	R	C		O
Oleaceae	*Jasminum volubile*	C	C	O	O	C	O	O	O	O	O	O	C	R			R	O			C		R	
Passifloraceae	*Passiflora herbertiana*							R		R		R												
*	*P. subpeltata*						R						R									R	R	
Ranunculaceae	*Clematis glycinoides*												R	R										R
Rosaceae	*Rubus moorei*										R									R				R

Appendix 3. (continued)

Rubiaceae	*Morinda acutifolia*	C	O																					
	M. jasminoides			R	O	O		O	R								C	C	C				C	
Smilacaceae	*Eustrephus latifolius*		C		O	R	R	O		R	R	O	R	O	R	O	O	R	R	R	R	O	R	R
	Geitonoplesium										O													
	cymosum			O	R	O	R											O		O			R	
	Ripogonum album														O	O	R	R	O		R	O		R
	Smilax australis					R					O													
Vitaceae	*Cayratia clematidea*			R	O	O	O	C	O	C	R	O	O	O	O	O	O	O	R	O	O		O	O
	Cissus antarctica	C	VC	C	C		V	O	VC	C	C	C	C	C	VC	V	C	C	V	VC	VC	V	VC	VC
	C. hypoglauca			R	R	V	C							R	O	C		R	C			C	R	O
	Tetrastigma nitens	C	VC	V	C	C			C	O	C	O	C	VC	C	O	C	C	O	C	C	O	C	C
				C			C	C								O						C		
						O													C					

EPIPHYTES and LITHOPHYTES

Aspleniaceae	*Asplenium attenuatum*		—		R	R			R				R					O	R					
	A. australasicum		—												R	R		R	O			R	R	R
	A. polyodon		—				R																	
Orchidaceae	*Dendrobium gracilicaule*		—	R	O	R					O		R		R	R		R	O			R		
	D. linguiforme	R	—		R					R			R	R	R									
	D. schoeninum		—		O														R					
	D. speciosum	O	—	R	O	O	O		R				O					O					R	O
	Plectorrhiza tridentata		—				R				R								R			R		
	Sacrochilus falcatus	R	—				R			R			O				O	O		R	O	C	R	
	S. hillii		—								O								O	R				
	S. olivaceus		—				R																	
Piperaceae	*Peperomia leptostachya*		—			O			O	O	O		O			R		R				O		
	P. tetraphylla		—																					
						R																		
Polypodiaceae	*Dictymia brownii*	R	—							R					O	R			R					
	Platycerium bifurcatum	R	O		R	O	O		R	R		R	R		R	R	R	R	O	R	R	O	R	
	P. superbum		—				O						R				R	O					R	R
	Pyrrosia confluens	O	—	V	C		C	R	O	O	O	O	C		O	O	R	O		O	O	C	O	C
	P. rupestris		—	C		C													C			O		O
																			R					