

Identification of Rainforest

Field Guide



Shane Ruming



Purpose and use of this rainforest field key

Purpose of this key

The purpose of this key is to provide a process for verifying rainforest mapping and identifying rainforest vegetation. The key provides a definition of rainforest and a simple field key.

The key relies on the user having a reasonable knowledge of the vegetation of the area. At a minimum the user will need to be able to identify rainforest tree species that are used in the key. It may also be necessary to identify understorey species. The terms dominant, co-dominant and sub-dominant refer to the contribution of the species in question to the cover of the canopy layer of the vegetation. If a single species clearly contributes more than any other species to the canopy cover of the stand, it is dominant; if one or more species contribute equally they are co-dominant; and species that contribute less than a dominant species are sub-dominant.

It should be noted that the ecotone boundary between rainforest and other vegetation types is dynamic and may vary over time dependent on site factors such as fire.

How to use this key

This key provides a brief history of defining rainforest both as a written definition and as a mapped spatial layer. The key should be used to both verify the mapped boundary of rainforest at a site level and to identify and map areas of rainforest not previously mapped.

Acknowledgments

The preparation of this guideline was assisted by many people including, in particular, the following DEC staff (in alphabetical order) John Hunter (principal author), Sarah Tumbers and John Turbill. Adrienne Farago is thanked for editing and comments and Dee Rogers for publishing. Acknowledgment is also made of funding assistance provided by the Department of Infrastructure, Planning and Natural Resources.

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August 2004



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1 Background

1.1 Rainforest Definition

The definition and spatial delineation of rainforest has been a vexed issue for many years in NSW and Australia. While many definitions have been proposed (for example Beadle and Costin (1952); Webb (1959), (1968), (1978), (1992); Baur (1965); Dale et al (1980); Hopkins (1981); Werren and Allsworth (1982); Jarman and Brown (1983); Floyd (1990); Cameron (1992); Adam (1992); Pugh (1997); Lynch and Neldner (2000)); and while many of these are similar, there is still no general agreement of what defines rainforest within Australia. In particular, the status of communities with closed canopies of rainforest species below tall eucalypts remains unclear. Within Australia such 'mixed forests' are variously regarded as non-rainforest, seral stages of rainforest or as distinct vegetation types/communities.

The Comprehensive Regional Assessment (CRA) process undertaken as a prelude to the completion of Regional Forest Agreements (RFAs) for the upper and lower north-east of NSW had as part of its objectives the establishment of a comprehensive, adequate and representative (CAR) reserve system for all forest communities. To undertake the assessments required for this process, a classification system for forest ecosystems was created including a definition of rainforest and resolution of the status of 'mixed forests'.

The CRA process determined that the definition of rainforest would include areas mapped by State Forests of NSW as rainforest (i.e. forest types 1 to 26 following the definitions within Research Note 17 (Baur (1965))), and areas with an overstorey of pyrophytic vegetation where an understorey of rainforest species was present ('mixed forests'). Aerial photograph interpretation (API) was used to map rainforest using this definition. The project found that API could generally distinguish areas where an understorey of rainforest with pyrophytic 'emergents' up to a crown cover of pyrophytes of about 30% occurs. However it was acknowledged that other areas definable as rainforest occur where the rainforest understorey is obscured on aerial photographs by the crowns of the pyrophytes.

The acceptance of 'mixed forests' as a component of rainforest in NSW has implications for private as well as public lands. Considerable analysis and discussion of the definition of rainforest and determination of 'High Conservation Value' (HCV) vegetation across private land was undertaken as part of the state government's former regional vegetation plans and catchment plans. This was primarily based on data derived across all land tenures as part of the CRA process. This analysis determined that past clearing rates of rainforest was significant and accordingly rainforest was defined under the JANIS¹ criteria as being a Rare and Endangered forest ecosystem with a 100% target for protection. Consequently due to its rarity and risk to further degradation rainforest was considered to have very high ecological significance and therefore requires protection from any further degradation or clearing. As part of the CRA process rainforest was mapped (CRAFTI mapping²) by API using 1:25,000

¹ JANIS is the 'Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee', a Federal Government committee which set nationally agreed criteria for the establishment of a Comprehensive, Adequate and Representative Reserve System in Australia.

² CRAFTI stands for 'Comprehensive Regional Assessment Forest Type Inventory'. CRAFTI was designed as part of the CRA to provide raw data on floristics, growth stage and distribution of forests for upper and lower north-east NSW.

colour aerial photographs. This map layer provides an indicator of the spatial extent of rainforest.

However to verify the mapping or to determine whether other areas that were too small to have been mapped are rainforest, it is necessary to firstly determine an acceptable definition of rainforest which can be consistently applied across the landscape. In determining a definition for rainforest it is worth noting that in north-eastern NSW considerable work has already been undertaken within the former regional vegetation management planning process, in particular, work undertaken by the former Richmond, Clarence and Manning regional vegetation committees.

The definitions adopted within the draft Richmond and Clarence Regional Vegetation Management Plans (as exhibited) are very similar and are based on the definition developed by Lynch and Neldner (2000). The definition in the draft Richmond Regional Vegetation Plan states:

‘Rainforest is a tree dominated woody vegetation where the tallest tree or shrub layer (canopy) is usually, but not always, closed (with a projective foliage cover of greater than 70%), is greater than 3 metres in height and is dominated (50% or more of locally indigenous species) by rainforest species.

Rainforest may include mixed (transitional, ecotonal, seral and secondary) communities where emergent non rainforest species comprise a crown cover of up to 50% and the lower strata is of similar botanical composition to mature rainforests.

Rainforest species are native species occurring in NSW listed in Floyd (1989) Rainforest Trees of Mainland South Eastern Australia or Williams et al (1984) Rainforest Trees and Shrubs of NSW and Southern Queensland.’

The definition in the draft Clarence Regional Vegetation Management Plan differs only slightly in the first paragraph:

‘Rainforest is a tree dominated woody vegetation where the tallest tree or shrub layer (canopy) is usually, but not always, closed (with a projective foliage cover of greater than 70%). Rainforest is greater than 3 metres in height and is dominated (50% or more) by rainforest species.’

The draft Clarence Regional Vegetation Management Plan also defines the spatial limits of the vegetation. It states:

‘Rainforest includes small remnants and isolated rainforest clumps and trees below the minimum mappable area of 2ha or 50m in width used in producing the maps that form part of this Plan. These unmapped remnants may include single trees or isolated clumps of trees belonging to rainforest species or lineal strips of rainforest greater than 3m in height.’

The definition in the draft Manning Regional Vegetation Plan is as follows:

‘Rainforest (including Vine Scrub): any contiguous area of woody vegetation where the tree stratum with the greatest canopy cover is dominated by rainforest species. The canopy is closed, shading more than 70% of the ground. Other emergent species must have crown cover of less than 30%. Also areas of continuous rainforest understorey regardless of proportion of emergents.’

Another definition of rainforest that may be of relevance is that contained within the *Plantations and Reafforestation Act 1999* (P&R Act). It states:

‘Rainforest vegetation, means any contiguous area of woody native vegetation dominated by rainforest species and with a rainforest structure’

The definition contained within the *Interim Guidelines to managing Private Native Forests in North East NSW* (Department of Land and Water Conservation 2000) is very similar to that in the P&R Act:

‘Any area of vegetation dominated by rainforest species and with a rainforest structure, and including a rainforest as defined in the integrated forestry operations approvals under the Forestry and National Parks Estate Act 1998.’

It is considered however that all of the above definitions are inadequate in that they are unclear and in some cases contradictory. Accordingly, they can not be easily applied in the field.

1.2 Rainforest Mapping

Rainforest was specifically mapped from 1:25,000 scale colour aerial photographs by the CRAFTI project as part of the CRA process. The dates of the aerial photographs used ranged from 1993 to 1997. The minimum mapping unit was two hectares and the minimum width for mapping of polygons was 50 metres. That is, areas of less than two hectares or less than 50 metres in width could not be mapped as a polygon (due to limits of scale). However, smaller areas of rainforest, when identifiable, were recorded as point features or, for very narrow strips along waterways, linear features.

Rainforest was recognised as tree dominated woody vegetation where the tallest tree or shrub layer (canopy) is usually (but not always) closed, is greater than three metres in height and is dominated by rainforest species. Rainforest also included areas with up to 30% cover of non-rainforest species but with a rainforest understorey.

A descriptive code was added to denote the presence of eucalypts, Brush Box or mixed eucalypt / Brush Box emergents principally to split polygons larger than 25 hectares down to 10 hectare units. Additional codes were used to identify specific site features within rainforest polygons such as Lantana, Camphor Laurel or viney scrub. Any isolated patches of eucalypts within a rainforest polygon were mapped to a minimum unit of 5 hectares. Refer to Table 1 for information on the descriptive codes used in the CRAFTI rainforest mapping.

The CRAFTI map layer of rainforest spatially depicts rainforest areas within the mapping scale limitations discussed above. This layer should be used as an indicative map of rainforest areas across the landscape.

1.3 Refined Definition of Rainforest

For the purposes of this key and to achieve a workable and consistent field definition of rainforest the following definition is recommended. This definition draws on the review of existing definitions as discussed above in section 1.1.

Box 1: Rainforest Definition

'Rainforest is tree-dominated vegetation where the tree stratum with the greatest crown cover (not necessarily the tallest stratum) has rainforest species making up 50% or more of the crown cover. This stratum is usually, but not always, closed (with a projective foliage cover greater than 70%).

Rainforest species are native species occurring in NSW listed in Floyd (1989) Rainforest Trees of Mainland South Eastern Australia or Williams et al (1984) Rainforest Trees and Shrubs of NSW and Southern Queensland.

Rainforest includes not only stands mappable at a 1:25,000 scale but also isolated clumps of trees belonging to rainforest species and lineal strips of rainforest trees (in each case at least two specimens).

A tree is defined as a woody plant more than three metres in height with a single stem or with branches well above the base.'



Photograph: Shane Ruming

Figure 1: Rainforest Vegetation

The emphasis in this definition is on the **tree stratum with the greatest crown cover**. Provided this stratum is composed of trees and has more than 50% of the crown cover made up of rainforest species, then the vegetation is rainforest. The strength of this definition lies in the emphasis it places on the single most important unifying structural feature of rainforest (Cameron (1992)) – the presence of a more or less closed canopy of primary or secondary rainforest species, with or without emergents.

The main points of this definition are:

- **Tree dominated vegetation.** A tree is defined as a woody plant more than three metres in height with a single stem or with branches well above the base. Trees dominate the vegetation if the biomass of trees exceeds 50% of the biomass of the vegetation.
- **Tree stratum with the greatest crown cover.** Crown cover is the vertical projection of the periphery of tree crowns within a designated area. Crowns are treated as opaque (no holes). Crown cover is relatively easily estimated in the field or on large-scale air photos. If necessary it is calculated using the mean gap between crowns divided by mean crown width (the crown separation ratio, see 3.2). In most cases it will be relatively easy to identify visually the tree stratum with the greatest crown cover.

- **Rainforest species making up 50% or more of the crown cover.** This is a feature that, in most cases, can be easily identified visually in the field. If necessary, it can be calculated using a modified crown cover calculation.
- **Canopy usually closed.** A canopy is closed if the **projective foliage cover** of the canopy exceeds 70%. Projective foliage cover is the vertical projection of the leaves (as opposed to the crown cover which is the actual projection of the crowns of the trees). However, the definition does not require that areas defined as rainforest have closed canopies. Regardless of whether the canopy is closed or not, if rainforest species make up more than 50% of the crown cover of the tree stratum with the greatest crown cover, then the area is rainforest.
- **Rainforest species.** These are defined as native species occurring in NSW which are listed in Floyd (1989) and/or Williams et al (1984). That is, if the species is identified in either or both of these publications and is a species that is indigenous to NSW then it is a rainforest species. Therefore, species such as Brush Box (*Lophostemon confertus*) and Blackwood (*Acacia melanoxylon*) are rainforest species.

The areas of rainforest mapped by the CRAFTI project for the CRA or by the Big Scrub Remnant Mapping project indicate the spatial extent of rainforest. As noted above, the CRAFTI mapping has a minimum mapping unit of 2 hectares with a minimum width of 50 metres. Smaller areas, where identifiable, are recorded as point features or linear features. However, small remnants of rainforest are often not mapped. These unmapped remnants may include isolated clumps of trees including rainforest species or lineal strips of rainforest greater than 3m in height. In verifying vegetated clumps or lineal strips as rainforest, at least two specimens of rainforest species (as listed in Floyd (1989) and/or Williams et al (1984)) must be present in the rainforest-dominated tree stratum with the greatest crown cover. Additionally, more than 50% of that stratum should exceed 3m in height.

2 Field Validation

The above definition provides guidance for the observer wishing to determine if a particular stand of vegetation is or is not rainforest, either in site verification of mapped rainforest or in identification of rainforest not mapped. This is discussed further below and a key is provided in Section 2.2. Also refer to Figure 5 for a flow chart of the recommended rainforest field verification process and to Appendix 1 for further information on rainforest subformations and Appendix 2 for a field proforma sheet.

2.1 Pre Field Trip

Before the subject stand is inspected in the field it is useful to examine the CRAFTI rainforest map layer to determine:

- Has the area been mapped as rainforest?
- Does the mapping include additional codes indicating that emergents of non-rainforest species are present or that Lantana, Camphor Laurel or viney scrub are present?
- What is the extent of the mapped rainforest?

The areas where rainforest mapping has been undertaken for the North East CRA Region are depicted in the inset in Figure 2. Figure 2 also shows rainforest mapping for the former Upper North Coast Catchment Management Board area. Figure 3 illustrates an example at a site level of rainforest polygons and attribute codes. This information and recent air photographs (if available) may give an indication of how detailed a site inspection is required in the field and will provide guidance regarding features such as variations in topography that may need to be sampled if transects are required.

2.2 Field Key for the Determination of Rainforest in North East NSW

- 1** Aboveground biomass not dominated by trees eg. grasses, sedges, herbs, shrubs.

NON-RAINFOREST

- 1*** Aboveground biomass dominated by trees

.....2

- 2** Tree stratum with greatest crown cover has rainforest species making up less than 50% of the canopy cover.

NON-RAINFOREST

- 2*** Tree stratum with greatest crown cover has rainforest species making up more than 50% of the canopy cover.

RAINFOREST

Figure 2: Rainforest Mapping - Upper North Coast CMB Region

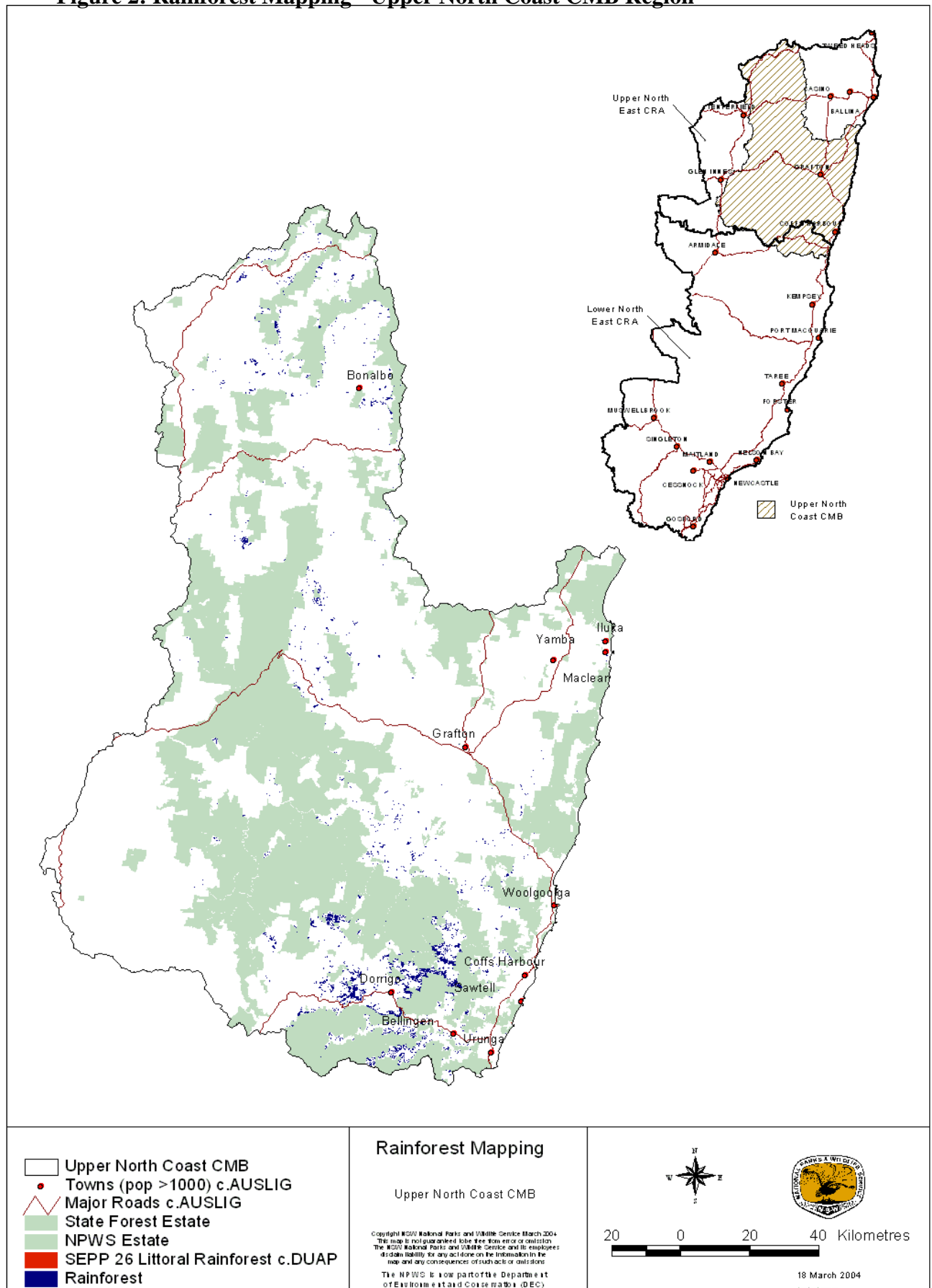


Figure 3: Map of woody vegetation and CRAFTI rainforest codes

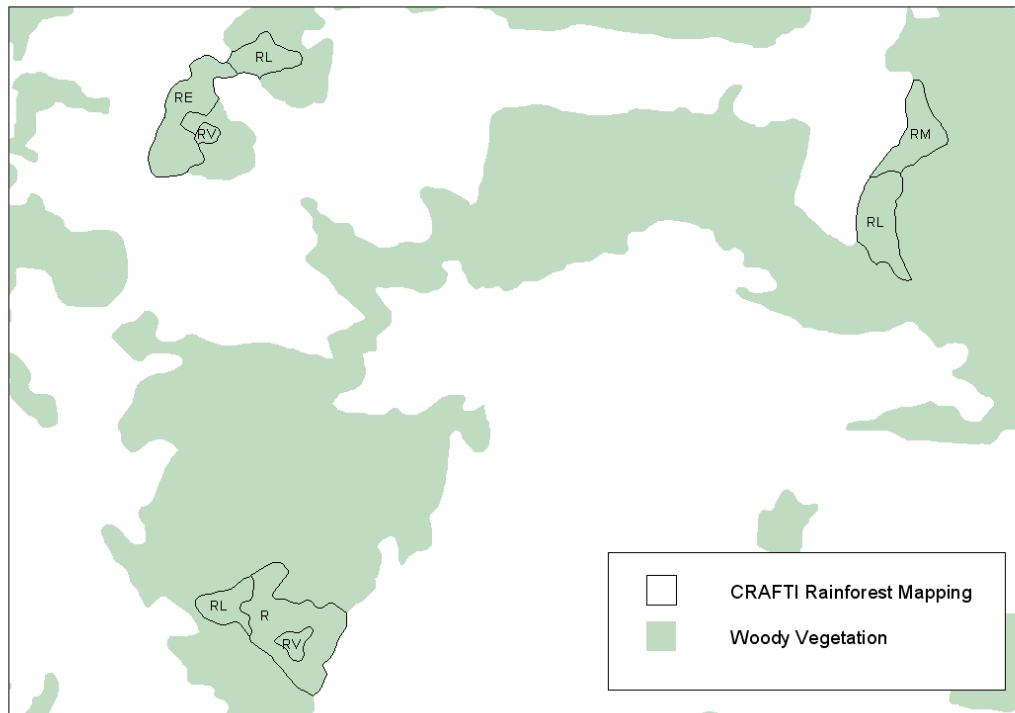


Table 1: Rainforest Classes from CRAFTI Rainforest Mapping

Class	Code
Rainforest	R
Emergents > 5%	
Eucalypt	E
Brush Box	B
Mixed	M
Rainforest Site Features:	
lantana	L
viney scrub	v
camphor laurel	c

3 Field Surveys

3.1 Tree-Dominated Woody Vegetation

After correctly locating yourself in the area of vegetation to be assessed, determine firstly - 'Is the vegetation dominated by trees?' If the vegetation is not dominated (>50% biomass) by trees, then it is not rainforest.

A tree is defined as a woody plant more than three metres in height with a single stem or with branches well above the base. Some rainforest trees may have more than one stem rising from a common base; in these cases the individual stems branch well above the base.

In most cases it will be easy to determine whether an area of vegetation is tree-dominated. However, in some areas it may be necessary to examine the stand in more detail to establish

whether the woody vegetation reaches on average three metres or more in height. In very marginal cases measured transects through the vegetation may be required to gain representative data as a basis for making a decision.

3.2 Tree Strata with the Greatest Crown Cover

The next step in field survey is identification of the tree strata with the greatest crown cover. This will be relatively easy in most cases – just look for the strata that is most ‘closed’. Measurement of the crown cover of several strata to determine which has the greatest crown cover is a relatively simple procedure (see below). However, such measurement will only be necessary if one of the strata with similar crown covers is predominantly composed of rainforest species and the other is predominantly composed of non-rainforest species. Crown cover is relatively easily estimated in the field.

The crown separation ratio (C) and crown cover % are estimated as follows:

1. Sample along a zig-zag transect as shown in Figure 4. Establish a straight line transect PQ. Starting at a crown in the stratum you wish to measure near P (in this case crown A), select the next crown in the stratum encountered going *towards* or *across* the transect line PQ and in the direction of Q.
2. Measure crown widths and crown gaps for the subject stratum. A mean of twelve measurements are normally sufficient; therefore measure twelve crown widths and twelve associated crown gaps.
3. Where crown overlap occurs, the crown gap has a negative value; the greater the overlap, the larger the negative value.
4. The crown separation ratio (C) =
$$\frac{\text{Mean crown gap}}{\text{Mean crown width}}$$

The stratum with the lowest crown separation ratio (C) has the greatest crown cover.
The stratum with the highest crown cover % has the greatest crown cover.

$$\text{Crown cover \%} = \frac{k}{(1 + C)(1 + C)}$$

where the constant $k = 80.6$ for samples taken along a zig-zag transect as shown in Figure 4 (method follows Walker and Hopkins 1990).

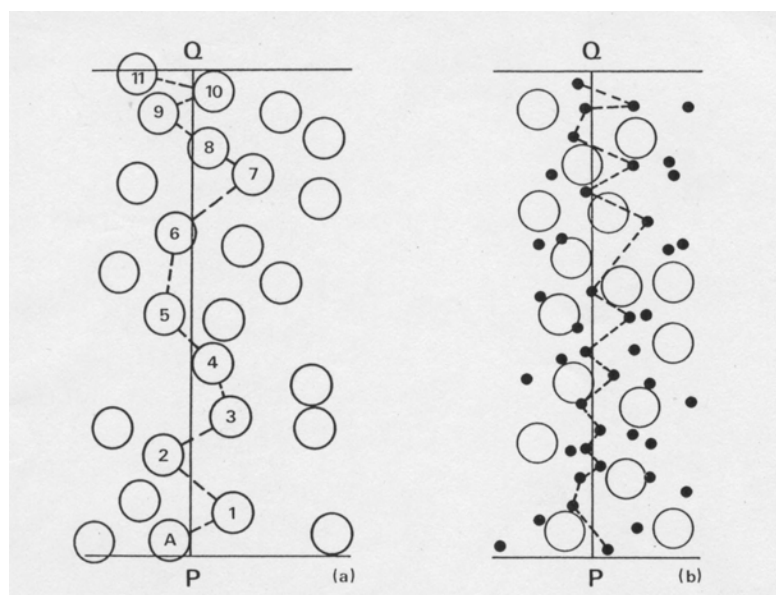


Figure 4: Sampling Procedure

The zig-zag sampling procedure is used for each stratum or layer, for example (a) for an upper stratum (b) for a mid stratum (Walker and Hopkins 1990).

3.3 Determining Dominance of Rainforest Species

Rainforest species are defined as native species occurring in NSW listed in Floyd (1989) *Rainforest Trees of Mainland South Eastern Australia* or Williams et al (1984) *Rainforest Trees and Shrubs of NSW and Southern Queensland*. Using this definition if the species is native, occurs in NSW and is listed in either of those books it is a rainforest species. Therefore, species that may be regarded as marginal (with respect to being a rainforest species), such as Brush Box (*Lophostemon confertus*) or Blackwood (*Acacia melanoxylon*) are, by this definition, defined as rainforest species.

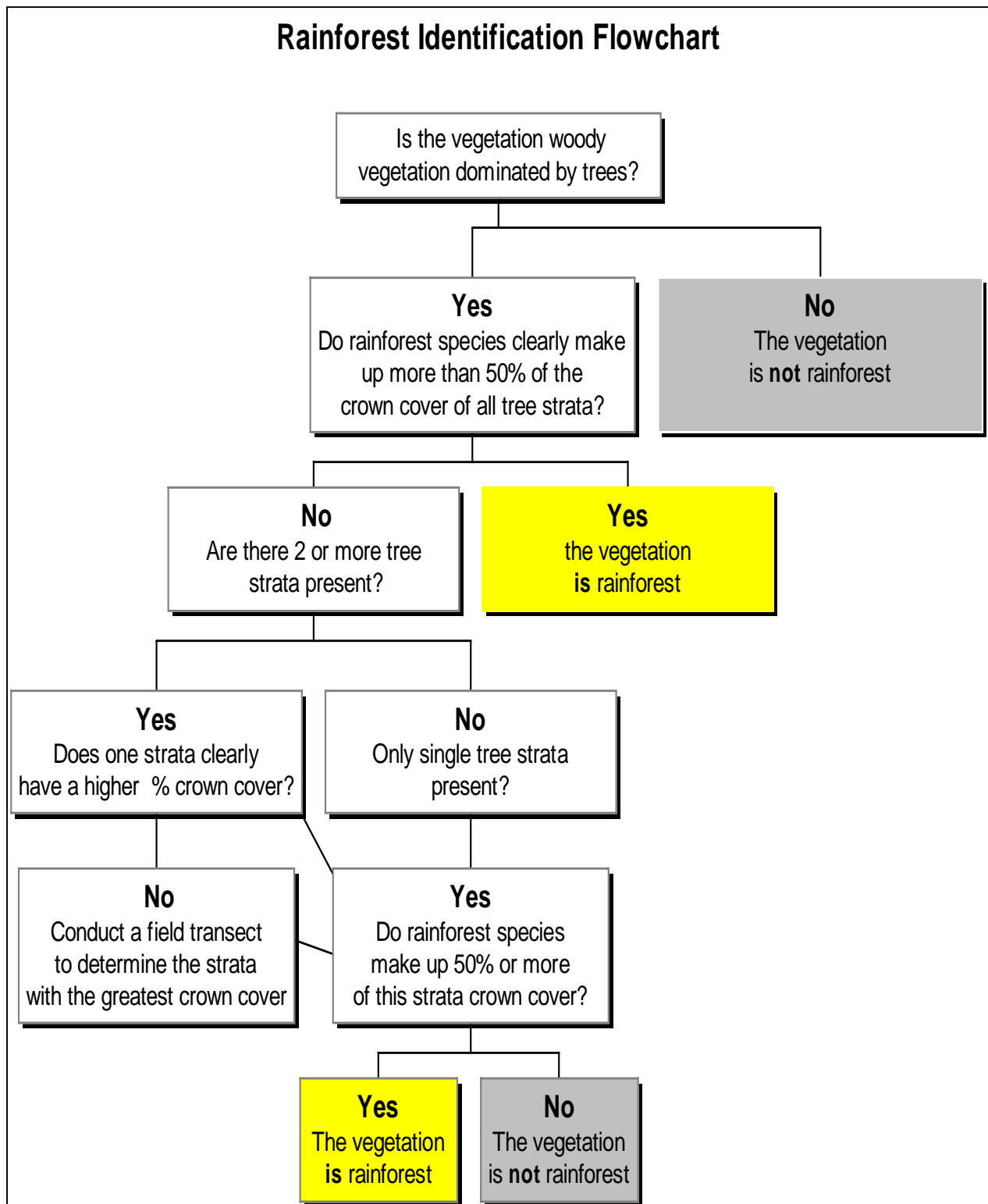
Crown cover measurement (as discussed above) can be used, if necessary, to determine whether or not rainforest species make up more than 50% of the crown cover. This can be ascertained by undertaking the same zig-zag transect but only measuring the crown widths of twelve crowns and whether or not the crowns are of rainforest species. If the sum of the widths of rainforest species exceeds the sum of the widths of non-rainforest species then rainforest species dominate the tree layer (and vice versa).

3.4 Determining Presence of Closed Canopy

A closed canopy is one that has a Projective Foliage Cover (PFC) equal to or greater than 70%. PFC is the percentage of the sample site occupied by the vertical projection of upper strata foliage only. The measure of PFC is relatively time-consuming to estimate in the field and requires the use of point quadrats, optical instruments or photographs. Furthermore, it is difficult to estimate where lower vegetation blocks the line of sight to the upper strata and where either deciduous species or species with vertical or near-vertical leaves occur (Walker and Hopkins 1990).

It should be noted that the presence of a closed canopy is not a necessary requirement for the definition of rainforest vegetation.

Figure 5 - Flowchart



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Acts & Regulations

Plantations and Reafforestation Act 1999

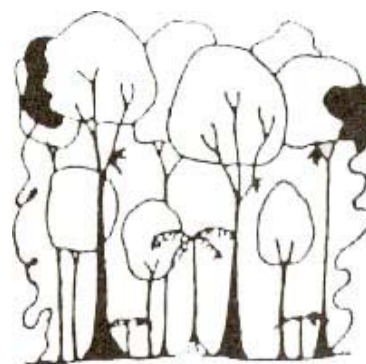
Forestry and National Parks Estate Act 1998

APPENDIX 1: Sub-formations of Rainforest

PURE RAINFOREST STANDS³

SUBTROPICAL RAINFOREST

Subtropical rainforest occurs in high rainfall areas (>1,300mm) from sea level to 900m elevation. It contains 2 to 3 strata of trees with diversity of canopy species ranging from 10 – 60 species. Stranglers (figs), palms, plank-buttresses are usually common and the canopy is generally uneven and non-uniform. Vines and large epiphytes are common and diverse and special features such as large-leaved herbs and ground-ferns are common.



DRY RAINFOREST

Dry rainforest occurs in warm areas of fairly low rainfall (630-1,100mm) and mostly contains 2 strata of trees. The lower stratum is 6-18m tall, diverse (10-30 species) and continuous whilst the upper stratum is mostly made up of scattered tall *Araucaria* or semi-deciduous species.

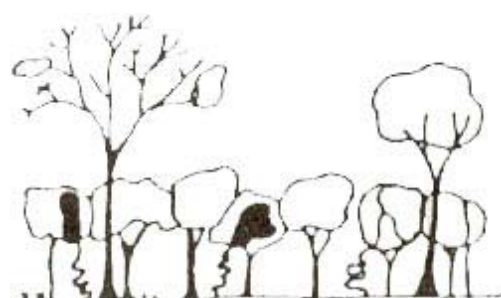
Strangers (figs) maybe rare or frequent, plank buttressing is rare and palms may be absent. Large vines are very common and diverse. Large epiphytes are rare, or sometimes common, but with few species. Special features such as mosses and ground ferns are rare, there are no tree ferns and prickly shrubs are common.

Common emergent trees include: Hoop Pine (*Araucaria cunninghamii*), Lace-bark Tree (*Brachychiton discolor*), Teak (*Flindersia australis*).

The canopy layer is often dominated by trees of a few families: Sapindaceae, Euphorbiaceae, Cleastaceae, Oleaceae, Anacardiaceae, Moraceae.



Dry Rainforest – Hoop Pine



Dry Rainforest –emergent Strangler Figs

WARM-TEMPERATE RAINFOREST

Warm-temperate rainforest occurs in areas of high rainfall (>1,300mm) and medium to high altitudes (450-1,200m). It consists of 2 strata of trees that are less diverse than subtropical rainforest with a canopy layer of between 3 – 15 species. Strangers (figs), palms and plank-buttresses are rare or absent and it has a fairly even canopy. Large vines and epiphytes are sparse to fairly common. Special features include slender uniform tree trucks and ground ferns frequent.



³ Text and Figures adapted from Williams, Harden & McDonald (1984).

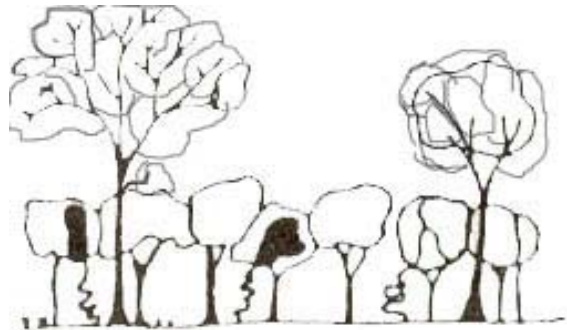
COOL-TEMPERATE RAINFOREST

Cool-temperate rainforest occurs in areas of very high rainfall (1,750-3,500mm) and high altitude (900-1,500m). There is mostly 2 strata of trees, sometime 1 with a very low diversity (1 – 3 species). The canopy is generally even and uniform. Stranglers (figs), palms and plank-buttresses are absent. Large vines and epiphytes are rare or absent, however thin wiry vines and small ferns and orchids may be frequent or common. Special features such as epiphytes and lichens, ground ferns and tree ferns often very common/abundant.



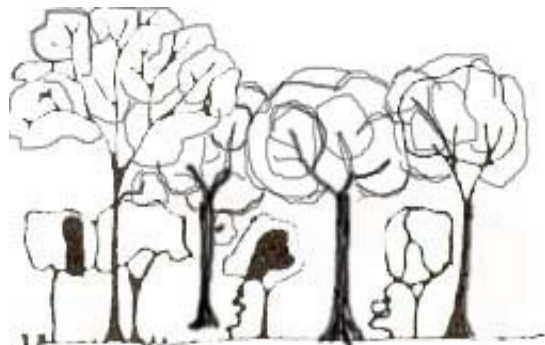
RAINFOREST WITH NON-RAINFOREST EMERGENTS

Sometimes referred as mixed forest. This forest type is common in sites when rainforest is transitional to non-rainforest. Commonly eucalypts remain as scattered individuals over a developing rainforest stratum. In the illustrated example there are two tree strata present and the crown cover of the lower layer is clearly greater than of the upper layer. As the lower layer is dominated by rainforest species this vegetation is defined as rainforest.



EUCALYPT DOMINATED WITH RAINFOREST UNDERSTOREY

This forest type may also be referred to as mixed forest with in this case a developed overstorey of non-rainforest species (usually eucalypts) with rainforest species in the lower stratum understorey. In this example the upper stratum of non-rainforest species clearly has a greater crown cover than the lower rainforest layer and therefore this vegetation type is not rainforest. This vegetation type is more difficult to assess when both layers are very similar in crown cover and contain mixed rainforest and non-rainforest species.



APPENDIX 2: Rainforest Identification:				Field Proforma sheet					
Site Number: _____		Date: _____		Assessment Officer: _____					
Location: _____				AMG: _____					
1. Tree dominated woody vegetation:				Yes / No					
2. Number of tree strata: (circle one)				1		2		3	
3. Tree strata with greatest crown cover: (tick one)				1		2		3	
4. Field Transect (where more than one tree strata of similar crown cover and both rainforest and non-rainforest species present)									
Strata 1				Strata 2					
Measurement	Crown Width (m)	Crown Gap (m)	Rainforest tree yes/no	Measurement	Crown Width (m)	Crown Gap (m)	Rainforest tree yes/no		
1				1					
2				2					
3				3					
4				4					
5				5					
6				6					
7				7					
8				8					
9				9					
10				10					
11				11					
12				12					
Mean				Mean					

Crown Separation Ratio (C) =

Crown Separation Ratio (C) =

Crown Cover % =

Crown Cover % =

The Crown separation ratio (C) = $\frac{\text{Mean crown gap}}{\text{Mean crown width}}$

$$\text{Crown cover \%} = \frac{k}{(1 + C)(1 + C)}$$

Where the constant $k = 80.6$ for sample taken along a zig zag transect

5. Is Area Dominated by Rainforest Species:

Yes/No

Zig Zag sampling transect

