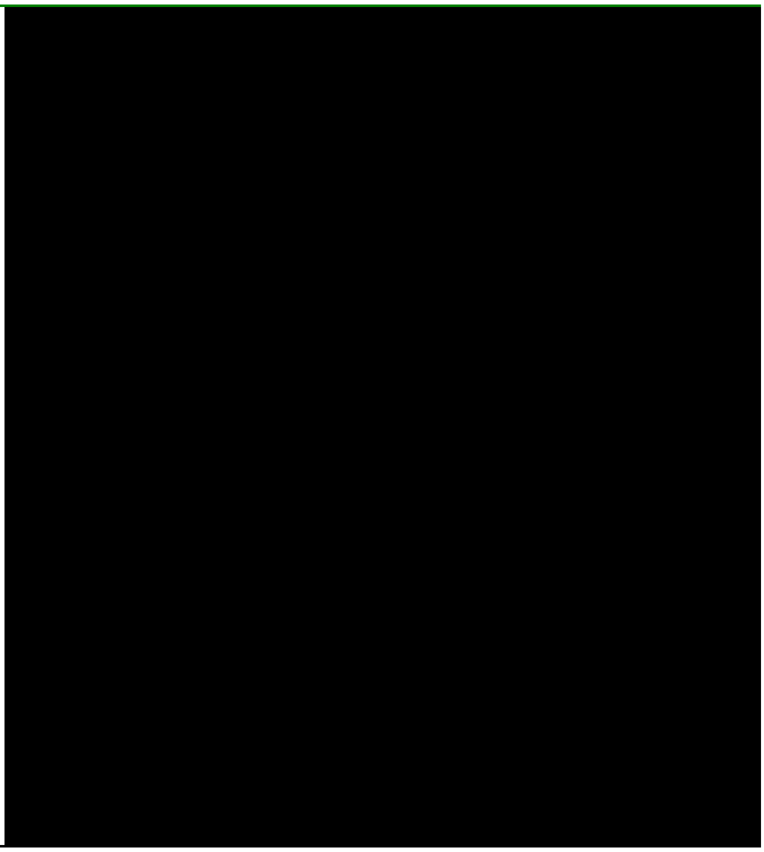
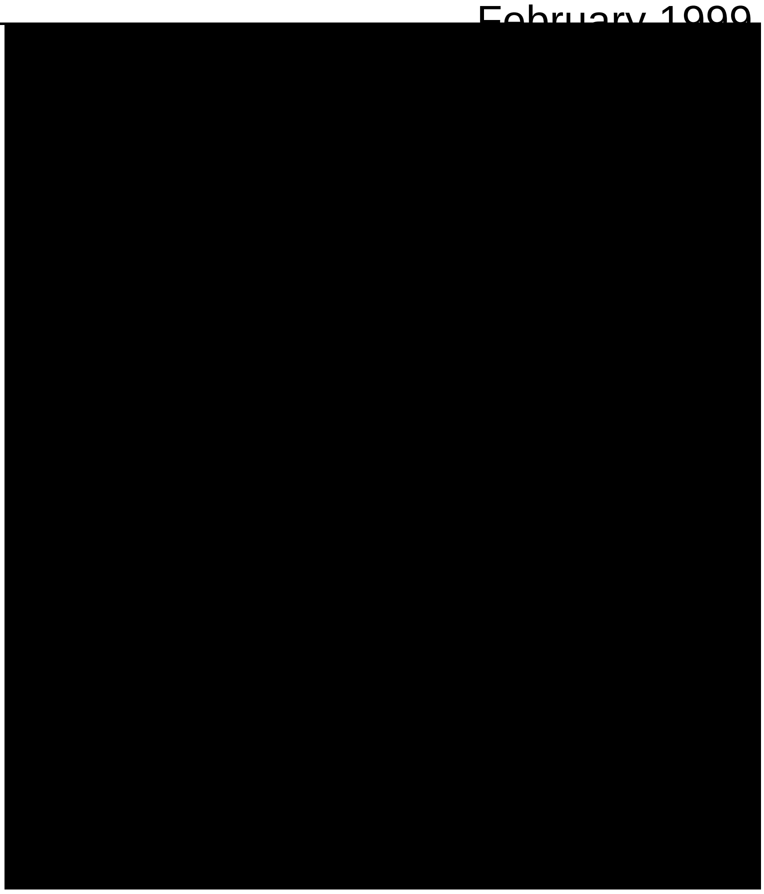


Old-growth Forest Related Projects - UNE / LNE Regions

A project undertaken as part of the NSW Comprehensive Regional Assessments

February 1999



OLD-GROWTH FOREST RELATED PROJECTS - UNE / LNE CRA REGIONS

NSW NATIONAL PARKS AND WILDLIFE SERVICE

A project undertaken as part of the
NSW Comprehensive Regional Assessments
project number NA 28/EH

February 1999

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The project has been overseen and the methodology has been developed through the Environment and Heritage Technical Committee which includes representatives from the New South Wales and Commonwealth Governments and stakeholder groups.

NSW NPWS wish to thank members of the Environment and Heritage Technical Committee and other stakeholder representatives who participated with the workshops associated with this projects. Thanks must go to the expert panel members comprising Professor Tony Norton, Ms Jane Coram, Paul O'Connor and Ken Boer (SFNSW). The project was managed by Paul O'Connor. NPWS staff who worked on the project and invested long hours and many late nights included Leander Wiseman (GIS), Ed Knowles (GIS), Tim Perry and Carmel Flint . Thanks are also due to NPWS RACAC unit staff Jo White, Greg Dodd, Lynda Wild and Kathy Cowie and to Lynne Dalton from NPWS northern zone.

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PROJECT SUMMARY

This working paper describes a project undertaken as part of the comprehensive regional assessments of forests in New South Wales. The comprehensive regional assessments (CRAs) provide the scientific basis on which the State and Commonwealth Governments will sign regional forest agreements (RFAs) for major forest areas of New South Wales. These agreements will determine the future of these forests, providing a balance between conservation and ecologically sustainable use of forest resources.

Project objectives

This project aimed to define, identify and map old-growth forest and the range of successional stages for the UNE & LNE CRA regions. It was composed of several different phases and involved the overlay of growth stage and disturbance information generated from Aerial Photographic Interpretation with other relevant data layers to identify ‘old-growth forest’. This project fulfilled the mapping requirements for old-growth contained in Attachment 1 of the scoping agreement required for the application of the JANIS reservation criteria.

The project addressed the following project areas from the Environment and Heritage Technical Framework: 3.3 - 3.5 inclusive.

Methods

An expert panel was formed to review available information and advise on definition issues and ruleset development. The project utilised a GIS based ruleset to integrate CRAFTI API, Management History information together with data on Forest Ecosystems to define ecological maturity and negligible disturbance as required by the JANIS definition and derive old-growth forest and other successional stages. For the LNE due to the non availability of CRAFTI data an interim layer based on a modification of the BOGMP old-growth layer was derived.

Key results and products

- The project derived the first quantitative site productivity index coverage for the northern region
- Mapped interpretability classes based on expert API classification of the UNE forest ecosystems
- Mapped structural maturity for the UNE based on integration of Interpretability and growth stage mapping from CRAFTI API
- Mapped disturbance levels for the UNE & LNE regions
- The project applied the JANIS definition and mapped candidate old-growth forest & other successional stages over 1.95 million hectares of forest across all tenures / planning units within the UNE.
- Revised old-growth mapping in the LNE over 1.6 million hectares of forest on public lands

- Provided area statements for (where relevant) Interpretability, Structural Maturity classes, Disturbance Level and Derived Successional Stage for both UNE & LNE.

- For the UNE candidate old-growth forest was mapped over 685,500 ha (or 35%) of the forested area, disturbed old forest over 427,500 ha (or 22%), mature forest over 91,500 ha (5%), disturbed mature forest over 314,000 (16%), young forest over 206,000 ha (or 11%), recently disturbed forest over 61,500 ha or 3 % and rainforest over 160,100 ha or(8%).
- For the LNE candidate old-growth forest was mapped over 857,000 ha or 53% of the forested area, disturbed old forest over 60,000 ha (4%), mature forest over 116,000ha (7%), disturbed mature forest over 61,000 ha (4%), young forest over 161300 ha (10%), recently disturbed forest over 21350 ha (8 %) and rainforest over 233,300 ha (15%).

1. INTRODUCTION

1.1 BACKGROUND

This project has revised the identification of old-growth forest undertaken by the Broad Old-growth Mapping Project (BOGMP) during the Interim Assessment Process (IAP) for the UNE & LNE regions. This report does not attempt to review the definition or characteristics of old-growth forest, except in so far as these issues were raised and discussed during the stakeholder workshops or expert panel meetings conducted during this process.
Interested readers are referred to the following documents for further detail concerning the underlying conceptual and definitional aspects of old-growth forest:

- East Gippsland Old-growth Study (Woodgate *et al* 1994)
- Broad Old-growth Mapping Project (NPWS 1996)
- SE Queensland old-growth project (DNR Qld 1996)
- Joint Old-growth Forest Project (Clode and Burgman 1997)
- Characterisation and delineation of the eucalypt old-growth forest estate in Australia : a review (Burgman 1996)
- Old-growth Forest Related Projects - Eden Region (NPWS 1998)

Specific details concerning previous old-growth studies and attributes in North-east NSW are contained in NEFA (1991), NPWS (1993), (NPWS (1996) and Clode and Burgman (1997).

1.1.1 Process for identifying old-growth forest for this study

This project aimed to define, identify and map old-growth forest and the range of successional stages for the UNE & LNE CRA regions. It was composed of several different phases and involved the overlay of growth stage and disturbance information generated from Aerial Photographic Interpretation with other relevant data layers to identify ‘old-growth forest’. This project was essential in order to fulfill the mapping requirements for old-growth contained in Attachment 1 of the scoping agreement required for the application of the JANIS reservation criteria.

A project proposal was prepared for the Environment and Heritage Technical Committee (E&H TC) and then approved by the CRA/RFA Steering Committee. This proposal reflected the content and structure of Project areas 3.3, 3.4 & 3.5 of the E&H Technical Framework. It did not address Project areas 3.6, 3.7 & 3.8 regarding the conservation requirements of old-growth forest which formed part of another project. Details regarding this separate assessment are addressed in the report entitled JANIS Conservation Requirements for the UNE / LNE CRA region (NSW / Commonwealth Government 1999a). Specific details regarding growth stage mapping (Project Area 3.1 relating to old-growth forest in the E & H Technical Framework) or other components of the UNE / LNE CRAFTI project are presented in a separate project report (NSW / Commonwealth Government 1999b).

A key component of the project proposal was the formation of an independent expert panel. This panel was derived from a ballot of nominations from the E&H TC and was given the task of providing advice on conceptual and operational aspects of the methodology for defining old-growth forest. The expert panel met on five times during the project, three times in association with stakeholder workshops. They were also primarily responsible for the derivation of rule sets associated with old-growth classes.

Another key component of the project was stakeholder involvement and liaison. Workshops were held at the commencement and finalisation of the project. Stakeholders were invited to present their viewpoint(s) on aspects of the project methodology and other technical issues at these fora. Material concerning the discussions / deliberations of the expert panel and other progress was provided to stakeholders for their information and review through circulation to the E&H TC.

The above framework attempted to address the definitional aspects of old-growth contained in the National Forest Policy Statement and guided by the JANIS (1997) report . The JANIS report interprets old-growth forest as :

'ecologically mature forest where the effects of disturbances are now negligible'.

The following principles are to guide the application of the definition to forest ecosystems in a region.

- Ecological maturity is defined by the characteristics of the older growth stages.
- If data are available on the structural, floristic and functional qualities that would be expected to characterise an ecologically mature forest ecosystem, these data should be used in the assessment of the significance of disturbance effects.
- Negligible disturbance effects will be evident in most forests by a significant proportion of trees with age-related features and a species composition characteristic of the ecologically mature forest ecosystem.

2. METHODOLOGY

2.1 INTRODUCTION

The pathway initially proposed for assigning old-growth forest status to forest stands was based around three main processes (shown diagrammatically below). It should be noted that this was adapted to available time, resources and what could reach achieve stakeholder agreement prior to the deadlines for UNE / LNE data delivery in August 1998.

The first assigns a surrogate measure of ecological maturity, “forest structural maturity”, to forest stands based on the interpretation of crown forms from aerial photographs.

The second step assigns a disturbance likelihood to mapped disturbances based on a number of characteristics. The impact of each disturbance type on forest ecosystems is then assigned based on the expected recovery time.

The third step assigns old-growth status to forest stands based on their structural maturity, and their likely current disturbance level.

This process is superficially more complicated than that followed in the Eden Old-growth Forest Assessment. However, the same steps are followed, but in this case a discrimination is made between the likelihood of a mapped disturbance having occurred, and the expected impact of that disturbance (both part of the disturbance assessment). This was done implicitly in the Eden analysis, but is made explicit in this analysis.

Each of the decisions in these processes is based on a number of a priori assumptions which require field validation. A preliminary field validation procedure was undertaken as part of this process.

crown form + interpretability		mapped disturbance		
|		|		
forest structural maturity	+	disturbance likelihood	+	disturbance level
		|		
	old-growth forest status			

2.2 DERIVATION OF A SITE PRODUCTIVITY INDEX LAYER

A Site Productivity Index (SPI) layer was generated to help address the variability between forest ecosystems in the expression of age-related features and the effect of disturbances caused by factors such as physical setting, fire proneness and species composition (JANIS

1997). Burgman (1996) also identifies the influence of site quality on the expression of old-growth characteristics.

The use of the site productivity index or site quality layer to highlight variations in growth form characteristics both within and between forest communities was pursued during this project. The Site Productivity Index was to be used as a quantitative and objective means for identification of the potential productivity of the forest. In general terms site productivity or site quality are terms used to describe the complex interaction between climatic factors (air temperature, humidity, radiant energy, rainfall and wind), edaphic factors (soil physical and chemical properties, soil moisture and micro-organisms) and topographic factors (slope, aspect and elevation) which influence forest growth and morphology. The interaction of these factors also influences the frequency and intensity of events such as fire, windthrow and snow which may modify and restrict forest growth (NPWS 1996).

2.2.1 Explanation of Site Height Model

Site height data collected by SF NSW were modelled against environmental predictors using S-Plus.
A total of six environmental predictors were employed after preliminary screenings. Where necessary heavily skewed variables were transformed to achieve a less skewed distribution.

Predictor	*Transformation*
Temperature (mean annual)	-
Radiation	$(x/1000)^2$
Moisture Index	$(x)^3$
Mean soil depth	-
Geology (11 classes)*	class 1 excluded & classes 7,8 merged with class 11**
Wetness Index***	$\log_{10}(x)$

* 1 = Quaternary Sand, 2 = Quaternary alluvium, 3= Basic igneous, 4 = Acid volcanic, 5 = Granite,

6 = Leucogranite, 7 = Serpentinite, 8 = Limestone, 9 = Quartz sandstone, 10 = Sed. rocks (high quartz),

11 = Sed. rocks (low quartz).

** geology classes were merged or excluded where inadequate sampling had taken place within that class. Classes 7 and 8 were merged with class 11 as their fertility ranks were considered similar.

*** wetness index variable may also need to be transformed (depending on the version you have!) according to the formula: wetness index2 = $\ln(e^{(\text{wetness index1}/10)}/100)*10$

2.3 DEFINITION OF ECOLOGICAL MATURITY

2.3.1 Basic Approach

Descriptive information on the developmental stage of the forest overstorey is used as a surrogate for forest ecological maturity in this study. Since the reliability of this method remains to be evaluated from field testing, it is appropriate to adopt a precautionary approach when using such information to map candidate old-growth forests.

If there was comprehensive data on the old-growth state of other forest attributes, such as other forest structural attributes, flora or fauna species known to be old-growth forest dependent, biomass production, nutrient cycling and water flow/erosion rates these could also be used to identify ecological maturity. However, our current knowledge of forest ecology and the available datasets for this analysis are considered inadequate for using these other attributes to define ecological maturity at the landscape level.

Identifying and reliably mapping old-growth forest in the region is reliant on access to reliable spatial information on forest ecological maturity and forest ecosystem functionality. Given access to these types of information is currently very limited for all forest regions of Australia, particularly large geographic areas, indirect means need to be employed to approximate this desired outcome. In this study, descriptive information on the developmental stage of forest overstorey is used as a surrogate for helping to describe spatial variation in the ecological maturity of forests. Hence, aerial photographic interpretation of forest crown structure and overstorey florisitic composition is used primarily to map the "maturity" of forest stands. Since the reliability of this method remains to be adequately evaluated using field testing, it is appropriate to be prudent when using such information to map old-growth forest since it may be incorrect.

Assessing the functionality of forest ecosystems is even more difficult given the limited spatial data currently available for most forests. In this study, our assessment of forest functionality as it relates to old-growth forest, while at least as important as our assessment of forest structural-maturity, is naively simplistic and grossly inadequate. This means that we may easily under-estimate the functional significance of different forest stands and overstate the significance that different known disturbance events may have on the persistence of these functions. A further major limitation of our approach in reliably assessing forest functionality is the highly reductionist approach that is adopted in mapping forest structural-maturity. By definition, this approach largely precludes a more holistic analysis of landscape dynamics and the functional interplay between different juxtaposed and nearby forest units that are mapped in this way. Again, it is easy to under-estimate the role that different forests will play in sustaining old-growth forest functions.

Overall, current methodological limitations can easily lead us to under-estimate the true significance of different forest stands in sustaining the various functional attributes of old-growth forests that are intended to be mapped, reserved and conserved during the CRA exercise. Consistent with the definitions and guidelines articulated by JANIS, we have adopted a precautionary approach to try to minimise the likelihood of not identifying and/or conserving old-growth forest ecosystems in the region. In the case of the forest structural-maturity mapping, the decision-rules are intended to list forest stands as ecologically mature forest where there is no reliable evidence to suggest otherwise. In the case of the assessment of significance of disturbance (see later section), the decision rules are oriented toward applying the JANIS guidelines of assessing the current effects of disturbance on stand structure and function as distinct from excluding stands as being considered negligibly disturbed on the basis of the occurrence of a disturbance record per se. While this approach would seem a minimum to justify that a precautionary approach has been followed, it should be noted that the arising candidate old-growth forest map will require additional field evaluation if the intention is to minimise the likelihood that old-growth forests and, especially, old-growth forests of high conservation value are to be reliably identified and conserved regionally.

The following process was adopted for defining ecological maturity within the region.

2.3.2 Assessment of the interpretability of each forest ecosystem

The reliability of aerial photographic interpretation of growth stage details varies according to species, site conditions, quality of photography and interpreter experience and skill. This step enables evaluation of the reliability of the aerial photograph interpretation, based on the interpreters' confidence. Aerial Photographic Interpreters assigned individual Myrtaceous species to 'interpretability' classes based on:

- the development of Jacobsian characteristics; and
- the ease of detecting growth stage due to site characteristics.

'Interpretability' refers to the perceived degree of difficulty experienced by interpreters in assessing crown forms in stands in each forest ecosystem. The growth stageability of species across a range of environmental site quality classes was assessed. Low, moderate and high site quality were recognised by the interpreters and broadly defined in terms of how the forest is viewed from the photos and field observation of vegetation photo patterns.

Generally the low site quality forests are those which are woodland and dry open forest types. They tend to occur on the more exposed sites on the northern and western aspects with resultant high radiation levels. The shrub layer in these forests tends to be dry and sparse or they may simply have a grassy understorey only. Low site quality also includes those forest types inhabiting areas of poor drainage (possibly low nitrogen levels), such as swamps and boggy areas. High site quality forests are those which make up the tall, moist forest communities. They tend to inhabit the more protected sites on southern and eastern aspects with much lower radiation levels. The shrub layer in these communities tends to be moist. The moderate site quality forests include all those forests in between. These tend to include the majority of the forest types. They can range from relatively dry forests to the moist forest types.

Three interpretability classes were recognised; Easy, Difficult, and Special Case. Aerial Photographic Interpreters were asked to review a listing of Baur forest types and new forest ecosystems and asked to describe the 'typical' site quality / interpretability for each type and any variants. Using available floristic information associated with each forest type or ecosystem and the ease of growth staging each likely canopy species, each forest type / ecosystem was assigned to an interpretability class. As forest types / ecosystems may have had a number of 'interpretabilities' each forest ecosystem was given an overall interpretability based on expert review of the most 'typical' state for the UNE. Species assigned to the easy interpretability class exhibited a Jacobsian[1] growth habit of trees. There generally was a resultant high confidence (across all site qualities) of interpreters in discriminating between the regrowth, mature and senescent growth stages for these species. Species assigned to the difficult interpretability class exhibited a Non - Jacobsian [2] growth habit of trees and there was generally a resultant low confidence (across all site qualities) of interpreters in discriminating between the mature and senescent growth stages. The influence of site conditions on interpretability is pronounced for this interpretability class (see Appendix 2.1).

2.3.3 Allocation of interpreted crown forms to forest structural maturity stages

This step enables interpreted stand crown form classes to be converted to stand maturity stages, based on the interpretability class identified above and the crown form class mapped by the interpreters. For a stand to qualify as being old-growth forest under JANIS in terms of its age it must be ecologically mature forest. According to the JANIS old-growth definition ecological maturity is defined by the characteristics of the older growth stages. The stand maturity stages (from most mature to least mature) are: i) senescing (stand dynamics considered to be dominated by senescing trees), ii) older (stand dynamics considered to be dominated by mature trees but significantly influenced by the senescing component), iii) mature (stand dynamics considered to be dominated by mature trees with minimal influence from the senescing component) and iv) young (considered to be dominated by the regrowth component of the stand).

This step takes a precautionary approach and allocates crown form classes to the oldest likely forest maturity stage where there is some doubt or insufficient information to confidently make this allocation to a single stage. Details are provided in Table A.This step does not take into account disturbance characteristics interpreted from aerial photographs (the significance of these characteristics is interpreted in the next section, Defining Disturbance Levels).

It was noted during the Eden CRA Old-growth deliberations and during the initial stakeholder workshop for the UNE / LNE that attributes such as reproductive maturity of the understorey and indicator species could potentially be used in the definition of ecological maturity. At this workshop it was also noted that no work had been done within the UNE / LNE CRA region to aid the identification of ecological maturity and timeframes precluded the collection of such data for this project.

[1] Jacobsian — Tree species for which the classic stages of development and senescence (sensu Jacobs 1955) of the tree & crown are detectable from API.
[2] Non — Jacobsian — Tree species or forest types for which the classic stages of development and senescence (sensu Jacobs 1955) of the tree & crown are not detectable from API.

TABLE A: CRAFTI CROWN FORM AND GROWTH STAGE, INTERPRETABILITY & FOREST STRUCTURAL MATURITY CLASS CONVERSIONS

CRAFTI Crown Form Code & Growth Stage proportion				Structural Maturity Class		Comments
General (Available over all tenures)	**Regrowth**	**Senescing**	**Mature**	**Easy Interpretability Class**	**Difficult Interpretability Class**	
tA	0-10	30-100	0-70	Senescing	Senescing	Senescing Dominant
tB	0-10	10-30	60-90	Older	Senescing	Mature Dominant - Senescing exerts significant affect on stand
tC	0-10	0-10	80-100	Mature	Senescing	Mature Dominant
sA	10-30	30-100	0-60	Senescing	Senescing	Senescing Dominant
sB	10-30	10-30	40-80	Older	Senescing	Mature Dominant -Senescing exerts significant affect on stand
sC	10-30	0-10	60-90	Mature	Senescing	Mature Dominant
e	30-100	0-70	0-70	Young	Young	Regrowth

2.3.4 Field validation of assignment of forest structural maturity

This step is necessary to validate the decision steps detailed above. Although a statistically valid sample of the complete range of interpretability and crown form classes should be made, the time limitations of this process meant that stands were prioritised for field checking according to the level of confidence in each decision step, and the significance of the forest structural maturity class for conservation decisions later in the CRA. For this reason, emphasis should was placed on field checking the difficult aerial photograph interpretation classes, and on the senescing (as well as older, mature) forest structural maturity classes. Budget and weather conditions constrained the extent of field validation able to be undertaken during this project, however, a reasonable amount of validation was undertaken.

2.4 IDENTIFICATION OF NEGLIGIBLY DISTURBED FOREST

The JANIS (1997) report interprets old-growth forest as ecologically mature forest where the effects of disturbances are now negligible. The following principles relate to the assessment of the current significance of past disturbances.

- If data are available on the structural, floristic and functional qualities that would be expected to characterise an ecologically mature forest ecosystem, these data should be used in the assessment of the significance of disturbance effects
- Negligible disturbance effects will be evident in most forests by a significant proportion of trees with age-related features and a species composition characteristic of the ecologically mature forest ecosystem.

The initial stakeholder workshop discussed the potential sources of disturbance data which would need to be evaluated for use in the project. The major sources of disturbance information were the API growth stage and disturbance indicator tagging from the CRAFTI structural layer (RACD 1997) together with information on the logging, fire and grazing history GIS coverages provided by the MANHIC project (SFNSW 1997).

2.4.1 Defining Disturbance Level

The allocation of disturbance level requires several processes. The first involves validation of mapped disturbances, to determine the likelihood of these disturbances having occurred. The second involves assessment of the current disturbance level of each disturbance type, based on the expected severity and duration of impacts resulting from the disturbances, and the time since the disturbance.

Step 1: Disturbance validation

Some validation has been undertaken as part of the disturbance mapping project. However, the Expert Panel considers that some additional datasets available to the Old-Growth Project can also be used to assess the likelihood of mapped disturbances having occurred. The following tables provide detail of the disturbance validation steps. Disturbance likelihood is assessed according to whether it is unlikely, possible or probable that the mapped disturbance would have taken place.

a) Logging

The expert panel has noted the extensive logging disturbance data collated for the CRA , considered the type of information available from the 3 main covers from this database (UNE Log, TSI & Logunmap) and from the CRAFTI API project and attempted to evaluate the likelihood of logging using a combination of variables, namely nature and reliability of the MANHIC cover & source data, API growth stage , Relative Stand Density (RSD) and disturbance indicator information and forest ecosystem/ type commerciality.

It should be noted that expert panel agreement on a uniform set of rules assigning the likelihood of logging using the above variables could not be reached during this project. Preliminary work identified that the numbers of variable combinations including all categories of a variable with all categories of other variables was much larger than originally envisaged and hence ensuring the rules were free from logical inconsistency was a demanding and time consuming process. Furthermore, purely from a GIS perspective the size of the dataset for the UNE was very large and cumbersome due to the necessity of using both grids and vectors and intersecting all sources (CRAFTI, Manhic, Forest Ecosystem).

b) Grazing

The expert panel noted that the grazing history information was broad and did not contain the textual information originally anticipated. This information together with the API disturbance indicator '**p**' would be the most relevant information to determine likelihood of impact occurring

c) Wildfire

Information on the estimated spatial extent of the MANHIC wildfire coverage and it's reliability together with the API crown form class and disturbance indicators "**s,d,z, g + a"** were considered the most relevant information to determine the likelihood of wildfire.

d) Fuel reduction Burning

Similar types of information to the above for wild fire was identified as being relevant for the fuel reduction burning component with the exception that a reduced number of disturbance indicators , viz '**s, d & z'**

e) Other disturbance

API RSD and Disturbance indicator information was considered to indicate other disturbances. Where aerial photograph interpreters have noted disturbance classes, **"x,d, & L"** this is presumed to be a reliable indicator of probable disturbance. Care must be used in relation to the application of the emboldened disturbance indicators (**b -** bare soil (erosion, landslips,mining)**, o -** evidence of past clearing, rural residential subdivisions**, j -** tracks or other visible non logging disturbance**)** as these referred to the occurrence of point source disturbances which did not apply to the majority of the polygon.

2.4.2 Assessing disturbance level (current effects of disturbance)

Initial draft rules were developed for determing the current level of significance of disturbance events which have impacted upon forest stands. A preliminary indicative table was developed which identified two criteria that should be utilised to determine the significance of any event. The first of these is the severity of the initial impact, and the second is the nature of the impact. These criteria can be applied to available mapped information to provide a means of deriving a mapped layer of current disturbance impact. Information on the date and type of each disturbance event from historical mapped data (MANHIC) and from API can be used to determine the severity of the initial impact. For assessment of the severity of initial logging disturbances, the date and type of disturbance are used as a surrogate for intensity information which is not consistently available across the coverage and this avoids bias produced by differential data collection. This also avoids assumptions pertaining to the derivation of intensity indices based on volumes removed, which is problematic because information on the original stand structure is unavailable and volumes removed can only be interpreted meaningfully as a measure of intensity if such information is available.

The second criteria for the determination of the significance of disturbance is the nature of the impact and this can be derived from API and other information that indicates which components of the stand have been affected and to what extent.

It is essential that the second component, the nature of the impact, is considered along with the first for several reasons. Firstly, if the severity of the initial impact is utilised without any reference to the nature of the impact, then the derivation of disturbance significance is based purely on an anthropocentric classification of events, one which assumes that an event which is perceived to be the same will necessarily have exactly the same impact on every stand to which it is applied. However, in reality, there are a multitude of broad climatic and site specific microhabitat variables, along with diverse stand histories and unique compositional attributes which mean that the impact of 'anthropocentrically similar' disturbance events vary widely across the forest estate.

Secondly, information on the nature of the impact is essential when considering the JANIS definition of disturbance significance as it refers to the current affects on the stand. Utilising the initial severity of disturbance to derive disturbance significance without reference to the current affect of that disturbance results in an approach which does not implement the JANIS criteria. The JANIS definition is quite specific in relation to the importance of the current affect of any disturbance in determining its significance.

In the table below, the focus of the nature of impact is on the component of the stand which is sensitive to the disturbance type under consideration. For example, for logging disturbance evidence is sought of the affect on overstorey structure as provided by API growth stage and for grazing disturbance evidence is sought of the affect on understorey structure as provided by API understorey information and disturbance indicators.

The table below provides a means of deriving a complete coverage of the significance of disturbance across the landscape which can then be intersected with structural maturity and probability of disturbance layers to derive a candidate old-growth layer.

TABLE B: INITIAL DISTURBANCE LEVEL ASSESSMENT USING API & MANHIC DATA FOR THE UNE CRA REGION.

API Disturbance Indicator	MANHIC Disturbance	Type of MANHIC disturbance	Product / intensity from MANHIC disturbance	Date of MANHIC record	Severity of initial impact	Growth stage	Disturbance indicator	RSD	Nature of impact as indicated by API or other data	Disturbance level
Yes	Yes	HARV, HARVF, HARVU	INT, ALL	All	Severe	All	All except n	3 or 4	Severe alteration of forest structure	Significant
Yes	Yes	HARV, HARVF, HARVU	Q, SAL	pre-1960	Low	Growth stage tA, tB, tC, sA	All except n	3 or 4	Minimal alteration of forest structure	Negligible
Yes	Yes	HARV, HARVF, HARVU	Q, SAL	pre-1960	Low	Growth stage sB, sC	All except n	3 or 4	Moderate alteration of forest structure	Intermediate
Yes	Yes	HARV, HARVF, HARVU	Q, SAL	All	All	e, d, f, g	All	3 or 4	Severe alteration of forest structure	Significant
Yes	Yes	HARV, HARVF, HARVU	Q, SAL	1960-1970	Moderate	Growth stage tA, tB, tC, sA	All except n	3 or 4	Minimal alteration of forest structure	negligible
Yes	Yes	HARV, HARVF, HARVU	Q, SAL	1960-1970	Moderate	Growth stage sB, sC	All except n	3 or 4	Moderate to severe alteration of forest structure	significant
Yes	Yes	HARV, HARVF, HARVU	Q, SAL	post 1970	Severe	Growth stage tA, tB, tC, sA	All except n	3	minimal alteration of forest structure	significant
Yes	Yes	HARV, HARVF, HARVU	Q, SAL	post 1970	Severe	Growth stage tA, tB, tC, sA	All except n	4	minimal alteration of forest structure	negligible
Yes	Yes	HARV, HARVF, HARVU	Q, SAL	post 1970	Severe	Growth stage sB, sC	All except n	3 or 4	Moderate to severe alteration of forest structure	significant
Yes	Yes	HARV, HARVF, HARVU	NIL, BWD	All	Low	All	All except n	3 or 4	No alteration to forest structure	negligible

API Disturbance Indicator	MANHIC Disturbance	Type of MANHIC disturbance	Product/intensity from MANHIC disturbance	Date of MANHIC disturbance	Severity of initial impact	Growth stage	Disturbance indicator	RSD	Nature of impact as indicated by API or other data	Disturbance level
Yes	Yes	HARV, HARVF, HARVU	PSM, UPM, V, U	All	Low	All	All except n	3 or 4	Minimal alteration to forest structure	negligible*
Yes	Yes	CLEAR, PLT	All	All	Severe	All	All except n	3 or 4	Severe alteration of forest structure and composition	significant
Yes	Yes	TSI, TREAT	Not applicable	pre-war	Low	Growth stage tA, tB, sA	All except n	3 or 4	minimal alteration of forest structure	negligible
Yes	Yes	TSI, TREAT	Not applicable	pre-war	Low	Growth stage tC, sB, sC	All except n	3 or 4	moderate alteration of forest structure	intermediate
Yes	Yes	TSI, TREAT	Not applicable	pre-war	Low	Growth stage e, d, f, g	All except n	3 or 4	moderate alteration of forest structure	significant
Yes	Yes	TSI, TREAT	Not applicable	post war	Moderate	Growth stage tA, tB, sA	All except n	3 or 4	alteration of forest structure	negligible
Yes	Yes	TSI, TREAT	Not applicable	post war	Moderate - severe	Not tA, tB, or sA	All except n	3 or 4	alteration of forest structure	significant
Yes	Yes	GRAZING POTENTIAL	High	API disturbance indicator 'p'	Moderate	All	disturbance indicators p and one of (L, a, w or understorey L)	3 or 4	weed invasion of understorey	intermediate
Yes	Yes	GRAZING POTENTIAL	High	API disturbance indicator 'p'	Low	All	disturbance indicator p and absence of disturbance indicators (L, a, w or understorey L)	3 or 4	no evident weed invasion of understorey	negligible

API Disturbance Indicator	MANHIC Disturbance	Type of MANHIC disturbance	Product/intensity from MANHIC disturbance	Date of MANHIC disturbance	Severity of initial impact	Growth stage	Disturbance indicator	RSD	Nature of impact as indicated by API or other data	Disturbance level
Yes	Yes	GRAZING POTENTIAL	Low, moderate	All	All	All	All except n	3 or 4	All	negligible
Yes	Yes	Wildfire cover	All	All	Variable	All	All except d	3 or 4	minimal alteration of forest structure	negligible
Yes	Yes	Wildfire cover	All	All	Variable	All	d	3 or 4	moderate to severe alteration of forest structure	significant
Yes	Yes	Fuel reduction burn	All	All	Low to moderate	All	All except d	3 or 4	minimal alteration of understorey forest structure	negligible
Yes	Yes	Fuel reduction burn	All	All	Severe	All	d	3 or 4	severe alteration of understorey forest structure	significant
Yes	No	Not applicable				tA, tB, tC, sA	not (either x, c, g+z, s, g+a, g+w, L)	3 or 4	low	negligible
Yes	No	Not applicable				tA, tB, tC, sA	with g+z, s	3 or 4	moderate alteration to forest structure	intermediate
Yes	No	Not applicable				tA, tB, tC, sA	with (either x, c, g+a, g+w, L)	3 or 4	severe alteration of forest structure	significant

API Disturbance Indicator	MANHIC Disturbance	Type of MANHIC disturbance	Product/intensity from MANHIC disturbance	Date of MANHIC disturbance	Severity of initial impact	Growth stage	Disturbance indicator	RSD	Nature of impact as indicated by API or other data	Disturbance level
Yes	No	Not applicable				sB, sC	not (either x, c, g+z, s, g+a, g+w, L)	3 or 4	moderate	intermediate/significant
Yes	No	Not applicable				sB, sc	with (either x, c, g+z, g+a, g+w, L)	3 or 4	severe	significant
Yes	No	Not applicable				e, d, f, g	all	3 or 4	severe	significant
Yes	Yes & No	All				all except e, d, f, g	n	3 or 4	low	negligible
Yes	Yes & No	All				e, d, f, g	n	all	severe	significant
Yes	Yes & No	All				all (except e,d,f,g)	all	1 or 2	severe	significant
No	No	N/A				tA,tB,tC sB, sC	Unassessed	3,4 or 0	unknown	negligible
No	No	N/A				tA,tB,tC sB,sC	Unassessed	1 or 2	unknown	significant
No	Yes					tA,tB,tC, sB, sC	Unassessed	3,4, 0	unknown	negligible
No	No					e,d,f,g	Unassessed	All		significant
Yes	Yes & No					all except e,d,f,g	all except N	0	unknown	negligible
No	No					all except e, d, f, g	all except n	0		negligible
No	Yes					all except e, d, f, g	all except ‘n’	0		negligible
No	Yes					all except e, d, f, g	all except ‘n’	0		significant
* Layers of significance will be derived separately for each MANHIC disturbance type and product as utilised in this table. Significance for one MANHIC layer overides non significance for another MANHIC layer but not for 'n' no evidence of disturbance.										

2.5 IDENTIFICATION AND DELINEATION OF CANDIDATE OLD-GROWTH FOREST

2.5.1 Derivation of old-growth status

The intended decision rules for allocating old-growth status developed by the expert panel are outlined below in Table 2.5.1.

The previous sections defined (i) forest structural maturity, (ii) likelihood of mapped disturbances having occurred, and (iii) the likely impact of disturbances. The allocation of old-growth status takes into account the outputs from each of these definitions as detailed below. A conservative approach is taken to assigning likely disturbance significance where forest stands satisfy the structural maturity requirements of the old-growth forest definition.

TABLE C: ALLOCATION OF OLD-GROWTH STATUS FOR UNE & LNE

	LIKELY DISTURBANCE LEVEL			
STRUCTURAL MATURITY STAGE	**probable significant disturbance**	**possible significant disturbance**	**unlikely significant disturbance**	**negligible disturbance (of any likelihood) or no mapped disturbance**
senescing	disturbed older forest	candidate old-growth forest (possibly disturbed)	candidate old-growth forest	candidate old-growth forest
older	disturbed older forest	older forest – candidate older forest (possibly disturbed)	older forest - candidate old-growth forest	older forest- candidate old-growth forest
mature	disturbed mature forest	possibly disturbed mature forest	mature forest	mature forest
regrowth	disturbed regrowth forest	possibly disturbed regrowth forest	regrowth forest	regrowth forest

2.5.2 Decision Rules applied for UNE

Following review of the draft rulesets outlined in table J by EHTC stakeholders. The above approach was modified and simplified by integrating the disturbance probability and disturbance level assessments. This was to facilitate the delivery of layers by required dates and also to minimise perceived repetition between the disturbance likelihood & disturbance level assessment. The following ruleset (see Table J) was applied to the forest structural maturity and disturbance level classifications to derive a candidate old-growth and other successional stages layer. Further details regarding the actual rulesets applied for forest structural maturity and disturbance level can be found in section 2.3. and Section 2.4.

TABLE K. DERIVATION OF OLD-GROWTH STATUS FOR UNE CRA REGION

	Old-growth Status (Derived Successional Stage)	
Forest Structural Maturity Class	**Significant Disturbance level**	**Negligible Disturbance level**
Senescing Forest	Disturbed Old Forest	Candidate Old-Growth Forest
Mature Forest	Disturbed Mature Forest	Mature Forest
Young Forest	Young Forest	Young Forest
Recently Disturbed Forest	Post - photo logged areas	not applicable

2.5.3 Decision Rules for LNE

Due to the lack of CRAFTI API data and completed MANHIC disturbance history data by the required time frames, the above ruleset was not applied for the LNE. For the LNE the BOGMP Old-growth layer was modified by the relevant adjustment of the Forest Structural Maturity layer, by updating the post photo logging layer from the available logging history from MANHIC and merging rainforest from the Forest Ecosystems layer.

Candidate old-growth forest was modelled over NPWS estate south of the Hunter River by applying a random assignment of 85 % of grid cells in Service estate. This figure was derived by taking the proprion of NPWS estate within the LNE north of the Hunter which was candidate old-growth forest.

2.5.4 Field Validation

As previously mentioned, this analysis procedure relies on a number of untested assumptions. Given the current timelines to complete the old-growth assessment, it is critical to be very focussed about what assumptions are tested, and when. The following field validation and analysis process was suggested as the best way to optimise available time and resources.

The field validation work described in this report was carried out to ground truth the old-growth layer of the UNE CRA database. The field validation was designed essentially to test the API growth stage coding of eucalypt forest, and by logical extension the validity of the old-growth classing of that forest.

Site selection:

Areas were selected on the basis of land tenure (national park or state forest), accessibility (within 200m of a vehicular track), and other site attributes including growth stage code, interpretibility, and disturbance indicator. Each area selected was targeted with between two and nine transect sites, resulting in a total of 128 sites to be visited and surveyed. An effort was made to ensure that sites would be relatively easy to locate (at road intersections for example), but apart from that, siting was random within the desired co-incident attributes; growth stage, interpretability & disturbance indicator group). Sites were numbered firstly on area and secondly on transect. For example, Site 83 refers to the third transect in area 8. Site locations were stored as a point theme in ArcView.

An A3 map (1: 25000 scale) of each area was prepared showing tenure boundaries, road access, growth stage code and other site attributes (AMG, elevation, map sheet id, interpretibility, disturbance assessment).

Field sampling:

Each site was located using a combination of GPS technology and topographic maps. Once a site had been confidently located it was sampled in the following manner:

To minimise the disturbance effects next to the road, the start point for a 100 metre transect was located between 50 and 150 metres from the road. The transect was located and oriented with sighting compass to avoid sudden changes in topography such as gulleys and cliffs, and generally followed the contour. Three 20 metre radius plots were sampled from the transect; one each at the start, centre and finish of the transect. If a plot was found to be in an anomalous area (the middle of a snig track, for example) it was moved so as to include a more representative part of the surrounding forest. A number of attributes, including crown cover, relative crown cover of regrowth, mature and senescent growth stages, height and DBH of three largest trees, and a variety of habitat and disturbance attributes were recorded from each 20 metre radius plot. All measurements apart from DBH were by visual estimation, reinforced by the occasional clinometer tree height measurement, and two point to plant transects to increase confidence in crown cover estimates. A photograph was taken at each plot, looking along the transect. Data from each site were recorded using a standard survey pro-forma.

3. RESULTS

3.1 BACKGROUND

This section presents the main results of the project. These results take the form mainly of final applied rulesets for GIS overlays of the primary spatial datasets discussed in Section 2 together with maps and area statements associated with the various stages in deriving candidate old-growth forest.

The tenure categories used are those from the UNE & LNE RFA Negotiation planning unit layers. It should be noted that the NSW Government's northern forests RFA decision has resultant in changes of tenure with approximately 380,000 ha of new reserves. As the final boundaries of the new reserves are not available at the time of writing area presented in this report relate to the pre RFA decision planning units. Where deemed relevant, information on the new reserves is also included, however the areas will only be indicative and relate just to proposed NPWS dedicated reserves and to not include those areas of Crown Land flagged for further investigation (these areas are also being finalised at the time of writing). The data presented here is derived mainly from gridcell based tabulation and when figures are presented comparing vector data with gridcell data discrepances can occur due to transformation issues. The figures presented should be treated as indicative.

3.2 SITE PRODUCTIVITY INDEX

The model was derived as a Generalised Additive Model (GAM). This model contains smooth non-parametric functions relating site height to the predictors. The model can also be approximated by the following parametric polynomial regression:

siteht(metres) = -796.894 + 18.078*moisture index + 688.800*wetness index - 156.288*wetness index^2 + 6.735*temp - 0.209*temp^2 + 0.109 (if geology = 2) + 1.99 (if geology = 3) - 0.807 (if geology = 4) + 1.322 (if geology = 5) - 3.362 (if geology = 6) - 1.602 (if geology = 9) + 1.211 (if geology = 10) + 1.388 (if geology = 11) + 13.220*soil depth - 0.011*radiation.

The model explains approximately 23% of the variation in site height across the region. Incorporation of refined soil layers and yield associations when available is likely to improve the fit.

There was insufficient time to evaluate the SPI layer prior to the old-growth rulesets being finalised. Consequently, it was not factored into decision rules. The SPI layer produced for the UNE / LNE regions is presented in Figure A. It should be noted that integration of the refined soil attribute information will assist in the improving the existing layer. This should also extend the coverage beyond the NEFBS region.

3.3 DEFINITION OF ECOLOGICAL MATURITY

3.3.1 Interpretability Classes

The results of this assessment are presented in Table E and Appendix A. Further detail regarding the description and derivation of forest ecosystems (including the upper canopy species frequency) can be found in NPWS (1998) together with the Forest Ecosystem report (see NSW / Commonwealth Government 1999c). A list of the forest ecosystem name and numerical identifiers is contained in Appendix 3.1. The distribution of interpretability classes is presented for the UNE region in Figure B.

The interpretability grid cover was derived using the Forest Ecosystem layer for UNE and the classification outlined in Table E. To improve the efficiency of GIS processing and to remain consistent with the general scale of aerial interpretation work, the interpretability grid was converted to a vector coverage and areas less than 5 ha were eliminated on the basis of the value of the largest adjacent neighbour. The areal extent of these interpretability classes for the UNE is as follows; Easy 695,216 ha representing 30 % of the vegetated area, Difficult 1,253,688 ha, representing 55% of the total vegetated area and Special Case 351,697 ha representing 15 % of the total vegetated area. The area of the different interpretability classes per planning unit for the UNE region is presented in Table F.

Results for the LNE are not presented as an interpretability layer was not derived for the LNE.

TABLE E. CLASSIFICATION OF FOREST ECOSYSTEMS TO INTERPRETABILITY CLASSES

Interpretability Class	UNE / LNE Forest Ecosystem
Easy	2, 7, 8, 11, 19, 20, 25, 26, 28, 29, 31, 32, 34, 36, 40, 44, 42, 45, 46, 48, 49, 52, 57, 59, 60, 62, 65, 67, 68, 69, 70, 72, 74, 78, 80, 81, 82, 83, 84, 85, 87, 88, 89, 90, 91, 92, 93, 94, 95, 100, 101, 102, 104, 105, 107, 110, 111, 117, 118, 123, 124, 127, 134, 135, 137, 138, 146, 148, 150, 152, 153, 154, 155, 156, 158, 162
Difficult	3, 6, 12, 13, 14, 15, 17, 21, 23, 27, 30, 33, 35, 37, 38, 39, 41, 43, 47, 50, 51, 54, 55, 56, 53, 61, 63, 73, 75, 79, 86, 97, 98, 99, 103, 106, 108, 109, 113, 114, 115, 116, 119, 122, 126, 128, 129, 130, 131133, 132, 139, 140, 145, 147, 157, 163
Special Case	5, 10, 16, 18, 22, 64, 66, 76, 77,96, 112, 120, 121,125, 141, 142, 143, 151, ,169 ,

Insert Figure A. Site Productivity Index for the NEFBS area of the LNE & UNE CRA regions.

Insert Figure B Distribution of Interpretability classes for the UNE region.

TABLE F. AREAS OF INTERPRETABILITY CLASSES FOR UNE PLANNING UNITS

Tenure Code	Tenure Description	Easy	Difficult	Special Case	Total	% of Tenure type in Easy	% of Tenure Type in Difficult	% of Tenure type in Special Case
OTH	Other Land	262223	697722	133196	1093141	24.0	63.8	12.2
CNR	Crown Reserve	10405	37105	7375	54885	19.0	67.6	13.4
CNL	Crown Lease	40228	110633	8357	159218	25.3	69.5	5.2
NP	National Park	115399	149314	108655	373368	30.9	40.0	29.1
ALC	Aboriginal Land Claim	702	3767	676	5145	13.6	73.2	13.1
VCA	Voluntary Conservation Agreement	48	172	115	335	14.3	51.3	34.3
SFN	State Forest Native Forest	255243	240391	70546	566180	45.1	42.5	12.5
PM13	State Forest PMP1.3	2688	3613	4125	10426	25.8	34.7	39.6
SFS	State Forest Softwood Plantation	508	643	11326	12477	4.1	5.2	90.8
SFH	State Forest Non Accredited Hardwood Plantations	1624	117	4871	6612	24.6	1.8	73.7
SFP	State Forest Plantation	3483	3587	784	7854	44.3	45.7	10.0
NPP	National Park Purchased not gazetted	1465	5072	673	7210	20.3	70.3	9.3
TR	Timber reserve	1092	491	248	1831	59.6	26.8	13.5

TABLE G. AREAS OF CRAFTI GROWTH STAGES BY INTERPRETABILITY CLASS FOR THE UNE REGION.

Pgs_	**Easy**	**% of total for growth stage**	**Difficult**	**% of total for growth stage**	**Special Case**	**% of total for growth stage**	**Total**
e	83399	39.87	116751	55.81	9046	4.32	209196
sA	18842	53.18	14511	40.96	2075	5.86	35428
sB	118211	41.60	155715	54.80	10221	3.60	284147
sC	81134	32.97	157324	63.92	7660	3.11	246118
tA	140797	38.25	203244	55.22	24011	6.52	368052
tB	167530	36.32	279014	60.49	14676	3.18	461220
tC	47717	33.16	92472	64.25	3730	2.59	143919
Total	657630	37.62	1019031	58.29	71419	4.09	1748080

TABLE H. AREA S OF FOREST STRUCTURAL MATURITY CLASSES WITHIN THE UNE REGION.

Forest Structural Maturity Class			**Total**
Senescing	**Mature**	**Young**	
1206497	380287	219483	1806267
66.7	21.1	12.2	100

Insert Figure C: The distribution of Forest Structural Maturity classes for the UNE CRA region.

3.3.2 Forest Structural Maturity classes

The distribution of Forest Structural Maturity Classes for the UNE is presented in Figure C. The areas of CRAFTI growth stages on National Park and State Forest is presented in Figure D. Table H identifies the areas of the Forest Structural Maturity classes.

3.4 IDENTIFICATION OF NEGLIGIBLY DISTURBED FOREST

This proved to be the most complex component of the old-growth derivation process and was made difficult due to the very large and complex datasets, GIS storage issues, processing time and a lack of time to fully explore correlations between variables. The ruleset which is presented in Section 3.2.2 received general stakeholder agreement at a workshop to finalise decision rules.

3.4.1 Use of Growth Stage and Disturbance Information.

Readers are referred to the Management History report for a detailed description pf the coverages developed by the MANHIC project. Three coverages were available for the UNE: Log_Une, Log Unmap and the TSI (Silviculture) together with Fire and grazing information. Attribute information collated with the logging history linework was detailed and covered a range of variables including type of logging event, start date, finish date, products removed, volume removed and reliability of record. Consistency across geographic areas ie Forestry Management Areas varied. The Log Une and TSI covers depicted events for which a record of the actual logging event was recorded cf the Log-Unmapped cover which depicted compartments recorded as having been logged not the boundaries of the actual event. The MANHIC covers were compared with API information and were examined in terms of total extent, date of last event, intensity, reliability index. More time than was available would be required to fully analyse API and logging history data due to the numbers of variables and the variety of forest ecosystems. Examples of some of the relationships examined are represented below in Figures D,G and H and present the areas of growth stage and disturbance indicator by tenure and MANHIC derived logging history. Figure D identifies the growth stages for National Parks & State Forests (prior to January 1999). NPWS estate largely undisturbed has large areas of tA, tB & sB growth stages while State Forest is dominated by tB and equal amounts of tA & sB with sC also being quite extensive.

Amalgamations of disturbance indicators of growth stage, RSD and MANHIC data was developed using modification of the disturbance indicator groupings outlined in Section 2.4.1 and Table B. Preliminary rulesets developed by the expert panel were modified by E&H TC stakeholders which were subsequently revised and adopted.

INSERT Figure XX Map of MANHIC Logged Forest over all forest.

INSERT Figure XX Distribution of MANHIC Logging History Records with a Reliability of 1, 2 or 3.

FIGURE D. GROWTH STAGE PROFILE FOR NATIONAL PARK & STATE FOREST WITHIN THE UNE CRA REGION.

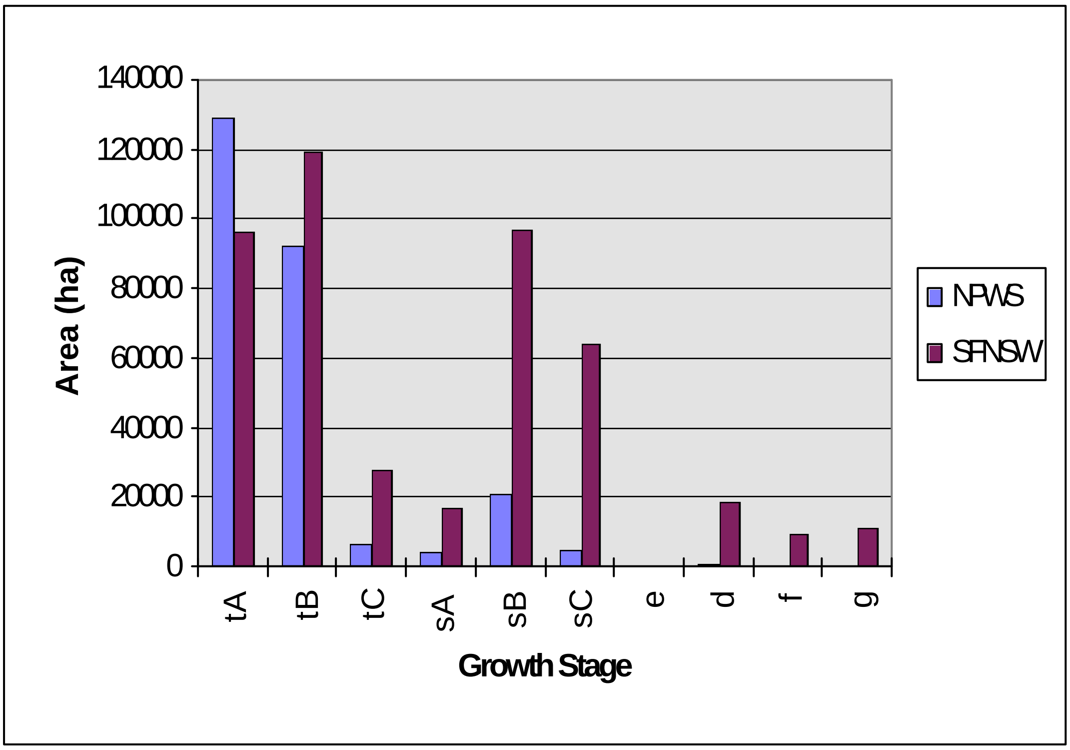


FIGURE G. AREAS OF GROWTH STAGE / RSD COMBINATION IN LOGGED & UNLOGGED SF & NP

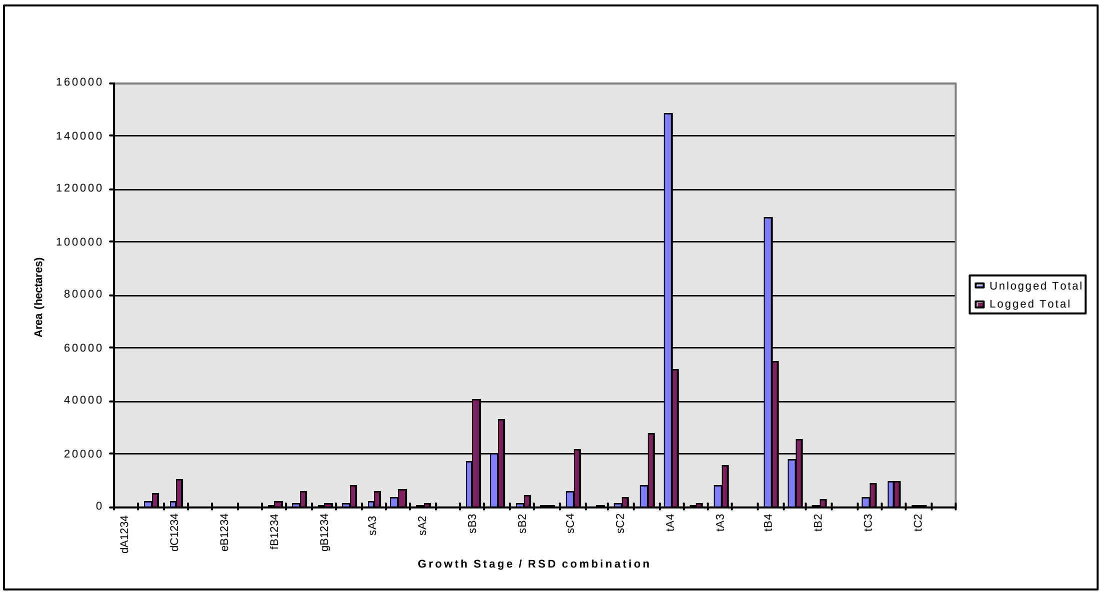
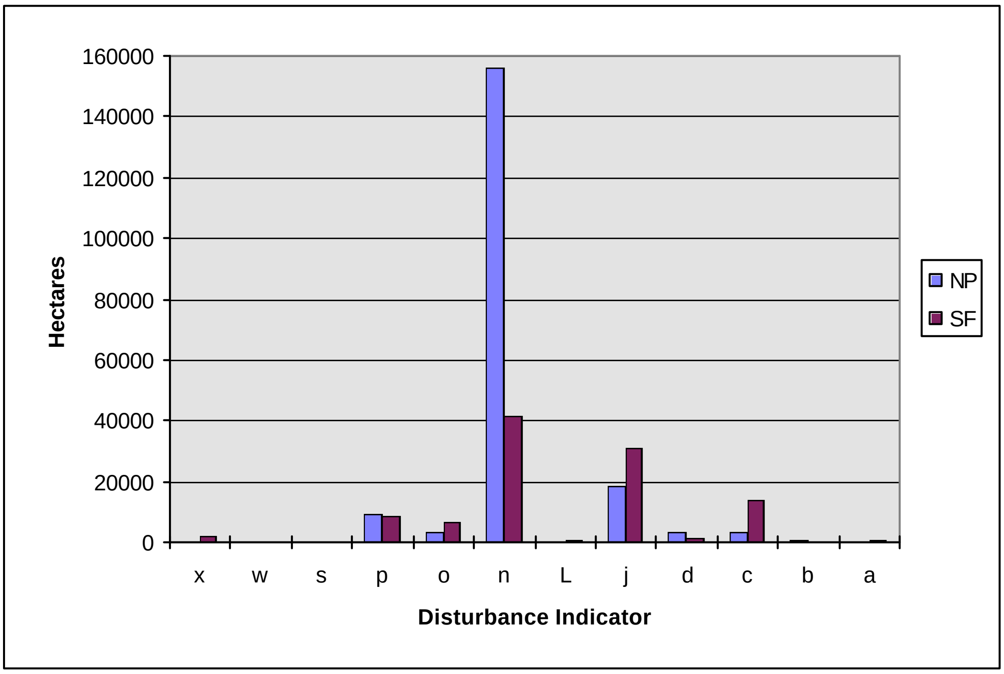


FIGURE H. AREAS OF DISTURBANCE INDICATOR FOR NATIONAL PARK & STATE FOREST



3.4.2 Ruleset for application of Disturbance Level

Table I identifies the ruleset for identifying significantly and negligibly disturbed forest. Figures I & J identifies the distribution of disturbance level for the UNE & LNE CRA regions. Tables J & K indicates areas of different disturbance levels per planning unit for the UNE.

TABLE I. INTEGRATION OF API AND LOGGING HISTORY INFORMATION TO DERIVE DISTURBANCE LEVEL

Growth Stage	Relative Stand Density	Disturbance Indicators	MANHIC	Disturbance Level
tA, tB, tC, sA	3 or 4	n, or not (x, c, g+z, g+a, g+w, W,L, s, d)	All years (with or without)	Negligible
tA, tB, tC, sA	3 or 4	x, c, g+w, L, W, s, d	with / without	Significant
tA, tB, tC, sA	3 or 4	g+z, g+a	with	Significant
tA, tB, tC, sA	3 or 4	g+z, g+a	without (Public)	Negligible
tA, tB, tC, sA	3 or 4	g+z, g+a	Private Land	Significant
sB & sC	3 or 4	n, or not (x, c, g+z, g+a, g+w, W,L, s, d)	Without	Negligible
sB & sC	3 or 4	n, or not (x, c, g+z, g+a, g+w, W,L, s, d)	With	Significant
sB & sC	3 or 4	(x, c, g+z, g+a, g+w, W,L, s, d)	with / without	Significant
e,d, f, g	1,2,3,4	All	All	Significant
All		b,o or J	Non SF & NP	Significant
All		p	All tenures	Significant
All	1 or 2	all	All tenures	Significant

API CODING DETAILS

API Code	Description
Growth Stage	
tA	< 10 % regrowth & > 30 % senescence
tB	< 10 % regrowth & 10 - 30 % senescence
tC	< 10 % regrowth & < 10 % senescence
sA	10 - 30 % regrowth & > 30 % senescence
sB	10 - 30 % regrowth & 10 - 30 % senescence
sC	10 - 30 % regrowth & < 10 % senescence
e, d, f, g	> 30 % regrowth
Relative Stand density	
1	RSD of 0-25 %
2	RSD of 26 - 50%
3	RSD of 51 - 75%
4	RSD of 76 - 100%
Disturbance Indicators	
n	No visible disturbance
x	recent logging
c	old logging
g	canopy gaps
z	uneven crown heights
a	native pioneers
w	weeds
L	Lantana
s	dead standing trees greater than 5 per ha
d	severe dieback, crown fire, defoliation
p	Evidence of grazing activities
o	Evidence of past clearing
b	Landslips (point source <2 ha)
J	tracks

TABLE J. AREAS OF DISTURBANCE LEVEL BY PLANNING UNIT FOR THE UNE REGION

Tencode	Tenure Description	Significant	Area of Significance Disturbance Level as a % of total for Tenure type	Negligible	Area of Negligible Disturbance Level as a % of total for Tenure type	Rainforest	Area of Rainforest Disturbance Level as a % of total for Tenure type	Total
OTH	Other Land	587439	70.21	218444	26.11	30797	3.68	836680
CNR	Crown Reserve (VCL)	21167	50.56	20342	48.59	355	0.85	41864
CNL	Crown Lease	45015	34.00	85199	64.34	2198	1.66	132412
NP	National Park	41411	12.37	226290	67.62	66956	20.01	334657
ALC	Aboriginal Land Claim	1408	31.01	3111	68.51	22	0.48	4541
VCA	Voluntary Conservation Agreement	111	35.13	110	34.81	95	30.06	316
SFN	State Forest Native Forest	283247	50.92	218454	39.27	54524	9.80	556225
PM13	State Forest PMP1.3	1542	15.21	4702	46.38	3894	38.41	10138
SFS	State Forest Softwood Plantation	510	39.57	584	45.31	195	15.13	1289
SFH	State Forest Non Accredited Hardwood Plantations	2654	85.53	159	5.12	290	9.35	3103
SFP	State Forest Purchased	5979	76.41	1505	19.23	341	4.36	7825
NPP	National Park Purchased Not Gazetted	1558	22.90	4949	72.75	296	4.35	6803
TR	Timber Reserve	490	27.30	1162	64.74	143	7.97	1795
	Total	992531	51.22	785011	40.51	160106	8.26	1937648
	Proposed NPWS Dedicated Reserve	45449	36.06	51954	41.23	28618	22.71	126021

TABLE K. AREAS OF DISTURBANCE LEVEL BY PLANNING UNIT FOR THE LNE REGION

Tencode	Tenure Description / Status	Area with a Significant Disturbance level (ha)	Area of Significance Disturbance Level as a % of total for Tenure type	Area with a Negligible Disturbance level (ha)	Area of Negligible Disturbance Level as a % of total for Tenure type	Area of Rainforest (ha)	Area of Rainforest as a % of total for Tenure type	Total Area of Tenure Type (ha)
CNL	Crown Lease	1154	1.8	55718	86.4	7600	11.8	64472
CNR	Crown Reserve (VCL)	1622	9.6	12206	72.6	2995	17.8	16823
SFH	State Forest Hardwood Plantation Not Accredited	4868	82.6	269	4.6	754	12.8	5891
SFN	State Forest Native Forest	379661	52.7	235461	32.7	104838	14.6	719960
PM13	State Forest PMP1.3 (Flora Reserve)	1731	8.5	10417	51.3	8161	40.2	20309
SFS	State Forest Softwood Plantation	744	31.0	1608	67.1	45	1.9	2397
NP	National Park	13984	1.1	1100441	90.0	107713	8.8	1222138
NPP	National Park Purchased Not Gazetted	59	1.4	3997	92.3	276	6.4	4332
VCA	Voluntary Conservation Agreement	8	3.7	203	94.4	4	1.9	215
ALC	Aboriginal Land Claim	32	8.4	272	71.0	79	20.6	383
SFP	State Forest Purchased	65	42.5	79	51.6	9	5.9	153
TR	Timber Reserve	36	3.0	319	26.3	860	70.8	1215
	Total	403964	19.6	1420990	69.0	233334	11.3	2058288
PR	Proposed Reserves	85411	36.3	99847	42.4	50062	21.3	235320

Insert Figure I. Distribution of Disturbance Level for the UNE

Insert Figure J. Distribution of Disturbance Level for the LNE

3.5 IDENTIFICATION AND DELINEATION OF OLD-GROWTH FOREST

3.5.1 Delineation of Successional Stages

The rule set discussed in Section 2.5 was applied to define a similar range of successional stages as used in the Eden CRA assessment viz candidate old-growth forest, disturbed old forest, mature forest, disturbed mature forest, young forest and recently disturbed forest. These stages together with rainforest areas complete the old-growth layers for the UNE & LNE. A schematic outlining the GIS data sets and unions adopted in deriving the old-growth layers for the UNE & LNE is presented in Appendix 6.2. Insert information on relevant AMLs if appropriate.

Figures K & L outline the distribution of candidate old-growth forest and other successional stages for the UNE & LNE respectively. Summary area statistics for successional stages is provided . The area of successional stages by API growth stages for both regions is presented in Tables M & N. The areas of CRAFTI API disturbance indicators by successional stage categories for the UNE is presented in Table O. Tables P & Q provides the breakdown of areas of successional stages by planning unit categories.

Tables U & R contains the areas of each successional stage for eucalypt or related forest ecosystems for the UNE and LNE vegetation communities while Figure K outlines the areas of candidate old-growth forest for each UNE Forest Ecosystem graphically.

The patch sizes for Candidate Old-growth were extracted using Arcview's "regiongroup" command. The Candidate Old-growth layer is in grid/raster format. "Regiongroup" connects cells that are orthogonally connected or, both orthogonally and diagonally connected. It then gives each connected group a value. In this case the 'diagonal & orthogonal' option was used. See below:-

N.B. Cell size = 100 x 100 m (1 hectare)

Before "regiongroup" After "regiongroup"

(all one value - black) (different values - greys)

This allows Arcview to then select patches based on area. This was done for Candidate Old-growth to divide it into patches < 5 hectares (< 5 cells), .>= 5 and < 10 hectares(>= 5cells & <10 cells) and .>= 10 and < 25 hectares(>= 10 cells & <25 cells), .>= 25 and < 100 hectares(>= 25cells & <100 cells), .>= 100 and < 200 hectares(>= 100 cells & <200 cells), .>= 200 and < 1000 hectares(>= 200 cells & <1000 cells), .>= 1000 and < 10000 hectares(>= 1000 cells & <10000 cells), .>= 10000 and < 15000 hectares(>= 10000 cells & <15000 cells) >= 150000 hectares (>= 150000 cells). Patches on the map may appear as all sorts of shapes and sizes due to the nature of the cells connections, BUT all patches will fall within the specified area range.

Table T identifies the frequency and area within various patch size classes for the UNE. Figure O illustrates this graphically.

Insert Figure K. Distribution of Candidate Old-growth Forest and other successional stages for the UNE CRA region

Insert Figure L. Distribution of Candidate Old-growth Forest and other successional stages for the LNE CRA region

TABLE M. AREA OF SUCCESSIONAL STAGES BY API GROWTH STAGES FOR THE UNE CRA REGION

Growth Stage	Growth Stage Description	Candidate Old-growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently disturbed Forest	Rainforest
dA	30 - 50% regrowth & > 30% senescing	0	0	0	1	1305	425	101
dB	30 - 50% regrowth & 10 - 30% senescing	3	9	0	1	11519	1285	293
dC	30 - 50% regrowth & <10% senescing	9	3	1	3	22001	3507	478
e	>30 % regrowth	43	30	5	15	133473	140	832
fB	51-70% regrowth & 10-30% senescing	4	1	0	1	5167	549	146
fC	51-70% regrowth & <10% senescing	5	3	1	5	16260	2632	424
gB	>70% regrowth & 10-30% senescing	0	0	0	0	1408	16	15
gC	>70% regrowth & <10% senescing	13	2	0	4	14372	2283	603
sA	10 -30% regrowth & > 30% senescing	16328	16808	7	30	23	1682	1038
sB	10 -30% regrowth & 10 - 30% senescing	38545	125872	20097	91038	197	13115	3949
sC	10 -30% regrowth & <10% senescing	98	98	52886	191353	65	13661	2008
tA	<10% regrowth & >30% senescing	305475	51437	6	46	27	5175	7466
tB	<10% regrowth & 10-30% senescing	288285	164452	24	84	47	11370	5634
tC	<10% regrowth & <10% senescing	31043	68317	18458	30881	9	3577	712

TABLE N. AREA OF SUCCESSIONAL STAGES BY API GROWTH STAGES FOR THE LNE CRA REGION

Code	Growth Stage description	Candidate Old-growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently Disturbed Forest	Rainforest
ta	<10% regrowth & >30% senescing	209162	3160	213	59	15	5382	43929
tb	<10% regrowth & 10-30% senescing	176917	18371	885	40	64	16120	31661
tc	<10% regrowth & <10% senescing	16856	4497	12763	1092	105	5839	3625
sa	10 -30% regrowth & > 30% senescing	1550	1643	37	3	3	959	2433
sb	10 -30% regrowth & 10 - 30% senescing	39464	17165	49354	29036	223	16133	14656
sc	10 -30% regrowth & <10% senescing	2251	1793	49444	30535	85	18119	5647
e	>30% regrowth	52	33	92	34	102134	19326	11153
o	non forest	16	3	10	0	14	1710	2210
l	recently logged forest	14	2	6	12	43079	14480	2896
r	rainforest	22	5	23	53	3	2	113649
untyped	areas not growth staged	0	0	0	0	0	368	196
total		446304	46672	112827	60864	145725	98438	232055

TABLE O. AREA OF CRAFTI API DISTURBANCE INDICATORS BY SUCCESSIONAL STAGES FOR THE UNE CRA REGION.

Disturbance Indicator	Description	Candidate Old-growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently disturbed Forest	Rainforest
a	native pioneers	666	4535	161	2665	318	863	473
b	Landslips (point source <2 ha)	491	902	24	1010	9	70	13
c	old logging	2424	77710	321	41103	12023	10061	1463
d	severe dieback, crown fire, defoliation	4142	15137	126	4218	300	532	161
j	tracks	57725	136546	7001	84338	11104	11846	2593
L	Lantana	203	5590	52	4780	718	378	295
n	No visible disturbance	384204	4637	7007	2885	1593	5378	6764
o	Evidence of past clearing	10742	49362	1369	36028	2458	2144	379
p	Evidence of grazing activities	2391	99960	417	64281	6456	1250	270
s	dead standing trees greater than 5 per ha	95	3261	5	1111	249	129	88
w	weeds	13	516	6	385	19	0	4
x	recent logging	532	12023	65	6250	964	666	182
g	canopy gaps	172591	277537	64081	256010	43094	36818	11186
z	uneven crown heights	45771	106078	9305	105514	16522	9811	4537

TABLE P. AREA OF SUCCESSIONAL STAGES BY PLANNING UNITS FOR THE UNE CRA REGION

Tenure Description	Candidate Old-growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently disturbed Forest	Rainforest	Total
Other Land	159422	262467	59600	188511	135918	439	30797	837154
Crown Reserve (VCL)	18859	13101	1540	6255	1867	8	355	41985
Crown Lease	80114	25023	5214	12050	7975	4	2198	132578
National Park	225186	24906	6274	9554	6651	312	66956	339839
Aboriginal Land Claim	2902	744	201	424	238	3	22	4534
Voluntary Conservation Agreement	105	84	6	25	6	0	95	321
State Forest Native Forest	187290	97035	17317	93515	48623	59941	54524	558245
State Forest PMP1.3	4305	918	404	446	183	28	3894	10178
State Forest Softwood Plantation	429	377	149	54	86	0	195	1290
State Forest Non Accredited Hardwood Plantations	72	95	72	348	1786	741	290	3404
State Forest Purchased	980	1266	524	2352	2345	8	341	7816
National Park Purchased Not Gazetted	4834	1149	115	162	247	0	296	6803
Timber Reserve	1044	256	119	123	115	0	143	1800
Total	685542	427421	91535	313819	206040	61484	160106	1945947
Proposed NPWS Dedicated Reserve	47908	18045	3479	17408	8253	2541	28539	126173

INSERT TABLE Q. AREA OF SUCCESSIONAL STAGES BY PLANNING UNITS FOR THE LNE CRA REGION

Tencode	Tenure Description / Status	Candidate Old-growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently Disturbed Forest	Rainforest
CNL	Crown Lease	53079	243	2639	122	536	253	7600
CNR	Crown Reserve (VCL)	11557	552	649	161	832	77	2995
SFH	State Forest Hardwood Plantation Not Accredited	80	36	189	97	2049	2686	754
SFN	State Forest Native Forest	145241	55995	90220	57677	150111	115878	104838
PM13	State Forest PMP1.3 (Flora Reserve)	8277	327	2140	317	782	305	8161
SFS	State Forest Softwood Plantation	778	94	830	152	371	127	45
NP	National Park	633726	2678	18875	2839	6448	2019	107713
NPP	National Park Purchased Not Gazetted	3818	0	179	0	59	0	276
VCA	Voluntary Conservation Agreement	203	0	0	0	8	0	4
ALC	Aboriginal Land Claim	233	1	39	2	29	0	79
SFP	State Forest Purchased	31	18	48	0	44	3	9
TR	Timber Reserve	216	3	103	3	30	0	860
Total		857239	59947	115911	61370	161299	121348	233334
	Proposed New Reserves	75794	15149	24053	15731	31041	23490	50062

TABLE U. AREAS OF SUCCESSIONAL STAGES FOR UNE FOREST ECOSYSTEMS

Ecosystem Number	Ecosystem	Candidate Old-growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently disturbed Forest	Total
2	Alpine Gum	251	398	77	436	29	42	**1233**
3	Baileys Stringybark	21733	7721	966	2227	1559	134	**34340**
10	Black Sallee	4	0	0	0	0	0	**4**
12	Blue Mountain Ash	106	10	1	0	0	2	**119**
14	Brown Barrell	30	88	6	16	1	0	**141**
15	Brown Barrell-Gum	141	562	26	100	8	0	**837**
17	Candlebark	498	745	86	307	151	0	**1787**
18	Casuarina Woodland	0	2	0	0	0	0	**2**
19	Central Mid Elevation Sydney Blue Gum	1131	622	432	2191	1791	203	**6370**
20	Clarence Lowland Needlebark Stringybark	5847	1606	513	1246	433	644	**10289**
21	Lowlands Grey Box	2642	10120	943	5011	3547	422	**22685**
23	Coast Range Bloodwood-Mahogany	1951	1988	249	739	453	264	**5644**
24	Clarence Lowlands Spotted Gum	32921	50187	10829	33458	31802	8618	**167815**
25	Coast Range Spotted Gum-Blackbutt	107	57	156	230	151	34	**735**
26	Coastal Flooded Gum	2108	1524	704	2623	1538	61	**8558**
27	Coastal Sands Blackbutt	2240	134	34	21	54	0	**2483**
29	Corkwood-Crabapple and Mixed Stringybarks	2891	1261	86	972	430	307	**5947**
30	Diehard Stringybark-New England Blackbutt	151	701	3	77	27	0	**959**
31	Dorrigo White Gum	2802	178	29	104	168	10	**3291**
32	Dry Foothills Blackbutt-Turpentine	1043	446	351	2191	2119	948	**7098**
33	Dry Foothills Spotted Gum	39933	31577	2134	7397	7017	1867	**89925**
34	Dry Grassy Blackbutt-Tallowwood	1148	629	351	2164	1209	299	**5800**
35	Dry Grassy Stringybark	40951	16881	1408	4592	4643	159	**68634**
36	Dry Grassy Tallowwood-Grey Gum	572	345	625	1881	1834	14	**5271**
37	Dry Heathy Blackbutt-Bloodwood	14649	13463	2106	5896	5502	3687	**45303**
38	Dry Heathy New England Blackbutt	2762	1013	23	211	67	124	**4200**
39	Dry Heathy New England Stringybarks	1099	56	0	0	1	0	**1156**
40	Dry Heathy Sandstone Blackbutt	7877	2128	2142	3998	1765	959	**18869**
41	Dry Open New England Blackbutt	52268	42294	2587	10787	6561	1704	**116201**
42	Dry Redgum-Bloodwood-Apple	221	11	0	9	1	0	**242**
43	Dry Silvertop Stringybark-Apple	9893	1749	99	247	847	0	**12835**
44	Dry open Redgum-Broad Leaved Apple	8373	761	116	499	279	0	**10028**
45	Dunns White Gum	108	210	42	392	119	11	**882**

Ecosystem Number	Ecosystem	Candidate Old-growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently disturbed Forest	Total
46	Eastern Red Gums	1436	208	475	569	154	20	**2862**
47	Escarpment Redgum	6571	11220	1140	3992	3425	392	**26740**
48	Escarpment Scribbly Gum-Apple	3205	665	329	681	262	311	**5453**
50	Wet Bangalow-Brushbox	3452	2311	517	1591	1122	71	**9064**
52	Foothill Grey Gum-Ironbark-Spotted Gum	12588	6940	6088	11773	6003	2350	**45742**
53	Gorge Grey Box	8325	1622	114	234	724	3	**11022**
54	Grey Box-Red Gum-Grey Ironbark	4836	8010	533	2689	3413	46	**19527**
55	Foothills Grey Gum-Spotted Gum	1495	2941	169	1722	1551	541	**8419**
56	Granite Mallee	1417	341	2	17	58	0	**1835**
57	Highland Granite Stringybarks	1795	511	22	69	4	0	**2401**
58	Gorge Grey Gum	4198	962	25	117	172	1	**5475**
59	Gorge Ironbark-Grey Gum	27179	9764	5174	11368	5652	3085	**62222**
60	Grassy New England Blackbutt-Tallowwood-Blue Gum	19176	6931	1129	8457	2871	1020	**39584**
61	Grey Box-Ironbark	42	49	11	8	3	16	**129**
62	Grey Box-Northern Grey Gum	13	33	3	165	251	0	**465**
63	Grey Gum-Stringybark	9212	2074	147	396	731	123	**12683**
65	Heathy Scribbly Gum	3179	1056	671	1520	570	499	**7495**
66	Herbfield and Fjaeldmark	0	2	0	0	0	0	**2**
67	High Elevation Ferny Blackbutt	1990	616	586	3392	2425	1318	**10327**
68	High Elevation Messmate-Brown Barrell	108	17	11	44	4	0	**184**
69	High Elevation Moist Open Tallowwood-Blue Gum	1513	239	91	950	550	70	**3413**
70	High Elevation Open Spotted Gum	15622	9821	2623	14226	4847	1825	**48964**
71	Ironbark	472	1686	453	2363	1959	414	**7347**
72	Low Relief Coastal Blackbutt	37	8	95	382	220	70	**812**
73	Lowland Red Gum	8679	15465	2882	11126	9700	5440	**53292**
74	Lowlands Scribbly Gum	1396	354	243	692	282	90	**3057**
75	Lowlands Spotted Gum-Box	1288	5217	516	4777	3476	3913	**19187**
76	Coastal Mallee	261	46	19	7	19	0	**352**
78	Mann River Wet New England Blackbutt	4280	237	178	125	240	5	**5065**
79	Manna Gum-Stringybark	63	20	0	1	5	0	**89**
80	Manna Gum	164	887	4	83	15	28	**1181**
81	Messmate	1775	1577	517	1633	248	198	**5948**
83	Mid Elevation Wet Blackbutt	222	43	53	368	435	0	**1121**
84	Mid North Coast Wet Brushbox-Tallowwood-Blue Gum	3152	673	373	3365	1360	1017	**9940**
85	Mixed Moist Hardwood	62	161	10	76	14	4	**327**
86	Mixed New England Stringybarks	1096	1388	49	277	119	35	**2964**
87	Mixed Tableland Stringybark-Gum OpenForest	1005	1572	320	1242	269	31	**4439**
88	Moist Escarpment New England Blackbutt	7451	913	306	765	566	140	**10141**

Ecosystem Number	Ecosystem	Candidate Old-growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently disturbed Forest	Total
89	Moist Foothills Spotted Gum	14111	5554	2749	7169	3185	2535	**35303**
90	Moist Messmate-Gum	10627	5576	493	5385	1448	1256	**24785**
91	Moist Open Escarpment White Mahogany	807	60	130	570	132	85	**1784**
92	Moist Shrubby Stringybark-Gum	1314	842	41	1192	469	179	**4037**
93	Montane Stringybark-Gum	7190	7265	3115	7881	1774	9	**27234**
95	Northern Moist Blackbutt	1585	398	830	3287	2334	0	**8434**
97	Needlebark Stringybark-Large Fruited Blackbutt	5360	2583	165	371	675	730	**9884**
98	New England Peppermint	1459	1298	6	198	475	52	**3488**
99	New England Stringybark-Blakelys Red Gum	6653	2786	68	378	625	0	**10510**
100	Northern Grassy Sydney Blue Gum	3263	1918	516	2118	861	257	**8933**
101	Northern Open Grassy Blackbutt	4816	3195	2407	5541	3890	902	**20751**
102	Northern Ranges Dry Tallowwood	11286	13464	5313	17991	5973	486	**54513**
103	Northern Wet Brushbox	4740	5331	514	2323	2105	639	**15652**
104	Northern Wet Tallowwood-Blue Gum	9766	4416	1513	5615	2019	1632	**24961**
105	Nymboida Tallowwood-Turpentine	1284	132	145	561	265	197	**2584**
106	Open Coastal Brushbox	1860	1331	193	1402	1028	276	**6090**
109	Open Shrubby Brushbox-Tallowwood	7011	5630	665	1769	1230	377	**16682**
110	Open Silvertop Stringybark-Blue Gum	1885	488	116	407	138	30	**3064**
111	Open Silvertop Stringybark-Tallowwood	2144	712	64	906	508	114	**4448**
113	Peppermint	2693	2303	197	676	255	72	**6196**
114	Peppermint-Mountain/Manna Gum	3112	5535	716	1753	661	0	**11777**
115	Red Bloodwood	15	37	0	24	5	128	**209**
116	Red Gum-Stringybark	2616	901	118	358	118	0	**4111**
117	Red Mahogany	649	44	49	62	9	0	**813**
118	Richmond Range Spotted Gum	2011	2427	3291	9006	4425	80	**21240**
119	Richmond Range Spotted Gum-Box	3694	5869	1406	6303	6452	337	**24061**
122	Rough-barked Apples	900	332	40	121	102	80	**1575**
123	Roundleaved Gum	6929	4397	849	3677	1200	77	**17129**
124	Roundleaved Gum-Turpentine	7	0	0	3	20	0	**30**
126	Sandstone Spotted Gum-Blackbutt	1378	1282	246	993	641	108	**4648**
127	Sherwood Needlebark Stringybark	3736	2388	447	1741	571	1	**8884**
128	Silverleaved Ironbark	978	385	129	113	339	0	**1944**
129	Smoothbarked Apple	203	19	3	3	0	0	**228**
131	Snow Gum	131	97	9	16	11	6	**270**
132	Snow Gum -Mountain/Manna Gum	1860	1901	137	492	141	0	**4531**

135	South Coast Tallowwood-Blue Gum	1283	372	303	1432	1451	213	**5054**
138	Steel Box/Craven Grey Box	16	47	47	146	109	15	**380**
139	Stringybark-Apple	12652	12282	835	3712	3795	25	**33301**
140	Stringybark-Mallee	1842	318	1	1	7	0	**2169**
142	Swamp Mahogany	100	55	27	22	54	5	**263**
145	Sydney Peppermint-Stringybark	120	53	25	38	13	0	**249**
146	Tallowwood	5278	1479	288	527	738	2	**8312**
147	Turpentine	338	313	104	964	888	0	**2607**
148	Very Wet New England Blackbutt-Tallowwood	1240	73	24	12	98	0	**1447**
149	Mallee-Peppermint mosaic	714	503	81	118	103	24	**1543**
150	Washpool Brushbox-Tallowwood	5047	175	15	137	117	14	**5505**
152	Wet Bloodwood-Tallowwood	4400	3702	2608	12185	7301	1365	**31561**
153	Wet Coastal Tallowwood-Brushbox	187	220	630	1920	2107	1183	**6247**
154	Wet Flooded Gum-Tallowwood	675	740	688	3160	2813	179	**8255**
155	Wet Foothills Blackbutt-Turpentine	1196	293	711	2752	1840	443	**7235**
157	Wet Shrubby Brushbox-Tallowwood	2339	739	110	645	468	276	**4577**
158	Wet Spotted Gum-Tallowwood	800	77	56	430	169	1003	**2535**
162	Whitetopped Box	4	0	0	0	0	0	**4**
163	Yellow Box-Blakely's Red Gum	728	224	40	40	34	0	**1066**
174	Orange Gum-Tumbledown Gum-Apple	1663	623	74	449	95	0	**2904**
175	Orange Gum-New England Blackbutt-Tumbledown Gum	1645	922	151	341	82	0	**3141**
176	Orange Gum-Ironbark	2306	950	118	172	110	0	**3656**
177	Outcrop Orange Gum-New England Blackbutt	1706	453	27	123	32	0	**2341**
178	Outcrop Black Cypress-Tumbledown Gum	110	33	9	35	7	0	**194**
179	Yellow Box-Broad-leaved Stringybark	873	264	31	87	31	0	**1286**
180	Western New England Blackbutt	7857	195	94	7	83	0	**8236**
181	Stringybark-Gum	24412	427	59	19	30	0	**24947**
182	Apple-Black Cypress	703	19	0	0	0	0	**722**
183	Red Gum-Apple	18	16	4	0	0	0	**38**
184	Tumbledown Gum-Ironbark	8089	93	24	6	12	0	**8224**
185	Orange Gum-Black Cypress	2419	41	9	1	4	0	**2474**
186	Open Tumbledown Gum-Black Cypress-Orange Gum	939	396	35	83	37	0	**1490**
189	Silverleaved Ironbark-Cypress	6741	283	682	75	53	0	**7834**
190	Yellow Box-Grey Box-Red Gum	1662	694	82	156	86	0	**2680**
194	Round-leaved Gum wet heath	3011	56	185	17	10	0	**3279**
195	Apple-Manna Gum woodland	1599	460	113	175	32	0	**2379**
196	Broad-leaved Stringybark-Apple Box	4326	969	128	221	107	0	**5751**
197	Broad-leaved Stringybark	153	63	3	12	5	0	**236**
198	Silvertop Stringybark	42	314	13	77	13	0	**459**
200	Broad-leaved Stringybark-Ribbon Gum	87	175	35	65	18	0	**380**

	Total	**654599**	**406054**	**88151**	**302051**	**194861**	**58981**	**1704697**

TABLE R. AREA OF SUCCESSIONAL STAGE FOR LNE FOREST ECOSYSTEMS

Value	Ecosystem	Candidate Old-growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently Disturbed Forest	Rainforest
2	Alpine Gum	784	644	139	15	327	210	0
3	Baileys Stringybark	62	0	2	0	0	0	0
6	Barrington Dry Shrubby New England Blackbutt-Blue Gum	601	23	633	184	521	4	0
7	Barrington Moist Blue Gum-White Mahogany	1719	993	6115	393	5863	2964	0
8	Barrington Wet New England Blackbutt-Blue Gum	5206	281	4327	1226	1802	766	0
10	Black Sallee	1	0	0	0	0	0	0
11	Blackbutt-Sydney Peppermint-Smoothbarked Apple	360	0	0	0	3	5	0
12	Blue Mountain Ash	1	0	0	0	0	0	0
13	Blue-leaved Stringybark	15	0	10	0	0	0	0
14	Brown Barrell	239	28	71	5	169	59	0
15	Brown Barrell-Gum	1716	481	658	171	1178	833	0
17	Candlebark	1	0	1	0	0	0	0
19	Central Mid Elevation Sydney Blue Gum	5301	497	2426	900	2209	1668	0
20	Clarence Lowland Needlebark Stringybark	11	0	6	0	0	0	0
21	Lowlands Grey Box	829	0	6	0	0	0	0
23	Coast Range Bloodwood-Mahogany	439	3	3	0	94	1	0
25	Coast Range Spotted Gum-Blackbutt	0	0	2	23	0	0	0
26	Coastal Flooded Gum	268	9	688	224	1381	1680	0
27	Coastal Sands Blackbutt	4966	0	467	0	218	0	0
28	Cool Moist Messmate	1454	226	331	178	719	1165	0
29	Corkwood-Crabapple and Mixed Stringybarks	1367	48	187	28	148	73	0
30	Diehard Stringybark-New England Blackbutt	21799	2905	3149	969	4096	3054	0
31	Dorrigo White Gum	147	0	2	0	0	0	0
32	Dry Foothills Blackbutt-Turpentine	3763	323	3305	2143	4443	1866	0
33	Dry Foothills Spotted Gum	1651	148	497	181	580	452	0
34	Dry Grassy Blackbutt-Tallowwood	4036	334	3611	1947	3541	4459	0
35	Dry Grassy Stringybark	37472	1047	3410	791	3173	1865	0
36	Dry Grassy Tallowwood-Grey Gum	32666	10523	12357	5724	15027	7734	0
37	Dry Heathy Blackbutt-Bloodwood	713	11	197	46	190	213	0
38	Dry Heathy New England Blackbutt	324	13	6	2	28	108	0

Value	Ecosystem	Candidate Old-growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently disturbed Forest	Total
39	Dry Heathy New England Stringybarks	0	7	0	0	8	0	0
41	Dry Open New England Blackbutt	9239	439	952	455	1356	1024	0
42	Dry Redgum-Bloodwood-Apple	24064	647	2952	260	874	609	0
43	Dry Silvertop Stringybark-Apple	8981	70	302	51	210	121	0
44	Dry open Redgum-Broad Leaved Apple	2091	0	1	0	3	0	0
46	Eastern Red Gums	1	0	0	0	0	0	0
47	Escarpment Redgum	1894	162	521	57	618	144	0
48	Escarpment Scribbly Gum-Apple	2941	4	60	3	4	43	0
49	Escarpment Tallowwood-Bloodwood	17423	1926	2227	664	3113	2428	0
50	Wet Bangalow-Brushbox	1138	48	151	180	569	55	0
51	Eurabbie	157	108	0	0	0	1	0
53	Gorge Grey Box	4851	10	40	2	7	1	0
54	Grey Box-Red Gum-Grey Ironbark	7553	64	124	3	50	50	0
55	Foothills Grey Gum-Spotted Gum	111	11	137	22	82	26	0
56	Granite Mallee	1232	34	205	38	209	68	0
57	Highland Granite Stringybarks	206	1	57	1	47	0	0
58	Gorge Grey Gum	40	0	0	0	0	0	0
60	Grassy New England Blackbutt-Tallowwood-Blue Gum	16535	675	2113	1027	3333	2390	0
63	Grey Gum-Stringybark	34755	84	155	25	122	64	0
65	Heathy Scribbly Gum	9491	487	373	6	534	409	0
67	High Elevation Ferny Blackbutt	9253	1102	2893	2012	5219	2084	0
68	High Elevation Messmate-Brown Barrell	2113	711	2030	318	1679	3087	0
69	High Elevation Moist Open Tallowwood-Blue Gum	11728	441	1549	897	1871	1386	0
70	High Elevation Open Spotted Gum	1	0	1	0	0	0	0
71	Ironbark	24391	1125	2386	150	7452	4516	0
72	Low Relief Coastal Blackbutt	162	29	654	661	1972	1533	0
73	Lowland Red Gum	140	18	38	2	30	6	0
74	Lowlands Scribbly Gum	5063	34	24	0	70	21	0
76	Coastal Mallee	40	0	4	0	2	0	0
79	Manna Gum-Stringybark	79	11	15	4	10	3	0
80	Manna Gum	814	185	137	41	153	187	0
81	Messmate	2817	519	1050	442	2202	1694	0
Value	**Ecosystem**	**Candidate Old-growth Forest**	**Disturbed Old Forest**	**Mature Forest**	**Disturbed Mature Forest**	**Young Forest**	**Recently disturbed Forest**	**Total**

82	Messmate-Mountain Gum Forest	1949	242	633	239	1235	402	(
83	Mid Elevation Wet Blackbutt	949	473	971	1532	2450	129	(
84	Mid North Coast Wet Brushbox-Tallowwood-Blue Gum	9276	787	2768	2117	5170	2122	(
85	Mixed Moist Hardwood	0	0	6	20	77	32	(
87	Mixed Tableland Stringybark-Gum OpenForest	1657	151	478	158	668	436	(
88	Moist Escarpment New England Blackbutt	12187	1606	1524	991	2223	1456	(
89	Moist Foothills Spotted Gum	235	32	209	112	362	974	(
90	Moist Messmate-Gum	5	0	1	0	1	0	(
91	Moist Open Escarpment White Mahogany	19070	1261	1495	374	1179	1621	(
92	Moist Shrubby Stringybark-Gum	109	18	47	6	25	8	(
93	Montane Stringybark-Gum	457	0	9	0	32	50	(
94	Mountain Gum-Brown Barrell	1826	56	655	103	315	0	(
97	Needlebark Stringybark-Large Fruited Blackbutt	22	17	40	13	207	3	(
98	New England Peppermint	594	0	0	0	8	0	(
99	New England Stringybark-Blakelys Red Gum	10323	10	84	20	5	113	(
105	Nymboida Tallowwood-Turpentine	62	34	66	4	4	26	(
106	Open Coastal Brushbox	10714	2412	8218	6654	4267	3090	(
107	Open Messmate-New England Blackbutt	4109	251	1018	57	425	466	(
108	Open Ribbon Gum	8403	1478	1274	420	3600	2757	(
109	Open Shrubby Brushbox-Tallowwood	462	122	92	166	58	383	(
110	Open Silvertop Stringybark-Blue Gum	13132	977	3955	1314	3014	2369	(
111	Open Silvertop Stringybark-Tallowwood	899	18	121	32	65	64	(
113	Peppermint	4175	89	610	84	397	244	(
114	Peppermint-Mountain/Manna Gum	1389	11	73	4	69	37	(
116	Red Gum-Stringybark	4	0	0	0	0	0	(
122	Rough-barked Apples	377	0	164	1	175	3	(
123	Roundleaved Gum	28	0	1	2	0	0	(
124	Roundleaved Gum-Turpentine	50	0	2	0	0	0	(
129	Smoothbarked Apple	1655	567	580	7	1465	1202	(
Value	**Ecosystem**	**Candidate Old-growth Forest**	**Disturbed Old Forest**	**Mature Forest**	**Disturbed Mature Forest**	**Young Forest**	**Recently disturbed Forest**	**Total**

130	Smoothbarked Apple-Sydney Peppermint-Stringybark	955	1047	79	33	3504	9	0
131	Snow Gum	2856	77	202	20	213	108	0
132	Snow Gum -Mountain/Manna Gum	5395	959	446	37	697	495	0
133	Snow Gum-Black Sallee	7	0	0	0	7	0	0
134	South Coast Shrubby Grey Gum	4203	2786	4887	4313	7267	18514	0
135	South Coast Tallowwood-Blue Gum	6205	728	5154	2870	6975	8206	0
137	Southern Wet Sydney Blue Gum	5215	1281	5101	783	6116	2921	0
138	Steel Box/Craven Grey Box	38	0	79	0	2	0	0
139	Stringybark-Apple	30925	304	908	170	253	268	0
140	Stringybark-Mallee	270	178	33	90	70	0	0
142	Swamp Mahogany	189	9	74	13	186	43	0
145	Sydney Peppermint-Stringybark	8712	504	277	106	1588	126	0
146	Tallowwood	583	0	4	0	1	0	0
147	Turpentine	18	0	22	15	129	36	0
148	Very Wet New England Blackbutt-Tallowwood	1604	135	208	249	399	8	0
149	Mallee-Peppermint mosaic	1258	9	115	7	150	58	0
153	Wet Coastal Tallowwood-Brushbox	269	28	1224	1072	1150	227	0
154	Wet Flooded Gum-Tallowwood	140	32	617	490	1826	600	0
155	Wet Foothills Blackbutt-Turpentine	4140	1529	6417	10656	13667	3604	0
156	Wet New England Blackbutt-Silvertop Stringybark	3682	191	2327	182	2060	226	0
157	Wet Shrubby Brushbox-Tallowwood	9497	1397	3009	2852	3372	1547	0
162	Whitetopped Box	345	32	48	17	14	2	0
163	Yellow Box-Blakely's Red Gum	47	0	1	0	1	0	0
164	Agricultural Plantations-Orchards and Vineyards	1	0	0	1	0	0	0
165	Rainforest	0	0	0	0	0	0	256326
175	Orange Gum-New England Blackbutt-Tumbledown Gum	101	0	3	0	0	0	0
176	Orange Gum-Ironbark	16	0	1	0	0	0	0
177	Outcrop Orange Gum-New England Blackbutt	24	0	4	0	0	0	0
178	Outcrop Black Cypress-Tumbledown Gum	1	0	0	0	0	0	0
Value	**Ecosystem**	**Candidate Old-growth Forest**	**Disturbed Old Forest**	**Mature Forest**	**Disturbed Mature Forest**	**Young Forest**	**Recently disturbed Forest**	**Total**
182	Apple-Black Cypress	77	0	6	0	1	0	0
183	Red Gum-Apple	1316	12	28	0	43	10	0

186	Open Tumbledown Gum-Black Cypress-Orange Gum	110	0	8	0	0	0	0
189	Silverleaved Ironbark-Cypress	2	0	0	0	0	0	0
190	Yellow Box-Grey Box-Red Gum	184	0	3	0	0	1	0
195	Apple-Manna Gum woodland	66	0	7	0	0	0	0
196	Broad-leaved Stringybark-Apple Box	125	1	5	0	3	0	0
197	Broad-leaved Stringybark	19	0	1	0	1	0	0
198	Silvertop Stringybark	14	0	8	0	0	0	0
202	Peppermint-Apple-Turpentine	23789	981	1009	37	1490	951	0
203	Grey Gum-Stringybark-Apple	27326	454	233	23	685	540	0
204	Grey Gum - Scribbly Gum	15596	151	188	12	141	58	0
205	Peppermint-Silvertop Ash-Stringybark	892	0	0	0	0	0	0
206	Apple-Grey Gum-Turpentine	12120	601	910	15	1706	1319	0
207	Hunter Spotted Gum-Ironbark	32	149	40	1	1660	580	0
208	Hunter Roughbarked Apple-Red Gum	732	9	12	0	45	7	0
209	Yellow Bloodwood-Stringybark	28816	806	1371	24	909	1013	0
210	Yellow Bloodwood-Ironbark	14868	206	278	0	56	253	0
211	Apple-Turpentine	15124	304	61	21	101	49	0
212	Yellow Bloodwood-Narrowleaved Apple	37686	324	177	7	146	243	0
213	Stringybark-Scribbly Gum Woodland	7816	39	30	13	138	0	0
214	Brown Bloodwood-Dwyers Redgum	1020	0	0	0	0	0	0
215	Brown Bloodwood-Ironbark	9727	4	23	5	39	14	0
216	Sandstone Ironbark	7683	0	0	0	0	0	0
218	Ironbark-Stringybark	4040	0	0	0	0	0	0
219	Brown Bloodwood	3672	0	0	0	0	0	0
220	Yellow Bloodwood-Stringybark-Narrowleaved Apple	26305	314	31	0	50	38	0
221	Apple-Red Bloodwood-Peppermint-Turpentine	14264	415	1028	51	622	631	0
222	Stringybark-Mallee Woodland	5947	24	35	13	29	0	0
Value	**Ecosystem**	**Candidate Old-growth Forest**	**Disturbed Old Forest**	**Mature Forest**	**Disturbed Mature Forest**	**Young Forest**	**Recently disturbed Forest**	**Total**
223	Dwarf Apple Forest	13651	205	21	0	46	14	0
224	Coastal Apple-Stringybark-Scribbly Gum	0	0	4	1	22	0	0

225	Wyong Apple-Scribbly Gum	27	15	13	1	127	0	(
226	Mahogany-Banksia Heath	5368	0	6	0	39	0	(
227	Turpentine-Myrtle	10134	864	674	31	1317	275	(
228	Turpentine-Oak-Myrtle	7208	152	176	8	108	276	(
229	Roughbarked Apple-Forest Oak	17093	569	364	3	244	998	(
230	Watagan Blackbutt-Blue Gum	616	599	3059	149	2592	1686	(
231	Watagan Blue Gum	525	640	4616	251	3073	1892	(
232	Watagan Spotted Gum-Ironbark-White Mahogany	209	279	1314	40	2597	396	(
233	Roundleaved Gum - Turpentine	2015	108	537	25	305	62	(
234	Grey Gum - Grey Myrtle	17146	1695	973	18	934	2968	(
235	Wet Roundleaved Gum Forest	1936	19	6	0	3	0	(
236	Bangalay-Blue Gum	7074	258	254	19	203	20	(
237	Wollemi Manna Gum	1882	0	3	0	8	0	(
238	Tablelands Grey Gum-Scribbly Gum	194	0	0	0	0	0	(
239	Wollemi Roughbarked Apple	2148	1	114	0	18	9	(
240	Roughbarked Apple-Redgum	91	1	0	0	2	0	(
241	Ironbark-Redgum	182	0	0	0	0	0	(
242	Hunter Grey Box	3904	17	18	0	1	50	(
243	Grey Gum-Mugga Ironbark	1766	0	0	0	0	0	(
244	White Box-Grey Gum	314	37	18	0	9	12	(
245	Grey Box	529	0	0	0	0	0	(
246	Scribbly Gum-Redgum Woodland	1427	0	1	0	3	0	(
247	Coastal Bastard Mahogany Forest	2727	161	130	21	578	54	(
248	Apple-Forest Oak	1904	37	80	11	81	25	(
249	White Box-Ironbark-Red Gum	2005	3	0	0	5	14	(
250	Banksia Heath-Scribbly Gum-Apple	98	56	15	15	92	0	(
#N/A	Total	879570	59837	137979	61692	174924	120572	25632(

3.6 FIELD VALIDATION

Growth stage data from the three plots in each transect were averaged to give a single set of figures for relative crown cover of each growth stage in the transect. Growth stage codes were derived using the cut-offs in the table shown below. The cut-off values have been modified slightly so that the codes are exclusive.Where the percentages from a transect fall on the division between two codes both codes have been included in the results. For example, a transect which returns 10% regrowth, 85% mature, and 5% senescent is coded as tC/sC.

Data on disturbance within a transect (stump count, grazing intensity, and overall disturbance) have been averaged over the three plots to give a single indicator for each transect.

The results of the preliminary field validation work are presented below. Due to the incomplete sample size no statistical analysis has been attempted. The sites selected for validation and sampled in the field are presented in Figure M, while attributes relating to these sites including API and field assessed growth stage are presented in Table S.

For further relevant results regarding the CRAFTI API the reader should refer to the CRAFTI UNE Accuracy Assessment report and for further information on the field validation of the State Forests MANHIC database refer to the MANHIC project report.

Insert Figure M. Map of Selected and Sampled Field Sites for UNE validation.

TABLE S. RESULTS FROM FIELD VALIDATION FOR THE UNE

#	Site	Interp	Crafti Growth Stage	Field Growth Stage	Stumps / plot	Stumps / Ha	Site Quality	Successional Stage	Manhic Logging	Change of SS Status using field growth stage and same old-growth rule set
36	212	Easy	sA	sA	1	8.0	mod	Candidate Old-growth Forest	no	no
54	284	Difficult	sB	sB	5.3	42.2	low	Candidate Old-growth Forest	no	no
45	251	Difficult	tB	sB	3	23.9	mod	Candidate Old-growth Forest	no	no
50	264	Difficult	sB	tC/sC	1	8.0	mod	Recently Disturbed Forest	no	no
51	281	Difficult	sB	tC (P/P=tC)	0	0.0	low	Candidate Old-growth Forest	no	no
55	285	Difficult	sB	tC	0	0.0	low	Candidate Old-growth Forest	no	no
43	243	Easy	tA	tC				Disturbed Old Forest	no	no
37	213	Easy	tA	tA	0	0.0	mod	Candidate Old-growth Forest	no	no
27	192	Difficult	tB	tB	1.6	12.7	high	Disturbed Old Forest	no	no
29	195	Difficult	tB	tB	0	0.0	mod	Disturbed Old Forest	no	no
38	214	Easy	tB	tB	0.6	4.8	mod	Candidate Old-growth Forest	no	no
39	215	Easy	tB	tB	0.3	2.4	mod	Candidate Old-growth Forest	no	no
7	32	Difficult	tB	tA	0	0.0	v. low	Candidate Old-growth Forest	no	no
46	254	Difficult	sB	e	2.6	20.7	low	Candidate Old-growth Forest	no	yes
22	92	Easy	sB	tB/sB	3	23.9	mod	Disturbed Mature Forest	no	yes
35	211	Easy	tA	tC	1.3	10.3	mod	Candidate Old-growth Forest	no	yes
19	82	Easy	sA	tB	1.3	10.3	high	Candidate Old-growth Forest	yes	no
25	99	Easy	sA	sB	0.6	4.8	mod	Candidate Old-growth Forest	yes	no
47	261	Difficult	sB	tC	0	0.0	mod	Recently Disturbed Forest	yes	no
48	262	Difficult	sB	tC/sC	0.6	4.8	mod	Recently Disturbed Forest	yes	no
49	263	Difficult	sB	tB	0	0.0	mod	Recently Disturbed Forest	yes	no
53	283	Difficult	sB	tC	0.6	4.8	low	Candidate Old-growth Forest	yes	no
56	286	Difficult	sB	tC	0	0.0	low	Candidate Old-growth Forest	yes	no
21	91	Difficult	sB	sB	2	15.9	mod	Disturbed Mature Forest	yes	no
16	63	Easy	sC	sC	3.6	28.6	mod	Mature Forest	yes	no
#	**Site**	**Interp**	**Crafti**	**Field**	**Stumps /**	**Stumps /**	**Site**	**Successional Stage**	**Manhic**	**Change**

			Growth Stage	Growth Stage	plot	Ha	Quality		Loggin g	of SS Status using field growth stage and same old-growth rule set
3	21	Difficult	tA	tA	0.6	4.8	mod	Candidate Old-growth Forest	yes	no
31	197	Difficult	tA	tA	1	8.0	high	Disturbed Old Forest	yes	no
42	223	Special Case	tA	tA	2.6	20.7	high	0	yes	no
5	23	Difficult	tA	sA	0.3	2.4	mod	Candidate Old-growth Forest	yes	no
11	41	Difficult	tA	tB	0	0.0	mod	Candidate Old-growth Forest	yes	no
13	43	Difficult	tA	tB	0	0.0	mod	Candidate Old-growth Forest	yes	no
18	81	Easy	tA	tB (P/P=tB)	3.3	26.3	high	Candidate Old-growth Forest	yes	no
23	97	Easy	tA	tB	1.3	10.3	high	Candidate Old-growth Forest	yes	no
41	222	Special Case	tA	sA	0.6	4.8	high	Disturbed Mature Forest	yes	no
2	12	Easy	tA	tA	1	8.0	low/mod	Candidate Old-growth Forest	yes	no
8	33	Difficult	tB	tB	0.6	4.8	mod	Candidate Old-growth Forest	yes	no
12	42	Difficult	tB	tB	0	0.0	mod	Candidate Old-growth Forest	yes	no
24	98	Easy	tB	tB	0.3	2.4	mod	Candidate Old-growth Forest	yes	no
26	153	Difficult	tB	tB	0.6	4.8	mod	Disturbed Old Forest	yes	no
28	193	Difficult	tB	tB	1	8.0	mod	Disturbed Old Forest	yes	no
40	221	Easy	tB	tB	0	0.0	mod	Candidate Old-growth Forest	yes	no
4	22	Difficult	tA	sA	0.6	4.8	mod	Candidate Old-growth Forest	yes	no
6	31	Difficult	tB	tB/tA	0.6	4.8	low	Candidate Old-growth Forest	yes	no
14	61	Easy	tB	tC/tB	0.3	2.4	v. high	Candidate Old-growth Forest	yes	no
33	202	Difficult	tB	tA	0	0.0	mod	Disturbed Old Forest	yes	no
44	244	Difficult	tB	tC	0	0.0	low	Disturbed Old Forest	yes	no
52	282	Difficult	sB	sC	1	8.0	low	Candidate Old-growth Forest	yes	yes
15	62	Easy	sB	sC	2.3	18.3	mod	Disturbed Mature Forest	yes	yes
17	64	Easy	sB	sC	2	15.9	mod/high	Mature Forest	yes	yes
20	83	Easy	sB	tC	1.6	12.7	high	Disturbed Mature Forest	yes	yes
30	196	Difficult	tA	tB/tA	1.6	12.7	mod	Disturbed Old Forest	yes	no
10	35	Difficult	tA	sB	0	0.0	low	Candidate Old-growth Forest	yes	no
#	Site	Interp	Crafti Growth	Field Growth	Stumps / plot	Stumps / Ha	Site Quality	Successional Stage	Manhic Logging	Change of SS Status

			Stage	Stage						using field growth stage and same old-growth rule set
32	201	Difficult	tA	sC/sB	1	8.0	mod	Candidate Old-growth Forest	yes	yes
1	11	Difficult	tA	e	0	0.0	low	Candidate Old-growth Forest	yes	yes
9	34	Difficult	tA	e	0	0.0	low	Candidate Old-growth Forest	yes	yes
34	207	#N/A	tA	tB	0	0.0	mod	#N/A	#N/A	no

4. DISCUSSION

4.1 DISTRIBUTION AND ABUNDANCE OF CANDIDATE OLD-GROWTH FOREST

4.1.1 General trends from this study

All discussion regarding the distribution and abundance of candidate old-growth forest should be made with cognisance of the UNE / LNE Old-growth expert panel report. This report is presented in full in Appendix 6.3 and the recommendations are presented below. It should be noted when considering all the nominated limitations that this project did bring together and involve stakeholders throughout the process and attempted to address the identified constraints in a fair and objective fashion. What also should be stressed is that all decisions were made using the best available data within a very tight schedule.

Not withstanding the above, the following general points can be made in relation to the distribution of candidate old-growth forest and other successional stages within the UNE & LNE regions.

This study identified in the UNE region just over 685,500 ha (35% of mapped area) of candidate old-growth forest, 427,421 ha (1%) of disturbed old forest, 91,535 ha (5%) of mature forest, 313,819 ha of disturbed mature forest (16%), ha of young forest (11%) and 61,484 ha (3%) of recently disturbed forest. In addition 160106 ha (8%) was classified as Rainforest. For the LNE 857,239 ha of candidate old-growth forest was mapped (53.2%), 59,947 ha (4%) of disturbed old forest, 115,911 ha or 7 % of mature forest, 61,370ha of disturbed mature forest (4 %), 161,299 ha of Young forest (10 %), 121,348 ha of recently disturbed forest (8%), 233,334 of Rainforest (15%). It should be noted that the coverage of the LNE growth stage mapping is incomplete and hence the above figures do not give an accurate across tenure picture of successional stages.

It should be noted that in the discussion below the term 'successional stage' is used in a general sense to refer to the main derived growth stages such as candidate old-growth forest, mature forest etc, together with areas of rainforest. Additional discussion in relation to the distribution of successional stages and Interpretability classes , Logging History, API Growth Stage, Forest Ecosystem and Patch size is made below.

Interpretability and Forest Structural Maturity Classes

Over 30.2 % of the forest within the UNE was classified as easy to interpret, almost 55% was classified as Difficult to interpret and 15% was classified as Special Case (see Table F). Around 234,000ha or 34% of candidate-old-growth forest is found within the Easy interpretability class, 417,000 ha or 61 % within the Difficult class and 28,800 ha or 4 % within the Special Case class for the UNE region.
The difficult interpretability class is characterised by containing Myrtaceous species which cannot be growth staged reliably. Table E indicates the predominance of these Forest Ecosystems within the UNE typically characterised by drier types or species such as the spotted gum complex which are very difficult to growth stage using aerial photography.

During discussions there was no expert disagreement as to the classification of Forest Ecosystems into the the respective classes and a conservative approach was adopted where there was any doubt. A summary of assumptions and issues relating to interpretability classes and growth stage mapping is contained in Section 2 of the expert panel's report (see Appendix 6.3).

Of the senescing forest around one third was found in forest ecosystems classified as easy to interpret and two thirds in the Difficult or Special case categories. The extensive distribution of senescing forest is due to the large areas of low site quality forest west of the escarpment in the Guy fawkes gorges country, large areas such as washpool NP park, lsome areas in the lower Clarence e.g Fortis Creek NP. This was also evident in terms of large areas of tA, tB & sA growth stages throughou the UNE region.

Areas classified as negligibly disturbed.

Within the UNE approximately 56 % of the area growth staged (excluding rainforest) was classified as significantly disturbed and 44 % was classified as negligibly disturbed. For the UNE 51 % of the forested landscape was classified as significantly disturbed and 41% negligibly disturbed and 8 % as rainforest (disturbance level not taken into account) . Taking the “Other Land” planning unit as primarily freehold land indicates that 70 % of this forest is significantly disturbed while 26 % is identifed as negligibly disturbed. Planning units with high proportions classified as significantly disturbed include the State Forest units ie Non Accredited Hardwood Plantation Land (86%), Purchased Land (76%), Native State Forest 51% and Crown Reserves (Vacant Crown Land). Of the State Forest native forest area 37 % was classified as negligibly disturbed and 10 % as rainforest.

Of the National Park estate (excluding new reserves) 41,400 ha or 12 % has a significant disturbance classification while 226,300 ha or 68 % has a negligible classification and almost 67,000 ha or 20 % is comprised of rainforest. Fifteen percent of State Forest Flora reserves was classified as significantly disturbed forest, 46 % as negligibly disturbed and 38 % rainforest.

For the LNE 22% of the area growth staged (excluding rainforest areas) was identified as significantly disturbed and 78% as negligibly disturbed. Overall when the area of rainforest is accounted for just under 20 % of forested landscape received a significantly disturbed classification and 69% negligibly disturbed and 11 % as rainforest (disturbance level not taken into account). Within the State Forest native forest estate almost 53% is identified as significantly disturbed, 33% as negligibly disturbed and the balance (15%) as rainforest. Of the reserved estate, 1.1 % of National Parks was classified as significantly disturbed, 90 % as negligibly disturbed and almost 9 % as rainforest. State Forest Flora Reserves are more disturbed, with 9 % classified as significantly disturbed 51 % as negligible and 40 % as rainforest.

The above trends concur with what would be expected given past management history. National Parks are dominated by negilibly disturbed areas. This comes as no surprise given the predominance in the reserve system (excluding the recent January 99 additions) of steep infertile areas less likely to have been disturbed prior to gazettal and given that management intent precludes major structural disturbance. State Forest Flora Reserves reveal higher levels of disturbance than their National Park counterparts which indicating the trend of some Flora Reserves being gazetted following previous timber harvesting. The different trend overall noted in LNE of lower levels of significant disturbance is attributable to the better areal representation of National Parks in LNE versus UNE (44% versus 29% based on the pre January 1999 gazettals) and the fact that the cross all tenure derivation of candidate old-growth has not occurred due to the non availability of CRAFTI data.

The distribution of recently disturbed forest for both regions is indicated in Figures L & M. In the UNE 61, 500 ha was identified as recently disturbed which equates with post photo logging. Within the LNE over 121300 ha was identified as recently disturbed. **Refer to Commonwealth image analysis work (Look at Landsat for the UNE & LNE.)**

Tenure / Planning Unit

The distribution of all successional stages across planning unit categories is presented in Tables P & Q.

For the UNE most of the candidate old-growth forest is found on National Park Estate (33%), State Forest Native Forest (27%) and the Other Land category (primarily freehold around (23%). Just under 12 % of candidate-old-growth forest is found on Crown Leasehold land. Overall, 66% of National Park which was growth staged is candidate-old-growth forest compared with 60 % of Crown Lease, 45 % of Crown Reserve (VCL), 34 % of State Forest (Native Forest) and 19 % of the Other Land categories.

Other predominant ‘mapped’ successional stages on National Park are disturbed old forest and rainforest which account for 7 % and 19 % of the National Park area which was growth staged. Of the 560000 ha of State Forest NativeForest 34% is candidate old-growth, 17 % is disturbed old forest, 3 % is mature forest, 17 % is disturbed mature forest, 8 % is young forest, 11 % is recently disturbed forest and 10 % is rainforest. Of the recently gazetted National Parks (January 1999) 48,000 ha consists of candidate old-growth forest and almost 29000 ha of rainforest, accounting for 38 % and 23 % of the new additions respectively.

In the LNE over 630,000 ha of candidate old-growth forest is found on National Park Estate which is 74 % of the candidate old-growth throughout the region . Other planning units containing important levels of candidate old-growth include State Forest Native Forest 17 % (145000 ha) and Crown Lease 6 % (53000 ha). Of the 235,000 ha of new National Parks (January 1999) in the LNE, 76000 ha or 32 % is candidate old-growth forest, 21% is rainforest and 20 % is mature forest and recently disturbed forest.

Most (82%) of the growth staged National Park estate is candidate old-growth forest, with most of the remaining forest being rainforest (14%). Overall, 20% of State Forest Native Forest is comprised of candidate old-growth forest, 8% disturbed old forest, 13 % mature forest, 8 % disturbed mature forest, 21 % young forest, 16 % recently disturbed forest and 15 % rainforest. It should be remembered that overall area statistics for the LNE are incomplete as the current layer was based on the Broad Old-growth Mapping Project Layer.

API Growth Stage Classes

Generally , for both CRA regions similar trends in terms of the distribution of API growth stages within candidate old-growth forest and in the proportions overall of different API growth stages mapped exist. In the UNE candidate old-growth forest was comprised of the following API growth stage codes (see Table I in Section 3 for coding explanation); tA (45 %), tB (42%), tC (5%), sA (2%) and sB (6%). Overall, of the area mapped tA accounted for (21 %), tB (26%), tC (8%), sA (2%), sB (16%), sc 14 % and e (> 30 % regrowth codes) 12 %.

In the LNE candidate old-growth forest was comprised of the following API growth stage codes ; tA (47%), tB (40%), tC (4%), sA (.3%) and sB (9%). Of the area mapped tA accounted for (23 %), tB (21%), tC (4%), sA (.6%), sB (15%), sC (9 %) and e (> 30 % regrowth codes) 12 %.

It should be noted that the 'tB' and 'tC' stands are dominated by mature, as opposed to senescent, trees. The influence of senescent trees on the whole stand has been found by other studies (Woodgate *et al*, 1994) to become significant when > 10%. The inclusion of the senescing crown form class 'tC' in the mature/senescing growth stage class for the 'difficult to interpret' community reflects the difficulty in interpreting any senescing crown forms in these communities.

API Disturbance Indicators and Logging History

Over the UNE region CRAFTI disturbance indicators were used over 1.6 million ha . This represents 89% of the area which was growth staged. Of the fourteen disturbance indicators applied consistently across the UNE, the most extensively used was “g” for canopy gaps (861,000ha) followed by “n” no visible disturbance (384,200 ha), tracks (311,153 ha), uneven crown heights (297,538 ha).

Of the candidate old-growth forest 56 % had no visible disturbance, 25 % had a record of canopy gaps and 8 % of areas with some tracks visible. In terms of the ruleset and initial assessment by API staff of the application of the “g” disturbance indicator ie its overuse particularly in low density stands, it was decided to qualify the exclusion of candidate old-growth status on the basis of “g” alone and that it had to be used with “a”‘ native pioneers, “w” weeds and “z” uneven crown heights. Canopy gaps have been associated with old-growth forest (Scotts in Love *et al.* 1992) and are found in most forests, particularly low density stands and along ecotones, drainage lines or sites of previous disturbance. Of the areas of candidate old-growth forest which had gaps (173,000 ha) around about 27 170 ha or 16 % had a record of logging. When the logging history records delineating the actual recorded logging event are considered rather than all records (which include records referring to the compartment, but nothing finer) the actual area is (ha) CHECK insert figures.

In the absence of a more detailed understanding of the correlations between all variables and also issues relating to the incomplete coverage of the Management History records in terms of both spatial extent and the attribution , experts and stakeholders decided it was most in keeping with the JANIS Old-growth definition to be precautionary and emphasise the current affects of disturbance determined by growth stage & API disturbance indicators and with reference to the extent of MANHIC coverage. Time permitting more analysis could be pursued in future old-growth work of the correlation between growth stage, RSD, disturbance indicators and logging history records.

Forest Ecosystems

This discussion will refer primarily to the UNE as it is only for this region where across all tenure coverage is possible. Available data on the distribution of candidate old-growth forest for forest ecosystems is provided in Tables U & R. Of the 142 forest ecosystems in the UNE, the frequency and total area within different area intervals is provided in Figures K. Around one third of forest ecosystems have less than 1000 ha of candidate old-growth and two thirds have 1000 ha or greater. Forest ecosystems with greater than 100 ha contribute 98 % of the total candidate old-growth area.

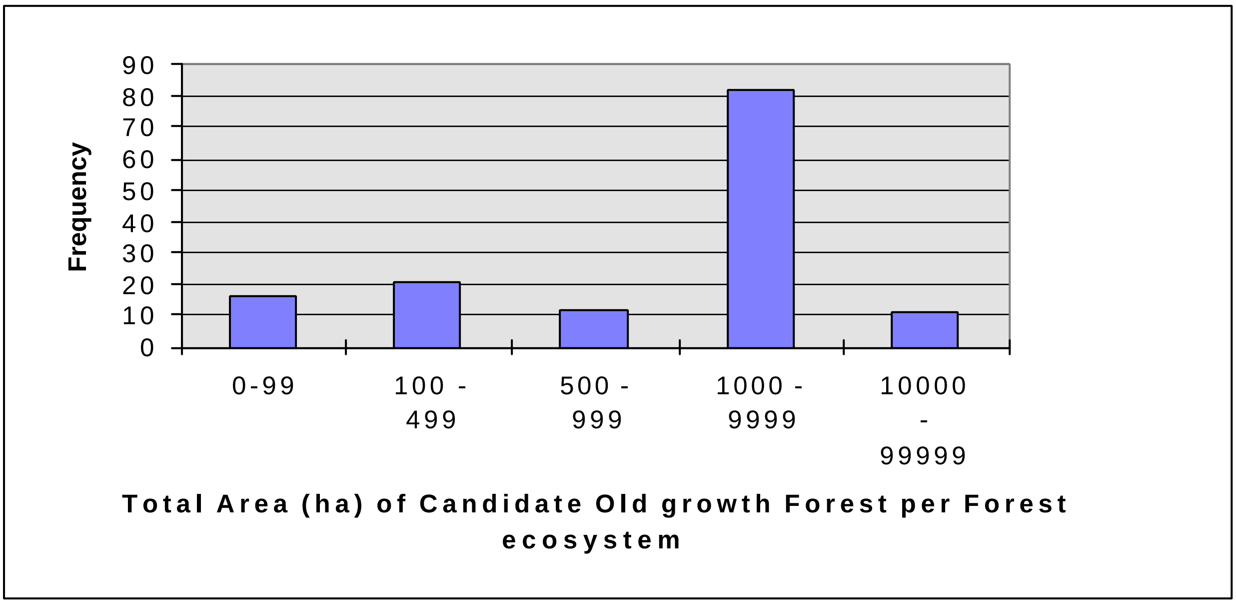
Within the UNE, the forest ecosystems with the most old-growth are generally the lower site quality forest ecosystems such as Dry Open New England Blackbutt (52,268 ha), Dry Grassy Stringybark (40,951 ha), Dry Foothills Spotted Gum (39,933 ha), Clarence Lowlands Spotted Gum (32,921 ha), Gorge Ironbark - Grey Gum (27,179 ha) , Stringybark - Gum (24,412 ha) and Baileys Stringybark (21,733 ha). The proportion of each forest ecosystem in a candidate-old-growth forest condition varies widely, however those forest ecosystems which have less than or equal to 10 % of their total distribution in an old-growth condition are generally the higher site quality forest ecosystems. Ten such ecosystems occur in the UNE, namely Richmond Range Spotted Gum (2011 ha), Lowlands Spotted Gum-Box (1288 ha), Wet Flooded Gum-Tallowwood (675 ha), Ironbark (472 ha), Wet Coastal Tallowwood - Brushbox (187 ha), Silvertop Stringybark (42 ha), Low Relief Coastal Blackbutt (37 ha), Steel Box / Craven Grey Box (16 ha), Red Bloodwood (15 ha) and Grey Box-Northern Grey Gum (13 ha).

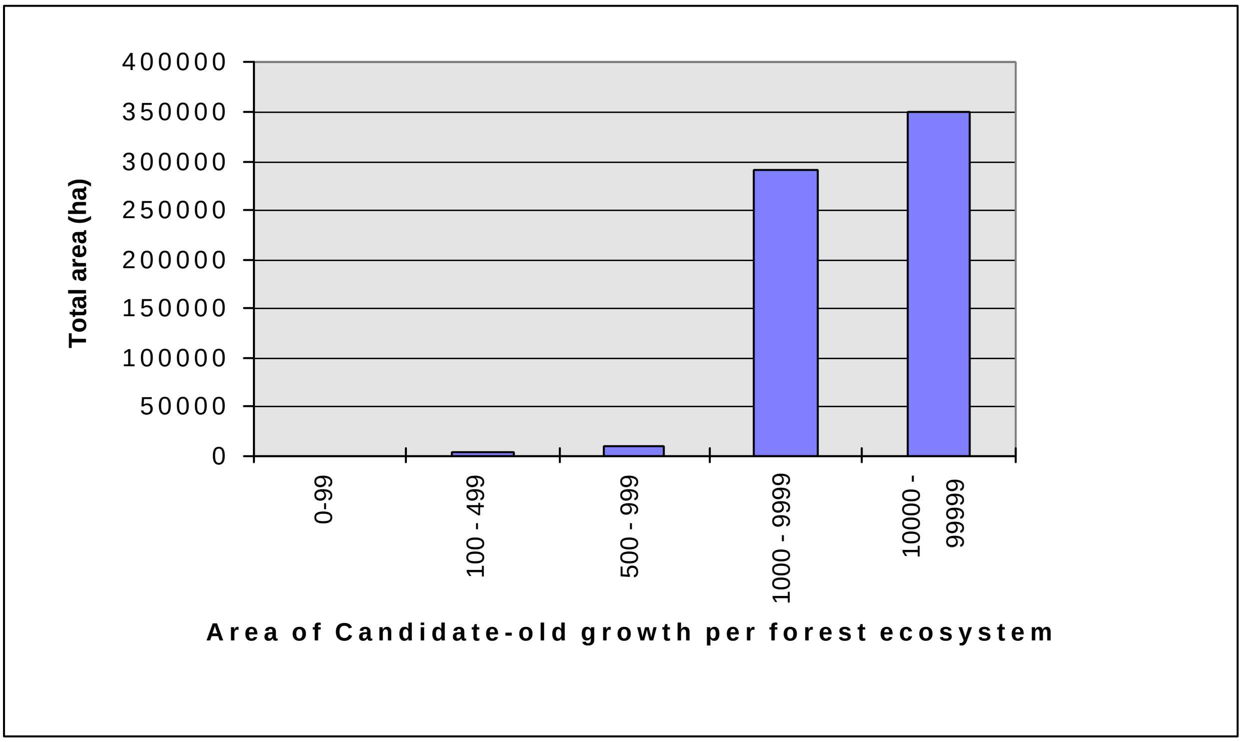
Discussion here will only focus on the UNE as the LNE patch size analysis is compromised by the incomplete nature of the BOGMP mapping.

Patch Size

Readers should refer to the results section which gives a brief explanation concerning how the indicative patch sizes were generated. Discussion here will only focus on the UNE as for the LNE patch size analysis awaits all tenure mapping from CRAFTI. The distribution of candidate old-growth forest of different patch sizes for the UNE is depicted graphically in Figure O and in Table T. Four percent of the total area of candidate old-growth forest is made up by patches less than 10 ha in size. A further 2% of the total area is made up of by patches between 10 & 25 ha. There are a relatively low number of large patches (> 1000 ha) which contribute 77 % of the overall area.

FIGURES KA & KB . FREQUENCY AND AREA OF FOREST ECOSYSTEMS WITHIN DIFFERENT EXTENT THRESHOLDS OF CANDIDATE OLD-GROWTH FOREST



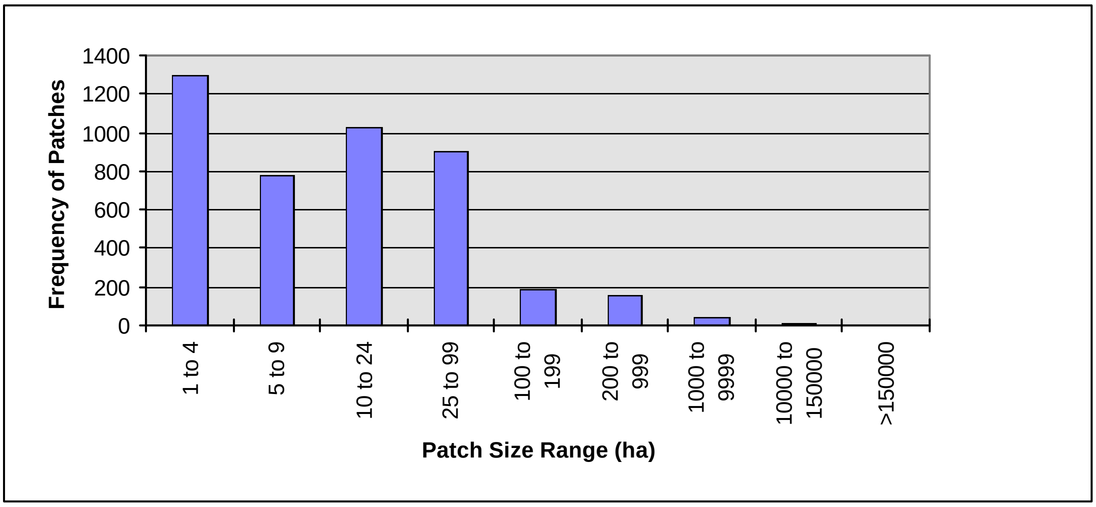


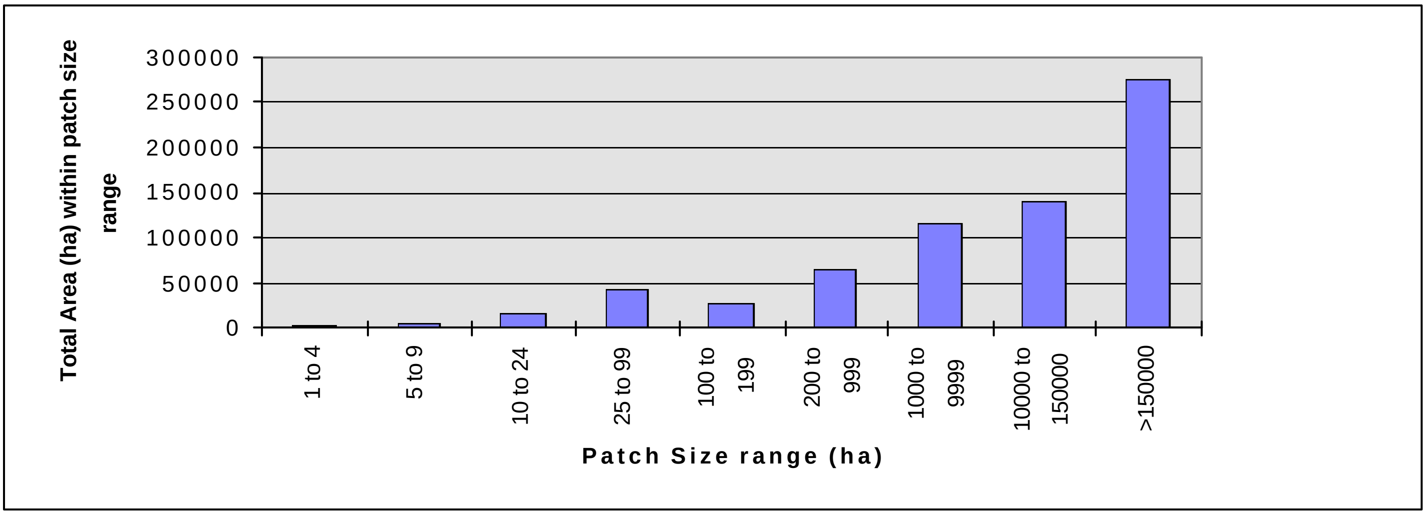
400000
350000
300000
250000
200000
150000
100000
50000
0
Total area (ha)
0-99
100 - 499
500 - 999
1000 - 9999
10000 - 99999
Area of Candidate-old growth per forest ecosystem

TABLE T. AREA AND FREQUENCY OF CANDIDATE OLD-GROWTH FOREST WITHIN VARIOUS PATCH SIZE CLASSES FOR THE UNE

Patch Size range (ha)	Cumulative Frequency	Frequency	Total Area within patch Size range	% of Total Area within Patch Size
1 to 4	1300	1300	3017	0.44
5 to 9	2082	782	5283	0.76
10 to 24	3106	1024	15989	2.31
25 to 99	4011	905	44084	6.36
100 to 199	4202	191	26712	3.86
200 to 999	4358	156	66617	9.61
1000 to 9999	4402	44	115449	16.66
10000 to 150000	4408	6	140954	20.34
>150000	4409	1	274772	39.66
			692877	100.00

FIGURE LA & LB. FREQUENCY AND AREA HISTOGRAMS OF CANDIDATE OLD-GROWTH FOREST PATCH SIZE CLASSES FOR THE UNE.





4.2 FIELD VALIDATION

Twenty three of the 56 sites surveyed correlate with the Crafti API growth stage assessment (see table below). This gives an agreement rating of 41%. Of the 33 sites which do not agree, 2 recieved a higher coding during the field assessment (Sites 32 and 202), with the remainder receiving a lower coding (that is, a lower percentage of senescence, or a higher percentage of regrowth than the Crafti API assessment). These results are not dissimilar from the results from the CRAFTI growth stage accuracy assessment field work for the UNE (48%). These preliminary results should be interpreted cautiously as while they represent a sample based result issues surrounding the location of the sampled API polygons, size of the polygon, transect location and the number of replicate plots within transects make it extremely difficult to conclude much of the overall accuracy of growth staging, particularly in heteogenous polygons.

In both the CRAFTI and the old-growth assessments sampling previous production forest was oversampled relative to National park areas. Within the current study the old-growth sample size is inadequate to draw any firm conclusions regarding growth stage reliability. The general broad area based conclusions from the CRAFTI assessment were that generally in the UNE the CRAFTI field accuracy assessment identified less senescence than mapped by API and less ‘t’ regrowth, and more ‘s’ regrowth than mapped by API.

If the field based growth stage was applied to the same ruleset (in place of the mapped growth stage) for structural maturity classes and disturbance level then overall agreement with the existing candidate old-growth layer for the LNE is 78 % ie 22 % disagreement or 22% of cases where the successional stage would lead to a change of status.

4.3 COMPARISON WITH OTHER STUDIES

In addition to this several other studies have recently defined and mapped 'old-growth forest' within the UNE & LNE regions. These include various mapping exercises as part of the SFNSW northern forests EIS program, the NEFA Wild Cattle Creek study and the Broad Old-growth Mapping Project work undertaken during the IAP.

More Candidate Old-growth Forest was mapped during this exercise than the IAP and the EIS for the UNE and less for the LNE. The UNE mapping covered all tenures while the LNE work involved a modification of the existing BOGMP layer. Different rules were applied in all studies to derive old-growth. For the UNE which had been growth staged during the IAP, more candidate old-growth forest (4399 ha) or 1.2 % was mapped during the CRA compared with the IAP (369,308 ha versus 364,909 ha). Changes in relation to the delineation of successional stages could be due to changes in growth staging mapping units, changed disturbance information recent disturbance and other factors. The most significant change in the old-growth layer for the LNE revolved around the ‘modelling’ of candidate old-growth forest over NPWS estate south of the Hunter River. This resulted in over 450,000 ha of candidate old-growth forest being added to the area mapped during the IAP south of the Hunter River.

4.4 EXPERT PANEL RECOMMENDATIONS

The following recommendations were developed by the Expert Panel.

- In future studies the availability of key primary datasets should be made available to allow sufficient time for detailed analysis and field checking.
- That, given the limitations of this process, the resulting areas identified be termed "candidate" old-growth.
- In all future studies, an indication of the likelihood of disturbance should be included where possible in all old-growth classes delineated by the analysis.

- That field checking of candidate old-growth forest areas be conducted prior to any tenure changes based on this attribute, given the considerable uncertainty as to the reliability of the analysis results.
- That this process, and all subsequent old-growth forest inventories, be subject to extensive, iterative review based on statistically valid field checking. Such review should be realistically costed into initial budget estimates.
- That, given the dynamic nature of old-growth forest and ongoing disturbances, ongoing updating of primary datasets be conducted on an annual basis, and the old-growth forest analysis process be rerun when appropriate.

4.5 RECOMMENDATIONS FOR FUTURE WORK

Many of the shortcomings with the UNE / LNE Old-growth Project can be attributable to a lack of time to adequately investigate relevant data. The latter was due to a combination of delays in provision of key data sets such as API and disturbance information type together with tight deadlines for the UNE / LNE negotiation phase. All stakeholders received a copy of the old-growth layer for review prior to the UNE / LNE negotiations.

Future work on the revised LNE successional stage layer utilising the CRAFTI data set should initially apply the UNE ruleset and compare on public land the current distribution of candidate old-growth. The modelled distribution of Candidate Old-growth forest on NPWS estate south of the Hunter River will need to be combined with this revised layer to complete the revised LNE old-growth coverage.

The ruleset for the LNE could also be applied to a sample of the Southern CRA study area e.g the SF Narooma Management Area as key datasets become available (CRAFTI, Forest Ecosystems or floristics API & MANHIC data). The development of interpretability classifications for the Southern CRA region will need some refinement due to the different behaviour of some tree species / forest ecosystems in the South. Every effort should be made to maximise the chances of iterative development of the successional stage layer through ongoing analysis and field inspection prior to use in negotiations. This approach refines the end product through error checking for errors both in the GIS application of the ruleset and by ground truthing ‘the ruleset ‘ itself.

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6. APPENDICES

6.1 CLASSIFICATION OF FOREST ECOSYSTEMS WITHIN THE UNE REGION ACCORDING TO EASE OF INTERPRETABILITY AND SITE QUALITY

			Site Quality / Interpretability Information			
No.	Ecosystem no.	Forest Ecosystem Name	Usual Site Quality/ Interpretability	Variation 1 Site Quality/ Interpretability	Variation 2 Site Quality/ Interpretability	Overall Interpretability
30	142	Swamp Mahogany				Special Case
31	112	Paperbark				Special Case
32	143	Swamp oak				Special Case
33	77	Mangrove				Special Case
42	11	Blackbutt-Sydney Peppermint-Smoothbarked Apple	ME			E
45	146	Tallowwood	MMo			E
49	147	Turpentine	HD	MD		D
50		Bangalay				Special Case
51	45	Dunns White Gum	HE			E
52	124	Roundleaved Gum-Turpentine	ME			E
54	162	Whitetopped Box	ME			E
55	85	Mixed Moist Hardwood	HE			E
64	63	Grey-gum Stringybark	LD			D
68	117	Red Mahogany	ME			E
81	62	Grey Box-Northern Grey Gum	HE	ME		E
83	61	Grey Box-Ironbark	MD	LD		D
84	71	Ironbark	MD			
87	138	Steel Box/Craven Grey Box	ME			E
93	46	Eastern Red Gums	ME			E
98	31	Dorrigo White Gum	MMo			E
101	12	Blue Mountain Ash	LD	MD		D
105	129	Smoothbarked Apple	LD	LD		D
106	130	Smoothbarked Apple-Sydney Peppermint-Stringybark	ME	LD		D
107	5	Banksia				Special Case
111	113	Peppermint	MD	LD		D
115	145	Sydney Peppermint-Stringybark	MMo	LD		D
121	13	Blue-leaved Stringybark				D
128		Sydney Peppermint	MD	LD		D
129	122	Rough-barked Apples	LD	MD		D
130	115	Red Bloodwood	LD	MMo		D
131	114	Peppermint-Mountain/Manna Gum	LD	MD		D
136	133	Snow Gum-Black Sallee	LD			D

137	10	Black Sallee				Special Case
138	131	Snow Gum	LD			D
140	132	Snow Gum-Mountain/Manna Gum	LD	ME		D
141	17	Candlebark	LD			D
142	98	New England Peppermint	LD			D
144	18	Casuarina Woodland				Special Case
147		Alpine Ash	HE			E
150	81	Messmate	HE	ME		E
154	14	Brown Barrel	MD			D
155	15	Brown Barrel-Gum	MD			D
158		Southern Blue Gum	HE			E
160	79	Manna Gum-Stringybark	LD			D
161	123	Roundleaved Gum	ME			E
162		White Ash	HE			E
164	51	Eurabbie	MD			D
170	86	Mixed New England Stringybarks	LD	MMo	HE	D
172	163	Yellow Box-Blakely's Red Gum	LD			D
174		White Box-Western Boxes	LD			D
176		White Box-Stringybark	LD			D
177	116	Red Gum-Stringybark	LD			D
184		Black Cypress Pine-Scribbly Gum	ME			E
207	128	Silverleaved Ironbark	LD			D
211	120	River Oak				Special Case
213	16	Bull Oak				Special Case
214	151	Wattle				Special Case
215	22	Coast Cypress Pine				Special Case
223	64	Heath				Special Case
224	169	Scrub				Special Case
225	76	Mallee				Special Case
226	125	Saltbush				Special Case
230	96	Natural Grassland				Special Case
231	141	Swamp				Special Case
232	66	Herbfield and Fjaelmark				Special Case
233	172	Sand Ridge				Special Case
234	121	Rock				Special Case
1179 a258	74	Lowlands Scribbly Gum	ME			E
1179 a910	48	Escarpment Scribbly Gum-Apple	ME			E
1179 g6	65	Heathy Scribbly Gum	ME			E
122a 60	35	Dry grassy Stringybark Forest	MD-LD			D
122g 3	93	Montane Stringybark-Gum	ME			E
122g 5	149	Warra Mallee-Peppermint mosaic	LD			D
122g 6	38	Dry heathy New England Blackbutt	MD			D
126g 2	23	Coast RangeBloodwood-Mahogany	LD			D
151g 3	68	High elevation Messmate-Brown Barrel	HE	ME		E
151g 4	94	Mountain Gum-Brown Barrel	HE	ME		E
152g 3	28	Cool Moist Messmate	HE	ME		E
152g	82	Messmate-Mountain Gum forest	HE	ME		E

4						
153g 1	87	Mixed Tableland Stringybark-Gum open forest	HE	ME		E
159a 24	80	Manna Gum	HE			E
159g 3	2	Alpine Gum	HE			E
163a 5248	88	Moist escarpment New England Blackbutt	HE			E
163a 5362	30	Diehard Stringybark-New England Blackbutt	LD			D
163a 5557	60	Grassy New England Blackbutt-Tallowwood-Blue Gum	ME			E
163g 38	148	Very wet New England Blackbutt-Tallowwood	HE			E
163g 39	140	Stringybark Mallee	LD			D
163g 40	39	Dry heathy New England Stringybarks	LD			D
163g 49	6	Barrington dry shrubby New England Blackbutt-Blue Gum	LD			D
163g 63	108	Open Ribbon Gum	MMo			D
163g 68al	90	Moist Messmate-Gum	HE			E
163g ran	41	Dry open New England Blackbutt	MMo			D
167g 1	43	Dry Silvertop Stringybark-Apple	LD	MMo		D
1689 a151	107	Open Messmate-New England Blackbutt	HE			E
1689 a60	110	Open Silvertop Stringybark-Blue Gum	HE			E
1689 g11	92	Moist Shrubby Stringybark Gum	HE			E
1689 g14	156	Wet New England Blackbutt-Silvertop Stringybark	HE			E
1689 g16	8	Barrington wet New England Blackbutt-Blue Gum	HE			E
1689 g17	111	Open Silvertop Stringybark-Tallowwood	HE			E
1689 g18	29	Corkwood-Crabapple and Mixed Stringybarks	HE			E
3637 a39	40	Dry heathy sandstone Blackbutt	HE			E
3637 g10	95	Mt Warning Blackbutt	HE			E
3637 g11	72	Low relief coastal Blackbutt	HE			E
3637 g19	34	Dry grassy Blackbutt-Tallowwood	HE			E
3637 g20	153	Wet coastal Tallowwood-Brushbox	HE			E
3637 g21	67	High elevation ferny Blackbutt	HE			E
3637 g22	83	Mid elevation wet Blackbutt	HE			E
3637 g23	32	Dry foothils Blackbutt-Turpentine	HE			E
3637 g24	155	Wet foothills Blackbutt-Turpentine	HE			E
3637 g6f	101	Northern open grassy Blackbutt	HE			E

38a24	97	Needlebark Stringybark-Large Fruited Blackbutt	LD	ME		D
3976g1	126	Sandstone Spotted Gum-Blackbutt	LD			D
3976g2	25	Coast Range Spotted Gum-Blackbutt	ME			E
401a3578	37	Dry Heathy Blackbutt-Bloodwood	LD			D
401a910	27	Coastal Sands Blackbutt	LMo			D
46a910	137	Southern wet Sydney Blue Gum	HE			E
46g2	100	Northern grassy Sydney Blue Gum	HE			E
46ga378	137	Central mid elevation Sydney Blue Gum	HE			E
47a3134	69	High elevation moist open Tallowwood-Blue Gum	HE			E
47g33	84	Mid North Coast wet Brushbox-Tallowwood-Blue Gum	HE			E
47g37	150	Washpool Brushbox-Tallowwood	HE			E
47g39	78	Mann River wet New England Blackbutt	HE			E
47g6a38	104	Northern wet Tallowwood-Blue Gum	HE			E
47g9112	135	South coast Tallowwood-Blue Gum	HE			E
48a34	26	Coastal Flooded Gum	HE			E
48g2	154	Wet Flooded Gum-Tallowwood	HE			E
53a512	106	Open coastal Brushbox	MD			D
53a68	50	Escarpment wet Bangalow-Brushbox	HD-HMo			D
53a913	157	Wet shrubby Brushbox-Tallowwood	HD			D
53g14	103	Northern wet Brushbox forest	MD			D
53g7	109	Open shrubby Brushbox-Tallowwood	HD-HMo			D
60a4647	152	Wet Bloodwood-Tallowwood	HE			E
60g11		Barrington moist Blue Gum-White Mahogany forest	HE			E
60g1456	134	South coast shrubby Grey Gum	HE			E
60g17f2	42	Dry Redgum-Bloodwood-Apple	HE			E
60g2f	57	Gibraltar Range Needlebark-Stringybark	HE			E
60g3435	36	Dry grassy Tallowwood-Grey Gum	HE			E
60g3638	59	Gorge Ironbark-Grey Gum	HE			E
60g39	52	Foothill Grey Gum-Ironbark-Spotted Gum	HE			E
60g3f3	91	Moist open escarpment White Mahogany	HE			E
60g40425	102	Northern ranges dry Tallowwood	HE			E
60g53	49	Escarpment Tallowwood-Bloodwood	HE			E
60g54	105	Nymboida Tallowwood-Turpentine	HE			E

6592n2	73	Lowland Red Gum	LD			D
6592n3	99	New England Stringybark-Red Gum	LD			D
6592n5	139	Stringybark Apple	LD			D
6592n6	47	Escarpment Red Gum	LD			D
707274g	75	Lowlands Spotted Gum-Box	MD			D
7074g2	158	Wet Spotted Gum-Tallowwood	HE			E
70a74g5	70	High elevation open Spotted Gum	HE	ME		E
7174a236	24	Coast Range Spotted Gum	MD			D
71g1	118	Richmond Range Spotted Gum	HE	ME		E
7274g1	119	Richmond Range Spotted Gum-Box	MD			D
74a1215	55	Foothills Grey Gum-Spotted Gum	MD			D
74a811	89	Moist Foothills Spotted Gum	HE			E
74g9	33	Dry foothills Spotted Gum	MD			D
80g1	53	Foothills Grey Box	MD			D
80g3	54	Foothills Grey Box-Red Gum-Grey Ironbark	MD			D
80g4	21	Clarence lowlands Grey Box	MD			D
9293g1	44	Dry open Redgum-Apple	MMo			E
9293g2	58	Gorge Grey Gum	MD			D
97a48	20	Clarence lowland Needlebark Stringybark	ME			E
97g5	127	Sherwood Needlebark Stringybark	ME			E
97g6a38g3	3	Baileys Stringybark	LD			D
97g7	56	Gibraltar Mallee	LD			D

6.2 GIS OVERLAYS & OUTPUTS

6.3 NORTH EAST CRA OLD-GROWTH STUDY REPORT FROM THE EXPERT PANEL

Introduction

An expert panel was established by the N.S.W. and Commonwealth governments to provide scientific advice on the development of old-growth forest maps for the comprehensive regional assessment (CRA) of forest regions in north east New South Wales. The expert panel was required to review the API and disturbance data sets compiled during the present CRA process and to to develop a old-growth forest analysis / rule set for the CRA in north east N.S.W. This report summarises the finding of the expert panel.

Due to imposed time constraints, the old-growth forest expert panel was required to make decisions using data sets that, in some cases (particularly the disturbance and environmental site quality), had had only limited field validation. Although these data sets were the best available for use in the analysis, their reliability is unknown. In addition, the analysis was written without the option of iterative review of the result and amendment of the analysis rules. There was no opportunity to field check the map or to iteratively review the results; which is normal practice in any reliable and scientifically-defensible modelling procedure.

Given these limitations, the panel emphasises that there is an extensive set of qualifications for any analyses resulting from the use of rule sets for the assignment of old-growth forest status in the North East CRA (detailed in the following pages).

This old-growth forest assessment process has concentrated on identifying old-growth forest according to attributes which are interpretable from the forest canopy through predominantly remote sensing techniques (such as aerial photograph interpretation). This is consistent with the Commonwealth and States' agreed JANIS definition of old-growth forest which places an emphasis on the use of overstorey attributes to identify old-growth forest. However, this approach does not assess the condition/maturity of the understorey, nor does it consider the potentially detrimental influences of other disturbances such as grazing on the overstorey, or the many other biotic (for example,. fauna), compositional, functional and aesthetic characteristics of old-growth forest ecosystems.

Whilst a more extensive set of disturbance data was available for use in this analysis compared with either the North East IAP or the Eden CRA old-growth assessments, these data were gathered largely by desk-top research. Although an indication was provided of the ‘reliability’ of the data based on the scale of mapping and the time relative to the disturbance that the disturbance map was compiled, the expert panel considered that this did not provide a useful gauge of how accurate the disturbance data was on the ground. Furthermore, there was virtually no information available on the intensity of the original disturbance. For these reasons it was initially recommended that a two-fold approach be applied to assessing impact of disturbance:

(i) likelihood of the disturbance having occurred; and
(ii) probable impact of the disturbance.

In previous old-growth assessments these two quite separate parameters have been assessed at the same time in a broad evaluation of the probable impact of disturbance. However, the expert panel felt that it was less misleading to include separate indices of likelihood of occurrence and likely impact in the old-growth forest analysis. This approach potentially provides a more informed basis for conservation decisions to be made in the subsequent integration phase of the CRA. Due to the severe time constraints caused by the late delivery of key datasets the immovable deadline for data sets for the negotiations and the size and complexity of the datasets involved, it was not possible to complete and evaluate this approach. Stakeholders felt that fully evaluating the options and testing for logical inconsistency would require far greater time than was available. Consequently, the rule set was developed by the expert panel without reference to the likelihood of disturbance impact.

In view of these limitations, and the many assumptions made in the recommended old-growth forest analysis, outlined below, the old-growth expert panel emphasises that this process will only identify forest stands that are candidates for listing as old-growth forest. Old-growth forest identified through a more comprehensive process is likely to be a subset of the candidate old-growth forest. Further, because of limitations with the available data, it is possible that some forests not currently listed as candidate old-growth actually support old-growth characteristics that warrant them being assigned as such. Some of the latter areas may support high conservation values.

Qualifications for any analyses resulting from the use of rule sets for the assignment of old-growth forest status in the North East CRA

1. Data limitations

1a. Accuracy of available data

The accuracy of available datasets which were used for the definition of old-growth forest varied considerably. These datasets included:

- crown form (considered to be of high accuracy, due to 2 phases of independent evaluations and extensive field checking);
- canopy species mapping (accuracy not known);
- floristic community mapping (considered to be of high accuracy as the mapping was based on plot data (existing and resampled); and has been evaluated twice);
- contemporary logging from historical records (unknown spatial accuracy) and API disturbance indicators (considered to be of high reliability but unknown spatial accuracy); and
- fire mapping (considered to be of moderate accuracy for large fires; no reliable API interpretation).

1b. Data collected but under-utilised

Some data sets which were collected were considered by the panel to have been under-utilised in the analysis. These include:

- floristic mapping (could have been more extensively interpreted to evaluate ecological maturity);
- Site Productivity Index (not available in time to be used reliably in this process); and
- fire (the lack of field checking meant that this could not be reliably used to interpret ecological maturity).

2. Derivation of data sets

A number of assumptions were made to derive key datasets from the primary datasets. These include:

(i) "Interpretability classes" derived from vegetation communities -

- Assumptions about interpretability of vegetation classes were based on interpreters' recollections of individual species' interpretability and not confirmed by the field checking. Again, this may limit the accuracy of the derived growth stage coverage.
- The understanding of the panel that the assumption that the growth habits of eucalypts are consistent with floristic communities as delineated by the CRA floristic modelling was only subject to limited, incidental field checking.

(ii) Growth stage classes derived from crown form mapping -

- Analysis rules to derive growth stage classes from crown form mapping were based on expert opinion derived from field work conducted in other study areas, and local API experts advice. Only very limited, incidental field checking in this study area was conducted to evaluate these rules.
- The growth stage class of mature and senescing-dominated classes with a subdominant (10-30%) regrowth class could not be determined by the panel with the available information and in the available time.
- Mature dominated classes were considered to constitute a senescing growth stage where they have a substantial component of senescing crowns (10-30%) and a negligible component of regrowth crowns (<10%). At these proportions senescing individuals are considered to exert a significant influence on the stand, whilst regrowth individuals are considered to exert a negligible influence of the site.
- The inclusion of the senescing crown form classes B and C in the senescing growth stage class for "difficult to interpret" communities reflects the difficulty in interpreting any senescing crown forms in these communities.

3. Limitations to the assignment of disturbance levels

- Assignment of disturbance levels was not conducted iteratively, nor was it subject to any field checking.
- The likelihood of disturbance occurrence was not assessed explicitly but was included implicitly in the assessment of disturbance impact.
- The assumption that API disturbance and weed mapping overrides disturbance records was based on interpreter confidence in the API mapping and was not field checked by the expert panel.
- API fire mapping was not considered to be sufficiently accurate to influence the assessment of disturbance levels.
- No use was made of floristic information in determining ecological maturity; areas identified as having low or negligible disturbance levels may potentially have disturbed understoreys beneath structurally intact overstoreys, as the result of factors such as grazing impacts (structurally intact overstoreys with weedy understoreys).
- In stands where regrowth was only present in proportions of less than 30%, the impact of fire was considered to be negligible. Such stands may include substantial proportions of prematurely senescing overstorey trees as the result of fire damage.

4. Assignment of old-growth status

All decision rules in assigning old-growth status to combinations of growth stages and disturbance level must be considered in the light of the previously discussed limitations in deriving these data layers.

Recommendations

In future studies the availability of key primary datasets should be made available to allow sufficient time for detailed analysis and field checking.

That, given the limitations of this process, the resulting areas identified be termed "candidate" old-growth.

In all future studies, an indication of the likelihood of disturbance should be included where possible in all old-growth classes delineated by the analysis.

That field checking of candidate old-growth forest areas be conducted prior to any tenure changes based on this attribute, given the considerable uncertainty as to the reliability of the analysis results.

That this process, and all subsequent old-growth forest inventories, be subject to extensive, iterative review based on statistically valid field checking. Such review should be realistically costed into initial budget estimates.

That, given the dynamic nature of old-growth forest and ongoing disturbances, ongoing updating of primary datasets be conducted on an annual basis, and the old-growth forest analysis process be rerun when appropriate.

22/09/98

Jane Coram, Land and Water Resources Division, AGSO, Canberra

Professor Tony Norton, Department of Land Information, RMIT University, Melbourne.

6.4 METADATA FOR THE UNE OLD-GROWTH LAYER

NSW CRA/RFA Metadata Proforma

CATEGORY	CORE METADATA ELEMENT	DESCRIPTION
DATASET	**Title:**	UNE Old-growth & other Successional Stages - Context layer (une_ogss)
	Custodian:	NSW National Parks and Wildlife Service
CONTACT ADDRESS	**Jurisdiction:**	Australia
	CRA Project Name:	UNE / LNE Old-growth and related projects
	CRA Project Number:	NA 28 EH
	Contact organisation:	NSW National Parks and Wildlife Service
	Contact position:	CRA Old-growth Co-ordinator - RACAC Unit
	Mail address 1:	PO Box 1967
	Mail Address 2:	PO Box 91,
	Suburb/place/locality:	Hurstville, 2221
	State/Locality 2:	Alstonville
	Country:	Australia
	Postcode:	2220
	Telephone:	612 9585667
	Facsimile:	612 95856606
	Electronic mail address:	paul.oconnor@npws.nsw.gov.au
DESCRIPTION	**Abstract:**	UNE / LNE Old-growth and related projects (NA 28 EH). Candidate old -growth forest and other forest growth stages derived by integrating structural maturity classes from API, interpretability classes derived from vegetation mapping units and disturbance history information from API and MANHIC logging history information together with rainforest from the UNE Forest ecosystem layer.
	Search Words:	Old-growth forest, API, disturbance, mapping
	Geographic Extent, Names	UNE CRA Region
	Geographic Extent, Polygon(s):	
	Type of feature:	Raster
	Attribute/Field List:	Value - Derived Successional stage 1-Candidate Old-growth Forest 2-Disturbed Old Forest 3-Mature Forest 4-Disturbed Mature Forest 5- Young Forest 6-Recently Disturbed Forest 7-Rainforest
	Attribute / Field Description	Value - Derived successional Stage identifier, Count =area in hectares
	Scale/Resolution:	1:25000
DATASET CURRENCY	**Beginning date:**	1/ 06/97
	Ending date:	13/8/98
DATASET STATUS	**Progress:**	Complete

	Maintenance and update frequency: Unknown	
DATASET ENVIRONMENT	**Software:**	Arc/INFO; ArcView
	Computer Operating System:	Unix, Windows NT
	Dataset Size:	.9Mb
ACCESS	**Stored Data Format:**	Arc View Grid file
	Available Format Type:	Floppy disk, CD-Rom,Exabyte tape
	Access constraints:	The dataset is available to all organisations and individuals. A licence agreement is required to obtain the dataset. A fee may be charged to consultants, commercial organisations and local councils. This is to cover the cost of transfer of the data , not for the data itself.
DATA QUALITY	**Lineage:**	The following layers were used to derive Candidate Old-growth forest and other successional stages according to a rule set described below. 1)structural growth stages mapped using aerial photographic interpretation from the CRAFTI UNE project 2) 3 classes of Interpretability using a classification based on the UNE Forest Ecosystem layer 3) API Relative Stand density and disturbance indicators from the UNE CRAFTI project. 4) Logging history extent information from the UNE MANHIC project 5) Rainforest from the UNE Forest Ecosystem layer The following rule set was applied to derive the candidate old-growth and other successional stage layer. Forest Structural Maturity Classes **Easy to interpret class** Senescing - - tA, tB, sA Mature - sB,sC Young - e (f,d,g) **Difficult to interpret (and special case) classes** Senescing - tA, tB, tC,sA, sB Mature - sC Young - e (f,d,g) The Forest Ecosystems assigned to the Easy class were : INSERT The Forest Ecosystems assigned to the Difficult class were (FE ID): 3,12,14,15,17,21,23,24,27,30,33,35,37,38,39,41,43,47,50,53,54,55,56,58, 61,63, 71,73,75,79,80,86,97,98, 99, 103,106,109,113,114,115,116,119,122,126,128,129,130,131,132,133, 139,140,144,145,147, 149, 157, 160,163, 174,175,176,177,178,179,180,181,182,183,184,185,186,190,195,196, 197, 198, 200 The Forest Ecosystems assigned to the Easy class are: 2, 19, 20, 25,26, 29, 31, 32, 34, 36, 40, 42, 44, 45, 46, 48,52, 57,59, 60,62, 65, 67, 68, 69, 70,72, 74,78,81,83,84,85,87,88,89,90,91,92,93,95, 100 ,101 ,102, 104, 105, 110, 111, 117, 118, 123,124,127,135,138,146, 148,150, 152,153, 154, 155, 158,159, 162, 189, 194 The Forest Ecosystems assigned to the Special Case class are: 5, 10, 16, 18, 22, 64, 66, 76, 77,96, 112, 120, 121,125, 141, 142, 143, 151, 164 ,166 ,167 ,168 ,169 ,172 ,173, 199, 201 The following rules were applied to the API growth stage and disturbance indicator information together with the MANHIC logging history data to apply a disturbance significance level. Growth Stage RSD Disturbance Indicators Manhic

		tA,tB,tC,sA	3 or 4	n, or not (x, c, g+z, g + a,	All years
				g +w W,L,s, d)	with / without
		tA,tB,tC,sA	3 or 4	(x, c,g+w,L.W,s,d)	with / without
		tA,tB,tC,sA	3 or 4	(g+z, g + a)	with
		tA,tB,tC,sA	3 or 4	(g+z, g + a)	without (Public)

		tA,tB,tC,sA	3 or 4	(g+z, g + a)	Non SF & NP
		sB & sC	3 or 4	(n, or not (x, c, g+z, g + a, g +w W,L,s, d)	No Manhic
		sB & sC	3 or 4	(n or not x, c, g + z, g+ a g + W,W,L,s,d)	With Manhic
		e,d,f,g	1,2,3,4	All	All

		All	b,o or J	Non SF & NP
		All	p	All tenures

Note that API coding information can be summarised as follows
Growth stage: regrowth levels ‘t’ is < 10%, ‘s’ is 10-30% , ‘e (d,f,g,h)’ is > 30%
senescing levels; ‘C’ is < 10 %, ‘B’ is 10 - 30 %, and ‘A’ is > 30%
RSD: 1 is 0-25%, 2 is 25-50%, 3 is 50 - 75%, 4 is 75 - 100%
Disturbance indicators:
n - No visible disturbance
x- recent logging
c- old logging
g- canopy gaps
z- uneven crown heights
a- native pioneers
w- weeds
L- Lantana,
s - dead standing trees greater than 5 per ha
d- severe dieback, crown fire, defoliation

The following ruleset was applied to the Forest Structural Maturity and Disturbance Level classifications to derive Candidate Old-growth and other successional stages.

	Significant	**Negligible**
Senescing	DOF	COGF
Mature	DMF	MF
Young	YF	YF
Recently Disturbed Forest	Post-photo logged areas	n/a

Post photo logging records were not able to be validated sing LANDSAT over the

		whole area. Post photo logging was validated using a combination of Section 120 License Records, **information from** information on post photo logging from the IAP, the IDFA areas, LANDSAT information from the CRA pilot project and local knowledge. Areas of tA, tB not triggered by the significant disturbance indicators and identified as 'unlikely' to have been logged from the above information retained their candidate old-growth forest status. Grid cells equal to 1 ha of Candidate Old-growth forest were removed and absorbed into the grid cell value of neighbouring grids (using largest area). An error in the CRAFT coding for a large miscoded polygon near Fortis Creek National park was corrected by merging the relevant derived successional stage from the corrected IAP coverage for the extent of the polygon with the rest of the layer
	Positional accuracy:	The positional accuracy of the linework is dependent upon the scale of the source data. CRAFTI API information was derived at 1: 25000 scale and positional accuracy estimated to be within 37.5 metres. MANHIC data collated from a variety of map scales and of unknown positional accuracy. The positional accuracy of the Forest Ecosystem layer is estimated at 100 metres.
	Attribute accuracy:	Mapped growth stage polygons were checked for 'level of agreement by CRAFTI API staff. At time of writing these results had not been authorised for release by RACD.
	Logical consistency:	There is a one to one relationship between the attribute value and successional stage (described in the attribute field list).
	Completeness:	Information is as complete as possible given availability of core datasets to 6/7/97.
NOTES	**Notes:**	
METADATA DATE	**Metadata date:**	9/8/98
METADATA COMPLETED BY	**Metadata sheet compiled by:** Paul O'Connor	
FURTHER INFORMATION	**Further information:**	Ferrier, S, Flint, C & Binns, D in prep (1998). Methododlogy for Forest ecosystem classification and mapping in Upper North East and lower North east CRA Regions. Draft 4 May 1998 RACD, 1997 CRAFTI API Trial Draft Report. Unpublished report by the Resource and Conservation Division

6.5 METADATA FOR THE LNE OLD-GROWTH LAYER

NSW CRA/RFA Metadata Proforma

CATEGORY	CORE METADATA ELEMENT	DESCRIPTION
DATASET	**Title:**	LNE Candidate Old-growth and other successional stages - context layer:
	Custodian:	NSW National Parks and Wildlife Service
CONTACT ADDRESS	**Jurisdiction:**	Australia
	CRA Project Name:	UNE/LNE Old-growth Related Projects
	CRA Project Number:	NA 28 EH
	Contact organisation:	NSW National Parks and Wildlife Service
	Contact position:	CRA Old-growth Coordinator - RACAC Unit
	Mail address 1:	PO Box 1967
	Mail Address 2:	PO Box 91
	Suburb/place/locality:	Hurstville
	State/Locality 2:	Alstonville, NSW 2480
	Country:	Australia
	Postcode:	2220
	Telephone:	612 9585 6667
	Facsimile:	612 9585 6606
	Electronic mail address:	paul.oconnor@npws.nsw.gov.au
DESCRIPTION	**Abstract:**	UNE / LNE Old-growth and related projects (NA 28 EH). Candidate old -growth forest and other forest growth stages derived by integrating structural maturity classes from API, environmental site quality classes defined by forest type and disturbance history information from API and MANHIC logging history information.
	Search Words:	FORESTS; VEGETATION; Mapping
	Geographic extent, Name(s):	LNE Region
	Geographic extent, Polygons	
	Type of feature:	raster
	Attribute/Field List:	1-Candidate Old-growth Forest 2-Disturbed Old Forest 3-Mature Forest 4-Disturbed Mature Forest 5- Young Forest 6-Recently Disturbed Forest 7-Rainforest
	Attribute/Field Description:	Value - Derived successional Stage identifier, Count =area in hectares
	Scale/Resolution:	1: 25000
DATASET CURRENCY	**Beginning date:**	Earliest date of photos 28/2/1986
	Ending date:	Last date of logging history Feb 1998

DATASET STATUS	**Progress:**	Complete
	Maintenance and update frequency:	Not planned
DATASET ENVIRONMENT	**Software:**	Arc/Info / ArcView
	Computer Operating System:	Digital Arc/Info 7.2.1 under SunOS Windows NT
	Dataset Size:	0.9 MB
ACCESS	**Stored Data Format:**	Digital Arc/Info 7.2.1 under SunOS
	Available Format Type:	Digital - Arc/Info, Arc View Grid file
	Access constraints:	No restrictions
DATA QUALITY	**Lineage:**	The Candidate old-growth forest and other successional stage layer was derived using the corrected IAP derived successional stage layer from the relevant parts of the Northern and central IAP study areas. Successional stage information from the IAP for the LNE CRA area was updated with the rainforest from the LNE forest ecosystem layer. This area of rainforest was also used to update the BOGM layer from the IAP. A post photo logging layer was also generated by adding post March 1996 logging events to the IAP post photo layer. These three layers were then combined. Areas that were Oldgrowth and a sc growth stage became Mature Old Forest. Any areas that were post photo became Recently Disturbed. Grid cells of Candidate Old-growth forest equal to 1 ha were filtered from the layer and given the value of surrounding grid cells (majority area). Below is the lineage statement for the IAP BOGM layer. Data collection Data were generated by API of forest growth stage using 1:25 000 scale contour aerial photographs. The study area was split into 35 different Management Units. Management Units were geographical areas delineated for the management of photo preparation, API, digitising and map preparation. Each Management Unit was allocated to an API interpreter for growth staging of National Park & Nature Reserve areas > 200 ha in size, State Forest and some Vacant Crown Land and Leasehold Land. Not all Vacant Crown Land and Leasehold Land was mapped (areas were selected for mapping on the basis of size and proximity to adjacent mapped National Park and State Forest). Sixteen Air Photo Interpreters were involved. The growth stage coding was undertaken according to a specific API pathway or decision tree based around a minimum polygon size of 25 ha. The API pathway involved deleting non-eucalypt forest, rainforest and

recently logged forest in addition to growth staging the remaining forest. This was achieved by estimating the projected crown cover according to three classes; <10, 10-30 and >30 percent of both the regrowth and senescent components of the forest.

The pathway also included a disturbance judgement as well as a confidence assessment.

Data verification

A final check of the API work was undertaken by SFNSW. The checking procedure was conducted by three teams of two API experts from SFNSW. The level of agreement between the interpreters coding checkers coding was assessed using a matrix scoring proforma.

Where agreement was below a nominal 70 percent linework was revised.

Disturbance history data collection and mapping

Information on disturbance history was collected from all available sources. Logging disturbance history data for State Forests and some National Parks were available from the North East Forests Biodiversity Study (NEFBS)

and a GIS layer (representing year of most significant recent logging event) for logging operations up until 01 Oct 1992. SFNSW provided additional data on logging during the period 01 Oct 1992 to 01 Oct 1995. These

records were digitised and imported into the GIS coverage of growth stage. Logging history records between 01 Oct 1995 and 01 Feb 1996 were collected and digitised separately by SFNSW. For some State

Forests Management Areas logging history details between 01 Oct 1995 and 30 Mar 1996 were provided by the SFNSW Wood Resources Study.

The above information was compared with the geographical coverage of aerial photo data within the GIS. The pre-1992 logging history was reclassified to represent areas as either known to be logged within the

last 30 years or areas known to be logged more than 30 years ago. Areas where logging occurred after photo date were imported into the growth stage layers and coded with an L indicating recent logging disturbance.

For areas logged prior to photo date API growth staging of recent logging disturbance was relied upon rather than the post 1992 logging layer.

Digitising and map preparation

For the majority of Management Units ground control points were established for all photos (full control). This allowed the establishment of a geographical coordinate system over the photo and the fitting of a Digital Terrain

		Model (DTM) to the linework. All growth staging linework on the aerial photo overlays was digitised using Digital Mapping Systems (DMS) single photo software and corrected to an accuracy of +/- 25m ground coordinate accuracy using the DMS software and a 100m resolution DTM provided by the NSW Land Information Centre. The data were then exported to a GIS where digitising errors were corrected. Further editing was undertaken after 1:25 000 scale draft maps were produced of the linework for each Management Unit. Major linework errors were corrected during this process. All polygons were then given an identifying point (centroid) which was allocated a code representing growth stage. A further check was undertaken by API staff for any coding or linework errors affecting large polygons (> 50 ha). Errors were corrected. A final check consisted of a random error check which examined 10 percent of randomly selected photographs which were fully checked for polygon coding errors and linework errors. If an error rate of 1 percent or greater was detected all polygons within that Management Unit were subjected to a full check. All errors were corrected prior to preparation of the final maps. Completed hard copy maps of all the units showing polygons, growth stage codes, State Forest and National Park Boundaries and Management Unit boundaries were produced.
	Positional accuracy:	Estimated at between 10 m to 100 m
	Attribute accuracy:	Visual checks were made of the final derived layer and no obvious anomalies spotted.
	Logical consistency:	One to one relationship between value and derived successional stage.
	Completeness:	Information is as complete as possible given availability of core datasets to end July 1998.
NOTES	**Notes:**	
METADATA DATE	**Metadata date:**	14/08/1998
METADATA COMPLETED BY	**Metadata sheet compiled by:**	Paul O'Connor
FURTHER INFORMATION	**Further information:**	RACAC 1996. Broad Old-growth mapping project: Final report. Unpublished report prepared by NPWS for the Resource and Conservation assessment Council