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Old-growth Forest Related Projects - Eden Region

A report undertaken for the NSW CRA/RFA Steering Committee

7 May 1998

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OLD-GROWTH FOREST RELATED PROJECTS - EDEN REGION

NSW NATIONAL PARKS AND WILDLIFE SERVICE

A report undertaken for the NSW CRA/RFA Steering Committee project number NE 29/EH

7 May 1998

Report Status

This report has been prepared as a working paper for the NSW CRA/RFA Steering Committee under the direction of the Environment and Heritage Technical Committee. It is recognised that it may contain errors that require correction but it is released to be consistent with the principle that information related to the comprehensive regional assessment process in New South Wales will be made publicly available.

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This project has been jointly funded by the New South Wales and Commonwealth Governments. The work undertaken within this project has been managed by the joint NSW / Commonwealth CRA/RFA Steering Committee which includes representatives from the NSW and Commonwealth Governments and stakeholder groups.

The project has been overseen and the methodology has been developed through the Environment and Heritage Technical Committee which includes representatives from the NSW and Commonwealth Governments and stakeholder groups. The project and subsequent report were coordinated and managed by Mr Paul O'Connor with GIS support from Mr Ed Knowles and Ms Leander Wiseman (NSW NPWS).

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 project. Thanks must go to all NPWS staff who worked on this project and the expert panel comprising Mr Bill Peel, Dr Tony Norton and Ms Jane Coram for their contribution to this project and cooperation with the difficult timelines imposed. Mr Bob Wilson also provided invaluable API advice. The assistance of the Bureau of Resource Sciences, Environment Australia, Resource and Conservation Division and State Forests of NSW with this project is also appreciated.

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1. EXECUTIVE SUMMARY

This report has been prepared for the joint Commonwealth/State Steering Committee which oversees 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 the major forests of New South Wales. These agreements will aim to provide for the ecologically sustainable management of the State's forests. It is planned to achieve this by establishing a conservation reserve system that is comprehensive, adequate and representative, and by applying ecologically sustainable practices in the commercial use of the forests. This report was undertaken to document the processes associated with the definition, identification and mapping of old-growth forest and other successional stages within the Eden CRA region. In particular the project aimed to identify forest that was both ecologically mature and where any effects of disturbance were now negligible as required by the Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee (JANIS) old-growth definition. The executive summary of the project outcomes is outlined below.

The Eden Old-growth project involved two stakeholder workshops to discuss project methodology and rule derivation in addition to two expert panel meetings and a two day reconnaissance trip to evaluate decision rule development. The rules developed during this project represent a refinement of the approach adopted during the Interim Assessment Process (IAP). The expert panel was not able to completely resolve the issue of old-growth definition rules and there was not consensus amongst stakeholders concerning the allocation of some aerial photograph interpreted (API) growth stage codes to the 'candidate old-growth class'. The chairs of the Environment and Heritage Technical Committee resolved the old-growth code allocation by deciding that sA, in addition to the codes tA, tB and tC nominated by the expert panel (and agreed to by stakeholders), would be considered candidate old-growth forest.

The layer representing old-growth and other successional stages for the Eden CRA region was derived using a set of rules which integrated vegetation types (assigned interpretability classes), API mapped growth stage attributes and logging history information. Within the Eden CRA region 20% (106 536 hectares) was identified as Candidate Old-growth, 1% (7555 hectares) as Disturbed Old Forest, 32% (171 489 hectares) as Mature Forest, 4% (22 969 hectares) as Disturbed Mature Forest, 23% (124 855 hectares) as Young Forest, 8% (44 551 hectares) as Recently Disturbed Forest and 2% (11 154 hectares) as Rainforest. Candidate Old-growth Forest was comprised of the following growth stage codes (see below for coding explanation); tA (16.4%); tAF, (.5%), tB (51.3%); tBF (.6%), tC (16.9%), tCF (.1%), SA (10.9%) and SAF (2.1%).

More candidate old-growth forest was mapped during this exercise (20% of CRA study area) compared with the IAP (14% of IAP study area). This is primarily due to much more of Wadbilliga National Park being growth staged during this assessment and a much higher proportion (51.5%) of the tB growth stage code being mapped in this exercise than during the IAP (33%). Smaller minimum mapping units also contributed to the increase in candidate old-growth forest mapped during this project.

Candidate old-growth forest has a highly fragmented distribution within the Eden CRA region. Most stands occur in a highly complex mosaic of mature and younger forest. Generally the coastal stands are smaller and more disjunct than on the escarpment. The largest stands are found in Wadbilliga, Tantawangalo, Coolangubra and Ben Boyd National Parks together with Tantawangalo and Murrabrine State Forests.

The limitations of the Eden CRA old-growth assessment identified by the expert panel consisted of incomplete disturbance data sets, a lack of time to analyse all relevant information and to refine the layer iteratively with the benefit of field checking / validation. Consequently, the panel stated that the identification of candidate old-growth with more complete data sets may be more restrictive than that undertaken during the CRA process. This could mean that the amount of old – growth may have been over estimated due to a lack of accurate and detailed disturbance information. They also identified that limitations in the current data might mean that some forests not currently listed as candidate old-growth actually support old-growth characteristics that warrant them being assigned as such. The expert panel also advised that field checking of candidate old-growth areas be conducted prior to any tenure changes based on this attribute.

NB (Re growth stage coding): t = < 10% regrowth, s = 10-30% regrowth, A = > 30% senescence, B = 10 -30% senescence and C = < 10% senescence. F = fire disturbed.

1. INTRODUCTION

1.1 BACKGROUND

This project has essentially been a refinement of the Broad Old Growth Mapping Project (BOGMP) undertaken during the Interim Assessment Process (IAP). 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)

Specific details concerning previous old-growth studies in the Eden CRA region are contained in SFNSW (1994), NPWS (1996) and Burgman (1996).

It should also be noted that details regarding the conservation requirements of old-growth forest are not addressed in this report but rather in the report entitled Conservation and National Estate requirements for the Eden CRA region. Specific details regarding growth stage mapping or other components of the Eden Aerial Photography Interpretation Mapping Project are presented in that project report (NSW / Commonwealth Government 1988).

1.1.1 Process for identifying old-growth forest for this study

A project proposal was prepared for the Environment and Heritage Technical Committee (EHTC) and then approved by the CRA/RFA Steering Committee. This proposal reflected the content and structure of Project areas 3.3, 3.4 and 3.5 of the E&H Technical Framework.

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 Environment and Heritage Technical Committee 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 four times during the project, twice in association with stakeholder workshops. They were also 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 in addition to a phone hook up between members of the Environment and Heritage Technical Committee. 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 Environment and Heritage Technical Committee.

2. METHODOLOGY

2.1 DERIVATION OF AN OLD-GROWTH FOREST VARIATION LAYER

It was intended to use the Site Productivity Index (SPI) project associated with the Eden FRAMES projects 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).

A number of possible approaches were initially evaluated by Bureau of Rural Resources (BRS) to derive a site quality index layer: Further information can be obtained regarding the derivation of the layer for FRAMES related projects in NSW / Commonwealth Governments 1998 c Section 3.4.

1) development of a generalised site productivity index (basically a climate driven growth index) using monthly short wave radiation (SWR), evaporation (E), temperature, precipitation (P) and topographic position. This essentially gave a monthly water balance according to (P-E*SWR) and adjusted for the number of frost days / month.
2) climate data together with topographic data concerning upslope contributing area, slope and flow plus lithology data, that is, soil texture plus soil depth
3) above data combined with generalised additive modelling techniques and site height plot data to derive an index.

The expert panel in consultation with the Bureay of Resource Sciences (BRS), NSW National Parks and Wildlife Service (NPWS) and State Forests of NSW (SFNSW) agreed to evaluate the use of a generalised SPI (climate driven growth index) as this was what could be derived and delivered within the very tight timelines available for the old-growth work. It was decided by the panel that field evaluation of the climate driven index was required to evaluate its utility for assisting with defining ecological maturity

In evaluating the SPI layer the main issues identified were to compare the variability between the coast, escarpment and tablelands and to evaluate the overall range in productivity for canopy species and vegetation communities. Time available for field evaluation was restricted to around two days and therefore would cover only a limited number of sites. It was hoped that pending appropriate field validation / checking the SPI layer would be able to be used to assist decision rule splits within the variable interpretability class (see next section for outline of communities). The procedure for sampling involved identification of communities thought to be variable or which required review and which covered a range of geographic locations. The communities targeted are outlined in Appendix 3.1.

It was not considered practical to utilise the layer to assist with determining areas of negligible disturbance due to time constraints and the accuracy and reliability of the disturbance data sets for the Eden region.

2.2 DEFINITION OF ECOLOGICAL MATURITY

This process involved allocating growth stage codes to classes of ecological maturity. The broad classes which were used for the IAP as part of the BOGMP project were agreed to by the experts and stakeholders namely old-growth, mature and young forest.. Appendix 2.2.1 outlines all growth stage code combinations together with the associated proportions of regrowth, senescence and disturbance indicators used by the Eden CRA API project.

In order to assign API growth stage information to these classes the following classification was undertaken.

2.2.1 Development of interpretability classes

The reliability of aerial photographic interpretation of growth stage details varies according to species, site conditions, quality of photography and interpreter experience and skill. 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.

The growth stageability of species across a range of environmental site quality classes were recognised. Low, medium 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 medium 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.

Four interpretability classes were recognised, easy, difficult, variable and special case. 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). The variable interpretability class included species which could be Jacobsian or Non Jacobsian or somewhere in between dependent on the site.

Following review and modification of the above API classification by the most experienced interpreters a finalised list of species interpretability was produced. The results of this assessment are presented in Appendix 2.1. SFNSW and NPWS representatives, together with an expert API contractor, then allocated Keith and Bedward (1997) vegetation types to the above interpretability classes. This was done by using the updated community profile lists and assigning them on the basis of the interpretability of each likely canopy species to an interpretability class.

A number of types were difficult to decide on with regard to the 'interpretability class due to varying species behaviour. A subset of the Keith and Bedward vegetation types were prioritised for field

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

evaluation in relation to the Site Productivity layer. These were Keith and Bedward communities 71 (Subalpine Basalt Grass Forest), 24 (Subalpine Dry Shrub Forest), 22 (Numeralla Dry Shrub Woodland), 31 (Hinterland Dry Grass Forest), 19 (Bega Wet Shrub Forest), 44 (Foothills Dry Shrub Forest), 47 (Eden Dry Shrub Forest) and 46 (Lowland Dry Shrub Forest).

2.2.2 Allocation of growth stage codes to ecological maturity classes

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 JANIS ecological maturity is defined by the characteristics of the older growth stages. Table 2a gives an indication of the relative proportions of the seven primary growth stage combinations and whether these stands are dominated by senescing or mature forest. It was noted during the initial stakeholder workshop 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 Eden CRA region to aid the identification of ecological maturity and timeframes precluded the collection of such data for this project.

2.2.3 Identification of negligibly disturbed forest

Initial stakeholder workshop discussions

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 significance of disturbance.

- 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

TABLE 2A: API GROWTH STAGE CODES AND DEGREE TO WHICH STANDS ARE DOMINATED BY SENESCING OR MATURE COMPONENTS

Stand Attributes	Growth Stage	% of Regrowth, Mature & Senescent components
Dominant in Senescing	tA	0-10% regrowth, 0-60% mature, 30-100% senescing
	sA	10-30% regrowth, 0-40% mature, 30-90% senescing
Dominant in Mature	tB	0-10% regrowth, 60-90% mature, 10-30% senescing
	tC	0-10% regrowth, 80-100% mature, 0-10% senescing
	sB	10-30% regrowth, 40-80% mature, 10-30% senescing
	sC	10-30% regrowth, 60-90% mature, 0-10% senescing
Young	e codes	>30% regrowth and variable mature and senescing

- 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 'y' disturbance tagging together with logging and fire history Geographic Information Systems (GIS) coverages.

During the initial stakeholder workshop there was considerable discussion regarding the effects of fire events on the maturity of the understorey. Some members of the expert panel felt that fire events that altered the reproductive maturity of the understorey may preclude the forest being considered negligibly disturbed despite the presence of a senescent dominated (or co-dominant or subdominant) canopy.

The Conservation stakeholders strongly objected to any such definition. It was also noted that modelling the effects of disturbance on floristic communities to assist with and evaluate the

identification of negligible disturbance would not be possible given the available data sets for Eden.

The above issue regarding disturbance to the understorey was raised at the Environment and Heritage Technical Committee where it was decided on a without prejudice basis (for other CRA regions) not to apply the model of precluding classification of forests as candidate old-growth on the basis of understorey disturbance.

The Environment and Heritage Technical Committee requested information concerning disturbance history layers potentially available for the Eden CRA region and the derivation of old-growth. Table 2b below summarises available disturbance data for the Eden Old-growth project.

It should be noted that an additional broad disturbance history coverage based on earlier API photography from 1967 / 68 became available after the above list was discussed and after the disturbance rules had been formulated by the expert panel. This layer was being generated to assist the refining of fauna modelling and to potentially assist the delineating of earlier major fire events. It was undertaken in a short time frame and was not able to be validated, however, it is expected to be reasonably reliable given the disturbance classes used. It was never clear how under the JANIS old-growth definition how such a layer could be utilised in the decision rules for determining old-growth. The primary determinant according to the JANIS definition of old-growth is the current canopy structure and not what it may have experienced thirty or more years ago. This is not to say that past disturbance data is not potentially relevant to the derivation of old-growth, but that time and the nature of the data did not allow consideration / analysis of the data set in deriving the current layer.

Feedback from the API Manager (Resource and Conservation Division, Department of Urban Affairs and Planning) advised the expert panel that lack of a 'y' tag did not necessarily indicate a lack of disturbance. He also advised that the under interpretation of regrowth within areas mapped as recently logged 'L' areas during the IAP would give an incorrect derived successional stage class if a similar classification to the IAP was adopted. It was noted that this could be accommodated for in a straightforward way in the decision rules and the expert panel adopted the API Managers advice.

TABLE 2B: SUMMARY OF DISTURBANCE HISTORY DATA AVAILABLE FOR THE EDEN CRA REGION.

Data Layer	Held by	Tenure	Coverage Type	Limitations
Logging history from 1970 - August 1997. Linework of comp boundaries only. Year of harvest and proportion of coupe logged.	SFNSW	State Forest tenure only and parts of some recently declared National Parks	Digital coverage Coupe level resolution	Does not reflect net harvested area of past logging operations
Pre-1970 logging history information for Murrah, Mumbulla and Tanja and some other State Forest	SFNSW NPWS	State Forest	Paper copies only. Often a list of coupes and decade or year logged.	Of unknown reliability and of same spatial limitations as post 1972 layer
Fire History from Eden EIS and NPWS Fire History Layer	SFNSW NPWS	State Forest and National Park	Digital	Broad EIS Fire History Maps
API Growth Stage Mapping Project disturbance notation including obvious fire and logging disturbance	NPWS	All tenures	Digital	Subjective tag difficult to quantify and apply accurately and consistently even across a range of experienced interpreters.

Draft decision rules concerning disturbance

The expert panel reviewed the assignment of disturbance level in terms of negligible, significant or no disturbance and origin as natural or unnatural for integrated harvesting post 1970, selective harvesting post 1960, fire and no known record of disturbance. These draft tables (see Appendices 2.2.2 - 2.2.8) were circulated to stakeholders for comments and form the basis for the disturbance assessment.

They can be simply summarised by noting firstly that any growth stage polygon with a 'y' tag denoted obvious logging disturbance could not be considered candidate old-growth forest. Furthermore, the existence of a historic logging history record or fire history record did not

generally preclude an area being considered candidate old-growth forest if the current canopy structure reflected the appropriate proportions of senescence and regrowth. It was considered by the expert panel that in relation to the API growth stage the most reliable indicator of current canopy structure in relation to both integrated harvesting and past catastrophic fire records. This was due to a lack of accurate spatial extent of the disturbance events and any reliable associated intensity information with which to undertake further analysis within the timeframe available. This approach was consistent with recent published thinking regarding the use of fire indicators on their own to exclude stands from consideration as old-growth will lead to errors in the classification of old-growth (Burgman 1996) and directives from the Environment and Heritage Technical Committee re consideration of sub canopy disturbance information. Limitations regarding the assignment of disturbance levels as identified by the expert panel are contained in Section 4 of Appendix 4.1.

The experts identified that any growth stage code exhibiting a trace level (< 10%) of regrowth should be considered negligibly disturbed forest. There was considerable discussion about the 's' regrowth band representing the 10 - 30% regrowth range. It was raised that stands containing lower levels of regrowth within this band would contain most or all of the characteristics of candidate old-growth forest and similarly stands with higher levels generally would not warrant consideration as old-growth. It was acknowledged that there was no ability to discriminate between these stands without further API.

There was not stakeholder consensus concerning the allocation of 's' regrowth codes to candidate old-growth status. An attempt was made to examine the frequency distribution of growth stage classes for each Keith and Bedward vegetation community in areas with no logging history. This information was produced and circulated to stakeholders for a phone hook -up to resolve the issue of what stands may be limited by site conditions and natural disturbance regimes and could reasonably be considered the oldest stands for a particular vegetation type. An example of this information for a subset of vegetation types is contained in Appendix 2.3. The expert panel were unable to review the information in any considered fashion due to time constraints except for commenting that a more detailed analysis would be required to identify the above. Stakeholders reviewed the information and identified a range of options for deliberation on by the co-chairs of the Environment and Heritage Technical Committee.

2.3 IDENTIFICATION AND DELINEATION OF CANDIDATE OLD-GROWTH FOREST

The draft decision rules associated with the GIS overlay of API growth stage and disturbance data, logging history and interpretability information is outlined in Table 2c. A decision was made by the Environment and Heritage Technical Committee co-chairs concerning the inclusion of 'sA' as these stands are dominated by senescing trees and it represented a compromise position between the various interest groups.

Concerns had been expressed by SFNSW staff during the expert panel meetings that natural patterns of 'sA' would occur in the south east corner of the study area as a result of small 10 hectares post 1972 patchwork logging operations and retention of non commercial species. Limited field observations during the site quality layer reconnaissance trip backed up this point. Consequently the inclusion of 'sA' in the candidate old-growth category was made subject to non coincidence with a post 1972 logging history record. Summary statistics for successional stages in relation to API growth stage codes, Post 1972 logging History, patch size class and Keith and Bedward Vegetation types will be provided in the results section for information purposes.

TABLE 2C: DRAFT DECISION RULES FOR THE DERIVATION OF CANDIDATE OLD-GROWTH FOREST AND OTHER SUCCESSIONAL STAGES.
Note allocation of unassessed or 'U' codes to successional stages followed the BOGMP precedent (see NPWS 1996).

Successional Stage	Interpretability Class	
	Easy	**Variable and Difficult**
COGF	tA, tAf, tB, tBf, sA, sAf, tU, sU, uU	tA, tAf, tB, tBf, tC, tCf, sA, sAf, tU, sU, uU
DOF	tAy*, tAfy * tBy*, tBfy*, sAy* (plus logging record), sAfy * * only when areas not coincident with BOGMP L code areas	tAy*, tAfy*, tBy* tBfy*, sAy* (plus logging record), sAfy*, tCy*, tCfy* * only when areas not coincident with BOGMP L code areas
MF	tC, tCf, sB, sBf, sC, sCf, uC	sB, sBf, sC, sCf, uC
DMF	tcy, tCfy, sBy, sBfy, sCy, sCfy	sBy sBfy, sCy, sCfy
YF	all e classes less y tag	all e classes less y
RDF	all e classes with y tag plus asterisked codes from DOF coincident with BOGMP L code areas as well as areas logged post photo and areas classified as cleared between 1994 and 1997 using change detection image analysis from Landsat TM	all e classes with y tag plus asterisked codes from DOF coincident with BOGMP L code areas as well as areas logged post photo and areas classified as cleared between 1994 and 1997 using change detection image analysis from Landsat TM

2.4 ACCURACY ASSESSMENT OF GROWTH STAGE MAPPING

The API interpreters who did the accuracy evaluation were both employees of SFNSW and were endorsedby the API Expert Working Group (APIEWG). Both interpreters had previously worked on the BOGMP and one had worked on the BOGMP desktop audit.

Survey intensity was spread evenly over the region.

The API validation was assessed according to the heritage of API polygons, therefore:

- Original: BOGMP polygon remains unchanged after CRA re-evaluation.
- Changed Code: BOGMP polygon code has changed.
- New Polygon and Code: Additional polygon has been inserted into the BOGMP layer.
- Combined: Additional of all polygons regardless of API heritage.

Level of agreements were assessed for both growth stage and disturbance assessments. For further discussion see NPWS 1998a.

3. RESULTS

3.1 OLD-GROWTH FOREST VARIATION LAYER

3.1.1 Climate driven Site Productivity Index (SPI) layer

The SPI layer derived for evaluation in the project is contained in Map 3a. The targeted 'variable' vegetation communities checked in the field and the results of the field evaluation are contained in Appendix 3.1. The SPI index was consistent with changes in aspect and topography encountered in the field at the local level and with the qualitative assessment of site quality by the API interpreter (Bob Wilson) present on site. Appendix 3.1 indicates two columns relating to the SPI index. The Qualitative SPI index was assigned to the site using field examination of the digital layer or from a 1:125000 scale overview map split into 5 classes. The SPI index column contains a value for the SPI obtained from the AMG attributed to each site gleaned from the SPI layer after the field trip (note that there may be some georeferencing problems as a GPS was not able to locate better than +/- 300 metres in some cases and there may have been some sites incorrectly georeferenced in the field). Sites where most error is anticipated are indicated with an asterisk. Overall 83% of the Qualitative API assessment of site quality agreed with the qualitative assessment of the SPI index in the field and 8% partial agreement and 8% disagreement. The range in SPI for the Low API Environmental Site Quality (ESQ) areas was 23 - 44, Moderate API ESQ areas was 23 - 55 and High API ESQ areas was 23 - 33.

The above results indicated considerable overlap between what in the field were consistently distinguishable sites and stands. The impression gained the visiting field sites by Bill Peel was that the layer lacked regional calibration.Consequently the use of the index to determine cut points in terms of allocating 'variable interpretability' vegetation communities to either the easy or difficult interpretability classes was considered inappropriate. Due to a decision not to proceed with use of the layer by the expert panel no subsequent analysis has been undertaken of the overall distribution of SPI against the easy, difficult and variable interpretability classes. A SPI layer which integrates lithology information, soil water holding capacity and site height data may give better results. It was not possible to derive this layer within the time frames associated with this project and due to problems encountered by BRS in using the site height data.

3.2 DEFINITION OF ECOLOGICAL MATURITY

3.2.1 Interpretability classes

Table 3a contains the allocation of Keith and Bedward vegetation types to interpretability classes. Further detail regarding the vegetation communities can be found in Keith and Bedward (1997) together with the Eden Vegetation Mapping Project report (see NSW / Commonwealth Government 1998b). A list of the Eucalypt Keith and Bedward type numerical and name identifiers is contained in Table 3f. The distribution of these interpretability classes across the Eden CRA region is outlined in Map 3b. The areal extent of these interpretability classes are as follows: Easy 274 333 hectares representing 51% of the total vegetated area, Difficult 82 469 hectares or 15% of the total vegetated area, Variable 158 118 hectares or 29% of the total vegetated area and Special Case covering 22 009 hectares or 4.1%.

Map 3a: Site Productivity Index for the Eden CRA Region

Map 3b: Distribution of Interpretability Classes used in project

TABLE 3A: THE CLASSIFICATION OF KEITH AND BEDWARD VEGETATION COMMUNITIES TO INTERPRETABILITY CLASSES

Interp Class	Keith and Bedward Vegetation Communities
Easy	9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 28, 29, 32, 33, 35, 41, 42, 43, 49, 82, 84
Variable	3, 19, 20, 21, 22, 25, 26, 27, 30, 31, 34, 44, 45, 48, 58, 79, 81, 85, 86
Difficult	24, 36, 37, 46, 47, 50, 71, 72, 83
Special Case	1, 2, 4, 5, 6, 7,8, 23, 38, 39, 40, 51, 52, 53, 54, 55, 56, 57, 59, 60, 61, 63, 64

3.2.2 Identification of areas of negligible disturbance

For further discussion regarding the approach adopted during this project is outlined in Section 2.2.3.

The post 1972 logging history is outlined in Map 3c. The areas associated with areas logged since 1972 is contained in Table 3b. Areas associated with particular growth stage codes are presented in Table 3c. Appendix 4.1 contains the Expert panel report. Readers are referred to section 4 of this report for a discussion on limitations associated with disturbance levels. It should be noted that the inaccuracies in the post 1972 logging history layer which were identified during the Eden negotiations have been accounted for in the derivation of the current old-growth layer.

3.3 IDENTIFICATION AND DELINEATION OF OLD-GROWTH FOREST

3.3.1 Delineation of successional stages

The rule set discussed in Section 2.3 was applied to define the range of successional stages previously discussed. These stages together with areas which were not growth staged and rainforest complete the old-growth layer. A schematic outlining the GIS data sets and unions adopted in deriving the old-growth layer is presented in Appendix 3.2. A brief explanation of the primary GIS covers outlined in Appendix 3.2 is contained in Appendix 3.3. The Arc Info AML used in deriving the Old-growth layer is presented in Appendix 3.4.

Map 3d outlines the distribution of candidate old-growth forest and other successional stages.

Summary statistics for successional stages is provided. The area of successional stages by API growth stages is presented in Table 3c. Table 3d provides the breakdown of areas of successional stages by broad tenure class.

Map 3c presents post 1972 logging history overlayed with candidate old-growth forest. Table 3b presents areas of each successional stage by post 1972 logging history. Map 3e outlines candidate old-growth forest with areas that were derived from 'sA' growth stage polygons highlighted and 'tC' polygons from the variable interpretability class. Map 3f identifies the patches of candidate old-growth forest < 500 hectares, 500 - 999 hectares and >1000 hectares. The following explanation details how patches were derived for this analysis.

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 and orthogonal' option was used. See below:

Before "regiongroup" (all one value - black) After "regiongroup" (different values - greys)

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

This allows Arcview to then select patches based on area. This was done for Candidate Old-growth to divide it into patches < 500 hectares (< 500 cells), >= 500 and < 1000 hectares(>= 500cells and <1000 cells) and >= 1000 hectares (>= 1000 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 3e contains the areas of each successional stage for eucalypt Keith and Bedward vegetation communities while Figure 3a outlines the areas of candidate old-growth forest for each Keith and Bedward vegetation type graphically.

Map 3c: Post 1972 logging history overlayed by Candidate Old-growth Forest

TABLE 3B: AREAS OF DIFFERENT SUCCESSIONAL STAGES WITH A POST 1972 LOGGING HISTORY

	Successional Stage								
Year of Logging	**Areas Not Growth Staged**	**Candidate Old-growth Forest**	**Disturbed Old Forest**	**Mature Forest**	**Disturbed Mature Forest**	**Young Forest**	**Recently Disturbed Forest**	**Rain-forest**	**Total**
1972	16	7	0	36	0	795	7	5	**866**
1973	293	311	0	405	0	3078	19	40	**4146**
1974	184	164	0	547	0	2416	6	21	**3338**
1975	718	334	0	500	0	2794	85	62	**4493**
1976	286	554	0	637	0	3321	22	25	**4845**
1977	65	239	13	565	90	2817	104	81	**3974**
1978	14	156	11	481	256	1800	219	111	**3048**
1979	48	132	16	354	27	1827	130	66	**2600**
1980	47	94	34	425	467	2321	191	54	**3633**
1981	41	54	28	392	162	1779	287	35	**2778**
1982	35	170	115	622	272	2569	335	57	**4175**
1983	36	316	144	522	217	804	669	22	**2730**
1984	84	182	88	633	245	1766	612	39	**3649**
1985	47	316	100	652	245	2068	383	48	**3859**
1986	31	297	43	674	235	1988	1012	46	**4326**
1987	75	140	12	380	76	858	1012	5	**2558**
1988	131	496	53	693	441	760	1874	24	**4472**
1989	7	337	179	604	156	500	1920	19	**3722**
1990	25	128	102	424	72	302	1676	25	**2754**
1991	32	181	12	423	161	178	2419	24	**3430**
1992	23	180	25	292	101	62	2026	11	**2720**
1993	3	109	32	267	77	87	1656	21	**2252**
1994	5	182	8	149	12	112	3938	27	**4433**
1995	12	77	6	80	35	202	3842	32	**4286**
1996	21	25	9	133	16	156	3842	37	**4239**
1997	6	4	11	50	4	123	2331	1	**2530**
Total 1972 - 1997	**2285**	**5185**	**1041**	**10940**	**3367**	**35483**	**30617**	**938**	**89856**
4000 (PMP Corridors)	1977	5164	344	8447	523	7058	815	926	**25254**
Total	**4262**	**10349**	**1385**	**19387**	**3890**	**42541**	**31432**	**1864**	**115110**
Total Area of Successional Stage within Eden Region	**47961**	**106536**	**7555**	**171489**	**22969**	**124855**	**44551**	**11154**	**537070**
% of each SS with a known post 1972 logging history	**5**	**5**	**14**	**6**	**15**	**28**	**69**	**8**	**17**

TABLE 3C: AREAS OF API GROWTH STAGE CLASSES BY BROAD SUCCESSIONAL STAGE

API Growth Stage Code	Areas not Growth Staged	Candidate Old Growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently Disturbed Forest	Rain-forest	Total
'e'	0	0	0	1	0	16985	702	11	**17701**
'eA'	0	0	0	0	0	3379	77	8	**3465**
'eAF'	0	0	0	0	0	235	0	0	**236**
'eAY'	0	0	0	0	0	0	21	0	**21**
'eB'	0	0	0	0	0	16587	424	29	**17041**
'eBF'	0	0	0	0	0	2358	89	0	**2448**
'eBY'	0	0	0	0	0	0	701	0	**701**
'eC'	0	4	0	4	0	81374	3502	175	**85062**
'eCF'	0	0	0	0	0	3546	38	5	**3590**
'eCY'	0	0	0	0	0	0	762	0	**762**
'eF'	0	0	0	0	0	168	0	0	**169**
'eY'	0	0	0	0	0	0	4128	3	**4130**
'eYF'	0	0	0	0	0	0	37	0	**37**
'L'	0	0	0	0	0	0	18286	14	**18300**
'NON_EUC'	12910	3	0	2	1	2	287	80	**13285**
'OUT'	28212	0	0	2	0	1	134	62	**28413**
'pO'	3900	0	0	0	0	0	153	16	**4069**
'pR'	2154	0	0	0	0	0	0	8	**2162**
'RAIN'	147	62	8	97	17	34	36	10186	**10587**
'sA'	0	11630	147	0	0	0	267	55	**12101**
'sAF'	0	2186	48	0	0	0	0	11	**2245**
'sAY'	0	0	640	0	0	0	112	3	**755**
'sAYF'	0	0	18	0	0	0	0	0	**18**
'sB'	0	3	0	71214	0	12	3981	172	**75384**
'sBF'	0	0	0	2648	0	1	320	6	**2975**
'sBY'	0	1	0	0	9662	2	886	38	**10591**
'sBYF'	0	0	0	0	340	0	34	0	**375**
'sC'	0	2	1	65598	0	20	4095	114	**69831**
'sCF'	0	0	0	1599	0	0	63	2	**1665**
'sCY'	0	0	0	0	10477	1	572	34	**11084**
'sU'	0	12	0	0	0	0	0	0	**12**
'tA'	0	17517	0	0	1	1	494	125	**18138**
'tAF'	0	552	0	0	0	0	0	2	**554**
'tAY'	0	0	727	0	0	0	196	4	**928**
'tAYF'	0	0	13	0	0	0	0	0	**13**
'tB'	0	54674	0	5	0	9	1358	216	**56264**
'tBF'	0	617	0	0	0	0	0	0	**617**
'tBY'	0	0	4258	0	1	1	1140	14	**5417**
'tBYF'	0	0	197	0	0	0	186	0	**383**
'tC'	0	17967	3	23445	6	26	956	139	**42543**
'tCF'	0	107	0	35	0	0	0	0	**143**
'tCY'	0	4	1517	4	2438	0	286	11	**4260**
'tU'	0	68	0	0	0	0	0	0	**68**
'uC'	0	0	0	6800	0	0	34	0	**6833**
'UNKNOWN'	1125	0	0	0	0	0	0	4	**1130**
'uU'	0	1127	0	0	0	0	61	1	**1190**
Total	**48452**	**106539**	**7579**	**171459**	**22946**	**124747**	**44422**	**11552**	**537697**

Map 3d: Distribution of Candidate Old-growth Forest and other successional stages

TABLE 3D: AREAS OF SUCCESSIONAL STAGES BY TENURE CLASS

Successional Stage	'Leasehold Crown Land'	'National Park / Nature Reserve'	'Other Crown Land'	'Private Land'	'Reserved Crown Land'	'State Forest Plantation'	State Forest	Total
Areas Not Growth Staged	214	8097	321	26964	248	5912	6219	47975
Candidate Old Growth Forest	1381	59600	913	19202	1357	237	23864	106558
Disturbed Old Forest	45	3088	77	1375	34	19	2919	7558
Mature Forest	2066	77034	1646	34027	2391	551	53833	171551
Disturbed Mature Forest	262	5784	53	8306	168	187	8214	22973
Young Forest	757	36220	594	22917	857	664	62894	124904
Recently Disturbed Forest	36	7219	74	3039	102	119	33973	44562
Rainforest	6	5418	9	2309	104	11	3293	11151
Total	**4768**	**202460**	**3686**	**118139**	**5260**	**7700**	**195209**	**537232**

TABLE 3E: AREAS OF DIFFERENT SUCCESSIONAL STAGES (SS) WITHIN DIFFERENT SLOPE CLASS AND THE PERCENTAGE OF TOTAL SS WITHIN EACH SLOPE CLASS

Successional Stage (SS)	Slope Class					
	flat (0-8 degrees)	low - mod (9-16 deg.)	moderate (17-24 deg.)	steep (25-33 deg.)	very steep (>33 deg.)	Total
	Area (hectares) of total SS within a slope class					
Areas Not Growth Staged	20848	17571	5773	2646	1123	47961
Candidate Old-growth Forest	27967	31530	23839	16809	6391	106536
Disturbed Old Forest	2255	2742	1832	657	69	7555
Mature Forest	46997	58540	38411	21918	5623	171489
Disturbed Mature Forest	7195	9414	4970	1298	92	22969
Young Forest	39687	46208	25066	10947	2947	124855
Recently Disturbed Forest	16519	18734	7616	1576	106	44551
Rainforest	1368	3139	3451	2556	640	11154
Total	**162836**	**187878**	**110958**	**58407**	**16991**	**537070**
	Percentage (%) of total SS within a slope class					
Areas Not Growth Staged	43	37	12	6	2	100
Candidate Old-growth Forest	26	30	22	16	6	100
Disturbed Old Forest	30	36	24	9	0	100
Mature Forest	27	34	22	13	3	100
Disturbed Mature Forest	31	41	22	6	0	100
Young Forest	32	37	20	9	2	100
Recently Disturbed Forest	37	42	17	4	0	100
Rainforest	12	28	31	23	6	100
% of Total within Slope Class	**30**	**35**	**21**	**11**	**3**	**100**

Map 3e: Candidate Old-growth Forest overlayed by 'sA' and 'tC' growth stage polygons

Map 3f: Candidate Old-growth Forest grouped into three 'indicative' patch sizes

TABLE 3F: AREAS OF CANDIDATE OLD-GROWTH FOREST AND OTHER SUCCESSIONAL STAGES FOR EUCALYPT KEITH AND BEDWARD VEGETATION TYPES WITHIN THE EDEN CRA REGION

Keith and Bedward Vegetation Type		Areas Not Growth Staged	Candidate Old Growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently Disturbed Forest	Rain-forest
9	Mountain Wet Layered Forest (*Eucalyptus nitens*)	43	431	226	466	144	295	188	6
10	Mountain Wet Layered Forest (*Eucalyptus fastigata*)	1103	3817	477	4737	1636	2694	3210	106
11	Tantawangalo Wet Shrub Forest	29	208	110	214	105	75	57	3
12	Mountain Wet Fern Forest	49	570	82	904	76	160	382	7
13	Hinterland Wet Fern Forest	1778	9455	581	17741	1530	8966	2589	447
14	Hinterland Wet Shrub Forest	1182	4047	188	9677	881	7559	1674	345
15	Mountain Wet Herb Forest	680	5793	856	9427	2812	3975	6310	29
16	Basalt Wet Herb Forest	656	1692	370	3046	1334	2420	2225	14
17	Flats Wet Herb Forest	859	276	11	1149	447	422	223	7
18	Brogo Wet Vine Forest	692	419	77	1617	119	1166	0	63
19	Bega Wet Shrub Forest	7573	2813	182	4293	537	3152	327	110
20	Bega Dry Grass Forest	1034	358	23	1005	21	492	13	30
21	Candelo Dry Grass Forest	102	482	3	435	110	130	3	4
22A	Monaro Dry Grass Forest	39	804	0	2070	5	279	0	0
22B	Numeralla Dry Shrub Woodland	275	2386	71	2708	373	1558	165	0
23B	Monaro Basalt Grass Woodland	48	555	21	448	115	368	41	0
24	Subalpine Dry Shrub Forest	1020	8591	549	7064	1424	3250	1350	1
25	Sandstone Dry Shrub Forest	0	183	0	489	0	50	60	0
26	Tableland Dry Shrub Forest	2575	1481	111	5665	242	3849	3062	3
27	Waalimma Dry Grass Forest	12	71	24	337	9	595	275	0
28	Wog Wog Dry Grass Forest	385	76	0	139	0	550	146	0
29	Nalbaugh Dry Grass Forest	57	206	22	533	214	259	584	1
30	Wallagaraugh Dry Grass Forest	289	80	1	461	11	187	114	0
31	Hinterland Dry Grass Forest	4663	5088	899	10106	1414	5120	3474	87
32	Coastal Dry Shrub Forest (*Eucalyptus longifolia*)	295	2531	470	7282	2886	6848	1773	168
33	Coastal Dry Shrub Forest (*Eucalyptus muelleriana*)	409	2849	108	8009	182	2556	1726	142
34	Brogo Dry Shrub Forest	260	3025	603	3718	1579	2681	672	245
35	Escarpment Dry Grass Forest	7678	5119	288	7833	1939	2498	330	272
36	Dune Dry Shrub Forest	0	136	1	64	2	52	8	0
37	Coastal Dry Shrub Forest (*Angophora floribunda*)	1061	3078	37	4286	111	4885	532	41
41	Mountain Dry Shrub Forest (*Eucalyptus fraxinoides*)	132	335	59	514	53	597	157	13
42	Coastal Dry Shrub Forest (*Eucalyptus obliqua*)	1167	1860	29	6881	156	8729	3014	56
43	Mountain Dry Shrub Forest (*Eucalyptus cypellocarpa*)	3	517	4	1656	2	242	56	1
44	Foothills Dry Shrub Forest	27	744	16	1237	34	432	596	5
45	Mountain Dry Shrub Forest (*Eucalyptus sieberi*)	49	362	5	545	163	460	285	8

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Keith and Bedward Vegetation Type		Areas Not Growth Staged	Candidate Old Growth Forest	Disturbed Old Forest	Mature Forest	Disturbed Mature Forest	Young Forest	Recently Disturbed Forest	Rain-forest
46A	Timbillica Dry Shrub Forest	1066	1870	0	4899	218	10191	4719	25
46B	Lowland Dry Shrub Forest	421	4772	427	5307	395	2401	442	48
47	Eden Dry Shrub Forest	424	4394	113	4673	86	6560	353	152
48	Bega Dry Shrub Forest	54	784	108	984	597	1602	223	47
49	Coastal Dry Shrub Forest (*Eucalyptus agglomerata*)	971	3498	89	9995	369	14276	2221	130
50	Genoa Dry Shrub Forest	21	878	11	1153	4	264	129	1
58	Swamp Forest	246	114	5	428	3	182	71	0
W1	Wadbilliga Dry Shrub Forest	1178	11181	26	8006	12	6579	117	147
W2	Wadbilliga Range Ash Forest	139	401	0	173	0	175	0	2
W4	Wadbilliga Range Wet Forest	205	1324	32	921	59	283	106	7
W5	Wadbilliga Gorge Dry Forest	329	2056	28	2865	64	1516	0	43
W6	Wadbilliga River Valley Forest	27	541	22	780	34	374	18	34

3.4 ACCURACY ASSESSMENT OF API

As part of the Eden API growth stage mapping an independent accuracy assessment was commissioned by the API Expert Working Group. Summary results of this assessment are presented in Tables 3g and 3h. Further more detailed information is contained in the Eden API report (see NSW / Commonwealth Government 1998a). Section 4.2 contains some summary discussion of these results.

TABLE 3G: SUMMARY OF COLLATED INDEPENDENT AGREEMENT ASSESSMENT FOR ATTRIBUTES OF FINAL GROWTH STAGE MAP, EDEN CRA

Code Group from Old-growth Project	Number of Polygons	
	Growth Stage Map	Independent Validator
tA, tB, sA	528 (30%)	505 (28%)
tC, sB, sC	891 (50%)	891 (50%)
e	261 (15%)	297 (17%)
L	102 (5%)	89 (5%)
Total	1782 (100%)	1782 (100%)

TABLE 3H: LEVEL OF AGREEMENT MATRIX FOR EDEN API IN RELATION TO OBVIOUS VISIBLE DISTURBANCE

Final Growth Stage API Map Validator	No evidence of Disturb-ances.	Evidence of Logging	Evidence of Fire	Total
No evidence of Disturbances	1473	25	25	1523
Evidence of Logging	116	119	1	236
Evidence of Fire	6	7	10	23
Total	1595	151	36	1782

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 Eden Old-growth expert panel report. This report is presented in full in Appendix 4.1 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 Eden region.

This study identified just over 106 500 hectares (20% of mapped area) of candidate old-growth forest, 7555 hectares (1%) of disturbed old forest, 171 489 hectares (32%) of mature forest, 22 969 hectares of disturbed mature forest (4%), 124 855 hectares of young forest (23%) and 44 551 hectares (8%) of recently disturbed forest. In addition 47 961 hectares were not growth staged due to being predominantly non forest, for example, rock, heath, swamp etc and 11 154 hectares (2%) was classified as Rainforest. 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 not growth staged and rainforest.

Additional discussion in relation to the distribution of successional stages and Interpretability classes, Logging History, API Growth Stage, Vegetation type and Patch size is made below.

Interpretability Classes

Over 50% of the area within the Eden CRA region was classified as Easy to interpret. The Difficult, Variable and Special Case classes accounted for 15%, 29% and 4% respectively (see Table 3a). Around 43% of candidate old-growth forest is found within the Easy interpretability class and 24% within the difficult interpretability class. Approximately 32 000 hectares or 30% of the total candidate old-growth forest identified is found within the variable interpretability class.

The variable interpretability class is characterised by containing Myrtaceous species which behave differently in terms of their growth stage and / or because there are variations in growth stage across different site qualities. Within areas classified as variable interpretability the 'tC' code in addition to the codes outlined in Table 2c for the Easy class also defines candidate old-growth.

The candidate old-growth forest within the variable interpretability class was composed of 25 244 hectares of tA, tB, sA combined and 6773 hectares of tC. It is possible that the 6773 hectares of tC / tCf may overestimate the distribution of candidate old-growth dependent on the site conditions and dominant species on these sites. If, on these sites the species display predominantly Jacobsian characteristics then the classification of these areas as Candidate Old-growth rather than Mature forest is invalid. It is also possible that these 'tC' stands are predominantly Non Jacobsian and appropriately classified as Candidate Old-growth. These stands obviously pose interpretation difficulties due to site conditions. Map 3d indicates that most of the variable 'tC' old-growth is found in Wadbilliga National Park with some other stands in Tantawangalo State Forest. It should be noted that during the decision rule development it was agreed

that these sources of candidate old-growth would be identified separately from other candidate old-growth forest (see Map 3d). It should also be noted that during discussions there was no stakeholder opposition to this issue, as opposed to the 's' regrowth issue about which there was considerable diversity in opinion.

A summary of assumptions and issues relating to interpretability classes is contained in Section 2 of the expert panel's report (see Appendix 4.1).

Areas classified as negligibly disturbed using post 1972 Logging History.

It should be noted that a more sophisticated approach to identifying negligibly disturbed forest and significantly disturbed forest would ideally involve analysis of a more complete range of accurate disturbance data sets which were unavailable for Eden. Such analyses could examine the differences in disturbance impacts within and between forest ecosystems rather than assume effects are constant across all forest ecosystems.

The following discussion refers to the results using the approached dictated by time and data availability. Table 3b indicates that within the Eden CRA region just under 90 000 hectares of forest has a post 1972 logging history. Of the total area identified as candidate old-growth forest 5185 hectares or 5% had a post 1972 logging history. This is likely to result from the course level of logging history resolution used within the Eden region. Logging History was attributed to individual coupes rather than net logged area within coupes. For logging prior to date of photography 'the growth stage overriding disturbance record' principle means that these areas are classified as candidate old-growth if the growth stage code is appropriate (refer Table 2c). The 5185 hectares therefore probably relates to remnant stands within coupes left as corridors or areas not harvested due to other reasons such as access.

For logging post photography any remnant stands within coupes with 'old-growth' growth stage codes would have been classified as recently disturbed forest. The use of satellite imagery change detection work has potential to refine the identification of candidate old-growth and other successional stages within these areas, however, time constraints did not allow this to be addressed during this study with respect to refining the net area logged within State Forest coupes. It was used to refine the delineation of candidate old-growth forest across all tenures for areas cleared since 1994. It should be noted that the net effect of this was to account for private property clearing post 1994. Only a very limited area of post 1994 disturbance existed which was not covered by the SFNSW coupe coverage.

Tenure

Most of the candidate old-growth forest within the Eden CRA region is found on National Parks and Nature Reserves (56%) and State Forests (22%). Approximately (18%) is found on freehold land and (1.%) on leasehold land. Around (56%) of National Parks and Nature Reserves consist of candidate old-growth forest compared with (38%) of mature forest and 18% of young forest. For the 195 209 hectares of non plantation State Forest 12% consists of candidate old-growth forest and 27.6% as mature forest, 32% as young forest and 17% as recently disturbed forest.

API Growth Stage Classes

Candidate Old-growth Forest was comprised of the following API growth stage codes (see below for coding explanation); tA (16.4%); tAF, (.5%), tB (51.3%); tBF (.6%), tC (16.9%), tCF (.1%), SA (10.9%) and SAF (2.1%).

Most (88%) of the candidate old-growth forest identified during this study consisted of forest stands with trace levels of regrowth interpreted from aerial photographs. 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 'C' 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. Stands mapped as 'sA' during the API project, that is, characterised by 10 - 30% rccp levels of regrowth and greater than 30% levels of senescence accounted for 12% of all candidate old-growth forest. The distribution of these stands is outlined in Map 3d.

Keith and Bedward Vegetation Types

Figure 3a (and Table 3f) indicates that many Keith and Bedward vegetation types have small areas of candidate old-growth forest. Sixteen types have less than 500 hectares of candidate old-growth.

Eighteen types have more than 2000 hectares of candidate old-growth forest and eleven types have between 500 to 1999 hectares of candidate old-growth. The overall area of candidate old-growth forest is most relevant in terms of the proportion of each vegetation type which is comprised of candidate old-growth. More than 40% of the area of the following types is candidate old-growth forest: W1 (Wadbilliga Dry Shrub Forest), W2 (Wadbilliga Range Ash Forest), W4 (Wadbilliga Range Wet Forest), 36 (Dune Dry Shrub Forest). Less than 10% of the area of the following types is candidate old-growth forest: 17 (Flats Wet Herb Forest), 26 (Tableland Dry Shrub Forest), 27 (Waalimma Dry Grass Forest), 28 (Wog Wog Dry Grass Forest), 30 (Wallagaraugh Dry Grass Forest), 42 (Coastal Dry Shrub Forest), 46A (Timbillica Dry Shrub Forest).

In relative terms the vegetation types which have proportionately more candidate old-growth forest compared with what would be expected on the basis of vegetation area alone are the lower site quality types 24 (Subalpine Dry Shrub Forest), 46B (Lowland Dry Shrub Forest) and W1 (Wadbilliga Dry Shrub Forest). Those types which have proportionately less candidate old-growth forest relative to vegetation area alone include type 26 (Tableland Dry Shrub Forest) and 32, 42 and 49 representing the various coastal dry shrub forest types.

In absolute area terms the vegetation types with the most candidate old-growth forest are Wadbilliga Dry Shrub Forest (W1) and Subalpine Dry Shrub Forest (24) which are both low site quality types together with Hinterland Wet Fern Forest (13), Hinterland Wet Shrub Forest (14) and Mountain Wet Herb Forest (15) which are higher site quality types. Other important types in terms of the total distribution of candidate old-growth are Hinterland Dry Grass Forest (31), Lowland Dry Shrub Forest (46B), Eden Dry Shrub Forest (47) and Coastal Dry Shrub Forest (49).

Patch Size

Readers should refer to the results section which gives a brief explanation concerning how the indicative patch sizes were generated.

The distribution of candidate old-growth forest of different patch sizes are depicted graphically in Map 3e and Table 4a. Map 3e indicates that all patch size classes are distributed throughout the region. Table 4a indicates that 3% of the total area of candidate old-growth forest is made up by patches less than 10 hectares in size. A further 7% of the total area is made up of by patches between 10 and 25 hectares. There are a large number of moderate size patches (25 - 100 hectares) which contribute 20% of the overall area.

There is a significant number (136) of 100 - 1000 hectares patches which overall account for 31.5% of all candidate old-growth. Most candidate old-growth forest (39%) consists of patches larger than 1000 hectares in size. The largest patch of candidate old-growth forest is over 16 000 hectares in extent and is found in Wadbilliga National Park.

4.2 ACCURACY ASSESSMENT OF API GROWTH STAGING

4.2.1 General overview of API agreement assessments

The significance of results of API checking and agreement assessment requires careful consideration. In broad terms, while it is necessary to tabulate numbers of samples or polygons and to analyse the qualities of different categories of checks or results, it can be quite unwise to attach absolute meaning to such numerical analyses. In this Eden API project for example it was feasible to do only a small check sample (both office and field). API attempts to compartmentalise a forest which, especially in eucalypt forests may be very heterogeneous without providing discrete boundaries between stands.

It is also necessary to reflect on the nature of API and its decision making processes when considering independent checks of its products. For example a difference in polygon boundary location or polygon labelling between interpreter and office validator or field validator may be arguable or it may be a serious difference or a relatively trivial difference. Each “difference” tends to be recorded (and tabulated) the same way. Results presented below for the Eden API need to be treated with caution see Tables 4b and 4c.

TABLE 4B: AREAS OF EACH SUCCESSIONAL STAGE (SS) WITHIN FOUR ASPECT CLASSES AND PERCENTAGE OF TOTAL SS WITHIN EACH ASPECT CLASS

	Aspect class or % of total SS within aspect class								
Successional Stage (SS)	**North**	**% of total SS with Nth Aspect**	**East**	**% of total SS with E Aspect**	**South**	**% of total SS with Sth Aspect**	**West**	**% of total SS with W Aspect**	**Total**
Areas not growth staged	13136	28	13986	29	9802	21	10716	22	47640
Candidate Old-growth Forest	24842	23	33497	31	26514	25	21570	20	106423
Disturbed Old Forest	1598	21	2295	30	2098	28	1560	21	7551
Mature Forest	40296	24	48684	28	43330	25	38924	23	171234
Disturbed Mature Forest	5495	24	6822	30	5876	26	4756	21	22949
Young Forest	29721	24	31247	25	31496	25	32201	26	124665
Recently Disturbed Forest	9172	21	12336	28	12488	28	10523	24	44519
Rainforest	3649	33	4589	41	1698	15	1203	11	11139
Total	**127909**		**153456**		**133302**		**121453**		**536120**
% of Total	**24**		**29**		**25**		**23**		**100**

TABLE 4C: AREA AND FREQUENCY OF CANDIDATE OLD-GROWTH FOREST WITHIN VARIOUS PATCH SIZE CLASSES

Patch Size Class Range (ha)	No. of Patches	Total Area	% of Total Area
< 5	673	1377	1.3
5 - 9.9	264	1810	1.7
10 - 24.9	454	7212	6.8
25 - 99.9	438	20908	20
100 - 1000	136	33619	31.5
> 1000	15	41684	39.1

4.2.2 Summary

In this project it was feasible only to check a relatively small sample using field validation and desktop audit. The results indicate trends rather than statistically meaningful data. At the completion of the project polygon agreement check by experienced interpreters of 1782 polygons from 56 photographs was completed. This represents 6% of all the photographs analysed or approximately 9% of photographs containing forests.

Initial results indicated only a fair agreement between the field validation and the growth stage map. However there appeared to be no bias in the disagreements regarding regrowth or senescence Code agreement between independent interpreters and the growth stage map occurred in 62.9% of all the polygons checked. No bias toward over or under estimating regrowth or senescent contribution was encountered (OER 18.7%, UER 18.4%) NPWS 1998a.

In terms of disturbance tagging there was generally a high level of agreement (1602 from 1782 or 89.9%) between API interpreters and validators overall (see Table 4c). There was a 49.1% underestimation of evidence of logging and a 50.4% agreement for this attribute. There was a 43% agreement in relation to evidence of fire with API interpreters underestimating this attribute by 26% in relation to validators. Furthermore there was a 30.4% disagreement where ‘Evidence of Logging’ was interpreted but was validated as ‘Evidence of Fire’. Evidence of a disturbance by CRA interpreters was only recorded where it was obvious on aerial photography. The reason for this was to improve the confidence and precision of applying API techniques to forest stands that could not validated in the field because of resource constraints.

During the IAP the logging tag was found to be inconsistently applied and very susceptible to interpreter experience and skill. The CRA API exercise has demonstrated more consistency in the application of the 'y' tag, however, it has underestimated the extent of logging disturbance.

One possible reason for the under interpretation of logging disturbance tags could be due to the intensive use of field checking during the validation assessment and / or a different perception of obvious logging disturbance between the validators and interpreters. This may have (depending on the growth stage codes this was attributable to) ramifications in relation to the identification of candidate old-growth forest in some areas and should be considered in relation to the recommendations of the expert panel (see below) and Appendix 4.1.

The above results highlight the need to have accuracy information available of API and other data sets for comparison and review during decision rule development.

4.3 COMPARISON WITH OTHER STUDIES

In addition to this study two other studies have recently defined and mapped 'old-growth forest' within the Eden region. The first of these was the Eden Environmental Impact Statement (EIS) in 1994 and the second was the Broad Old Growth Mapping Project work in the IAP.

More Candidate Old-growth Forest was mapped during this exercise than the IAP and the EIS. All studies employed API to determine relative forest age and condition yet the methodology was different between the EIS study and the IAP. The EIS did not attempt to map the full extent of 'old-growth forest' as it adopted a sampling strategy and sought to generate an estimate of old-growth on State Forest and Conservation Reserves. Different rules were applied in all studies to derive old-growth. More candidate old-growth forest was mapped in this exercise compared with the IAP (106 000 hectares versus 69 118 hectares). A substantial component of this increase would have been attributable to the inclusion of areas such as Wadbilliga National Park which contains large stands of candidate old-growth forest.

Use of the smaller minimum mapping unit for candidate old-growth would have accounted for approximately 10 000 hectares compared with the IAP although this figure is only indicative. Another major reason for additional candidate old-growth being mapped in this study is due to the revised interpretation and a trend to map less regrowth during this study relative to the IAP. A trend of underestimating logging disturbance could also have resulted in more candidate old-growth forest being mapped. Accuracy estimates undertaken as part of the BOGMP were based on desktop analysis only. The lack of systematic field validation of the final IAP growth stage map makes it difficult to directly compare the two growth stage layers. Inferring absolute accurate base line data from either the GIS or IAP growth stage data without independent accuracy assessment should be avoided.

It should also be noted (as is pointed out below) that the results of this study have not been field validated and should consequently be treated cautiously until that occurs. It should also be noted that the results of the previous EIS and BOGMP studies also lacked an iterative field validation / modification of decision rule phase.

Appendix 4.1 details problems associated with this study in terms of available data sets and analysis identified by the expert panel.

4.4 EXPERT PANEL RECOMMENDATIONS

The following recommendations were developed by the Expert Panel.

- That, given the limitations of this process, the resulting areas identified be termed "candidate" old-growth forest rather than the more certain term "likely" old-growth forest.
- 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.

* It should be noted that this is probably not feasible before tenure decisions are made. The old-growth layer is the best data available and providing the weaknesses are acknowledged the data should be used to make decisions.

4.5 RECOMMENDATIONS FOR FUTURE WORK

Many of the shortcomings with the Eden Old-growth Project can be attributable to a lack of relevant data, that is, accurate disturbance history information and a lack of time to analyse relevant data. The latter was due to a combination of delays in provision of key data sets such as growth stage and vegetation type together with tight deadlines for the Eden CRA/RFA negotiation phase

All stakeholders received a copy of the old-growth layer for review prior to the Eden negotiations. It should be noted that some refinements to the old-growth layer were requested by the Environment and Heritage Technical Committee based on stakeholder review and identified problems such as small GIS slivers and some errors in the logging history layer.

Future work on the Eden successional stage layer should initially focus on field validation to give an indication of overall reliability and identify where improvements can be made.

A more comprehensive coverage of disturbance layers particularly for logging history will be available for the Upper North East, Lower North East and Southern CRA regions. More explicit analyses would be required in future regarding the use of a site quality layer and related decisions.

The challenge ahead for the old-growth projects will be the evaluation, integration and analysis of more complex disturbance data and API data sets with other information. A suggested focus will be to target preliminary analysis to a subset of areas with a broad range of API growth stages and disturbance data sets. Field checking and associated refinement of decision rules to delineate 'old-growth' will be an important improvement to the projects for other regions. Timely delivery of key data sets is likely to continue to be an issue for other CRA regions.

5. REFERENCES

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6. APPENDICES

APPENDIX 2.1: CLASSIFICATION OF EUCALYPTUS SPECIES WITHIN THE EDEN CRA REGION ACCORDING TO EASE OF INTERPRETABILITY AND QUALITATIVE ASSESSMENT OF ENVIRONMENTAL SITE QUALITY (ESQ)

	Growth Habit									
	Easy interpretability types: growth stage characteristics usually discernable			Difficult interpretability types: growth stage characteristics rarely discernable			Variable interpretability types: growth stage characteristics sometimes discernable			Comments
Site Quality	**High**	**Medium**	**Low**	**High**	**Medium**	**Low**	**High**	**Medium**	**Low**	
Angophora floribunda				*	*	*				Regrowth shows Jacobsian habit
E. agglomerata		*				*				
E. angophoroides								*		mature - senescence: Jacobsian
E. badjensis	*									
E. baueriana					*					
E. baxterii						*				
E. bosistoana	*	*								
E. botryoides		*				*				
E. bridgesiana					*	*				
E. camphora						*				
E. consideniana						*		*		
E. cypellocarpa	*	*								
E. dalrympleana	*	*								
E. dives						*		*		
E. elata	*							*		
E. fastigata	*	*								
E. fraxinoides	*	*								
E. globoidea		*				*				
E. gummifera		*	*							
E. imlayensis						*				Not a large enough population to determine
E. kybeanensis						*				Not a large enough population to determine
E. longifolia		*								
E. macroryncha									*	
E. maculata								*		
E. maidenii		*								
E. melliodora		*								
E. mannifera						*				
E. muelleriana	*	*								
E. nitens	*									
E. obliqua	*	*								
E. ovata		*							*	Senescence hard to pick up from API

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E. paliformis						*				
E. parvifolia						*				
E. pauciflora		*				*				
E. pilularis		*								
E. polyanthemos		*				*				
E. radiata	*				*	*				
E. rubida		*							*	
E. sieberi	*	*							*	
E. smithii								*		
E. stellulata						*				
E. stenosoma						*				
E. tereticornis		*								
E. tricarpa								*		
E. viminalis	*							*		

This information was gathered based on how these species are seen from API with field knowledge. It was not gathered from field knowledge only.

APPENDIX 2.2.1: GROWTH STAGE CODE INFORMATION FROM EDEN API PROJECT

Growth Stage Code	Proportion of Regrowth and Senescing and disturbance indicators
tA	<10% Regrowth/ >30% Senescence
tAF	<10% Regrowth/ >30% Senescence with fire disturbance
tAY	<10% Regrowth/ >30% Senescence with logging disturbance
tAFY	<10% Regrowth/ >30% Senescence with fire and logging disturbance
tB	<10% Regrowth/ 10-30% Senescence
tBF	<10% Regrowth/ 10-30% Senescence with fire disturbance
tBY	<10% Regrowth/ 10-30% Senescence with logging disturbance
tBFY	<10% Regrowth/ 10-30% Senescence with fire and logging disturbance
tC	<10% Regrowth/ <10% Senescence
tCF	<10% Regrowth/ <10% Senescence with fire disturbance
tCY	<10% Regrowth/ <10% Senescence with logging disturbance
tCFY	<10% Regrowth/ <10% Senescence with fire and logging disturbance
sA	10-30% Regrowth/ >30% Senescence
sAF	10-30% Regrowth/ >30% Senescence with fire disturbance
sAY	10-30% Regrowth/ >30% Senescence with logging disturbance
sAFY	10-30% Regrowth/ >30% Senescence with fire and logging disturbance
sB	10-30% Regrowth/ 10-30% Senescence
sBF	10-30% Regrowth/ 10-30% Senescence with fire disturbance
sBY	10-30% Regrowth/ 10-30% Senescence with logging disturbance
sBFY	10-30% Regrowth/ 10-30% Senescence with fire and logging disturbance
sC	10-30% Regrowth/ <10% Senescence
sCF	10-30% Regrowth/ <10% Senescence with fire disturbance
sCY	10-30% Regrowth/ <10% Senescence with logging disturbance
sCFY	10-30% Regrowth/ <10% Senescence with fire and logging disturbance
eA	>30% regrowth/ >30% senescence
eAF	>30% regrowth/ >30% senescence with fire disturbance
eB	>30% regrowth/ 10-30% senescence
eBF	>30% regrowth/ 10-30% senescence with fire disturbance
eC	>30% regrowth/ <10% senescence
eCF	>30% regrowth/ <10% senescence with fire disturbance
O	Other Forest (non forest)
R	Rainforest with <5-10% pryrophytic emergents
RE	Rainforest with >10% pryrophytic emergents
L	Recently Logged Forest

APPENDIX 2.2.2: ASSIGNMENT OF DISTURBANCE LEVEL

Dist. Type	Vegetation Community	Growth Stage *	API Notation	Source	Comment	Dist. Level **
CONT. LOGGING > 1970	Easy (Jacobsian)	S	Y	API	API notation overrides growth stage	3u
		M	Y	API	Y (< or >30 yr rule from BOGMP	3u
		R	Y	API	dropped)	3u
	Difficult (Non-Jacobsian)	S	Y	API	API notation overrides growth stage	3u
		M	Y	API	Y (< or >30 yr rule from BOGMP	3u
		R	Y	API	dropped)	3u
	Variable	S	Y	API	API notation overrides growth stage	3u
		M	Y	API	Y (< or >30 yr rule from BOGMP	3u
		R	Y	API	dropped)	3u

*** Growth Stage**: S = senescent; M = mature; R = regrowth.
**** Disturbance Level**: 1 = no disturbance; 2 = negligible; 3 = significant; n = natural; u = unnatural.

APPENDIX 2.2.3: ASSIGNMENT OF DISTURBANCE LEVEL

Dist. Type	Vegetation Community	Growth Stage *	API Notation	Source	Comment	Dist. Level **
CONT. LOGGING > 1970	Easy (Jacobsian)	S	- (no y)	Dist. record	Growth stage overrides disturbance record	2u
		M	- (no y)	"	As above (30 yrs not long enough for R to become M)	2u
		R	- (no y)	"	Growth stage confirms disturbance record	3u
	Difficult (Non-Jacobsian)	S	- (no y)	Dist. record	Growth stage overrides disturbance record	2u
		M	- (no y)	"	As above (30 yrs not long enough for R to become M)	2u
		R	- (no y)	"	Growth stage confirms disturbance record	3u
	Variable	S	- (no y)	Dist. record	Growth stage overrides disturbance record	2u
		M	- (no y)	"	As above (30 yrs not long enough for R to become M)	2u
		R	- (no y)	"	Growth stage confirms disturbance record	3u

*** Growth Stage**: S = senescent; M = mature; R = regrowth.
**** Disturbance Level**: 1 = no disturbance; 2 = negligible; 3 = significant; n = natural; u = unnatural.

APPENDIX 2.2.4: ASSIGNMENT OF DISTURBANCE LEVEL

Dist. Type	Vegetation Community	Growth Stage *	API Notation	Source	Comment	Dist. Level **
SELECTIVE LOGGING > 1960	Easy (Jacobsian)	S	Y	API	API notation overrides growth stage	3u
		M	Y	API	(< or >30 year rule from BOGMP	3u
		R	Y	API	dropped)	3u
	Difficult (Non-Jacobsian)	S	Y	API	API notation overrides growth stage	3u
		M	Y	API	(< or >30 year rule from BOGMP	3u
		R	Y	API	dropped)	3u
	Variable	S	Y	API	API notation overrides growth stage	3u
		M	Y	API	(< or >30 year rule from BOGMP	3u
		R	Y	API	dropped)	3u

*** Growth Stage**: S = senescent; M = mature; R = regrowth.
**** Disturbance Level**: 1 = no disturbance; 2 = negligible; 3 = significant; n = natural; u = unnatural.

APPENDIX 2.2.5: ASSIGNMENT OF DISTURBANCE LEVEL

Dist. Type	Vegetation Community	Growth Stage *	API Notation	Source	Comment	Dist. Level **
SELECTIVE LOGGING > 1960	Easy (Jacobsian)	S	- (no y)	Dist. record	Growth stage and vegetation community overrides disturbance record	2u
		M	- (no y)	"	As above	2u
		R	- (no y)	"	Growth stage confirms disturbance record	3u
	Difficult (Non-Jacobsian)	S	- (no y)	Dist. record	Growth stage and vegetation community overrides disturbance record	2u
		M	- (no y)	"	As above	2u
		R	- (no y)	"	Growth stage confirms disturbance record	3u
	Variable	S	- (no y)	Dist. record	Growth stage and vegetation community overrides disturbance record	2u
		M	- (no y)	"	As above	2u
		R	- (no y)	"	Growth stage confirms disturbance record	3u

*** Growth Stage**: S = senescent; M = mature; R = regrowth.
**** Disturbance Level**: 1 = no disturbance; 2 = negligible; 3 = significant; n = natural; u = unnatural.

APPENDIX 2.2.6: ASSIGNMENT OF DISTURBANCE LEVEL

Dist. Type	Vegetation Community	Growth Stage *	API Notation	Source	Comment	Dist. Level **
FIRE	Easy (Jacobsian)				"F" notation ignored	
		S	- (no y)	Dist. record	Growth stage indicates no significant overstorey disturbance	2n
		M	- (no y)	"	As above	2n
		R	- (no y)	"	Growth stage corroborates fire record	3n
	Difficult (Non-Jacobsian)				"F" notation ignored	
		S	- (no y)	Dist. record	Growth stage indicates no significant overstorey disturbance	2n
		M	- (no y)	"	As above	2n
		R	- (no y)	"	Growth stage corroborates fire record	3n
	Variable				"F" notation ignored	
		S	- (no y)	Dist. record	Growth stage indicates no significant overstorey disturbance	2n
		M	- (no y)	"	As above	2n
		R	- (no y)	"	Growth stage corroborates fire record	3n

*** Growth Stage**: S = senescent; M = mature; R = regrowth.
**** Disturbance Level**: 1 = no disturbance; 2 = negligible; 3 = significant; n = natural; u = unnatural.

APPENDIX 2.2.7: ASSIGNMENT OF DISTURBANCE LEVEL

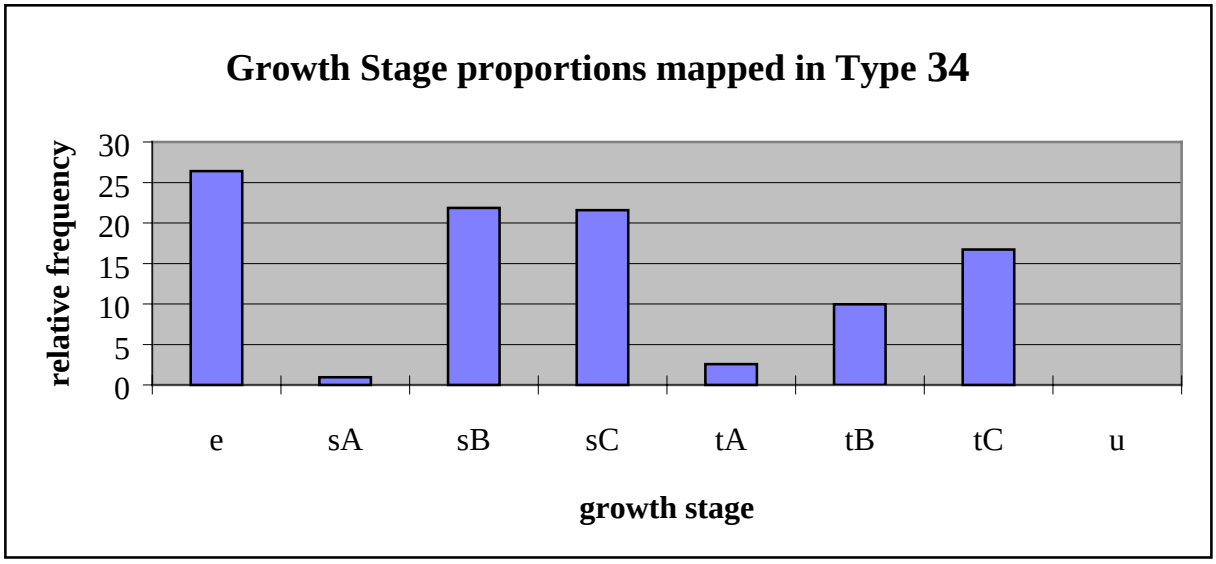
Dist. Type	Vegetation Community	Growth Stage *	API Notation	Source	Comment	Dist. Level **
NO RECORD OF DISTURBANCE e.g. logging, selective logging, wildfire; i.e. grazing, pathogens, mining,fuel reduction burns not considered	Easy (Jacobsian)	S	- (no y)	n/a	Disturbance cause unknown	1
		M	- (no y)		"	1
		R	- (no y)		"	3
	Difficult (Non-Jacobsian)	S	- (no y)	n/a	Disturbance cause unknown	1
		M	- (no y)		"	1
		R	- (no y)		"	3
	Variable	S	- (no y)	n/a	Disturbance cause unknown	1
		M	- (no y)		"	1
		R	- (no y)		"	3

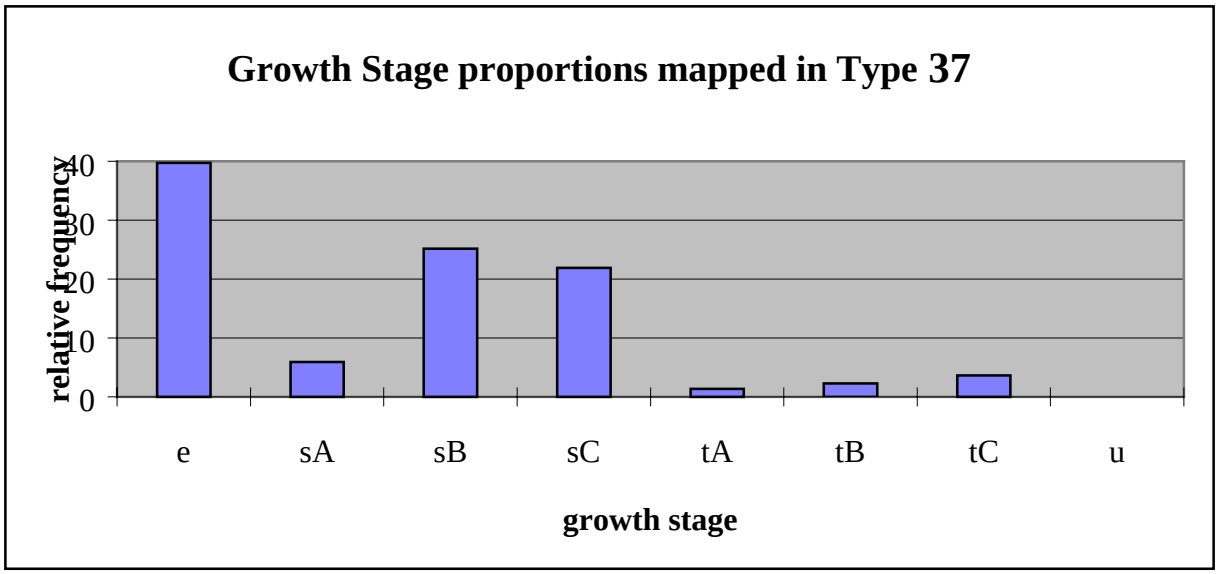
*** Growth Stage**: S = senescent; M = mature; R = regrowth.
**** Disturbance Level**: 1 = no disturbance; 2 = negligible; 3 = significant; n = natural; u = unnatural.

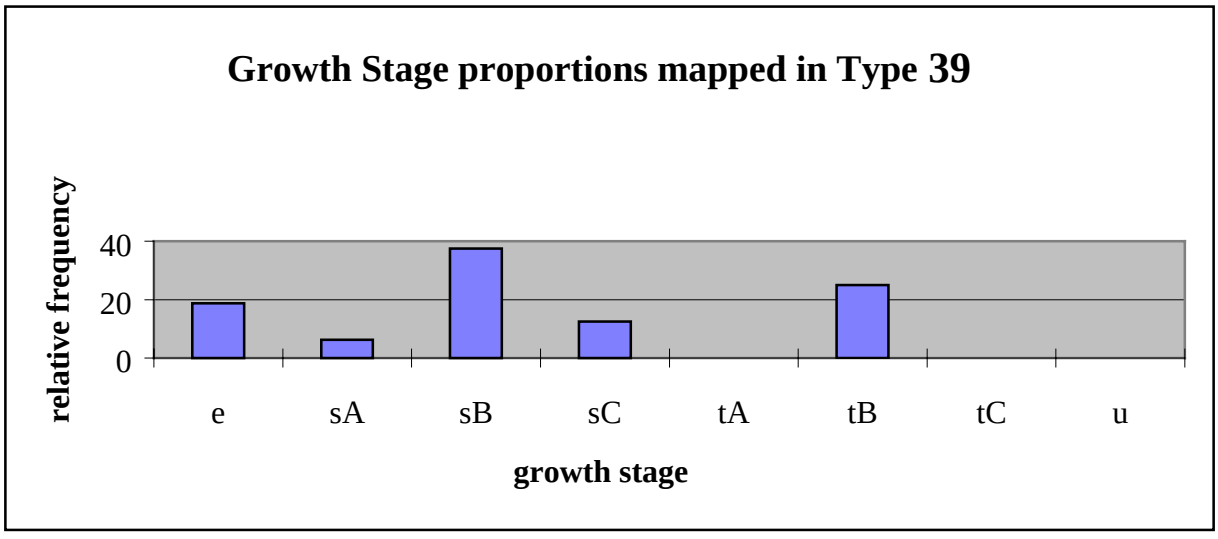
APPENDIX 2.2.8: ASSIGNMENT OF OLD-GROWTH STATUS

	GROWTH STAGE		
DISTURBANCE LEVEL	**SENESCING**	**MATURE**	**REGROWTH**
SIGNIFICANTLY DISTURBED (Levels 3unnatural, 3natural,)	DISTURBED OLD FOREST	DISTURBED MATURE FOREST	DISTURBED YOUNG FOREST
NEGLIGIBLY DISTURBED (Levels 2unnatural, 2natural)	LIKELY OLD-GROWTH FOREST	MATURE FOREST	YOUNG FOREST
UNDISTURBED (level 1 no disturbance, 1natural)	LIKELY OLD-GROWTH FOREST	MATURE FOREST	YOUNG FOREST

APPENDIX 2.3: EXAMPLE OF GROWTH STAGE FREQUENCY HISTOGRAMS FOR KEITH AND BEDWARD VEGETATION COMMUNITIES







APPENDIX 3.1: OVERVIEW OF RESULTS FROM FIELD ASSESSMENT OF EDEN SPI AND VARIABLE COMMUNITIES

Site No.	Location	Keith & Bedward Vegetation Community		Eucalyptus Species	API Growth Stage	Ground Growth Stage	Tree Height (metres)
1a	Nimmitabel	71	Subalpine Basalt Grass Forest	*E. pauciflora* *E. stellulata* *E. viminalis*	n/a	tB	10 - 15
1b	Nimmitabel	71	Subalpine Basalt Grass Forest	*E. pauciflora* *E. stellulata* *E. viminalis*	n/a	tB	15 - 20
2	Glenbog State Forest	24 (27)	Subalpine Dry Shrub Forest	*E. fastigata* *E. dalrympleana* *E. pauciflora*	n/a sA	sA	30 - 35
3	Coolumbooka Nature Reserve	22 (68)	Bombala Dry Grass Forest	*E. dives* *E. viminalis*	n/a	tB	10 - 15
4	Coolangubra State Forest	31 (21)	Hinterland Dry Grass Forest	*E. globoidea* *E. angophoroides* *E. radiata / cr.*	n/a	tB	30 - 35
5	Near Nullica State Forest	19 (53)	Bega Wet Shrub Forest	*E. viminalis* *E. elata* *E. angophoroides*	n/a	tC	40
6	Near Nullica	19 (53)	Bega Wet Shrub Forest	*E. angophoroides* *E. bosistoana* *E. baueriana*	n/a	tC	25 - 30
7	East Boyd State Forest	44 (6)	Foothills Dry Shrub Forest	*E. seiberi* *E. globoidea*	n/a	e	25 - 30
8a	East Boyd State Forest	47 (4)	Eden Dry Shrub Forest	*E. sieberi* *Angophora floribunda*	n/a sA	e	30 - 35
8b	East Boyd State Forest	47 (4)	Eden Dry Shrub Forest	*E. sieberi* *Angophora floribunda*	n/a sA	e	30 - 35
9	East Boyd State Forest	46 (3)	Lowland Dry Shrub Forest	*E. globoidea* *E. muelleriana* *E. cypellocarpa*	n/a	tB	30 - 35
10	East Boyd State Forest	46 (3)	Lowland Dry Shrub Forest	*E. consideniana*	n/a	t/s, C/B	25
11	Nullica State Forest	47 (4)	Eden Dry Shrub Forest	*E. agglomerata* *E. sieberi* *Angophora floribunda*	n/a sA	tB	20 - 25

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Site No.	Topographic Position	Aspect	Soil Depth	Qualitative Environmental Site Quality	Site Productivity Index (SPI)	Qualitative SPI	Disturbance
1a	Mid slope	South	Skeletal	Low	23 - 33	Low	Grazing Logging Fire
1b	Mid slope	North	Skeletal	Low	34 - 44	Low	Grazing Logging Fire
2	Upper slope	West	Moderate	Moderate - High	23 - 33	Moderate - High	Selective Logging Fire
3	Upper slope	East	Skeletal	Low	23 - 33	Low - Moderate	
4	Ridge top	All	Moderate	Low - Moderate	23 - 33	Low - Moderate	Selective Logging
5	Gully	South West	Deep	High	23 - 33	High	
6	Mid slope	West	Moderate	Low - Moderate	34 - 44	Low-Medium	Selective Logging
7	Ridge top	All	Deep	Moderate	23 - 33	Medium	Fire Selective Logging
8a	Ridge top	All	Moderate	Moderate	23 - 33	Medium	Logging
8b	Ridge top	Varied	Moderate	Moderate	34 - 44	Low	
9	Upper slope	East	Deep	Moderate	45 - 55	Medium	
10	Lower slope		Deep	Low	34 - 44	Low	
11	Upper slope	North West		Low	34 - 44	Low	

APPENDIX 3.3: BRIEF EXPLANATION OF PRIMARY GIS COVERS OUTLINED IN APPENDIX 3.2

The following covers were used to derive the old-growth layer:

BOGMP L code

- Identification of recently logged areas mapped during the Broad Old Growth Mapping Project.

SFNSW Coupe Logging History

- Post 1972 logging history on current State Forest on a coupe basis.

Change Detection of areas cleared between 1994-1997

- Cover derived from Landsat TM image detection analysis work from ERIN.

Logging History of NPWS estate

- Referred to coupes identified by SFNSW as having a post 1972 logging history but part of NPWS Estate. Refers to areas which were State Forest but became National Park / Nature Reserve after the Interim Assessment Process.

Growth Stage

- API growth stage codes as mapped by the Eden CRA API project.

Interp

- Interpretability classes as described and explained in Section 2.2.1 Development of Interpretability Classes and section 3.2.1 Interpretability classes.

Subset

- Eden CRA region divided into two classes relating to the year of photography either 1991 or 1994.

Rf_dk

- Subset of Keith and Bedward vegetation types defined as rainforest types.

APPENDIX 3.4: ARC INFO AML USED TO DERIVE THE EDEN OLD-GROWTH LAYER

```
tables

select theworks2.pat

reselect INTERP = 'E'
reselect GSTAGE_CODE in {'tA', 'tAF', 'tB', 'tBF'}
calc oldgrowth = 1

asel
reselect INTERP = 'E'
reselect GSTAGE_CODE in {'tAY', 'tAYF', 'tBY', 'tBYF', 'sAY', 'sAYF'}
calc oldgrowth = 6
reselect BOGM_TAG ne 'L'
calc oldgrowth = 2

asel
reselect INTERP = 'E'
reselect GSTAGE_CODE in {'tC', 'tCF', 'sB', 'sBF', 'sC', 'sCF'}
calc oldgrowth = 3

asel
reselect INTERP = 'E'
reselect GSTAGE_CODE in {'tCY', 'tCYF', 'sBY', 'sBYF', 'sCY'}
calc oldgrowth = 4

asel
reselect INTERP in {'V', 'D', 'S'}
reselect GSTAGE_CODE in {'tA', 'tAF', 'tB', 'tBF', 'tC', 'tCF'}
calc oldgrowth = 1

asel
reselect INTERP in {'V', 'D', 'S'}
reselect GSTAGE_CODE in {'tAY', 'tAYF', 'tBY', 'tBYF', 'tCY', 'tCFY', 'sAY', 'sAYF'}
calc oldgrowth = 6
reselect BOGM_TAG ne 'L'
calc oldgrowth = 2

asel
reselect INTERP in {'V', 'D', 'S'}
reselect GSTAGE_CODE in {'sB', 'sBF', 'sC', 'sCF'}
calc oldgrowth = 3

asel
reselect INTERP in {'V', 'D', 'S'}
reselect GSTAGE_CODE in {'sBY', 'sBYF', 'sCY'}
calc oldgrowth = 4

asel
reselect GSTAGE_CODE lk 'e*'
calc oldgrowth = 5
resel GSTAGE_CODE in {'eAY', 'eBY', 'eCY', 'eYF', 'eY'}
```

```
calc oldgrowth = 6

asel
reselect GSTAGE_CODE in {'sU', 'tU', 'uU'}
calc oldgrowth = 1

asel
reselect GSTAGE_CODE in {'sA', 'sAF'}
calc oldgrowth = 1
reselect LOG_YR > 0 and LOG_YR < 1991 and SUBSET = 1
calc oldgrowth = 2
asel
reselect GSTAGE_CODE in {'sA', 'sAF'}
reselect LOG_YR > 0 and LOG_YR < 1994 and SUBSET = 0
calc oldgrowth = 2

asel
reselect LOG_YR > 1990 and LOG_YR < 4000 and SUBSET = 1
calc oldgrowth = 6
asel
reselect LOG_YR > 1993 and LOG_YR < 4000 and SUBSET = 0
calc oldgrowth = 6

asel
reselect GSTAGE_CODE in {'uC'}
calc oldgrowth = 3

asel
resel GSTAGE_CODE = 'L'
calc oldgrowth = 6

asel
resel dk_rf > 0
calc oldgrowth = 7

asel
resel CHANGE = 1 or NPWS_LOG = 1
calc oldgrowth = 6

q

&return
```

APPENDIX 4.1: REPORT FROM THE OLD-GROWTH FOREST EXPERT PANEL

EDEN CRA OLD-GROWTH STUDY

REPORT FROM THE OLD-GROWTH FOREST EXPERT PANEL

Introduction

The expert panel consisted of Jane Coram, Tony Norton and Bill Peel. It was asked to review the existing IAP data sets and rules for the IAP old-growth layer and to suggest data set amendments and additions in order to generate a revised old-growth forest analysis for the Eden CRA.

Due to time constraints, however, the old-growth forest expert panel's decisions were made with either incomplete data sets, or data sets that arrived too late to be considered in any detail by the panel. Although these data sets were used in the analysis, at this stage we can not be confident of their reliability. In addition, the analysis was written without the option of iterative review of the result and amendment of the analysis rules. Further, 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 wishes to emphasise 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 Eden 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.

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 which are candidates for 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.

1. Data limitations

1a. Data not collected

A number of critical datasets for the comprehensive delineation of old-growth forest were not available for this analysis. These include:

- disturbance types (not comprehensive list)

  pathogens
  grazing
  agricultural clearing
  mining
  wind damage (small scale)
  fuel reduction burning
  pre-1970 logging

- stand top height (as ESQ surrogate)
- DEM (to more accurately model extent of disturbances)

- recent logging on private land between 1992 and 1995
- crown cover (to more accurately model the extent of disturbances such as selective logging, pathogens and agricultural clearing especially in non-woodland environments)

1b. Data collected

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 mapped either under Research Note 17 or rapid assessment (accuracy not determined)
- floristic community mapping (considered to be of high accuracy as the mapping was based on plot data (existing and resampled); and has been iterated twice)
- contemporary logging from records and API (considered to be of high reliability but unknown spatial accuracy)
- fire mapping (considered to be of moderate accuracy for large fires; no reliable API interpretation)
- modelled Environmental Site Quality (ESQ) (of unknown accuracy, since not field checked)
- Landsat forest/non-forest mapping (of high accuracy).

1c. Data colllected but under-utilised

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

- floristics (could have been more extensively interpreted to evaluate ecological maturity)
- Site Productivity Index (not available in time for use in this process)
- fire (the lack of field checking meant that this could not be reliably used to interpret ecological maturity)
- canopy species mapping (if available earlier could have been used to define the extent of the variable interpretability crown form class).

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 and ESQ classes

- ESQ modelling did not include any iterative, field based review and hence the relibability of the ESQ coverage which formed the basis of this derivation is untested. This may limit the accuracy of the derived growth stage coverage.
- Assumptions about interpretability of vegetation classes were based on interpreters' recollections of individual species' interpretability and not always confirmed by the limited field checking undertaken. This suggested that individual species may not always occur at every site in the nominated vegetation community (hence the need for canopy species mapping). Again, this limits the accuracy of the derived growth stage coverage.
- The assumption that the growth habits of eucalypts are determined by ESQ were only subject to limited, incidental field checking
- Limited field inspection of the variable interpretability class indicated that all sites with dominant mature and senescing crown forms exhibited a senescing-dominated growth stage. This confirmed that, in these interpretability classes, the regrowth component is a more reliable indicator of stand age and disturbance impact. As a consequence, the variable class was deemed be treated in the same manner as the 'difficult' interpretability class. It is important to note that this decision is based on very limited field inspection.

(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 assumption that API 'Y' mapping overrides disturbance records was based on APIers confidence in the API mapping and was not field checked by the expert panel.
- API 'F' was not considered to be sufficiently accurate to influence the assessment of disturbance levels.
- The IAP 30 year cut-off for logging records were not used in this analysis to assign old-growth status, as this was considered an unnecessarily arbitrary cut-off given the much more reliable API data available.
- 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:

  -.grazing impacts (structurally intact overstoreys with weedy understoreys)

  - historic logging (changes in overstorey species composition and/or alterations to age structure of the overstorey)

  - pathogens (changes to overstorey and understorey composition).
- No use was made of a DEM to predict where disturbances are likely to have occurred.
- 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 senescencing overstorey trees as the result of fire damage. These stands were classified as older forest (old-growth status unknown).
- Other examples of stands where regrowth was present in proportions of less than 30% were found during field inspection to have misinterpreted the presence of regrowth; some communities on the Tablelands had a mature understorey of Snow Gum beneath and overstorey of Mountain Gum; in the coastal areas had substantial amounts of Black Sheoke in the canopy gaps that was interpreted as regrowth; whilst others in the coastal area had been subjected to 'checkerboard logging' where non-commercial species were left standing and high proportions of regrowth resulted. The first two categories were left as possible categories to be included in old-growth whilst the last one was disqualified on the basis of significant un-natural disturbance.

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

That, given the limitations of this process, the resulting areas identified be termed "candidate" old-growth forest rather than the more certain term "likely" old-growth forest.

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.

10/9/97

Jane Coram

Tony Norton

Bill Peel

APPENDIX 5. METADATA STATEMENT FOR THE EDEN OLD-GROWTH STUDY

METADATA CATEGORY	CORE METADATA ELEMENT	DESCRIPTION
DATASET	Title	Old-growth Forest and other successional stages for Eden CRA region
	Custodian	NSW National Parks and Wildlife Service
	Jurisdiction	NSW
	CRA Project Name	Old-growth Forest Related Projects
	CRA Project Number	NE 29/EH
CONTACT ADDRESS	Contact organisation	NSW National Parks and Wildlife Service Land Assessment Unit Conservation and Planning Division
	Contact position	CRA Old-growth Coordinator
	Mail Address 1	PO Box 1967, Hurstville NSW 2220
	Mail Address 2	Optional extension of mail address 1
	Suburb/Place/Locality	Hurstville.
	State/Locality 2	NSW
	Country	Australia
	Postcode	2220
	Telephone	02 95856663
	Facsimile	02 95856495
	Electronic mail address	paul.oconnor@npws.nsw.gov.au
DESCRIPTION	Abstract	Candidate old-growth forest and other forest growth stages derived by integrating structural classes mapped from API, interpretability classes derived from vegetation mapping units and logging history information using a set of decision rules developed by the Eden Old-growth Expert Panel and refined by the Environment and Heritage Technical Committee.
	Search Word	Old-growth Mapping, successional stage.
	Geographic Extent Name(s)	Eden CRA region (as defined by the Resource and Conservation Division, Department of Urban Affairs and Planning).
	Geographic Extent Polygon(s)	36.00 S 148.30E 38.00 S 150.30E
	Type of feature	Polygon coverage
	Attribute/Field List	0 - Not Growth Staged (NGS) 1 - Candidate old-growth forest (COGF) 2 - Disturbed old forest (DOF) 3 - Mature forest (MF) 4 - Disturbed mature forest (DMF) 5 - Yound forest (YF) 6 - Recently disturbed Forest (RDF) 7 - Rainforest (RF)

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DESCRIPTION (continued)	Attribute/Field Description	The following rule set was applied to derive the old-growth and other successional stage layer. Easy to interpret class NGS - predominantly 'o' non forest code COGF - sA*, sAF*, tA,tAF,tB,tBF, tU,sU, uU DOF - sAy*, sAFy*, tAY*, tAYF*,tBY*,tBYF* (*only when areas not coincident with BOGMP L code areas) MF - tC,tCF,sB,sBF,sC,sCF,uC DMF - tCY,sBY,sBYF,sCY, YF - e,eA,eAF,eA RDF - eAY,eBY,eCY,eY,eYF plus sAy*, sAFy*, tAY*, tAYF*,tBY*,tBYF*(*only when coincident with BOGMP L code areas) plus areas logged post photo, plus areas classified as cleared between 1994 and 1997 using change detection image analysis from Landsat TM. Variable, Difficult and Special Case class NGS - predominantly 'o' non forest code COGF - sA*, sAF*,tA,tAF,tB,tBF,tC,tCF,tU, sU, uU DOF - sAy*, sAFy*, tAY*,tAYF*,tBY*,tBYF*, tCY* (*only when areas not coincident with BOGMP L code areas) MF -,sB,sBF,sC,sCF,uC DMF -sBY,sBYF,sCY, YF - e,eA,eAF,eA RDF - eAY,eBY,eCY,eY,eYF plus sAy*, sAFy*, tAY*, tAYF*,tBY*,tBYF*(*only when coincident with BOGMP L code areas) plus areas logged post photo plus areas classified as cleared between 1994 and 1997 using change detection image analysis from Landsat TM. RF - KBS types 1, 5, 6, 7 and 8 The KBS Vegetation types classified according to interpretability class Easy - 9, 10, 11, 12, 13, 14, 15, 16, 17, 18,,28, 29, 32, 33, 35, 41,42,43,49,82,84 Variable - 3,19,20,21,22,25,26,27,30,31,34, 44,45,48,58,79,81,85,86 Difficult - 24, 36,37,46,47,50, 71,72 and 83 Special Case - 1,2, 4, 5, 6, 7, 8, 23, 38, 39, 40, 51, 52, 53, 54, 55, 56, 57, 59, 60, 61,63, 64
	Scale/Resolution	The dataset has been derived from interpretation of 1:25000 scale colour aerial photography using a minimum polygon size of 10 hectares for everything except rainforest which is set at 2 hectares.
DATASET CURRENCY	Beginning date	1/09/95
	Ending date	14/9/97
DATASET STATUS	Progress	Complete
	Maintenance and update frequency	Unknown.
DATASET ENVIRONMENT	Software	ARC/INFO; ArcView
	Computer Operating System	UNIX, DOS
	Dataset Size	25 Mb
ACCESS	Stored Data Format	ARC/INFO Grid Format.
	Available format types	ARC/INFO; ArcView.
	Access constraints	None.

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DATA QUALITY	Lineage	Three layers were used to derive candidate old-growth forest and other successional stages according to a rule set: 1) structural growth stages mapped using aerial photographic interpretation of 1:25000 scale colour photography 2) 4 classes of API interpretability were derived from the Keith Bedward and Smith vegetation layer based on expert decision 3) Post 1970 logging history information Expert decision rules allocated different mapped structural codes to old-growth forest and other successional stages based on interpretability and disturbance (both API and logging history) information.
	Positional accuracy	All data layers were derived at a scale of 1:25000 scale. Accuracy checked to within 37.5 metres from linear control features (for example, coastline, drainage lines) displayed on 1: 25000 topographic maps was accepted.
	Attribute accuracy	Mapped growth stage polygons were checked for 'level of agreement' by State Forests and Independent Aerial Photographic Interpreters.Overall a 63% level of agreement was reached (see API Mapping growth stage Metadata statement). Due to time constraints the old-growth layer has not been field validated.
	Logical consistency	The rule set used to derive the old-growth layer was checked including the assignment of interpretability classes and the allocation of mapped growth stage codes to the various successional stages and disturbance overlays.
	Completeness	The Eden Old-growth Expert Panel qualified the CRA identification of old-growth forest in the following terms "this process will identify forest stands which are candidates for 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.
NOTES	Notes	
METADATA DATE	Metadata date	19//9/97.
METADATA COMPLETED BY	Metadata sheet compiled by	Paul O'Connor
FURTHER INFORMATION	Further information	None