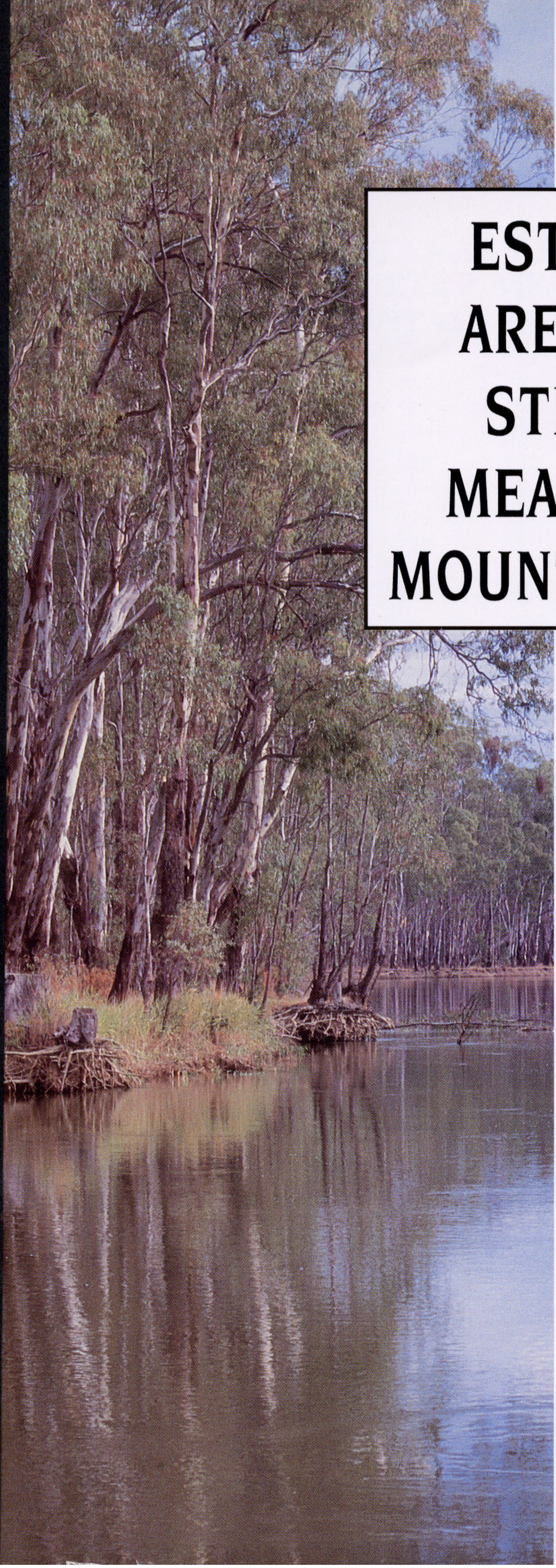

ESTIMATING LEAF AREA INDEX FROM STEM DIAMETER MEASUREMENTS IN MOUNTAIN ASH FOREST

F. G. R. Watson
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Report 96/7
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COOPERATIVE RESEARCH CENTRE FOR
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Preface

The material in this report is a contribution to one of the core research projects in the Cooperative Research Centre for Catchment Hydrology (CR-CCH), entitled "Development and evaluation of predictive tools for water production in natural, disturbed and managed forests". The project aims to clarify how water, soils, trees and catchments interact. A key part of this project has been a study linking forest leaf area development to stand water use and catchment runoff.

This report summarises a study aimed at improving the estimation of leaf area index in mountain ash forests; the key forest species in the Melbourne Water Supply area. It builds upon early work carried out by the Melbourne and Metropolitan Board of Works (now known as Melbourne Water). Those initial studies have been complemented by further field experiments conducted by CRCCH researchers. The work has culminated in the development of a model which can be used to estimate leaf area index for mountain ash forests of different ages.

In future work the model will be used to explain the long-observed relationship between forest age and water yield in mountain ash forest. This will help catchment managers to predict better the impact of wildfires and logging on water yields from mountain ash forest.

Prof. Russell Mein

Director

Cooperative Research Centre for Catchment Hydrology

Abstract

A model is presented enabling the prediction of the leaf area of an individual Mountain Ash (*Eucalyptus regnans*) tree given both the diameter at breast height (DBH) of the tree and the mean ln(DBH) of all trees in the stand from which the tree came. The model was calibrated using linear regressions on natural log data obtained through destructive measurement of the leaf areas of 78 trees.

Predictions of the leaf area of individual trees and of the total leaf area of a sample of trees were tested using destructive leaf area measurements from a further 88 trees. Tests of individual predictions showed that the model was able to accurately reproduce the dominant patterns of intra-stand variability in leaf area. Tests of total leaf area predictions revealed that the model could predict the leaf area index (LAI) of stands with errors ranging from 10% to 32% for trees younger than 60 years old, to a maximum of 88% for old-growth trees (225 years old).

The model was applied to a database of 2079 DBH measurements from 17 Mountain Ash stands. This application proceeded in two ways. Firstly, in a direct application of the model, individual tree leaf area predictions were made from each of the 2079 DBH measurements, and summed over respective stand areas to give LAI predictions for the 17 stands. When plotted against stand age and adjusted for variations in stocking rate, LAI predictions followed an expected pattern peaking at just under 4 m^2/m^2 for 10 to 20 year old forest and decreasing to less than 2 m^2/m^2 for old-growth stands.

A more general application of the model was to anayltically combine the key model equation, predicting leaf area from DBH and mean ln(DBH), with regression equations describing age-related variation in the stem diameters of Mountain Ash forest. In particular the variation with age of mean stand ln(DBH), intra-stand distribution of DBH, and stocking rate were characterised. The combination of these equations produced an equation relating LAI to stand age which predicted a similar pattern of variation with age to the direct LAI predictions. This equation provided continuous estimates of LAI over a wide range of ages of Mountain Ash forest.

Acknowledgements

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We gratefully acknowledge the following people:

Sharon O'Sullivan a current Monash PhD student - who collected the five 'O'Sullivan' DBH data sets and who contributed much of the fieldwork to the five 'Vertessy & O'Sullivan' data sets.

Jason Beringer a former Monash vacation scholar - who was the principal collector of the five previously unpublished 'Beringer' data sets.

Nick Ronan formerly of the Melbourne Water Catchment Hydrology Research Programme - who allowed us to use his unpublished data, the two 'Ronan' data sets.

Greg Dunn who explained aspects of the Dunn & Connor datasets.

Richard Benyon, Jack Snodgrass, Ian Watson, Jamie Hall, Hugh Edwards, and Shane Haydon of Melbourne Water (formerly in RB and HE's case) who hunted for, and explained a great deal of previously collected and unpublished data.

Jim Brophy, Jamie Margules, and Peter Reece of CSIRO Division of Water Resources, and many others who stripped leaves off trees for a number of weeks to provide the leaf area component of the 'Vertessy & O'Sullivan' data sets.

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Fred Watson was supported by an Australian Postgraduate Award and a CRC for Catchment Hydrology Studentship.

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1. Introduction

In the Mountain Ash (*Eucalyptus regnans*) forests of south east Australia, stand age is a major determinant of catchment runoff rate. It is now well documented that regrowth Mountain Ash yields significantly less runoff than old-growth Mountain Ash (Langford, 1976; Kuczera, 1987; Jayasuriya et al., 1993). These water yield patterns have been attributed *inter alia* to transpiration differences caused by age-dependent changes in forest density and structure (Vertessy et al. 1994). A great deal has been revealed about the hydro-ecologic functioning of Mountain Ash forests through investigations on root development (Ashton 1975), stand structure (Ashton, 1976), tree water relations (Connor et al., 1977) and nutrient cycling (Feller, 1981; Polglase & Attiwill, 1992; Polglase et al., 1992a, 1992b). However, comparatively little has been reported on the leaf area index of Mountain Ash.

Leaf area index (LAI) is the ratio of leaf area of a forest stand to the area on the ground which it occupies. It is a major determinant of a number of hydrologic processes in forests including rainfall interception, transpiration and radiation partitioning. For these reasons, LAI is a key parameter in most process-based catchment hydrological models, being frequently used as the 'change parameter' to represent vegetation cover dynamics and its affect on water balance (Band et al., 1993; Vertessy et al., 1993, 1996).

In this paper, we describe a simple technique to estimate LAI from stem diameter at breast height over bark (DBH) measurements. The model is an empirical one, being based on a limited sample of measurements collected in the Mountain Ash forests of the Victorian Central Highlands. However, the model performs well when tested against several independent data sets collected from the same area. Further, by combining our model with known relationships between mean stem diameter, stocking rate and age, we develop an analytical expression that predicts LAI for different ages of Mountain Ash. This expression helps to elucidate the mechanisms behind the stand age/ water yield relationship reported by Langford (1976) and Kuczera (1987).

2. Existing techniques for measuring leaf area index

A number of techniques, of varying accuracy and difficulty, have been developed for measuring LAI. These include:

Destructive sampling This involves felling a sample of trees, weighing all their leaves, and measuring the leaf area of a weighed sub-sample of leaves using a planimeter. It is the most accurate means of measuring the leaf area (LA) of individual trees. The LAI can be calculated if all the trees in a known area are felled.

Estimation from DBH measurements DBH measurements are far more convenient to make than leaf area measurements. Thus, if only a sample of trees in a plot of known area is felled, and DBH measurements are taken for all trees in the plot, then LAI can be estimated by correlating LA and DBH from the sampled trees. The resulting fitted relationship can be applied to the DBH data for the remaining trees to get the total LA which when divided by the plot area gives the LAI. This method has been used by Vertessy et al. (1995, in prep.), who used power-function relationships (see Section 3), and Teskey & Sheriff (1996), who used a linear relationship.

Estimation from sapwood area measurements Sapwood area can be used in a similar way to DBH for predicting LAI. The technique has the advantage that sapwood area is a measure of living conductive tissue in the stem which is likely to be more closely related to LAI than DBH. It has the disadvantage that sapwood area is less easily measured than DBH. Jarvis & Leslie (1988) predicted LAI from sapwood area in old-growth Mountain Ash forest using a weak ($r^2 = 0.657$) leaf area/sapwood area regression given by Ronan (1984). These authors also give a tentative LAI versus age curve.

Hemispherical photographic analysis (HPA) This involves taking a photograph of the sky hemisphere looking upward through the forest canopy (Rich 1990, Rich et al. 1993). Photographs are digitally scanned and the LAI of the stand is calculated from digital measurements of the amount of sky obscured by vegetation using some assumptions about leaf geometry and distribution within the canopy.

Light interception analysis using light meters This involves comparing radiation incident on a light meter above the canopy with that incident on a light meter beneath the canopy. The ratio of above-canopy to below-canopy radiation reflects the integrated effect of obstruction of light by vegetation - from which an estimate of LAI can be made using similar logic to HPA. Specialised units are available for such measurements, including the LICOR LAI-2000 Plant Canopy Analyser (PCA) (Welles and Norman 1991), the CEPTOMETER (Pierce and Running 1988, Rich et al. 1993), and the DEMON (Lang et al. 1985, Whitford et al. 1995).

Remote sensing of LAI This involves correlating multispectral satellite or aerial imagery with ground based measurements of LAI. The correlations can be used to predict the spatial distribution of LAI from the imagery where there are no ground measurements. The approach has been used successfully in coniferous forests in the Northern Hemisphere (Nemani et al., 1993) but has had limited application to broadleaf forests. We are currently exploring applications to Australian eucalypt forests.

3. Previous methods for estimation of LAI from stem diameter measurements

In the Maroondah Catchments, Vertessy et al. (1995, in prep.) have fitted power-function curves to measurements of leaf area (LA) and DBH from a *sample* of trees within plots of known area. Figures 1 to 3 illustrate the relationships which were found for 4 year old, 16 year old[1], and 56 year old Mountain Ash forest respectively. The corresponding regression equations predicting the LA of individual trees were as follows:

4 year old forest (Vertessy, unpub.)

$$\widehat{LA} = 0.259\, DBH^{2.07} \qquad r^2 = 0.81 \qquad n = 20 \tag{1}$$

16 year old forest (Vertessy et al., 1995)

$$\widehat{LA} = 0.003\, DBH^{2.99} \qquad r^2 = 0.93 \qquad n = 19 \tag{2}$$

56 year old forest (Vertessy et al., in prep.)

$$\widehat{LA} = 0.005\, DBH^{2.51} \qquad r^2 = 0.66 \qquad n = 11 \tag{3}$$

For a given stand, the LAI was calculated by applying the fitted relationship to DBH measurements for all trees in a plot to estimate the LA for every tree. The leaf areas were then summed and divided by the plot area to give LAI.

The method is useful for measuring the LAI of a plot by converting destructive LA measurements of a sample of trees to stand LAI, but it has two key limitations:

1. The process of directly fitting power functions is sensitive and not robust with respect to the software used to fit the curve. Vertessy et al. (1995) used Macintosh-based Cricket Graph and Kaleidagraph software. While these yielded similar fits, different PC-based curve fitting software produced different equations.

[1] Vertessy et al. (1995) report the age as 15 years, which is calculated using the date of seeding as the origin of the stand. In this report, we use the date of cessation of logging and burning as the origin date, in order that the ages of seeded and un-seeded stands (e.g. those burnt by wildfire) are consistent. This results in an age of 16 years for this stand.

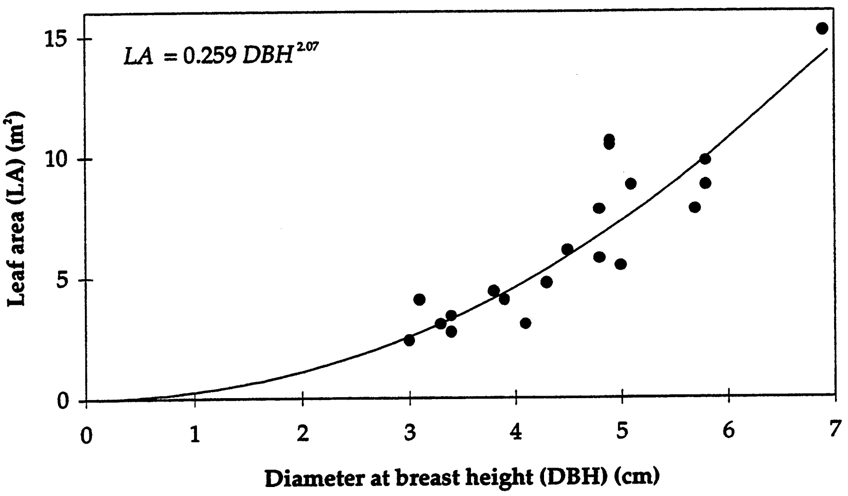

Figure 1: Power function fitted to LA versus DBH data for 4 year old forest in the Murrindindi catchment by Vertessy (unpub.).

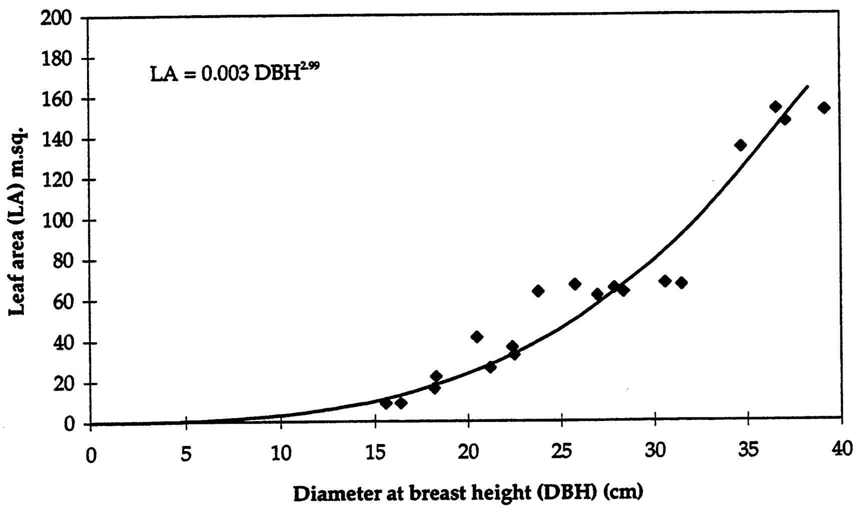

Figure 2: Power function fitted to LA versus DBH data for 15 year old forest near the Monda experimental catchments by Vertessy et al. (1995).

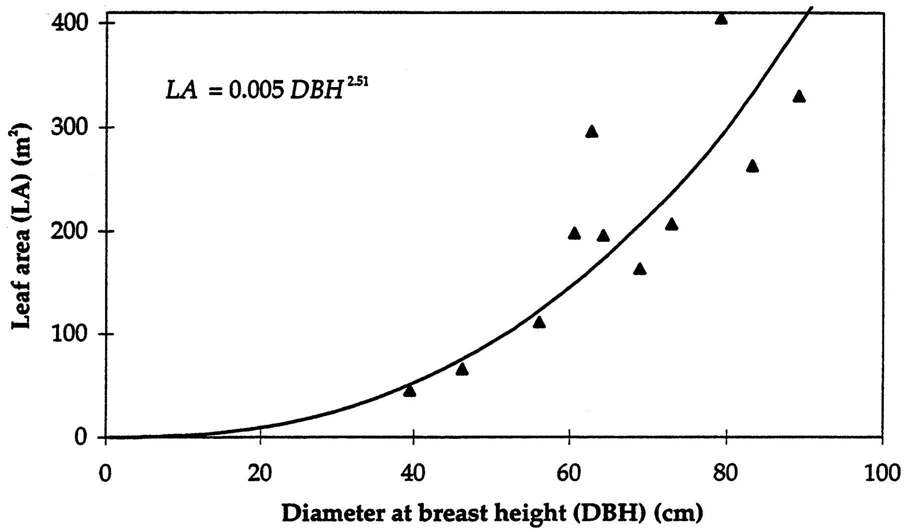

Figure 3: Power function fitted to LA versus DBH data for 56 year old forest near the Blacks' Spur experimental catchments by Vertessy et al. (in prep.).

2. A different curve must be constructed for different aged stands and the method offers no means of generalising to new stands where LA has not been measured.

4. Study area

The study area, as shown in Figures 4 to 6, is known as the Maroondah Catchments - five water supply catchments with a total area of 163 km^2. It is located near Healesville about 55 kilometres east-north-east of Melbourne. Eighteen small experimental catchments have been established within and nearby the study area (O'Shaughnessy & Jayasuriya, 1991) and much of the data we report originates from within these catchments.

The terrain consists of heavily forested, incised mountain ranges and valleys forming part of the Great Dividing Range of eastern Australia. Slightly more than half the area is forested with pure stands of Mountain Ash (*Eucalyptus regnans*), most of which is regrowth from the 1939 wildfires. The remaining portion of the study area carries mixed species eucalypt forest, including Messmate (*E. obliqua*) and Manna Gum (*E. viminalis*). A wet, cool, temperate climate prevails with mean annual precipitation ranging from about 1000 to 2800 mm throughout the study area (Watson et al., 1996).

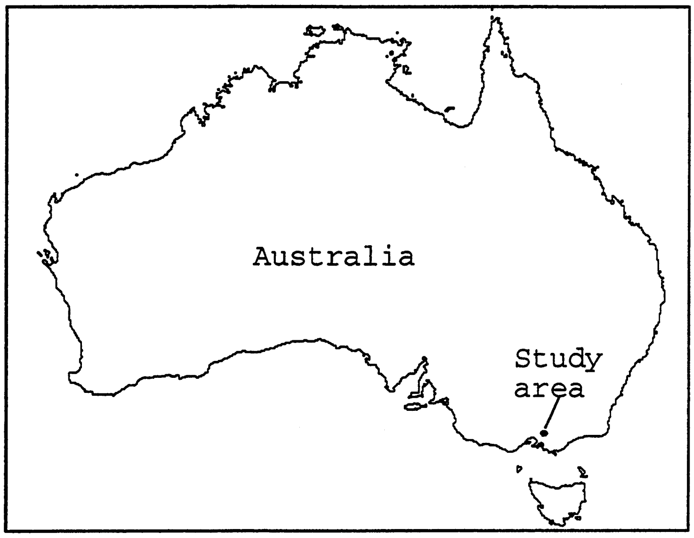

Figure 4: Location of the Maroondah study area within Australia.

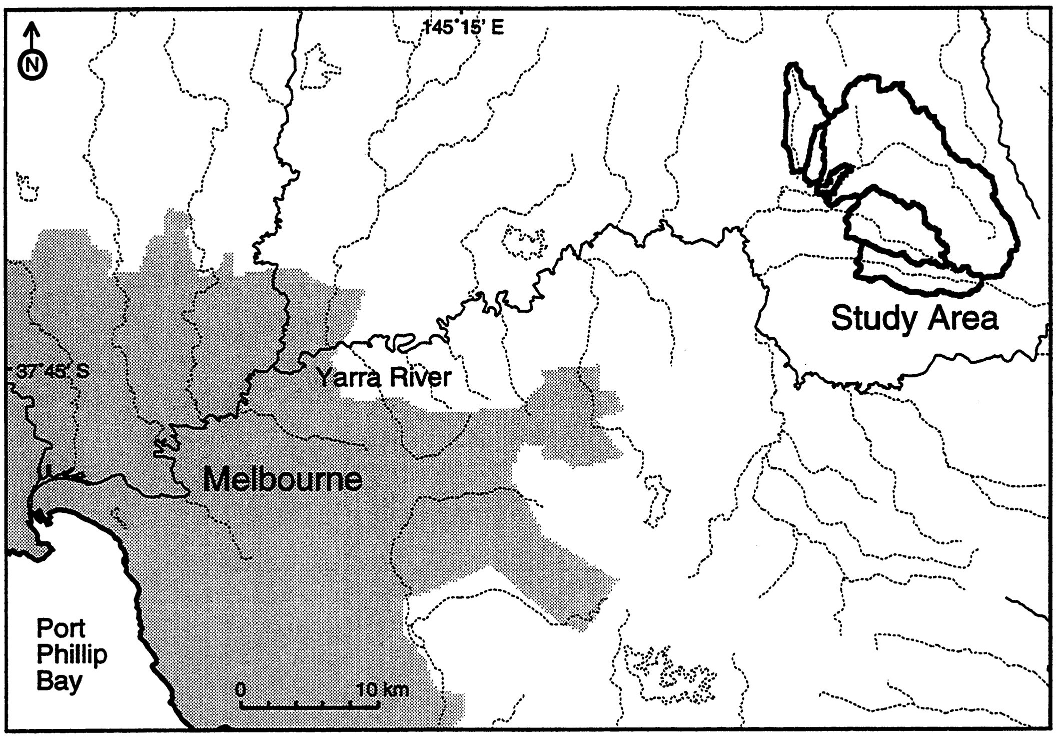

Figure 5: Location of the Maroondah study area 55 km east-north-east of Melbourne.

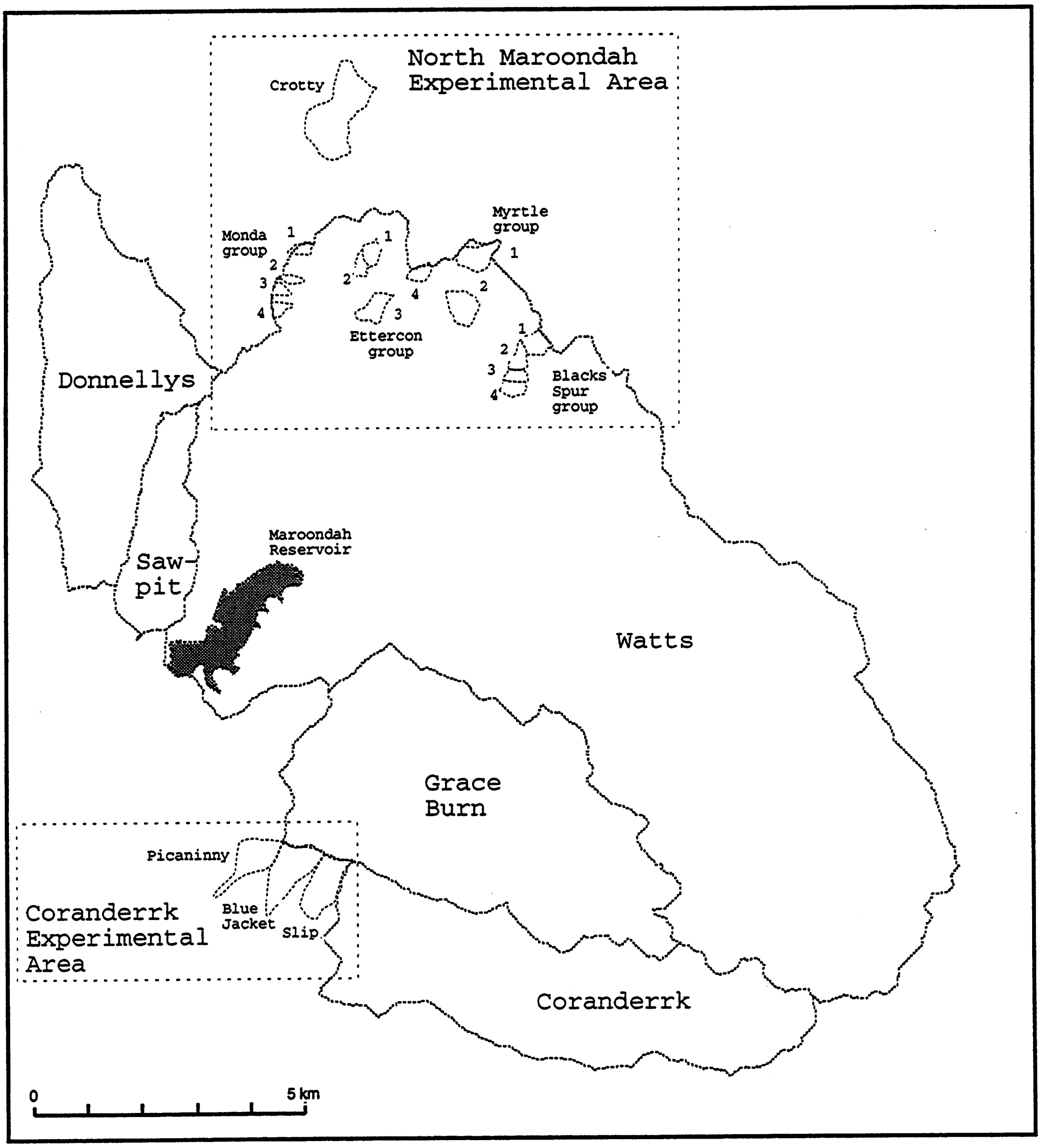

Figure 6: The Maroondah Catchments.

5. Data used in this study

5.1 The database

A number of data sets based on destructive sampling of Mountain Ash leaf area are available. These are used in the calibration and testing of the model (Sections 7 and 8). Four of these data sets were collected by the present authors and our colleagues. The remainder were collected as part of previous studies by other workers. Table 1 summarises these data sets which are reproduced in full in Appendix B.

Additionally, a number of data sets comprised soley of DBH measurements were collected by a variety of authors. These are used in the general characterisation of forest structural variation with age (Section 6) and in the application of the model to predict LAI variation with age (Section 9).

5.2 Data representation and notation

The 'calibration' and 'testing' data sets above are represented as follows:

We have data for a number of stands of trees occupying known areas. Within each stand, the DBH of every tree has been recorded. Also, within a sample of trees in each stand, the LA has been measured destructively. The data from the sampled trees are of the form:

$$(DBH_{s,i}, LA_{s,j}) \tag{4}$$

... where $s = 1, ..., S$, S is the number of stands, $j = 1, ..., n_s$, n_s is the number of trees in the measured sample from stand s, $i = 1, ..., N_s$, and N_s is the number of trees in the whole population of stand s.

From experience, we have observed that the distributions of $(DBH_{s,i}, LA_{s,j})$ data are highly skewed. Both $LA_{s,j}$ measurements and $DBH_{s,i}$ measurements are concentrated towards lower values and sparse at higher values. Additionally, the data are heteroscedastic. By taking logarithms of the data, we can now analyse the data using ordinary least squares analysis. The following notation will be adopted:

Age	Name	Principal investigator(s)	Location	No. of DBHS	No. of LAs	Use	References
4	Vert4	Vertessy & O'Sullivan	Murrindindi catch.	20	20	Testing	
5	Vert5	Vertessy & O'Sullivan	Murrindindi catch.	143	42	Calibration	
8	Ber8	Beringer	Myrtle 2 catch.	340	NA	Testing	Beringer (1994), Ord (1985)
9	OS9	O'Sullivan	Myrtle 2 catch.	105	0	Application	O'Sullivan (In prep.)
11	Vert11	Vertessy & O'Sullivan	Myrtle 2 catch.	128	30	Testing	
14	Orr14	Orr	Picaninny catch.	18	18	Testing	Orr et al. (1986, App. 2)
14	Orr14	Orr	Picaninny catch.	29	0	Application	Orr et al. (1986, App. 3, 'Dense' plots only)
15	Ber15	Beringer	Monda 2/3 catch.	103	0	Application	Beringer (1994)
16	OS16	O'Sullivan	Monda 2/3 catch.	127	0	Application	O'Sullivan (In prep.)
16	Vert16	Vertessy & O'Sullivan	Monda 2/3 catch.	164	19	Calibration	Vertessy et al. (1994, 1995), O'Sullivan (In prep.)
21	Ber21	Beringer	Picaninny catch.	249	0	Application	Beringer (1994)
22	OS22	O'Sullivan	Picaninny catch.	104	0	Application	O'Sullivan (In prep.)
38	Ron38	Ronan	Blacks' Spur 1 catch.	15	15	Testing	Ronan (1984)
50	Dun50	Dunn	Monda Road	44	0	Application	Dunn & Connor (1991, 1993)
50	Dun150	Dunn	Monda Road	1	0	Mixed age	Dunn & Connor (1991, 1993)
50	Dun230	Dunn	Myrtle 1 catch.	10	0	Mixed age	Dunn & Connor (1991, 1993)
54	Ber54	Beringer	Blacks' Spur catch.	153	0	Application	Beringer (1994)
55	OS55	O'Sullivan	Ettercon 3 catch.	59	0	Application	O'Sullivan (In prep.)
56	Vert56	Vertessy & O'Sullivan	Blacks' Spur catch.	94	11	Calibration	Vertessy et al. (In prep.), O'Sullivan (In prep.)
90	Dun90	Dunn	Monda Road	17	0	Mixed age	Dunn & Connor (1991, 1993)
90	Ron225	Ronan	Myrtle 2 catch.	3	3	Testing	Ronan (1984)
150	Dun150	Dunn	Monda Road	13	0	Application	Dunn & Connor (1991, 1993)
150	Ron225	Ronan	Myrtle 2 catch.	1	1	Testing	Ronan (1984)
154	Ber154	Beringer	Monda Road	54	0	Mixed age	Beringer (1994)
212	MW212	Melbourne Water	Myrtle 2 catch.	29	0	Application	(Pure 'overmature' plots only)
225	Ron225	Ronan	Myrtle 2 catch.	7	7	Calibration	Ronan (1984)
230	Dun230	Dunn	Myrtle 1 catch.	8	0	Mixed age	Dunn & Connor (1991, 1993)
235	OS235	O'Sullivan	Myrtle 1 catch.	41	0	Mixed age	O'Sullivan (In prep.)
	Sum			2079	166		

Table 1: Summary of the data sets used in this study. The complete data sets appear in Appendix B. The 'use' column denotes how the data are used in this report. 'Calibration' data are used to calibrate the LA versus DBH model. 'Testing' data are used to test the model. 'Application' data are used in the example applications of the model. 'Mixed-age' data are data where the age of individual trees is in doubt and are only used in Figure 7.

$$x_{s,i} = \ln(DBH_{s,i}) \quad (5)$$

... and:

$$y_{s,j} = \ln(LA_{s,j}) \quad (6)$$

Note that values such as $y_{s,j}$ are often estimated in the course of the following analyses. In such cases, a 'hat' is used to denote 'estimated value', e.g. $\hat{y}_{s,j}$.

DBH measurements were taken for the entire population. In the log domain these are the $x_{s,i}$ values from Equation 5. The sample mean of $x_{s,i}$ is $\bar{x}_s$ and the population mean is μ_s, both of which can be calculated directly from the data. LA measurements were taken only for a sample of the population of trees. From Equation 6 these are the $y_{s,j}$ values in the log domain. The sample mean of $y_{s,j}$ is $\bar{y}_s$ which is calculated directly from the data. The population mean of y_s is ν_s is unknown but is estimated below as $\hat{\nu}_s$.

From this point onwards, all analysis of LA and DBH data is performed on the logged data, that is, in terms of $x_{s,i}$ and $y_{s,j}$ instead of $DBH_{s,i}$ and $LA_{s,j}$. Conversions back to the original scale occur for some plots and results.

When taking a mean of log-transformed data we refer in the text to the value $\bar{x}_s$, for example, as 'mean ln(DBH)' - not 'mean DBH'. When mean ln(DBH) is plotted, the exponential is taken, transforming it back into linear units as what is here termed 'exp-mean-ln DBH'. This back-transformed value is then plotted on standard log axes. Hence the data are displayed on a log scale as desired, but the units on the axes are meaningful and as originally measured. Note that we use natural logarithms despite the fact that the axes are marked in powers of ten.

Additionally, residuals about means of log data are refered to as 'exp-residual-ln' values.

6. Observations of DBH and stocking rate variation for Mountain Ash forest

6.1 General DBH distribution characteristics

Figure 7 shows histograms of DBH values for each stand. The DBHs were measured from a population of trees from a plot of known area. These histograms illustrate how the distributions of DBH within stands varies with the age of the stands. The DBH classes were constructed along a log scale to enable stands of all ages to be viewed within the same domain with approximately uniform variance. Note that the DBH classes for the youngest trees in the Vert5 stand are smaller than the precision of measurement. As a result, the histogram for these classes displays more peaks than are present in the data. This is of negligible consequence. The following observations are made:

- The mean ln(DBH) increases with age, an obersvation which is explored in Section 6.2.
- Many of the distributions are multimodal, reflecting plot sizes which are too small to accurately characterise the distribution shape. However, many of these can be assumed to follow a normal distribution. This observation is explored in Section 6.3.
- The youngest three distributions appear systematically bimodal, perhaps indicating that the forest originates by two waves of germination in successive years, and that by about 10 years of age, competition and other forces obscures this pattern. Perhaps more plausibly, based on observations of growth and water use of Flooded Gum (*Eucalyptus grandis*), Benyon[1] (pers. comm.) suggests that competition itself may cause the bimodality and that at about four or five years of age, the stand separates into distinct dominant and suppressed size classes, the suppressed trees eventually dying. Similar observations were made by Ashton (1976). Some older distributions are also bi-modal or even multi-modal, due partly to under-sampling, and partly to the sampling of mixed-age stands where the authors of the data have been unable to assign ages to individual trees and have simply recorded the age of the oldest trees in the stand.

[1] Richard Benyon, Post-doctoral fellow, CSIRO Forestry and Forest Products, Canberra

- Some stands, in particular the Ber154 and the OS235 stands, are clearly of mixed age, having trees from a much wider range of DBH classes than most stands. Data from these stands are of little use unless the trees can be separated into age classes. The mixed-age stands are included in Table 1 and Figure 7 to illustrate the need to consider whether DBH data are from a single-aged stand or a mixed-aged stand. In the remainder of this report however, mixed-age data are not considered unless the ages of all trees in the data set are known. In cases where the age of trees in old-growth, mixed-age stands *is* known, only data for the oldest stratum is used, unless otherwise stated. This is because the growth of sub-dominant trees in a mixed-age stand is likely to be different to that of trees of the same age in a single-age stand. The converse may be true to some extent for dominant trees in a mixed-age stand but, as *all* old-growth stands in the database are of mixed-age, we must use data from old-growth trees in mixed-age stands if the old-growth data are to be of any use.

6.2 Relationship between DBH and age

Some of the leaf area data used in this study were not collected in conjunction with DBH measurements from an *entire population* of trees within a plot of known area. In these cases, the population mean ln(DBH) cannot be calculated directly. As will become clear, the population mean ln(DBH) is an important quantity. We examine its variation with age here, primarily for the purposes of constructing a simple relationship between DBH and age. This relationship can be used for situations where the mean ln(DBH) is not known.

Figure 8 shows exp-mean-ln DBH against stand age. Only stands exhibitting single-aged trees are included. Additionally, some stands in the Orr14 data set were excluded because they were part of particularly low stocked, poorly regenerated forest documented by Langford & O'Shaughnessy (1980). Non-linearity and non-uniformity are evident in the data and can be rectified by replotting against log age as shown in Figure 9. The now uniform distribution of points along the x-axis indicates a strongly linear relationship for all but the youngest two stands.

If we assume forest structural development does not commence until some years after age zero (here taken as the end of burning due to either wildfire

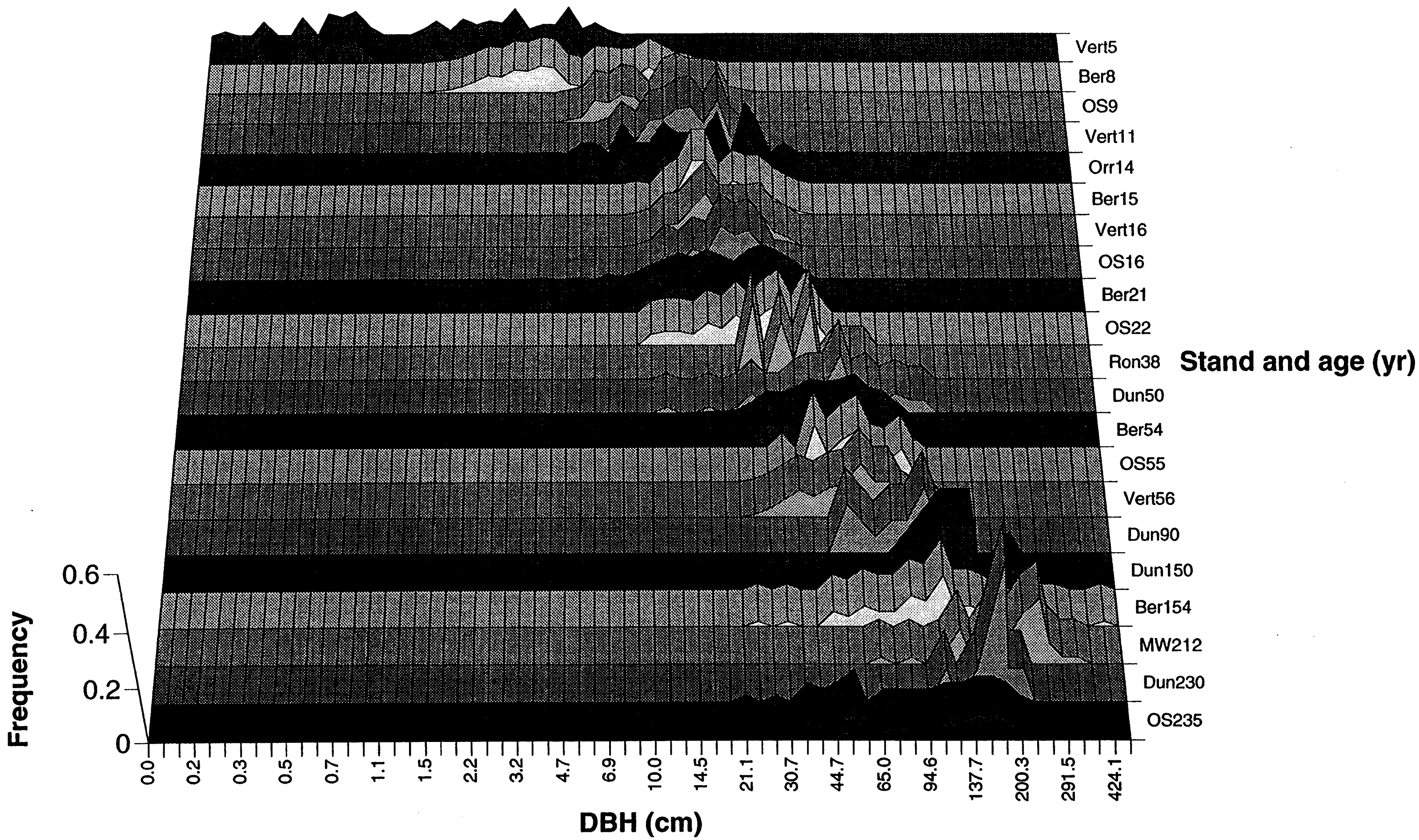

Figure 7: Histograms of DBH values for each stand in the database. DBH classes are calculated and plotted along a natural logarithmic scale.

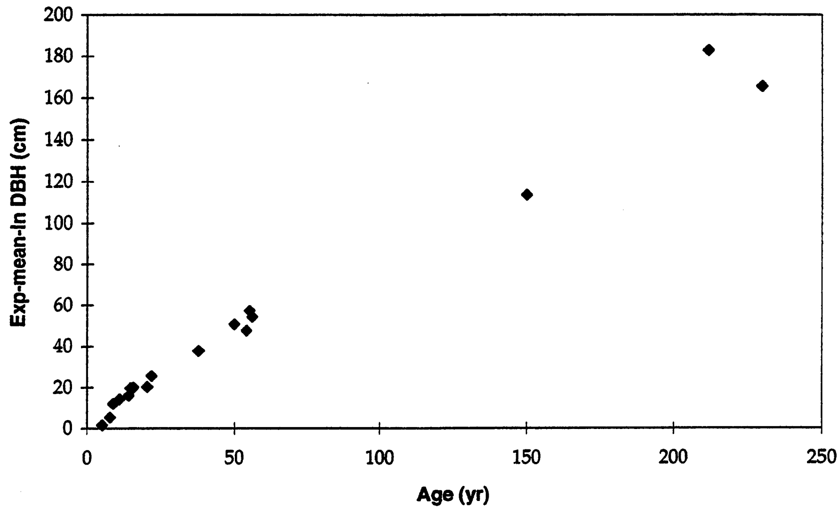

Figure 8: Linear plot of exp-mean-ln DBH versus forest age for all healthy, single-aged stands where all DBHs in a plot or plots of known area have been measured

or logging), then it is reasonable to consider not 'age' but 'age minus some value' as the independent variable. Hence, the following equation relating exp-mean-ln DBH to age was constructed:

$$\hat{\mu}_s = d_1 + d_2 \ln(AGE_s - d_3) \quad (7)$$

The parameters d_1 and d_2 were obtained using ordinary least squares linear regression, adjusting d_3 to maximise the associated r^2 value. The estimated parameters, resulting in $r^2 = 0.987$, were:

$$d_1 = 1.206 \quad (8)$$
$$d_2 = 0.719 \quad (9)$$
$$d_3 = 5.04 \quad (10)$$

Figure 10 shows the line of best fit for the data after adjustment of age (i.e. $AGE - d_3$). The two youngest stands have been 'pulled into line' by the age adjustment though the model will not reliably predict exp-mean-ln DBH for forests younger than or close to $d_3 = 5.04$ years old. The calibrated value of 5.04 for d_3 is higher than would be expected given our earlier hypothesis of delayed forest structural development. Forests younger than five years old are frequently well developed. Clearly, more data from young forests are required if we are to consolidate the age adjustment approach. Presently, Equation 7 is used in latter parts of this report even though we have some reservations about its appropriateness. We feel it reflects a meaningful approach to modelling DBH versus age relationships but could be improved with more data, which would probably reduce the calibrated value of d_3.

For Mountain Ash in other areas, Ashton (1976) gives the relation:

$$\log(D\hat{B}H) = 1.02\log(AGE)$$

with some ambiguity as to whether means or individual trees were used to construct the relationship. Using the form of Ashton's equation in the present study area, we obtained:

$$\log(\overline{D\hat{B}H_s}) = -0.029 + 1.002\log(AGE_s),\ r^2 = 0.906$$

of mean values, which is very similar to Ashton's equation.

6.3 DBH distribution shape

Figure 11 shows histograms of standardised ln(DBH) data from all single-aged healthy stands overlaid upon one another[2]. A standard normal probability density function (PDF) is overlaid upon these histograms, indicating that the ln(DBH) values are approximately normally distributed. Exceptions arise for stands where a small number of trees were measured, and plotted distributions appear irregular, multi-modal, and peaked.

[2]The standardistion follows the equation:

$$z = \frac{x_{s,i} - \mu_s}{\sigma_s} \tag{11}$$

where z is the standardised value of $x_{s,i}$ and σ_s is the population standard deviation of $x_{s,i}$.

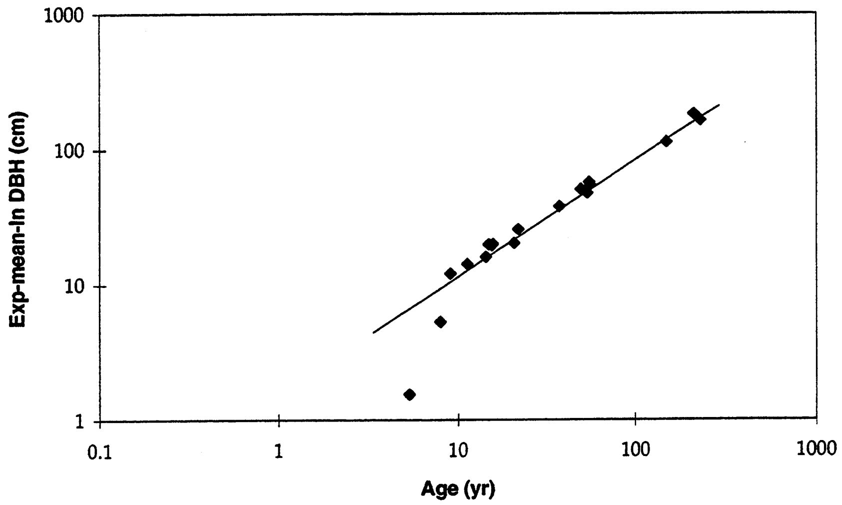

Figure 9: Logarithmic plot of exp-mean-ln DBH versus age with the line of best fit obtained by ordinary linear regression.

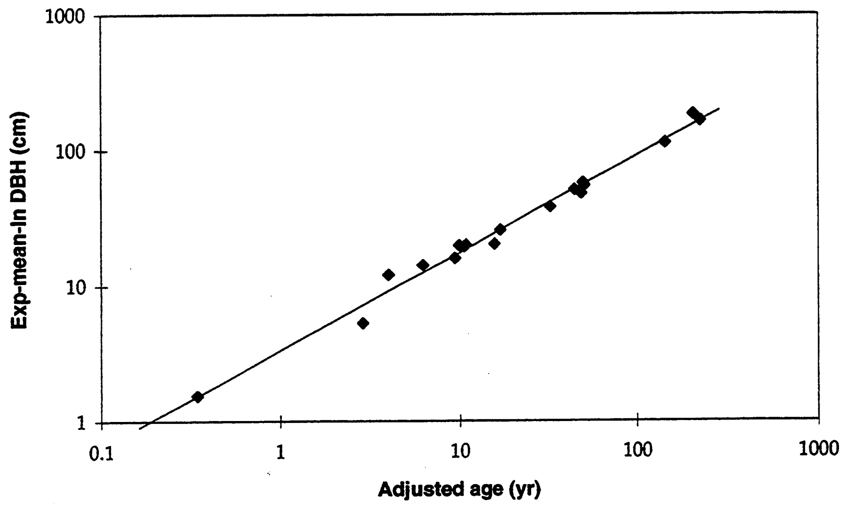

Figure 10: Logarithmic plot of exp-mean-ln DBH versus *adjusted* age, including the line of best fit obtained by ordinary linear regression.

6.4 Stocking rate versus age

Figure 12 shows stocking rate plotted against age on log/log axes for the same stands as above. A strong pattern of forest thinning is evident from 5 year old to 230 year old forest. This information provides a useful background to the remainder of the report, particularly in helping determine whether variations in leaf area index with age are due to variations in stocking rate, or some other influence. The following regression has been fitted to the stocking rate data:

$$\ln(\widehat{SR}_s) = r_1 + r_2 \ln(AGE_s) \tag{12}$$

which becomes, after estimation of regression parameters:

$$\ln(\widehat{SR}_s) = 11.610 - 1.624 \ln(AGE_s) \qquad r^2 = 0.921 \tag{13}$$

where $\widehat{SR}_s$ is an estimate of SR_s, the stocking rate of a stand.

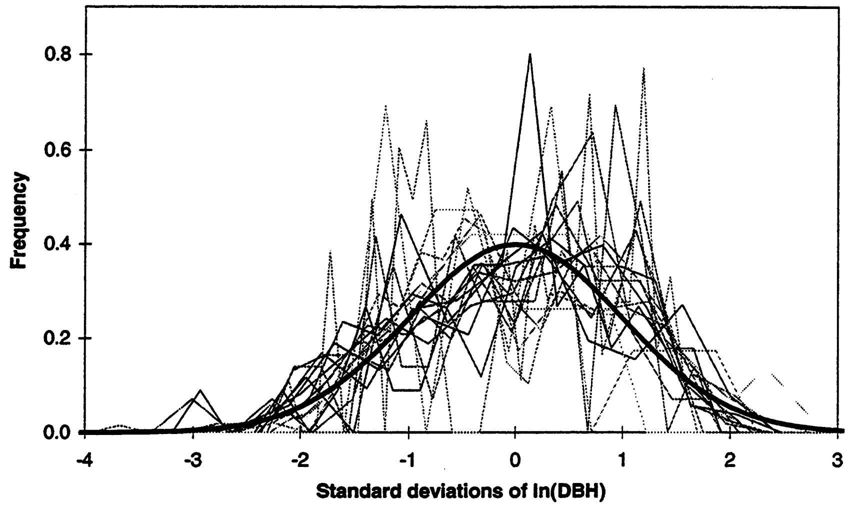

Figure 11: Histograms of ln(DBH) values within each stand, standardised and scaled to have zero mean, unit standard deviation, and unit area. A standard normal PDF has been overlaid to demonstrate that the distribution of ln(DBH) for any given stand tends towards a normal distribution. For clarity, the histograms have been plotted using lines instead of bars.

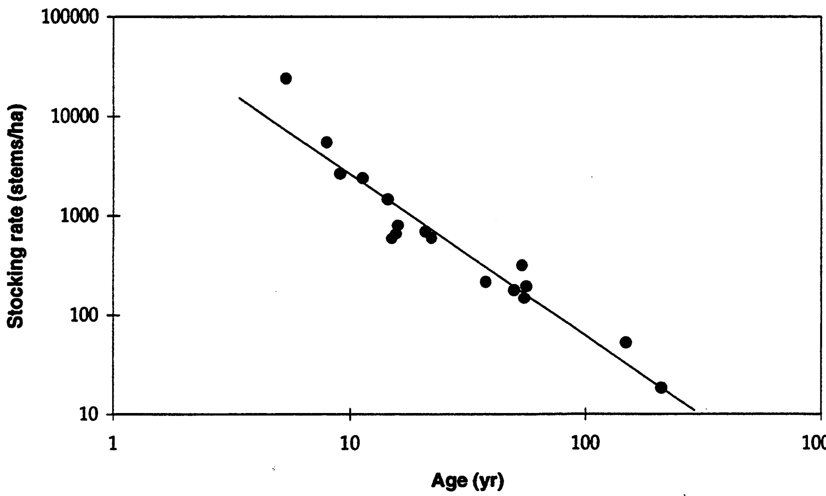

Figure 12: Stocking rate versus age for a number of forest stands, plotted on log/log axes, including the line of best fit obtained by ordinary linear regression.

7. A new, generalised model for estimating LAI from stem diameter measurements

7.1 Introduction

In this section, we describe a new model which linearises the observed relationship between LA and DBH, and generalises it to a wide range of Mountain Ash stands. The model was developed using data from four Mountain Ash stands and then tested using data from several other stands (refer to Table 1).

The calibration data are plotted on linear axes in Figure 13 and on log/log axes in Figure 14. Figure 13 clearly shows the variance increasing with LA and DBH, and the non-uniform distribution of points along each axis. Logarithmic transformations of both LA and DBH resulted in a more constant variance and uniformity in both variables (see Figure 14). Figure 14 illustrates clustering of the data into four groups, corresponding to the four stands which were sampled. There appears to be some variability amongst observations within a cluster, though the mean values of each cluster align linearly. The relationships between ln(LA) and ln(DBH) in the three youngest stands, can be represented quite well by linear regressions.

The model predicting LA from DBH measurements was derived in two parts. Firstly, the relationship between population mean LA and population mean DBH was obtained. Secondly, we developed a relationship between residual LA and DBH *within* each stand. In the following two sections, we describe these procedures in full.

7.2 Calculation of mean stand LA versus mean stand DBH

To relate mean LA to mean population DBH in the log domain, a linear regression of $\hat{\nu}_s$ on μ_s was performed. We calculated μ_s directly, and estimated $\hat{\nu}_s$. This was accomplished using separate linear regressions on the $(x_{s,j}, y_{s,j})$ data from each stand as follows:

In Figure 14, a linear relation between $y_{s,j}$ and $x_{s,j}$ is evident within each stand. We assumed that the sampled ln(DBH) values were uniformly dis-

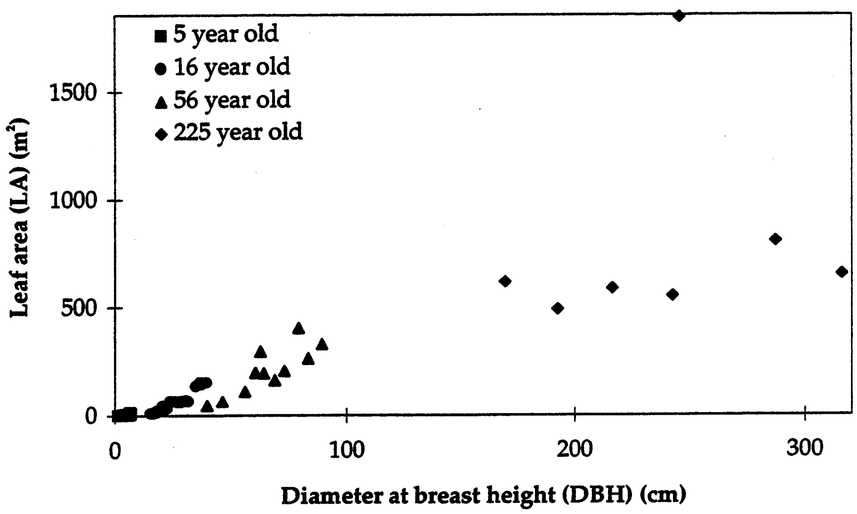

Figure 13: Sampled LA versus DBH for the four 'calibration' stands - plotted on linear axes

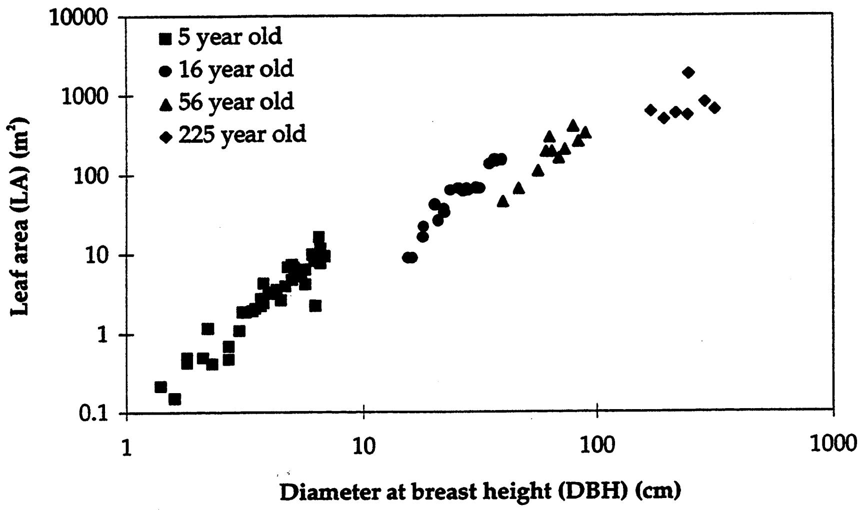

Figure 14: Sampled LA versus DBH for the four 'calibration' stands - plotted on log axes

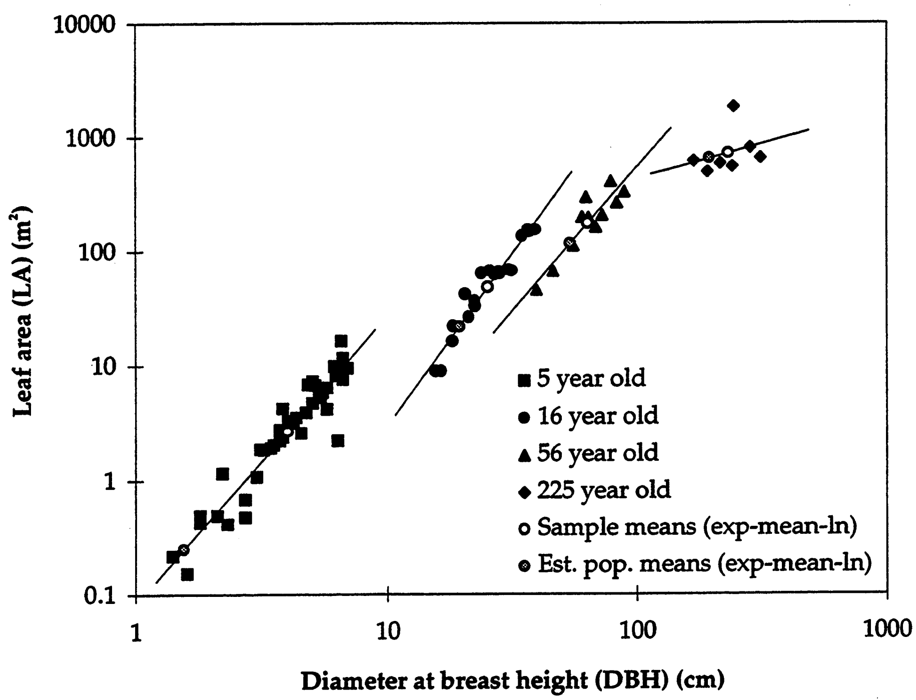

Figure 15: Estimating the population mean ln(LA) of stands: four separate regression lines are fitted; the white circles are sample means; the grey circles are population means estimated from the sample regression equations.

tributed and that, for each value of ln(DBH), measurements of ln(LA) were normally distributed about their mean. This assumption is independent of the observation in Section 6.3 that *populations* of ln(DBH) values are approximately normally distributed. Figure 14 shows that the sampled ln(DBH) values are not always uniformly distributed within each stand. The following ordinary least squares analyses are limited to some degree by this fact. Four separate linear regressions of the form:

$$\hat{y}_{s,j} = \gamma_s + \delta_s x_{s,j} \tag{14}$$

... were fitted to the data in each stand. Estimates of $y_{s,i}$ were obtained by substituting $x_{s,i}$ values into the resulting linear equation. The linear regressions calculated for each stand were:

Stand 1: 5 year old

$$\hat{y}_{1,i} = -2.502 + 2.526\, x_{1,i} \qquad r^2 = 0.898 \tag{15}$$

Stand 2: 16 year old

$$\hat{y}_{2,i} = -5.780 + 2.987\, x_{2,i} \qquad r^2 = 0.929 \tag{16}$$

Stand 3: 56 year old

$$\hat{y}_{3,i} = -5.293 + 2.513\, x_{3,i} \qquad r^2 = 0.836 \tag{17}$$

Stand 4: 225 year old

$$\hat{y}_{4,i} = 3.313 + 0.597\, x_{4,i} \qquad r^2 = 0.085 \tag{18}$$

These relationships are graphed in Figure 15.

Log/log relationships between LA and DBH have been recognised by other authors. For five tree species in Western Australia including two eucalypts, Hingston et al. (pers. comm.[1]) obtained $\log_{10}/\log_{10}$ relationships between *leaf weight* and DBH. These relationships, although using base-ten logarithms instead of natural logarithms, and leaf weight instead of leaf area, can be compared to our LA versus DBH relationships by adjusting the intercept, γ_s, in Equation 14. The slope term in Equation 14, δ_s, is directly comparable without adjustment. Hingston et al's slopes range from 1.62 to 2.06, slightly lower than ours. Attiwill (1962), in a Messmate forest, formed a $\log_{10}/\log_{10}$ relationship between dry leaf weight and *branch* girth with a slope of 1.66, also lower than ours. In Mountain Ash, Attiwill (1991) formed several ln/ln relationships between dry leaf weight and DBH but only provided an equation for one, which had a slope of 2.38, being similar to ours. Feller (1980) obtained slopes ranging from 1.7 to 6.8 for ln/ln relationships between leaf weight and DBH in three eucalypt species. Ronan (1984) and Teskey and Sheriff (1996) obtained linear regressions between LA and *basal area* for Mountain Ash and Radiata Pine, respectively. Because basal area is proportional to the square of DBH, a linear LA versus basal area relationship translates into the log/log domain as a LA versus DBH relationship with $\delta_s = 2$. Conversely, relationships such as ours (above) and Hingston et al's, where δ is approximately equal to two, will appear linear if basal area is used

[1] Hingston, F.J., Galbraith, J.H., & Jones, M.S., CSIRO Division of Forestry and Forest Products, W.A. Divisional Research Group, Western Australia

as the independent variable instead of DBH. However, we prefer the log/log domain to Ronan's and Teskey and Sheriff's linear approach because: it allows for cases where δ_s is not equal to two; it forces the relationship through zero, thus avoiding negative leaf areas; it reduces non-uniformity in the distribution of the independent variable (in our case ln(DBH)); and it reduces heteroscedasticity in the dependent variable (in our case ln(LA)). Ronan's basal area values are non-uniformly distributed, which biases his ordinary linear regression towards low values. Pook (1984) adopted a quadratic model for a regression on un-transformed LA versus basal area data. His Figure 4 shows non-uniformity which suggests that data transformation could improve the model.

We can calculate the sample mean ln(LA) and sample mean ln(DBH) for each stand, but our estimation of the mean relationship between LA and DBH should be based on the population means and not the sample means. This is necessary for the method to be independent of the sampling procedure. Thus, we estimated the population mean ln(LA), ν_s, for each stand using Equations 15 to 18, by substituting in the population mean ln(DBH), μ_s, for each stand:

$$\hat{\nu}_s = \gamma_s + \delta_s \mu_s \tag{19}$$

The sample means $(\bar{x}_s, \bar{y}_s)$ and population means $(\mu_s, \hat{\nu}_s)$ for each stand are plotted in Figure 15. There is a clear offset between sample and population means for each stand. This indicates that the samples are not representative of the populations for each stand, because of the bias to sample larger trees, hence justifying the separate consideration of sample and population means. The population means do, however, fall within the domain of the sampled trees, thus validating the estimation of population mean ln(LA) from the sample data.

A further linear regression is performed on the estimated population means giving the relationship between mean stand ln(LA) and mean stand ln(DBH) represented by the solid line in Figure 16 (i.e. the line of best fit to the grey circles in Figure 15). Note that the estimate of population mean ln(LA) produced here is an *estimate derived from an estimate*, written as $\hat{\hat{\nu}}_s$, which occurs in the general regression equation:

$$\hat{\hat{\nu}}_s = \alpha + \beta \mu_s \tag{20}$$

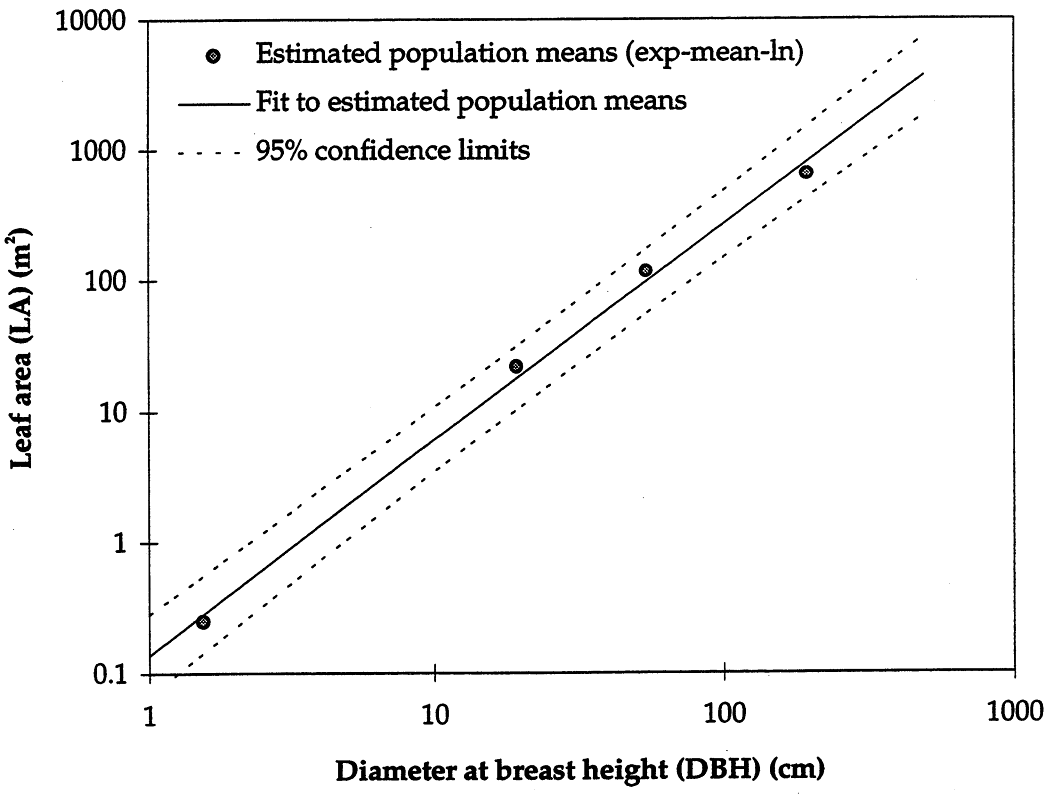

Figure 16: Estimated variation in (estimated) population mean ln(LA) between stands.

The resulting line of best fit in Figure 16 is:

$$\hat{\nu}_s = -1.980 + 1.642\mu_s \qquad r^2 = 0.996 \tag{21}$$

The estimate, $\hat{\nu}_s$, for stands of Mountain Ash described by Equation 20 is subject to regression errors which are calculated in Section A.1. The 95% confidence limits were subsequently calculated and plotted in Figure 16. All points fall within the confidence limits. There are additional errors in the measurement of leaf area and in the estimation of population means from sample means. The magnitude of these is not explicitly investigated here but is implicit in the errors discussed in Section 8. In the following section, a relationship describing the intra-stand variability of leaf area is described which assumes that ν_s is known. This intra-stand relationship is thus subject not only to its own errors, but also the error in the mean relationship, or $\hat{\nu}_s - \nu_s$.

7.3 Calculation of LA versus DBH within each stand

As discussed in Section 7.1, a linear relationship between $y_{s,j}$ and $x_{s,j}$ is evident *within* each stand. The calculated residuals about the estimated population means for each tree in each stand, $(x_{s,j} - \mu_s, y_{s,j} - \hat{\nu}_s)$, are plotted in Figure 17.

The line of best fit represent the relationship between the residuals. However, a *single* linear regression is not suitable for this data because it is biased towards stands with more trees. Instead, we used the separate regressions for each stand fitted earlier (Equations 15 to 18). The slope of the line of best fit for all residuals, $\bar{\delta}$, is taken as the mean of the slopes of the separate regressions, δ_s. The intercept is zero because the population means about which the residuals are calculated are defined to lie *on* the separate regression lines from Equations 15 to 18. Taking the mean slope is equivalent to performing a single regression on unbiased data for the zero-intercept case.

The r^2 for the 225 year old forest (Equation 18) is very low. The strong intra-stand relationship between leaf area and DBH observed in the younger stands does not hold for older forest. We suggest that the intra-stand patterns observed for the younger forest are a result of thinning processes within the stand. If a tree has a DBH significantly lower than the mean DBH of the

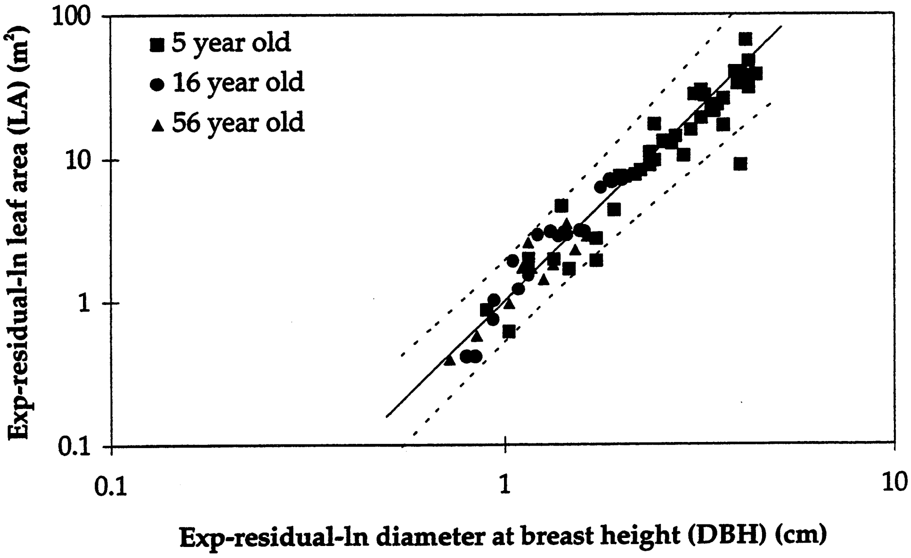

Figure 17: Mean of three separate regressions on residual LA versus DBH variation within each stand. Dashed lines indicate 95% confidence limits for the mean regression.

stand, it is most likely to become a victim of natural thinning. As such, it is in sub-optimal health, and its leaf area will be lower than would be predicted by the inter-stand relationship described in Section 7.2. The converse applies to trees of larger DBH than the stand mean. This argument leads to a LA versus DBH relationship which is steeper within stands than between stands, which is what is observed in Figure 15. Once a forest begins to senesce (i.e. branches which are destroyed by the elements are not replaced), thinning through competition amongst trees is perhaps less prevalent and the steep intra-stand LA versus DBH relationship will weaken. The structure of the forest will be primarily influenced by more random controls such as catastrophic crown damage in storms and so forth.

Because of the weak intra-stand pattern in the 225 year old forest, the slope of the mean line of best fit to the residuals was calculated as the mean of the slopes for the *three younger stands only.* The resulting mean line of best fit to the residuals is plotted in Figure 17 and described by the following equation:

$$\hat{y}_{s,i} - \hat{\nu}_s = \gamma + \bar{\delta}(x_{s,i} - \mu_s) \quad s = 1, 2, 3 \tag{22}$$

By substituting in parameter values of $\gamma = 0$ and $\bar{\delta} = \frac{1}{3}\sum_{s=1}^{3}\delta_s = 2.675$ we obtained:

$$\hat{y}_{s,i} - \hat{\nu}_s = 2.675(x_{s,i} - \mu_s) \qquad (23)$$

At this point we could have used the specific regression slopes, δ_s, for each stand. However, the slopes for each stand are quite similar and a general relationship with only one slope, $\bar{\delta}$, is more useful. We have done some testing of the improvement in predictive accuracy offered by separate regressions of the residuals and found the improvement is not so large as to offset the benefits of a general relationship.

The estimate of $y_{s,i} - \hat{\nu}_s$ described by Equation 22 is subject to regression errors which are calculated in Section A.2. They are subsequently used in the calculation of the 95% confidence limits which are plotted in Figure 17. All but two of the 72 data points fall within the confidence limits, indicating that the limits are a valid characterisation of the error in the fit to residuals. Additional errors arise in the use of a single fit to approximate the fits for stands of different ages, and in the extrapolation of the residual relationship to forests older than 56 years. The model of residuals assumes that the population mean ln(LA) values for each stand is accurate, an assumption which itself is subject to the errors noted in Section 7.2. The total magnitude of the error in $\hat{y}_{s,i} - \hat{\nu}_s$ is implicit in the errors discussed in Section 8.

7.4 The full model

The relationship between ln(LA) and ln(DBH) was obtained by substituting Equation 20 into Equation 22, giving:

$$\hat{y}_{s,i} = \alpha + \beta\mu_s + \gamma + \bar{\delta}(x_{s,i} - \mu_s) \qquad (24)$$

and:

$$\hat{y}_{s,i} = -1.980 + 1.642\mu_s + 2.675(x_{s,i} - \mu_s) \qquad (25)$$

once the appropriate parameter values were substituted.

Back-transformation of these equations gave:

$$\widehat{LA}_{s,i} = e^{\alpha + \beta\mu_s + \gamma + \bar{\delta}(\ln DBH_{s,i} - \mu_s)} \tag{26}$$

and:

$$\widehat{LA}_{s,i} = e^{-1.980 + 1.642\mu_s + 2.675(\ln DBH_{s,i} - \mu_s)} \tag{27}$$

once the appropriate parameter values were substituted.

Equations 26 and 27 were simplified as:

$$\widehat{LA}_{s,i} = e^{\alpha+\gamma}\, M_s^{\beta-\delta}\, DBH_{s,i}^{\delta} \tag{28}$$

and:

$$\widehat{LA}_{s,i} = 0.138\, M_s^{-1.033}\, DBH_{s,i}^{2.675} \tag{29}$$

once the following substitution was made:

$$M_s = e^{\mu_s} = e^{\frac{1}{N_s}\sum_{i=1}^{N_s} \ln(DBH_{s,i})} \tag{30}$$

The relationship between LA and DBH described by Equation 29 is plotted in Figure 18 on log/log axes for each of the for stands, and on linear axes in Figure 19. The model enables the prediction of the leaf area of any tree in a stand of Mountain Ash given $x_{s,i}$, the natural log of the DBH of the tree, and M_s the exponential of the mean of the natural logs of the DBHs of all trees in the stand. Values for M_s can be estimated from the age of stand as discussed in Section 6.2. The model can also predict the LAI of a stand if the area of the stand is known and the DBHs of all trees in the stand are known.

The estimate of $LA_{s,i}$ described by Equation 29 is subject to the sum of the errors described in Sections 7.2 and 7.3, including the regression errors calculated in Section A.3. These regression errors are represented as 95% confidence limits in Figures 18 and 19. All but one of the points from the first three stands fall within the confidence limits, indicating that the limits are an accurate representation of the regression errors in the full model. Three of the seven points for the 225 year old stand fall outside the limits, which relates to the earlier observation that patterns of intra-stand variability in LA are weakened for old-growth forests. Predictions of *individual* tree LA for stands older than 56 years are *extrapolations*, the true confidence limits for which would be significantly wider than shown in Figures 18 and 19. The following section tests the model predictions using some additional leaf area data.

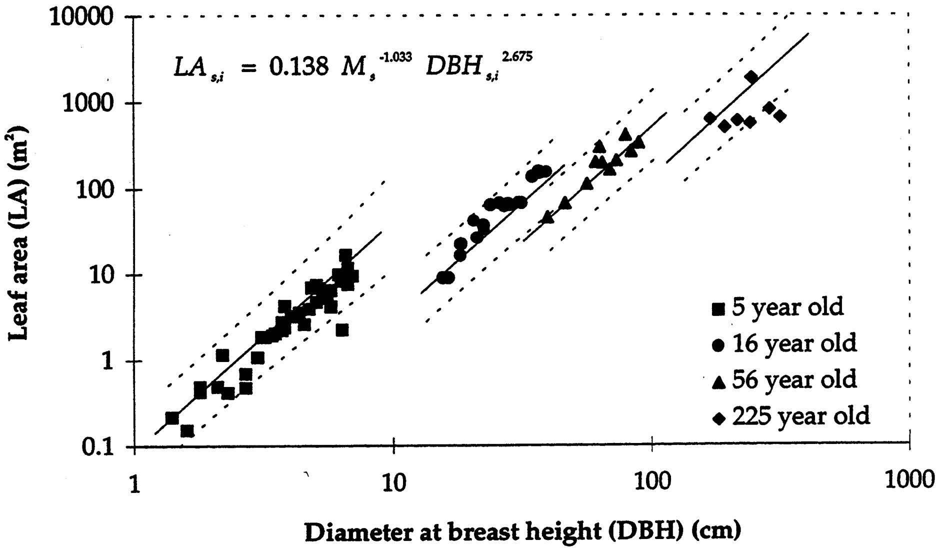

Figure 18: Final model of LA versus DBH for the four stands, plotted on log axes with 95% confidence limits (dashed lines).

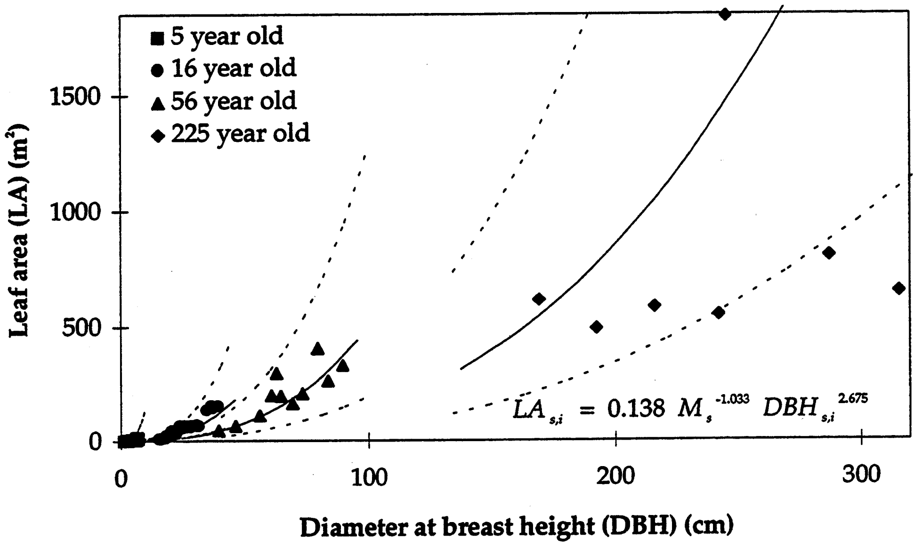

Figure 19: Final model of LA versus DBH for the four stands, plotted on linear axes with 95% confidence limits (dashed lines).

8. Model testing

Leaf area measurements from samples within four forest stands were used to construct and calibrate a general model for predicting the leaf area of a tree given its DBH and the mean ln(DBH) of the population of trees from which it came. In this section, a further five sets of leaf area measurements are used to independently test the model. Firstly, the prediction of individual tree leaf area is assessed and secondly, the prediction of the total leaf area of sampled trees is assessed.

8.1 Testing of individual tree leaf area predictions

Data from five forest stands are available for testing individual tree leaf area predictions (see Table 1). Two of these data sets were collected as part of the current research programme. The remaining three were collected as part of two previous research efforts in the same region. The five data sets are named after the chief researcher in each case and are examined separately as follows:

8.1.1 The Vertessy & O'Sullivan Murrindindi 4 year old data set

This data set was obtained by the destruction and leaf area measurement of 20 trees in the Murrindindi basin during July 1995. Unfortunately, DBH measurements were taken only for the destroyed trees and not for an entire population from a known area. This means that the data can only be used to test the intra-stand prediction of leaf area variation and not the mean leaf area of the stand in relation to other, older stands.

For the purposes of display, the population mean ln(DBH) was calibrated so that the total prediction error for the stand is zero. Modelled versus measured leaf area for this data set is plotted in Figure 20. The points are closely scattered around the 1:1 line at a similar slope. The overall proximity of the points to the line is of no consequence - being a result of calibration. However, the similarity in slope indicates that the model accurately predicts the intra-stand variability of leaf area for this stand.

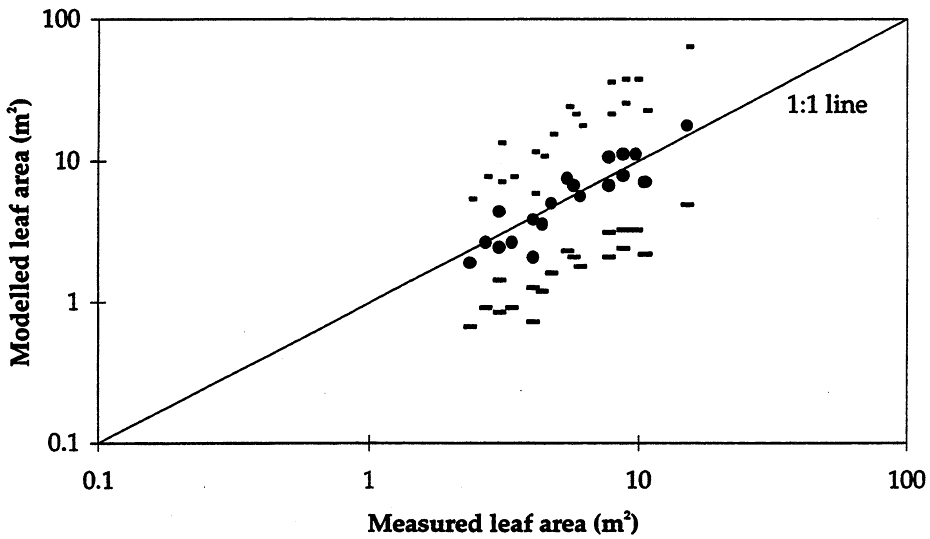

Figure 20: Modelled versus measured leaf area for the 'Vertessy & O'Sullivan Murrindindi 4 year old' data set. Dashes indicate 95% confidence limits for each prediction.

8.1.2 The Vertessy & O'Sullivan Myrtle 11 year old data set

This data set was obtained by the destruction and leaf area measurement of 30 trees from a 540 m^2 plot in the recently logged Myrtle 2 experimental catchment during July 1996. Additionally, DBH was measured for the full population of 128 trees in the plot, enabling the calculation of a population mean ln(DBH).

Modelled versus measured leaf area for this data set is plotted in Figure 21. The points are closely scattered along the 1:1 line at a similar but slightly shallower slope. The plot demonstrates that the model has accurately predicted both the mean leaf area of these 11 year old trees and the pattern of their intra-stand leaf area variability. The 95% confidence limits for two of the predictions fall away from the 1:1 line, approximately the number expected from a sample size of 30.

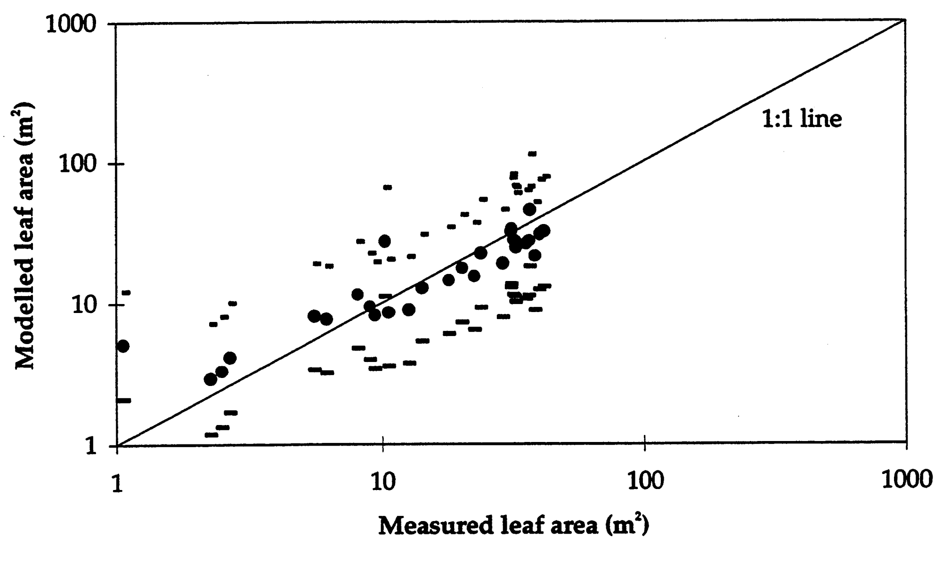

Figure 21: Modelled versus measured leaf area for the 'Vertessy & O'Sullivan Murrindindi 11 year old' data set. Dashes indicate 95% confidence limits for each prediction.

8.1.3 The Orr Picaninny 14 year old data set

This data set was obtained by Orr et al. (1986) in 1986 and involved the destruction and leaf area measurement of 18 trees from scattered locations bordering the Picaninny experimental catchment. Because of the scattered location of the trees, a population mean ln(DBH) cannot be calculated directly. Instead, a mean was obtained from the total population of six permanent growth plots[1] at Picaninny, surveyed by Melbourne Water in 1986. Use of this proxy mean is not ideal, owing to the patchy regeneration at Picaninny (Langford & O'Shaughnessy, 1980). However, it should be sufficient to enable the use of Orr et al's data to test the model.

Modelled versus measured leaf area for this data set is plotted in Figure 22. The points are less aligned with the 1:1 line than for the two previous examples. The mean location of points is slightly below the line, which may be partly due to the use of a proxy mean ln(DBH). Also, the slope of the line of best fit through the points is not as steep as the 1:1 line, in a similar manner to the Vertessy & O'Sullivan Myrtle 11 year old data. The 95% confidence limits for two of the predictions fall away from the 1:1 line. This is about twice the number expected from a sample size of 18.

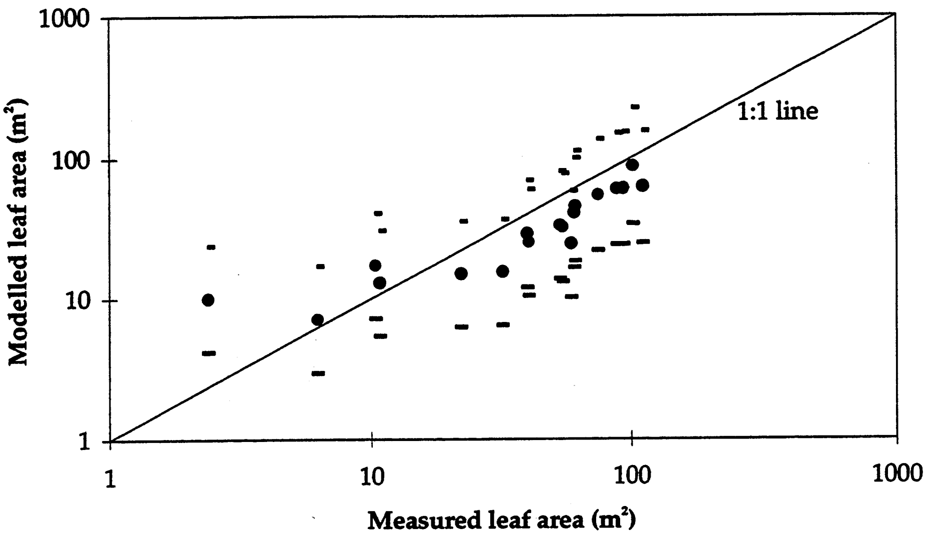

Figure 22: Modelled versus measured leaf area for the 'Orr Picaninny 14 year old' data set. Dashes indicate 95% confidence limits for each prediction.

[1] 45 plots are surveyed at Picaninny every 5 years. A subset is surveyed every year.

8.1.4 The Ronan Blacks' Spur 38 year old data set

This data set was obtained by Ronan (1984) in around December 1976. Fifteen 38 year old Mountain Ash trees comprising the total population of a plot of known area were felled for leaf area measurement; the DBH of each tree was also recorded.

Modelled versus measured area for this data set is plotted in Figure 23. A similar pattern to the above data is observed - with the mean leaf area being modelled accurately and a slope slightly lower than the 1:1 line. The 95% confidence limits for one of the predictions falls away from the 1:1 line, as would be expected from a sample size of 15. This data strongly supports the model.

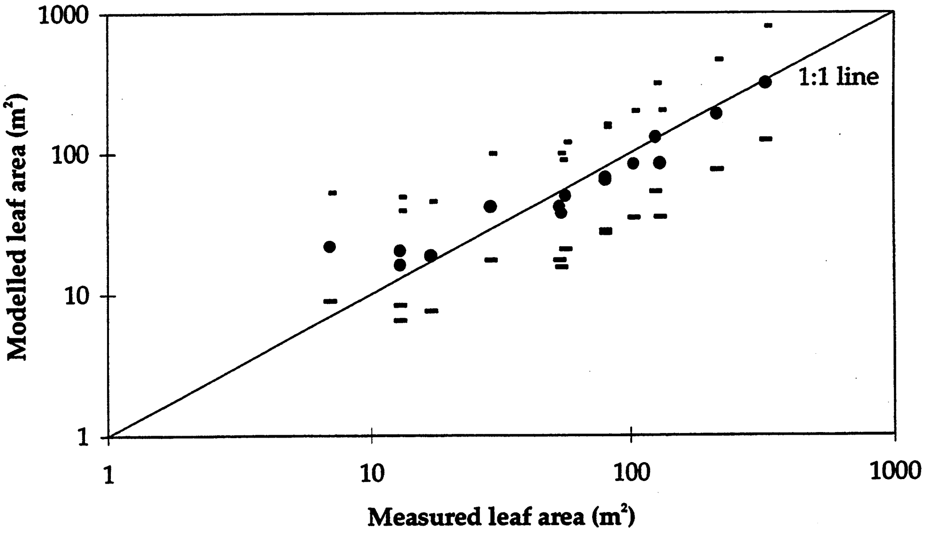

Figure 23: Modelled versus measured leaf area for the 'Ronan Blacks' Spur 38 year old' data set. Dashes indicate 95% confidence limits for each prediction.

8.1.5 The Ronan Myrtle 225 year old data set

Data from the 225 year old trees in this data set were used in the initial calibration of the model. Additionally, Ronan (1984) measured one 150 year old and three 90 year old trees from the same location. The data from these sub-dominant trees are examined here. Population mean ln(DBH) for both ages was derived from the DBH versus age relation given in Equation 7. Estimating the mean DBH in this manner may lead to some additional uncertainty in the estimation of mean leaf areas.

Modelled versus measured leaf area for this data set is plotted in Figure 24. The modelled leaf area for the 150 year old tree is accurate, but as there is only one observation, this offers no statistical support for the accuracy of the model. Both the mean and the trend of LAs for the 90 year old stand are poorly estimated. This may be due to the small sample size, inaccuracy in the estimated population means, and the fact that the trees are sub-dominants and have spent their entire lives beneath larger and older trees. The 95% confidence limits for two out of the three LA predictions for 90 year old trees fall away from the 1:1 line.

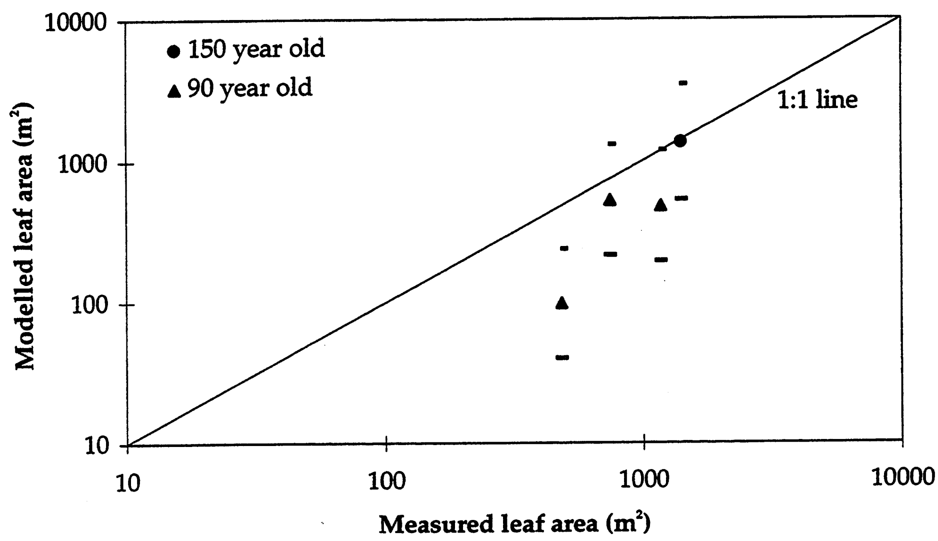

Figure 24: Modelled versus measured leaf area for the 'Ronan Myrtle 150 and 90 year old' data set. Dashes indicate 95% confidence limits for each prediction.

8.2 Testing of total sample leaf area and LAI predictions

The prediction of total leaf area for stands can be evaluated by summing measured and modelled leaf areas for all the trees in a sample from a stand. However, in most cases, only a sample of trees from a plot or plots within each stand had their leaf areas measured. Thus, bias between sampled trees and the full population of a plot will lead to differences between the error in total LA estimated from the sample and the true error which would be calculated if the whole population had their leaf areas measured. However, these differences are likely to be small.

Figure 25 shows the percentage error in the sample sum of modelled leaf areas for each stand, calculated as $100(\frac{Total\,modelled\,LA}{Total\,measured\,LA}-1)$. These values are a good approximation to the percentage errors in LAI estimation which would be made if total population leaf area was measured. In two cases (the Beringer 8 year old stand and the Ronan 38 year old stand), total population LA *was* measured, so the error in LAI is exactly the same as the error in sample sum LA as plotted in Figure 25 (-26% and -10%, respectively). For stands younger than about 60 years old, the maximum percentage error observed was +32%, with three of these stands displaying a percentage error less than ±13%. For the 90 year old stand of sub-dominant trees, an error of -54% was obtained. The 225 year old stand was modelled least accurately with an error of +88%. There was no dependence of error magnitude on whether the stand was part of the calibration or test data sets. This indicates that the model, as structured, was calibrated as well as possible, and that the observed errors are inherent in the data. As mentioned before, a more complex model could be constructed but we feel that the present model achieves a desirable balance between predictive ability and simplicity.

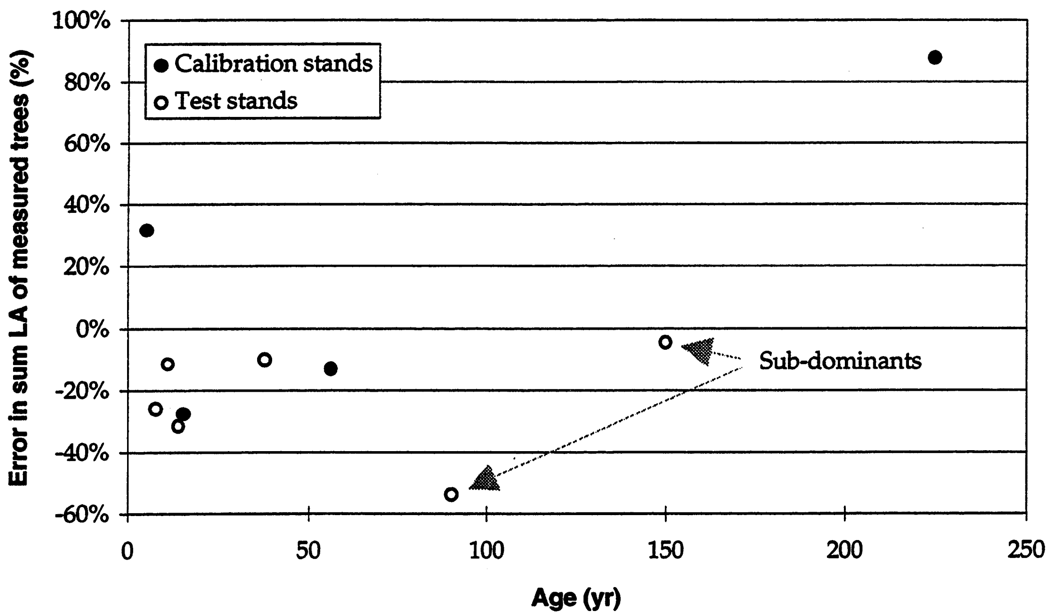

Figure 25: Percentage error in sample summed leaf area for both the calibration and testing stands. The values plotted are approximate percentage errors in predicted LAI, the differences being soley attributable to sample bias in each stand.

9. Application

There are a number of ways in which the model may be used. Here we use the model to construct curves relating LAI to age, both by applying the model to individual tree data, and to relationships expressing the variation in DBH and stocking rate with age, and the distribution of DBH values within stands.

9.1 Constructing an LAI versus age curve from individual tree measurements

Having constructed, calibrated, and tested a model enabling the prediction of LAs of individual trees, we can predict LAI by applying the model to populations of DBH measurements from a number of stands. The DBH database assembled for this study is large, but some ages of forest are poorly represented. The use of these data to predict LAI at a number of ages is presented chiefly as a *demonstration of the application of the model.* We have access to a much larger forest assessment database which will be the subject of future work.

From the database we selected data for all stands exhibiting healthy, single-aged Mountain Ash for which the DBH was recorded for all trees in plots of known area. The population exp-mean-ln DBH was calculated for each stand. Estimates of LA were calculated using Equation 29. The resulting LA predictions were summed for each stand and divided by the area of the measurement plot to give LAI predictions for each stand (Figure 26).

A great deal of scatter is evident, as are some expected features such as a peak in LAI for very young forest and a gradual decrease in LAI as the forest ages. Given the high accuracy with which the model can predict leaf areas, the scatter in Figure 26 was unexpected. The most likely cause is variability in the stocking rates of stands from the general relationship between stocking rate and age described in Section 6.4. To correct for this, we divided the predicted LAI by a 'stocking rate deficit', calculated as measured stand stocking rate divided by the rate predicted by Equation 13 as follows:

$$Corrected\,\widehat{LAI}_s = \frac{\widehat{LAI}_s}{\frac{SR_s}{\widehat{SR}_s}} \qquad (31)$$

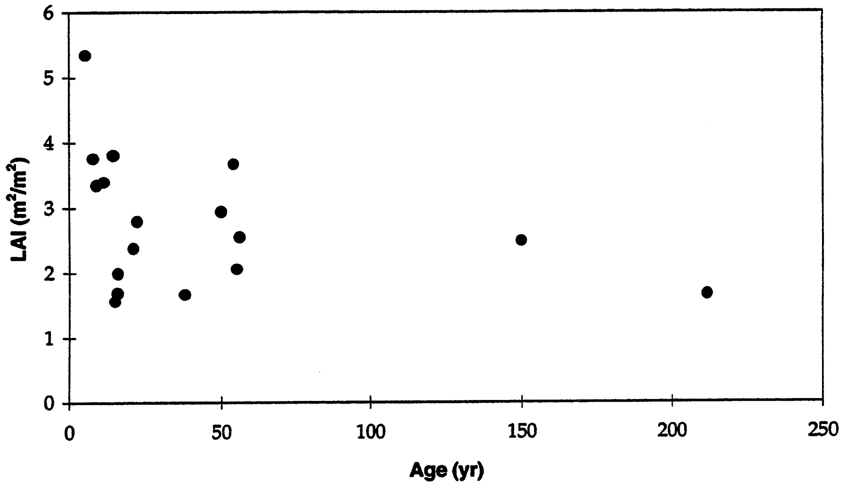

Figure 26: Predicted LAI versus age for each healthy, single-aged stand (uncorrected).

This correction essentially replaces the actual stocking rate of the experimental plot with the rate expected for a stand of the particular age. This results in Figure 27 which shows considerably reduced scatter and describes an LAI versus age relationship which peaks at just under 4 m^2/m^2 for 10 to 20 year old forest and then declines gradually to below 2 for old-growth forest.

9.2 Constructing an LAI versus age curve from previously derived relationships

We can derive an equation that mimics the relationship shown in Figure 27 using a number of the equations derived throughout this report. Firstly, we express LAI as the product of mean LA and stocking rate (adjusted to use the same units):

$$\widehat{LAI}_s = \frac{\widehat{SR}_s \overline{\widehat{LA}_s}}{10000} \tag{32}$$

$\widehat{SR}_s$ can be easily obtained from Equation 13 and $\overline{\widehat{LA}_s}$, can be estimated by making some assumptions about the distribution of $x_{s,i}$ values within any

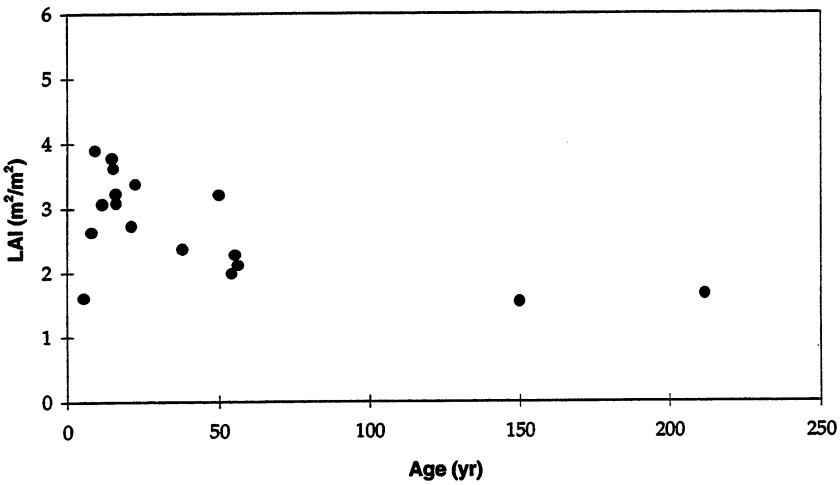

Figure 27: Predicted LAI versus age for each healthy, single-aged stand (corrected for variability in stocking rate).

given stand. Assume that the distribution of $x_{s,i}$ for all stands follows the shape of a standardised probability density function (PDF), $g(z)$, where z is the standardised value of $x_{s,i}$:

$$z = \frac{x_{s,i} - \mu_s}{\sigma_s} \tag{33}$$

By substituting Equation 33 into the PDF $g(z)$, and dividing by σ_s to ensure the integral of the function remains equal to unity, the distribution of $x_{s,i}$ values for any particular stand can be written as the PDF $f(x_{s,i})$:

$$\begin{aligned} f(x_{s,i}) &= \frac{1}{\sigma_s} g(\frac{x_{s,i} - \mu_s}{\sigma_s}) \\ &= \frac{g(z)}{\sigma_s} \end{aligned} \tag{34}$$

where σ_s is the population standard deviation of $x_{s,i}$.

Treating $x_{s,i}$ as a continuous random variable distributed according to the PDF $f(x_{s,i})$, an expression for the expected or mean value of $\widehat{LA}_{s,i}$, itself a function of $x_{s,i}$, can be written:

$$\overline{\widehat{LA}_s} = \int_{-\infty}^{\infty} \widehat{LA}_s f(x_{s,i}) dx_{s,i} \tag{35}$$

Subtituting into this the equation for the leaf area of a single tree (Equation 26), and the equation for the PDF of $x_{s,i}$ (Equation 34), gives:

$$\begin{aligned}
\overline{\widehat{LA}_s} &= \int_{-\infty}^{\infty} e^{\alpha+\beta\mu_s+\gamma+\bar{\delta}(x_{s,i}-\mu_s)} \frac{1}{\sigma_s} g(\frac{x_{s,i}-\mu_s}{\sigma_s} dx_{s,i} \\
&= e^{\alpha+\beta\mu_s+\gamma} \int_{-\infty}^{\infty} e^{\bar{\delta}\sigma_s(\frac{x_{s,i}-\mu_s}{\sigma_s})} \frac{1}{\sigma_s} g(\frac{x_{s,i}-\mu_s}{\sigma_s})\, dx_{s,i} \\
&= e^{\alpha+\beta\mu_s+\gamma} \int_{-\infty}^{\infty} e^{\bar{\delta}\sigma_s z} \frac{g(z)}{\sigma_s} \frac{dx_{s,i}}{dz} \frac{dz}{dx_{s,i}} dx_{s,i} \\
&= e^{\alpha+\beta\mu_s+\gamma} \int_{-\infty}^{\infty} e^{\bar{\delta}\sigma_s z} g(z)\, dz
\end{aligned} \tag{36}$$

The mean estimated LA of trees in a given stand depends on an integral involving both the standardised PDF and the standard deviation of the $x_{s,i}$ values for the stand. As noted in Section 6.3, ln(DBH) values follow an approximately normal distribution. Therefore:

$$g(z) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}z^2} \tag{37}$$

Substituting this into Equation 36 gives:

$$\begin{aligned}
\overline{\widehat{LA}_s} &= e^{\alpha+\beta\mu_s+\gamma} \int_{-\infty}^{\infty} e^{\bar{\delta}\sigma_s z} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}z^2}\, dz \\
&= e^{\alpha+\beta\mu_s+\gamma} \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} e^{-\frac{1}{2}z^2+\bar{\delta}\sigma_s z}\, dz \\
&= e^{\alpha+\beta\mu_s+\gamma} \frac{e^{\frac{1}{2}(\bar{\delta}\sigma_s)^2}}{\sqrt{2\pi}} \int_{-\infty}^{\infty} e^{-\frac{1}{2}(z^2-2\bar{\delta}\sigma_s z+(\bar{\delta}\sigma_s)^2)}\, dz \\
&= e^{\alpha+\beta\mu_s+\gamma} \frac{e^{\frac{1}{2}(\bar{\delta}\sigma_s)^2}}{\sqrt{2\pi}} \int_{-\infty}^{\infty} e^{-\frac{1}{2}(z-\bar{\delta}\sigma_s)^2}\, d(z-\bar{\delta}\sigma_s)
\end{aligned} \tag{38}$$

The right hand portion of this equation:

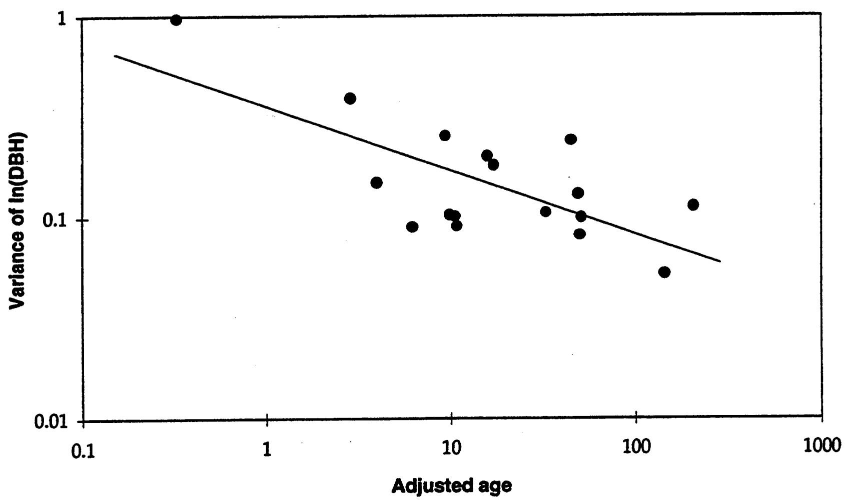

Figure 28: Line of best fit for variance of ln(DBH) versus age for each stand.

$$\frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} e^{-\frac{1}{2}(z-\bar{\delta}\sigma_s)^2} \, d(z - \bar{\delta}\sigma_s) \tag{39}$$

is the integral of a standard normal PDF for $z - \bar{\delta}\sigma_s$. By definition this integral is unity. Thus:

$$\begin{aligned} \overline{\widehat{LA}_s} &= e^{\alpha+\beta\mu_s+\gamma} \, e^{\frac{1}{2}(\bar{\delta}\sigma_s)^2} \\ &= e^{\alpha+\beta\mu_s+\gamma+\frac{1}{2}\bar{\delta}^2\sigma_s^2} \end{aligned} \tag{40}$$

There are two unknowns in Equation 40: μ_s and σ_s^2. An estmate of μ_s can be obtained from Equation 7. An estimate of σ_s^2 is not so easily calculated. Figure 28 shows σ_s^2 (the variance of ln(DBH) values within a stand) plotted on log/log axes with respect to adjusted age. The same age adjustment is used as in Equation 7. The regression of σ_s and AGE_s is given in Equation 41 and is drawn in Figure 28.

$$\ln(\widehat{\sigma_s^2}) = v_1 + v_2 \ln(AGE_s - d_3) \tag{41}$$

Substituting in d_3 from Equation 10 and estimating v_1 and v_2 by regression gives:

$$\ln(\widehat{\sigma_s^2}) = -1.029 + -0.319 \ln(AGE_s - 5.04), \qquad r^2 = 0.504 \tag{42}$$

The low r^2 value indicates that the regression of the variance of ln(DBH) on age does not fit the data well. As Figure 11 suggests, we have enough data points within each stand to accurately characterise the mean ln(DBH), but there are too many 'spikes' in the observed distributions to accurately characterise the variance. In future, we intend to process more available data to remedy this situation. Presently, we make use of Equation 41 and substitute it and Equation 7 into Equation 40 giving:

$$\overline{\widehat{LA_s}} = e^{\alpha+\beta[d_1+d_2 \ln(AGE_s-d_3)]+\gamma+\frac{1}{2}\bar{\delta}^2 e^{[v_1+v_2 \ln(AGE_s-d_3)]}} \tag{43}$$

Substituting Equations 13 and 43 into Equation 32 gives:

$$\begin{aligned}
\widehat{LAI}_s &= \frac{e^{r_1+r_2 \ln(AGE_s)} \, e^{\alpha+\beta(d_1+d_2 \ln(AGE_s-d_3))+\gamma+\frac{1}{2}\bar{\delta}^2 e^{[v_1+v_2 \ln(AGE_s-d_3)]}}}{10000} \\
&= \frac{e^{r_1+\alpha+\beta d_1+\gamma}}{10000} e^{r_2 \ln(AGE_s)} \, e^{\beta d_2 \ln(AGE_s-d_3)} \, e^{\frac{1}{2}\bar{\delta}^2 e^{[v_1+v_2 \ln(AGE_s-d_3)]}} \\
&= \frac{e^{r_1+\alpha+\beta d_1+\gamma}}{10000} AGE_s^{r_2} \, (AGE_s - d_3)^{\beta d_2} \, (e^{\frac{1}{2}\bar{\delta}^2 e^{v_1}})^{[(AGE_s-d_3)^{v_2}]}
\end{aligned} \tag{44}$$

If estimates of the regression parameters are then substituted into Equation 44, we get:

$$\widehat{LAI}_s = 11.014 \; AGE_s^{-1.624} \, (AGE_s - 5.04)^{1.180} \; 3.592^{[(AGE_s-5.04)^{-0.319}]} \tag{45}$$

The relationship between LAI and age (Equation 45) is plotted in Figure 29 along with the modelled LAI estimates for each stand. It is important to note that this equation was not directly fitted to the points plotted in Figure 29 (i.e. LAI values 'measured' using the LA versus DBH model given in Equation 29). Rather Equation 45 has been derived as a combination of equations representing approximations to the various factors that influence

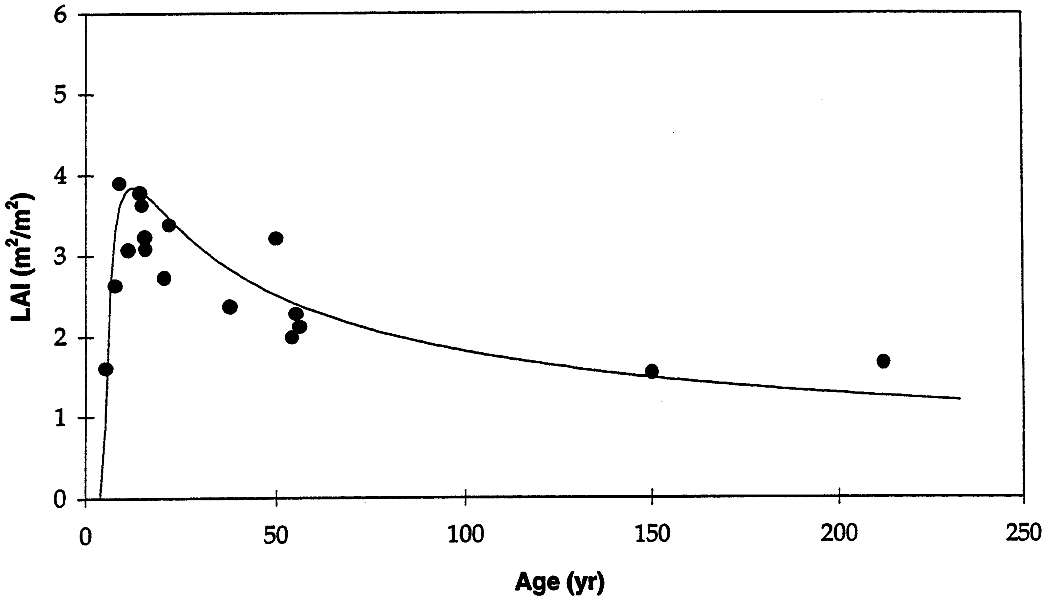

Figure 29: Predictions of LAI variation with stand age derived from Equation 45 plotted over individual (stocking-corrected) model predictions of LAI for all single-aged healthy stands in the database.

LAI variation with age, namely: stocking rate of trees in a stand; exp-mean-ln DBH of trees within a stand; variance of ln(DBH) values of trees within a stand; an assumption of normally distributed ln(DBH) values within each stand; and finally, the model predicting the leaf area of an individual tree in a stand given the DBH of the tree and the exp-mean-ln DBH of the stand. Figures 30 and 31 summarise these steps.

The relationship expressed in Equation 44 is simple, except for the last term, the nested power function. This term originates from the regression relating variance of ln(DBH) to stand age, which was not a good fit to the data. Investigations of this regression will follow. One hypothesis says that if we fit a linear/log regression to the variance data, the nested power function would dissappear, being subsumed into the third term of Equation 44.

Further improvements are expected to result from the use or more detailed data for young stands. Presently, the LAI model is very sensitive to perturbations in the regression fits to young aged stands, in particular to perturbations of $a_3 = d_3$, the age adjustment value.

The form of the curve is similar to that offered for a wide range of ages of

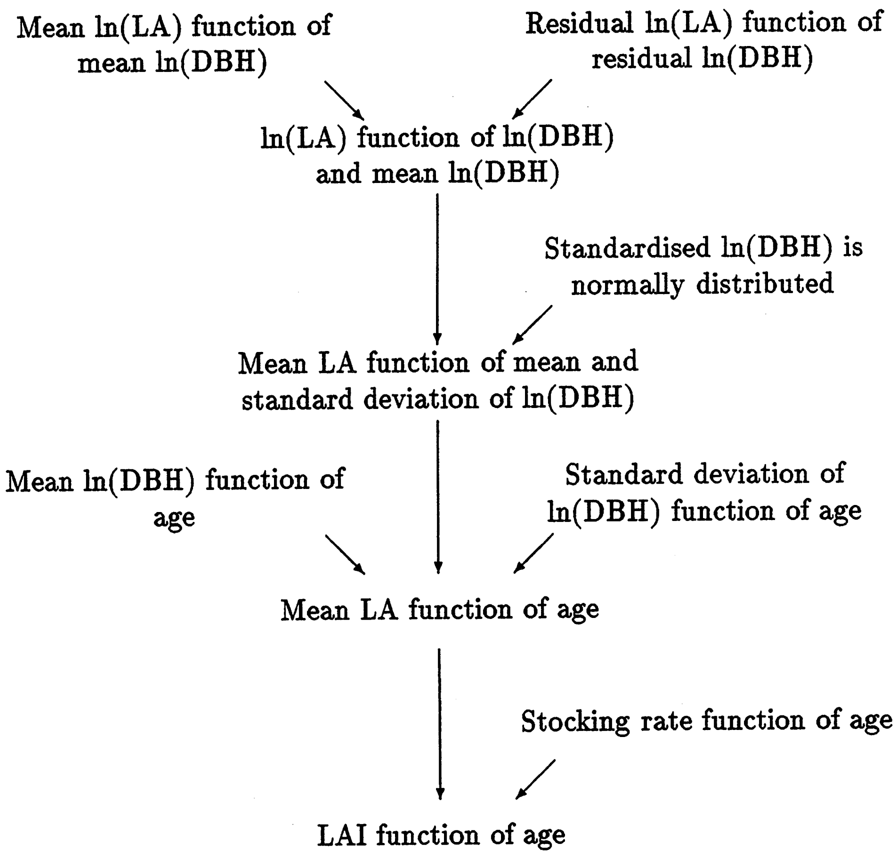

Figure 30: Flow chart summarising the steps taken to establish the relationship between LAI and age. A symbolic version is given in Figure 31.

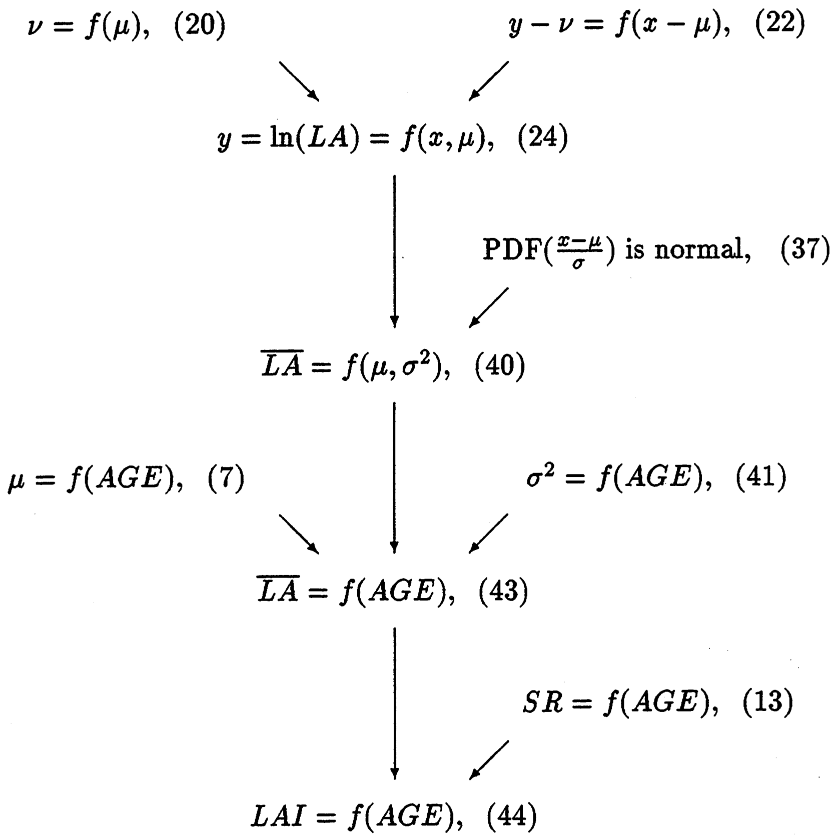

Figure 31: Symbolic version of Figure 30. Subscripts and 'hats' have been removed from variables for simplicity.

Mountain Ash by Jarvis & Leslie (1988) in some preliminary and exploratory work.

10. Summary

A large amount of data on the stem diameter and leaf area (LA) of Mountain Ash (*Eucalyptus regnans*) at various ages was collected - both through fieldwork conducted as part of the present study, and from a variety of other sources. The resulting database was organised by forest stand into two groups of data: that where diameter at breast height (DBH) only was measured; and that where both DBH and LA were measured. For each stand of the 'DBH only' data, DBH measurements were recorded for every tree in one or a number of plots of known area. For the 'DBH and LA' data, destructive leaf area measurements were recorded from either a sample of trees in a plot or a number of scattered trees. DBH measurements were occasionally made for the sampled trees only, but usually from all the trees in the plot.

Simple observations of the variation in mean ln(DBH) and stocking rate with age revealed clear organisation within the forest. A strong positive correlation was observed between DBH and age for all except the youngest ages of forest. This correlation was very similar to that observed by Ashton (1976). A strong negative correlation was observed between stocking rate and age. These observations are useful background to the analysis of leaf area patterns in Mountain Ash forest.

As previously noted by others, clear relationships were also shown between LA and DBH - both amongst stand mean values, and within the trees of each stand. Mean ln(LA) is linearly related to mean ln(DBH). Also, within each stand, individual tree ln(LA) and ln(DBH) exhibit separate linear relationships within each stand, with steeper slopes than the mean relationship. These relationships support observations made by Hingston et al. (pers. comm.), Feller (1980), Pook (1984), Ronan (1984), Attiwill (1962, 1991), and Teskey and Sheriff (1996) in both Mountain Ash forests and other forests. Pook (1984), Ronan (1984) and Teskey and Sheriff (1966) report linear and quadratic relationships using basal area as the independent variable. We suggest that these relationships could be re-derived in the log/log domain to give similar slopes to those found here, with the advantage that the data in the log/log domain would exhibit reduced non-uniformity and reduced heteroscedasticity. The steeper sloped relationships given for the intra-stand variability are likely to be governed by natural thinning resulting from competition amongst trees. The relationship weakens within the oldest (225 year old) forest whose intra-stand variability appears to be governed by intermittent catastrophic structural influences such as lightning strikes.

The above observations were used to construct a model enabling the prediction of the leaf area of any tree given its DBH and the mean ln(DBH) of the population of trees from which it came. Data from four stands, aged between 5 and 225 years old, were used in the construction and calibration of the model. The model was constructed using a number of linear regressions on natural log DBH and LA data. Four separate regressions (one for each stand) were computed in order to estimate population mean ln(LA) for each stand, with population mean ln(DBH) being calculated directly from the data. Then, a single regression was computed on the four population means, yielding a line of best fit to the inter-stand variability in mean ln(LA) versus mean ln(DBH). Finally, the mean slope of the separate regressions for the three youngest stands was used to give the slope of a line of best fit to the residual intra-stand varibility in ln(LA) versus ln(DBH). The two lines of best fit were added together to give the final model, which is reproduced here in two alternate forms from Equations 27 and 29:

$$\widehat{LA}_{s,i} = e^{-1.980 + 1.642\mu_s + 2.675(\ln DBH_{s,i} - \mu_s)}$$

$$\widehat{LA}_{s,i} = 0.138\ M_s^{-1.033}\ DBH_{s,i}^{2.675}$$

where $\widehat{LA}_{s,i}$ is the estimated leaf area of tree i from stand s, $\ln(DBH_{s,i})$ is the natural log DBH of tree i from stand s, μ_s is the population mean ln(DBH) of stand s, and M_s is e^{μ_s}.

Plots of modelled versus measured LA showed that the model could reproduce the intra-stand and inter-stand leaf area relationships of the calibration data set. As expected, intra-stand variability was not well predicted for the 225 year old trees which, as described above, are subject to different structural influences to the younger forest.

Five further data sets were introduced to independently test the model. Some of these data sets lacked a population mean ln(DBH), so the DBH versus age relationship constructed earlier was used to fill in the missing values. The model was able to predict the intra-stand and inter-stand variability of the test data set, with some qualifications. For mid-aged forests, the slope of the intra-stand LA versus DBH pattern was overpredicted by the model. Perhaps a more complex model could take account of this variation, but we suggest that more data would be needed to justify such complexity (which would probably require an extra parameter in the model). Prediction of leaf areas for 90 year old trees which were sub-dominant to 225 year old trees in a mixed-age stand was not accurate. Amongst other influences, this could be because the trees were sub-dominants and thus we do not assert the model's validity as a predictor of the leaf area of sub-sominant trees. Overall, considering the wide range of ages and locations of the forest stand data, the model performed well on independent tests against individual tree leaf area measurements.

Tests of the model's ability to predict *total* LA and LAI were also possible. Most of the 'DBH & LA' data sets do not include destructive LA measurements for all trees in a plot of known area, so the percentage error in the model's prediction of LAI cannot usually be calculated. However, the percentage error in predictions of the total LA of measured trees is an estimator of LAI error - the differences being essentially due to sample bias. LAI errors thus estimated ranged from -10% to ±32% for trees younger than 60 years old. The errors for 90 and 150 year old sub-dominant trees were -54% and -5% respectively. As noted above, these values are influenced by the trees' sub-dominance. For the oldest trees (225 years old), the error increased to +88%.

Two example applications of the model were presented. The first involved applying the model to DBH measurements from all trees in all single-aged, healthy stands where a population of trees from a plot of known area was measured. The model predictions were summed and divided by the plot areas to yield LAI estimates for 17 plots. When plotted against age, a scattered pattern was observed. This was improved by applying a correction to the LAI predictions based on deviations in stocking rate for each stand from the pattern of stocking rate versus age constructed earlier. This is a sensible correction because many plots contained too few trees to give an adequate reflection of stocking rate for the corresponding stand. The corrected LAI data, when plotted against age, were much less scattered and followed an expected trend; LAI increasing to a peak of just under 4 m^2/m^2 for 10 to 20 year old forest then gradually decreasing to less than 2 m^2/m^2 for old-growth stands.

The second example application of the LA versus DBH model involved deriving an equation predicting LAI variation with age by combining the LA versus DBH model with expressions of DBH and stocking rate variation with age and an expression of the distribution of DBH values within each stand. The combined expressions included: the regression of stocking rate against age; the regression of exp-mean-ln DBH against age; a new regression of variance in ln(DBH) against age; an assumption that ln(DBH) values within each stand are always normally distributed; and the LA versus DBH model itself. The analytical combination of these expressions yielded the following equation for LAI versus age (reproduced from Equation 45):

$$\widehat{LAI}_s = 11.014\ AGE_s^{-1.624}\ (AGE_s - 5.04)^{1.180}\ 3.592^{(AGE_s - 5.04)^{-0.319}}$$

where $\widehat{LAI}_s$ is an estimate of the LAI of stand s and AGE_s is the age of stand s.

The plot of this equation (Figure 29) showed that analytically predicted LAI varied both as expected, and in the same manner as the points derived from explicit application of the model to individual DBH measurements. We hope to replace the awkward final term of the equation, representing the effect of changing variance in ln(DBH) values, with a more simple expression upon processing further DBH data. Finally, it is noted that Equation 45 (reproduced above) is very sensitive to changes in the expression of forest structural descriptors (such as stocking rate) *for young aged forest stands.*

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A. Error analyses

A.1 Confidence limits for the model of inter-stand variability in mean ln(LA)

Following the method described in Ezekiel and Fox[1] (1959) we can place 95% confidence limits on the regression of mean ln(LA) against mean ln(DBH) (see Section 7.2) by 'estimating the reliability of an individual forecast' as:

$$CL_{\hat{\nu}_s.\mu_s} = \pm 1.960\, SE_{\hat{\hat{\nu}}_s - \hat{\nu}_s} \tag{46}$$

where $CL_{\hat{\hat{\nu}}_s.\mu_s}$ is the confidence limit for an estimate of $\hat{\nu}_s$ given μ_s, and $SE_{\hat{\hat{\nu}}_s - \hat{\nu}_s}$ is the standard error of that estimate given by:

$$SE^2_{\hat{\hat{\nu}}_s - \hat{\nu}_s} = SE^2_{\bar{\hat{\hat{\nu}}}_s} + (SE_\beta(\mu_s - \bar{\mu}))^2 + \widehat{SE}^2_{\hat{\hat{\nu}}_s.\mu_s} \tag{47}$$

with:

$$\bar{\mu} = \frac{1}{S}\sum_{s=1}^{S} \mu_s \tag{48}$$

where $SE_{\bar{\hat{\hat{\nu}}}_s}$ is the standard error of the estimate of the mean value of $\hat{\nu}_s$, SE_β is the standard error of the estimate of β, and $\widehat{SE}_{\hat{\hat{\nu}}_s.\mu_s}$ is the (estimated) standard error of the estimates of $\hat{\hat{\nu}}_s$ from μ_s. The corresponding calculated values are as follows:

$$SE_{\bar{\hat{\hat{\nu}}}_s} = 0.127 \tag{49}$$
$$SE_\beta = 0.072 \tag{50}$$
$$\widehat{SE}_{\hat{\hat{\nu}}_s.\mu_s} = 0.255 \tag{51}$$

[1]Refer to Ezekiel and Fox's Equations 1.1, 1.2, 1.4, 2.1, 5.6, 17.1, 17.3, and 19.1.

A.2 Confidence limits for the model of intra-stand variability in residual ln(LA)

Ninety-five percent confidence limits for the mean line of best fit to residuals (see Section 7.3) are calculated from the associated standard error in a similar fashion to Equations 46 and 47 with two differences. The squared standard errors for the three component lines of best fit are averaged. Also, because the three lines of best fit were fitted to residual data and are hence *effectively* constrained to have zero intercepts, a term for the independent variable, $x - \mu_s$, is used instead of that value's deviation from its mean. The resulting equation is:

$$SE^2_{(\hat{y}-\hat{\nu}_s)-(y-\hat{\nu}_s)} = \frac{1}{3}\sum_{s=1}^{3} SE^2_{\overline{\hat{y}_{s,j}-\hat{\nu}_s}} + (SE_{\delta_s}(x-\mu_s))^2 + \widehat{SE}^2_{(y_{s,j}-\hat{\nu}_s).(x_{s,j}-\mu_s)} \quad (52)$$

where $SE_{(\hat{y}-\hat{\nu}_s)-(y-\hat{\nu}_s)}$ is the standard error of an estimate of $y - \hat{\nu}_s$ given x, and for each stand, $SE_{\overline{\hat{y}_{s,j}-\hat{\nu}_s}}$ is the standard error of the estimate of the mean value of $y - \hat{\nu}_s$, SE_{δ_s} is the standard error of the estimate of δ_s, and $\widehat{SE}_{(y_{s,j}-\hat{\nu}_s).(x_{s,j}-\mu_s)}$ is the standard error of the estimates of $y_{s,j} - \hat{\nu}_s$ from $x_{s,j} - \mu_s$. The corresponding calculated values are as follows:

$$SE_{\overline{\hat{y}_{1,j}-\hat{\nu}_1}} = 0.063 \quad (53)$$
$$SE_{\overline{\hat{y}_{2,j}-\hat{\nu}_2}} = 0.146 \quad (54)$$
$$SE_{\overline{\hat{y}_{3,,j}-\hat{\nu}_3}} = 0.406 \quad (55)$$
$$SE_{\delta_1} = 0.062 \quad (56)$$
$$SE_{\delta_2} = 0.226 \quad (57)$$
$$SE_{\delta_3} = 0.271 \quad (58)$$
$$\widehat{SE}_{(y_{1,j}-\hat{\nu}_s).(x_{1,j}-\mu_s)} = 0.089 \quad (59)$$
$$\widehat{SE}_{(y_{2,j}-\hat{\nu}_s).(x_{2,j}-\mu_s)} = 0.377 \quad (60)$$
$$\widehat{SE}_{(y_{3,j}-\hat{\nu}_s).(x_{3,j}-\mu_s)} = 0.295 \quad (61)$$

A.3 Confidence limits for the full LA model

Ninety-five percent confidence limits for the full model are calculated from the associated standard error in a similar fashion to Equation 46, with $SE_{\hat{y}-y}$, the standard error of an estimate of y given x and μ_s, calculated as:

$$SE^2_{\hat{y}-y} = SE^2_{\hat{\hat{\nu}}_s-\hat{\nu}_s} + SE^2_{(\hat{y}-\hat{\nu}_s)-(y-\hat{\nu}_s)} \tag{62}$$

B. Full database listing

The full database of DBH and LA measurements used in this study is reproduced below. Most of the data has appeared elsewhere either in published or unpublished reports. It is collected here in a consistent format, and is supplemented with extensive ancilliary information including plot locations in Australian Map Grid coordinates, exact dates of origin and measurement, and exact ages. This information enhances the utility of the data, which will be of use in future research by ourselves and by readers of this report.

The data are printed exactly as stored in our Microsoft Excel spreadsheets. When looking at the upright text, read left to right across one page, and then down to the facing page. The data sets appear in order of age. To find a given data set, search through the pages looking at the age component of the data set title. There are no page numbers. Each data set begins with descriptive header information, then numerical header information, and then the data itself. Where a data set is comprised of data from a number of plots (e.g. Orr14 and MW212 data sets), the associated numerical header information appears in a table after the data.

The format of the header information is described first, under the title: 'Guide to fields in the DBH and LA data sets'.

When making use of this data, where appropriate, please cite this document and the works refered to herein. Remember that many of the source documents are unpublished.

Guide to fields in the DBH and LA data sets

Field	Description
Data set name:	Format is "Author/s Location Age"
Summary:	Summary of key data in dataset.
Measured by:	Principal investigator or collector. This is occaisionally difficult to determine. Often, the first author of associated publications is used.
Region:	General region in which the measurements were made.
Location:	Descriptive, accurate location in which the measurements were made.
Species:	Common name of canopy species.
Regeneration:	How was the forest regenerated? e.g. by wildfire or clearfell & burn etc.
Other data:	Lists some of the other data that is known to exist for the site.. Was LAI measured using the LICOR unit? Was sapwood area measured? Was anything about the understorey measured? etc.
References:	Have any publications referred to this data? Or do any refer to any aspect of the data (e.g. logging dates etc.)?
AMG Easting:	AMG coordinates are given as accurately as possible for the site.
AMG Northing:	In many cases the coordinates were obtained by estimating the location of a site on a map from written or verbal descriptions of how to reach the site. Errors will be present. Source maps include the 'DSM' maps which are the standard topographic maps produced by the Division of Survey and Mapping, Victoria; and the 'MMBW' or 'MW' maps which are the fire control maps produced by the MMBW (Melbourne Metrpolitan Board of Works, now Melbourne Water).
Elevation:	Usually obtained by querying the GRASS GIS elevation map (elev1d.fill@dem) at the given AMG coordinates. The GIS is maintained by Fred Watson at Melbourne University. From time to time, it is improved and slight changes in derived values are expected.
Slope:	Usually from the GIS as above, but occaisionally given from field measurements. Sometimes both are given.
Aspect:	In degrees true unless otherwise stated Similar source notes as for 'slope'.
Origin:	The origin of a stand is taken as the date all loging and burning ceased. This achieves consistency between logged and un-logged sites. If the site was logged, the field contains the date of cessation of logging and burn. If the site was burnt by wildfire, the field contains the estimated date of cessation of wildfire. If separate logging, burning, seeding, and/or planting dates are known, they are given in according fields.
Felled by:	(see above)
Burnt by:	(see above)
Seeded:	(see above)
Measurement date:	Date on which the data were measured. If measured over a period the mid-date is usually given. If day of month is not known, the first of the month is used.
Age at measurement:	Calculated as 'measurement date' minus 'origin' if possible. If dates are given in days, the following formula is used: AGE = (MEAS.DATE - ORIGIN) / 365.25
Plot shape:	Self explanatory.
Plot area:	Self explanatory.
Old growth meas. hgt:	Height above ground at which DBH was measured for old growth stems (i.e. was the measurement made above buttresses or not?)
No. of DBHs:	The number of DBH values which were measured.
Stocking rate:	Number of stems (DBHs) per hectare. This is only given where a 'population' of ALL stems in a known area were counted/measured.
No. of LAs:	Number of destructive leaf area measurements which were made.

Vertessy & O'Sullivan Murrindindi 4 data set

Summary:	Plot of known area.
	All DBHs in plot were NOT measured.
	Sample of DBHs & LAs determined by destructive sampling.
Measured by:	Vertessy et al.
Region:	Murrindindi Forest Block
Location:	In "Monda Road" logging coupe (Block: 0694502) adjacent to Maroondah Catchments.
	Two plots with a few tens of metres of each other near the Murrindindi CRCCH met. tower.
Species:	Mountain Ash
Regeneration:	Seeded after clearfell & burn.
Other data:	LICOR LAI.
References:	None

	Value	Unit	Source
AMG Easting:	373175	m	
AMG Northing:	5838525	m	
Elevation:	882.3	m	GRASS (elev1d.fill@dem)
Slope:	6	deg	GRASS (slop@dem)
Aspect:	312	deg	GRASS (asp@dem)
Origin:	20/02/91		Gary Dash, Toolangi DNRE
Measurement date:	4/07/95		(mid-point of 3-5/7/95)
Age at measurement	4.37	yr	
Plot shape:	10x3 each plot	m	
Plot area:	30 each plot	m.sq	
No. of DBHs:	20		
No. of LAs:	20		

Sample of LAs		
#	DBH (cm)	LA (m.sq)
1	4.9	10.61
2	6.9	15.16
3	5.8	9.77
4	3.9	4.04
5	3.8	4.38
6	4.9	10.44
7	5.8	8.76
8	3.3	3.03
9	3.0	2.36
10	4.8	7.75
11	4.3	4.72
12	5.7	7.75
13	3.4	2.70
14	5.1	8.76
15	3.1	4.04
16	4.8	5.73
17	5.0	5.42
18	4.5	6.06
19	3.4	3.37
20	4.1	3.03

Vertessy & O'Sullivan Murrindindi 5 data set

Summary:	Plot of known area.
	All DBHs in plot were measured.
	Sample of DBHs & LAs determined by destructive sampling.
Measured by:	Vertessy et al.
Region:	Murrindindi Forest Block
Location:	In "Monda Road" logging coupe (Block: 0694502) adjacent to Maroondah Catchments.
	Next to 4WD track leading past Murrindindi CRCCH met. tower, about 20 metres (on th right) past walkking track to tower.
Species:	Mountain Ash
Regeneration:	Seeded after clearfell & Burn.
Other data:	None
References:	None

	Value	Unit	Source
AMG Easting:	373200	m	DSM map, Jim Brophy
AMG Northing:	5838575	m	DSM map, Jim Brophy
Elevation:	881.9	m	GRASS (elev1d.fill@dem)
Slope:	6	deg	GRASS (slop@dem)
Aspect:	290	deg	GRASS (asp@dem)
Origin:	20/02/91		Gary Dash, Toolangi DNRE
Measurement date:	8/07/96		
Age at measurement	5.38	yr	
Plot shape:	10x6	m	
Plot area:	60	m.sq	
No. of DBHs:	143		
Stocking rate:	23833.33	stems/ha	
No. of LAs:	42		

Population of DBHs			Sample of LAs		
Mean:	2.34	0.44		20.1	4.31
#	DBH (cm)	ln(DBH)	#	DBH (cm)	LA (m.sq)
1	6.04	1.80	1	6.6	7.6075
2	3.50	1.25	2	6.6	11.637
3	2.90	1.06	3	4.8	6.8329
4	1.80	0.59	4	6.1	9.8338
5	0.70	-0.36	5	6.2	8.1547
6	0.70	-0.36	6	4.3	3.528
7	0.50	-0.69	7	2.7	0.6813
8	0.50	-0.69	8	5.5	5.8194
9	3.20	1.16	9	3.2	1.8401
10	1.50	0.41	10	1.4	0.2155
11	4.80	1.57	11	6.5	9.2611
12	6.70	1.90	12	3.4	1.9117
13	6.20	1.82	13	5	4.718
14	0.60	-0.51	14	1.6	0.1513
15	0.50	-0.69	15	3.8	4.2352
16	0.40	-0.92	16	5.7	4.171
17	0.80	-0.22	17	4.7	3.9088

18	6.20	1.82
19	7.20	1.97
20	4.80	1.57
21	4.40	1.48
22	2.90	1.06
23	4.90	1.59
24	1.40	0.34
25	2.90	1.06
26	3.10	1.13
27	0.50	-0.69
28	0.70	-0.36
29	0.60	-0.51
30	3.00	1.10
31	0.60	-0.51
32	2.80	1.03
33	1.50	0.41
34	7.00	1.95
35	1.50	0.41
36	0.70	-0.36
37	0.50	-0.69
38	3.20	1.16
39	0.40	-0.92
40	2.20	0.79
41	1.80	0.59
42	2.00	0.69
43	1.50	0.41
44	2.90	1.06
45	1.80	0.59
46	4.00	1.39
47	5.30	1.67
48	5.20	1.65
49	0.40	-0.92
50	0.80	-0.22
51	4.00	1.39
52	5.00	1.61
53	4.90	1.59
54	1.80	0.59
55	3.30	1.19
56	0.30	-1.20
57	0.60	-0.51
58	0.70	-0.36
59	4.20	1.44
60	0.70	-0.36
61	5.40	1.69
62	0.70	-0.36
63	2.90	1.06
64	4.80	1.57
65	5.40	1.69
66	0.50	-0.69
67	0.40	-0.92
68	2.40	0.88
69	1.20	0.18

18	5.3	5.4869	
19	6.3	2.2178	
20	5.1	6.7443	
21	1.8	0.49	
22	3.1	1.85	
23	6.9	9.42	
24	3.8	2.39	
25	5.7	6.39	
26	5.0	7.31	
26a	6.3	9.51	
27	2.7	0.47	
27a	3.7	2.74	
28	4.5	2.60	
29	6.5	16.33	
30	3.7	2.21	
31	4.0	3.22	
32	2.3	0.41	
33	4.2	3.16	
34	4.0	3.27	
35	3.5	2.04	
36a	5.4	5.23	Note that there's no 36
37	1.8	0.42	
38	2.2	1.15	
39	3.0	1.08	
40	2.1	0.49	

70	2.90	1.06
71	0.50	-0.69
72	1.20	0.18
73	2.80	1.03
74	0.60	-0.51
75	4.90	1.59
76	2.60	0.96
77	2.70	0.99
78	2.30	0.83
79	2.80	1.03
80	1.80	0.59
81	4.20	1.44
82	0.60	-0.51
83	0.70	-0.36
84	0.50	-0.69
85	1.70	0.53
86	2.10	0.74
87	1.20	0.18
88	3.90	1.36
89	2.50	0.92
90	5.00	1.61
91	5.20	1.65
92	0.40	-0.92
93	0.70	-0.36
94	0.70	-0.36
95	0.50	-0.69
96	3.20	1.16
97	1.80	0.59
98	0.70	-0.36
99	2.40	0.88
100	0.80	-0.22
101	0.40	-0.92
102	3.60	1.28
103	0.30	-1.20
104	4.50	1.50
105	0.60	-0.51
106	4.30	1.46
107	3.10	1.13
108	1.40	0.34
109	0.80	-0.22
110	2.20	0.79
111	2.10	0.74
112	6.50	1.87
113	6.20	1.82
114	0.30	-1.20
115	0.30	-1.20
116	0.30	-1.20
117	0.50	-0.69
118	0.70	-0.36
119	6.40	1.86
120	4.10	1.41
121	1.80	0.59

122	2.30	0.83
123	2.70	0.99
124	5.30	1.67
125	0.30	-1.20
126	2.50	0.92
127	5.00	1.61
128	0.30	-1.20
129	1.90	0.64
130	0.20	-1.61
131	0.40	-0.92
132	0.60	-0.51
133	1.50	0.41
134	0.60	-0.51
135	3.80	1.34
136	5.00	1.61
137	0.40	-0.92
138	3.20	1.16
139	1.70	0.53
140	2.50	0.92
141	0.20	-1.61
142	0.50	-0.69
143	0.40	-0.92

Beringer Myrtle 8 data set

Summary: Plot of known area.
All DBHs in plot are given.
Mountain Ash LA by destructive sampling known for whole plot only.
Understorey LA by destructive sampling known for each species.

Measured by: Beringer

Region: North Maroondah Experimental Area

Location: In Myrtle 2 catchment. c. 190 m beyond gauge clearing at end of Road 33, 20m in on right.

Species: Mountain Ash

Regeneration: Seeded after clearfell & burn

Other data: Tree height.
Understorey composition.
LICOR LAI of both full vegetation and canopy only (after destruction of understorey).
LAI (by destructive sampling) 10x25m sample of understorey.
LAI (by destructive sampling) 10x10m sample of canopy.

References: Beringer (1994), Ord (1985)

	Value	Unit	Source
AMG Easting:	377600	m	Visit by Watson, MMBW map, Aerial photo,
AMG Northing:	5839725	m	Langford & O'Shaughnessy (1977, p. 51)
Elevation:	735.4	m	GRASS (elev1d.fill@dem)
Slope:	6	deg	Beringer (1994)
Aspect:	150	deg. magnetic	Beringer (1994)
Logged by:	6/03/85		Ord (1985)
Burnt by:	20/03/85		Ord (1985)
Seeded and planted:	?		Scheduled for Winter 85 (Ord, 1985) Extensive areas in Myrtle 2 were re-burnt 1 year later (probably not this plot).
Measurement date:	26/02/93		Beringer (1994), date given for end of week of LICOR surveying.
Age at measurement:	7.94	yr	
Plot shape:	25x25	m	(10x25m sample for understorey LAI, 10x10m sample for canopy LAI)
Plot area:	625	m.sq	
No. of DBHs:	340		
Stocking rate:	5440.00	stems/ha	
No. of LAs:	Aggregated (see below)		

Population of DBHs			LAIs		
mean	6.3862	1.66			
#	DBH	ln DBH	Species	LAI	Plot size
1	8.0	2.08	Christmas Bush	0.552	10x25 m
2	7.4	2.00	Mountain Pepper	0.0168	10x25 m
3	3.4	1.22	Mountain Correa	0.0216	10x25 m
4	3.3	1.19	Unnamed sp.	0.00016	10x25 m
5	4.1	1.41	Blakwood	0.0632	10x25 m

6	9.0	2.20
7	4.5	1.50
8	2.2	0.79
9	9.6	2.26
10	2.6	0.96
11	10.3	2.33
12	1.8	0.59
13	3.5	1.25
14	5.5	1.70
15	7.6	2.03
16	3.8	1.34
17	4.6	1.53
18	3.4	1.22
19	3.2	1.16
20	4.1	1.41
21	10.8	2.38
22	12.7	2.54
23	8.1	2.09
24	11.2	2.42
25	9.7	2.27
26	10.7	2.37
27	8.3	2.12
28	5.3	1.67
29	13.3	2.59
30	10.0	2.30
31	3.6	1.28
32	14.2	2.65
33	3.4	1.22
34	2.5	0.92
35	9.6	2.26
36	3.7	1.31
37	2.3	0.83
38	6.1	1.81
39	6.5	1.87
40	3.3	1.19
41	12.7	2.54
42	2.9	1.06
43	12.1	2.49
44	3.8	1.34
45	2.5	0.92
46	10.0	2.30
47	5.6	1.72
48	4.7	1.55
49	3.5	1.25
50	14.8	2.69
51	4.3	1.46
52	3.8	1.34
53	12.5	2.53
54	4.0	1.39
55	11.9	2.48
56	4.5	1.50
57	3.8	1.34

Stinking Annie	0.00002	10x25 m
Silver Wattle	0.00028	10x25 m
Hazel	0.0108	10x25 m
Total understorey	**0.67**	10x25 m
Mountain Ash	**5.07**	10x10 m

58	16.1	2.78
59	4.9	1.59
60	2.5	0.92
61	5.7	1.74
62	3.3	1.19
63	3.3	1.19
64	2.9	1.06
65	10.4	2.34
66	3.8	1.34
67	8.5	2.14
68	7.3	1.99
69	6.5	1.87
70	4.5	1.50
71	6.1	1.81
72	3.8	1.34
73	12.4	2.52
74	3.0	1.10
75	3.8	1.34
76	7.3	1.99
77	10.3	2.33
78	6.3	1.84
79	6.5	1.87
80	4.4	1.48
81	4.6	1.53
82	5.0	1.61
83	2.1	0.74
84	2.8	1.03
85	4.1	1.41
86	17.3	2.85
87	18.7	2.93
88	4.9	1.59
89	4.2	1.44
90	8.8	2.17
91	10.7	2.37
92	12.5	2.53
93	12.7	2.54
94	11.0	2.40
95	3.2	1.16
96	8.3	2.12
97	11.9	2.48
98	5.1	1.63
99	3.7	1.31
100	11.3	2.42
101	3.0	1.10
102	3.2	1.16
103	4.3	1.46
104	3.1	1.13
105	15.9	2.77
106	4.1	1.41
107	13.1	2.57
108	7.1	1.96
109	2.4	0.88

110	2.5	0.92	162	12.8	2.55
111	9.4	2.24	163	3.0	1.10
112	3.5	1.25	164	2.4	0.88
113	5.7	1.74	165	2.8	1.03
114	3.0	1.10	166	12.3	2.51
115	4.1	1.41	167	7.3	1.99
116	17.0	2.83	168	3.9	1.36
117	14.3	2.66	169	3.9	1.36
118	4.1	1.41	170	4.6	1.53
119	7.9	2.07	171	2.5	0.92
120	3.2	1.16	172	2.2	0.79
121	2.2	0.79	173	6.5	1.87
122	3.6	1.28	174	7.0	1.95
123	12.0	2.48	175	9.9	2.29
124	9.2	2.22	176	9.5	2.25
125	4.7	1.55	177	2.8	1.03
126	4.4	1.48	178	3.5	1.25
127	2.6	0.96	179	3.4	1.22
128	8.4	2.13	180	2.7	0.99
129	9.7	2.27	181	6.2	1.82
130	9.2	2.22	182	3.7	1.31
131	2.9	1.06	183	2.0	0.69
132	2.7	0.99	184	2.9	1.06
133	4.4	1.48	185	14.4	2.67
134	3.5	1.25	186	14.7	2.69
135	11.3	2.42	187	11.1	2.41
136	10.2	2.32	188	3.8	1.34
137	2.1	0.74	189	2.4	0.88
138	1.9	0.64	190	7.2	1.97
139	12.4	2.52	191	8.0	2.08
140	3.3	1.19	192	4.4	1.48
141	2.0	0.69	193	2.1	0.74
142	9.0	2.20	194	17.7	2.87
143	8.3	2.12	195	7.5	2.01
144	3.5	1.25	196	2.4	0.88
145	2.8	1.03	197	3.7	1.31
146	3.5	1.25	198	3.2	1.16
147	2.6	0.96	199	9.8	2.28
148	1.5	0.41	200	13.8	2.62
149	10.0	2.30	201	4.0	1.39
150	9.3	2.23	202	7.7	2.04
151	3.0	1.10	203	3.9	1.36
152	1.6	0.47	204	3.1	1.13
153	3.6	1.28	205	4.8	1.57
154	6.1	1.81	206	12.7	2.54
155	3.9	1.36	207	2.5	0.92
156	2.1	0.74	208	4.1	1.41
157	15.1	2.71	209	2.1	0.74
158	3.8	1.34	210	9.8	2.28
159	13.2	2.58	211	12.3	2.51
160	2.3	0.83	212	11.0	2.40
161	1.8	0.59	213	6.1	1.81

214	6.6	1.89
215	4.4	1.48
216	3.3	1.19
217	6.4	1.86
218	3.3	1.19
219	7.4	2.00
220	2.6	0.96
221	14.3	2.66
222	3.2	1.16
223	16.3	2.79
224	7.3	1.99
225	4.5	1.50
226	10.3	2.33
227	11.3	2.42
228	15.9	2.77
229	12.0	2.48
230	10.7	2.37
231	4.4	1.48
232	2.6	0.96
233	11.8	2.47
234	11.0	2.40
235	8.3	2.12
236	7.9	2.07
237	11.2	2.42
238	7.4	2.00
239	2.7	0.99
240	7.9	2.07
241	12.4	2.52
242	11.1	2.41
243	6.4	1.86
244	3.2	1.16
245	2.4	0.88
246	1.5	0.41
247	1.7	0.53
248	1.9	0.64
249	6.7	1.90
250	3.2	1.16
251	9.7	2.27
252	5.6	1.72
253	4.5	1.50
254	15.2	2.72
255	2.3	0.83
256	8.2	2.10
257	6.5	1.87
258	2.3	0.83
259	3.8	1.34
260	1.9	0.64
261	13.2	2.58
262	4.3	1.46
263	6.8	1.92
264	4.7	1.55
265	3.8	1.34

266	2.7	0.99
267	2.6	0.96
268	3.5	1.25
269	5.8	1.76
270	4.6	1.53
271	3.8	1.34
272	3.4	1.22
273	3.9	1.36
274	2.2	0.79
275	2.6	0.96
276	8.7	2.16
277	3.3	1.19
278	4.6	1.53
279	12.3	2.51
280	10.0	2.30
281	7.1	1.96
282	2.3	0.83
283	3.1	1.13
284	12.5	2.53
285	4.3	1.46
286	6.8	1.92
287	2.8	1.03
288	7.1	1.96
289	2.8	1.03
290	11.3	2.42
291	10.7	2.37
292	11.2	2.42
293	5.1	1.63
294	8.9	2.19
295	13.0	2.56
296	13.0	2.56
297	6.7	1.90
298	2.3	0.83
299	13.5	2.60
300	14.7	2.69
301	6.2	1.82
302	2.1	0.74
303	5.2	1.65
304	10.8	2.38
305	7.4	2.00
306	11.1	2.41
307	4.5	1.50
308	1.9	0.64
309	5.8	1.76
310	4.7	1.55
311	4.9	1.59
312	8.2	2.10
313	4.7	1.55
314	2.9	1.06
315	9.6	2.26
316	4.2	1.44
317	7.3	1.99

318	1.8	0.59
319	2.3	0.83
320	2.9	1.06
321	1.7	0.53
322	3.0	1.10
323	10.9	2.39
324	2.7	0.99
325	2.2	0.79
326	7.5	2.01
327	3.6	1.28
328	6.8	1.92
329	2.4	0.88
330	2.9	1.06
331	8.5	2.14
332	5.0	1.61
333	12.0	2.48
334	2.9	1.06
335	7.1	1.96
336	4.2	1.44
337	2.9	1.06
338	9.0	2.20
339	3.9	1.36
340	2.3	0.83

O'Sullivan Myrtle 9 data set

Summary:	Plot of known area. All DBHs in plot are given. No LA measurement. 100 metres from Berenger Myrtle 9 plot
Measured by:	O'Sullivan et al.
Region:	North Maroondah Experimental Area
Location:	In Myrtle 2 catchment. 50 m to left at the clearing at the end of Road 33.
Species:	Mountain Ash
Regeneration:	Seeded after clearfell & burn
Other data:	LICOR LAI. Sapwood area for sample of 40 trees. No understorey DBH.
References:	O'Sullivan (In prep.), Ord (1985)

	Value	Unit	Source
AMG Easting:	377675	m	Visit by Watson, MMBW map, Aerial photo,
AMG Northing:	5839600	m	Langford & O'Shaughnessy (1977, p. 51) (probably more accurate than O'Sullivan's GPS [377644,5839537]).
Elevation:	717.7	m	GRASS (elev1d.fill@dem)
Slope:	12	deg	GRASS (slop@dem)
Aspect:	173	deg	GRASS (asp@dem)
Logged by:	6/03/85		Ord (1985)
Burnt by:	20/03/85		Ord (1985)
Seeded and planted:	?		Scheduled for Winter 85 (Ord, 1985) Extensive areas in Myrtle 2 were re-burnt 1 year later (probably not this plot).
Measurement date:	1/05/94		O'Sullivan pers. comm.
Age at measurement	9.11	yr	
Plot shape:	20x20	m	
Plot area:	400	m.sq	
No. of DBHs:	105		
Stocking rate:	2625.00		
No. of LAs:	0		

Population of DBHs

Mean:	12.9	2.48
Tree ID	DBH	ln(DBH)
1	19.4	2.97
2	8.9	2.19
3	14.0	2.64
4	13.2	2.58
5	12.0	2.48
6	11.3	2.42
7	10.6	2.36
8	6.5	1.87
9	6.8	1.92
10	18.2	2.90

11	16.8	2.82
12	6.1	1.81
13	7.8	2.05
14	7.8	2.05
15	12.5	2.53
16	14.2	2.65
17	5.2	1.65
18	7.0	1.95
19	6.2	1.82
20	12.3	2.51
21	12.8	2.55
22	16.3	2.79
23	18.2	2.90
24	8.2	2.10
25	12.4	2.52
26	12.4	2.52
27	16.0	2.77
28	19.2	2.95
29	16.7	2.82
30	8.4	2.13
31	13.4	2.60
32	8.3	2.12
33	15.8	2.76
34	19.3	2.96
35	17.2	2.84
36	12.5	2.53
37	7.6	2.03
38	8.4	2.13
39	5.9	1.77
40	22.0	3.09
41	7.4	2.00
42	19.2	2.95
43	7.0	1.95
44	16.2	2.79
45	10.5	2.35
46	7.3	1.99
47	8.3	2.12
48	13.4	2.60
49	7.6	2.03
50	6.3	1.84
51	9.8	2.28
52	5.5	1.70
53	20.2	3.01
54	6.8	1.92
55	24.2	3.19
56	9.6	2.26
57	12.0	2.48
58	14.8	2.69
59	9.9	2.29
60	17.6	2.87
61	12.7	2.54
62	13.4	2.60
63	20.5	3.02
64	12.3	2.51
65	17.0	2.83
66	11.6	2.45
67	8.3	2.12
68	14.4	2.67
69	12.9	2.56
70	19.8	2.99
71	18.0	2.89
72	18.2	2.90
73	13.2	2.58
74	15.7	2.75
75	9.4	2.24
76	12.0	2.48
77	9.8	2.28
78	7.2	1.97
79	15.8	2.76
80	13.2	2.58
81	17.4	2.86
82	10.5	2.35
83	16.1	2.78
84	17.0	2.83
85	13.8	2.62
86	13.9	2.63
87	14.3	2.66
88	6.3	1.84
89	14.9	2.70
90	19.1	2.95
91	19.2	2.95
92	19.2	2.95
93	23.2	3.14
94	8.7	2.16
95	6.6	1.89
96	9.2	2.22
97	15.3	2.73
98	9.1	2.21
99	16.0	2.77
100	8.0	2.08
101	9.6	2.26
102	13.4	2.60
103	17.5	2.86
104	20.2	3.01
105	16.0	2.77

Vertessy & O'Sullivan Myrtle 11 data set

Summary:	Plot of known area.		
	All DBHs in plot were measured.		
	Sample of DBHs & LAs determined by destructive sampling.		
Measured by:	Vertessy et al.		
Region:	North Maroondah Experimental Area		
Location:	In Myrtle 2 catchment. c. 100 m beyond gauge clearing at end of Road 33, 20m in on left.		
Species:	Mountain Ash		
Regeneration:	Seeded after clearfell & burn		
Other data:	LICOR LAI.		
	Height of each sample tree.		
References:	Ord (1985)		

	Value	Unit	Source
AMG Easting:	377625	m	DSM map, Jim Brophy
AMG Northing:	5839675	m	DSM map, Jim Brophy
Elevation:	733.2	m	GRASS (elev1d.fill@dem)
Slope:	7	deg	GRASS (slop@dem)
Aspect:	173	deg	GRASS (asp@dem)
Logged by:	6/03/85		Ord (1985)
Burnt by:	20/03/85		Ord (1985)
Seeded and planted:	?		Scheduled for Winter 85 (Ord, 1985)
			Extensive areas in Myrtle 2 were re-burnt 1 year later (probably not this plot).
Measurement date:	10/07/96		Mid-point of 9-11/7/96
Age at measurement:	11.31	yr	
Plot shape:	30x18	m	
Plot area:	540	m.sq	
No. of DBHs:	128		
Stocking rate:	2370.37	stems/ha	
No. of LAs:	30		

Population of DBHs

#	DBH (cm)	ln DBH
mean	14.80	2.65
1	8	2.08
2	8.4	2.13
3	6.9	1.93
4	13.1	2.57
5	8.7	2.16
6	16	2.77
7	11.8	2.47
8	19.2	2.95
9	17.6	2.87
10	11.5	2.44
11	19.9	2.99
12	10.8	2.38
13	14.5	2.67
14	12	2.48
15	14.4	2.67
16	13	2.56
17	14.5	2.67
18	19.6	2.98
19	20.6	3.03
20	17.3	2.85
21	23	3.14
22	12.9	2.56
23	9	2.20
24	10	2.30
25	11.9	2.48
26	9.3	2.23
27	16.6	2.81
28	9.3	2.23
29	11.8	2.47
30	13.9	2.63
31	19.8	2.99
32	13.2	2.58
33	18.5	2.92
34	13.5	2.60
35	18.3	2.91
36	21.5	3.07
37	15	2.71
38	22.3	3.10
39	9.2	2.22
40	15.8	2.76
41	20	3.00
42	15.8	2.76
43	19.4	2.97
44	20.4	3.02
45	13.2	2.58
46	8.5	2.14
47	21.3	3.06
48	13.2	2.58
49	10.5	2.35
50	13	2.56
51	11.7	2.46
52	12.5	2.53
53	23.3	3.15
54	12.9	2.56
55	16.3	2.79
56	16	2.77
57	20.1	3.00
58	11.2	2.42
59	13.4	2.60
60	13.4	2.60
61	10.1	2.31
62	20.3	3.01
63	12.3	2.51
64	17.5	2.86
65	23.9	3.17

Sample of LAs

#	DBH (cm)	LA (m.sq)
	14.5	16.57
1	12.80	9.4375
2	13.00	10.649
3	17.50	28.933
4	19.70	35.439
5	12.70	5.5431
6	9.10	2.48
7	8.70	2.2442
8	21.20	31.136
9	16.20	22.478
10	17.00	20.229
11	13.50	9.0377
12	10.70	1.0627
13	18.60	23.797
14	15.10	14.258
15	9.90	2.6577
16	18.30	38.379
17	13.20	12.696
18	12.50	6.1446
19	14.50	8.1525
20	20.20	31.738
21	19.40	32.365
22	15.80	18.014
23	20.00	32.146
24	20.90	40.057
25	20.10	36.434
26	21.60	31.162
26a	20.00	10.346
27	24.20	36.752
27a	21.30	41.592
28	19.30	32.454

66	17.3	2.85
67	11.9	2.48
68	11.6	2.45
69	19.8	2.99
70	14.7	2.69
71	10.9	2.39
72	15.3	2.73
73	15.6	2.75
74	22.7	3.12
75	13.4	2.60
76	16.4	2.80
77	13.3	2.59
78	20.3	3.01
79	8.1	2.09
80	21	3.04
81	14.7	2.69
82	24.1	3.18
83	19.4	2.97
84	18.8	2.93
85	18.8	2.93
86	13.1	2.57
87	10.7	2.37
88	17.5	2.86
89	15	2.71
90	19.9	2.99
91	10.2	2.32
92	7.8	2.05
93	16.9	2.83
94	16	2.77
95	10.7	2.37
96	8	2.08
97	14.8	2.69
98	11.3	2.42
99	10.6	2.36
100	16.5	2.80
101	7.6	2.03
102	10	2.30
103	18.4	2.91
104	15.3	2.73
105	13.7	2.62
106	12.2	2.50
107	19.8	2.99
108	8.6	2.15
109	20.2	3.01
110	20.6	3.03
111	11.2	2.42
112	14.6	2.68
113	15.5	2.74
114	11	2.40
115	18.2	2.90
116	11.7	2.46
117	8.5	2.14
118	12.6	2.53
119	15	2.71
120	19.8	2.99
121	12	2.48
122	12.1	2.49
123	19.9	2.99
124	15.4	2.73
125	15.2	2.72
126	19.8	2.99
127	16.7	2.82
128	9.4	2.24

Orr Picaninny 14 (DBH & LA) data set

Summary:	Taken from a general area, not a plot.
	Various DBHs and LAs (by destructive sampling) in plot are given.
	See also DBH plot data published in this study.
Measured by:	Orr et al. (1986)
Region:	Coranderrk Experimental Area
Location:	Picaninny catchment. Scattered locations.
Species:	Mountain Ash
Regeneration:	Seeded after clearfell & burn
Other data:	Sapwood area.
	Bark area.
References:	Orr et al. (1986, App. 2)

	Value	Unit	Source
AMG Easting:	Various	m	
AMG Northing:	Various	m	
Elevation:	Various	m	
Slope:	Various	deg	
Aspect:	Various	deg	
Origin:	28/03/72		Langford & O'Shaughnessy (1980, pp. 33,27,28)
Measurement date:	1/06/86		Probably around mid-year.
Age at measurement	14.18	yr	
Plot shape:	Scattered trees		
Plot area:	None		
No. of DBHs:	18		
No. of LAs:	18		

Sample of DBHs and LAs

#	DBH (cm)	ln(DBH)	LA (m.sq)
Mean:	14.5	2.7	2.40
1	14.5	2.67	2.4
2	12.8	2.55	6.3
3	17.8	2.88	10.4
4	16.0	2.77	10.86
5	16.9	2.83	22.19
6	17.1	2.84	32.25
7	21.6	3.07	40.2
8	20.5	3.02	40.63
9	22.8	3.13	53.69
10	22.5	3.11	54.9
11	20.3	3.01	59.29
12	24.6	3.20	60.84
13	25.6	3.24	61.35
14	27.4	3.31	74.77
15	28.4	3.35	88.21
16	28.5	3.35	93.7
17	32.7	3.49	101.8
18	28.8	3.36	110.8

Orr Picaninny 14 (DBH only) data set

Summary:	6 Plots of known area.
	All DBHs in plot are given.
	No LA measurement.
	Subset of the Melbourne Water Picaninny Dataset.
	See also DBH & LA for some trees near these plots (also by Orr et al.)
Measured by:	Orr et al.
Region:	Coranderrk Experimental Area
Location:	Picaninny catchment. 6 permanent vegetation survey plots.
Species:	Mountain Ash
Regeneration:	Seeded after clearfell & burn
Other data:	Height of two tallest trees ?
References:	Orr et al. (1986, App. 3), Langford & O'Shaughnessy (1980)

(Table of summary statistics by plot appears after table of data)

	Value	Unit	Source
AMG Easting:	Various	m	MMBW map,
AMG Northing:	Various	m	Langford & O'Shaughnessy (1980, pp. 56,61,62)
Elevation:	Various	m	GRASS (elev1d.fill@dem)
Slope:	Various	deg.	GRASS (slop@dem)
Aspect:	Various	deg.	GRASS (asp@dem)
Origin:	Various		Langford & O'Shaughnessy (1980, pp. 33,27,28,56)
Measurement date:	Various		
Age at measurement	Various	yr	
Plot shape:	Various	m	
Plot area:	Various	m.sq	
No. of DBHs:	Various		
Stocking rate:	Various	stems/ha	
No. of LAs:	0		
Classed as:	Various		Orr et al. (1986)
Mean DBH:	Various	cm	
Mean ln(DBH):	Various		

Populations of DBHs

Plot	Tree ID	DBH (cm)	ln(DBH)
4	1	15.1	2.71
4	2	19.0	2.94
4	3	15.8	2.76
4	4	11.9	2.48
4	5	15.1	2.71
4	6	28.4	3.35
4	7	17.2	2.84
7	1	26.6	3.28
7	2	10.6	2.36
7	3	12.2	2.50
7	4	19.1	2.95
7	5	16.6	2.81
7	6	24.2	3.19
7	7	18.7	2.93

7	8	22.3	3.10
7	9	4.0	1.39
7	10	25.9	3.25
7	11	12.8	2.55
7	12	4.8	1.57
7	13	17.8	2.88
7	14	4.6	1.53
7	15	25.9	3.25
7	16	26.1	3.26
10	1	37.5	3.62
10	2	6.6	1.89
10	3	37.0	3.61
17	1	8.7	2.16
17	2	20.4	3.02
17	3	18.9	2.94
17	4	24.4	3.19
17	5	14.1	2.65
17	6	9.1	2.21
17	7	12.2	2.50
17	8	27.6	3.32
17	9	8.2	2.10
17	10	26.4	3.27
17	11	6.2	1.82
17	12	26.0	3.26
19	1	20.3	3.01
19	2	16.1	2.78
19	3	8.4	2.13
19	4	16.5	2.80
19	5	5.7	1.74
19	6	37.9	3.63
19	7	17.1	2.84
19	8	25.5	3.24
19	9	30.5	3.42
19	10	14.4	2.67
19	11	11.7	2.46
19	12	11.9	2.48
19	13	18.7	2.93
19	14	15.6	2.75
19	15	26.3	3.27
19	16	29.9	3.40
19	17	11.1	2.41
25	1	10.2	2.32
25	2	6.2	1.82
25	3	34.2	3.53
25	4	27.8	3.33
25	5	15.4	2.73
25	6	19.2	2.95
25	7	31.1	3.44
25	8	30.8	3.43
25	9	21.7	3.08
25	10	32.9	3.49
25	11	17.5	2.86
25	12	16.3	2.79
25	13	25.3	3.23
25	14	11.0	2.40
25	15	22.5	3.11
25	16	9.2	2.22
25	17	26.0	3.26
25	18	25.3	3.23
25	19	9.2	2.22
25	20	4.2	1.44
25	21	28.6	3.35
25	22	9.4	2.24

Beringer Monda 15 data set

Summary:	Plot of known area.
	All DBHs in plot are given.
	No LA at all
Measured by:	Beringer
Region:	North Maroondah Experimental Area
Location:	(Probably between) Monda 2 & Monda 3 experimental catchments. Starting from Road 9, 200m down a catchment boundary track between the two, and in on left.
Species:	Mountain Ash
Regeneration:	Seeded after clearfell & burn
Other data:	Tree height
	Understorey composition
	LICOR LAI
References:	— Beringer (1994)

	Value	Unit	Source
AMG Easting:	374250	m	MW map, described by Beringer
AMG Northing:	5839850	m	MW map, described by Beringer
Elevation:	784.9	m	GRASS (elev1d.fill@dem)
Slope:	11	deg	Beringer (1994)
Slope:	10	deg	GRASS (slop@dem)
Aspect:	135	deg. magnetic	Beringer (1994)
Aspect:	147	deg. true	GRASS (asp@dem)
Felled and burnt by:	6/03/78		Langford & O'Shaughnessy (1979, p. 61),
Seeded:	17/05/78		(probably burnt with Monda 2).
Measurement date:	26/02/93		Beringer (1994), date given for end of week of LICOR surveying
Age at measurement:	14.98	yr	
Plot shape:	42x42	m	
Plot area:	1764	m.sq.	
No. of DBHs:	103		
Stocking rate:	583.90	stems/ha	
No. of LAs:	0		

Population of DBHs		
Mean:	20.72	2.98
Tree no.	DBH (cm)	ln(DBH)
1	22.2	3.10
2	13.1	2.57
3	11.6	2.45
4	16.2	2.79
5	15.8	2.76
6	11.6	2.45
7	14.4	2.67
8	14.7	2.69
9	9.6	2.26
10	16.1	2.78
11	15.0	2.71

	Plots							
	4	7	10	17	19	25	Dense	All
AMG E:	374050	373775	373725	374000	373700	373550	373850	373800 (average)
AMG N:	5829400	5829425	5829325	5829250	5829275	5829100	5829263	5829296 (average)
Elevation:	739.8	646.3	575.7	670	553.2	462.7	611.60	607.95 (average)
Slope:	24	32	28	22	24	18	23.00	24.67 (average)
Aspect:	211	205	222	198	242	228	220.00	217.67 (average)
Origin:	21/03/72	29/03/72	5/05/72	21/03/72	5/05/72	5/05/72	12/04/72	13/04/72 (average)
Meas. date:	23/09/86	23/09/86	23/09/86	23/09/86	23/09/86	23/09/86	23/09/86	23/09/86 (average)
Meas. age:	14.51	14.49	14.39	14.51	14.39	14.39	14.45	14.44 (average)
Plot shape:	10x20	10x20	10x20	5x20	5x20	10x20	5x20	Various
Plot area:	200	200	200	100	100	200	200	1000 (total)
No. DBHs:	7	16	3	12	17	22	29	77 (total)
Stck. rate:	350	800	150	1200	1700	1100	1450	770
No. LAs:	0	0	0	0	0	0	0	0 (total)
CLass:	Open	Open	Open	Dense	Dense	Open	Dense	Various
Mean DBH:	17.50	17.01	27.03	16.85	18.68	19.73	17.92	18.57 (tree ave.)
Mean ln("):	2.83	2.68	3.04	2.70	2.82	2.84	2.77	2.79 (tree ave.)

12	17.8	2.88
13	32.9	3.49
14	12.9	2.56
15	14.7	2.69
16	13.8	2.62
17	27.9	3.33
18	20.0	3.00
19	14.8	2.69
20	16.8	2.82
21	27.3	3.31
22	16.5	2.80
23	30.4	3.41
24	12.3	2.51
25	13.9	2.63
26	16.9	2.83
27	15.5	2.74
28	26.5	3.28
29	22.4	3.11
30	14.3	2.66
31	17.2	2.84
32	14.2	2.65
33	17.3	2.85
34	16.2	2.79
35	17.3	2.85
36	25.5	3.24
37	14.5	2.67
38	16.2	2.79
39	18.5	2.92
40	11.8	2.47
41	17.2	2.84
42	21.6	3.07
43	16.8	2.82
44	14.8	2.69
45	44.0	3.78
46	16.9	2.83
47	21.6	3.07
48	27.8	3.33
49	20.2	3.01
50	26.4	3.27
51	14.8	2.69
52	27.9	3.33
53	18.4	2.91
54	17.0	2.83
55	18.5	2.92
56	33.3	3.51
57	32.2	3.47
58	16.2	2.79
59	26.6	3.28
60	19.5	2.97
61	19.6	2.98
62	15.0	2.71
63	17.9	2.88
64	12.4	2.52
65	19.5	2.97
66	22.9	3.13
67	17.9	2.88
68	14.6	2.68
69	22.2	3.10
70	15.4	2.73
71	17.4	2.86
72	17.6	2.87
73	13.8	2.62
74	23.4	3.15
75	26.3	3.27
76	22.0	3.09
77	16.9	2.83
78	11.8	2.47
79	20.4	3.02
80	24.2	3.19
81	25.2	3.23
82	27.0	3.30
83	28.4	3.35
84	20.5	3.02
85	33.6	3.51
86	30.9	3.43
87	14.9	2.70
88	23.6	3.16
89	35.7	3.58
90	14.7	2.69
91	24.9	3.21
92	14.9	2.70
93	30.6	3.42
94	28.2	3.34
95	37.9	3.63
96	21.6	3.07
97	35.2	3.56
98	23.7	3.17
99	23.9	3.17
100	30.3	3.41
101	27.6	3.32
102	26.6	3.28
103	34.4	3.54

O'Sullivan Monda 16 data set

Summary:	Plot of known area.		
	All DBHs in plot are given.		
	No LA measurement.		
Measured by:	O'Sullivan et al.		
Region:	North Maroondah Experimental Area		
Location:	In Monda 2 catchment. At the throughfall troughs about 100 m down from Road 9.		
Species:	Mountain Ash		
Regeneration:	Seeded after clearfell & burn		
Other data:	Sapwood area.		
	LICOR LAI.		
	DBH of understorey species - not in computer yet.		
References:	O'Sullivan (In prep.)		
	Value	Unit	Source
AMG Easting:	374344	m	
AMG Northing:	5839939	m	
Elevation:	779.9	m	GRASS (elev1d.fill@dem)
Slope:	14	deg	GRASS (slop@dem)
Aspect:	93	deg	GRASS (asp@dem)
Origin:	6/03/78		Langford & O'Shaughnessy (1979, p. 61)
Measurement date:	1/02/94		O'Sullivan pers. comm.
Age at measurement	15.91	yr	
Plot shape:	40x40	m	
Plot area:	1600	m.sq	
No. of DBHs:	127		
Stocking rate:	793.75		
No. of LAs:	0		

Population of DBHs

Tree ID	DBH	ln(DBH)
Mean:	20.8	2.99
1	27.1	3.30
2	21.2	3.05
3	23.3	3.15
4	29.7	3.39
5	23.6	3.16
6	15.0	2.71
7	12.5	2.53
8	24.1	3.18
9	20.7	3.03
10	20.9	3.04
11	19.6	2.98
12	22.4	3.11
13	26.6	3.28
14	16.7	2.82
15	20.2	3.01
16	21.1	3.05
17	10.0	2.30
18	17.7	2.87
19	26.6	3.28
20	20.4	3.02
21	24.0	3.18
22	15.5	2.74
23	21.3	3.06
24	16.6	2.81
25	13.6	2.61
26	19.3	2.96
27	23.7	3.17
28	28.0	3.33
29	15.2	2.72
30	21.5	3.07
31	20.0	3.00
32	18.7	2.93
33	12.4	2.52
34	13.7	2.62
35	30.4	3.41
36	30.2	3.41
37	14.7	2.69
38	30.8	3.43
39	13.9	2.63
40	27.7	3.32
41	14.6	2.68
42	29.5	3.38
43	28.2	3.34
44	14.5	2.67
45	24.4	3.19
46	23.6	3.16
47	27.9	3.33
48	31.5	3.45
49	20.9	3.04
50	11.5	2.44
51	16.7	2.82
52	25.6	3.24
53	16.4	2.80
54	16.6	2.81
55	21.3	3.06
56	22.6	3.12
57	20.1	3.00
58	27.5	3.31
59	13.8	2.62
60	11.8	2.47
61	25.8	3.25
62	28.4	3.35
63	13.4	2.60
64	23.6	3.16
65	17.5	2.86
66	15.2	2.72
67	20.1	3.00
68	24.9	3.21
69	15.0	2.71
70	20.0	3.00

71	27.8	3.33
72	28.7	3.36
73	13.9	2.63
74	22.8	3.13
75	19.9	2.99
76	36.2	3.59
77	36.2	3.59
78	16.6	2.81
79	27.0	3.30
80	15.2	2.72
81	19.6	2.98
82	24.9	3.21
83	27.1	3.30
84	10.6	2.36
85	17.8	2.88
86	12.3	2.51
87	23.5	3.16
88	25.0	3.22
89	25.9	3.25
90	25.3	3.23
91	30.4	3.41
92	10.6	2.36
93	16.2	2.79
94	22.5	3.11
95	16.4	2.80
96	11.7	2.46
97	20.2	3.01
98	9.7	2.27
99	18.8	2.93
100	29.6	3.39
101	19.1	2.95
102	17.9	2.88
103	25.5	3.24
104	20.6	3.03
105	25.1	3.22
106	20.1	3.00
107	22.8	3.13
108	26.8	3.29
109	18.9	2.94
110	12.3	2.51
111	22.3	3.10
112	16.0	2.77
113	12.7	2.54
114	16.9	2.83
115	17.3	2.85
116	21.5	3.07
117	21.5	3.07
118	33.8	3.52
119	25.5	3.24
120	12.8	2.55
121	24.5	3.20
122	15.5	2.74
123	11.6	2.45
124	20.4	3.02
125	22.8	3.13
126	26.9	3.29
127	20.6	3.03

Vertessy & O'Sullivan Monda 16 data set

Summary:	Plot of known area.
	All DBHs in plot are given.
	Sample of LAs determined by destructive sampling.
Measured by:	Vertessy et al.
Region:	North Maroondah Experimental Area
Location:	Between Monda 2 & Monda 3 catchments. About 100 m down from Road 9.
Species:	Mountain Ash
Regeneration:	Direct seeding after clear-cutting
Other data:	Sapwood area and sap flow records for sampled trees.
	LICOR LAI measurements for plot.
	Various data on Silver Wattle & Mountain Hickory within plot.
References:	Vertessy et al. (1994, 1995)

	Value	Unit	Source	Notes
AMG Easting:	374200	m	MMBW map	
AMG Northing:	5839925	m	MMBW map	
Elevation:	801.6	m	GRASS (elev1d.fill@den	Value in Vert. et al. (1995) is wrong
Slope:	12	deg	GRASS (slop@dem)	
Aspect:	125	deg	GRASS (asp@dem)	
Felled and burnt by:	6/03/78		Langford & O'Shaughnessy (1979, p. 61),	
Seeded:	17/05/78		(probably burnt with Monda 2).	
Measurement date:	10/11/93		Vertessy et al. (1994, p. 22) - mid-point of week of felling.	
Age at measurement	15.68	yr		
Plot shape:	50x50	m		
Plot area:	2500	m.sq		
No. of DBHs:	164			
Stocking rate:	656.00	stems/ha		
No. of LAs:	19			

	Population of DBHs		Sample of LAs		
mean	20.4	2.97		26.2	64.79
#	DBH (cm)	ln DBH	Tree	DBH (cm)	LA (m.sq)
1	35.6	3.57	MA-REF	22.4	36.33
2	20.7	3.03	MA1	18.3	21.83
3	11.9	2.48	MA2	27.9	65.03
4	22.4	3.11	MA3	18.2	16.13
5	27.3	3.31	MA4	30.6	67.48
6	14.0	2.64	MA5	21.2	26.13
7	24.4	3.19	MA6	15.6	8.89
8	18.3	2.91	MA7	23.8	63.02
9	25.9	3.25	MA8	31.5	66.32
10	27.1	3.30	MA9	22.5	32.57
11	28.3	3.34	MA10	16.4	8.89
12	25.0	3.22	MA11	28.4	63.08
13	19.7	2.98	MA12	20.5	41.21
14	19.7	2.98	MA13	27.0	61.27
15	20.4	3.02	MA14	37.1	146.78
16	27.0	3.30	MA15	39.2	152.26
17	28.9	3.36	MA16	25.8	66.41
18	27.9	3.33	MA17	34.7	134.34
19	20.7	3.03	MA18	36.6	153.13
20	23.7	3.17			
21	24.4	3.19			
22	31.3	3.44			
23	14.8	2.69			
24	9.6	2.26			
25	15.0	2.71			
26	16.4	2.80			
27	16.5	2.80			
28	11.5	2.44			
29	13.3	2.59			
30	24.4	3.19			
31	18.1	2.90			
32	15.1	2.71			
33	13.4	2.60			
34	13.1	2.57			
35	34.2	3.53			
36	18.2	2.90			
37	17.2	2.84			
38	12.5	2.53			
39	15.3	2.73			
40	27.4	3.31			
41	22.8	3.13			
42	16.5	2.80			
43	11.5	2.44			
44	14.5	2.67			
45	22.1	3.10			
46	11.1	2.41			
47	11.8	2.47			
48	30.6	3.42			
49	23.6	3.16			
50	28.5	3.35			
51	11.5	2.44			
52	21.2	3.05			
53	14.9	2.70			
54	17.1	2.84			
55	28.1	3.34			
56	14.4	2.67			
57	27.8	3.33			
58	16.0	2.77			
59	23.2	3.14			
60	17.2	2.84			
61	16.8	2.82			
62	12.3	2.51			
63	14.4	2.67			
64	15.6	2.75			
65	12.6	2.53			
66	18.3	2.91			
67	23.8	3.17			

68	31.5	3.45
69	14.7	2.69
70	18.4	2.91
71	22.5	3.11
72	15.5	2.74
73	16.4	2.80
74	15.1	2.71
75	26.3	3.27
76	17.8	2.88
77	17.3	2.85
78	22.5	3.11
79	16.8	2.82
80	17.5	2.86
81	12.4	2.52
82	16.1	2.78
83	17.1	2.84
84	25.8	3.25
85	19.7	2.98
86	22.7	3.12
87	14.2	2.65
88	17.3	2.85
89	10.7	2.37
90	28.8	3.36
91	12.9	2.56
92	14.0	2.64
93	11.0	2.40
94	21.2	3.05
95	13.3	2.59
96	18.7	2.93
97	17.0	2.83
98	28.7	3.36
99	12.0	2.48
100	25.0	3.22
101	25.0	3.22
102	21.5	3.07
103	24.1	3.18
104	15.0	2.71
105	18.5	2.92
106	18.5	2.92
107	17.5	2.86
108	22.4	3.11
109	28.4	3.35
110	16.9	2.83
111	20.5	3.02
112	11.8	2.47
113	15.6	2.75
114	18.9	2.94
115	18.5	2.92
116	18.8	2.93
117	17.0	2.83
118	27.0	3.30
119	15.0	2.71
120	24.2	3.19
121	21.1	3.05
122	16.6	2.81
123	18.8	2.93
124	17.3	2.85
125	16.5	2.80
126	17.0	2.83
127	19.8	2.99
128	22.2	3.10
129	20.6	3.03
130	27.4	3.31
131	18.7	2.93
132	15.7	2.75
133	16.0	2.77
134	17.6	2.87
135	26.1	3.26
136	18.0	2.89
137	12.9	2.56
138	21.8	3.08
139	27.8	3.33
140	11.2	2.42
141	13.8	2.62
142	12.3	2.51
143	15.0	2.71
144	20.7	3.03
145	37.1	3.61
146	28.8	3.36
147	19.3	2.96
148	39.2	3.67
149	14.9	2.70
150	22.2	3.10
151	28.2	3.34
152	30.7	3.42
153	15.0	2.71
154	24.1	3.18
155	15.0	2.71
156	37.2	3.62
157	25.8	3.25
158	27.6	3.32
159	30.8	3.43
160	34.7	3.55
161	32.8	3.49
162	31.2	3.44
163	34.7	3.55
164	36.6	3.60

Beringer Picaninny 21 data set

Summary:	Plot of known area.		
	All DBHs in plot are given.		
	No LA at all		
Measured by:	Beringer		
Region:	Coranderrk Experimental Area		
Location:	In Picaninny experimental catchment above Road 42 (upper) probably quite close to Soil Moisture Bore-Hole Number 5 (see map in Langford & O'Shaughnessy, 1980, p. 9).		
Species:	Mountain Ash		
Regeneration:	Seeded after clearfell & burn		
Other data:	Tree height.		
	Understorey composition.		
	LICOR LAI ?		
References:	Beringer (1994)		

	Value	Unit	Source
AMG Easting:	373900	m	Beringer (pers. comm.) - approximate.
AMG Northing:	5829275	m	Beringer (pers. comm.) - approximate.
Elevation:	652.7	m	GRASS (elev1d.fill@dem)
Slope:	27	deg	Beringer (1994)
	23	deg	GRASS (slop@dem)
Aspect:	225	deg. magneti	Beringer (1994)
	247	deg. true	GRASS (asp@dem)
Burnt:	29/03/72		Langford & O'Shaughnessy (1980, pp. 27,28)
Seeded:	10/04/72		Langford & O'Shaughnessy (1980, pp. 27,28,33) (mid-point of 6/4/72-14/4/72)
Measurement date:	26/02/93		Beringer (1994), date given for end of week of LICOR surveying.
Age at measurement	20.91	yr	
Plot shape:	60x60	m	
Plot area:	3600	m.sq	
No. of DBHs:	249		
Stocking rate:	691.67	stems/ha	
No. of LAs:	0		

	Population of DBHs	
Mean:	22.20	3.01
#	DBH	ln(DBH)
1	36.9	3.61
2	15.9	2.77
3	33.5	3.51
4	18.4	2.91
5	14.7	2.69
6	34.4	3.54
7	24.1	3.18
8	32.8	3.49
9	36.8	3.61
10	33.9	3.52
11	39.3	3.67
12	15.4	2.73
13	12.5	2.53
14	12.2	2.50
15	19.6	2.98
16	13.4	2.60
17	12.4	2.52
18	24.3	3.19
19	10.4	2.34
20	25.2	3.23
21	30.8	3.43
22	28.1	3.34
23	13.5	2.60
24	38.7	3.66
25	31.1	3.44
26	16.6	2.81
27	13.5	2.60
28	18.0	2.89
29	29.1	3.37
30	18.0	2.89
31	22.0	3.09
32	15.9	2.77
33	16.8	2.82
34	33.8	3.52
35	25.4	3.23
36	31.2	3.44
37	18.4	2.91
38	18.5	2.92
39	25.6	3.24
40	14.5	2.67
41	28.2	3.34
42	36.7	3.60
43	33.9	3.52
44	30.6	3.42
45	12.0	2.48
46	11.6	2.45
47	12.3	2.51
48	18.7	2.93
49	11.1	2.41
50	21.2	3.05
51	25.9	3.25
52	12.0	2.48
53	29.5	3.38
54	27.2	3.30
55	36.4	3.59
56	16.9	2.83
57	16.1	2.78
58	20.8	3.03
59	24.7	3.21
60	18.5	2.92
61	17.5	2.86
62	24.6	3.20

63	15.8	2.76
64	20.0	3.00
65	14.1	2.65
66	15.2	2.72
67	18.6	2.92
68	14.8	2.69
69	17.0	2.83
70	38.1	3.64
71	23.3	3.15
72	19.9	2.99
73	13.4	2.60
74	27.4	3.31
75	15.3	2.73
76	4.1	1.41
77	36.2	3.59
78	21.9	3.09
79	23.5	3.16
80	33.8	3.52
81	16.9	2.83
82	27.1	3.30
83	11.7	2.46
84	14.2	2.65
85	11.8	2.47
86	15.1	2.71
87	34.4	3.54
88	18.5	2.92
89	13.4	2.60
90	27.4	3.31
91	9.0	2.20
92	12.3	2.51
93	11.7	2.46
94	39.6	3.68
95	10.2	2.32
96	37.2	3.62
97	32.9	3.49
98	14.3	2.66
99	14.1	2.65
100	20.6	3.03
101	22.5	3.11
102	32.0	3.47
103	30.0	3.40
104	18.0	2.89
105	14.3	2.66
106	17.8	2.88
107	11.1	2.41
108	42.1	3.74
109	37.0	3.61
110	25.1	3.22
111	35.8	3.58
112	20.6	3.03
113	12.4	2.52
114	15.8	2.76

115	12.7	2.54
116	22.7	3.12
117	10.5	2.35
118	12.9	2.56
119	22.4	3.11
120	12.1	2.49
121	22.1	3.10
122	33.1	3.50
123	20.4	3.02
124	22.3	3.10
125	33.3	3.51
126	29.2	3.37
127	17.4	2.86
128	20.1	3.00
129	15.8	2.76
130	7.1	1.96
131	15.6	2.75
132	26.3	3.27
133	38.1	3.64
134	33.7	3.52
135	21.1	3.05
136	24.7	3.21
137	29.5	3.38
138	25.7	3.25
139	27.2	3.30
140	21.8	3.08
141	43.1	3.76
142	26.9	3.29
143	16.8	2.82
144	33.1	3.50
145	10.4	2.34
146	17.9	2.88
147	17.8	2.88
148	16.6	2.81
149	24.4	3.19
150	19.6	2.98
151	22.9	3.13
152	17.3	2.85
153	15.5	2.74
154	24.2	3.19
155	19.3	2.96
156	8.6	2.15
157	28.3	3.34
158	7.2	1.97
159	16.3	2.79
160	26.2	3.27
161	25.1	3.22
162	13.2	2.58
163	8.6	2.15
164	16.9	2.83
165	7.5	2.01
166	36.7	3.60

167	14.1	2.65
168	20.3	3.01
169	10.7	2.37
170	11.2	2.42
171	29.9	3.40
172	9.8	2.28
173	33.6	3.51
174	13.5	2.60
175	11.2	2.42
176	18.8	2.93
177	16.4	2.80
178	9.7	2.27
179	34.5	3.54
180	40.3	3.70
181	21.1	3.05
182	24.4	3.19
183	25.0	3.22
184	35.5	3.57
185	24.1	3.18
186	27.5	3.31
187	28.8	3.36
188	17.4	2.86
189	40.4	3.70
190	19.9	2.99
191	29.0	3.37
192	13.6	2.61
193	24.7	3.21
194	34.8	3.55
195	30.8	3.43
196	16.4	2.80
197	22.7	3.12
198	30.5	3.42
199	35.1	3.56
200	10.2	2.32
201	18.7	2.93
202	39.8	3.68
203	23.1	3.14
204	21.9	3.09
205	20.9	3.04
206	12.7	2.54
207	7.6	2.03
208	13.0	2.56
209	9.5	2.25
210	13.8	2.62
211	30.7	3.42
212	18.4	2.91
213	27.5	3.31
214	12.0	2.48
215	10.8	2.38
216	13.7	2.62
217	9.7	2.27
218	21.1	3.05
219	30.1	3.40
220	11.3	2.42
221	28.1	3.34
222	12.1	2.49
223	5.7	1.74
224	13.6	2.61
225	16.0	2.77
226	13.5	2.60
227	14.9	2.70
228	29.2	3.37
229	27.6	3.32
230	34.8	3.55
231	41.0	3.71
232	29.9	3.40
233	19.1	2.95
234	24.8	3.21
235	-25.3	3.23
236	34.6	3.54
237	29.8	3.39
238	34.7	3.55
239	9.5	2.25
240	13.9	2.63
241	37.2	3.62
242	25.0	3.22
243	41.8	3.73
244	36.4	3.59
245	43.4	3.77
246	27.3	3.31
247	30.2	3.41
248	30.4	3.41
249	35.5	3.57

O'Sullivan Picaninny 22 data set

Summary:	Plot of known area.
	All DBHs in plot are given.
	No LA measurement.
Measured by:	O'Sullivan et al.
Region:	Coranderrk Experimental Area
Location:	Picaninny catchment. At throughfall troughs above Road 42 crossing of creek.
Species:	Mountain Ash
Regeneration:	Seeded after clearfell & burn
Other data:	LICOR.
	Sapwood area.
	No measurement of understorey DBH - heavily coppiced.
References:	O'Sullivan (In prep.)

	Value	Unit	Source
AMG Easting:	373443	m	GPS (by O'Sullivan),
AMG Northing:	5829129	m	(see also Langford & O'Shaughnessy, 1980, p. 9)
Elevation:	442.2	m	GRASS (elev1d.fill@dem)
Slope:	23	deg	GRASS (slop@dem)
Aspect:	229	deg	GRASS (asp@dem)
Origin:	28/03/72		Langford & O'Shaughnessy (1980, pp. 33,27)
Measurement date:	1/06/94		O'Sullivan pers. comm.
Age at measurement	22.18	yr	
Plot shape:	50x35	m	
Plot area:	1750	m.sq	
No. of DBHs:	104		
Stocking rate:	594.29		
No. of LAs:	0		

Population of DBHs

Tree ID	DBH	ln(DBH)
Mean:	27.8	3.24
1	45.0	3.81
2	34.5	3.54
3	29.5	3.38
4	32.7	3.49
5	11.0	2.40
6	20.1	3.00
7	39.8	3.68
8	16.5	2.80
9	34.5	3.54
10	19.9	2.99
11	29.4	3.38
12	36.6	3.60
13	38.6	3.65
14	14.9	2.70
15	14.4	2.67
16	34.5	3.54
17	24.9	3.21
18	11.8	2.47
19	34.2	3.53
20	12.1	2.49
21	42.0	3.74
22	24.3	3.19
23	14.5	2.67
24	21.6	3.07
25	34.4	3.54
26	45.3	3.81
27	48.8	3.89
28	19.8	2.99
29	16.5	2.80
30	13.0	2.56
31	24.0	3.18
32	42.7	3.75
33	25.2	3.23
34	12.0	2.48
35	30.1	3.40
36	29.5	3.38
37	41.2	3.72
38	46.5	3.84
39	23.2	3.14
40	45.8	3.82
41	12.8	2.55
42	39.4	3.67
43	32.8	3.49
44	34.2	3.53
45	44.3	3.79
46	16.5	2.80
47	28.1	3.34
48	23.6	3.16
49	15.3	2.73
50	20.4	3.02
51	22.3	3.10
52	27.3	3.31
53	31.6	3.45
54	30.2	3.41
55	29.0	3.37
56	15.4	2.73
57	25.9	3.25
58	22.9	3.13
59	35.8	3.58
60	32.2	3.47
61	17.0	2.83
62	10.5	2.35
63	34.7	3.55
64	32.6	3.48
65	17.9	2.88
66	10.5	2.35
67	10.6	2.36
68	41.2	3.72
69	39.4	3.67
70	17.6	2.87

71	26.0	3.26
72	46.5	3.84
73	39.7	3.68
74	30.3	3.41
75	22.0	3.09
76	38.0	3.64
77	32.3	3.48
78	43.9	3.78
79	32.3	3.48
80	18.9	2.94
81	40.8	3.71
82	24.4	3.19
83	12.3	2.51
84	22.0	3.09
85	40.7	3.71
86	28.0	3.33
87	33.5	3.51
88	15.8	2.76
89	28.8	3.36
90	12.9	2.56
91	42.5	3.75
92	39.5	3.68
93	44.6	3.80
94	40.3	3.70
95	17.4	2.86
96	23.1	3.14
97	13.4	2.60
98	22.1	3.10
99	29.0	3.37
100	41.5	3.73
101	21.3	3.06
102	22.2	3.10
103	18.5	2.92
104	20.3	3.01

Ronan Blacks' Spur 38 data set

Summary:	Plot of known area.
	All DBHs and LAs (by destructive sampling) in plot are given.
Measured by:	Ronan
Region:	North Maroondah Experimental Area
Location:	In Blacks' Spur 1 catchment. Centred on Soil Moisture Borehole 17 (see map in Langford & O'Shaugnessy, 1979, p.17).
History:	Felled during this measurement.
	Patch cut between 20/12/76 & 3/5/77 (Lang. & O'Shaugh., 1977, p.271)
Species:	Mountain Ash
Regeneration:	Wildfire
Other data:	Visual estimates of LA and LAI made using detailed methodology (1976, 1977, 1980) ('cannot be regarded as accurate').
	Sapwood area.
	Tree height.
	Vertical distribution of LA within trees.
References:	Ronan (1984), Langford & O'Shaughnessy (1977, p.271)

	Value	Unit	Source
AMG Easting:	378700	m	MW map, Lang. & O'Shaugh. (1979, p.17)
AMG Northing:	5838825	m	MW map, Lang. & O'Shaugh. (1979, p.17)
Elevation:	580.3	m	GRASS (elev1d.fill@dem)
Slope:	17	deg	GRASS (slop@dem)
Aspect:	141	deg	GRASS (asp@dem)
Origin:	31/01/39		
Measurement date:	1/12/76		Estimated from Ronan (1984), Langford & O'Shaughnessy (1977, pp. 45,53,263,271)
Age at measurement	37.83436	yr	
Plot shape:	15 m radius		
Plot area:	706.8583	m.sq	
No. of DBHs:	15		
Stocking rate:	212.21	stems/ha	
No. of LAs:	15		

Population of DBHs and LAs				
mean	39.8	3.63	87.00	
#	DBH (cm)	ln DBH	LA (m.sq)	LAI
1	52.4	3.96	125	1.85
2	60.2	4.10	215	
3	34.3	3.54	29	
4	44.5	3.80	103	
5	26.9	3.29	7	
6	40.4	3.70	80	
7	44.6	3.80	130	
8	36.7	3.60	56	
9	41.0	3.71	80	
10	24.0	3.18	13	
11	26.2	3.27	13	

12	34.3	3.54	53
13	72.9	4.29	330
14	32.9	3.49	54
15	25.4	3.23	17

Dunn Monda Road 50 data set

Summary:	Plot of known area.		
	All DBHs in plot are given.		
	No LA measurement.		
Measured by:	Dunn & Connor (1991), (actually measured by Benyon)		
Region:	North Maroondah Experimental Area		
Location:	30 m west of forest edge at Road 9 about 100 to 200 m before where fire break leaves Road 9 near Road 33.		
Species:	Mountain Ash		
Regeneration:	Wildfire		
Other data:	Sapwood area.		
	Water use by various methods.		
	Understorey DBH and sapwood area.		
	No LA measurement.		
References:	Dunn & Connor (1991, 1993)		

	Value	Unit	Source
AMG Easting:	378631	m	MW map, described by Richard Benyon
AMG Northing:	5839531	m	MW map, described by Richard Benyon
Elevation:	590	m	DSM map, MW map
Slope:	5	deg	Dunn & Connor (1991, p. 11)
Aspect:	220	deg	Dunn & Connor (1991, p. 11)
Origin:	13/01/39		
Measurement date:	1/06/89		Used the date of mid-point of study.
Age at measurement	50.38	yr	
Plot shape:	50x50	m	
Plot area:	2500	m.sq	
No. of DBHs:	44		
Stocking rate:	176.00		
No. of LAs:	0		

	Population of DBHs	
Mean:	56.3	3.92
Tree	DBH	ln(DBH)
1	71.3	4.27
2	73.2	4.29
3	51.5	3.94
4	45.4	3.82
5	49.8	3.91
6	25.9	3.25
7	55.8	4.02
8	60.1	4.10
9	56.6	4.04
10	57.3	4.05
11	57.3	4.05
12	51.0	3.93
13	59.6	4.09
14	38.5	3.65
15	52.5	3.96

Beringer Blacks' Spur 54 data set

Summary:	Plot of known area.
	All DBHs in plot are given.
	No LA at all.
Measured by:	Beringer
Region:	North Maroondah Experimental Area
Location:	On top of Blacks' Spur above the Blacks' Spur experimental catchments.
Species:	Mountain Ash
Regeneration:	Wildfire
Other data:	Tree height.
	Understorey composition.
	LICOR LAI ?
References:	Beringer (1994)

	Value	Unit	Source
AMG Easting:	378200	m	MMBW map, taken as same as Vertessy Blacks'
AMG Northing:	5838100	m	Spur 56 site.
Elevation:	569.5	m	GRASS (elev1d.fill@dem)
Slope:	4	deg	Beringer (1994)
Aspect:	270	deg. magnetic	Beringer (1994)
Origin:	13/01/39		
Measurement date:	26/02/93		Beringer (1994), date given for end of week of
			LICOR surveying.
Age at measurement	54.12	yr	
Plot shape:	70x70	m	
Plot area:	4900	m.sq	
No. of DBHs:	153		
Stocking rate:	312.24	stems/ha	
No. of LAs:	0		

	Population of DBHs	
Mean:	50.64	3.86
#	DBH	ln(DBH)
1	83.9	4.43
2	82.6	4.41
3	27.5	3.31
4	45.7	3.82
5	33.8	3.52
6	61.5	4.12
7	63.0	4.14
8	38.0	3.64
9	41.5	3.73
10	60.6	4.10
11	72.5	4.28
12	59.2	4.08
13	63.2	4.15
14	47.5	3.86
15	41.5	3.73
16	63.5	4.15

16	29.3	3.38
17	44.9	3.80
18	32.6	3.48
19	48.0	3.87
20	62.1	4.13
21	69.8	4.25
22	44.1	3.79
23	92.7	4.53
24	69.3	4.24
25	40.1	3.69
26	111.0	4.71
27	109.1	4.69
28	81.0	4.39
29	12.1	2.49
30	104.3	4.65
31	105.5	4.66
32	77.1	4.35
33	51.2	3.94
34	41.9	3.74
35	90.8	4.51
36	26.7	3.28
37	23.6	3.16
38	55.7	4.02
39	35.7	3.58
40	25.0	3.22
41	17.4	2.86
42	38.7	3.66
43	44.2	3.79
44	87.0	4.47

17	24.4	3.19
18	43.8	3.78
19	64.0	4.16
20	40.0	3.69
21	35.5	3.57
22	32.5	3.48
23	26.0	3.26
24	48.0	3.87
25	38.0	3.64
26	75.0	4.32
27	70.0	4.25
28	57.5	4.05
29	80.1	4.38
30	45.6	3.82
31	72.8	4.29
32	44.4	3.79
33	50.0	3.91
34	89.0	4.49
35	44.7	3.80
36	55.2	4.01
37	27.8	3.33
38	55.2	4.01
39	29.4	3.38
40	56.6	4.04
41	80.9	4.39
42	32.6	3.48
43	52.2	3.96
44	34.8	3.55
45	34.3	3.54
46	50.3	3.92
47	32.0	3.47
48	31.4	3.45
49	56.5	4.03
50	36.9	3.61
51	85.0	4.44
52	56.7	4.04
53	30.5	3.42
54	73.4	4.30
55	29.3	3.38
56	49.2	3.90
57	53.5	3.98
58	59.0	4.08
59	78.5	4.36
60	46.4	3.84
61	81.5	4.40
62	69.6	4.24
63	44.2	3.79
64	39.0	3.66
65	42.0	3.74
66	48.5	3.88
67	66.6	4.20
68	50.6	3.92

69	39.0	3.66
70	37.7	3.63
71	40.1	3.69
72	77.5	4.35
73	68.2	4.22
74	86.1	4.46
75	23.1	3.14
76	60.0	4.09
77	57.0	4.04
78	35.9	3.58
79	63.2	4.15
80	81.5	4.40
81	24.4	3.19
82	39.6	3.68
83	33.2	3.50
84	37.2	3.62
85	40.9	3.71
86	58.9	4.08
87	38.5	3.65
88	16.7	2.82
89	69.9	4.25
90	43.6	3.78
91	46.0	3.83
92	61.6	4.12
93	76.2	4.33
94	23.1	3.14
95	45.1	3.81
96	45.3	3.81
97	27.1	3.30
98	40.0	3.69
99	20.5	3.02
100	24.0	3.18
101	62.3	4.13
102	29.8	3.39
103	37.0	3.61
104	55.0	4.01
105	53.0	3.97
106	60.0	4.09
107	35.0	3.56
108	85.0	4.44
109	49.1	3.89
110	72.5	4.28
111	39.1	3.67
112	89.3	4.49
113	61.8	4.12
114	68.0	4.22
115	39.5	3.68
116	42.1	3.74
117	40.0	3.69
118	33.5	3.51
119	56.2	4.03
120	30.4	3.41

121	47.5	3.86
122	64.9	4.17
123	32.6	3.48
124	82.5	4.41
125	53.8	3.99
126	28.2	3.34
127	29.7	3.39
128	46.9	3.85
129	57.5	4.05
130	54.7	4.00
131	28.5	3.35
132	45.5	3.82
133	25.8	3.25
134	56.6	4.04
135	37.2	3.62
136	40.5	3.70
137	54.1	3.99
138	72.5	4.28
139	34.1	3.53
140	72.6	4.28
141	70.0	4.25
142	51.0	3.93
143	74.1	4.31
144	41.6	3.73
145	59.8	4.09
146	52.5	3.96
147	67.5	4.21
148	61.5	4.12
149	30.0	3.40
150	58.0	4.06
151	76.2	4.33
152	54.2	3.99
153	30.1	3.40

O'Sullivan Ettercon 55 data set

Summary:	Plot of known area.
	All DBHs in plot are given.
	No LA measurement.
Measured by:	O'Sullivan et al.
Region:	North Maroondah Experimental Area
Location:	Ettercon 3 catchment. Near start of boundary track leaving Road 13 at NW of catchment.
Species:	Mountain Ash
Regeneration:	Wildfire
Other data:	LICOR LAI.
	Sapwood area.
	Likely to have DBH of understorey - not in computer
References:	O'Sullivan (In prep.)

	Value	Unit	Source
AMG Easting:	375770	m	GRASS (d.where)
AMG Northing:	5839530	m	GRASS (d.where)
Elevation:	789.2	m	GRASS (elev1d.fill@dem)
Slope:	12	deg	GRASS (slop@dem)
Aspect:	117	deg	GRASS (asp@dem)
Origin:	13/01/39		
Measurement date:	1/05/94		O'Sullivan pers. comm.
Age at measurement	55.30	yr	
Plot shape:	80x50	m	
Plot area:	4000	m.sq	
No. of DBHs:	59		
Stocking rate:	147.50		
No. of LAs:	0		

Population of DBHs

Mean:	59.3	4.04
Tree ID	DBH	ln(DBH)
1	61.1	4.11
2	44.1	3.79
3	68.2	4.22
4	31.5	3.45
5	54.5	4.00
6	59.3	4.08
7	47.3	3.86
8	50.4	3.92
9	40.0	3.69
10	40.4	3.70
11	43.4	3.77
12	49.4	3.90
13	43.5	3.77
14	60.0	4.09
15	60.6	4.10
16	43.0	3.76

17	44.5	3.80
18	60.9	4.11
19	52.6	3.96
20	56.1	4.03
21	58.2	4.06
22	55.0	4.01
23	40.4	3.70
24	52.2	3.96
25	44.1	3.79
26	61.2	4.11
27	42.3	3.74
28	60.2	4.10
29	45.1	3.81
30	51.9	3.95
31	31.8	3.46
32	32.1	3.47
33	62.2	4.13
34	49.2	3.90
35	64.0	4.16
36	86.1	4.46
37	48.3	3.88
38	50.9	3.93
39	42.4	3.75
40	55.5	4.02
41	84.7	4.44
42	65.5	4.18
43	71.8	4.27
44	84.2	4.43
45	85.5	4.45
46	79.1	4.37
47	40.7	3.71
48	87.2	4.47
49	80.1	4.38
50	68.3	4.22
51	54.9	4.01
52	81.2	4.40
53	61.0	4.11
54	85.5	4.45
55	65.8	4.19
56	94.7	4.55
57	99.7	4.60
58	84.3	4.43
59	82.4	4.41

Vertessy & O'Sullivan Blacks' Spur 56 dat set

Summary:	Plot of known area.		
	All DBHs in plot are given.		
	Sample of LAs determined by destructive sampling.		
Measured by:	Vertessy et al.		
Region:	North Maroondah Experimental Area		
Location:	On top of Blacks' Spur above the Blacks' Spur experimental catchments.		
Species:	Mountain Ash		
Regeneration:	Wildfire		
Other data:	Tree water use.		
	LICOR LAI.		
	Soil hydraulic properties.		
References:	Vertessy et al. (In prep.)		
	Value	Unit	Source
AMG Easting:	378200	m	MMBW map
AMG Northing:	5838100	m	MMBW map
Elevation:	569.5	m	GRASS (elev1d.fill@dem)
Slope:	5	deg	GRASS (slop@dem)
Aspect:	275	deg	GRASS (asp@dem)
Origin:	13/01/39		
Measurement date:	22/03/95		(during week of 20-24 Mar. 1995)
Age at measurement	56.19	yr	
Plot shape:	70x70	m	
Plot area:	4900	m.sq	
No. of DBHs:	94		
Stocking rate:	191.84	stems/ha	
No. of LAs:	11		

	Population of DBHs		Sample of LAs	
mean	56.9	3.99	65.7	207.37
	DBH		DBH	
#	(cm)	ln DBH	(cm)	LA (m.sq)
1	71.3	4.27	62.8	296.5
2	33.8	3.52	64.3	195.8
3	60.6	4.10	56	111.3
4	69.3	4.24	89.3	330.4
5	83.3	4.42	73	206.8
6	29.0	3.37	83.3	263.5
7	40.1	3.69	46.2	66.1
8	46.5	3.84	69	163
9	32.6	3.48	60.6	197.8
10	44.0	3.78	39.5	45.1
11	54.5	4.00	79.2	404.8
12	63.4	4.15		
13	76.0	4.33		
14	39.5	3.68		
15	43.9	3.78		
16	68.8	4.23		
17	57.5	4.05		

18	59.5	4.09
19	39.5	3.68
20	57.8	4.06
21	83.1	4.42
22	47.4	3.86
23	71.2	4.27
24	59.5	4.09
25	45.0	3.81
26	38.0	3.64
27	63.9	4.16
28	70.8	4.26
29	75.4	4.32
30	57.2	4.05
31	48.5	3.88
32	79.2	4.37
33	71.3	4.27
34	73.0	4.29
35	62.8	4.14
36	56.6	4.04
37	64.3	4.16
38	37.5	3.62
39	59.0	4.08
40	33.6	3.51
41	76.8	4.34
42	29.3	3.38
43	39.5	3.68
44	63.6	4.15
45	40.9	3.71
46	84.5	4.44
47	46.2	3.83
48	55.9	4.02
49	37.4	3.62
50	54.3	3.99
51	31.3	3.44
52	53.1	3.97
53	56.0	4.03
54	36.8	3.61
55	69.2	4.24
56	48.7	3.89
57	37.0	3.61
58	97.1	4.58
59	78.8	4.37
60	78.1	4.36
61	69.3	4.24
62	55.6	4.02
63	47.6	3.86
64	64.0	4.16
65	26.6	3.28
66	56.2	4.03
67	38.0	3.64
68	53.0	3.97
69	67.1	4.21
70	61.7	4.12
71	30.3	3.41
72	46.9	3.85
73	47.3	3.86
74	77.1	4.35
75	33.6	3.51
76	51.4	3.94
77	73.2	4.29
78	78.8	4.37
79	32.2	3.47
80	62.5	4.14
81	65.0	4.17
82	57.5	4.05
83	92.0	4.52
84	89.3	4.49
85	35.7	3.58
86	86.0	4.45
87	76.6	4.34
88	62.3	4.13
89	63.8	4.16
90	37.2	3.62
91	68.5	4.23
92	45.0	3.81
93	80.2	4.38
94	37.7	3.63

Dunn Monda Road 90 data set

Summary:	Plot of known area.
	All DBHs in plot are given.
	No LA measurement.
Measured by:	Dunn & Connor (1991)
Region:	North Maroondah Experimental Area
Location:	At west border of Road 9 about 80 m up road from where fire break leaves Road 9 near Road 33.
Species:	Mountain Ash
Regeneration:	Wildfire
Other data:	Sapwood area.
	Water use by various methods.
	Understorey DBH and sapwood area.
	No LA measurement.
References:	Dunn & Connor (1991, 1993)

	Value	Unit	Source
AMG Easting:	378556	m	MW map, described by Richard Benyon
AMG Northing:	5839725	m	MW map, described by Richard Benyon
Elevation:	615	m	DSM map, MW map
Slope:	14	deg	Dunn & Connor (1991, p. 11)
Aspect:	170	deg	Dunn & Connor (1991, p. 11)
Origin:	1899		
Measurement date:	1/06/89		Used the date of mid-point of study.
Age at measurement	90	yr	
Plot shape:	40x40	m	
Plot area:	1600	m.sq	
No. of DBHs:	17		
Stocking rate:	106.25		
No. of LAs:	0		

Population of DBHs

Mean:	83.9	4.39
Tree	DBH	ln(DBH)
1	54.9	4.01
2	95.9	4.56
3	109.8	4.70
4	86.8	4.46
5	77.7	4.35
6	96.6	4.57
7	98.9	4.59
8	128.5	4.86
9	77.5	4.35
10	60.0	4.09
11	68.8	4.23
12	87.5	4.47
13	113.0	4.73
14	52.8	3.97
15	105.8	4.66
16	59.5	4.09
17	52.8	3.97

Dunn Monda Road 150+50 data set

Summary:	Plot of known area.
	All DBHs in plot are given.
	No LA measurement.
	DBHs probably affected by buttressing.
Measured by:	Dunn & Connor (1991)
Region:	North Maroondah Experimental Area
Location:	About 30 m down (west) from Road 9 starting from about 30 m past (north of) where Road 9 leaves the firebreak near Road 33.
Species:	Mountain Ash
Regeneration:	Wildfire
Other data:	Sapwood area.
	Water use by various methods.
	Understorey DBH and sapwood area.
	No LA measurement.
References:	Dunn & Connor (1991, 1993)

	Value	Unit	Source
AMG Easting:	378600	m	MW map, described by Richard Benyon
AMG Northing:	5839663	m	MW map, described by Richard Benyon
Elevation:	605	m	DSM map, MW map
Slope:	14	deg	Dunn & Connor (1991, p. 11)
Aspect:	180	deg	Dunn & Connor (1991, p. 11)
Origin:	1839		
Measurement date:	1/06/89		Used the date of mid-point of study.
Age at measurement:	150	yr	
Plot shape:	50x50	m	
Plot area:	2500	m.sq	
No. of DBHs (old):	13		
No. of DBHs (young):	1		
Stocking rate (old):	52.00		
Stocking rate (young):	4.00		
No. of LAs:	0		

Population of DBHs			
Mean:	119.4	4.73	
Tree	DBH	ln(DBH)	Age
1	118.5	4.77	150
2	139.7	4.94	150
3	128.0	4.85	150
4	123.1	4.81	150
5	143.9	4.97	150
6	226.3	5.42	150
7	89.5	4.49	150
9	98.0	4.58	150
10	112.0	4.72	150
11	123.3	4.81	150
12	106.5	4.67	150
13	120.5	4.79	150
14	146.6	4.99	150

Population of DBHs			
Mean:	57.7	4.06	
Tree	DBH	ln(DBH)	Age
8	57.7	4.06	50

Beringer Monda Road 154 data set

Summary:	Plot of known area.		
	All DBHs in plot are given.		
	No LA at all.		
	Numerous ages of forest present. Mode is about 150 years old.		
Measured by:	Beringer		
Region:	North Maroondah Experimental Area		
Location:	Probably very close to the Dun150 site - assuming so.		
Species:	Mountain Ash		
Regeneration:	Wildfire		
Other data:	Tree height.		
	Understorey composition.		
	LICOR LAI ?		
References:	Beringer (1994)		

	Value	Unit	Source
AMG Easting:	378600	m	See Dun150 data set.
AMG Northing:	5839663	m	See Dun150 data set.
Elevation:	605	m	See Dun150 data set.
Slope:	7	deg	Beringer (1994)
Slope (Dun150):	14	deg	Dunn & Connor (1991, p. 11)
Aspect:	225	deg. magneti	Beringer (1994)
Aspect (Dun150):	180	deg	Dunn & Connor (1991, p. 11)
Origin:	1839		See Dun150 data set.
Measurement date:	26/02/93		Beringer (1994), date given for end of week of LICOR surveying.
Age at measurement	154	yr	(Mode age. Stand is of mixed age.)
Plot shape:	110x110	m	
Plot area:	12100	m.sq	
No. of DBHs:	54		
Stocking rate:	44.63	stems/ha	
No. of LAs:	0		

	Population of DBHs	
Mean:	115.26	4.60
#	DBH	ln(DBH)
1	166.3	5.11
2	238.0	5.47
3	116.6	4.76
4	90.5	4.51
5	140.3	4.94
6	69.3	4.24
7	128.3	4.85
8	123.6	4.82
9	108.0	4.68
10	69.2	4.24
11	81.5	4.40
12	157.0	5.06
13	98.0	4.58
14	326.3	5.79
15	90.0	4.50
16	123.6	4.82
17	272.8	5.61
18	54.9	4.01
19	26.7	3.28
20	178.8	5.19
21	62.1	4.13
22	58.3	4.07
23	120.2	4.79
24	115.6	4.75
25	110.0	4.70
26	73.6	4.30
27	81.5	4.40
28	116.3	4.76
29	52.5	3.96
30	48.1	3.87
31	117.1	4.76
32	48.8	3.89
33	32.1	3.47
34	130.0	4.87
35	139.5	4.94
36	140.2	4.94
37	60.9	4.11
38	108.2	4.68
39	149.0	5.00
40	90.8	4.51
41	106.0	4.66
42	463.2	6.14
43	93.0	4.53
44	93.0	4.53
45	96.0	4.56
46	116.1	4.75
47	165.2	5.11
48	44.8	3.80
49	76.1	4.33
50	112.5	4.72
51	99.2	4.60
52	60.9	4.11
53	99.0	4.60
54	84.8	4.44

Melbourne Water Myrtle 212 data set

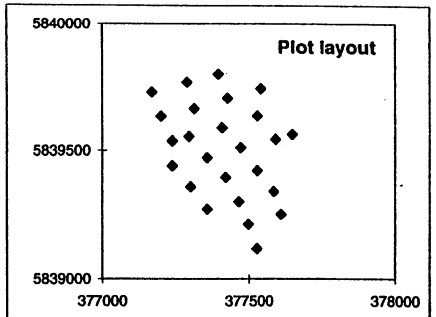
Summary:	25 plots of known area.
	All DBHs in plot are given.
	No LA measurement.
Measured by:	Melbourne Water Catchment Hydrology Research
Region:	North Maroondah Experimental Area
Location:	Myrtle 2 experimental catchment. Eight transects across catchment.
Species:	Mountain Ash
Regeneration:	Wildfire
Other data:	One tree height per plot.
References:	Langford & O'Shaughnessy (1977)

(Table of summary statistics by plot appears after table of data)

	Value	Unit	Source	Class
AMG Easting:	Various	m	Map in MW files, DSM 1:25k map	
AMG Northing:	Various	m	Map in MW files, DSM 1:25k map	
Elevation:	Various	m	GRASS (elev1d.fill@dem)	
Slope:	Various	deg.	Original datasheets	
Slope:	Various	deg.	GRASS (slop@dem)	
Aspect:	Various	deg.	GRASS (asp@dem)	
Origin:	1759		Approx. from Ronan (1984)	
Measurement date:	Various		Original datasheets	
Age at measurement:	Various	yr		
Plot shape:	Various	ft	Deduced from map in MW files	
Plot area:	Various	m.sq	Deduced from map in MW files	
No. of LAs:	0			
Pure over-mature?	Various	=yes, 0=no		
Over-mature trees:				
No. of DBHs (OM):	Various			
Stocking rate:	Various	stems/ha		
Mean DBH (OM):	Various	cm		
Mean ln DBH (OM):	Various			
Mature trees:				
No. of DBHs (M):	Various			
Stocking rate:	Various	stems/ha		
Mean DBH (M):	Various	cm		
Mean ln DBH (M):	Various			
Poles:				
No. of DBHs (Pole):	Various			
Stocking rate:	Various	stems/ha		
Mean DBH (Pole):	Various	cm		
Mean ln DBH (Pole):	Various			

Transect ('Strip')	Plot	Tree	Class	Pure OM?	GBH (ft)	DBH (cm)	ln(DBH)
					Population of DBHs		
7	1	1	OM	1	25.25	245.0	5.50
7	1	2	OM	1	11.75	114.0	4.74
7	1	3	OM	1	24.50	237.7	5.47
7	1	4	OM	1	22.42	217.5	5.38
7	2	1	OM	1	26.58	257.9	5.55
7	2	2	OM	1	26.17	253.9	5.54
7	2	3	OM	1	30.00	291.1	5.67
7	2	4	OM	1	13.83	134.2	4.90
7	3	1	OM	0	35.00	339.6	5.83
7	3	1	Pole	0	3.83	37.2	3.62
7	3	2	Pole	0	8.25	80.0	4.38
7	3	3	Pole	0	8.25	80.0	4.38
7	3	4	Pole	0	4.75	46.1	3.83
7	3	5	Pole	0	5.25	50.9	3.93
7	3	6	Pole	0	5.17	50.1	3.91
7	3	7	Pole	0	5.00	48.5	3.88
7	3	8	Pole	0	3.00	29.1	3.37
7	3	9	Pole	0	4.83	46.9	3.85
7	3	10	Pole	0	5.33	51.7	3.95
7	3	11	Pole	0	3.00	29.1	3.37
8	4	1	OM	0	22.92	222.3	5.40
8	4	2	OM	0	20.83	202.1	5.31
8	4	1	Pole	0	6.67	64.7	4.17
8	4	2	Pole	0	6.67	64.7	4.17
8	4	3	Pole	0	5.00	48.5	3.88
8	4	4	Pole	0	6.75	65.5	4.18
8	4	5	Pole	0	5.17	50.1	3.91
8	5	1	Pole	0	4.08	39.6	3.68
8	6	1	OM	0	22.33	216.7	5.38
8	6	2	OM	0	13.00	126.1	4.84
8	6	1	Pole	0	2.67	25.9	3.25
8	6	2	Pole	0	6.25	60.6	4.10
8	7	1	OM	1	18.08	175.4	5.17
9	8	1	OM	1	25.08	243.4	5.49
9	9	-	-	0	-	-	
9	10	1	OM	1	18.00	174.6	5.16
9	11	1	OM	0	26.33	255.5	5.54
9	11	1	M	0	12.58	122.1	4.80
9	11	1	Pole	0	8.42	81.7	4.40
9	11	1	Pole	0	5.67	55.0	4.01
10	12	1	OM	0	27.33	265.2	5.58
10	12	1	Pole	0	7.92	76.8	4.34
10	12	2	Pole	0	8.75	84.9	4.44
10	12	3	Pole	0	6.42	62.3	4.13
10	12	4	Pole	0	6.50	63.1	4.14
10	12	5	Pole	0	5.25	50.9	3.93
10	12	6	Pole	0	8.67	84.1	4.43
10	12	7	Pole	0	7.17	69.5	4.24
10	12	8	Pole	0	7.58	73.6	4.30
10	12	9	Pole	0	5.58	54.2	3.99
10	12	10	Pole	0	7.92	76.8	4.34
10	13	1	OM	1	23.08	224.0	5.41
10	13	2	OM	1	30.67	297.5	5.70
10	14	-	-	0	-	-	

10	15	1	OM	1	13.67	132.6	4.89
10	15	2	OM	1	19.50	189.2	5.24
10	16	1	OM	1	23.58	228.8	5.43
10	16	2	OM	1	21.83	211.8	5.36
11	17	1	OM	1	12.67	122.9	4.81
11	17	2	OM	1	13.58	131.8	4.88
11	17	3	OM	1	7.17	69.5	4.24
11	17	4	OM	1	19.50	189.2	5.24
11	18	-	-	0	-	-	
11	19	1	OM	0	20.92	202.9	5.31
11	19	2	OM	0	18.33	177.9	5.18
11	19	1	Pole	0	3.58	34.8	3.55
11	19	2	Pole	0	4.33	42.0	3.74
12	20	1	OM	1	17.58	170.6	5.14
12	20	2	OM	1	17.17	166.6	5.12
12	21	-	-	0	-	-	
12	22	1	OM	1	24.42	236.9	5.47
13	23	1	Pole	0	5.25	50.9	3.93
13	24	1	OM	1	14.58	141.5	4.95
13	24	2	OM	1	17.83	173.0	5.15
13	24	3	OM	1	23.75	230.4	5.44
14	25	1	OM	1	9.75	94.6	4.55
14	25	2	OM	1	23.50	228.0	5.43



	Symbol	Plots: All	Pure OM	1	2	3
AMG Easting:		377416	377463	377166	377287	377395
AMG Northing:		5839500	5839490	5839726	5839764	5839796
Elevation:		695	691	787.1	769.7	746.5
Slope:		17.8	18.2	13	22	4
Slope:		15.0	15.5	13	14	11
Aspect:		154	164	169	103	41
Origin:		1759	1759			
Measurement date:		15/12/71	15/12/71	13/12/71	13/12/71	13/12/71
Age at measurement:		212	212	212	212	212
Plot shape:		66x198	66x198	66x198	66x198	66x198
Plot area:		30351.42	15782.74	1214.06	1214.06	1214.06
No. of LAs:		0	0	0	0	0
Pure over-mature?		0	1	1	1	0
Over-mature trees:	OM					
No. of DBHs (OM):		38	29	4	4	1
Stocking rate:		12.52	18.37	32.95	32.95	8.24
Mean DBH (OM):		199.79	192.54	203.54	234.26	339.57
Mean ln DBH (OM):		5.25	5.21	5.27	5.42	5.83
Mature trees:	M					
No. of DBHs (M):		1		0	0	0
Stocking rate:		0.33		0.00	0.00	0.00
Mean DBH (M):		122.08		0.00	0.00	0.00
Mean ln DBH (M):		4.80		0.00	0.00	0.00
Poles:	Pole					
No. of DBHs (Pole):		34		0	0	11
Stocking rate:		11.20		0.00	0.00	90.61
Mean DBH (Pole):		56.76		0.00	0.00	49.98
Mean ln DBH (Pole):		3.99		0.00	0.00	3.86

4	5	6	7	8	9	10	11
377197	377312	377427	377541	377529	377408	377293	377236
5839631	5839662	5839701	5839739	5839631	5839586	5839554	5839535
768.8	746	738.8	740.5	716.5	699	727.1	728.5
23	9	16	6	15	23	18	16
11	15	14	7	20	22	24	23
166	129	166	108	202	153	146	153
15/12/71	15/12/71	15/12/71	15/12/71	15/12/71	15/12/71	15/12/71	15/12/71
212	212	212	212	212	212	212	212
66x198	66x198	66x198	66x198	66x198	66x198	66x198	66x198
1214.06	1214.06	1214.06	1214.06	1214.06	1214.06	1214.06	1214.06
0	0	0	0	0	0	0	0
0	0	0	1	1	0	1	0
2	0	2	1	1	0	1	1
16.47	0.00	16.47	8.24	8.24	0.00	8.24	8.24
212.23	0.00	171.40	175.45	243.36	0.00	174.64	255.49
5.36	0.00	5.11	5.17	5.49	0.00	5.16	5.54
0	0	0	0	0	0	0	1
0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.24
0.00	0.00	0.00	0.00	0.00	0.00	0.00	122.08
0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.80
5	1	2	0	0	0	0	2
41.18	8.24	16.47	0.00	0.00	0.00	0.00	16.47
58.70	39.62	43.26	0.00	0.00	0.00	0.00	68.32
4.06	3.68	3.68	0.00	0.00	0.00	0.00	4.20

12	13	14	15	16	17	18	19
377236	377357	377471	377592	377650	377529	377420	377299
5839439	5839471	5839510	5839541	5839561	5839420	5839395	5839357
703.4	681.2	677.9	690.7	710.7	655.4	652.9	682.9
21	27	8	23	18	18	12	18
11	19	10	20	17	14	14	18
153	124	170	209	196	193	144	139
16/12/71	16/12/71	16/12/71	16/12/71	16/12/71	16/12/71	16/12/71	16/12/71
212	212	212	212	212	212	212	212
66x198	66x198	66x198	66x198	66x198	66x198	66x198	66x198
1214.06	1214.06	1214.06	1214.06	1214.06	1214.06	1214.06	1214.06
0	0	0	0	0	0	0	0
0	1	0	1	1	1	0	0
1	2	0	2	2	4	0	2
8.24	16.47	0.00	16.47	16.47	32.95	0.00	16.47
265.19	260.74	0.00	160.89	220.32	128.35	0.00	190.40
5.58	5.55	0.00	5.07	5.39	4.79	0.00	5.25
0	0	0	0	0	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0	0	0	0	0	0	2
82.37	0.00	0.00	0.00	0.00	0.00	0.00	16.47
69.61	0.00	0.00	0.00	0.00	0.00	0.00	38.40
4.23	0.00	0.00	0.00	0.00	0.00	0.00	3.64

20	21	22	23	24	25
377586	377465	377357	377497	377611	377527
5839338	5839299	5839268	5839210	5839248	5839115
642.1	629.9	645.5	611.6	619.5	595.9
22	15	15	42	22	18
15	15	17	9	13	8
201	155	115	139	221	144
17/12/71	17/12/71	17/12/71	17/12/71	17/12/71	17/12/71
212	212	212	212	212	212
66x198	66x198	66x198	66x198	66x198	66x198
1214.06	1214.06	1214.06	1214.06	1214.06	1214.06
0	0	0	0	0	0
1	0	1	0	1	1
2	0	1	0	3	2
16.47	0.00	8.24	0.00	24.71	16.47
168.57	0.00	236.89	0.00	181.64	161.30
5.13	0.00	5.47	0.00	5.18	4.99
0	0	0	0	0	0
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00
0	0	0	1	0	0
0.00	0.00	0.00	8.24	0.00	0.00
0.00	0.00	0.00	50.94	0.00	0.00
0.00	0.00	0.00	3.93	0.00	0.00

Ronan Myrtle 225+150+90 data set

Summary:	Taken from a general area, not a plot. Various DBHs and LAs (by destructive sampling) in plot are given.
Measured by:	Ronan
Region:	North Maroondah Experimental Area
Location:	In Myrtle 2 catchment. Within a c. 100 m radius area centred about 100 m past the turnaround at the end of Road 33.
Species:	Mountain Ash
Regeneration:	Wildfire
Other data:	Sapwood area Height
References:	Ronan (1984), Ord (1985)

	Value	Unit	Source
AMG Easting:	377600	m	MW map, Ronan pers. comm.
AMG Northing:	5839700	m	MW map, Ronan pers. comm.
Elevation:	735.2	m	GRASS (elev1d.fill@dem)
Slope:	4	deg	GRASS (slop@dem)
Aspect:	200	deg	GRASS (asp@dem)
Origin (old):	1759		Approx. (Tree ring study by Ronan, 1984; see also Banks, 1993)
Origin (med.):	1834		Approx. (Tree ring study by Ronan, 1984)
Origin (young):	1894		Approx. (Tree ring study by Ronan, 1984)
Measurement date:	31/10/84		Plot map in Ronan's stored files at Melb. Water
Meas. age (old):	225	yr	
Meas. age (med.):	150	yr	
Meas. age (young):	90	yr	
Plot shape:	Scattered		
Plot area:	None		
Old growth meas. hgt:	1.3	m	Ronan pers. comm.
No. of DBHs (old):	7		
No. of DBHs (med.):	1		
No. of DBHs (young):	3		
No. of LAs (old):	7		
No. of LAs (med.):	1		
No. of LAs (young):	3		

Scatter of DBHs and LAs

	#	DBH (cm)	ln(DBH)	Rough age	Tree ID	LA (m.sq)
Mean:		238.4	5.5			790.7
	1	216.2	5.38	225	1	585
	2	287.4	5.66	225	2	805
	3	245.4	5.50	225	3	1840
	4	192.5	5.26	225	5	490
	5	169.2	5.13	225	6	615
	6	315.7	5.75	225	9	650
	7	242.3	5.49	225	10	550

Scatter of DBHs and LAs

Dunn Myrtle 230+50 data set

Summary:	Plot of known area.		
	All DBHs in plot are given.		
	No LA measurement.		
	DBHs probably affected by buttressing.		
	Mixed age: 230 and 50 years old.		
Measured by:	Dunn & Connor (1991)		
Region:	North Maroondah Experimental Area		
Location:	Myrtle 1 catchment. About 50 m down from Road 9.		
	Crosses Myrtle 1 boundary - more out than in the catchment.		
	(O'Shaughnessy's description: c. 100 m up E. catchment boundary from weir)		
Species:	Mountain Ash		
Regeneration:	Wildfire		
Other data:	Sapwood area.		
	Water use by various methods.		
	Understorey DBH and sapwood area.		
	No LA measurement.		
References:	Dunn & Connor (1991, 1993)		

	Value	Unit	Source
AMG Easting:	377944	m	Visit by Watson, MMBW map, Aerial photo, Langford & O'Shaughnessy (1977, p. 51). Description by Benyon probably most accurate.
AMG Northing:	5840181	m	(probably more accurate than O'Sullivan's GPS [377996,5840240]). (Pat O'Shaughnessy described a location which appeared to be coincident with O'Sullivan's plots in Myrtle 1 catchment).
Elevation:	675	m	DSM map, MW map.
Slope:	21	deg	Dunn & Connor (1991, p. 11)
Aspect:	200	deg	Dunn & Connor (1991, p. 11)
Origin (old):	1759		Approx. (Tree ring study by Ronan, 1984)
Origin (young):	13/01/39		
Measurement date:	1/06/89		Used the date of mid-point of study.
Meas. age (old):	230	yr	
Meas. age (young):	50.38		
Plot shape:	50x50	m	
Plot area:	2500	m.sq	
Old growth meas. hgt:	6	m	
No. of DBHs (young):	10		
No. of DBHs (old):	8		
Stocking rate (young):	40.00		
Stocking rate (old):	32.00		
No. of LAs:	0		

Population of DBHs

Mean:	45.0	3.79

#	DBH (cm)	ln(DBH)	Rough age	Tree ID	LA (m.sq)
Mean:	197.2	5.3			1420.00
1	197.2	5.28	150	15	1420

Scatter of DBHs and LAs

#	DBH (cm)	ln(DBH)	Rough age	Tree ID	LA (m.sq)
Mean:	99.9	4.6			805.00
1	63.9	4.16	90	11	485
2	116.0	4.75	90	13	1180
3	119.8	4.79	90	14	750

O'Sullivan Myrtle 235 data set

Summary:	Plot of known area.		
	All DBHs in plot are given.		
	No LA measurement.		
Measured by:	O'Sullivan et al.		
Region:	North Maroondah Experimental Area		
Location:	Myrtle 1 catchment. 50 m down from Road 9 about 50 m up from where boundary crosses road.		
Species:	Mountain Ash		
Regeneration:	Wildfire		
Other data:	LICOR LAI.		
	Sapwood area.		
	No understorey DBH.		
References:	O'Sullivan (In prep.)		
	Value	Unit	Source
AMG Easting:	377900	m	Visit by Watson, MMBW map, Aerial photo,
AMG Northing:	5840250	m	Langford & O'Shaughnessy (1977, p. 51) (probably more accurate than O'Sullivan's GPS [377996,5840240]).
Elevation:	678.2	m	GRASS (elev1d.fill@dem)
Slope:	10	deg	GRASS (slop@dem)
Aspect:	213	deg	GRASS (asp@dem)
Origin:	1759		Approx. (Tree ring study by Ronan, 1984)
Measurement date:	1/06/94		
Age at measurement:	235	yr	
Plot shape:	90x90	m	
Plot area:	8100	m.sq	
Old growth meas. hgt:	6	m	
No. of DBHs:	41		
Stocking rate:	50.62		
No. of LAs:	0		

Population of DBHs		
Mean:	98.4	4.43
Tree ID	DBH	ln(DBH)
1	206.5	5.33
2	181.2	5.20
3	159.5	5.07
4	96.8	4.57
5	172.3	5.15
6	43.5	3.77
7	80.0	4.38
8	34.9	3.55
9	101.5	4.62
10	111.7	4.72
11	49.5	3.90
12	107.5	4.68
13	66.7	4.20

Tree	DBH	ln(DBH)	Age
1	43.8	3.78	50
2	67.8	4.22	50
3	44.8	3.80	50
11	45.1	3.81	50
12	40.0	3.69	50
13	33.6	3.51	50
15	39.5	3.68	50
16	40.7	3.71	50
17	49.0	3.89	50
18	45.6	3.82	50
Population of DBHs			
Mean:	167.3	5.11	
Tree	DBH (cm) (measured at 6	ln(DBH)	age
4	146.7	4.99	230
5	183.9	5.21	230
6	170.6	5.14	230
7	115.3	4.75	230
8	172.7	5.15	230
9	171.8	5.15	230
10	207.3	5.33	230
14	170.3	5.14	230

14	56.4	4.03
15	138.3	4.93
16	30.6	3.42
17	65.6	4.18
18	44.4	3.79
19	23.0	3.14
20	57.1	4.04
21	35.0	3.56
22	189.2	5.24
23	52.0	3.95
24	123.7	4.82
25	92.3	4.53
26	56.0	4.03
27	183.9	5.21
28	123.4	4.82
29	136.4	4.92
30	52.8	3.97
31	75.5	4.32
32	46.6	3.84
33	149.7	5.01
34	85.4	4.45
35	166.5	5.11
36	150.2	5.01
37	139.6	4.94
38	157.0	5.06
39	46.7	3.84
40	108.8	4.69
41	36.1	3.59

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