GROWTH OF SAWLOGS IN MULTIAGED FOREST AT EDEN

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BACKGROUND

Yield analyses in Eden Management Area (EMA) since the commencement of integrated logging (in 1970) have assumed that sawlog quality trees in the multiaged forest are <u>not</u> producing net volume growth. This assumption was based on professional experience, knowledge of the forest condition and its disturbance history and observation of the amount of internal defect in the logs harvested from the forests. Information from growth plots in stands within the EMA which have not been affected by integrated logging was examined to test the validity of this assumption.

STUDY AREA

Growth plots had previously been established in EMA in State Forests south of the Towamba River and east of the headwaters of the Genoa River.

METHODS

Twenty eight plots were established in 1982 and 1983. They were established in unlogged or reserved sections of areas that had been generally subject to integrated logging for sawlogs and pulpwood. The plots were subjectively located in stands judged to be representative of the logged areas. A further 54 plots were estabished in 1987 in an experimental area within Yambulla State Forest known as the Burning Study Area. These plots were randomly located in two strata (upper and lower) within coupes which had been randomly assigned to a ‘no logging’ treatment.

Circular plots of 0.2 ha were established within which all trees ≥ 10cm dbhob were measured. Diameter (dbhob) and bole height of each tree was measured as well as total height for trees within plots in the Burning Study Area and dominant trees in the other plots. Trees were assigned to a merchantability class according to an external visual assessment of their form, dimensions and species. Classes were sawlog, mining timber, pole, pulpwood, good form advanced growth, poor form advanced growth, potentially useful and useless.

Plots were remeasured after a period ranging between 3 and 14 years.

DATA ANALYSIS

Trees from the sawlog, pole and good form advanced growth categories were classified as sawlogs in the analysis providing that they were greater than 45cm dbhob at the second measure and had a bole length of at least 3m. Trees from these three merchantability classes were classified as small sawlogs if they had a dbhob of 35 to 44cm and a bole length of at least 5m.

Volumes were calculated using the 'Forsil' volume equations (Appendix 1) based on dbh and bole height for sawlogs of 55cm dbhob or greater. For sawlogs and small sawlogs under 55cm dbhob regrowth volume equations (Bi 1996) (Appendix 1) based on dbhob and bole height were used. However the upper boles of these smaller trees are unsuitable for sawlogs because they have small diameters and a relatively large 'knotty' core. Following comparison of the length distribution of small sawlogs in current operations (previous 12 months) with the distribution of bole lengths of small sawlogs in the plots (Appendix 2) it was decided to arbitrarily reduce bole lengths as follows. Where the recorded bole heights of these trees were greater than or equal to 10m, a bole height equal to half the recorded bole height was used in the calculation. Where the recorded bole height was less than 10m, 4m was used as the bole height.

For non sawlog trees, the regrowth volume equations (Bi 1996) were used for potentially useful trees. For other non sawlog trees the 'Forsil' volume equations were used if dbh was at least 30cm. If dbhob was under 30cm, the regrowth volume equations (Bi 1996) were used.

Where recorded bole length varied between the first and final measure, the smaller value was used. Thus volume growth was based on diameter growth alone.

Individual tree volumes were summed by merchantability class and converted to a volume per hectare. Mean volume per hectare and volume increment by class were calculated for each 'section' of forest and an overall volume and increment by class was calculated for the 81 plots.

Recruitment of trees into the small sawlog class was estimated by calculating the mean stocking and diameter increment of those trees in the 25 - 35cm dbhob class which were classified as good form advance growth.

RESULTS

Estimated standing gross volume of sawlogs averaged 18m^3ha^{-1} and ranged from 10m^3ha^{-1} at East Boyd to 62m^3ha^{-1} at Nadgee (Table 1). Gross increment averaged 0.2$m^3ha^{-1}yr^{-1}$ and varied from zero at Yambulla to 0.8$^3ha^{-1}yr^{-1}$ at Nadgee. Small sawlogs contributed, on average, an additional 1.3m^3ha^{-1} of gross volume ranging from 0.4m^3ha^{-1} at Yambulla to 5.5m^3ha^{-1} at East Boyd. Volume increment of small sawlogs ranged from zero at Nadgee to 0.1$m^3ha^{-1}yr^{-1}$ at East Boyd.

Both estimated standing volume and increment of sawlogs was extremely variable (Table 1, 2).

Table 1
Standing Volume and Volume Increment by Merchantability Class

	SAWLOG		SMALL SAWLOG		PULP		TOTAL NON SAWLOG		TOTAL	
	m^3/ha	m^3/ha/yr	m^3/ha	m^3/ha/yr	m^3/ha	m^3/ha/yr	m^3/ha	m^3/ha/yr	m^3/ha	m^3/ha/yr
SECTION	**STANDING**	**INC**	**STANDING**	**INC**	**STANDING**	**INC**	**STANDING**	**INC**	**STANDING**	**INC**
Nadgee	62	0.8	0.4	.002	170	1.8	215	2.0	277	2.8
East Boyd	10	0.1	5.5	0.08	128	1.6	181	2.4	197	4.2
Timbillica	20	0.3	1.6	0.03	170	1.3	193	1.5	215	1.8
Yambulla	31	0.003	0.4	0.02	173	1.3	216	2.2	247	2.6
BSA	13	0.2	1.1	0.03	136	1.7	168	2.1	182	2.3
TOTAL	18	0.2	1.3	0.03	146	1.6	178	2.0	197	2.2

Table 2
Estimated standing volume and increment
of sawlogs in EMA

(Numbers shown are means ± standard deviations)

	STANDING VOL. (m^3/ha)	**INCREMENT (m^3/ha/yr)**
Sawlog	18 ± 32	0.2 ± 0.4
Small sawlog	1.3 ± 3.6	0.03 ± 0.08

Recruitment of trees into the small sawlog class was slow (Table 3). Diameter increments of trees in the 25-35cm dbh class ranged from 0.4cm yr^{-1} at Timbillica to 0.9 cm at Nadgee and stockings ranged from 3 stems ha^{-1} at Timbillica to 17 at Yambulla. On average it was estimated that it would take 20 years for 7 stems ha^{-1} to be recruited into the small sawlog class (by growing 10cm in dbh). Put another way this represents recruitment of 1 small sawlog every 3 years or 4 small logs over half the 25 year analysis period. Each 'recruitment' log will have a volume of about 0.1632 m^3 (*E.sieberi* equation Appendix 1) giving an average 'increment' of 0.7 m^3 gross over a 25 year period.

Table 3
Stocking and Diameter Increment of Potential Sawlogs
(25 - 35 cm dbhob trees)

SECTION	STOCKING (trees/ha)	CAI DBH (cm)
Nadgee	4	0.9
East Boyd	7	0.6
Timbillica	3	0.4
Yambulla	17	0.5
BSA	7	0.5
Average	7	0.5

DISCUSSION

The estimated standing volume of sawlogs ($18m^3ha^{-1}$) is higher than actual yields derived from logged areas (Table 4). This is to be expected since many trees whose external appearance indicates that they will be suitable for sawlogs will have internal defects which will render them unsuitable. Also sections of the boles of many trees which are utilised for sawlogs will have defects which will be docked out producing a smaller volume than the estimated sawlog volume from the tree. Even those parts of trees which are utilised for sawlogs contain, on average, about 20% non useful defective material ranging from 19% in the smallest logs to 23% in the largest (E Raper pers comm).

Of the trees which were judged, in plots, to contain sawlog material, many would be unavailable for harvesting in a logging operation due to constraints on removal of trees for a number of reasons including environmental protection requirements.

The high variability in estimated sawlog yields reflects the variability of the forests and is generally consistent with historical yields (Table 4) For example higher average yields were obtained in Nadgee State Forest than in the Burning Study Area (Table 4).

The estimates of standing sawlog volume appear to be consistent in order of magnitude with actual yields but about 3 to 4 times higher (Table 4). Real yields will inevitably be smaller than estimates from standing trees. For the same reasons gross sawlog volume increments will be overestimated by the plot analyses. Net sawlog volume increments were not estimated as no defect assessments or measurements occurred. Due to the severe fire history of the EMA it is unlikely that internal defects in sawlog quality trees would not be developing at least a similar rate to new wood. Thus total net sawlog volume increments in those areas which will be available for normal integrated logging operations over the next 25 years will be very close to zero.

Table 4

Comparison of estimated standing volumes and historical yields

	SAWLOG (m^3/ha)		PULP	
SECTION	**ESTIMATED**	**HISTORICAL**	**ESTIMATED (m^3/ha)**	**HISTORICAL (tonnes/ha)**
Nadgee [1]	62	17	170	130
East Boyd [1]	16	4	128	53
Timbillica [2]	22	7	170	135
Yambulla [2]	31	9	173	119
BSA	13	3	136	82

[1] Alternate coupe logging only (not whole compartments)

[2] 1994/95 logging year

Appendix 2

The distribution of log lengths of small logs sold in the EMA during 1996 compared with the distribution of bole lengths of small sawlog quality trees in growth plots.

	CATEGORY	NUMBER	MIN	MAX	MEAN	MODE
	Logs	3750	2.4	14.3	6.9	6.1
Trees	45-55cm	23	7.0	23.2	15.5	
Trees	35-44cm	28	9.0	20.0	14.1	