The Coming of Age to Australian Forests

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SUMMARY

The concept of 'old-growth' has gained public recognition and political force in Australia where government agencies are engaged in mapping its distribution. Its curious definition has stimulated an examination of how forest age has come to be constructed over the period since the white invasion in 1788. The paper examines age as a parameter in colonial and recent science. It then recounts attempts to impose an ordered progression of age classes on the forests of Victoria and Queensland according to the classical principles of forestry transmuted through an imperial model. Forest age is discussed first during the boom period of the 1950s and 1960s, and then as an indicator during the environmental era of the 1970s to the present. Old-growth became an icon of environmental campaigns which had to be defined before it could be delineated. The final part of the paper reports the varying perceptions and values held in Australia about forest age.

CONCEPTS OF AGE

Forest age is as much a social construct with a history as a measurable parameter, but this too has its history. Australian interest has been stimulated recently by the sudden arrival of 'old-growth' forests as a category with public recognition and political force. Government bureaucracies have had to negotiate a definition with interested parties and are busy delineating forests to meet it as part of a national forest strategy to create conservation reserves (Australia, Council of Australian Governments 1992). 'Old-growth', they declare, 'is a forest which is ecologically mature and has been subject to negligible unnatural disturbance ...' It is a curious statement which puts the ecological notion of maturity, itself problematic in many forests, alongside the absence of human action, even though the correlation between the two is far from perfect. It reflects both the ideal of environmental protection and the concept of wilderness with all its colonialist baggage. If the bureaucratic definition begs more questions than it

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answers, it neatly demonstrates how inseparable social, ecological and historical dimensions are for understanding forests.

This paper explores the history of forest age in Australia from the mid-nineteenth century to the present and is based on recent studies by several authors covering different periods, perspectives and States (in Dargavel 1997a and 1997b). It does not cover indigenous perspectives on the forests, not because these are undervalued, but because they warrant serious treatment in their own right and framework. The paper proceeds through various perspectives taken by the settler society and draws out how the concepts and values of forest and tree age have changed.

The settler society which formed in Australia after the 1788 invasion imposed its will bloodily on the inhabitants and its agriculture forcefully on the landscape. Cows, horses, sheep and yet more sheep, wheat, oats, potatoes, fruits, flowers, garden plants, trees and weeds, rabbits and foxes were all suddenly introduced. There was no gradual transition, it was sharp break. The point is important for understanding how non-indigenous Australians came to understand the forests differently from the woods of Britain they knew. There, where there was no divide between Aborigines and settlers, the woods had been domesticated by centuries of evolving use (Rackham 1997; Peterken 1996) and the notion of an original 'wildwood' was more myth than reality, powerful though that myth was as Schama (1995) has shown, especially in Germania. The settlers could not see that their new landscape had been transformed by the original people, or they chose not to do so. To have chosen else might have made Aboriginal dispossession seem less comfortable. It was better to see the land as an 'undisturbed' wilderness, a primeval forest available first for farmers, now for environmentalists. In this Australia is more like America than Europe.

AGE AS PARAMETER

The age of the trees was not immediately thought of. Ships captains kept a sharp eye for ships timber and masts, cutters for what they could split easily or work best, and farmers for what indicated the best soil. They thought that tallest trees grew on the best land, although they could be bitterly mistaken as they were over the jarrah (*Eucalyptus marginata*) forest in Western Australia where tall trees grew on miserable land, soon impoverished once the trees were gone (Sanders 1997). But the mountain ash (*E. regnans*) in Victoria were immense, marvels, the tallest hardwood in the world it would be found. As colonial science, and particularly botany, developed, people started to measure these giant trees (Moulds 1993). But what of their age?

The start of scientific measurement of the age of notable British trees by counting the number of 'integuments', or annual growth rings, on transverse sections is reflected, if somewhat uncertainly, by John Evelyn who wrote in 1664

that:

> It is commonly and very probably asserted, That a Tree gains a new one [annual growth ring] every year. In the body of a great Oak in the New-Forest cut transversely ... even three and four hundred have been distinguish'd. (*Sylva,* 1st edn. ch.29).

In Britain, with its cold winters, the rings are easy to see and count, but in Australia this is the case only in the colder or higher regions with marked seasonal variations. Moreover, there can be apparently 'false' growth rings in some years and many of the old trees have hollow centres. Bonyhady (1997) describes how in 1849 the Governor of Van Diemen's Land (now Tasmania), Sir William Dennison, noted the age of two huge blue gums (*E. bicostata*) which had been felled as being 'from 270 to 300 years old, judging from the annual rings'. But the early colonial scientists found it hard to believe that such huge trees were not far older. The clergyman-scientist, William Woolls, thought that tree rings were unreliable and tried to estimate age from measurements of younger trees whose age was known. He judged that a mountain ash of 4.8 metres diameter which towered 146 metres into the air – or so he thought, but the tree was probably shorter – 'must be 1000 or 2000 years old'.

The age of the world and all its natural objects were of intense interest, particularly to the clergymen scientists of the period such as William Woolls, Victoria's eminent Government Botanist, Ferdinand von Mueller, and the remarkable Catholic missioner, Julian Tenison-Woods. Tenison-Woods thought that blue gums put on two rings a year and so considered that the largest Tasmanian trees were only 75 years old. Although there was considerable confusion as to how old the oldest trees actually were, the concept that the forests were in some sense 'primeval' retained a sacred atmosphere which, as von Mueller put it, 'inspires us with awe ... as if we were brought more closely before that divine power by which "the worlds without end" were created' (1879).

By the 1950s forest research had established that annual rings could only be counted by eye accurately for trees in the highlands of south-eastern Australia where cold winters produced clear rings (Jacobs 1955). Non-durable eucalypts, such as mountain ash, were thought capable of living to 200-400 years while durable species, such as jarrah and river red gum (*E. camaldulensis*), were capable of living to approximately 1000 years. Gradually, government forest assessors accumulated occasional observations and ring counts on age. Douglas (1997) has tabulated 57 of these for the East Gippsland region of Victoria made between 1931 and 1996 on a variety of species. The oldest tree, a small conifer (*Podocarpus lawrencii*), was thought to be 450 years old, a few were 300 years old, but half were between 140 and 200 years old. Few detailed dendrochronological studies were undertaken until the 1980s when X-ray and, later, carbon dating techniques started to be applied. These are enabling the measurement of forest age to be extended from the highland forests into some of the dry sclerophyll forests and woodlands (Banks 1997).

AGE IN ORDERED PROGRESSION

Classical theories of forestry hold that the ideal of a sustained yield of timber products is to be obtained from a forest consisting of a progression of age classes. To achieve this, order has to be imposed on human use, by regulating the amount which is allowed to be cut each year; and imposed on natural variation, by replacing the old and poorly-growing trees with young vigorous ones. The idea is quite simple: as each stand of trees is felled on reaching maturity, there must always be a younger stand ready to take its place. Thus, the so-called 'normal' forest model consists of equal areas of every age class from seedlings to mature trees, with appropriate allowances being made for variations in site. The 'rotation age' at which the trees are considered to be mature enough to be felled is the critical factor. It may be set to maximise the total wood productivity of the forest, the quantity of some particular product, such as sawlogs, or the economic return. Whichever is chosen, information is needed about the rate of growth of the forest and the amount of timber that could be produced at various ages, preferably arranged in a 'yield table' (table 1).

As the imposition of an ordered progression of age classes is so central to the classical forestry paradigm, one would expect it to feature with increasing prominence as forestry became established in a new land. Comprehensive histories of forestry in Australia and some of its States can be found in Carron (1985), Dargavel (1995), Moulds (1991) and Taylor (1994). This paper considers the history of forest age in two of the States, Queensland and Victoria (Dargavel and Maloney 1997; Dargavel and McRae 1997). It should be noted that States are the appropriate legal entities because they had prime constitutional responsibility for the forests, first as self-governing colonies and then, from federation in 1901, as States within the Commonwealth of Australia. It is only since the 1970s that the Commonwealth has used some of its indirect powers to influence their forest policies (Carron 1993).

Forestry was established only slowly in Australia, as it ran against the prevailing ethos of clearing the forests for agriculture and land settlement. The devastation of the forests by the Victorian gold-rushes of the 1850s did lead some officials and scientists, von Mueller among them, to put forward a 'case for forest conservancy', but little was achieved in the nineteenth century against well-entrenched colonial Lands Departments and the agriculturists. Nevertheless, the case gained momentum and in this the German and imperial influences were critical. Many Germans – Krichhauff, the 'father of forestry in South Australia', von Mueller, Leichardt and Schomburgk among them – were important in Australian botany, astronomy and exploration (Home 1995). The influence of German science and scientists was felt worldwide, particularly so in forestry. The strongly-developed bureaucratic ordering of information and scientific education was applied to the problems of forest depletion (Lowood 1990). The theories of classical forestry which emerged were taught in forestry schools

YIELD TABLES USED IN SAXONY

For One Acre of a normal, or fully stocked, wood in solid cubic feet.

Oak.						Beech.					
Age, Years.	Quality classes, in solid cubic feet.					Age, Years.	Quality classes, in solid cubic feet.				
	I.	II.	III.	IV.	V.		I.	II.	III.	IV.	V.
10	290	240	200	140	70	10	330	290	240	190	100
20	740	610	490	360	200	20	800	660	510	390	200
30	1,270	1,060	840	630	330	30	1,310	1,160	900	640	330
40	1,870	1,560	1,210	930	470	40	2,160	1,760	1,360	960	470
50	2,560	2,120	1,670	1,250	640	50	3,020	2,440	1,870	1,300	630
60	3,320	2,750	2,170	1,600	810	60	3,990	3,220	2,440	1,670	800
70	4,160	3,430	2,700	1,970	1,000	70	5,070	4,070	3,070	2,070	980
80	5,060	4,160	3,250	2,340	1,190	80	6,260	5,000	3,740	2,490	1,160
90	5,990	4,990	3,800	2,720	1,360	90	7,460	5,930	4,400	2,880	1,330
100	6,960	5,660	4,360	3,070	1,520	100	8,570	6,800	5,030	3,260	1,480
110	7,950	6,430	4,920	3,420	1,670	110	9,620	7,650	5,590	3,570	1,600
120	8,950	7,220	5,480	3,740	1,800	120	10,580	8,330	6,090	3,840	1,700
130	9,900	7,950	6,000	4,060	1,930	130	11,450	8,990	6,530	4,070	1,770
140	10,830	8,670	6,520	4,340	2,040	140	12,250	9,570	6,920	4,260	1,830
150	11,700	9,350	6,990	4,620	2,140	150	12,960	10,100	7,250	4,400	1,860
160	12,560	10,000	7,450	4,890	2,240						
170	13,350	10,600	7,860	5,120	2,330						
180	14,090	11,160	8,250	5,330	2,410						
190	14,780	11,680	8,590	5,500	2,470						
200	15,330	12,100	8,870	5,660	2,530						

Example.—A fully stocked beech-wood has a volume, when 60 years old, of 3,220 cubic feet; hence it grows on a locality of the II. Quality. *Again*, a fully stocked oakwood, 140 years old, shows a volume of 7,600 cubic feet; hence it grows on a locality between II. and III. Quality.

TABLE 1. Part of a German yield table shown in Schlich's *Manual of Forestry* (1895)

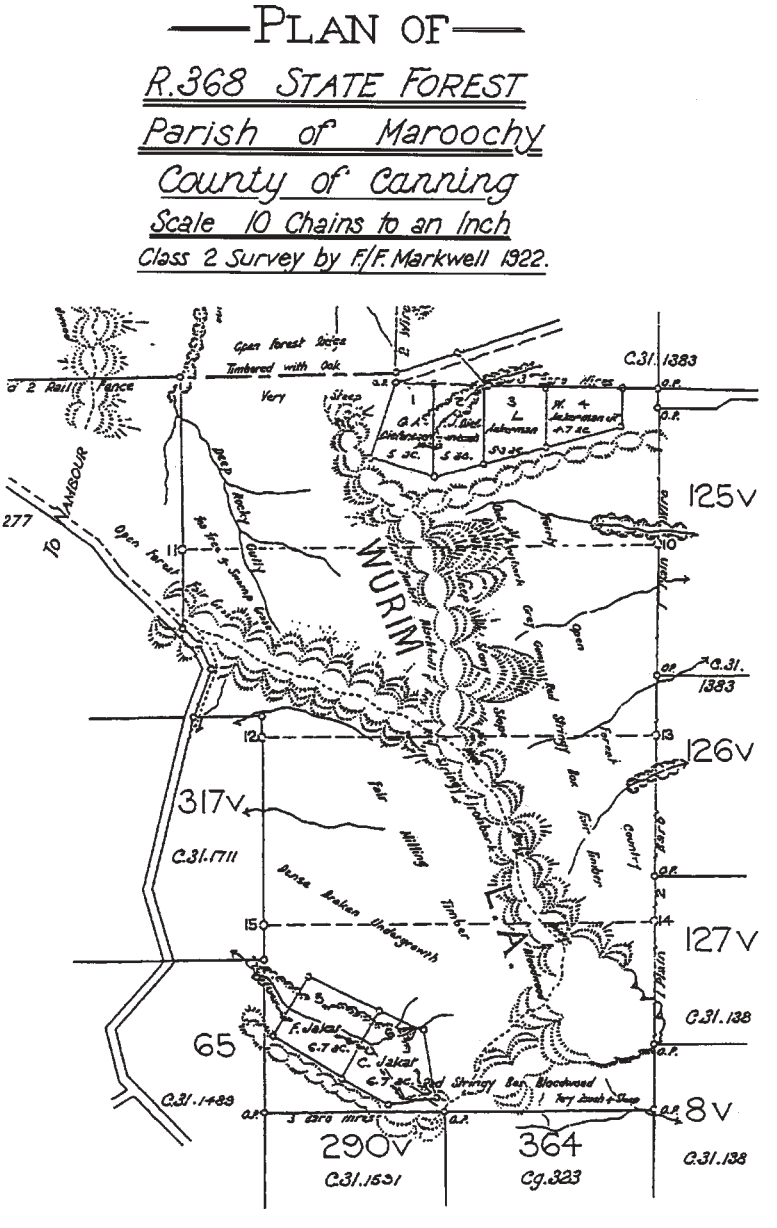
established in St Petersburg in 1803, Schemnitz 1808, Tharandt 1811, Warsaw 1816, Berlin/Eberswalde 1821 and Nancy in France in 1824. As forestry was increasingly taken up in India and other parts of the British Empire, German foresters were appointed to many of the first positions. It is notable that the first three Inspectors-General of Forests in India were German: Dietrich Brandis, Wilhelm Schlich, and Berthold Ribbentrop, who was to castigate the Victorian Government for its failure to protect and manage the colony's forests adequately. Even when Britain eventually set up its own training school at Coopers Hill, subsequently part of Oxford University, it was the eminent, by then Sir William, Schlich who was its first professor.

The imperial model of forestry that was developed in India involved the 'demarkation' of the best areas as permanent state forests protected from encroachment and managed by a cadre of professionally-trained foresters. Vast areas had to be brought under 'systematic working' by the expatriate staff and formal 'working plans' were prepared to a standard format to maintain continuity between staff movements (D'Arcy [1891] 1898). The plans recorded information on growth rates, available yield tables, the rotations to be adopted and the calculations of the 'allowable cut' which could be taken each year. Australian voices and the urging of succession of imperial foresters such as F. D'A. Vincent in 1887, Berthold Ribbentrop in 1895 and Sir David Hutchins in 1916 gradually led to the imperial model being adopted in Australia. Victoria had established its own forestry training school at Creswick in 1910 and passed a Forestry Act in 1918 which established a fully professional Forests Commission with one of Schlich's Oxford graduates, Owen Jones, as its first Chairman. Queensland appointed its first Director of Forests in 1906, although it was not until about 1920 that a professional forest service could be said to be in operation.

Finding and Assessing the Forests

Although some state forests had already been declared, mapping, assessment and demarcation were urgent tasks. In Queensland they were formidable due to the huge areas to be investigated and the rudimentary nature of the existing maps. As well as assessing the timber, the topography had to be detailed by strip assessments which surveyed parallel lines through the forests recording the species and size of the trees either side of the lines and mapping rivers, creeks, ridges and other features. The strips were placed at 10, 20 or 40 chain (approx. 200, 400 or 800 m) intervals according to the importance of the survey. They demanded an enormous physical effort in which, at their peak in 1940/41, the crews traversed a total of 7704 kilometres almost all in straight lines up ridge and down gully, across creeks and through vegetation thick and thin.

The forest services in both States had to provide the timber industry with its resources as well as aim to order the forests in a way that would enable the yields to be sustained in the long-term. Clearly, the basic assessments and maps were



MAP 1. Part Maroochy State Forest (R368), Queensland. Class 2 Survey by Forest Foreman Markwell, 1922. Reduced from original scale of 10 chains to 1 inch (1:7920). Showing strip survey lines at 20 chain (400m) intervals.

needed before forest management plans could be contemplated, but it was the need to identify timber resources for utilisation which appears to have dominated the assessors' observations with comments such as 'fair milling timber' and 'cut out' being made on the maps. Forest types were categorised by the predominant commercial timber species with other areas denoted on the Queensland maps as 'useless', 'lantana', 'scrub' etc. Structural categories such as 'over-mature', 'regrowth' or 'young poles' were used from the 1950s once aerial photographs became generally available for interpretation. Other than these, it appears that it was the quantity of the commercial timber standing in the forest, not its age, which was the prime consideration. Very similar assessments with much the same emphasis were conducted in Victoria.

Silviculture and Working Plans

Victoria's new Forests Commission knew that the transformation to an ordered progression of age classes would be a slow and difficult business, partly because funds were limited, and partly because the Creswick forestry school was only training four or five foresters a year, but more because of the actual condition of the forests:

> ... containing as they do in many instances large areas of mature or over-mature timber; these require to be cut over as soon as possible, but they can only gradually be taken in hand owing to inaccessibility or to the necessity of avoiding a present glut followed by a subsequent shortage. (Forests Commission, *Annual Report* 1919/20)

Clearly age was an important planning category, and the excess, as they saw it, of old trees with negligible growth rates was an impediment to creating a productive forest estate. The old trees would have to be sold at a rate the market could absorb, or if they were worthless, as very many were, felled or ring-barked to waste to the extent that could be afforded. The assessment programme started energetically in 1925 was closely followed by an equally energetic programme to prepare working plans which covered over one-half a million hectares in a decade; a quarter of Victoria's state forests (table 2).

The working plans followed the two-part imperial format outlined by D'Arcy, a 1910 edition of whose text is believed to have been part of the Forests Commission's library. The plans were made for periods of about five years after which they were to be revised, as several of the earliest ones were. They were approved very formally by the Commission over its seal and often issued with strict instructions that they were to be adhered to. A matter which was easier to specify than follow if markets and funds did not eventuate. The plans had to deal with very different problems in the Victoria's three major forest regions discussed in turn in what follows.

Year ending 30th June	Area of state forest reserved (hectares)	Area covered by working plans (hectares)	Examples of the forests covered	
			Forest type	District or region
1929	1,759,992	99,499	Box-ironbark Cypress pine	Dunolly, Mildura
1930	n.a.	n.a.	Mixed species	Sandon, Muckleford, Walmer
1931	1,893,186	182,357	Red gum Plantation areas Box-ironbark Ash, messmate, silvertop Ash	Barmah and Shepparton Ovens, Bright, Aire Valley, Stanley, Rushworth Southern Baw Baw, Part Upper Yarra Rubicon
1932	1,897,321	234,448	Box-ironbark	Heathcote, Scarsdale
1933	n.a.	n.a.	Messmate and mixed species Ash	Ballarat and Creswick Neerim boys camp
1934	1,899,154	n.a.		
1935	1,922,031	263,619	Box-ironbark	Maryborough
1936	1,948,253	277,864	" "	Heathcote
1937	n.a.	277,864		
1938	1,949,891	378,841	" "	Gladstone
1939	1,961,105	512,896		

TABLE 2. Areas of state forests reserved and covered by working plans in Victoria

Source: Forests Commission, *Annual reports* and *Working plans*

Box-ironbark and Messmate Forests

The need to counter the devastation of the box-ironbark and messmate forests in the goldfields region, north of Melbourne, had been a major impetus for Victorian forestry. These forests regenerate naturally with comparative ease so that by the 1930s there were considerable areas of dense seedling and coppice growth resulting from the removal of the 'virgin crop' in the 1855-75 period. They were still an important source of mining timber and firewood, although these markets were declining, and they had considerable potential for producing sawlogs.

It was intended that the better messmate (*E. obliqua* and other spp.) forests would be converted to high forest again and that most of the box-ironbark (*E.hemiphloia, E. leucoxylon, E. sideroxylon* and other spp.) forests would be managed on a coppice with standards system with some of the poorer areas being managed just for firewood. Clearly there was a long task ahead before an ordered progression of age classes could be established as a high forest. The plan for one of the better forests noted that although:

> ... no useful data regarding growth and yield are available as no sample plots have been established [and] no yield tables have been constructed, [the forests are in such poor condition that] no regulation of the output of mature trees is prescribed ... as the policy of building up the growing stock will be maintained. (*Ballarat and Creswick Working Plan* 1933 and revision 1938)

The coppice with standards system envisaged selecting a few of the best trees or 'standards' on each hectare to be grown on a 50 year rotation, while the remaining trees would be cut and allowed to grow as 'coppice' on a 20 year rotation (*The Sandon Forest Working Plan* 1930, *Walmer Forest Working Plan* 1930). Perhaps more realistically at Rushworth, 'owing to lack of growth statistics, no rotation period can be fixed. It is estimated that 80 years should produce a 14-15 inch [35-38 cm] diameter breast height tree' (*Rushworth Working Plan* 1931). Although a few plots were established to measure the growth rates of the box-ironbark forests in 1919, no systematic programme to do so on a larger scale was started and the amount of information on which to base sustained yield calculations was still inadequate half a century later (Newman 1961; FCV file 68/791).

But it was lack of markets and money that forced more realistic plans, particularly during the economic depression of the 1930s. The Commission directed unemployment relief funds largely to thinning and other silvicultural work in the goldfields forests which may well have hastened the preparation of working plans for them. Nevertheless there was a limit to what could be done. For example, when the Heathcote Working Plan was revised in 1936 it was clear that 'yield regulation shall be governed by demand and by the money available ... in accord with the silvicultural system prescribed'. Similarly, whereas the first Scarsdale Working Plan in 1932 had hopefully sought to sell poles as rapidly as

possible, its revision in 1937 noted that silvicultural work would depend on the extent of unemployment relief funds.

Red Gum Forests

The red gum (*E. camaldulensis*) forests along the River Murray had been cut heavily for railway sleepers and other durable timber products during the nineteenth century with virtually no control (Fahey 1988). A minimum girth limit for felling was imposed about 1911 of 8 feet 6 inches [2.6 m girth or 82 cm diameter] measured at 5 feet [1.5 m] above the ground. A detailed assessment revealed that although some smaller 'faulty and deteriorating' trees were removed, the forest had many very old trees unwanted by the cutters, regrowth of various ages determined by the severity of past grazing and, as we now know, by the history of floods, but insufficient mature and middle-aged trees to provide future yields. Some silvicultural work had been done to remove 'dead, dying and suppressed material' and sap-ring 'old, useless material', which had led to small patches of advance growth. Generally there had not been enough money to make the patches big enough for them to be fully productive.

The Barmah and Shepparton working plan in 1931 faced the difficult task of calculating the proper rotation when there were no yield tables, no sample plots which could be remeasured and no records of growth. Moreover, the stands had such a mix of ages that no estimates of mean annual growth could be made. Luckily, the Forestry Commission of New South Wales, over the river, had measured the growth of 23 red gums for 13 years and found that they had put on 0.24 inches [0.61 cm] of diameter growth a year on average. With this, and some measurements from another red gum forest, the rate of diameter growth on the best sites was estimated (table 3) and an 80 year rotation designed to grow a 30

Age	Average diameter growth per year		Giving a tree of diameter	
(years)	(inches)	(cm)	(inches)	(cm)
0-10	0.6	1.5	6	15
10-20	0.5	1.3	11	28
20-50	0.4	1.0	23	58
50-80	0.25	0.6	30.5	77

TABLE 3. Estimates of diameter growth at breast height for red gum for Victoria's *Barmah and Shepparton Working Plan* 1931

inch [76cm] diameter tree was set. The plan prudently prescribed that sample plots should be installed so that better information would be available for subsequent revisions.

Mountain Forests

The forests of mountain ash and alpine ash (*E. delegatensis*) in Victoria's central highlands, with messmate and silvertop (*E. sieberi*) on their lower slopes, were the most important to the Commission. Their history of intermittent cutting and periodic bushfires had created a complex mosaic of cut-over areas and regeneration. They were particularly difficult to assess because of the huge size of the trees, dense undergrowth, steep slopes and the fact that many patches of good trees were still left in inaccessible parts of the cut-over areas. Intense strip assessments were started in 1928 and continued throughout the 1930s with the lines only 10 chains [200 m] apart. Simple age categories of 'overmatured', 'matured', 'saplings', 'seedlings' and sometimes 'immatured', 'young timber' and 'pole timber' were mapped. Sample plots were located along the strip lines, in which detailed tree measurements were made. The calculations of volume involved 'cumbersome reckoning' because there were no 'proper volume and yield tables'. There was very little information on growth but the hard-pressed forest assessor reported that:

> In spare moments the number of rings were counted on some stumps in order to get some information about the age of matured trees. The number of rings on the outer inch [2.5 cm] of the diameter on some trees were also measured. An age of 87 years is the average obtained from 8 trees on the girth classes 11, 13 and 15 [107, 126, 146 cm diameter].

In 1930 the Commission managed to get H.R. Gray, an Oxford-trained British forester recruited from the Sudan for the new Australian Forestry School in Canberra, to prepare a working plan for the Rubicon forest which supported an expanding sawmilling centre (Evans 1994). Gray and his students counted the number of rings on 23 alpine ash stumps and measured the felled trees closely. He drew an age-height growth curve from the data and showed that the trees reached a height of 200 feet [61 m] at age 135 and observed that dominant trees in the regrowth achieved half this height by 18 years (possibly later amended to 16 years). He set the rotation of the new crop provisionally at 60 years by which age he thought that it should be possible to grow a 30 inch [76 cm] diameter tree, if the stands were thinned. The plan envisaged that each major part of the forest, or 'felling series' would be converted to an ordered progression of areas ranging from zero to sixty years.

The Fiery End

Almost all this patient work in assessing Victoria's mountain forests and preparing plans for their future was swept away by the terrible fires of January 1939 which leapt across Victoria's mountain forests killing seventy-one people, destroying sixty-nine sawmills and killing trees containing over six million cubic metres of logs, of which only about one-half could be salvaged (Griffiths 1992; Moulds 1991; Pyne 1991). The classic ideal of an ordered progression of age classes in each forest was irrelevant in the face of disaster on such a scale. Only State-wide planning could marshal industry to the salvage operations and then relocate sawmills to other forests until the mountain forests should have grown again.

AGE AND DEVELOPMENT

The classic ideal had failed too in most of Australia's forests because there simply was not a big enough market for anything except good sawlogs, plylogs and poles, and not enough funds to fell enough of the unsaleable trees to waste. As only the best trees were cut, the gaps they left were often not big enough for such light-demanding species as eucalypts to regenerate well and the commercial productivity of large areas of the resource deteriorated. The economic boom of the 1950s and 1960s both exacerbated the problem by increasing the demand for sawtimber and relieved it in some areas by creating a demand for pulpwood from the few pulpmills which had been built in Victoria and Tasmania at the end of the 1930s. At last forests near them could be clear-felled and new even-aged crops started.

The first Victorian working plan to deal with the new situation was prepared in 1952 prepared to manage 20,000 hectares of the Boola Boola mixed species forest in the Gippsland foothills on a pulpwood rotation for the nearby Maryvale pulpmill. Although 'no accurate information is available in respect of increment and growing stock', the increment of firewood in forests at Ballarat was assumed to be sufficiently similar which, with 'casual growth observations and random yields', allowed a tentative rotation of 32 years to be calculated (by dividing the anticipated growing stock of 84 cubic metres per hectare by the estimated mean annual increment of 2.6 cubic metres per hectare per year). While a pulpwood market promised new crops in some areas, the Victorian Commission was well aware that 'extensive areas of foothill country ... after a century of logging and severe fires ... are virtually unproductive'. Moreover, it was 'gravely concerned with the rate of depletion of the State's resources of native timber of sawlog quality [particularly as] there is no prospect of obtaining worthwhile logs of genuine sawlog grade from mountain ash forests in less than 60 years' (*Annual Report* 1960/61). As in other States and nationally, a major call was made for

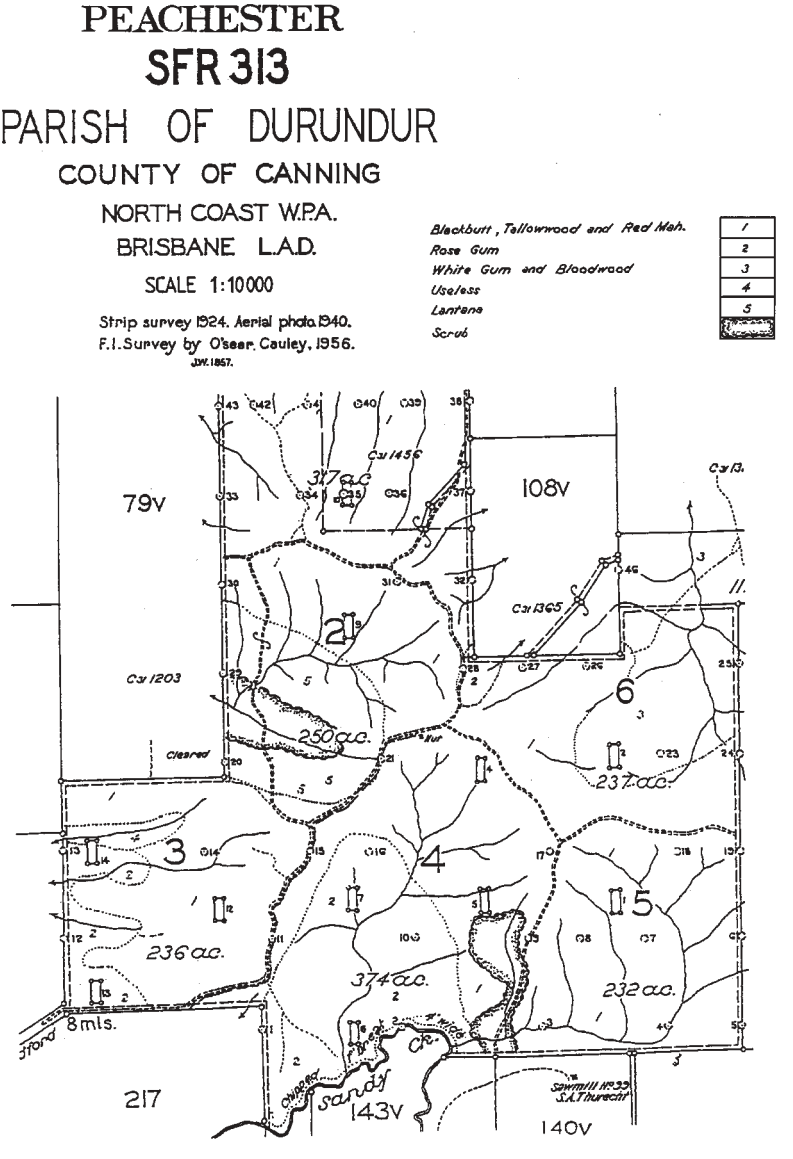
funds to establish pine plantations which could grow logs more quickly than in the native forests. Native forest planning was strengthened in the Working Plans Branch and several foresters undertook postgraduate training in advanced quantitative methods. The work concentrated on the mountain ash districts with the intention of starting to fell the regrowth from the 1939 and earlier fires about 1970. The Commission's aim was 'to control utilization and regeneration in a manner which will lead to sustained yield management' (*Annual Report* 1962/63). A very detailed cutting plan was prepared for the Upper Yarra Forest District which reasserted the ordered progression ideal:

> In order to produce a constant supply of sawlogs, it is desirable to have a "normal" series of equiproductive age classes. At the present time, this is far from the case, where over 50% of the area of ash type forest in the Upper Yarra Forest District is of the one age, having resulted from extensive wildfires in 1939. (*Upper Yarra Forest District Cutting Plan 1968-72*, Appendix 7)

Continuous Forest Inventory

The expanding national economy benefited the State forest services, which were able both to establish fast-growing pine plantations to offset the declining yields from the over-cut native forests and to improve their management. Aerial photographs became widely available to aid mapping and computers were used to relieve the 'cumbersome reckoning' of assessments. Importantly, the concept of assessment as taking an inventory of the forest at one point in time was enlarged to include growth. To this end, permanently marked plots were installed through the forests and remeasured periodically in the so-called 'Continuous Forest Inventory' system whose effectiveness relied on computer storage and processing of the data.

Queensland took the lead, trying the new system in the 1940s, and then deciding to installed a grid of quite large, 0.4 hectare, permanently marked plots in every 200 hectares or so in which the girth of every tree was measured and its species recorded (map 2). By 1968, approximately 5500 plots had been installed on about 40 per cent of the state forest. The plots were remeasured every five years or so. Successive stand tables showing the number of trees in each diameter class prepared from these data enabled the growth of the forest to be estimated. In forests which can be managed intensively on a silvicultural selection system, the approach provided a basis for deciding how many trees of each size class could be cut. In addition, individual tree measurements were made on some permanent growth plots to provide more detailed information on the major forest types (Vanclay et al. 1987). Victoria followed suit by installing a system in the Wombat messmate forest in 1964 and remeasuring it five years later (Smith 1973). Series of permanent growth plots were also installed which eventually enabled computer-based statistical models of the growth of mountain ash and



MAP 2. Part Peachester State Forest (SFR 313), Queensland.

The map of the original 1924 strip survey was probably drawn at a scale of 10 or 20 chains to the inch (1:7,920 or 1:15,840). This map (shown reduced) was drawn by J.W. in 1957 at a scale of 1:10,000 and shows the large forest inventory plots installed by Overseer Cauley in 1956. The stand types shown are probably those mapped in 1924.

silvertop stands to be constructed – the modern equivalents of yield tables. These models incorporated both size and age classes.

In the early 1970s, Australian forestry seemed to be progressing brightly: a substantial estate of softwood plantations was being established, growth information on some of the major native forests was being collected, new crops were growing on those areas which were being clear-cut for the domestic pulp and paper industry and Japan's sudden demand for hardwood pulpwood was enabling far greater areas to be clear-felled for export as woodchips. This last proved a decisive turning point, much to the surprise of the foresters who found their efforts reviled by a rapidly expanding environment movement.

AGE AS AN ENVIRONMENTAL INDICATOR

Although attitudes to the protection of forests for their many environmental and spiritual attributes can be traced from ancient roots (e.g. Hughes 1994, 1997) to expressions by people like von Mueller, it was not until the 1970s that environmentalism gained popular acceptance and political clout as a new social movement in Australia. There were intense contests over the use of the native forests through into the 1990s which generated a host of public inquiries, legal cases, intractable political disputes and even constitutional challenges between the Commonwealth and State governments which have been described at length elsewhere (e.g. Dargavel 1995; Mercer 1991; Papadakis 1993). A powerful strand in the environment movement was the drive to preserve 'wilderness' from development and the landmark battle to stop the damming of the Franklin River in Tasmania had proved its political potency (Green 1981). It is sufficient here to note the relationship between forest age and environmental attributes. In the following sections the relationship between age, political processes and community values are discussed.

It was the fate of the forest fauna which first attracted public attention. Australian forests support a number of endemic arboreal mammals of which the most widely known is the now much-loved koala. Various species of possums, gliders, cuscus and bats are less widely known, largely because they are nocturnal. The forests also support many species of birds of which parrots, cockatoos and rosellas of various sorts are the most well-known, and some species of owls which because they are also nocturnal are less well-known. These creatures depend on big old trees in the forest in order to shelter and nest in the holes which develop in the stems and larger branches high in the crowns. Suitable nesting hollows develop only slowly when the eucalypts are perhaps a hundred years old and when decay sets in to broken branch stubs or damaged stems. The trees which provided the best habitat were exactly the sort of trees that the foresters were removing to raise timber productivity. Moreover, the new crops would never be grown on long-enough rotations; commercial maturity is far shorter than ecological maturity.

There were two responses to this dilemma. One by the peak environmental body, the Australian Conservation Foundation, was to call for an end to logging in all native forests on public land. The other by the forest services was to ameliorate their practices by retaining a scattering of the old 'habitat' trees in each clear-felled coupe and by setting aside uncut streamside and wildlife corridor strips. The importance of old forests in the public mind shifted somewhat from the initial concern over the protection of the 'cute and cuddly' species depicted on the ubiquitous wildlife calendars to a more ecological view as the dependence of the whole suite of forest species on each other became better known.

After twenty-five years of political, legal and constitutional conflicts over the forests, the Commonwealth and State governments finally negotiated a *National forest policy statement* (Australia, Council of Australian Governments 1992) which aimed to provide a national system of conservation reserves and resource security for industrial expansion. As part of this, the governments agreed to 'conserve and manage areas of old-growth forests ... as part of the reserve system.' Clearly, forest age had come to national prominence, but exactly what 'old-growth' meant and where it might be found was unclear.

OLD-GROWTH AS AN ICON

'Old-growth' was a new term in Australia, although it was known as a logging term on the Pacific North-west coast of North America from 1931 (Munger and Brandstrom 1931). As a forestry term it was an oxymoron from the start. Andrews and Cowlin (1940) used it for Douglas fir stands over 160 years of age in which mortality and decay balanced the increment and thus had no net growth. By the 1950s it was used occasionally in US logging and forestry research reports, while 'virgin forest' was commonly used there and elsewhere for forests which had not been opened up for logging. The latter fell into disfavour in the 1960s and the notions it carried appear to have been transposed onto 'old-growth'.

Internationally, 'old-growth' is a descriptive rather than a scientific term. It is noticeably absent from forestry textbooks, and is rare in the professional literature until the 1980s when it started to appear with increasing frequency in *Forestry Abstracts* (an average of 13 publications a year in 1980-84, 42 in 1985-89, and 77 in 1990-95). Titles indexed in *Ecological Abstracts* paint much the same picture (5 in 1989 rising to 25 in 1995). From the 1980s it was applied to many old forests – even to a 70 year old eucalypt plantation in India – but became particularly prominent during the environmental controversies in the Pacific North-west. It gained an ecological meaning of being 'a late successional stage' while retaining some of its earlier meaning by being 'at least 180-200 years old ... with indications of old and decaying wood' (US Forest Service and Bureau of

Land Management 1994). The protection of 'late successional reserves' of old-growth forests from roading and logging became couched as protection from all human 'disturbance'. The past centuries of indigenous influence went unrecognised.

In Australia, 'old-growth' followed the North American meaning and notably, acquired a similar iconic meaning for Australian environmentalists (Dargavel 1995: 203). Curby (1997) has reported how environmentalists in northern New South Wales first campaigned with the icon of 'rainforests' carrying implicit value for the old trees they contained. When the government decided to stop most rainforest logging in 1982, they needed other terms to cover the broader range of forests they deemed worthy of preservation. 'Wilderness' and later 'old-growth' came into widespread use. Campaigns for the protection of old-growth in several other States led to its use in public policy and necessitated a formal definition for bureaucratic processes as 'a forest which is ecologically mature and has been subject to negligible unnatural disturbance' (Australia, Council of Australian Governments 1992). It appears as a curious marriage of ecological and social dimensions but this is hardly surprising considering that it emerged from protracted negotiations between ecologists, many of whom were closely allied to the environmental movement, and both Commonwealth and State bureaucracies.

A process of 'comprehensive regional assessment' was commenced under the national policy which included the cultural and Aboriginal values of the forests as well as the natural environmental ones and delineated the old-growth forests (e.g. Smith and Maloney 1997). Such work in these and other areas has given a considerable boost to the assessment of cultural factors, even if only under the derogatory label of 'disturbance'. Such work is making the range of values held about the forests by different parts of the Australian community increasingly apparent.

AGE IN COMMUNITY PERCEPTION AND VALUE

Age is only one aspect of the perceptions and values which people have about the forests and is not readily or necessarily separated in the public mind from other attributes. We have to see it in the framework of how people see the forest and recognise that this is historically and socially contingent. The historic changes in Australia have been mentioned already in this paper – from the era of agricultural settlement, when trees were either useful for timber or obstructions to grass and grain, to the era of forestry, when an ordered progression of age classes was sought, to the environmental era of preservation. Each era continues into the present with differently held values.

In contrast to the extensive assessment of the timber values of the forests and the detailed fauna and flora surveys being carried out in the environmental era,

there has been comparatively little assessment of the values held by people. As in other countries, public opinion surveys have shown that Australians consistently rank their concern about the environment quite highly. A comprehensive survey of attitudes to forests reflected many of the general attitudes (McAllister 1991). Most people saw the preservation of forests as important and believed that clear-felling harms native wildlife and was being done too quickly. They also saw the forests as important for a whole range of economic, employment and other benefits. The two sets of attitudes were held somewhat separately with some people (38 per cent) consistently supporting either a preservation or an exploitation view, but one-half of the people (54 per cent) taking a middle position on at least one of the fifteen topics investigated. Protecting water quality, preventing soil erosion and protecting wildlife and plants were the most important matters, with Greenhouse, wilderness, employment and 'allowing large old trees to grow' not far behind.

Similarly, there has been comparatively little research into how such attitudes are formed or how complex they are. Watson (1990) studied environmentalists and timber workers in the north coast region of New South Wales and showed how closely the values held were correlated with people's work and means of subsistence; the timber workers, who relied on the forest for their livelihoods, held productionist views, while the environmentalists, who typically drew their livelihoods from the state or as independent professionals, held preservationist views. Lamb and Morris (1997) conducted a very detailed qualitative study of the cultural and personal meanings which people attach to the forest environment with particular reference to old-growth. They interviewed one specialist group of foresters and biologists, and another group of 'ordinary people' drawn from various parts of the community. Among their detailed findings, they noted that the specialists' concept of old-growth forest was detailed and specific whereas the community group's included more forest types and levels of disturbance. Both groups shared an 'image' of forests with big trees, rainforest, epiphytes, water, wildlife, understorey and moistness which many of Australia's forests do not have. Interestingly, the concept of ecological maturity and minimum levels of disturbance on which the bureaucratic definition of old-growth is based were hardly mentioned.

Although one specialist in Lamb and Morris' study thought that 'old-growth is an ideal, it isn't real', it was a view formed within a frame of reference current among Australian forest ecologists. Lamb and Morris concluded that:

> The values of forests to the community do not necessarily relate to experience, knowledge, or 'facts', as established by others. Effort needs to be put into acknowledging the legitimacy of spiritual and symbolic values, and assessing their relationship to complex, abstract and artificial values, such as ecological maturity and disturbance. Only then can there be consensus on the appropriate criteria and means to identify and reserve forests.

Clearly, we need to know about how the forests are valued by people as we need to know about their ecology and uses. As Hughes (1996) has emphasised, environmental history offers one of the ways of considering these two constructions of the forests together.

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